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Toxicity of Selected Insecticides against Cotton Thrips (*Thrips tabaci* Lindeman) in Laboratory Bioassays

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Abstract

Investigations on toxicity of insecticides against cotton thrips (*Thrips tabaci* Lindeman) was carried out at laboratory of Main Cotton Research Station, Navsari Agricultural University, Surat during August to October 2020 through the IRAC leaf dip bio-assay technique. Thrips population from the farmer's field of Bharuch district were collected and reared at Main Cotton Research Station, NAU, Surat under field cage cover. Leaf dip bio-assays were carried out for the five insecticides *viz.,* fipronil 5 SC, buprofezin 25 SC, diafenthiuron 50 WP, profenophos 50 EC and imidacloprid 17.8 SL with eight concentrations. At recommended rate, diafenthiuron 50 WP at 0.06% and profenophos 50 EC at 0.1% recorded 90.36 and 83.29% mortality of thrips at 72 hours after exposure. Buprofezin 25 SC at 0.05%, imidacloprid 17.8 SL at 0.00445% and imidacloprid 17.8 SL at 0.00445% recorded 79.81, 63.54 and 57.06% mortality of thrips under laboratory bioassay at 72 hours after exposure. The recommended rate of the test insecticides except fipronil 5 SC and imidacloprid 17.8 SL did not show much variation in susceptibility at 72 hours after exposure.

Keywords: Bioassay, concentration, exposure, mortality, susceptibility

1. Introduction

Cotton (*Gossypium hirsutum* Linnaeus) is a major fiber crop of global significance. It is also called as "white gold" and its importance as a multipurpose crop that supply five basic products i.e., lint, oil, seed meal, hulls and linters. Cotton contributes about 80% of the raw material to textile industry in the country providing livelihood for more than 100 million people through production, processing, trading and marketing (Rakesh and Kathane, 1989). India stands first in the world cotton area i.e., 11.0 million hectares representing 28% of the world coverage of cotton area and contributes 21% of global cotton produce. Within a decade, India became the world's 2nd largest producer and 2nd largest exporter (behind China) by doubling cotton production (31.08 million bales in 2010-11 from 12.8 million bales in 2000-01). Cotton scenario in India is now dominated by *Bt* cotton covering more than 90% area (Barik, 2010). World total crop production was 113.32 million bales from 32.20 million hectares of total cultivated area with 766 kg ha^{-1} productivity in 2020-21. In India, production of cotton was 371 lakh bales from the 129.57 lakh hectares of cultivated area and 487 kg ha^{-1} productivity during 2020−21. Gujarat is the largest cotton producing state with 90.50 lakh bales of the total production of the country from approximately 22.73 lakh hectares with 677 kg ha^{-1} productivity during 2020-21 (Anonymous, 2021). Among the various causes of low productivity of cotton in India, insect pests are major one. The genetically engineered Bt cotton provide effective management of bollworm complex but now a day sucking pests *viz*., sap feeder's thrips (*Thrips tabaci* Lindeman), leafhopper (*Amrasca biguttula biguttula* Ishida), aphid (*Aphis gossypii* Glover) and whitefly (*Bemisia tabaci* Gennadius) are of major importance in Gujarat. Thrips is a serious pest on seedling cotton in Gujarat. Due to sucking pests, 2.14% loss in seed cotton yield was observed in Surat and Bharuch districts during 2015-16 to 2017-18 (Bhanderi et al., 2020 and Anonymous, 2018). They rasp tender leaves and terminal buds with their sharp mouthparts and feed on the juices. Leaves may turn brown on the edges, develop a silvery color, or become distorted and curl upward. Traditionally, suppression of thrips in early season cotton is achieved by planting insecticide treated seed. However, such crop protection measures may have reduced effectiveness under severe thrips infestations, which would then require rescue treatments for suppression. Limited data is available for assessing insecticide toxicity to thrips species and describing application technology parameters that might influence efficacy of rescue treatments for controlling thrips on cotton. Development of such data will help in the judicious selection of insecticides for effective thrips management and monitoring of insecticidal resistance. Objectives of this study were to obtain data on relative toxicities of insecticides for the control of thrips species on cotton through the IRAC leaf dip bio-assay technique.

2. Materials and Methods

2.1. *Test insect*

Cotton thrips (*Thrips tabaci)* was chosen as the test insect for the experiment. The population of *T. tabaci* was collected from farmer's field of Bharuch district of Gujarat which was not treated with insecticides for more than fifteen days. For collecting the samples, infested cotton leaves with thrips colonies at reasonable population pressure (50 leaf^{-1}) were plucked and collected in the special plastic bucket (height- 26 cm, diameter- 30 cm) having 40 mesh wire net fitted window at the whole central periphery to allow air circulation and the mouth of the bucket covered with muslin cloth and tied with rubber band. Such buckets were brought to the Main Cotton Research Station, Navsari Agricultural University, Surat for bioassays study. The collected thrips samples were reared under field caged condition on hybrid, G.Cot.Hy.8 BG II for three generations at Research Farm, Main Cotton Research Station, Navsari Agricultural University, Surat. The established population after three generations was utilized for bioassay studies of five commonly used insecticides.

2.2. *Test insecticides and preparation of insecticidal solution*

The commonly used five insecticides *viz*., fipronil 5 SC, buprofezin 25 SC, diafenthiuron 50 WP, profenophos 50 EC and imidacloprid 17.8 SL were procured and used for bioassay against thrips. The details of five insecticides used are given in Table 1. Bioassay was carried out for each of the five insecticides with eight concentrations in distilled water with three repetitions. The concentrations for each test insecticide rendering mortality between 20 to 80% mortality considered for bio-assays based on pilot scale testing. Insecticide solutions with graded concentration/doses especially in geometrical progression with three lower and three higher field recommended doses to get better responses along with no exposure were prepared by serial dilution technique in the glass jars with wide mouth (height-15cm, diameter-13 cm) after washing thoroughly with distilled water just prior to experimentation and such jars with eight graded concentrations of single insecticide were properly labeled.

