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Bio-efficacy of synthetic insecticides against onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae)

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Abstract
The experiment was conducted under field condition at Haveli Farm, University of Horticultural sciences, Bagalkot to evaluate the efficacy of synthetic insecticides against onion thrips during *kharif* season (2017 - 18). The experiment plot area was replicated thrice and eight treatments with randomised block design. The results revealed that thiamethoxam 25 WG @ 25 g *a.i.*/ha recorded significantly lowest population of thrips after first, second and third spray during the experimental period by recording 4.90 thrips per plant which was at par with imidacloprid 17.8 SL @ 22.25 g *a.i.*/ha with 5.19 thrips per plant indicating the superiority of both the treatments against onion thrips. The next best treatments were, cyazypyr10.26 OD @ 76.95 g *a.i.*/ha, diafenthiuron 50 WP @ 250 g *a.i.*/ha and tolfenpyrad 15 EC @ 150 g *a.i.*/ha with 6.89, 7.29 and 7.56 thrips per plant, respectively. Whereas, lamda cyhalothrin 5 EC @ 12.5 g *a.i.*/ha and chlorfenapyr 10 SC @ 12.5 g *a.i.*/ ha found to be least effective in reducing thrips population with 8.67 and 8.46 thrips/plant. The data on bulb yield indicated that highest bulb yield was registered in thiamethoxam 25 WG @ 25 g *a.i.*/ha and imidacloprid 17.8 SL @ 22.25 g *a.i.*/ha treated plots with 25.39 and 24.67 t per hectare, respectively. Whereas, minimum bulb yield was noticed with lambda cyhalothrin 5 EC @ 12.50 g *a.i.*/ha treated plots (17.94 t/ha).

Keywords: Onion thrips, synthetic insecticides, bulb yield

1. Introduction
Onion (*Allium cepa* L.) belongs to the family Amaryllidaceae (Alliaceae) is one of the most important commercial vegetable and condiment crop grown in India for more than 5000 years. It is consumed throughout the socioeconomic spectrum [1]. India is the second largest onion producing country in the world, next only to china. It contributes 11.9 per cent of total onion production in the world with a production of 215.63 lakh tones and 21.2 MT/ha productivity with an area of 1.27 million ha. Major onion producing states are Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu and Haryana. In Karnataka, it occupies an area of 0.19 million ha with production of 27.67 lakh tones and productivity of 14.16 MT/ha. Dharwad, Chitradurga, Bijapur, Bellary and Gulbarga are major districts of onion cultivation in Karnataka [2]. Onion crop is subjected to attack by various insect pests right from seedling stage to harvest, that can reduce yield and quality. The important ones are onion thrips, *Thrips tabaci* Lindeman, head borer, *Helicoverpa armigera* (Hubner), onion maggot, *Delia antiqua* (Meigen), tobacco caterpillar, *Spodoptera litura* (Fabricius) and cut worm *Agrotis ipsilon* (Hufn.) [3]. Among the insect pests, onion thrips, *Thrips tabaci* is one of the major limiting factor in reducing the productivity and reported to cause significant economic losses up to 30-50 per cent [4].
Onion thrips is a cosmopolitan pest which is recorded on more than 300 species of host plants mainly cabbage, cotton, carnation, garlic, onion and cereals especially wheat [5]. Both nymphs and adults are the damaging stages which feed by rasping the leaves and other tissues of plants and suck the sap, as a result, it causes silver patches and streaks on leaves. Besides direct damage to foliage, it can indirectly aggravate purple blotch [6]. It is also a vector of "Iris Yellow Spot Virus" which is a tospovirus causing adverse effects on bulb and seed yield of onion crop in India. More often use of insecticides is one of the most common and popular methods of thrips control on onion crop. These chemicals need to be used wisely in the control or management of any key pest like onion thrips with due consideration of cost economics and

environmental damage by this insecticides. With this background the experiment was conducted to evaluate the efficacy of synthetic insecticides against onion thrips.

