Madras Agric. J., 2019; doi:10.29321/MAJ 2019.000297

RESEARCH ARTICLE

Field Evaluation of Thiacloprid 240 SC Against Thrips Scirtothrips dorsalis Hood in Pomegranate

Vinothkumar, B*, Sangamithra, S, Shanmugapriya, R, Muthukrishnan, N and Kuttalam, S
*Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore - 641 003.

Received : 29th October, 2018
Revised : 08th May, 2019
Accepted : 10th May, 2019

ABSTRACT

Two field trials were conducted at Tamil Nadu Agricultural University, Coimbatore during 2016 and 2017 using pomegranate variety Ruby in randomized block design (RBD) to evaluate the thiacloprid 240 SC against pomegranate thrips, *Scirtothrips dorsalis* Hood. Thiacloprid 240 SC was tested in three different doses (0.24 g a.i. l^{-1}, 0.30 g a.i. lit^{-1} and 0.36 g a.i. lit^{-1}) along with standard check cyantraniliprole 10.26 OD @ 0.075 g a.i. lit^{-1} and an untreated check. Results revealed that thiacloprid 240 SC at 0.36 g a.i. lit^{-1} significantly reduced thrips population and recorded mean population reduction of more than 95 per cent over control followed by thiacloprid 240 SC at 0.30 g a.i. lit^{-1}. The untreated check recorded the thrips population of 22.38 $twig^{-1}$ $tree^{-1}$. Based on the per cent reduction of population over untreated check, the order of efficacy of different insecticidal treatments were thiacloprid 240 SC at 0.36 g a.i. l^{-1} > thiacloprid 240 SC at 0.30 g a.i. lit^{-1} > thiacloprid 240 SC at 0.24 g a.i. lit^{-1} (90.22 %) = cyantraniliprole 10.26 OD at 0.075 g a.i. lit^{-1}. Thiacloprid 240 SC in all the test doses did not cause much harm to the population of coccinellids and spiders population in the pomegranate agroecosystem. Pomegranate sprayed with thiacloprid 240 SC at 0.36 and 0.72 g a.i.lit^{-1} did not show any phytotoxic effects. Thiacloprid 240 SC at 0.36 and 0.30 g a.i. lit^{-1} was effective in increasing the fruit yield and recorded 24.40 and 24.12 t ha^{-1} and 25.13 & 25.00 t ha^{-1} during first and second season, respectively and found to be on par with each other.

Keywords: *Thiacloprid, Pomegranate, Thrips, Bioefficacy, Phytotoxicity*

Pomegranate (*Punica granatum* L.) is one of the important fruit crops in India and is being cultivated in Gujarat, Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh and Tamil Nadu (Balikai *et al.*, 2011). Pomegranate trees are infested by more than 50 species of insects (Verghese and Jayanthi, 2001) and 32 insect and non-insect pests (Balikai, 2000). Sucking pests infest the crop during flowering and fruiting stage of the crop and thereby reduce the vigour of the plant in addition to excretion of honeydew on the leaves and development of sooty mould on leaves and fruits (Dong *et al.,* 2014). Among sucking pests, thrips cause more damage to the crop by reducing the fruit set and also the quality of the fruit. The main thrips species on pomegranate is *Rhipiphorothrips cruentatus* (Hood) which is often seen on leaves and also on young fruits causing characteristic scab on fruits and thereby reducing the market and export value. When severe on leaves, it causes leaf tip curl, drying and shedding of flowers. Other species of thrips recorded on pomegranate are *Scirtothrips dorsalis* Hood, *Retithrips syracus* Mayet, *Anaphothrips oligochaetus* Karny and *Ramaswamiahiella subnudula* Karny. Among these the first one feeds on leaves and the other three infest the flowers (Butani, 1979).

