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Effectiveness of different insecticides against whitefly (*Bemisia tabaci)* in sunflower

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Abstract
The present field experiment were conducted to evaluate "Effectiveness of different insecticides against whitefly (*Bemisia tabaci)* in sunflower" under field condition during *rabi* season of 2017 at research farm of Oilseed Research Station, Latur, Maharashtra, India. The treatments of different insecticides *viz.*, thiamethoxam 0.005 per cent, imidacloprid 0.00356 per cent, spiromesifen 0.02748 per cent, flonicamide 0.02 per cent, profenophos 0.1 per cent and triazophos 0.08 per cent were evaluated against whitefly, *Bemisia tabaci* revealed that imidacloprid 0.00356 per cent was found most effective treatment in reducing the population of whitefly (1.13 and 0.87 whiteflies per 6 leaves) followed by spiromesifen 0.12 per cent. Significantly higher seed yield (2450 kg/ha) of sunflower was recorded in treatment imidacloprid 0.00356 per cent however, it was found at par with treatment thiamethoxam 0.005 per cent (2264 kg/ha).

Keywords: Effectiveness, different insecticides, whitefly

Introduction
Sunflower, *Helianthus annuus* Linnaeus (Family Asteraceae or Compositae) is grown in India as an ornamental plant since ancient time, introduced into India in the 16th century. Sunflower is major oilseed crops. It contains 32 to 44 per cent oil, 18 to 22 per cent carbohydrates, 20 to 24 per cent vitamins, and 4 to 6 per cent salts. Sunflower oil contains high percentage of linoleic acid (64 per cent) (Dake, 2015) [11]. High amount of poly-unsaturated fatty acids (60 per cent) present in sunflower oil which accepted largely in diet to reduce cholesterol in blood. The oil is used as culinary purpose. Oil is also used in salads, cooking, manufacture of margarines and as a lubricant (Muhammad and Muhammad, 2001) [16]. In India during 2017-18 sunflower was grown on an area of 0.33 million hectares with 0.23 million metric tons of production and 0.70 metric tons per hectare of productivity (Anonymous, 2019) [4]. In Maharashtra, sunflower is grown on an area of 0.61 lakh hectare with 27.67 thousand tons of production and 407 kg per hectare of productivity during 2014-2015 (Anonymous, 2015) [3].
In India, more than fifty insect species have been found to damage the crop at different phonological stages of the crop growth. Out of them, nine are major insect pests and remaining are of minor importance and are capable of causing considerable damage to the crop if the conditions are favorable (Basappa, 1995) [6]. Infestation of sucking insect-pests is becoming a major concern in obtaining expected yield from sunflower crop because; their incidence starts from seedling stage and prevail through the entire plant life. Whitefly *B. tabaci* (Homoptera: Aleyrodidae) is minor pest of sunflower crop. The pest found infesting on lower surface of the leaf. Maximum population has been noticed on upper leaves (48.7 per cent) followed by middle leaves (31.8 per cent) and the smallest population on lower leaves (19.6 per cent) (Basappa *et al*., 2005) [8]. Whitefly nymphs and adults also desap the plant and shows symptoms like stunted growth and yellowing of leaves. Sucking insect-pests of sunflower cause 44 per cent of yield losses (Kakakhel *et al*., 2000) [15].
Numerous chemical measures like use of insecticides have been used for the efficient management of sunflower whitefly. But according to several reports many of these insecticides could not gave effective results. Hence, these insecticides along with some new insecticides need to be re-evaluated against sunflower insect-pests for effective management.

Materials and Methods
The field experiment with sunflower crop using variety KBSH-44 was conducted during *Rabi* season 2017 at Oilseed Research Station, Latur, Maharashtra, India.