2. Materials and Methods

The experiment was conducted under field condition at Haveli Farm, University of Horticultural sciences, Bagalkot to evaluate the efficacy of synthetic insecticides against onion thrips. The variety, Bhima super was selected for this experiment and sown during *kharif* season (2017 - 18). Seedlings were transplanted at 45 days after sowing with inter and intra row spacing of 15 cm x 10 cm. The experiment was laid out in randomized complete block (RCBD) design with eight treatments comprising of synthetic insecticides along with standard and untreated check and each treatment was replicated thrice. The area under each block was 4 m × 3 m (Plate 3). All agronomic practices were followed as per the recommended package of practices of the University of Horticultural Sciences, Bagalkot [7]. The experimental details are presented in Table 1.

Table 1: Treatment details of synthetic insecticides evaluated against onion thrips

Treatments No.	Chemical name	Dosage	Dosage (g *a.i.*/ha)
T_1	Thiamethoxam 25 WG	0.20 g/l	25.00 g
T_2	Tolfenpyrad 15 EC	2.00 ml/l	150.00 g
T_3	Chlorfenapyr 10 SC	0.25 ml/l	12.50 g
T_4	Cyantraniliprole 10.26 OD	1.50 ml/l	76.95 g
T_5	Diafenthiuron 50 WP	1.00 g/l	250.00 g
T_6	Lambda cyhalothrin 5 EC	0.50 ml/l	12.50 g
T_7	Imidacloprid 17.8 SL (Standard Check)	0.25 ml/l	22.25 g
T_8	Untreated control	-	

2.1 Observations

Pre-treatment count was made prior to the each spray. The post treatment counts were made at three, seven and ten days after each spray. The observations made on tenth day act as pre-count for second spray. Number of thrips were recorded from ten randomly selected plants in each treatment through visual counting by opening leaf sheath at the base of onion plants.

2.2 Yield and economics

The treatment-wise bulb yield was recorded and computed to quintal per hectare basis. Further, cost economics was calculated based on total yield in quintal per hectare, other cost of cultivation and gross return based on market price at Rs. 10 per kg. The following formulae were used for calculation of B:C ratio.

1. Gross return = Yield x Market price of onion (Rs. 10/kg)
2. Net Returns = Gross Return - Total Cost
3. B: C ratio = Gross Return / Total Cost

2.3 Statistical analysis

The data regarding bio-inoculants, organic amendments, biorationals and synthetic insecticides evaluated against onion thrips were analysed using WASP statistical software. The treatment means were separated by using DMRT.

3. Results and Discussion

The experiment was conducted to evaluate synthetic insecticides for their efficacy against onion thrips and the results pertaining to thrips population are presented in Table 2.

Day before initiation of spraying showed that there was uniform distribution of thrips in the plots. The results revealed that all the treatments were significantly found superior over control. Among the different chemicals, thiamethoxam 25 WG @ 25 g *a.i.*/ha recorded significantly lowest population of thrips after first, second and third spray during the experimental period which was at par with imidacloprid 17.8 SL @ 22.25 g *a.i.* per hectare indicating the superiority of both the treatments against onion thrips. The next best treatments were, cyazypyr10.26 OD @ 76.95 g *a.i.* per hectare, diafenthiuron 50 WP @ 250 g *a.i.* per hectare and tolfenpyrad 15 EC @ 150 g *a.i.* per hectare. Whereas, lamda cyhalothrin 5 EC @ 12.5 g *a.i.*/ ha and chlorfenapyr 10 SC @ 12.5 g *a.i.* per hectare found to be least effective in reducing thrips population (Fig. 1). The present findings are in agreement with those of Nirgude (2017) [8] who reported that lowest mean of thrips population was recorded in thiamethoxam 25 WG (61) followed by imidacloprid 70 WG (92.33) in onion. Similarly Mehra and Singh (2013) [9], revealed that thiamethoxam 25 WG at 0.2 g/l was found to be the most effective treatment followed by imidacloprid 70 WG at 033 g/l (511.00/5 plants), dimethoate 30 EC at 1.7 ml/1 (563.67/5 plants), profenophos 50 EC at 1ml/1 (569.00/5 plants) and acetamaprid 20 SP at 0.5 g/l (567.67 / 5 plants) in garlic. Tirkey and Kumar (2017) [10] reported that thiamethoxam was proved to be the most effective treatment followed by fipronil, abamectin and imidacloprid in chilli. Ghosh *et al*. (2009) [11] who reported that thiamethoxam (90.1 %) was most effective insecticide followed by acetamiprid (89.8 %), fipronil (88.8 %), clothianidin (87.4 %) and oxydemeton-methyl (76.9 %). The efficacy of thiamethoxam 25 WG and imidacloprid 17.8 SL may be attributed due to its unique and novel mode of action against thrips as both the insecticides belong to the same group of chemicals (Neonicotinoids). Thiamethoxam is a systemic insecticide that is absorbed quickly by plants and transported to all parts of the plant, where it acts as a deterrent to insect feeding. It is active in the stomach of the insects and also through direct contact.

