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Bio-efficacy of seed treatment insecticidal molecules against cucumber leaf miner, *Liriomyza trifolii* (Burgess)

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Abstract
The experiment was conducted against leaf miner, *Liriomyza trifolii* infesting cucumber for the two consecutive year (2015-16 and 2016-17) at Agronomy Farm, BACA, AAU, Anand-388 110, Gujarat, India. The objective of the experiment was to evaluate bio-efficacy of different insecticides including seed treatment molecules. The experimental plot area was replicated thrice and ten treatments with randomized block design. The experimental results revealed that among the different insecticides evaluated significant lower number of mines and leaf damage were recorded in seed treatment with Thiamethoxam 35 FS + Thiamethoxam 25 WG (2.25/leaf; 9.93 %) followed by seed treatment with Imidacloprid 600 FS + Thiamethoxam 25 WG (2.42/leaf; 11.65%) and Thiamethoxam 25 WG (2.53/leaf; 12.96 %), respectively. The data on fruit yield of cucumber indicated that significant maximum cucumber fruit yield (112.01 q/ha) was recorded from the plot treated seed treatment with Thiamethoxam 35 FS + Thiamethoxam 25 WG. The next best effective treatments were Imidacloprid 600 FS + Thiamethoxam 25 WG (102.35 q/ha)] and Thiamethoxam 50 WG (88.35 q/ha) which were remained at par with each other.

Keywords: Cucumber, *Liriomyza trifolii***,** Thiamethoxam, Yield

1. Introduction

Cucumber is one of the oldest cultivated cucurbits which classified as slicing type as well as pickling type fruit vegetable. It is grown in almost all the states of India and popularly known as kakadi in Gujarati. The area and production of cucumber is 71000 hectares and 1.2 MT, respectively in India [3]. Among the various insect pests, leaf miner, *L. trifolii* is an important pest in cucumber. The major form of the damage is mining of leaves by larvae which results in destruction of leaf mesophyll. The leaf mining and stippling causes the premature leaf drop which ultimately affect cucumber fruit yield. Krishna Kumar and his coworkers were recorded as many as 14.4 mines/cucumber leaf due to *L. trifolii* at Raichur in Karnataka [4]. This pest is one of the most important species of Agromyzidae family of Diptera order which feeding on field crops, vegetables, fruit crops, ornamentals and number of weeds. The pest also causes severe losses to economically important vegetable crops like tomato, celery, melons, beans, pea, onion, pepper, brinjal, potato, lettuce, carrot, *etc*., in many parts of the world [9,11]. Srinivasan *et al*. (1995) [11] also reported its incidence on 79 species of plants in Southern part of India. Management of this pest becomes very difficult due to internal mining activity of larvae within the leaf. By and large insecticides spray are only used for the control of this problematic pest. But, the present experiment was proposed to evaluate the efficacy of different seed treatment insecticide molecule as well as spray molecules against leaf miner infesting cucumber leaves. These practices may helpful to farmers during Integrated Pest Management programme by reducing the number of spray in the field condition.

2. Materials and methods

The experiment was conducted during the two consecutive year (2015-16 & 2016-17) at Agro-climatic Zone Middle Gujarat - III, AAU, Anand. All the agronomical practices were followed for raising the cucumber crop (Gujarat Cucumber-1) at Agronomy Farm, B. A. College of Agriculture, AAU, Anand during the *kharif* season. The experiment plot was randomized with three replication and ten treatments. The plot size was divided as per the gross and net plot area 7.5 x 5.0 m^2 and 4.5 x 3.0 m^2, respectively. The seed treatment (10 ml/kg of seed) was applied at the time of sowing and the observation were recorded one week after germination till the picking of economic cucumber fruit. The first spray of respective insecticides was made after 30 days of germination and subsequent second spray applied after 15 days by using manually operated knapsack sprayer with Duromist nozzle. The active ingredient was calculated based on 500 litre of water/ha. For recording the observation, five plants were selected randomly from each plot. The healthy and damaged leaves were counted from three vines of each plant, whereas mines recorded from three leaves of each plant. The observations were recorded after one week of sowing till the first spray at an interval of seven days. However, the observations made in case of respective spray before and 5, 10 and 15 days after each spray from each replication. The yield data was recorded at each picking per plot. The data were analyzed by using standard statistical method. The pesticide residue will also make during the second or third year of study.