The experiment was laid out in randomized block design (RBD) with seven treatments including untreated control with three replications. The crop was sown on 20 November, 2017 with spacing 60m x 30m and gross plot of 4.8m x 4.2m. The seven treatments *viz.*, T1: thiamethoxam 0.005 per cent, T2: imidacloprid 0.00356 per cent, T3: spiromesifen 0.02748 per cent, T4: flonicamide 0.02 per cent, T5: profenophos 0.1 per cent, T6: triazophos 0.08 per cent and T7: Control used for investigation. Effectiveness of insecticides was judged on basis of level of whitefly population on randomly selected five plants from each treatment from six leaves that is two from each on top, middle and bottom. The pre-count of whitefly was recorded on a day prior to application and post-counts at 1, 3, 7, 10 and 14 days after first and second and application of insecticides.

Results and Discussion

Whitefly (*Bemisia tabaci*)

First spray

Data pertaining to effect of different insecticides on population of whitefly *(B. tabaci*) after first and second spray are presented in Table 1 and depicted in figure 1 revealed that the no significant differences were observed among various treatments before one day of the spray. All the insecticides were found significantly superior over untreated control in reducing population of sunflower leafhopper at 1, 3, 7, 10, and 14 days after first spray application.

At one day after first spray, significantly minimum population of whitefly (1.13 whiteflies per six leaves per plant) was registered from the plots treated with treatment T2 i.e. imidacloprid @ 0.00356 per cent which was followed by treatment T3 spiromesifen @ 0.02748 per cent (2.13 whiteflies per six leaves per plant). Both these treatments were found statistically at par with each other. The next effective treatment was treatment T1 i.e. thiamethoxam @ 0.005 per cent (3.07 whiteflies per six leaves per plant) in reducing whitefly population and found at par with subsequently effective treatment T4 i.e. flonicamide @ 0.02 per cent (4.20 whitefly per six leaves per plant). Treatment T6 i.e. triazophos @ 0.08 per cent and treatment T5 i.e. profenophos @ 0.1 per cent were the next effective treatments in managing whiteflies by recording 4.67 and 6.13 whiteflies per six leaves per plant, respectively. The highest population of whiteflies i.e. 14.47 per six leaves per plant) was observed in treatment T7 i.e. untreated control.

Table 1: Effect of different insecticides on the population of sunflower whitefly (After first spray)

Tr. No.	Treatment	Concentration used (%)	Mean population of whitefly per six leaves					
			1 day before Spraying	Days after spraying				
				1	3	7	10	14
T1	Thiamethoxam 25% WG	0.005	14.07 (3.81)*	3.07 (1.88)	3.27 (1.91)	3.53 (2.00)	3.73 (2.04)	3.93 (2.10)
T2	Imidacloprid 17.8% SL	0.00356	14.27 (3.83)	1.13 (1.28)	1.73 (1.47)	1.93 (1.54)	2.07 (1.58)	2.33 (1.66)
T3	Spiromesifen 22.9% SC	0.02748	14.13 (3.81)	2.13 (1.61)	2.40 (1.68)	2.53 (2.73)	2.73 (1.79)	2.87 (1.83)
T4	Flonicamide 50% WG	0.02	14.40 (3.85)	4.20 (2.17)	4.33 (2.17)	4.47 (2.22)	4.60 (2.25)	4.87 (2.31)
T5	Profenophos 50% EC	0.1	14.20 (3.82)	6.13 (2.56)	6.33 (2.60)	6.53 (2.65)	6.73 (2.69)	6.93 (2.71)
T6	Triazophos 40% EC	0.08	14.53 (3.86)	4.67 (2.26)	4.73 (2.24)	4.93 (2.33)	5.07 (2.34)	5.13 (2.36)
T7	Untreated Control	-	14.33 (3.80)	14.47 (3.87)	14.53 (3.87)	14.87 (3.92)	14.93 (3.93)	15.20 (3.96)
	S.E. ±		0.27	0.11	0.15	0.12	0.16	0.14
	C.D. at 5%		NS	0.34	0.45	0.37	0.47	0.43
	C.V. (%)		NS	8.64	11.36	9.03	11.33	10.22

