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Field Efficacy of Insecticides against Thrips on Pomegranate

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ABSTRACT: The investigations on efficacy of insecticides on pomegranate thrips was conducted at the Department of Entomology, College of Horticulture, Bagalkot, Karnataka during the year 2015-16. Thrips injury leads to leaf tip turn brown and get curled, drying and shedding of flowers and scab on fruits which will reduce the market value. Among the different insecticides evaluated against thrips on pomegranate, cyazypyr 10 OD @ 1.5 ml/l of water recorded significantly highest fruit yield (15.17 t/ha) and lowest fruit damage (6.22%) followed by imidacloprid 17.8 SL @0.3ml/l (14.67 t/ha and 9.65%, respectively). The next best treatments were, clothianidin 50 WDG @ 0.17 g/l and diafenthiuron 50 WP @ 1.0 g/l. So, spraying of cyazypyr 10 OD (a new anthranilicdiamide insecticide) @ 1.5 ml/l recorded highest net returns of Rs. 6,63,000 per ha followed by imidacloprid 17.8 SL @ 0.3 ml (Rs. 6,29,648/ha). However, in terms of benefit cost ratio, imidacloprid 17.8 SL proved best (3.77) followed cyazypyr 10 OD (3.62). Hence, spraying of imidacloprid 17.8 SL @ 0.3 ml or cyazypyr 10 OD @ 1.5 ml may be recommended for the effective management of thrips on pomegranate.

Keywords: Pomegranate, Thrips, Insecticides, Efficacy.

INTRODUCTION

Pomegranate (*Punica granatum* L.), an ancient fruit known as a "Fruit of Paradise" belongs to the botanical family Punicaceae, is one among the major fruit crops grown extensively in tropics and subtropics. It is indigenous to Iran and is cultivated extensively in Spain, Morocco, Egypt, Iran, Afghanistan, Arabia and other Mediterranean countries. Among the pomegranate growing states, Maharashtra is the largest producer occupying 2/3rd of total area in the country followed by Karnataka, Andhra Pradesh, Gujarat and Rajasthan. In India, it is regarded as a "vital cash crop", grown in an area of 1,43,140 ha with a production of 17,73,660 MT and average productivity of 12.39 MT during (Anon., 2015). Pomegranate is a good source of carbohydrates and minerals such as calcium, iron and sulphur. It is rich in vitamin-C and citric acid (Malhotra *et al*., 1983).

Pomegranate production is associated with many problems like non-availability of suitable varieties, environmental vagaries, nutritional deficiencies, physiological disorders, post-harvest glut, post-harvest losses, improper storage, lack of marketing facilities, price fluctuation and biotic constraints like pest and diseases. The losses due to pests and diseases are very high. Inspite of 25 to 30 per cent of total cost of production is being spent on plant protection loss due to biotic constraints could not be managed effectively. Perusal of literature revealed a total of 91 insects, 6 mites and 1 snail pest feeding on pomegranate crop in India (Balikai *et al*., 2011).

Among various insects pests, the sucking pests, infestation by pomegranate thrips in general and *Scirtothrips dorsalis* Hood in specific is an important and widely distributed because of its polyphagous nature. In the recent days, it has become very serious on pomegranate necessitating repeated sprays with systemic insecticides. The highest thrips incidence usually coincides with new flesh reducing the vegetative growth, affecting flowering, fruit development and reducing the fruit quality. Thus, it is one of the major constraints for sustainable production of export quality fruits in terms of size, colour, free from blemishes and pesticide residue. Though, farmers are using number of insecticides, the control of thrips is not satisfactory. Therefore, it is necessary to develop effective and need based management practices for thrips.

MATERIAL AND METHODS

The field experiments were carried out at Bagalkot in farmer's field and pomegranate research plot at Main Horticulture Research and Extension Centre (MHREC), University of Horticultural Sciences (UHS), Bagalkot, Karnataka during 2015-16. To know the relative efficacy of different new molecules of insecticide for managing *S. dorsalis* on pomegranate was laid out in progressive farmer field at Govinakoppa, Bagalkot, Karnataka (longitude of 76°E and latitude of 16°N at an altitude of 526.9 meters above mean sea level) during *Hasthabahar* of 2015-16. Normal agronomical practices and plant protection measures against pests and diseases except thrips were taken as per package of practices of UHS, Bagalkot (Anon., 2013).