3. Results

The data pooled over periods and sprays on numbers of mines and per cent leaf damage were presented in Table 1 and 2, respectively. The data on bio-efficacy of different insecticidal molecules against leaf damage caused by cucumber leaf miner reveled that there was uniform population in the field before the sprays which showed non-significant differences among them.

3.1 Effect on number of leaf mines/leaf

First year pooled data of first spray revealed that the plots treated (Table 1, Fig. 1) with T_7 [Thiamethoxam 25 WG (2.42/leaf)] was recorded significantly the lowest number of mines. The next best effective treatment was treatment T_5 [T_1 + Flonicamid 50 WG (2.46/leaf)] followed by treatment T_4 [T2 + Thiamethoxam 25 WG (2.70/leaf)] and treatment T_3 [T_1 + Thiamethoxam 25 WG, (2.96/leaf)]. The pooled data over second spray (Table 1) indicated that significantly lower leaf mines were recorded in case of treatment T_3 [T_1 + Thiamethoxam 25 WG (2.39/leaf)]. However, the next best effective treatment was T_4 [T_2 + Thiamethoxam 25 WG (2.70/leaf)] which was followed by Thiamethoxam 25 WG (2.81/leaf), Flonicamid 50 WG (4.08/leaf), T_5 [T_1 + Flonicamid 50 WG (4.17/leaf)], Dimethoate 30 EC (4.52/leaf) and T_6 [T_2 + Flonicamid 50 WG (5.31/leaf)]. The data on pooled over periods and sprays (Table 1) indicated that all the treatments registered lower number of mines except seed treatment with Thiamethoxam 30 FS and Imidacloprid 600 FS including control. The best effective treatment in recording lower number of mines was Thiamethoxam 25 WG (2.63/leaf) followed by treatment T_3 [T_1 + Thiamethoxam 25 WG (2.67/leaf)] and treatment T_4 [T_2 + Thiamethoxam 25 WG (2.70/leaf)].

3.2 Effect on per cent leaf damage

The pooled data over first spray indicated (Table 2, Fig. 1) that significantly the lowest per cent leaf damage was observed in case of plots treated with treatment T_3 [T_1 + Thiamethoxam 25 WG (10.97%)]. The next best effective treatments was Thiamethoxam 25 WG, (12.15%), treatment T_4 [T_2 + Thiamethoxam 25 WG (12.63%)] followed by treatment T_5 [T_1 + Flonicamid 50 WG (15.23%)]. The pooled data over second spray (Table 2) indicated that lower per cent leaf damage was observed in the treatment T_3 [T_1 + Thiamethoxam 25 WG (8.33%)] and treatment T_4 [T_2 + Thiamethoxam 25 WG (9.39%)]. Whereas, treatment T_5 [T_1 + Flonicamid 50 WG (10.21%)], T_6 [T_2 + Flonicamid 50 WG (11.60%)], Flonicamid 50 WG (11.96%) and Dimethoate 30 EC (12.07%) were next effective treatments. The data on pooled over periods and sprays on per cent leaf damage (Table 2) by leaf miner indicated that plots treated with treatment T_3 [T_1 + Thiamethoxam 25 WG (9.61%) was found the most effective in controlling leaf miner damage to leaf.

