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Evaluation of Novel Chemical Insecticides against Invasive Pest, *Liriomyza huidobrensis* (Blanchard) in Carrot

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ABSTRACT: The new invasive polyphagous leaf miner, *Liriomyza huidobrensisis* is affecting many vegetable crops like carrot, potato, garlic, pea and beetroot. At present, it becomes a major constraint for the cultivation of the carrot, *Daucus carota* because of leaf miner infestation. To attain the optimum yield, it is very important to manage the pest. The main objective of this experiment is to investigate the field efficacy of the novel insecticides like Cyantraniliprole 10.26 OD (90 g a.i./ha), Thiamethoxam 25 WG (50g a.i./ha), Imidacloprid 17.80 SL(10 g a.i./ha) and Chlorantraniliprole 18.5 SC (30 g a.i./ha) against the leaf miner in carrot. Among the various pesticides used, Cyantraniliprole 10.26 OD (90 g a.i./ha), and Imidacloprid 17.80 SL(10 g a.i./ha) gave the best result in managing the leaf miner when compared to other insecticides.

Keywords: Cyantraniliprole, Imidacloprid, *Liriomyza huidobrensis*, Percentage reduction.

INTRODUCTION

The carrot (*Daucus carat* L.) is one of the key crops in India and belongs to the Apiaceae family (Umbelliferae). Its edible taproot is the major reason for its production. Carrots are well-known for their health advantages which are rich in carotenoids, vitamins and polyacetylenes (da Silva Dias, 2014) as well as their delicious and refreshing flavour. From the standpoint of a farmer, carrot is a less labour-oriented crop that requires less intercultural operations with high profit when compared to other crops. However, nowadays, biotic and abiotic pressures such as insect pests, pathogens, and other weather-related changes have caused a major problem for carrot cultivation.

Pests such as carrot rust fly, carrot weevil, cutworm, and leaf miner feed on a carrot, and they mainly cause the damage either by directly feeding on taproot or by damaging the leaves and stem. Among these, a leaf miner, *Liriomyza huidobrensis* (Blanchard) member of the family Agromyzidae and the order Diptera which is a serious polyphagous pest has been found in 365 host plant species from 49 plant families all over the world (Weintraub *et al.*, 2017). This pest is now causing a major threat to the cultivation of carrots.The host plants are harmed by both larvae and adults. The larvae devour the mesophyll in the leaves, thereby limiting photosynthesis. Adult flies puncture the leaves for feeding and oviposition as well. Because of the large density of these stipples, the leaf surface becomes dry, resulting in lower yields of taproots (Bethke and Parrella 1985).

This leaf miner's pest status is a classic example of a 2ndary pest outbreak, adults developed pesticide resistance because of the indiscriminate spraying of insecticides against another pest (Weintraub *et al.*, 2017). Unfortunately, due to a lack of prescribed insecticides for this specific pest of the crop, carrot cultivators are having difficulty in managing the leaf miner and posing a threat to crop productivity. As a result, it is vital to control these pests and safeguard that crop production is trouble-free. So, the present research aimed to determine the most effective new insecticide against leaf miners in carrots.

MATERIALS AND METHODS

Cultivation of the crop. The experiment was led in two farmers' fields at Elanalli and kookal village in The Nilgiris district, Tamil Nadu from January to April 2022. The carrot seeds of the local variety were line sowed, and after the germination, the required thinning of the crop was made to avoid the competition of the

crop and overcrowding. Intercultural operations like rouging and weeding were done at the proper time. The field research was set up using a randomized complete block design with four replications and five treatments.

Chemicals and dosage. Chemicals that were utilised for treatments are 1) Cyantraniliprole 10.26 OD (90 g a.i./ha), 2) Thiamethoxam 25 WG (50 g a.i./ha), 3) Imidacloprid 17.80 SL (10 g a.i./ha), 4) Chlorantraniliprole 18.50 SC (30 g a.i./ha) and 5) untreated control. Each plot was 22.4 m^2 in size. The spray fluid was made by calculating the amount of insecticide necessary, stirring in a little amount of water, and thereafter mixing the remaining water to make up the appropriate volume (500 L/ha). To spray insecticides, insecticides were sprayed using aknapsack sprayer during the early hours of the day around 8.00 to 9.00 AM. A total of two sprays were given with an interval of 20 days. After the arrival of pests, the 1st spray was applied (45 days after sowing).