A. Efficacy of insecticides against thrips

The pomegranate field of seven year old var. Bhagwa planted at 4.5 × 4.5 m spacing was selected. The experiment was laid out in randomized block design with 12 treatments *viz*., T_1: Azadirachtin 10000 ppm @ 1.0 ml/ l, T_2: Fipronil 5 SC @ 1.0 ml/ l, T_3:Spinosad 45 SC@ 0.25 ml/ l, T_4: Imidacloprid 17.8 SL @ 0.3 ml/ l, T_5: Thiamethoxam 25 WG @ 0.25 g/ l, T_6: Acetamiprid 20 SP @ 0.2 g/ l, T_7: Clothianidin 50 WDG @ 0.17 g/ l, T_8: Lambda cyhalothrin 5 EC@0.50 ml/l, T_9: Cyazypyr 10 OD @ 1.5 ml/l, T_{10}: Diafenthiuron 50 WP @1.0 g /l, T_{11}: Dimethoate 30 EC @1.7 ml/l, T_{12}: Untreated control (Water Spray) with three replications (3 plants/replication). The treatments were imposed based on infestation level. The spray was done with knapsack sprayer using spray solution at the rate of 750 liter per ha.

Observations on the number of thrips were recorded one day prior to the spray and three, seven and 14 days after each spray. Observations on thrips were made from ten randomly selected and tagged plants under unprotected conditions. From each plant, five tender shoots of 10 cm length were selected randomly and were gently tapped on to a stiff black paper board (30x30 cm) and the number of thrips (both nymph and adult) was counted using hand lense. Similarly, number of thrips from ten flower buds, flowers and young fruits per plant were counted visually and recorded. Observations were also recorded on the total number of fruits and number of damaged fruits per plant and fruit weight (average of 10 fruits) at the time of harvest. Further, the yield data was extrapolated on hectare basis and cost benefit was calculated for each treatments.

B. Statistical Analysis

The data on the management of thrips population were analyzed statistically by one way ANOVA as given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

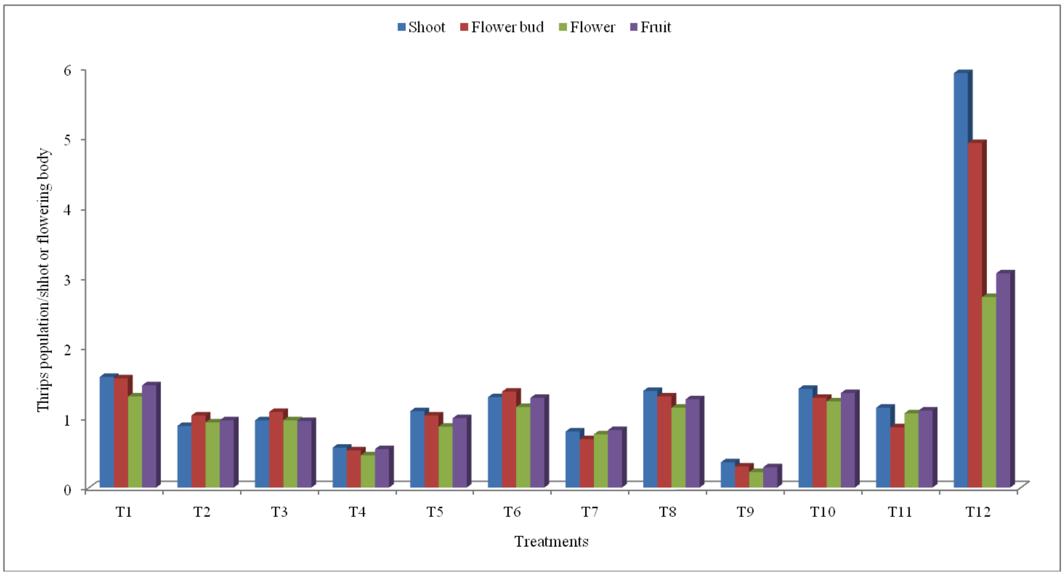
Results of the experiment on the management of thrips during *Hasta bahar* of 2015-16 revealed that, all the insecticides were significantly superior over untreated control in suppressing the population of thrips.