Considering the potential of thrips in damaging any developing fruit stage right from flowering to harvest, it is necessary to manage this pest more effectively. Several pesticides have been reported to be effective against thrips of pomegranate. However, most of them are required to be sprayed with high doses, which may pose problems of residues. In recent years several new pesticides are available and claimed to be effective at low doses. Moreover many of them are ecofriendly and posses different modes of action than those of conventionally used pesticides belonging to organochlorine, organophosphate, carbamate and synthetic pyrethroid groups. Keeping in view suitability of such new pesticides in Integrated Pest Management, their evaluation against pomegranate thrips was considered essential. Thiacloprid [(Z)-3-(6-chloro-3-pyridylmethyl)-1,3-thiazolidin-2-ylidenecyanamide] is a neonicotinoid pesticide and it is the first chloronicotinyl insecticide to have activity

*Corresponding author's e-mail: vinothkumar@tnau.ac.in

not only against sucking insects such as aphids, whiteflies and some jassids but also against weevils, leafminers and various species of beetles, and it shows good plant compatibility in all relevant crops (Elbert *et al.,* 2000). Thiacloprid is considered to be an excellent insecticide for combating difficult-to-control insect pests encountered in fruit or vegetable cultivation (Jeschke *et al.,* 2011). However, there is no information about management of thrips in the pomegranate in Tamilnadu. Hence, present study was under taken to evaluate the efficacy of thiacloprid against pomegranate thrips along with safety to natural enemies and phytotoxicity of thiacloprid in pomegranate.

MATERIAL AND METHODS

Two field trials were conducted at Tamil Nadu Agricultural University, Coimbatore during February to May 2016 and May - July 2017 using pomegranate variety Ruby in randomized block design (RBD) to evaluate the thiacloprid 240 SC against pomegranate thrips, toxicity to natural enemies and phytotoxicity effect, if any. The crop was maintained well by adapting standard agronomic practices as per the recommendations of Tamil Nadu Agricultural University. The treatments were imposed when the pests attained ETL of 10 thrips per branch tapping or fruit infestation is > 1% (NCIPM, 2014) and control plots were maintained with water spray with a pneumatic knapsack sprayer using 500 litres of spray fluid per hectare for two years old pomegranate trees. All the treatments were replicated four times with three trees per replication. Two rounds of spray were given, at 15 days interval starting from the fruiting stage. The insecticides used in the present investigation and their dosages were, T_1 – Thiacloprid 240 SC @ 0.24 g a.i. lit^{-1}; T_2 – Thiacloprid 240 SC @ 0.30 g a.i. lit^{-1}; T_3 – Thiacloprid 240 SC @ 0.36 g a.i. lit^{-1}; T_4 – Cyantraniliprole 10.26 OD @ 0.075 g a.i. lit^{-1}; T_5 – Untreated check. The populations of thrips in pomegranate were recorded from ten randomly tagged leaves/twig on prior to spraying and on 3, 7, 10 and 14 days after spray and expressed as numbers $twig^{-1}$ $tree^{-1}$. To assess the safety of thiacloprid 240 SC against natural enemies, the number of coccinellids (*Cheilomenes sexmaculata* (Fabricius), *Scymnus* sp.,) and spiders (*Araneus* sp., *Cheiracanthium* sp.) were recorded on three trees per plot prior to insecticides spraying and on 3, 7, 10 and 14 days after each spray and expressed as number per three trees.

Assessment of the phytotoxic effect of thiacloprid on pomegranate, the trial was conducted by spraying thiacloprid 240 SC @ 0.36 g a.i. lit^{-1} (x dose) and 0.72 g a.i. lit^{-1} (2x dose) on the pomegranate tree. To know the crop tolerance, the trees were observed on 1, 3, 7, 10, 14 and 21 days after spraying as per the protocol of Central Insecticide Board Registration Committee (C.I.B. and R.C), phytotoxic symptoms like injury to leaf tip and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty were recorded based on the visual rating scale of 0 – 10 *viz*., 0 - No phytotoxicity; 1 - 1-10 %; 2 - 11-20 %; 3 - 21-30 %; 4 - 31-40 %; 5 - 41-50 %; 6 - 51-60 %; 7 - 61-70 %; 8 - 71-80 %; 9 - 81-90 % and 10 - 91-100 %. Per cent leaf injury was calculated using the formulae

$$\text{Per cent leaf injury} = \frac{\text{(Total grade points)}}{\text{(Max.grade X No.of leaves observed)}} \times 100$$

The corrected per cent reduction of the pest population over control in the field was worked out by using the formula given by Henderson and Tilton (1955).

$$\text{Corrected per cent reduction} = \left(1 - \left[\frac{T_a \times C_b}{T_b \times C_a}\right]\right) \times 100$$

where, T_a - Number of insects in the treatment after spraying; T_b - Number of insects in the treatment before spraying; C_b - Number of insects in the untreated check before spraying; C_a - Number of insects in the untreated check after spraying

The data on percentage were transformed into arc sine values $\sqrt{\text{per cent}}$ and the population number into $\sqrt{x + 0.5}$ before statistical analysis. The data obtained from field experiments were analyzed in randomized block design (RBD) (Gomez and Gomez, 1984). The mean values were separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1951).