Observation recorded. The incidence of leaf minor damage on carrots was examined 1 day before and three, five, seven, ten, and fourteen days after pesticide treatment. In each replication, 10 randomly selected plants in all five different treatments were observed to record the pest occurrence. To determine the prevalence of leaf miners, the percentage of leaf damage was evaluated and a record of the dead and alive maggots inside the leaf mines was also observed.

$$\text{Per cent leaf damage} = \frac{\text{Number of mined leaves}}{\text{Total number of leaves observed}}$$

Each treatment plot's yield data was gathered during harvest time and translated to yield/ha to determine the optimal treatment over the untreated control.

Statistical analysis. The acquired data on the leaf minor damage in percentage were subjected to an arcsine transformation. AGREES software was used to conduct the analysis. For each plot, the reduction over untreated control was calculated to determine the optimal treatment. Duncan's Multiple Range Test (DMRT) was used to compare treatment means.

RESULTS AND DISCUSSION

Table 1 shows the percentage of leaves damaged in the experiment field located in Ellanalli, Ooty. Before treating with Cyantraniliprole 10.26 OD @ 90 g a.i./ha, the per cent leaf damage was 32.57 per cent, after 5 days of the 1st and 2nd sprays the damage percentage dropped to 23.2% and 10.6%, then on the 7th day after 1st and 2nd spray the percentage damage has fallen to 17.02% and 5.7% respectively, then on 14 days of the 1st and 2nd sprays, the percentages dropped to 15.97% and 4.925%, respectively, and on 14 days after the 1st and 2nd sprays, the untreated control recorded 31.65 per cent and 36.06 per cent of the damage, respectively. It was followed by Imidacloprid 17.8 SL @ 10 g a.i./ha, which had a pre-treatment percentage of damage count of 30.25%. After 5 days of the 1st and 2nd sprays, the damage percentage dropped to 23.72 and 9.77% respectively, then on the 7th day after the 1st and 2nd spray, the percentage of damage has fallen to 16.325% and 6.6% respectively, and on the 14th day after the 1st spray, the leaf damage had fallen to 14.77 per cent, and on the 14th day after the 2nd spray, it had decreased to 5.925 per cent. Then on the 5th day of chemical treatment Chlorantraniliprole 18.5 SC (30 g a.i./ha) recorded a notable decrease in the damaged leaves from 30.025 to 20.22% and on the 5th day after the 2nd spraying it recorded 8.47% damage, then on the 7th day after 1st and 2nd spray, the percentage of damage has fallen to 16.775% and 8.025% respectively, then on 14th day of chemical treatment, Chlorantraniliprole 18.5 SC (30 g a.i./ha) recorded a notable decrease in the damaged leaves from 30.025 to 18.96% and 7.475% on 14th day after 2nd spraying. The plots which are applied with Thiamethoxam 25% WG 50g a.i./ha have also shown a substantial decrease in the damage percentage of leaf miner. On the 5th day after the 1st spray, the percentage of damage decreased to 25.1% from 30.25% and on the 5th day of the 2nd spray damage percentage reduced to 16.2%, on the 7th day of the 1st and 2nd sprays, the damage percentage dropped to 22.22% and 15.5% respectively, 14th day after the 1st spray, the damage decreased to 23.32% from 30.25% and on the 14th day of the 2nd spray, the treatment reduced the leaf damage to 14.9% from the pre-treatment count.