Fig 1: Plots showing efficacy of different treatments against cucumber leaf miner

3.3 Fruit Yield

The maximum fruit yield was obtained from plots treated with (Table 3) treatment T_3 [T_1 + Thiamethoxam 25 WG, (101.85 q/ha)] followed by treatment T_4 [T_2 + Thiamethoxam 25 WG (91.89 q/ha)] which were remained at par with each other. The plots treated with Thiamethoxam 25 WG (78.74 q/ha), treatment T_6 [T_2 + Flonicamid 50 WG (72.11 q/ha)], Dimethoate 30 EC (68.71 q/ha), T_5 [T_1 + Flonicamid 50 WG (68.70 q/ha)] and Flonicamid 50 WG (63.40 q/ha) were remained next effective treatments for production of fruit yield. However, the lower fruit yield was recorded from untreated plot (43.82 q/ha) which was remained at par with seed treatment with Imidacloprid 600 FS (48.17 q/ha) and seed treatment with Thiamethoxam 35 FS.

4. Discussion

Based on pooled over period, spray and year indicated that among the different insecticides evaluated, significant lower number of mines and leaf damage were recorded in T1 + Thiamethoxam 25 WG (2.25/leaf; 9.93 %) followed by T2 + Thiamethoxam 25 WG (2.42/leaf; 11.65%) and Thiamethoxam 25 WG (1.74/leaf; 21.10 %), respectively (Table 1-2). Imidacloprid 600 FS was significantly reduced the american leaf miner infestation over control [4]. Seed and root application of Imidacloprid against *Liriomyza* spp. were found more effective than other insecticide tested [5,6]. Thiamethoxam 25 WG was provided an effective control of aphids, whiteflies, thrips, rice hoppers, rice bugs, mealybugs, flea beetles, leaf miners and colorado potato beetle [1]. Thiamethoxam 25 WG was provided to be of a moderate effect in controlling the leaf miner incidence [7]. Spinosad 45 SC 0.01% was found as most effective treatment followed by Acetamiprid 0.008%, NSK 0.5% and Thiamethoxam 25 WG 0.003% against tomato leaf miner [10]. For effective management of leaf miner in early stage of the cucumber crop, the farmers of middle Gujarat are advised to treat the seeds before sowing with imidacloprid 70 WS @ 7.5 g/kg seeds or thiamethoxam 70 WS @ 4 g/kg seed [2]. The above findings also coincide with findings of that citrus leaf miner which revealed that thiamethoxam 25 WG (0.06%) recorded lowest 5.47 per cent leaf infestation of leaf miner [8].

Table 1: Effectiveness of different insecticides based on number of leaf mines due to leaf miner, *L. trifolii* infesting cucumber