Efficacy of insecticides against thrips. At three days after spray, cyazypyr 10 OD @ 1.5 ml per l and imidacloprid 17.8 SL @ 0.3 ml per l were significantly superior and on par with each other and recorded an average of less than 0.5 thrips per shoot during all sprays (Fig. 1). The next best treatments were clothianidin 50 WDG @ 0.17g, fipronil 5 SC @ 1.0 ml and spinosad 45 SC @ 0.25 ml have recorded less than 0.80 thrips per shoot. While, thiamethoxam 25 WDG @ 0.28 g, acetamiprid 20 SP @ 0.2 g, dimethoate 30 EC @ 1.70 ml and diafenthiuron 50 WP @ 1 g per l have recorded thrips population of around one per shoot. Whereas, azadirachtin 10000 ppm @ 1 ml and lambacyhalothrin 5 EC @ 0.5 ml were less effective but significantly superior than untreated control. The data recorded at fourteen days after first, second, third and fourth spray on shoot showed that treatment, cyazypyr 10 OD @ 1.5 ml and imidacloprid 17.8 @ 0.3 ml were consistent in suppressing the population of thrips followed by clothianidin 50 WDG @ 0.17 g, spinosad 45 SC @ 0.25 ml, fipronil 5 SC @ 1.0 ml, acetamiprid 20 SP @ 0.2 g and dimethoate 30 EC @ 1.7 ml in reducing the population of thrips and were statistically at par with each other and superior over thiamethoxam 25 WDG @ 0.25 g. The next best treatments were diafenthiuron 50 WP @ 1.0 g and lambda cyhalothrin 5 EC @ 0.5 ml which were statistically on par with each other. The botanical product, azadirachtin 10000 ppm @ 1.0 ml was statistically superior over untreated control (Fig. 1). Similar trend of results were observed on flower bud and flower. While on fruits, cyazypyr 10 OD proved quite persistent by reducing the thrips population up to 90 per cent followed by imidacloprid which reduced thrips population by 82 per cent over untreated control. But, in the other treatments thrips population reduction on fruits was less than 80 per cent.

It is evident from the results that, the mean number of thrips were significantly lowest in cyazypyr and imidacloprid treated plots compared to other treatments. The results are in accordance with Kambrekar (2015) who reported application of cyazypyr as most effective in reducing thrips number in grapes. Cyazypyr, a new molecule belonging to anthranilicamide group has broad systemic and contact action, in addition, exhibited quite longer period of persistency against thrips. That could be possible reason for least colonization by thrips in the subsequent sprays both on shoots and fruiting bodies, especially on young fruits. Ananda *et al.* (2009) reported imidacloprid was most effective treatment in reducing thrips population in pomegranate. A neonicotinoid systemic insecticide, imidiacloprid has showed very good efficacy against thrips and even better persistency next best to cyazypyr. Sunitha and Jagginavar (2008) also reported imidacloprid as most effective treatment in reducing thrips population in grape ecosystem which are in agreement with the present findings. In the present findings, next best treatments in reducing thrips population were clothianidin, fipronil, spinosad and thiomethoxam. These results are in conformity with the reports of Jayalaxmi *et al.* (2011) who reported clothianidin as effective in reducing thrips on rose. Arunkumar (2007) also reported clothianidin as effective treatment in reducing thrips population on chilli. Clothianidin, a new generation neonicotinoid systemic insecticide has exhibited broad efficacy against sucking pests in general and thrips in specific by several earlier works on different crops. In the present findings, it was next best to cyazypyr and imidacloprid.

Alternative to neonicotinoid group, few insecticides belonging to different chemical groups with alternate mode of action have shown promising against thrips. Fipronil belonging to phenyl pyrazole group with systemic action proved promising against thrips as an alternative to neonicotinoids. Shanmuga *et al.* (2016), who reported fipronil as effective in reducing the thrips damage in grapes. Jadhao *et al.* (2016) also reported fipronil and spinosad as most effective in reducing the thrips population in chilli. Ananda *et al.* (2009) reported thiamethoxam as most effective treatment in reducing thrips population in pomegranate. Thiametoxam, a neonicotinoid insecticide having both systemic and translaminar activity has proved promising in managing thrips even on cotton (Muhammad *et al*., 2003) and chilli (Amalendu *et al.*, 2009).