Kurbett (2018) [12] reported that thiamethoxam 25 WG @ 0.20 g per litre recorded significantly lowest population of thrips with 0.81 thrips per plant followed by cyantraniliprole 10 OD @ 1.00 g per litre with 0.84 thrips per plant indicating the superiority of both the treatments against chilli thrips. The efficacy is of cyazypyr10.26 OD is due to its root systemic activity with some translaminar movement. It is effective against the larval stages of lepidopteran insects, thrips, aphids, and some other chewing and sucking insects. Due to selective mode of action, it is effective against pest, while safe to non-target arthropods and conserves natural parasitoids, predators and pollinators. Similarly, diafenthiuron acts as inhibitors of oxidative phosphorylation, disruptors of ATP formation. In present study, lambda cyhalothrin 5 EC found least effective against onion thrips. It is may be due to the development of resistance to thrips as reported by Allen *et al*. (2005) [13] who studied resistance of *Thrips tabaci* to pyrethroid and organophosphorus insecticides. The results reported that lambda-cyhalothrin developed resistence to thrips, with resistance ratios (RR) ranging from 2 to 13.1, followed by deltamethrin, with RR ranging from 19.3 to 120.

3.1 Bulb yield and cost economics

The data obtained on the bulb yield and cost economics of chemical insecticides evaluated against onion thrips are presented in Table 3. The data clearly indicated that highest bulb yield was registered in thiamethoxam 25 WG @ 25 g *a.i.* per hectare and imidacloprid 17.8 SL @ 22.25 g *a.i.* per hectare treated plots with 25.39 and 24.67 t per hectare, respectively indicating both the molecules were equally effective in recording highest yield. Followed by cyazypyr10.26 OD @ 76.95 g *a.i.* per hectare (24.26 t/ha) and diafenthiuron 50 WP @ 250 g *a.i.* per hectare (22.47 t/ ha) and tolfenpyrad 15 EC @ 150 g *a.i.* per hectare (21.00 t/ha). Whereas, minimum bulb yield was noticed with lambda cyhalothrin 5 EC @ 12.50 g *a.i.* per hectare treated plots (17.94 t/ha). Cost economics worked out for different chemical insecticides revealed that thiamethoxam 25 WG @ 25 g *a.i.* per hectare recorded highest B:C ratio of 3.58 followed by imidacloprid 17.8 SL (3.40), diafenthiuron 50 WP@ 250 g *a.i.* per hectare (2.93), chlorfenapyr 10 SC @ 12.50 g *a.i.* per hectare (2.60), cyazypyr10.26 OD @ 10 g *a.i.* per hectare (2.52), tolfenpyrad 15 EC @ 150 g *a.i.* per hectare (2.51). While, minimum benefit cost ratio was noticed with lambda cyhalothrin 5 EC @ 12.50 g *a.i.* per hectare (2.39) (Fig. 2). The present findings are in close agreement with findings of Nirgude (2017)[8] who reported that thiamethoxam 25 WG and imidacloprid 70 WG were significantly superior among the chemicals tested and recorded higher B:C ratio (1:3.6 and 1:1.35). Das *et al*. (2017) [14] reported that the application of imidacloprid 17.8 SL showed positive response in minimizing population of onion thrips and improved the total yield (263.56 q/ha.) and marketable yield (247.55q/ha) with highest B:C ratio of (3.05). Verma *et al.* (2012) [15] revealed that highest garlic yield (172.49q/ha) was recorded when the crop was sprayed with imidacloprid @ 0.5 ml per litre.