*Figures in parentheses are square root (x + 0.5) transformed values. NS: Non significant

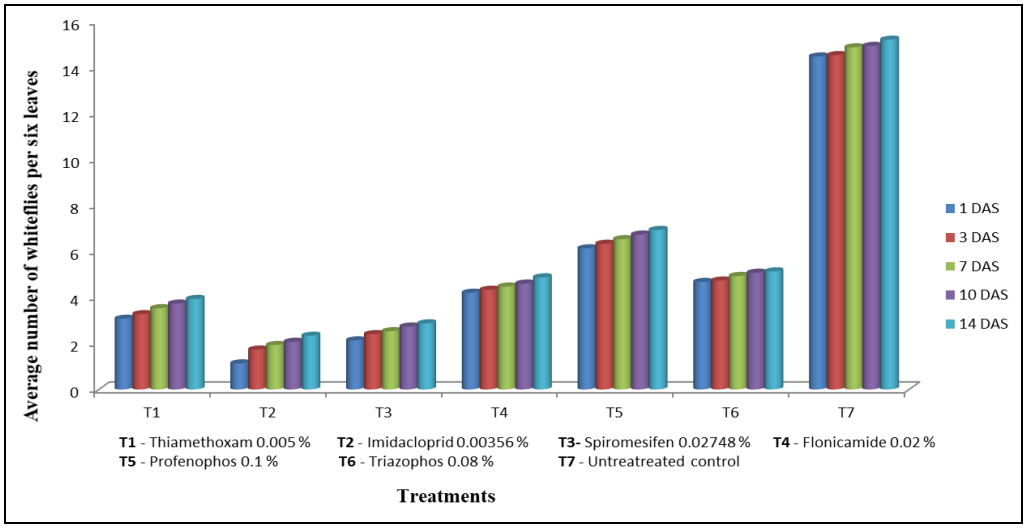

Fig 1: Effect of different insecticides on the population of sunflower whitefly (After first spray)

At three days after first spray, treatment T2 i.e. imidacloprid @ 0.00356 per cent, treatment T3 i.e. spiromesifen @ 0.02748 per cent and treatment T1 i.e. thiamethoxam 25% WG @ 0.005 per cent were found most effective and at par with each other by recording 1.73,2.40 and 3.27 whiteflies per six leaves per plant. The next effective treatment was treatment T4 i.e. flonicamide @ 0.02 per cent (4.33 whiteflies per six leaves per plant) which was followed by treatment T6 i.e. triazophos @ 0.08 per cent (4.73 whitefly per six leaves per plant) and treatment T5 i.e. profenophos @ 0.1 per cent (6.33 whitefly per six leaves per plant). All these three treatments were found at par with each other. The highest population of whiteflies (14.53 per six leaves per plant) was observed in treatment T7 i.e. untreated control.

At seven days after first spray, significantly lowest population of whitefly was registered from the plots treated with treatment T2 i.e. imidacloprid @ 0.00356 per cent (1.93 whiteflies per six leaves per plant) and was followed by treatment T3 i.e. spiromesifen @ 0.02748 per cent (3.53 whiteflies per six leaves per plant) and both these treatments were found to be statistically at par with each other. The next effective treatment was treatment T1 i.e. thiamethoxam @ 0.005 per cent (3.53 whiteflies per six leaves per plant) which was followed by treatment T4 i.e. flonicamide @ 0.02 per cent (4.47 whiteflies per six leaves per plant) and treatment T6 i.e. triazophos @ 0.08 per cent (4.93 whiteflies per six leaves per plant). All these three treatments were found statistically at par with each other. The treatment T5 i.e. profenophos @ 0.1 per cent was found intermediate by recording 6.53 whiteflies per six leaves per plant. Treatment T7 i.e. untreated control recorded the highest population of i.e. 14.87 whiteflies per six leaves per plant.