Table 2 shows the percentage of leaves damaged in the experiment field located in Kukkal, Kothagiri. Before treating with Cyantraniliprole 10.26 OD @ 90 g a.i./ha, the per cent leaf damage was 31.775 per cent, after 5 days of the 1st and 2nd sprays the damage percentage dropped to 22.62% and 10.02%, then on 7th day after 1st and 2nd spray the percentage damage has fallen to 16.57% and 6.7% respectively, then on 14 days of the 1st and 2nd sprays, the percentages dropped to 15.05% and 6.27%, respectively, and on 14 days after the 1st and 2nd sprays, the untreated control recorded 33.3% per cent and 38.6 per cent of the damage, respectively. It was followed by Imidacloprid 17.8 SL @ 10 g a.i./ha, which had a pre-treatment percentage of damage count of 30.65%. After 5 days of the 1st and 2nd sprays, the damage percentage dropped to 23.5% and 12.6% respectively, then on the 7th day after 1st and 2nd spray, the percentage of damage has fallen to 16.325% and 6.6% respectively, and on the 14th day after the 1st spray, the leaf damage had fallen to 19.8 per cent, and on the 14th day after the 2nd spray, it had decreased to 6.62 per cent. Then on the 5th day of chemical treatment Chlorantraniliprole 18.5 SC (30 g a.i./ha) recorded a notable decrease in the damaged leaves from 30.025 to 24.1% and on the 5th day after the 2nd spraying it recorded 11.12% damage, then on the 7th day after 1st and 2nd spray, the percentage of damage has fallen to 21.17% and 9.27% respectively, then on 14th day of chemical treatment, Chlorantraniliprole 18.5 SC (30 g a.i./ha) recorded a notable decrease in the damaged leaves from 30.25 to 16.00% and 8.22% on 14th day after 2nd spraying. The plots which are applied with Thiamethoxam 25% WG 50g a.i./ha have also shown a considerable decrease in the damage percentage of leaf miner.

Table 1: Effect of insecticides on leaf miner, *L. huidobrensis* affecting carrot at Ellanelli, Ooty, Nilgiri.

Treatments	PTC	Incidence of a Leaf miner (Percent Leaf Damage)													
		First Spray							Second spray						
		3 DAS	5 DAS	7 DAS	10DAS	14DAS	Mean	PRC	3 DAS	5 DAS	7 DAS	10DAS	14DAS	Mean	PRC
Cyantraniliprole 10.26 % OD 90 g a.i./ha	32.57	30.22	22.62	17.02	16.275	15.97	20.425	35.46	16.67	10.02	5.7	5.05	4.925	8.475	76.49
	(34.80)	(33.35)^{ab}	(28.40)^{bc}	(24.36)^{c}	(23.79)^{c}	(23.55)^{c}	(26.86)^{c}		(24.10)^{c}	(18.45)^{c}	(13.81)^{b}	(12.98)^{d}	(12.82)^{d}	(16.92)^{c}	
Thiamethoxam 25% wg 50g a.i./ha	30.25	28.025	25.1	22.22	20.7	20.55	23.32	26.319	19.8	16.02	15.5	15.075	14.975	16.275	54.86
	(33.36)	(31.96)^{ab}	(30.06)^{b}	(28.12)^{b}	(27.06)^{b}	(26.95)^{b}	(28.87)^{b}		(26.42)^{b}	(23.59)^{b}	(23.18)^{d}	(22.84)^{b}	(22.76)^{b}	(23.79)^{b}	
Imidacloprid 17.80 % SL	31.27	30.15	23.72	16.325	14.975	14.775	19.9	36.84	14.5	9.77	6.6	6.1	5.925	8.58	76.20
	(34.00)	(33.30)^{ab}	(29.14)^{b}	(23.83)^{c}	(22.76)^{c}	(22.60)^{c}	(26.55)c		(22.38)^{cd}	(18.21)^{c}	(14.88)^{cd}	(14.29)^{cd}	(14.08)^{cd}	(17.03)^{c}	
Chlorantraniliprole 18.5 SC 30 g a.i./ha	30.025	27.6	20.22	16.775	15.175	15.025	18.96	40.09	13.575	8.47	8.025	7.625	7.475	9.03	74.94
	(33.22)	(31.69)^{b}	(26.72)^{c}	(24.17)^{c}	(22.92)^{c}	(22.80)^{c}	2(5.812)^{c}		(21.61)^{d}	(16.92)^{c}	(16.45)^{c}	(16.02)^{c}	(15.86)^{c}	(17.49)^{c}	
untreated control	29.825	31.2	30.5	31.4	31.45	33.7	31.65		34.075	34.7	35.62	36.97	38.925	36.06	0
	(33.10)	(33.95)^{a}	(33.52)^{a}	(34.08)^{a}	(34.11)^{a}	(35.48)^{a}	(34.23)^{a}		(35.71)^{a}	(36.09)^{a}	(36.64)^{a}	(37.45)^{a}	(38.60)^{a}	(36.90)^{a}	
SE(d)	0.861	0.93	0.82	0.93	0.83	0.832	0.72		0.99	1.0411	1.071	1.14	1.16	1.02	
CD	1.877	2.02	1.78	2.026	1.8269	1.8145	1.57		2.157	2.26	2.33	2.48	2.535	2.23	
Significance	NS	Ns	**	**	**	**	**		**	**	**	**	**	**	

