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FIELD EFFICACY OF NEWER INSECTICIDES AGAINST ONION THRIPS *THRIPS TABACI* LINDEMAN

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ABSTRACT

Field experiments were conducted for two consecutive seasons (*kharif* and *rabi*) during 2017-18 to evaluate the efficacy of three newer insecticides, including cyantraniliprole (@ 90 & 120 gm ai/ha), emamectin benzoate (@ 11 & 22 gm ai/ha), tolfenpyrad @ 125 ai/ha along with a conventional insecticide, profenofos @ 160 ai/ha. A total of seven treatments, including untreated control, were imposed with a randomized block design having three replications. All the insecticides have been considerably effective against thrips over control. Profenofos @ 160 ai/ha was the most effective insecticide that produced an average reduction of 86.8-90% of population of thrips, low leaf curing and a maximum bulb yield (20.8-24.2 t/ha). Cyantraniliprole @ 120 gm ai/ha was next better insecticide with 73.8-79% decrease of thrips population, low leaf curling index and higher bulb yield (20.9-22.1 t/ha) and was on par with profenofos. From the study, it is recommended that new chemistry insecticide, cyantraniliprole may be used or rotated as alternative insecticide and may be integrated into insecticide schedule of the thrips management programme in onion.

Key words: Onion thrips, insecticides, field-efficacy, cyantraniliprole, emamectin benzoate, tolfenpyrad, profenofos, IPM

Onion is one of the important bulb vegetable crops of India and has a key position among vegetables. Besides culinary uses, they are well known for their wide range of medicinal properties. In the globe, India ranks first in area and second in onion production (Kumar *et al.*, 2015) and is grown in 1.3 million hectares area with the annual production of 22.40MT (FAOSTAT, 2017). However the productivity of onion in India is around 16.13 t/ha, which is low when compared to Republic of Korea where onion productivity was highest (57.03 t/ha) (Tripathi et al., 2017). One of the main reasons for low productivity is the occurrence of onion thrips that causes significant loss of yield.

Onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) is a major onion pest in India. It is a polyphagous pests with characteristics of high reproductive rate, short generation time, high survival *via* cryptic (non-feeding prepupa and pupa) instars and asexual reproduction (Soumia et al., 2017). Ability of thrips to transmit plant pathogens and development of resistance to insecticides makes it a global pest with increasing concern especially in commercial onion production. Onion thrips has a wide host of approximately 140 plant species within 40 families (Ananthakrishnan, 1973). Despite the large number of hosts, onion is the favorite host and, as a result, thrips is regarded to be a major pest of onion in the world. The pest can cause up to 50 per cent of loss of bulb yield through direct feeding (Mala, 2013) or indirectly via transmitting viral diseases (Gent and Schwartz, 2008) and fungal disease like purple blotch in onion (Arantha, 1980). Both nymphs and adults lacerate the tissue and suck the plant sap and remove chlorophyll from the leaf, which causes white to silver patches, leading in curling of the leaf, reduction in the photosynthetic area, further formation of undersized bulbs (Rueda et al., 2007; Karuppaiah et al., 2018; Karuppaiah et al., 2019).

Insecticides have been widely used to control onion thrips due to their easy adaptability, effectiveness and immediate control. The use of conventional organophosphorus (OP), carbamates and pyrethroids insecticides has been a main approach for the control of thrips in onion (Gill et al., 2015). Repeated use of broad-spectrum insecticides with similar mode of action may lead to resistance development and may be less effective (Martin et al., 2003; Allen et al., 2005; Shelton et al., 2006). To overcome resistance issues, the identification of new chemical molecules with better insecticidal properties, reduced dosage with selective action, periodical rotation, altered use of insecticides is a continuous process for inclusion into IPM strategies. However, the use of these novel molecules and data on the efficacy of these insecticides against onion thrips are very limited available. The present study was therefore undertaken to evaluate the field efficacy of these newer insecticides for the management of onion thrips in onion.