More or less similar trend was noticed after ten days after first spray and significantly lowest population of whitefly was recorded from the plots treated with treatment T2 i.e. imidacloprid @ 0.00356 per cent (2.07 whiteflies per six leaves per plant) followed by treatment T3 i.e. spiromesifen @ 0.02748 per cent (2.73 whiteflies per six leaves per plant) and treatment T1 i.e. thiamethoxam @ 0.005 per cent (3.73 whiteflies per six leaves per plant). All these three treatments were found statistically at par with each other. The next effective treatment was treatment T4 i.e. flonicamide 50 WG @ 0.02 per cent, treatment T6 i.e. triazophos @ 0.08 per cent and treatment T5 profenophos @ 0.1 per cent which recorded 4.60, 5.07 and 6.73 whiteflies per six leaves per plant, respectively and all these were found at par with each other. Treatment T7 i.e. untreated control plot recorded the highest population of 14.93 whiteflies per six leaves per plant.

A slight increase in whitefly population was noticed at 14 days after first spray. The treatment T2 i.e. imidacloprid @ 0.00356 per cent exhibited significantly lowest population of whitefly (2.33 per six leaves per plant) and found at par with next best treatment T3 i.e. spiromesifen @ 0.02748 per cent (2.87 whiteflies per six leaves per plant). The next effective treatments in whitefly management were treatment T1 i.e. thiamethoxam @ 0.005 per cent, treatment T4 i.e. flonicamide @ 0.02 per cent and treatment T6 i.e. triazophos @ 0.08 per cent by recording 3.93, 4.87 and 5.13 whiteflies per six leaves per plant, respectively and all these treatments were found at par with each other. Treatment T5 i.e. profenophos @ 0.1 per cent was found next best treatment by recording 6.93 whiteflies per six leaves per plant. The highest population of whiteflies i.e. 15.20 per six leaves per plant was recorded in treatment T7 i.e. untreated control.

Thus after first spray, overall the plots treated with imidacloprid @ 0.00356 per cent recorded significantly lowest population of whitefly on sunflower to the tune of 1.13, 1.73, 1.93, 2.07 and 2.33 per six leaves per plant at 1, 3, 7, 10 and 14 days after spraying, respectively over rest of the insecticidal treatments.

Second spray

The results in respect of effect of different insecticides on population of whitefly after second spray are presented in Table 2 and Fig. 2.

The data revealed that all the insecticides under investigation were significantly superior over untreated control in reducing the population of whitefly on sunflower at 1, 3, 7, 10 and 14 days after second spray.

At one day after second spray, significantly minimum population of whitefly (0.87 whiteflies per six leaves per plant) was recorded from the plots treated with treatment T2 i.e. imidacloprid @ 0.00356 per cent which was followed by treatment T3 i.e. spiromesifen @ 0.02748 per cent (1.73 whiteflies per six leaves per plant). Both these treatments were found statistically at par with each other. The next effective treatment was treatment T1 i.e. thiamethoxam @ 0.005 per cent (2.53 whiteflies per six leaves per plant) which was found at par with treatment T4 i.e. flonicamide @ 0.02 per cent (3.53 whiteflies per six leaves per plant). Subsequently effective treatments in order in reducing whitefly population were treatment T6 i.e. triazophos @ 0.08 per cent (3.93 whiteflies per six leaves per plant) and treatment T5 i.e. profenophos @ 0.1 per cent (5.73 whiteflies per six leaves per plant). The highest population of whitefly i.e. 13.40 per six leaves per plant was recorded in treatment T7 i.e. untreated control.

More or less parallel trend was observed at three days after second spray and the treatment T2 i.e. imidacloprid @ 0.00356 per cent registered significantly lowest population of whiteflies to the tune of 1.00 per six leaves per plant which was followed by treatment T3 i.e. spiromesifen @ 0.02748 per cent (1.93 whiteflies per six leaves per plant). Both these treatments were found statistically at par with each other. The next effective treatments were treatment T1 i.e. thiamethoxam @ 0.005 per cent and treatment T4 i.e. flonicamide @ 0.02 per cent by recording 2.73 and 3.73 whiteflies per six leaves per plant, respectively and found statistically at par with each other. The treatment T6 i.e. triazophos @ 0.08 per cent (4.20 whiteflies per six leaves per plant) and treatment T5 i.e. profenophos @ 0.1 per cent (5.93 whiteflies per six leaves per plant) were found to be subsequently effective treatments in reducing whitefly population. The highest population of whitefly (13.53 whiteflies per six leaves per plant) was observed in treatment T7 i.e. untreated control.