Whereas, the treatments, dimethoate, acetamaprid and diafenthiuron were comparatively less effective in reducing the thrips population. However, contrary to the present finding, these insecticides have been reported as most effective on other crops because of their strong systemic action and better persistency. Sujay *et al.* (2009) who reported dimethoate was most effective in reducing thrips population in chilli. Sunitha and Jagginavar (2008) reported acetamaprid as superior in reduction of thrips population in grapes. Mandal (2011) who reported difentheuron and acetamaprid were effective in reducing the thrips population in chilli.



T_1- Azadirachtin 10000 ppm, T_2- Fipronil 5 SC, T_3- Spinosad 45 SC, T_4- Imidacloprid 17.8 SL, T_5- Thiamethoxam 25 WG, T_6- Acetamaprid 20SP, T_7- Clothianidin 50 WDG, T_8- Lambdacyhalothrin 5 EC, T_9- Cyazypyr 10 OD, T_{10}- Diafenthiuron 50 SC, T_{11}- Dimethoate 30 EC, T_{12}- Untreated control

Fig. 1. Efficacy of different newer insecticide molecules for the management of thrips during *Hasta bahar.*

During present study, azadirachtin 10,000 ppm was found less effective in reducing thrips population on pomegranate. These results are in close conformity with the findings of Bhargava and Bhatnagar (2005); Suresh *et al.* (2006) who reported nimbicidine as less effective in controlling the thrips population as compared to chemical insecticides. In the present study it is evident that, azadirachtin 10,000 ppm unlike the earlier neem formulation with less azadirachtin concentration could able to reduce thrips population up to 80 per cent on foliage and up to 60 per cent on fruiting bodies. So, it can be explored as an alternative to rotate with chemical insecticides in pomegranate.

Time of application of insecticides assumes greater importance in pomegranate for the management of *S. dorsalis.* First spray at 20 to 25 days after pruning proved to be highly effective in bringing down the population to a greater extent. However, another back up spray (*i.e.* at 40 days after pruning) is required to provide better and consistent control of *S. dorsalis*. The necessity of second spray could be because of the fact that, *S. dorsalis* reaches its peak level at 25-40 days after pruning with the availability of tender leaves and initiation of flowering, so there is a likely chance of shifting of population from foliage to tender flower bud. Another spray during fruit initiation coinciding with 55 and 70 days after pruning can provide complete control of *S. dorsalis.* Fourth spray may be need based if fruits are allowed from subsequent flowers or if there are prolonged dry spells coupled with high temperature. Third and fourth sprays are necessary, because *S. dorsalis* cause direct damage to young fruits leading to scabbing or corky surface and fruit quality deterioration. Considering these results, it can be recommended that pomegranate fields need to be sprayed with insecticides at the economical phase of the crop growth (25 to 70 days after pruning). Further, the need based sprays on pomegranate with cyazypyr or imidacloprid twice at an interval of 15 days may be necessary to keep the population at low levels.

Fruit damage. Among the different insecticides evaluated against pomegranate thrips, cyazypyr and imidacloprid remained effective in reducing fruit damage below ten per cent up to harvesting stage (Fig. 2). The next best treatments were clothionidin, fipronil and spinosad with less than 20 per cent fruit damage in of one to three scale damage grades. The results are in line with findings of Verma *et al.* (2012) who reported imidacloprid as effective in reducing fruiting damage in garlic ecosystem. Thrips cause scab appearance on the fruit surface ranging from <10 per cent up to > 74 per cent scab surface, there by largely affecting the quality of the fruit and to some extent reducing the size of the fruit. Therefore, the next best treatments, clothianidin, fipronil, spinosad, and thiamethoxam have recorded fruit damage ranging from 13 to 16 per cent and implied that scaby area on the fruits was relatively on lower scale and not beyond unmarketable range. However, present finding strongly support the effectiveness of cyazypyr and imidacloprid in producing quality fruits.

Fruit yield (t/ha): Significantly highest fruit yield of 15.17 tonnes per ha was recorded in cyazypyr 10 OD which was statistically at par with imidacloprid (14.67 t/ha) (Fig. 3). These results are in agreement with Kambrekar (2015), who reported cyazypyr recording highest fruit yield in grapes. Sunitha and Jagginavar (2008) also reported significantly highest fruit yield of grapes in neonicotinoid treatments *viz.*, imidacloprid, acetamaprid, thiamethoxam. Cyazypyr and imidacloprid could increase the fruit yield in the range of 18 to 22 per cent over untreated control. Thrips often cause significant loss in terms of quality rather reducing the quantity of yield. However, significant foliage damage at vegetative phase immediately after pruning probably contributes even for loss in fruit yield as evident in the present findings. Though imidacloprid was next best to cyazypyr in efficacy against thrips its phytotonic effect might be contributing for its on par yield with cyazypyr in the present study.