Treatments	Number of mines/leaf*										
	First Year				Second Year				Pooled over period and spray		Pooled over period, spray and year
	First spray		Second spray		First spray		Second spray				
	BS	Pooled	BS	Pooled	BS	Pooled	BS	Pooled	First Year	Second Year	Pooled
T_1 (Seed treatment with Thiamethoxam 35 FS)	2.26	2.49^{a}	2.68	2.78^{a}	2.28	2.63^{b}	3.09	3.37^{a}	2.63^{b}	3.00^{ab}	2.82^{b}
	(4.61)	(5.70)	(6.68)	(7.23)	(4.70)	(6.42)	(9.05)	(10.86)	(6.42)	(8.50)	(7.45)
T_2 (Seed treatment with Imidacloprid 600 FS)	2.20	2.48^{ab}	2.61	2.76^{a}	2.38	2.51^{b}	3.05	3.34^{a}	2.63^{a}	2.92^{b}	2.77^{b}
	(4.34)	(5.65)	(6.31)	(7.12)	(5.16)	(5.80)	(8.80)	(10.66)	(6.42)	(8.03)	(7.17)
T_3 (T1 + Thiamethoxam 25 WG @ 50 ga.i/ha)	2.34	1.65^{f}	2.61	1.45^{c}	2.29	1.86^{cd}	3.05	1.70^{c}	1.55^{e}	1.78^{e}	1.66^{e}
	(4.98)	(2.22)	(6.31)	(1.60)	(4.74)	(2.96)	(8.80)	(2.39)	(1.90)	(2.67)	(2.25)
T_4 (T2 + Thiamethoxam 25 WG @ 50 ga.i/ha)	2.20	1.80^{def}	2.60	1.49^{c}	2.23	1.79^{d}	3.10	1.79^{c}	1.65^{e}	1.79^{e}	1.71^{e}
	(4.34)	(2.74)	(6.26)	(1.72)	(4.47)	(2.70)	(9.11)	(2.70)	(2.22)	(2.70)	(2.42)
T_5 (T1 + Flonicamid 50 WG @ 75 ga.i/ha)	2.34	1.92^{cde}	2.65	1.83^{b}	2.30	1.72^{d}	3.06	2.16^{b}	1.88^{cd}	1.94^{de}	1.91^{d}
	(4.98)	(3.19)	(6.52)	(2.85)	(4.79)	(2.46)	(8.86)	(4.17)	(3.03)	(3.26)	(3.15)
T_6 (T2 + Flonicamid 50 WG@ 75 ga.i/ha)	2.09	2.13^{c}	2.68	1.96^{b}	2.14	2.06^{c}	2.94	2.41^{b}	2.04^{c}	2.23^{c}	2.14^{c}
	(3.87)	(4.04)	(6.68)	(3.34)	(4.08)	(3.74)	(8.14)	(5.31)	(3.66)	(4.47)	(4.08)
T_7 (Thiamethoxam 25 WG @ 50 ga.i/ha)	2.18	1.92^{cde}	2.65	1.52^{c}	2.24	1.71^{d}	3.06	1.82^{c}	1.72^{de}	1.77^{e}	1.74^{e}
	(4.25)	(3.19)	(6.52)	(1.81)	(4.52)	(2.42)	(8.86)	(2.81)	(2.46)	(2.63)	(2.53)
T_8 (Flonicamid 50 WG @ 75 ga.i/ha)	2.27	2.19^{bc}	2.67	1.86^{b}	2.14	2.05^{c}	3.18	2.14^{b}	2.02^{c}	2.10^{cd}	2.06^{c}
	(4.65)	(4.30)	(6.63)	(2.96)	(4.08)	(3.70)	(9.61)	(4.08)	(3.58)	(3.91)	(3.74)
T_9 (Dimethoate 30 EC @ 150 ga.i/ha)	2.19	2.10^{c}	2.67	1.98^{b}	2.30	2.06^{c}	3.07	2.24^{b}	2.04^{c}	2.15^{cd}	2.10^{c}
	(4.30)	(3.91)	(6.63)	(3.42)	(4.79)	(3.74)	(8.92)	(4.52)	(3.66)	(4.12)	(3.91)
T_{10} [Control (Water spray)]	2.41	2.67^{a}	2.85	2.93^{a}	2.38	2.92^{a}	3.20	3.46^{a}	2.80^{ab}	3.19^{a}	2.99^{a}
	(5.31)	(6.63)	(7.62)	(8.08)	(5.16)	(8.03)	(9.74)	(11.47)	(7.34)	(9.68)	(8.44)
S. Em.(±) Treatment (T)	0.08	0.09	0.15	0.09	0.18	0.08	0.14	0.09	0.06	0.07	0.04
Period (P)	-	0.17	-	0.15	-	0.15	-	0.19	0.03	0.03	0.03
Spray (S)	-	-	-	-	-	-	-	-	0.02	0.03	0.14
Year (Y)	-	-	-	-	-	-	-	-	-	-	0.02
T x P	-	-	-	-	-	-	-	-	0.11	0.12	0.08
T x S	-	-	-	-	-	-	-	-	0.09	0.10	0.07
P x S	-	-	-	-	-	-	-	-	0.05	0.05	0.04
S x Y	-	-	-	-	-	-	-	-	-	-	0.03
P x Y	-	-	-	-	-	-	-	-	-	-	0.04
T x Y	-	-	-	-	-	-	-	-	-	-	0.07
Y x S x T	-	-	-	-	-	-	-	-	-	-	0.10
P xS xY	-	-	-	-	-	-	-	-	-	-	0.05
T x P x S	-	-	-	-	-	-	-	-	0.16	0.01	0.12
T x P x Y	-	-	-	-	-	-	-	-	-	-	0.12
T x P x S x Y	-	-	-	-	-	-	-	-	-	-	0.17
C.V. (%)	6.52	13.43	9.96	13.03	13.43	12.46	7.82	12.65	13.49	13.17	13.33