At seven days after second spray, significantly lowest population of whitefly (1.20 whiteflies per six leaves per plant) was recorded from the plots treated with treatment T2 i.e. imidacloprid @ 0.00356 per cent which was followed by treatment T3 i.e. spiromesifen @ 0.02748 per cent (2.07 whiteflies per six leaves per plant). Both these treatments were found statistically at par with each other. The next effective treatments were treatment T1 i.e. thiamethoxam @ 0.005 per cent, treatment T4 i.e. flonicamide @ 0.02 per cent and treatment T6 i.e. triazophos @ 0.08 per cent which recorded 2.87, 3.87 and 4.47 whiteflies per six leaves per plant, respectively and found statistically at par with each other. Subsequently effective treatment in reducing whitefly

population was treatment T5 i.e. profenophos @ 0.1 per cent (6.20 whiteflies per six leaves per plant). The highest population of whitefly (13.67 whiteflies per six leaves per plant) was recorded in treatment T7 i.e. untreated control.

Table 2: Effect of different insecticides on the population of sunflower whitefly (After second spray)

Tr. No.	Treatment	Concentration used (%)	Mean population of whitefly per six leaves					
			1 day before Spraying	Days after spraying				
				1	3	7	10	14
T1	Thiamethoxam 25% WG	0.005	13.53 (3.73)*	2.53 (1.70)	2.73 (1.74)	2.87 (1.80)	2.93 (1.85)	3.20 (1.92)
T2	Imidacloprid 17.8% SL	0.00356	13.20 (3.70)	0.87 (1.17)	1.00 (1.22)	1.20 (1.29)	1.33 (1.34)	1.53 (1.39)
T3	Spiromesifen 22.9% SC	0.02748	13.60 (3.74)	1.73 (1.48)	1.93 (1.54)	2.07 (1.59)	2.33 (1.67)	2.40 (1.69)
T4	Flonicamide 50% WG	0.02	13.87 (3.78)	3.53 (2.01)	3.73 (2.03)	3.87 (2.09)	4.07 (2.13)	4.20 (2.16)
T5	Profenophos 50% EC	0.1	13.40 (3.69)	5.73 (2.50)	5.93 (2.52)	6.20 (2.56)	6.33 (2.61)	6.47 (2.64)
T6	Triazophos 40% EC	0.08	13.33 (3.71)	3.93 (2.10)	4.20 (2.15)	4.47 (2.22)	4.53 (2.23)	4.73 (2.29)
T7	Untreated Control	-	13.27 (3.69)	13.40 (3.73)	13.53 (3.74)	13.67 (3.76)	13.80 (3.77)	13.93 (3.80)
	S.E. ±		0.26	0.12	0.13	0.15	0.14	0.12
	C.D. at 5%		NS	0.35	0.40	0.46	0.42	0.36
	C.V. (%)		NS	9.66	10.82	11.90	10.85	9.04

*Figures in parentheses are square root(x + 0.5) transformed values. NS: Non significant