MATERIALS AND METHODS

The field experiment was conducted for two seasons (*Kharif* and *Rabi*) in 2017-18 at the research farm of ICAR-Directorate of Onion and Garlic Research, Pune, Maharashtra. Onion variety *Bhima super* for *kharif* season and *Bhim kiran* for *rabi* season was planted in plots of size 2 X 3.0 m with a spacing of 15 X 10 cm. Except for insect-pest management, all the recommended agronomic practices were followed. The experiment was laid out in a randomized block design with seven treatments including untreated control. For each treatment, three replications were maintained.

The insecticide treatments are emamectin benzoate 5SG @11gm & @22gm a.i/ha (two doses), cyantraniliprole 10% OD @90 & 120 gm a.i/ha (two doses), tolfenpyrad 15EC 125 a.i./ha and one conventional insecticides profenofos 50EC @ 160 gm a.i/ha. During primary bulb initiation and development stages of the crop coinciding with incidence of thrips on leaves, two sprays were imposed using high volume knapsack sprayer (600 l/ ha) at 20 days interval.

Observations on thrips population in different insecticide treatments were recorded from five randomly selected plants per plot before spraying and 1, 3 and 5 days after each application. The visual counts were made to record the number of thrips (nymphs and adults) in each plant and mean number of thrips per plant was further worked out and pooled data of 2017 and 2018 were used for analysis. From randomly selected 5 plants, total number of leaves and curled leaves plant were examined. Per cent leaf curl was calculated using following formula and scoring of leaf curl index (LCI) was done using scale from 0 to 4 (0= no leaf curling; 1= less than 25% curling; 2= 25 to 50% leaf curling; 3= 50 to75% leaf curling; 4= more than 75% leaf curling) and on the basis of cumulative score leaf curling was further categorized into low (1–1.99), moderate (2–2.99), high (3–3.99) and severe (>4).

$$\text{Leaf curling index (LCI)} = \frac{\text{No. of Curled leaves}}{\text{Total no of leaves}} \times 100$$

The bulb yield was recorded on net plot area basis, which was converted to t/ha for statistical interpretations. Thrips data for each season was subjected to normalization with square root transformation, followed analysis of variance and Tukey's mean comparison using statistical analysis with SPSS v.16 software.

RESULTS AND DISCUSSION

The infestation of thrips (pooled data) in onion plots which were treated with different insecticides is presented in Table 1. All the six insecticide-treated plots recorded significantly fewer thrips than untreated control. In which treatment with T_3-profenophos @160gm ai/ha was more effective in restricting the thrips population and had least number thrips per plant after 1, 3 and 5 days after treatment with an average of 7.4 and 2.1 thrips per plant in first and second spray, respectively. Treatment T_6-cyanantraniliprole @ 120 gm ai/ha was the next best insecticide after the first and second spray with mean infestation of 11.8 and 5.5 thrips per plant, respectively. The average percentage decrease in the population of thrips was 88.4 % in profenophos treated plot followed by cyantraniliprole @ 120 gm ai (76.4 %), cyantraniliprole @ 90 gm ai (64.5 %), emamectin benzoate @ 22 gm ai (62.9 %), emamectin benzoate @ 11 gm ai (61.0 %) and tolfenpyrad @ 125 gm ai/ha (59.2). The order of efficacy was T_3- profenophos @160 gm ai/ha >T_6- chlorantraniliprole @120 gm ai/ha > T_2- chlorantraniliprole @ 90 gm ai/ha T_5-emamectin benzoate @ 22 gm ai/ha >T_1- emamectin benzoate @ 11 gm ai/ha >T_4-tolfenpyrad @ 125 gm ai/ha. The trend was almost similar in both the experiments. Regardless of seasons, profenofos was most effective followed cyantraniliprole @ 120 gm ai/ha.