$\sqrt{x+0.5}$ transformed values while, figures in the parentheses are original values; Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

Table 2: Effectiveness of different insecticides against leaf miner, *L. trifolii* based on leaf damage infesting cucumber

Treatments	Leaf damage (%)*										
	First Year				Second Year				Pooled over spray		Pooled over spray and year
	First spray		Second spray		First spray		Second spray				
	BS	Pooled	BS	Pooled	BS	Pooled	BS	Pooled	First Year	Second Year	Pooled
T$_1$ (Seed treatment with Thiamethoxam 35 FS)	23.92	27.87^{b}	35.65	38.13^{a}	22.15	26.20^{bc}	31.12	34.11^{a}	33.00^{b}	30.15^{a}	31.58^{b}
	(16.44)	(21.85)	(33.97)	(38.12)	(14.22)	(19.49)	(26.71)	(31.45)	(29.66)	(25.23)	(27.42)
T$_2$ (Seed treatment with Imidacloprid 600 FS)	24.07	28.37^{b}	32.35	37.80^{a}	22.91	26.95^{ab}	31.43	34.33^{a}	33.08^{b}	30.64^{a}	31.86^{b}
	(16.63)	(22.58)	(28.63)	(37.57)	(15.15)	(20.54)	(27.19)	(31.80)	(29.79)	(25.97)	(27.86)
T$_3$ (T1 + Thiamethoxam 25 WG @ 50 ga.i/ha)	23.00	19.38^{e}	33.81	18.00^{d}	22.85	19.34^{f}	30.44	16.78^{b}	18.69^{e}	18.06^{d}	18.37^{g}
	(15.27)	(11.01)	(30.96)	(9.55)	(15.08)	(10.97)	(25.67)	(8.33)	(10.27)	(9.61)	(9.93)
T$_4$ (T2 + Thiamethoxam 25 WG @ 50 ga.i/ha)	23.16	21.50^{de}	33.98	19.68^{cd}	22.83	20.82^{ef}	30.69	17.84^{b}	20.59^{e}	19.33^{cd}	19.96^{f}
	(15.47)	(13.43)	(31.24)	(11.34)	(15.05)	(12.63)	(26.05)	(9.39)	(12.37)	(10.96)	(11.65)
T$_5$ (T1 + Flonicamid 50 WG @ 75 ga.i/ha)	24.54	24.16^{cd}	34.38	22.41^{bc}	23.53	22.97^{de}	31.02	18.63^{b}	23.29^{d}	20.80^{bc}	22.04^{de}
	(17.25)	(16.75)	(31.89)	(14.53)	(15.94)	(15.23)	(26.56)	(10.21)	(15.63)	(12.61)	(14.08)
T$_6$ (T2 + Flonicamid 50 WG@ 75 ga.i/ha)	23.97	25.35^{bc}	34.61	24.14^{b}	23.04	24.49^{cd}	30.73	19.91^{b}	24.75^{cd}	22.20^{b}	23.47^{cd}
	(16.50)	(18.33)	(32.26)	(16.73)	(15.32)	(17.18)	(26.11)	(11.60)	(17.53)	(14.28)	(15.86)
T$_7$ (Thiamethoxam 25 WG @ 50 ga.i/ha)	24.81	23.16^{cd}	35.01	22.84^{b}	23.45	20.40^{f}	30.76	18.00^{b}	23.01^{d}	19.20^{cd}	21.10^{ef}
	(17.61)	(15.47)	(32.92)	(15.07)	(15.84)	(12.15)	(26.16)	(9.55)	(15.28)	(10.82)	(12.96)
T$_8$ (Flonicamid 50 WG @ 75 ga.i/ha)	23.55	24.95^{bc}	32.76	22.61^{bc}	23.27	23.39^{d}	30.75	20.23^{b}	25.78^{c}	21.81^{b}	23.80^{c}
	(15.96)	(17.79)	(29.28)	(14.78)	(15.61)	(15.76)	(26.14)	(11.96)	(18.92)	(13.80)	(16.28)
T$_9$ (Dimethoate 30 EC @ 150 ga.i/ha)	24.01	25.69^{bc}	34.32	22.96^{b}	22.95	24.18^{cd}	30.69	20.33^{b}	24.32^{cd}	22.26^{b}	23.29^{cd}
	(16.56)	(18.79)	(31.79)	(15.22)	(15.20)	(16.78)	(26.05)	(12.07)	(16.96)	(14.35)	(15.63)
T$_{10}$ [Control (Water spray)]	27.68	33.87^{a}	36.18	39.83^{a}	25.96	29.13^{a}	32.14	35.23^{a}	36.85^{a}	32.18^{a}	34.52^{a}
	(21.58)	(31.06)	(34.85)	(41.03)	(19.16)	(23.70)	(28.30)	(33.28)	(35.97)	(28.36)	(32.11)
S. Em.($\pm$) Treatment (T)	1.58	1.04	1.60	0.99	1.40	0.74	1.81	1.54	0.78	0.65	0.51
Period (P)	-	0.62	-	0.59	-	0.44	-	0.46	0.42	0.35	0.79
Spray (S)	-	-	-	-	-	-	-	-	0.35	0.29	0.73
Year (Y)	-	-	-	-	-	-	-	-	-	-	0.23
T x P	-	-	-	-	-	-	-	-	1.35	1.13	0.89
T x S	-	-	-	-	-	-	-	-	1.10	0.92	0.72
P x S	-	-	-	-	-	-	-	-	0.60	0.50	1.08
S x Y	-	-	-	-	-	-	-	-	-	-	0.32
P x Y	-	-	-	-	-	-	-	-	-	-	0.40
T x Y	-	-	-	-	-	-	-	-	-	-	0.72
Y x S x T	-	-	-	-	-	-	-	-	-	-	1.02
P xS xY	-	-	-	-	-	-	-	-	-	-	0.56
T x P x S	-	-	-	-	-	-	-	-	1.92	1.60	1.25
T x P x Y	-	-	-	-	-	-	-	-	-	-	1.25
T x P x S x Y	-	-	-	-	-	-	-	-	-	-	1.77
C.V. (%)	11.30	13.35	8.08	11.90	10.42	10.22	10.12	11.90	12.63	11.78	12.28