RESULTS AND DISCUSSION

The population of thrips before application of treatments ranged from 10.00 to 10.45 $twig^{-1}$ $tree^{-1}$ (Table 1). After first spray, thiacloprid 240 SC at 0.36 g a.i. lit^{-1} significantly reduced thrips population and recorded 6.05 thrips $twig^{-1}$ $tree^{-1}$ at 3 days after treatment (DAT), followed by thiacloprid 240 SC at 0.30 g a.i. lit^{-1} (7.00 thrips $twig^{-1}$ $tree^{-1}$). The standard check, cyantraniliprole 10.26 OD at 0.075 g a.i. lit^{-1} reduced the thrips population to 8.11 $twig^{-1}$ $tree^{-1}$ and was on par with thiacloprid 240 SC at 0.24 g a.i. lit^{-1} (8.05 thrips $twig^{-1}$ $tree^{-1}$). The analogous trend was recorded throughout the observation period. After 14 DAT, thiacloprid 240 SC at 0.36 g a.i. lit^{-1} recorded the lowest mean population of 4.11 thrips $twig^{-1}$ $tree^{-1}$ with 70.40 per cent reduction over control. After second application, similar trend in the reduction of thrips population was observed. After 14 DAT, thiacloprid 240 SC at 0.36 g a.i. lit^{-1} reduced the population significantly and recorded a mean population of 1.07 thrips $twig^{-1}$ $tree^{-1}$ followed by thiacloprid 240 SC at 0.30 g a.i. lit^{-1} (2.01 thrips $twig^{-1}$ $tree^{-1}$). The untreated check recorded the thrips population of 22.38 $twig^{-1}$ $tree^{-1}$.

Table 1. Effect of thiacloprid 240 SC on thrips in pomegranate – I Season

Treatments	First spray							Second spray					
	Number of thrips twig-1 tree-1						PRC	Number of thrips twig-1 tree-1					PRC
	PTC	3 DAT	7 DAT	10 DAT	14 DAT	Mean		3 DAT	7 DAT	10 DAT	14 DAT	Mean	
Thiacloprid 240 SC @ 0.24 g a.i. lit-1	10.45	8.05 (2.84)c	5.10 (2.26)c	5.05 (2.25)c	5.75 (2.40)c	5.99	56.82	5.03 (2.24)c	3.85 (1.96)c	2.20 (1.64)c	2.04 (1.59)c	3.28	85.34
Thiacloprid 240 SC @ 0.30 g a.i. lit-1	10.00	7.00 (2.65)b	4.20 (2.05)b	4.10 (2.02)b	4.84 (2.20)b	5.04	63.69	3.82 (1.95)b	2.11 (1.45)b	1.10 (1.26)b	1.00 (1.22)b	2.01	91.03
Thiacloprid 240 SC @ 0.36 g a.i. lit-1	10.30	6.05 (2.46)a	3.05 (1.75)a	3.00 (1.73)a	4.32 (2.08)a	4.11	70.40	2.59 (1.61)a	1.67 (1.29)a	0.00 (0.71)a	0.00 (0.71)a	1.07	95.24
Cyantraniliprole 10.26 OD @ 0.075 g a.i. lit-1	10.20	8.11 (2.85)c	5.28 (2.30)c	5.17 (2.27)c	6.02 (2.45)c	6.15	55.69	5.19 (2.28)c	4.06 (2.01)d	2.38 (1.70)c	2.30 (1.67)c	3.48	84.44
Untreated check	10.25	11.3 (3.36)d	13.15 (3.63)d	15.00 (3.87)d	16.02 (4.00)d	13.87	0.00	20.00 (4.47)d	22.00 (4.69)e	22.80 (4.83)d	24.70 (5.02)d	22.38	0.00
CD (0.05)	-	0.18	0.20	0.20	0.19	-	-	0.26	0.14	0.36	0.32	-	-