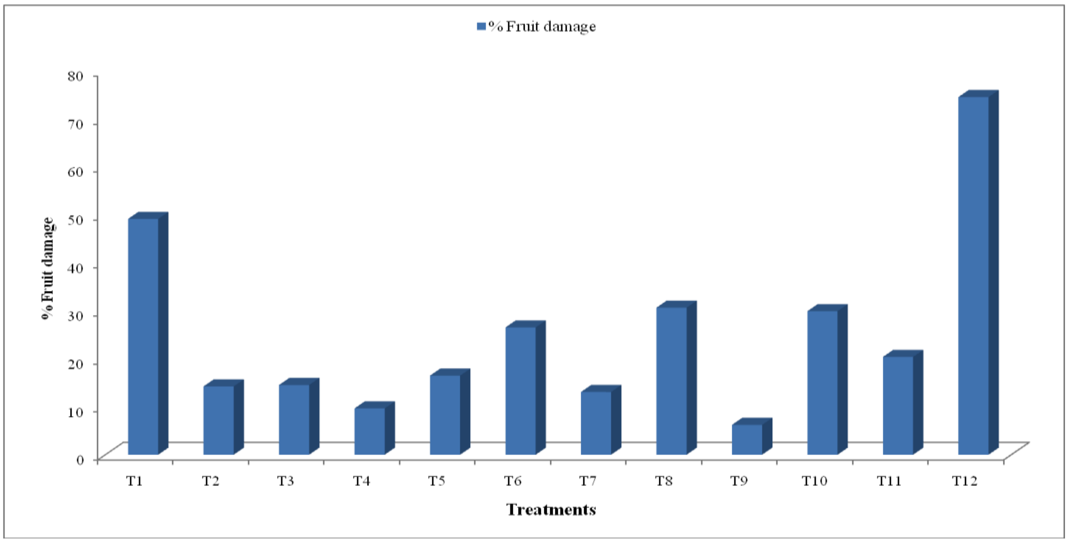
Next best treatments in recording highest fruit yield were, clothianidin (13.83 t/ha) and diafenthiuron (13.73 t/ha) and were intern on par with imidacloprid. The present findings are in line with Mandal (2011); Patel *et al.* (2006) who reported good yield of chilli obtained from diafenthiuron treated plots.

The treatments, thiamethoxam 25 WDG (13.60 t/ha), lambda cyhalothrin 5 EC (13.67 t/ha) dimethoate 30 EC (13.53 t/ha), acetamiprid 20 SP (13.40 t/ha), spinosad 45 SC (13.17 t/ha) and fipronil 5 SC (13.13 t/ha) were on par with each other in fruit yield in the present study. Sunitha and Jagginavar (2010a) reported acetamiprid, thiamethoxam and dimethoate treatments recording highest fruit yield in grapes. Sunitha and Jagginavar (2008) reported acetamiprid and thiamethoxam as best treatments and recorded highest yield in grapes.

Azadirachtin was less effective in recording higher fruit yield in the present study. Keshav and Veersingh (2013) also reported ineffectiveness of azadirachtin in increasing the fruit yield in garlic ecosystem which agrees with the present findings.