DAS - Days after Spraying; PTC – Pre-treatment count; PRC– Percent reduction over untreated control *Figures in parentheses are Arc sine transformed values. Treatment means with a letter(s) in common are on par with each other by DMRT at a 5% level of significance.

Table 2: Effect of insecticides on leaf miner, *L. huidobrensis* affecting carrot at Kukkalkothagiri, Nilgiris district, Tamil Nadu.

Treatments	PTC	Incidence of a Leaf miner (Percent Leaf Damage)													
		First Spray							Second spray						
		3 DAS	5 DAS	7 DAS	10DAS	14DAS	Mean	PRC	3 DAS	5 DAS	7 DAS	10DAS	14DAS	Mean	PRC
Cyantraniliprole 10.26 % OD 90 g a.i./ha	31.775	30.9	23.2	16.57	15.5	15.05	20.25	35.69	14.7	10.6	6.7	6.37	6.275	8.945	75.29
	(34.31)	(33.78)^{a}	(28.79)^{b}	(24.02)^{d}	(23.18)^{d}	(22.82)^{d}	(26.74)^{c}		(22.60)^{d}	(19.0)^{d}	(15.001)^{d}	(14.62)^{d}	(14.50)^{c}	(17.4)^{c}	
Thiamethoxam 25% wg 50g a.i./ha	30.775	29.35	25.52	22.67	21.85	22.15	24.31	22.80	21.5	19.15	16.45	15.62	15.6	17.665	51.20
	(33.69)	(32.80)^{a}	(30.34)^{b}	(28.43)^{b}	(27.86)^{b}	(28.07)^{b}	(29.54)^{b}		(27.62)^{b}	(25.95)^{b}	(23.92)^{b}	(23.28)^{b}	(23.26)^{b}	(24.85)^{b}	
Imidacloprid 17.80 % SL	30.65	29.97	23.5	19.8	18.85	18.67	22.17	29.59	17.8	12.6	6.62	5.62	6.3	9.79	72.95
	(33.61)	(33.19)^{a}	(29.03)^{b}	(26.42)^{c}	(25.73)c	(25.60)^{c}	(28.09)^{bc}		(24.95)^{c}	(20.79)^{c}	(14.91)^{d}	(13.71)^{d}	(14.53)^{c}	(18.23)^{c}	
Chlorantraniliprole 18.5 SC 30 g a.i./ha	30.25	28.05	24.1	21.17	18.47	16.00	21.561	31.53	13.8	11.12	9.27	8.37	8.22	10.1605	71.93
	(33.36)	(31.97)^{a}	(29.40)^{b}	(27.39)^{bc}	(25.45)^{c}	(23.58)^{d}	(27.67)^{c}		(21.80)^{d}	(19.48)^{cd}	(17.73)^{c}	(16.82)^{c}	(16.66)^{c}	(18.59)^{c}	
untreated control	29.275	29.85	30.72	31.62	31.9	33.3	31.49		33.97	34.97	36.57	36.87	38.6	36.2	0
	(32.75)	(33.11)^{a}	(33.66)^{a}	(34.21)^{a}	(34.38)^{a}	(35.27)^{a}	(34.14)^{a}		(35.65)^{a}	(36.25)^{a}	(37.21)^{a}	(37.39)^{a}	(38.41)^{a}	(36.99)^{a}	
SE(d)	0.87	1.09	1.025	0.79	0.68	0.66	0.75		0.63	0.66	0.51	0.653	1.042	0.579	
CD	1.9088	2.39	2.23	1.73	1.49	1.45	1.64		1.38	1.44	1.126	1.42	2.27	1.2616	
Significance	NS	NS	**	**	**	**	**		**	**	**	**	**	**	