*Mean of four replications; Values in parentheses are √x+0.5 transformed values; In a column, means followed by a common letter are not significantly different by DMRT (p=0.05); PTC- Pretreatment count; DAT – Days after treatment; PRC – Per cent reduction over control

The population of thrips before application of treatments ranged from 8.38 to 8.70 twig^{-1} tree^{-1} during second season (Table 2). Thiacloprid 240 SC at 0.36 g a.i. lit^{-1} significantly reduced thrips population and recorded the lowest mean population of 2.95 thrips twig^{-1} tree^{-1} with 74.48 per cent reduction over control after first spray. After second application, at 14 DAT, thiacloprid 240 SC at 0.36 g a.i. lit^{-1} reduced the population completely and recorded mean population of 0.34 thrips twig^{-1} tree^{-1} followed by thiacloprid 240 SC at 0.30 g a.i. lit^{-1} (0.84 thrips twig^{-1} tree^{-1}). The untreated check recorded the thrips population of 16.03 twig^{-1} tree^{-1}. Based on the per cent reduction in population over untreated check, the order of efficacy of different insecticidal treatments were thiacloprid 240 SC at 0.36 g a.i. lit^{-1} (97.86 %) > thiacloprid 240 SC at 0.30 g a.i. lit^{-1} (94.76 %) > thiacloprid 240 SC at 0.24 g a.i. lit^{-1} (90.22 %) > cyantraniliprole 10.26 OD at 0.075 g a.i. lit^{-1} (89.85 %).

Table 2. Effect of thiacloprid 240 SC on thrips in pomegranate – II Season

Treatments	First spray							Second spray					
	Number of thrips twig-1 tree-1						PRC	Number of thrips twig-1 tree-1					PRC
	PTC	3 DAT	7 DAT	10 DAT	14 DAT	Mean		3 DAT	7 DAT	10 DAT	14 DAT	Mean	
Thiacloprid 240 SC @ 0.24 g a.i. lit-1	8.38	5.89 (2.43)c	4.38 (2.09)c	4.30 (2.07)c	4.82 (2.20)c	4.85	58.06	3.00 (1.73)c	1.59 (1.26)c	1.10 (1.26)c	0.58 (1.04)b	1.59	90.22
Thiacloprid 240 SC @ 0.30 g a.i. lit-1	8.70	5.02 (2.24)b	3.60 (1.90)b	3.51 (1.87)b	4.01 (2.00)b	4.04	65.0-9	1.74 (1.32)b	1.00 (1.00)b	0.62 (1.06)b	0.00 (0.71)a	0.84	94.76
Thiacloprid 240 SC @ 0.36 g a.i. lit-1	8.46	4.36 (2.09)a	2.41 (1.55)a	2.36 (1.54)a	2.67 (1.63)a	2.95	74.48	0.86 (0.93)a	0.51 (0.71)a	0.00 (0.71)a	0.00 (0.71)a	0.34	97.86
Cyantraniliprole 10.26 OD @ 0.075 g a.i. lit-1	8.68	6.04 (2.46)c	4.40 (2.10)c	4.26 (2.06)c	4.84 (2.20)c	4.89	57.73	3.03 (1.74)c	1.66 (1.29)c	1.18 (1.30)d	0.64 (1.07)b	1.63	89.85
Untreated check	8.52	9.89 (3.14)d	11.00 (3.32)d	12.00 (3.46)d	13.34 (3.65)d	11.56	0.00	14.72 (3.84)d	15.06 (3.88)d	17.00 (4.18)e	17.34 (4.22)c	16.03	0.00
CD (0.05)	-	0.18	0.20	0.20	0.19	-	-	0.26	0.14	0.36	0.32	-	-

*Mean of four replications; Values in parentheses are √x+0.5 transformed values; In a column, means followed by a common letter are not significantly different by DMRT (p=0.05); PTC- Pretreatment count; DAT – Days after treatment; PRC – Per cent reduction over control