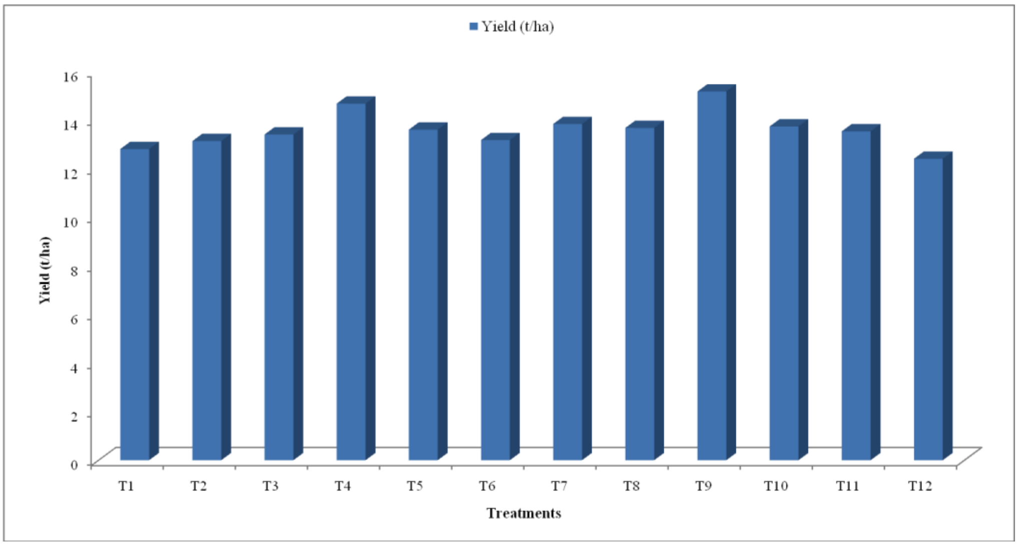
Economics of the management of thrips on pomegranate. The highest gross return was obtained from the cyazypyr 10 OD @ 1.5 ml (Rs. 9,16,000). The next best treatments in terms of gross return were, imidacloprid 17.8 SL @ 0.3 ml (Rs. 8,57,200) followed by clothianidin 25 WDG @ 0.17 g (Rs. 7,93,200), thiamethoxam @ 0.25 g (Rs. 7,74,000), spinosad 45 SC @ 0.25 ml (Rs. 7,68,000), fipronil 5 SC @ 1.0 ml (Rs. 7,60,000), and dimethoate 30 EC @ 1.7 ml (Rs. 7,60,800). The treatment, cyazypyr @ 1.5 ml recorded maximum additional return of Rs. 6,63,000 per ha (Table 1). The next best treatments were imidacloprid @ 0.3 ml (Rs. 6,29,648/ha), clothianidin @ 0.17 g (Rs. 5,56,200/ha) and thiamethoxam @ 0.25 g (Rs. 5,46,880/ha). However, the highest benefit cost ratio was obtained from the treatment,imidacloprid @ 0.3 ml (3.77) followed by cyazypyr @ 1.5 ml (3.62) and thiamethoxam @ 0.25 g (3.41) and clothianidin @ 0.17 g (3.35). The benefit cost ratio was highest in imidacloprid treatment compared to cyazypyr treatment because of high cost of cyazypyr compared to imidacloprid (Table 1).

Imidacloprid being a neonicotinoid systemic insecticide with yellow label can be recommended as cost effective. However, cyazypyr being an anthranilicamide insecticide with green label can be another best alternative for thrips management on pomegranate. In addition, azadirachtin 10000 ppm @ 1.0 ml may be one of the options under organic cultivation of pomegranate or to rotate with chemical insecticides.



T_1- Azadirachtin 10000 ppm, T_2- Fipronil 5 SC, T_3- Spinosad 45 SC, T_4- Imidacloprid 17.8 SL, T_5- Thiamethoxam 25 WG, T_6- Acetamaprid 20SP, T_7- Clothianidin 50 WDG, T_8- Lambdacyhalothrin 5 EC, T_9- Cyazypyr 10 OD, T_{10}- Diafenthiuron 50 SC, T_{11}- Dimethoate 30 EC, T_{12}- Untreated control

Fig. 2. Efficacy of various insecticides on thrips damage on pomegranate fruits during *Hasta bahar.*



T_1- Azadirachtin 10000 ppm, T_2- Fipronil 5 SC, T_3- Spinosad 45 SC, T_4- Imidacloprid 17.8 SL, T_5- Thiamethoxam 25 WG, T_6- Acetamaprid 20SP, T_7- Clothianidin 50 WDG, T_8- Lambdacyhalothrin 5 EC, T_9- Cyazypyr 10 OD, T_{10}- Diafenthiuron 50 SC, T_{11}- Dimethoate 30 EC, T_{12}- Untreated control

Fig. 3. Influence of various insecticides on pomegranate fruit yield used for management of thrips during *Hasta bahar.*

Table 1: Economics of management of thrips on pomegranate using various insecticides during *Hasta bahar.*