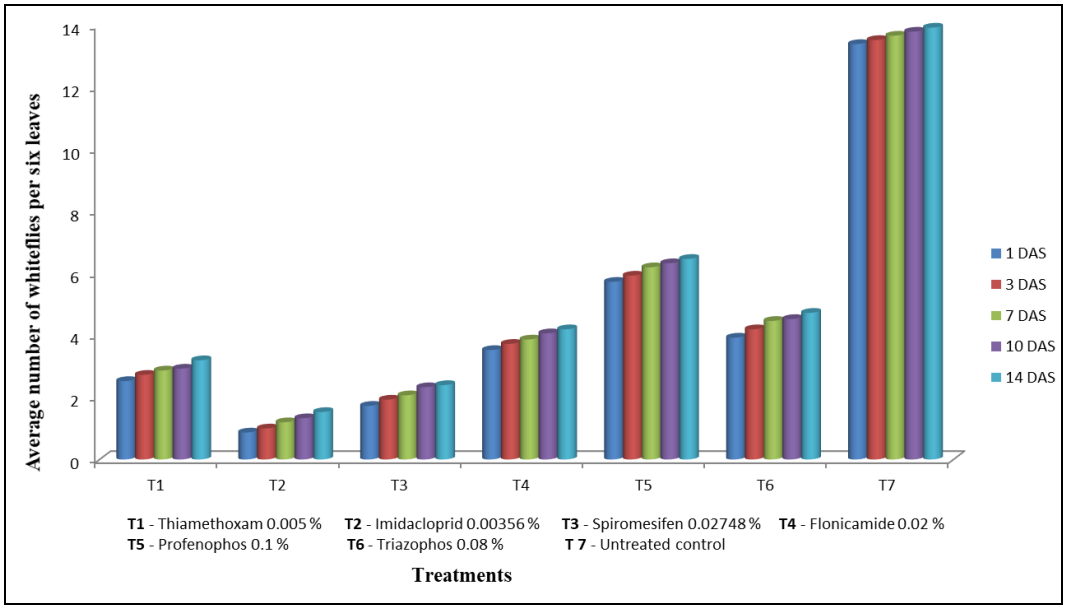

Fig 2: Effect of different insecticides on the population of sunflower whitefly (After second spray)

At ten days after second sprays analogous trend was noticed and the treatment T2 i.e. imidacloprid @ 0.00356 per cent registered significantly lowest population of whiteflies to the tune of 1.33 per six leaves per plant which was followed by treatment T3 i.e. spiromesifen @ 0.02748 per cent (2.33 whiteflies per six leaves per plant). Both these treatments were found statistically at par with each other. The next effective treatment was treatment T1 i.e. thiamethoxam @ 0.005 per cent (2.93 whiteflies per six leaves per plant) which was followed by treatment T4 i.e. flonicamide @ 0.02 per cent (4.07 whiteflies per six leaves per plant) and treatment T6 i.e. triazophos @ 0.08 per cent (4.53 whiteflies per six leaves per plant) and all these three treatments were found statistically at par with each other. Subsequently effective treatment was treatment T5 i.e. profenophos @ 0.1 per cent (6.33 whiteflies per six leaves per plant) in reducing whitefly population. The highest population of whiteflies i.e. 13.80 per six leaves per plant was recorded in treatment T7 i.e. untreated control.

At 14 days after second spray, significantly minimum population of whitefly (1.53 whiteflies per six leaves per plant) was recorded from the plots treated with treatment T2 i.e. imidacloprid @ 0.00356 per cent which was followed by treatment T3 i.e. spiromesifen @ 0.02748 per cent (2.40 whiteflies per six leaves per plant). Both these treatments were found statistically at par with each other. The next effective treatment was treatment T1 i.e. thiamethoxam @ 0.005 per cent (3.20 whiteflies per six leaves per plant) which was found at par with treatment T4 i.e. flonicamide @ 0.02 per cent (4.20 whiteflies per six leaves per plant). The treatment T6 i.e. triazophos @ 0.08 per cent (4.73 whiteflies per six leaves per plant) and treatment T5 i.e. profenophos @ 0.1 per cent (6.47 whiteflies per six leaves per plant) were found to be subsequently effective in reducing whitefly

population. The highest population of whitefly (13.93 whiteflies per six leaves per plant) was observed in treatment T7 i.e. untreated control.