The leaf scoring index recorded at 65 days after planting in each treatment were given in Table 2. The cumulative score was ranged from 1.1 to 3.1 in *kharif* season and 1.8 to 3.4 in *rabi* season. During *kharif*, the low level of leaf curling was recorded in the plots which are treated with profenofos, cyantraniliprole and emamectin benzoate @ 22 gm ai/ha; moderate level of leaf curling was recorded in the treatment emamectin benzoate @ 11 gm ai/ha and tolfenpyrad @ 125 ai/ha. The leaf curling index trend was same in *rabi* seasons among the insecticides treatments.

The season-wise bulb yield and incremental yield obtained in different insecticide treated plots over untreated control were presented in the Table 3. A significant difference in yield was recorded among the treatments irrespective of seasons. A maximum bulb yield of 20.8 to 24.2 t/ha was recorded in profenofos

Table 1. Efficacy of insecticides against onion thrips in *rabi* onion (2017-18)

Treatment	Pooled data- mean no. of thrips per plant												Mean reduction (%)
	Ist spray						IInd Second Spray						
	Pre-count	1 DAS	3 DAS	5 DAS	Mean	Reduction over control (%)	Pre-count	1 DAS	3 DAS	5 DAS	Mean	Reduction over control (%)	
T_1- Emamectin benzoate 5SG @11gm a.i/ha	38.2 (6.17)	18.2 (4.26)^{d}	20.0 (4.47)^{c}	17.7 (4.20)^{bc}	18.7	66.7	33.9 (5.82)	10.1 (3.17)^{c}	10.0 (3.15)^{bc}	8.3 (2.88)^{b}	9.4	55.2	61.0
T_2-Cyantraniliprole 10% OD 90 gm a.i/ha	41.7 (6.45)	10.9 (3.30)^{bc}	33.2 (5.76)^{d}	15.4 (3.92)^{b}	19.8	64.7	33.9 (5.81)	7.7 (2.77)^{bc}	7.6 (2.75)^{b}	7.1 (2.66)^{b}	7.5	64.3	64.5
T_3-Profenophos 160 gm a.i/ha	38.8 (6.23)	6.5 (2.54)^{a}	8.1 (2.84)^{a}	7.6 (2.75)^{a}	7.4	86.8	31.2 (5.58)	3.3 (1.80)^{a}	2.2 (1.48)^{a}	0.9 (0.94)^{a}	2.1	90.0	88.4
T_4-Tolfenpyrad 15EC 125 a.i./ha	42.6 (6.52)	15.7 (3.96)^{d}	18.0 (4.24)^{c}	22.0 (4.68)^{c}	18.5	67.0	32.4 (5.69)	10.0 (3.15)^{c}	12.3 (3.50)^{c}	8.4 (2.89)^{b}	10.2	51.4	59.2
T_5-Emamectin benzoate 5SG @22gm a.i/ha	38.4 (6.19)	15.5 (3.94)^{cd}	17.5 (4.18)^{c}	15.2 (3.90)^{b}	16.0	71.5	36.9 (6.07)	11.8 (3.43)^{c}	10.2 (3.19)^{bc}	7.0 (2.63)^{b}	9.6	54.3	62.9
T_6-Cyantraniliprole10% OD 120 gm a.i/ha	38.2 (6.18)	9.6 (3.10)^{ab}	11.9 (3.44)^{b}	14.0 (3.73)^{b}	11.8	79.0	36.7 (6.05)	4.3 (2.07)^{ab}	6.9 (2.62)^{b}	5.4 (2.32)^{b}	5.5	73.8	76.4
T_7-control	40.5 (6.36)	57.1 (7.55)^{e}	59.2 (7.69)^{e}	52.1 (7.22)^{d}	56.1	-	41.7 (6.45)	19.6 (4.42)^{d}	21.5 (4.64)^{d}	22.0 (4.68)^{c}	21	-	-

Values in the same column followed by the same letters are not significantly different at $P = 0.05$

Table 2. Leaf curl index of onion plants treated with insecticides (2017-18)