DAS - Days after Spraying; PTC – Pre-treatment count; PRC– Percent reduction over untreated control *Figures in parentheses are Arc sine transformed values. Treatment means with a letter(s) in common are on par with each other by DMRT at a 5% level of significance.

On the 5th day after the 1st spray, the percentage of damage decreased to 25.52% from 30.77% and on the 5th day of the 2nd spray damage percentage reduced to 19.5%, on the 7th day of the 1st and 2nd sprays, the damage percentage dropped to 22.6% and 16.45% respectively, 14th day after the 1st spray, the damage decreased to 22.15% from 30.25% and on the 14th day of the 2nd spray, the treatment reduced the leaf damage to 15.6% from the pre-treatment count.

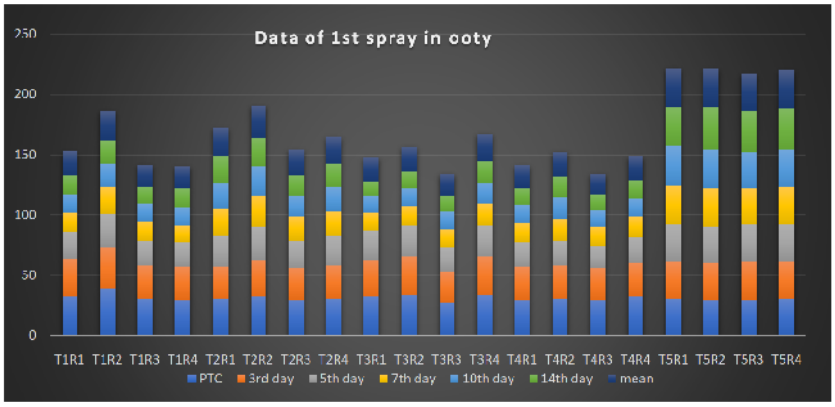
When we compare the percentage reduction of leaf damage over control, the plot that received Cyantraniliprole 10.26 OD (90 g a.i./ha) treatment had the greatest reduction in damage percentage (76.49%) and (75.29%) in Elanelli and Kukkal respectively. Then plots which were applied with Imidacloprid 17.8 SL (10 g a.i./ha), showed the 2nd-best result with a 76.20% and 72.95% reduction in damage percentage in location 1 and location 2. The next best treatments were Chlorantraniliprole 18.5 SC (30 g a.i./ha) and Thiamethoxam 25% WG (50g a.i./ha) with 74.94 and 54.86% reduction in leaf damage, respectively.

A similar study was done by Misra (2013) in Odisha during the winter season, He evaluated the bio-efficacy of a new anthranilic diamide, cyantraniliprole against the leaf miner, *Liriomyzatrifoli* in tomato at the field level and he found a significant reduction in leaf mines per observed leaves by the treatment of cyantraniliprole (HGW86) 10 OD @ 90 and 105 g a.i./ha with a mean reduction of 83.95-85.54%.