Thus, overall it was observed that the insecticidal treatments suppress the whitefly population for initial period only. The population increased slowly after three days onwards of the spray. Also, among the insecticides tested imidacloprid @ 0.00356 per cent was found most effective as it recorded significantly lowest population of whitefly on sunflower to the extent of 0.87, 1.00, 1.20, 1.33 and 1.53 per six leaves at 1, 3, 7, 10 and 14 days after spraying, respectively over rest of the insecticides. However, spiromesifen @ 0.02748 per cent was found at par with imidacloprid in managing the whiteflies on sunflower.

The above findings are in conformity with those of (Basappa *et al*., 2004) [7] and (Santharam *et al*., 2004) [20] who found imidacloprid seed treatment effective in management of whitefly on sunflower. While (Rathod *et al*., 2010) [19] found that imidacloprid 70 WS seed treatment was most effective followed by imidacloprid 200 SL foliar sprays given at 20 and 30 DAE against whitefly on sunflower. Similarly, the effectiveness of imidacloprid was also found against whitefly on cotton by (Sharma *et al*., 1996) [22], (Aslam *et al*., 2004) [5], (Kaiman *et al*., 2004) [14], (Choudhary *et al*., 2005) [10], (Ameta *et al*., 2006) [1]. The next best treatment found in present study in the management of whitefly was spiromesifen @ 0.02748 per cent followed by thiamethoxam @ 0.005 per cent. (Boda and Ilyas 2017) [9] found spiromesifen as more superior in reducing whiteflies population on cotton supporting the present findings. The effectiveness of spiromesifen against whiteflies on cotton was earlier also mentioned by (Naik *et al*., 2017) [17] while (Shaikh *et al*., 2014) [21] found it effective against whiteflies on brinjal and (Ameta *et al*., 2010) [2] on tomato. Thiamethoxam 70 WS seed treatment was found effective against cotton whiteflies by (Sitaramaraju *et al*., 2010) [23] and (El-Naggar EL-Hoda 2013) [12] while as foliar spray by Sreekanth and Reddy (2011) [24]. In present study also thiamethoxam was found effective against whitefly. The results of present investigation revealed that the organophosphate insecticides *viz*., triazophos and profenophos was found least effective in managing the whitefly population. (Huded *et al*., 2019) [13] found profenophos as least effective insecticide against whiteflies on sunflower supporting the findings of present study. Also, (Sreekanth and Reddy 2011) [24] found that triazophos effective only after neonicotinoid insecticide acetamiprid in managing whiteflies on cotton partially supporting the findings of present study. The above results reported different crops against whitefly but proved better which also found supports the present investigation.

Conclusion

In present investigation it can be concluded that among the seven treatments, all the insecticide treatments were more effective as compared to untrated control in suppressing the population of whitefly, *Bemisia tabaci* and imidacloprid 0.00356 per cent was found most effective treatment for controlling whitefly population on sunflower.