Tr. No.	Treatments	Gross yield (t/ha)			Gross return (Rs/ha)			Cost of cultivation (Rs/ha)			Net returns (Rs/ha)	BC ratio
		Healthy	Damaged	Total	Healthy	Damaged	Total	General	Additional	Total		
T_1	Azadirachtin 10000 ppm	6.80f	6.00b	12.80de	408000	240000	648000	225000	2800	227800	420200	2.84
T_2	Fipronil 5 SC	11.40cd	1.90g	13.13cde	684000	76000	760000	225000	3360	228360	531640	3.33
T_3	Spinosad 45 SC	11.60cd	1.80fg	13.40cd	696000	72000	768000	225000	10500	235500	532500	3.26
T_4	Imidacloprid 17.8 SL	13.52b	1.15i	14.67ab	811200	46000	857200	225000	2552	227552	629648	3.77
T_5	Thiamethoxam 25 WG	11.50cd	2.10f	13.60cd	690000	84000	774000	225000	2120	227120	546880	3.41
T_6	Acetamiprid 20SP	9.87e	3.30d	13.17cde	592200	132000	724200	225000	1200	226200	498000	3.20
T_7	Clothianidin 50 WDG	12.00c	1.83g	13.83bc	720000	102000	793200	225000	12000	237000	556200	3.35
T_8	Lambdacyhalothrin 5 EC	9.75e	3.92c	13.67cd	585000	156800	741800	225000	960	225960	515840	3.28
T_9	Cyazypyr 10 OD	14.40a	1.30h	15.17a	864000	52000	916000	225000	28000	253000	663000	3.62
T_{10}	Diafenthiuron 50 WP	10.00e	3.73c	13.73bc	600000	149200	749200	225000	12000	237000	512200	3.16
T_{11}	Dimethoate 30 EC	10.98d	2.55e	13.53cd	658800	102000	760800	225000	2600	227600	533200	3.34
T_{12}	Untreated control	3.40g	9.00a	12.40e	204000	360000	564000	225000	-	225000	339000	2.51
S.Em±		0.32	0.0836	0.6								
CD @ 5%		0.94	0.276	1.8								

BC: Benefit Cost Ratio,
Market price of pomegranate is (Rs.95/kg).

Azadiractin 10000 ppm 500ml: Rs.500
Fipronil 5% SC 250ml: Rs.280
Spinosad 45 SC 75ml: Rs.1050
Imidacloprid 17.8% 50ml: Rs.140
Thiomethoxam 25 WG 120gm: Rs.340
Dimethoate 30 EC 100ml: Rs.50
Lambda cyhalothrin 5 EC 250ml: Rs.160
Acetamaprid 20 SP 150g: Rs.300
Diafenthiuron 50 SC 250 ml: Rs.1000
Cyazypyr 10 OD 180ml: Rs.1800

CONCLUSIONS

The study can be conclude that, among the different insecticides evaluated against thrips on pomegranate, cyazypyr 10 OD @ 1.5 ml/l of water recorded significantly highest fruit yield (15.17 t/ha) and lowest fruit damage (6.22%) followed by imidacloprid 17.8 SL @ 0.3ml/l (14.67 t/ha and 9.65%, respectively). The next best treatments were, clothianidin 50 WDG @ 0.17 g/l and diafenthiuron 50 WP @ 1.0 g/l. So, spraying of cyazypyr 10 OD (a new anthranilicdiamide insecticide) @ 1.5 ml/l recorded highest net returns of Rs. 6,63,000 per ha followed by imidacloprid 17.8 SL @ 0.3 ml (Rs. 6,29,648/ha). However, in terms of benefit cost ratio, imidacloprid 17.8 SL proved best (3.77) followed cyazypyr 10 OD (3.62). Hence, spraying of imidacloprid 17.8 SL @ 0.3 ml or cyazypyr 10 OD @ 1.5 ml may be recommended for the effective management of thrips on pomegranate.

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Conflict of Interest. None.

REFERENCES

Amalendu, M. L., Chatterjee, K., Chakrabarti, L. and Samanta, A. (2009). Field evaluation of insecticides against chillithrips (*Scirtothrips dorsalis* Hood). *Annals of Plant Protection Sciences, 17* (1), 69-71.