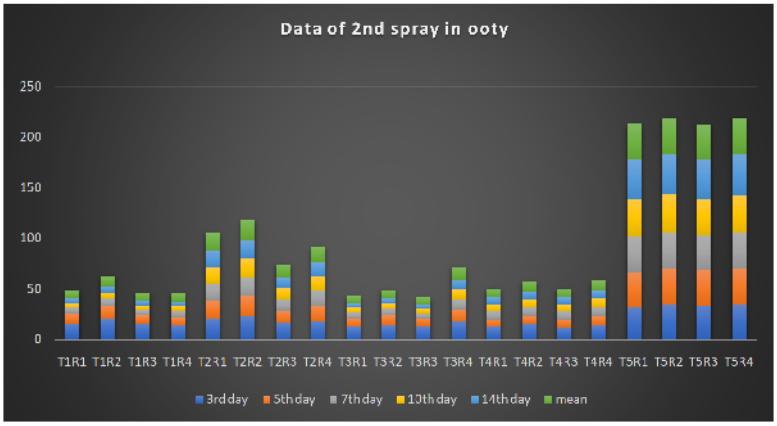
The superiority of new anthranilic diamide, cyantraniliprole in controlling leaf miner (*Liriomyza trifolii* Burgess) in gherkins was shown by Misra (2015). In his experiment, the plots which are treated with cyantraniliprole @ 90 and 105 g a.i./ha have shown an 86.03–93.59% reduction in the damage of leaf miner.

The results were also in line with the studies of Variya *et al*. (2012). They recorded a higher yield of tomatoes when they treated the plot with Imidacloprid 0.035% against leaf miner (*Liriomyzatrifolii* Burgess). Sankar and Jayaraj also recommended chlorantraniliprole 18.5SC @0.6ml/ l against leaf miner *Liriomyza* spp in watermelon (Sankar *et al.*, 2022).

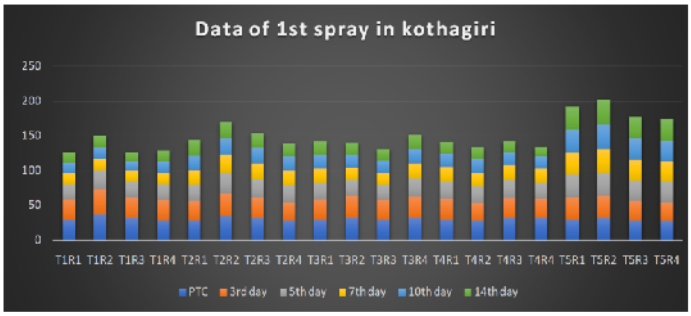
Graphical representation



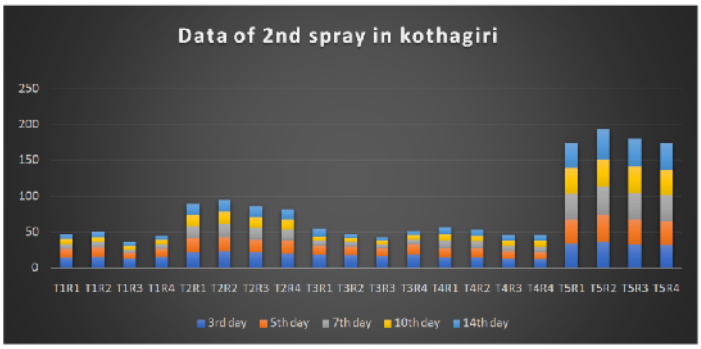
The above graph shows the reduction in percentage of damage over 14th day after 1st spraying, here we can see that the optimum effect of the treatment can be found on the 7th day after treatment since the decrease in the population is very high on 7th day compared to other days. (where T1- Cyantraniliprole 10.26 % OD 90 g a.i./ha, T2- Thiamethoxam 25% wg 50g a.i./ha, T3 - Imidacloprid 17.80 % SL, T4- Chlorantraniliprole 18.5 SC 30 g a.i./ha and T5- untreated control).