*Arc sin transformed values while, figures in the parentheses are original values; Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

Table 3: Impact of different insecticidal treatments on cucumber fruit yield

Treatments	Yield (q/ha) 2015-16	Yield (q/ha) 2016-17	Pooled over Year
T$_1$ (Seed treatment with Thiamethoxam 35 FS)	52.07^{e}	51.49^{def}	51.78^{e}
T$_2$ (Seed treatment with Imidacloprid 600 FS)	50.06^{e}	48.17^{ef}	49.12^{e}
T$_3$ (T1 + Thiamethoxam 25 WG @ 50 ga.i/ha)	122.16^{a}	101.85^{a}	112.01^{a}
T$_4$ (T2 + Thiamethoxam 25 WG @ 50 ga.i/ha)	112.81^{ab}	91.89^{ab}	102.35^{ab}
T$_5$ (T1 + Flonicamid 50 WG @ 75 ga.i/ha)	75.74^{cd}	68.70^{cd}	72.22^{d}
T$_6$ (T2 + Flonicamid 50 WG@ 75 ga.i/ha)	79.89^{cd}	72.11^{bc}	76.00^{cd}
T$_7$ (Thiamethoxam 25 WG @ 50 ga.i/ha)	97.97^{bc}	78.74^{bc}	88.35^{bc}
T$_8$ (Flonicamid 50 WG @ 75 ga.i/ha)	70.81^{de}	63.40^{cde}	67.11^{d}
T$_9$ (Dimethoate 30 EC @ 150 ga.i/ha)	89.81^{cd}	68.71^{cd}	79.26^{cd}
T$_{10}$ [Control (Water spray)]	50.43^{e}	43.82^{f}	47.12^{e}
S. Em.($\pm$) Treatment (T)	6.73	5.84	4.38
Y	-	-	1.99
T x Y	-	-	6.30
C. V. %	14.55	14.68	14.70

Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

5. Conclusion

Leaf miner is very important pest of the cucumber which can cause heavy damage to foliage plant part and resulted in to yield loss. These findings will helpful to the farmers in Integrated Pest Management programme to minimize the initial population of pest which ultimately reduce the damage done by leaf miner. Among the different insecticides evaluated, it was concluded that treatment T3 [T1 (Seed treatment with Thiamethoxam 35 FS) + Thiamethoxam 25 WG] effective in management of leaf miner, *L. trifolii* infesting cucumber leaves as well as the alternative treatment T4 [T2 (Seed treatment with Imidacloprid 600 FS) + Thiamethoxam 25 WG. These both the treatment molecules also recorded maximum cucumber fruit yield as compared to other tested molecules and untreated control.

6. References

1. Angst M, Hofer D, Senn R, Hopper TCGA. A novel broad spectrum insecticide supporting sustainable agriculture worldwide. Proceedings of the Brighton Crop Protection Conference: Plant and Diseases Brigthon, U.K. 1998; 1:26-28
2. Anonymous. Evaluation of different insecticides as seed treatments against leaf miner in cucurbitaceous vegetable crops. Agresco Report, MVRS, AAU, Anand, 2011.
3. Anonymous. Horticulture at a glance. Horticulture Statistics Division Department of Agriculture, Cooperation & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India, 2017, 514.
4. Krishna Kumar, NK, Krishna Moorthy PN, Rama N, Esther AA. Insect Environment. 1997; 2(4):125-126.
5. Nolasco JJ, Solis JF. Chemical control of whitefly, aphid and leaf miners by means of three methods of application of the insecticide imidocloprid (Bay NTN 33893) in green tomato (*Physalis ixocarpa* Brot) in Totolapan Morelos. Revista Chapingo Serie Protection Vegetal. 1995; 2(1):5-8.
6. Paradikovic N. New possibilities for controlling the leafininer, *Liriomyza trifolii* (Burgess) on gerberas in glasshouse. *Poijoprivreda*. 1998; 4(2):87-90
7. Rai D, Singh V, Singh VN, Ram K. Evaluation of different insecticides against american serpentine leaf miner, *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) in tomato crop. *Plant Archives*. 2017; 17(1):295-298.
8. Saad AS, Massoud MA, Abdel Megeed AA, Hamid NA, Mourad AK, Barakat AS. Abamectin, pymetrozine and azadirachtin sequence as a unique solution to control the leaf miner *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) infesting garden beans (Phaseolus vulgaris L.) in Egypt. Communications in Agricultural and Applied Biological Sciences. 2007; 72(3):583-93.
9. Saito T, Ikeda F, Ozawa A. Effect of pesticides on parasitoid complex of serpentine leaf miner *Liriomyza trifolii* (Burgess) in Shizuoka Prefecture. Japanese Journal of Applied Entomology and Zoology. 1996; 40(2):127-133.
10. Shinde SS, Neharkar PS, Dhurve NG, Sawai HR, Lavhe NV, Masolkar DS. Evaluation of different insecticides against citrus leaf miner on Nagpur mandarin. Journal of Entomology and Zoology Studies. 2017; 5(6):1889-1892.
11. Srinivasan K, Viraktamath CA, Gupta M, Tewari GC. Geographical distribution, host range and parasitioids of serpentine leaf miner *Liriomyza trifolii* (Burgess) in South India. Pest Managemnt in Horticultural Ecosystems. 1995; 1(2):93-100.