Table 2: Bio-efficacy of synthetic insecticides against thrips, *Thrips tabaci* on onion

Treatments	Dose (g *a.i.*/ha)	Mean number of thrips /plant									
		First Spray				Second Spray			Third Spray		
		Pre count	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS
T_1 -Thiamethoxam 25 WG	25.00	22.3 (4.77)	10.36 (3.29) ^{a}	9.90 (3.22) ^{a}	10.26 (3.28) ^{a}	4.97 (2.33) ^{a}	4.63 (2.25) ^{a}	5.10 (2.36) ^{a}	2.77 (1.80) ^{a}	2.55 (1.75) ^{a}	3.03 (1.87) ^{a}
T_2 - Tolfenpyrad 15 EC	150.00	21.63 (4.70)	12.80 (3.64) ^{cd}	11.86 (3.51) ^{cd}	12.06 (3.54) ^{cd}	6.37 (2.61) ^{abc}	5.87 (2.52) ^{abc}	6.37 (2.62) ^{bcd}	4.83 (2.24) ^{cd}	3.99 (2.21) ^{bc}	4.23 (2.16) ^{bc}
T_3 - Chlorfenapyr 10 SC	12.50	22.63 (4.80)	14.06 (3.81) ^{e}	12.50 (3.60) ^{de}	13.66 (3.76) ^{e}	7.10 (2.75) ^{bc}	6.93 (2.72) ^{bc}	7.18 (2.77) ^{de}	5.00 (2.34) ^{d}	4.51 (2.23) ^{c}	4.73 (2.28) ^{c}
T_4 – Cyantraniliprole 10.26 OD	76.95	19.00 (4.89)	11.10 (3.40) ^{ab}	10.76 (3.35) ^{ab}	11.52 (3.47) ^{bc}	5.40 (2.42) ^{a}	5.60 (2.47) ^{ab}	6.00 (2.54) ^{abc}	3.90 (2.08) ^{bc}	3.63 (2.03) ^{abc}	4.16 (2.15) ^{bc}
T_5 - Diafenthiuron 50 WP	250.00	22.83 (4.82)	11.80 (3.50) ^{bc}	11.20 (3.42) ^{bc}	11.66 (3.48) ^{c}	5.97 (2.54) ^{ab}	5.67 (2.48) ^{ab}	7.06 (2.75) ^{cde}	4.15 (2.14) ^{abc}	3.75 (2.06) ^{bc}	4.34 (2.19) ^{bc}
T_6 - Lambda cyhalothrin 5 EC	12.50	22.76 (4.82)	13.93 (3.79) ^{de}	12.93 (3.66) ^{e}	13.23 (3.70) ^{de}	7.89 (2.89) ^{c}	7.29 (2.79) ^{c}	7.82 (2.88) ^{e}	5.40 (2.42) ^{bcd}	4.76 (2.29) ^{c}	5.23 (2.38) ^{c}
T_7 . Imidacloprid 17.8 SL (Standard Check)	22.25	21.11 (4.65)	10.67 (3.79) ^{a}	10.06 (3.25) ^{a}	10.46 (3.31) ^{ab}	5.00 (2.34) ^{a}	4.73 (2.28) ^{a}	5.84 (2.51) ^{ab}	2.90 (1.83) ^{ab}	2.80 (1.83) ^{ab}	3.23 (1.93) ^{ab}
T_8 - Untreated control	-	22.43 (4.78)	24.80 (3.33) ^{f}	25.02 (5.05) ^{f}	23.06 (4.85) ^{f}	19.30 (4.45) ^{d}	23.03 (4.84) ^{d}	24.07 (4.95) ^{f}	21.79 (4.72) ^{e}	22.75 (4.82) ^{f}	19.26 (4.49) ^{f}
SEm±	-	-	0.06	0.04	0.09	0.10	0.08	0.07	0.10	0.09	0.09
C D at 5 %	-	NS	0.18	0.12	0.28	0.30	0.28	0.22	0.30	0.29	0.27