	Kharif crop (*rainy season)*		*Rabi* crop		*Kharif* crop (*rainy season)*		*Rabi* crop	
	Cumulative score	Leaf curl index	Cumulative score	Leaf curl index	Marketable bulb Yield t/ha	%Yield increase over control	Marketable bulb Yield t/ha	%Yield increase over control
T_1-Emamectin benzoate 5SG @11gm a.i/ha	2.0	Moderate	2.1	Moderate	17.4^{bc}	12.1	20.1^{ab}	15.9
T_2-Cyantraniliprole 10% OD 90 gm a.i/ha	1.3	Low	1.8	Low	18.7^{ab}	18.2	22.2^{a}	23.9
T_3-Profenophos 160 gm a.i/ha	1.1	Low	1.3	Low	20.8^{a}	26.4	24.2^{a}	30.2
T_4-Tolfenpyrad 15EC 125 a.i./ha	2.0	Moderate	2.2	Moderate	17.6^{bc}	13.1	19.3^{ab}	12.4
T_5-Emamectin benzoate 5SG @22gm a.i/ha	1.5	Low	1.9	Low	20.3^{ab}	24.6	19.6^{ab}	13.8
T_6-Cyantraniliprole10% OD 120 gm a.i/ha	1.2	Low	1.8	Low	20.9^{a}	26.8	22.1^{a}	23.5
T_7-control	3.1	High	3.4	High	15.3^{c}	0.0	16.9^{b}	0.0

Values in the same column followed by the same letters are not significantly different at $p = 0.05$

@160 gm ai/ha followed cyantraniliprole @ 120 gm ai/ha (20.9 to 22.1 t/ha) and was both the treatments were consistently at bar. The data on incremental yield also revealed the same trend with 26.4 to 30.2 % increased bulb yield in profenofos treatment followed by cyantraniliprole @ 120 gm ai/ha treatment with the yield increase of 23.5 to 26.8 %. Moreover, all the insecticide treatments were recorded significantly better yield over untreated control.

Owing to outbreak of onion thrips in onion fields, insecticides have been a main tool of IPM for managing thris pest (Nault and Shelton, 2010; Nault and Shelton, 2012; Gill et al., 2015). Studies are required to continuously evaluate the effectiveness of novel insecticides and identify strategies that minimize their use without compromising the level of control and that tone down insecticide resistance development. In the present study, conventional insecticide profenofos registered better results in controlling onion thrips, reducing leaf curling index as well as obtaining higher bulb yield relative to other treatments. In addition, cyantraniliprole, a new group insecticide belonging to the amide group was the second most effective insecticides against thrips and their leaf damage. Profenofos is an OP insecticide with mode of action that irreversibly inhibits acetylcholine esterase; the wide spectrum action may be likely factors for its efficacy. Although it is effective, the occurrence insecticide resistance in thrips to organophosphate and pyrethroid insecticides has been reported (Gill and Garg, 2014).

Moreover, the current finding indicated that in some instant in terms of efficacy and yield, cyantraniliprole was on par with profenofos. Cyantraniliprole is an anthranilic diamide that acts as an upwardly systemic, xylem mobile, translaminar, interferes with muscle function, and mainly kills thrips by ingestion. Nault and Shelton (2012) have been shown that cyantraniliprole to be one of most effective newer insecticides against onion thrips and excellent penetration of this insecticide would generate maximum efficacy. Our findings are consistent with the previous reports (Kalola et al., 2017; Lodaya et al., 2017). Furthermore, in comparison to untreated control, emamectin benzoate and tolfenpyrad were also found to be effective molecule for onion thrips. A substantial level of efficacy of emamectin benzoate and tolfenpyrad against onion thrips has also been reported in India (Kalyan et al., 2014; Sumalatha et al., 2017; Shweta et al., 2019). However, occurrence of profenophos and emamectin benzoate resistance was recorded in onion thrips (Allen et al., 2005; Nazemi et al., 2016; Labdev et al., 2013).

Hence, the present study suggests that apart from conventional insecticide profenofos, newer insecticide cyantraniliprole can be better insecticides as they are wide spectrum in activity, are relatively safer to the environment and require in lesser amount to control onion thrips. These can therefore be chosen for incorporation in the IPM schedule against onion thrips.

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