The above graph shows the reduction in the percentage of damage the over 14th day after the 2nd spraying, here we can see that Treatments 1 and 3 gave the best result in decreasing the leaf minor damage when compared to other treatments. (Where T1- Cyantraniliprole 10.26 % OD 90 g a.i./ha, T2- Thiamethoxam 25% wg 50g a.i./ha, T3 - Imidacloprid 17.80 % SL, T4- Chlorantraniliprole 18.5 SC 30 g a.i./ha and T5- untreated control).



The above graph shows the reduction in percentage of damage over 14th day after 1st spraying, here we can see that the optimum effect of the treatment can be found on the 7th day after treatment since the decrease in the population is very high on 7th day compared to other days. (where T1- Cyantraniliprole 10.26 % OD 90 g a.i./ha, T2- Thiamethoxam 25% wg 50g a.i./ha, T3 - Imidacloprid 17.80 % SL, T4- Chlorantraniliprole 18.5 SC 30 g a.i./ha and T5- untreated control).



The above graph shows the reduction in the percentage of damage the over 14th day after the 2nd spraying, here we can see that Treatments 1 and 3 gave the best result in decreasing the leaf miner damage when compared to other treatments. (Where T1- Cyantraniliprole 10.26 % OD 90 g a.i./ha, T2- Thiamethoxam 25% wg 50g a.i./ha, T3 - Imidacloprid 17.80 % SL, T4- Chlorantraniliprole 18.5 SC 30 g a.i./ha and T5- untreated control).

CONCLUSION

From the above experiment, we found that both Cyantraniliprole 10.26 OD (90 g a.i./ha) and Imidacloprid 17.80 % SL are on par with each other in controlling leaf miner, *Liriomyza huedobrensis* in carrot. When we compare the percentage reduction over control, we found that Cyantraniliprole 10.26 OD (90 g a.i./ha) is superior to all other forms of treatment.

FUTURE SCOPE

Since the leaf miner *Liriomyza huidobrensis* is an invasive pest it is very important to manage the pest without developing any resistance to the pest against various insecticides, so by the above study, the alternative usage of Cyantraniliprole 10.26 OD and Imidacloprid 17.80 SL with a different mode of action can be used effectively in resistance management.

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Conflict of Interest. None.

REFERENCES

Bethke, J. A., & Parrella, M. P. (1985). Leaf puncturing, feeding and oviposition behavior of *Liriomyzatrifolii*. *Entomologia Experimentalis et Applicata*, *39*(2), 149–154.

da Silva Dias, J. C. (2014). Nutritional and Health Benefits of Carrots and Their Seed Extracts. *Food and Nutrition Sciences*, *05*(22), 2147–2156.

Misra, H. P. (2013). Management of serpentine leafminer (*Liriomyzatrifolii*) (Diptera: Agromyzidae) on tomato (*Lycopersicon esculentum*) with a new insecticide cyantraniliprole. *Indian Journal of Agricultural Sciences*, *83*, 210–215.

Misra, H. P. (2015). Management of serpentine leafminer, *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) in gherkin with cyantraniliprole. *Indian Journal of Entomology*, *77*(1), 27.

Sankar C, Jayaraj J, Shanthi M, Chinniah C., & Vellaikumar S. (2022). Efficacy of insecticides against American serpentine leaf miner, *Liriomyza trifolii* (Burgess) in watermelon. *Indian Journal of Entomology Online Published Ref. No. E21249*.

Variya And, M. V, & Patel. (2012). Evaluation of different insecticides against leaf miner (*Liriomyza trifolii* Burgess)in tomato. *AGRES-An International e-Journal*, *1*, 453–462.

Weintraub, P. G., Scheffer, S. J., Visser, D., Valladares, G., Soares Correa, A., Shepard, B. M., Rauf, A., Murphy, S. T., Mujica, N., MacVean, C., Kroschel, J., Kishinevsky, M., Joshi, R. C., Johansen, N. S., Hallett, R. H., Civelek, H. S., Chen, B., & Metzler, H. B. (2017). The Invasive *Liriomyza huidobrensis* (Diptera: Agromyzidae): Understanding Its Pest Status and Management Globally. *Journal of Insect Science*, *17*(1), 28.

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