DAS- Days after spray NS- Non Significant

Figures in parenthesis are square root ($\sqrt{x+0.5}$) transformed value

Figures in each column followed by same alphabet (s) are not significantly different (P=0.05) by DMRT

Table 3: Cost economics of synthetic insecticides evaluated against onion thrips, *Thrips tabaci*

Treatments	Dose (g *a.i.*/ha)	Yield (t/ha)	Cost of plant protection (Rs./ha)	Other production cost (Rs./ha)	Total cost of production (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Cost benefit Ratio
T_1-Thiamethoxam 25 WG	25.00	25.39^{a}	762	70,130	70,892	2,53,888	1,82,996	3.58
T_2-Tolfenpyrad 15 EC	150.00	21.00^{ab}	13650	70,130	83,780	2,10,000	1,26,220	2.51
T_3- Chlorfenapyr 10 SC	12.50	18.61^{b}	1368	70,130	71,498	1,86,111	1,14,613	2.60
T_4- Cyantraniliprole 10.26 OD	76.95	24.26^{a}	26055	70,130	92,004	2,42,555	1,46,370	2.52
T_5- Diafenthiuron 50 WP	250.00	22.47^{ab}	6540	70,130	76,670	2,24,666	1,47,996	2.93
T_6- Lambda cyhalothrin 5 EC	12.50	17.94^{b}	4800	70,130	74,930	1,79,444	1,04,514	2.39
T_7- Imidacloprid 17.8 SL (Standard Check)	22.25	24.67^{a}	2434	70,130	72,564	2,46,666	1,74,102	3.40
T_8 - Untreated control	-	12.83^{e}	0	69,130*	69,130	1,28,333	59,003	1.85
SEm±	-	1.65	-	-	-	-	-	-
C D at 5 %	-	5.03	-	-	-	-	-	-

Figures in each column followed by same alphabet (s) are not significantly different (P=0.05) by DMRT

Gross return = Yield x Market price of onion (Rs. 10/kg), Net Returns = Gross Returns - Total Cost