The coccinellid population prior to treatment ranged from 6.65 to 7.20 three trees^{-1}. Thiacloprid 240 SC at the highest dose of 0.36 g a.i. lit^{-1} recorded 5.45 coccinellids three trees^{-1}, followed by its next test dose at 0.30 g a.i. lit^{-1} which recorded 6.18 coccinellids three trees^{-1} and found to be on par with standard check, cyantraniliprole 10.26 OD at 0.075 g a.i. lit^{-1} (6.20 coccinellids three trees^{-1}) (Table 3). Reduction in the coccinellid population was found to be proportional to the thiacloprid 240 SC test doses. The lowest test dose at 0.24 g a.i. lit^{-1} was less toxic to coccinellids and recorded 6.76 three trees^{-1}, next to untreated check (7.15 coccinellids three trees^{-1}). After the second spray, trend in coccinellid population was similar to that of first spray. Thiacloprid 240 SC at 0.36 g a.i. lit^{-1} was relatively safe and recorded coccinellid population of 5.07 three trees^{-1}. The untreated check recorded the highest population of 9.20 three trees $^{-1}$. The coccinellid population prior to treatment ranged from 4.00 to 4.64 three trees^{-1} in the second season. After two rounds of spray thiacloprid 240 SC at the highest dose of 0.36 g a.i. lit^{-1} recorded mean population of 2.69 coccinellids three trees^{-1}, followed by thiacloprid 240 SC at 0.30 g a.i. lit^{-1} which recorded 3.02 coccinellids three trees^{-1} and found to be on par with cyantraniliprole 10.26 OD at 0.075 g a.i. lit^{-1} (2.96 coccinellids three trees^{-1})

Table 3. Safety of thiacloprid 240 SC to coccinellids in pomegranate ecosystem

Treatments	I Season						II Season					
	First Spray			Second spray			First Spray			Second spray		
	PTC	Mean*	PRC	PTC	Mean*	PRC	PTC	Mean*	PRC	PTC	Mean*	PRC
Thiacloprid 240 SC @ 0.24 g a.i. lit^{-1}	7.20	6.81	13.47	7.45	6.68	27.39	4.00	3.65	19.25	3.80	3.45	34.66
Thiacloprid 240 SC @ 0.30 g a.i. lit^{-1}	6.95	6.27	20.33	6.75	5.98	35.00	4.48	3.09	31.64	3.38	3.02	42.80
Thiacloprid 240 SC @ 0.36 g a.i. lit^{-1}	6.65	5.42	31.13	5.90	5.07	44.89	4.32	2.68	40.71	3.00	2.69	49.05
Cyantraniliprole 10.26 OD @ 0.075 g a.i. lit^{-1}	6.85	6.30	19.95	6.80	5.89	35.98	4.64	3.06	32.30	3.34	2.96	43.94
Untreated check	6.90	7.87	-	8.52	9.20	-	4.10	4.52	-	5.00	5.28	-

*Mean of four replications at 3, 7, 10 and 14 DAT; PTC- Pretreatment count; DAT – Days after treatment; PRC – Per cent reduction over control

(Table 3). The spider population prior to treatments ranged from 4.75 to 5.30 three trees^{-1} during first season (Table 4). Reduction in the spider population was dose-dependent. After two rounds of spray, thiacloprid 240 SC at 0.36 g a.i. lit^{-1} recorded mean population of 3.82 spiders three trees^{-1}, followed by thiacloprid 240 SC 0.30 g a.i. lit^{-1} (4.19 spiders three trees^{-1}) which was on par with standard check, cyantraniliprole 10.26 OD at 0.075 g a.i. lit^{-1} (4.20 spiders three trees^{-1}).

Table 4. Safety of thiacloprid 240 SC to spiders in pomegranate ecosystem

Treatments	I Season						II Season					
	First Spray			Second spray			First Spray			Second spray		
	PTC	Mean*	PRC	PTC	Mean*	PRC	PTC	Mean*	PRC	PTC	Mean*	PRC
Thiacloprid 240 SC @ 0.24 g a.i. lit^{-1}	5.30	5.07	20.66	5.45	4.80	35.83	6.34	5.40	20.94	5.58	4.90	34.23
Thiacloprid 240 SC @ 0.30 g a.i. lit^{-1}	4.75	4.23	33.80	4.47	4.19	43.98	6.03	4.87	28.70	5.00	4.29	42.42
Thiacloprid 240 SC @ 0.36 g a.i. lit^{-1}	5.20	3.91	38.81	4.34	3.82	48.93	5.82	4.10	39.97	4.38	3.80	48.99
Cyantraniliprole 10.26 OD @ 0.075 g a.i. lit^{-1}	5.05	4.43	30.67	5.33	4.20	43.85	6.00	4.95	27.53	5.14	4.32	42.01
Untreated check	5.10	6.39	0.00	7.02	7.48	0.00	6.46	6.83	0.00	7.00	7.45	0.00