References

1. Ameta OP, Sarangdevot SS, Purohit D, Dangi NL. Bioefficacy of triazophos 20 EC (TRELKA) against whitefly, *Bemisia tabaci* (Genn.) in cotton. Pestology. 2006; 30(11):13-15.
2. Ameta OP, Sharma US, Padiwal NK. Bioefficacy of Spiromesifen 240 SC against Mite, *Tetranychus spp*. and Whitefly, *Bemisia tabaci* in Tomato. Pestology. 2010; 34(6):42-47.
3. Anonymous. Annual Progress Report (Sunflower), All India Coordinated Research Project on Oilseed. Directorate of Oilseed Research, Hyderabad, 2015, 167.
4. Anonymous. Sunflower seed area, yield and production. Foreign Agricultural Services/USDA, Office of Global Analysis, 2019. https://apps.fas.usda.gov/psdonline/circulars/production.pdf.
5. Aslam M, Muhammad Razaq, Syed Attaullah, Feheem Ahamad. Comparative efficacy of different insecticides against sucking pest of cotton. J Res. Sci. 2004a; 15(1):17-22.
6. Basappa H. Insect pest management in sunflower Innovative - approaches. Subject Matter Workshop cum Seminar on Integrated Pest Management in Oilseed crops. October 10-17, 1995, DOR, Hyderabad, 1995.
7. Basappa H. Integrated pest management in sunflower: An Indian scenario. Proc. 16th International Sunflower Conference., Fargo, North Dakota, USA 2004a.
8. Basappa H, Santha Lakshmi Prasad M. Insect pests and diseases of sunflower and their management. DOR, Hyderabad, 2005, 80.
9. Boda Vijay, Mohammad Ilyas. Evaluation of new insecticides against sucking pests of Bt cotton. Int. J Pl., Animal and Environ. Sci. 2017; 7(2):2231-4490.
10. Choudhary RK, Tomar SPS, Shrivastava VK, Yadav AS. Field evaluation of imidacloprid (Confidor 17.8 SL) against sucking pests of cotton in rainfed condition. J Cotton Res. 2005; 19(2):241-243.
11. Dake RB. Bioefficacy and residual toxicity of different insecticides against major insect-pests of sunflower. M.Sc. (Agri.) dissertation submitted to Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Unpublished), 2015.
12. El-Naggar JB, El-Hoda NA, Zidan. Field evaluation of imidacloprid and thiamethoxam against sucking insects and their side effects on soil fauna. J Pl. Prot. Res. 2013; 53(4):375-387.
13. Huded, Pravin B, Ghante VN, Vikas Kulkarni. Chemical management of whiteflies in sunflower. Int. J Curr. Microbiol. App. Sci. 2019; 8(4):2885-2890.
14. Kaiman M, Uthamasamy S, Mohan S. Impact of insecticides on sucking pests and natural enemy complex of transgenic cotton. Currentent Set. 2004; 86(5):726-729.
15. Kakakhel SA, Islam N, Amjad M, Malik MK. Insect-pests complex of sunflower, *Helianthus annuus* L. Pak. J Biol. Sci. 2000; 3(4):669-671.
16. Muhammad Ashfaq, Muhammad Aslam. Resistance of different sunflower (*Helianthus annuus* L, Compositae) genotypes against the attack of *Aphis gossypii* (Glower), *Nezara viridula* (L.) and *Thrips tabaci* (Lind). J Biol. Sci., 2001; 1(10):941-945.
17. Naik V, Kranthi S, Rahul Viswakarma. Impact of newer pesticides and botanicals on sucking pest management in cotton under high density planting system (HDPS) in India. J Ent. Zoology Studies. 2017; 5(6):1083-1087.
18. Rajamohan N. Pest complex of sunflower a bibliography. PANS. 1976; 22:546-563.
19. Rathod PK, Mane PN, Thakre AY, Deshmukh SN,

Barkhade UP. Management of whitefly, *Bemisia tabaci* and thrips, *Scirtothrips dorsalis* in *rabi* sunflower with botanicals and chemicals. Indian J Pl. Prot. 2010; 38(2):139-143.
20. Santharam G, Sivaveerapandian D, Ramesh Babu K, Kuttalam S. Bioefficacy of imidacloprid against leafhopper on sunflower. Madras Agric. J. 2004; 91(1-3):120-125.
21. Shaikh AA, Bhut JB, Variya MV. Effectiveness of different insecticides against sucking pests in brinjal. Int. J Pl. Prot., 2014; 7(2):339-344.
22. Sharma PD, Singh MJ, Arya D. Bioefficacy of different insecticides for the control of whitefly, *Bemisia tabaci* (Gennadius) on cotton. National seminar on 'Century of cotton' in Surat, India, 1996.
23. Sitaramaraju S, Prasad NVVSD, Krishnaiah PV. Bioefficacy of insecticides as seed dressers against early season sucking pest of cotton. Pestology. 2010; 34(2):21-25.
24. Sreekanth PN, Srinivas Reddy KM. Efficacy of different insecticides, 2011.