* Spraying cost of Rs.1000 in untreated control was excluded

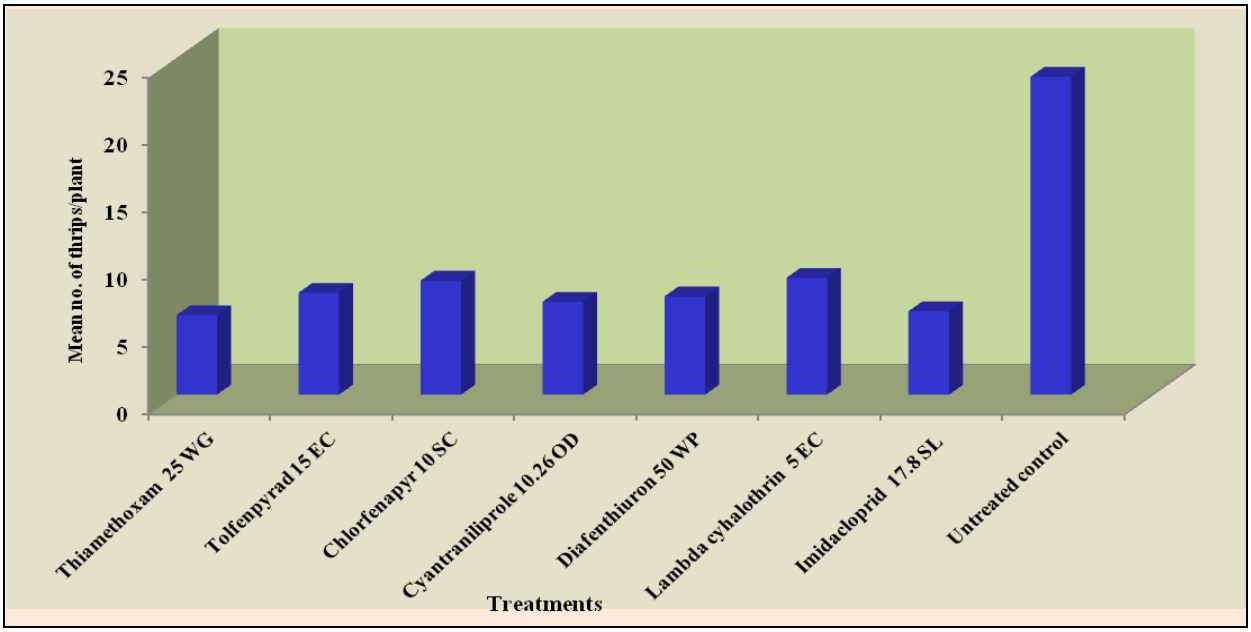

Fig 5: Bio-efficacy of synthetic insecticides against onion thrips, *Thrips tabaci*

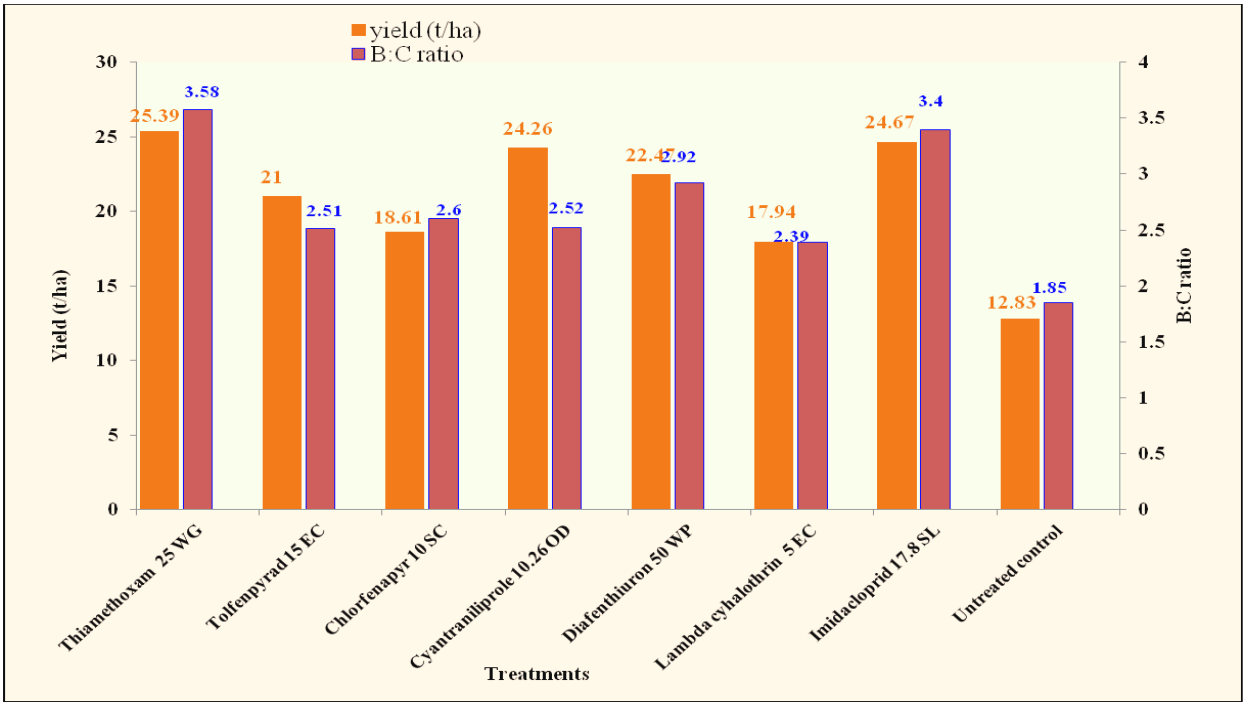

Fig 7: Economics of management of thrips in onion after treating with synthetic insecticides against onion thrips, *Thrips tabaci*

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