Ananda, N., Kotikal, Y. K. and Balikai, R. A. (2009). Management practices for major sucking pests of pomegranate. *Karnataka Journal of Agricultural Sciences*, *22*(4), 790-795.

Anonymous (2013). Integrated Horticultural Package, University of Horticultural Sciences, Bagalkot pp. 32-35.

Anonymous (2015). Area and production of pomegranate fruit.http://nhb.gov.in/Default.aspx.

Arunkumar, H. (2007). Management of chillimurda complex in irrigated ecosystem. *Ph. D. Thesis,* University of Agricultural Sciences, Dharwad, Karnataka (India), pp. 243.

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

Bhargava, K. K. and Bhatnagar, A. (2005). Field evaluation of conventional and eco-friendly insecticides against onion thrips, *T. tabaci* (Lindeman) (Thysanoptera : Thripidae). *Udyaika, 11*, 73-78.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. New Delhi, *Wiley International Sciences Publication*, *368* pp.

Jadhao, A. V., Patil, S., K. and Kulkarni, S. R. (2016). Evaluation of insecticides against chillithrips, *Scirtothrips dorsalis* Hood. *Annals Plant Protection Science*, *24*(1), 27-30.

Jayalaxmi, N. H., Chakravarthy, A. K., Nagamani, M. K. and Prabhakar, M. S. (2011). Management of thrips, *Scirtothrips dorsalis* Hood, on rose under open field and protected conditions. *Journal Horticulture Science*, *6*(2), 118-122.

Kambrekar, D. N. (2015). New generation anthranilicdiamide, cyazypyr (HGW86 10% OD) for the management of grape flea beetle and thrips. *Journal of Plant Protection, 43*(4), 411-415.

Keshav, M. and Veersingh (2013). Bioefficacy of new insecticides against *Thrips tabaci* Lindeman on Garlic. *Indian Journal of Entomology, 75*(3), 239-267.

Malhotra, N. K., Khajuria, H. N. and Jawanda (1983). Studies on physicochemical characters of pomegranate cultivars II. Chemical characters. *Punjab Horticulture Journal*, *23*, 158.

Mandal, S. K. (2011). Field evaluation of alternate use of insecticides against Chilli Thrips, *Scirtothrips dorsalis* (Hood).*Annals Plant Protection Science, 20*(1), 59-62.

Muhammad, R., Muhammad, A., Iqbal, M., Hussain, M. and Shahzad, A. (2003). Efficacy of six insecticides with different made of action against sucking pest of cotton. *Sarhad Journal of Agriculture, 19*(1), 97-100.

Patel, B. H., Patel, J. J., Bhatt, H. V., Maghodia, B. A. and Bhalala, M. K. (2006). Bioefficacy of thiomethoxam 25 WG and difenthiuron 50 WP against thrips, *Scirtothrips dorsalis* Hood infesting chilli (*Capsicum frutescens*). *Indian Journal of Entomology, 68*(3), 274-275.

Shanmuga, P. M., Sridharan, S. and Kuttalam, S. (2016). Fipronil 80 WG-A promising phenyl pyrrozole insecticide to manage thrips damage in grapes. *Annals Plant Protection Science, 24* (1), 61-66.

Sujay, Y. H., Dhandapani, N., Pushpa, V. and Giraddi, R. S. (2009). Evaluation of eco-friendly approaches for the management of sucking pests in chilli. *Karnataka Journal of Agricultural Sciences, 22*, 720-721.

Sunitha, N. D. and Jagginavar, S. B. (2008). Management for thrip complex in grape ecosystem. *Annals Plant Protection Science, 16*(1), 83-86.

Sunitha, N. D. and Jagginavar, S. B. (2010a). Management of *Scirtothrips dorsalis* in grapes. *Indian Journal of Plant Protection, 38*(2), 131-133.

Suresh, Rajavel, D. S., Baskaran, R. K. and Rani, B. U. (2006). *In vivo* evaluation of various botanicals against onion thrips, *Thrips tabaci* (Lindeman) and cutworm, *Agrotis ipsilon* (Hufn.). *Hexapoda, 13*, 47-52.

Verma, S. C., Thakur, M. and Kanwar, H. S. (2012). Efficacy of insecticides against onion thrips, *Thrips tabaci* Lindeman on garlic under mid-hill conditions of Himachal Pradesh. *Journal of Insect Science, 25*(1), 76-78.

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