*Mean of four replications at 3, 7, 10 and 14 DAT; PTC- Pretreatment count; DAT – Days after treatment; PRC – Per cent reduction over control

Thiacloprid 240 SC at 0.24 g a.i lit^{-1} recorded highest population (4.80 spiders three trees^{-1}) next to untreated check (7.48 spiders three trees^{-1}). During second season the spider population prior to treatments ranged from 5.82 to 6.46 three trees^{-1} (Table 4). The trend in the reduction of the spider population after two applications were similar to the first season Thiacloprid 240 SC at 0.36 g a.i. lit^{-1} was relatively safe and recorded mean spider population of 3.80 three trees^{-1} compared to untreated check (7.45 three trees^{-1}).

Table 5. Phytotoxic effect of thiacloprid 240 SC on pomegranate

Treatments	Phytotoxicity rating *					
	Leaf tip injury**	Wilting**	Vein clearing**	Necrosis & chlorosis**	Epinasty**	Hyponasty**
Thiacloprid 240 SC @ 0.36 g a.i. lit^{-1}	0	0	0	0	0	0
Thiacloprid 240 SC @ 0.72 g a.i. lit^{-1}	0	0	0	0	0	0
Untreated check	0	0	0	0	0	0

*Observed on 1, 3, 7, 10, 14 & 21 days after treatment; **Mean of seven replications

The results of the two field experiments conducted at Tamil Nadu Agricultural University, Coimbatore to assess the phytotoxic effect of thiacloprid 240 SC revealed that pomegranate sprayed with thiacloprid 240 SC at 0.36 and 0.72 g a.i.lit^{-1} did not show any phytotoxic effects like leaf tip injury, wilting, vein clearing, epinasty, hyponasty (Table 5). Thiacloprid 240 SC at 0.36 and 0.30 g a.i. lit^{-1} was effective in increasing the fruit yield and recorded 24.40 and 24.12 t ha^{-1}, respectively during the first season and found to be on par with each other. It was followed by its lowest dose at 0.24 g a.i. lit^{-1} and cyantraniliprole 10.26 OD at 0.075 g a.i. lit^{-1} (23.56 and 23.10 t ha^{-1}, respectively) which were on par with each other. Untreated check recorded the lowest of 22.14 t ha^{-1} (Figure 1). During second season also thiacloprid 240 SC at 0.36 and 0.30 g a.i. lit^{-1} was recorded highest yield 25.13 and 25.00 t ha^{-1}, respectively and untreated check recorded the lowest of 23.08 t ha^{-1} (Figure1).

The reports based on bioefficacy of chemical pesticides against thrips infesting pomegranate orchards are much less. In an experiment conducted by Bagle (1993) in Gujarat, out of eight evaluated pesticides, spraying of 0.05% monocrotophos provided effective control of thrips on pomegranate. Kadam (2006) studies the efficacy of some newly introduced pesticides against thrips on pomegranate

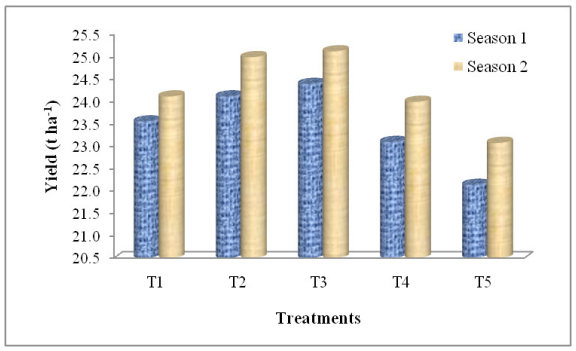

Figure 1. Effect of thiacloprid 240 SC on yield of pomegranate

and reported that spraying of 0.025% spinosad was most effective against infestation of thrips and also recorded highest fruit yield of about 12.6 t ha^{-1} followed by 0.01% acetamiprid and 0.018% spinosad with the yield of about 12.4 and 12.0 t ha^{-1}, respectively. Kulkarni (2007) evaluated the bioefficacy of 0.018% spinosad, 0.01% chlorfenapyr, 0.005% thiamethoxam, 0.005% acetamiprid, 0.015% cypermethrin and 5% NSE against pomegranate thrips and inferred that, all pesticide treatments were significantly effective in keeping the count of thrips (No./fruit) below 5, during 10 days after spray, when compared to the count of 17.82 to 20.85 on untreated plants. Adverse effect on predators was noticed in spray treatment of cypermethrin Vinothkumar et al., (2010) evaluated the combination of flubendiamide + thiacloprid 480 SC (RM) against bollworms and sucking pests of cotton and reported that flubendiamide + thiacloprid 480 SC (RM) @120 g. a.i. ha-1 is highly effective in controlling sucking pests in cotton

CONCLUSION

The results of the study on field efficacy of thethiacloprid 240 SC against pomegranate thrips revealed that, thiacloprid 240 SC at 0.36 g a.i.lit^{-1} was highly effective in controlling thrips in pomegranate, did not show any phytotoxic effects, relatively safer to natural enemies and realizing higher yield. Hence it may be recommended for management of thrips in pomegranate.

REFERENCES

Bagle, B.G. 1993. Seasonal incidence and control of thrip (*S. dorsalis* Hood.) in pomegranate. *Indian J. Ent.* **55 (2)**: 148-153.

Balikai, R.A. 2000. Status of pomegranate pests in Karnataka, *Pest management in Horticultural Ecosystems*. **6(1)**:65-66.

Balikai, R.A., Kotikal, Y.K. and P.M. Prasanna. 2011. Status of pomegranate pests and their management strategies in India. *Acta Horticulturae,* **(890)**, 569–583.

Butani, D.K. 1979. Pests of subtropical fruits - Pomegranate. In: Insects and Fruits, Periodical Expert Book Agency, D-42, Vivek Vihar, Delhi. 219-228.

Dong, S., Qiao, K., Wang, H., Zhu, Y., Xia, X. and K. Wang. 2014. Dissipation rate of thiacloprid and its control effect against *Bemisia tabaci* in greenhouse tomato after soil application. *Pest Management Science*, **70(8)**, 1267–1273. doi:10.1002/ps.3690

Duncan, D.B. 1951. A significance test for differences between ranked treatment means in an analysis of variance. *Virginia Journal of Science*, **2**: 171-189.

Elbert, A., Erdelen, C., Kuhnhold, J., Nauen, R., Schmidt, H.W., and Y. Hattori. 2000. Thiacloprid, a novel neonicotinoid insecticide for foliar application. In: *Proceedings, Brighton Crop Protection Conference - Pests and Diseases*; BCPC: Farnham, Surrey, U.K. 21-26.

Gomez, K.A. and A.A. Gomez. 1984. Statistical procedures for agricultural research. Wiley International Science Publications. John Wiley and Sons, New York, pp. 207-215.

Henderson, C.F. and E.N. Tilton. 1955. Tests with acaricides against the brown wheat mite. *Journal of Economic Entomology.* **48**: 157-161.

Jeschke, P., Nauen, R., Schindler, M. and A. Elbert. 2011. Overview of the status and global strategy for neonicotinoides. *Journal of Agricultural and Food Chemistry*, **59**: 2897- 2908.

Kadam, B. S. 2006. Studies on performance of low dose pesticides against pests of pomegranate. M.Sc. (Agri.) thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. p.156.

Kulkarni, S.R. 2007. Seasonal incidence of pests of pomegranate and control of fruit borer, *Deudorix Isocrates* Fabricius and thrip, *Scirtothrips dorsalis* Hood. Unpub. PhD thesis. Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. p.183.

National Centre for Integrated Pest Management (NCIPM) 2014. HORTSAP USER Manual 2014-15. P.60 http://www.ncipm.res.in/Horticulture/Pdf/HORTSAP%20USER-Manual-2014-15.pdf

Verghese, A. and P.D.K. Jayanthi. 2001. Integrated pest management (IPM) in major fruit crops. In: Integrated Pest Management in Horticultural Ecosystems (Eds: P. Parvatha Reddy, A. Verghese and N.K. Krishna Kumar), Capital Publishing Company, New Delhi. p. 12-15.

Vinothkumar, B, Boomathi, N., Kumaran N. and S. Kuttalam. 2010. Combination of Flubendiamide + Thiacloprid 480 SC (RM) against bollworms and sucking pests of cotton. *Madras Agricultural Journal*, 97 (4-6): 157-160.