2.3. *Bio-assay for T. tabaci against insecticides*

The thrips were collected from cotton grown under cage condition in field and exposed to graded concentrations of each test insecticide following leaf dip method recommended by Insecticide Resistance Action Committee (IRAC No. 14). For treating substrate, the top leaves with long petioles of

Table 1: Insecticides used for cotton thrips (*T. tabaci*) bio-assay

Sl. No.	Insecticides	Chemical name (IUPAC name)	Field dose ha^{-1} in 500 liters of water			Concentration for bio-assay (%)	Company Name
			a.i. (g)	Formulation (g or ml)	Field use conc.		
1.	Fipronil 5 SC	(±)-5-amino-1-[2,6-dichloro-4-(trifluoromethyl) phenyl]-4-(trifluoromethylsulfinyl) pyrazole-3-carbonitrile	75	1500	0.015	0.12, 0.06, 0.03, 0.015, 0.0075, 0.00375, 0.001875, 0.00	Bayer Crop Science Ltd., Mumbai
2.	Buprofezin 25 SC	(2Z)-3-Isopropyl-2-[(2-methyl-2-propanyl) imino]-5-phenyl-1,3,5-thiadiazinan-4-one	250	1000	0.05	0.4, 0.2, 0.1, 0.05, 0.025, 0.0125, 0.00625, 0.00	Coromandel International Ltd., Mumbai
3.	Diafenthiuron 50 WP	1-tert-butyl-3-[4-phenoxy-2,6-di(propan-2-yl)phenyl] thiourea	300	600	0.06	0.48, 0.24, 0.12, 0.06, 0.03, 0.015, 0.0075, 0.00	Syngenta (India) Pvt. Ltd., Mumbai
4.	Profenophos 50 EC	4-bromo-2-chloro-1- [ethoxy (propylsulfanyl) phos phoryl]oxybenzene	500	1000	0.1	0.8, 0.4, 0.2, 0.1, 0.05, 0.025, 0.0125, 0.00	Excel Crop Care Ltd., Mumbai
5.	Imidacloprid 17.8 SL	N-{1-[(6-Chloro-3-pyridyl) methyl]-4,5-dihydroimidazol-2-yl}nitramide	22.25	125	0.00445	0.0356, 0.0178, 0.0089, 0.00445, 0.002225, 0.0011125, 0.00055625, 0.00	Bayer Crop Science Ltd., Mumbai

75-90 days old plants were selected by slanting cut through sterilized sharp knife. The cut end of the petioles was wrapped immediately with cotton swab moisten with 10% sucrose solution and sealed with parafilm. Amongst selected ones, three leaves were dipped for 30 seconds in insecticidal solutions of each concentration for each of the insecticide. A control was run which were sprayed with distilled water. After dipping, each leaf was all owed to naturally shade dry for fifteen minutes under fan and placed individually in the petri dishes (9 cm diameter). About fifty cotton thrips were released per leaf of cotton in petri dishes with the help of pointed camel hair brush. Such 24 petri dishes, each containing 50 thrips were used for bioassay for single insecticide. Total of 120 sets comprising of five insecticides were kept for observations. Observations on mortality of thrips were recorded at 24 hours interval up to 72 hours after exposure to different test concentrations (fipronil 5 SC, buprofezin 25 SC, diafenthiuron 50 WP, profenophos 50 EC and imidacloprid 17.8 SL) under laboratory. At every 24-hour, numbers of dead thrips at the bottom of the petri dish were counted. The thrips which were not unable to right themselves within ten seconds once turned on their back were considered dead. In the event of doubt, the suspected individuals were gently touched using fine camel hair brush and mortality was recorded. After 72 hours, number of live and dead thrips were counted and the data so obtained for each concentration including control were subjected to LDP analysis through Polo Leora software. The mortality data of each treatment were corrected with respect to control mortality as per Abbott's formula (1925) for thrips bioassay.

Corrected mortality (%)=(X – Y)\(100 – Y)×100

Where, X= % mortality in the treated sample

Y= % mortality in the control

3. Results and Discussion

The data presented in Table 2 revealed that there was significant difference in mortality of thrips at different concentrations of different insecticides. The lowest to highest (0.001875 to 0.12%) concentration of fipronil 5 SC recorded 15.05 to 90.79% cumulative mortality of thrips at 72 hours after exposure. The cumulative mortality of thrips for fipronil 5 SC recorded at 72 hours after exposure was found highest (90.79%) in the highest concentration (0.12%) followed by next higher concentrations. At recommended concentration, thrips population was most susceptible to fipronil with 57.06% mortality. The lowest mortality (15.05%) of thrips was found at lowest concentration (0.001875%) of fipronil 5 SC. There was significant difference in mortality of thrips in

Table 2: Susceptibility of cotton thrips to insecticides

Sl. No.	Corrected cumulative mortality of thrips after treatments (%)									
	Fipronil 5 SC		Buprofezin 25 SC		Diafenthiuron 50 WP		Profenophos 50 EC		Imidacloprid 17.8 SL	
	Conc. (%)	72 HAT	Conc. (%)	72 HAT	Conc. (%)	72 HAT	Conc. (%)	72 HAT	Conc. (%)	72 HAT
1.	0.120000	72.31 (90.79)	0.400000	83.71 (98.79)	0.480000	89.96 (100.00)	0.8000	89.96 (100.00)	0.03560000	74.03 (92.44)
2.	0.060000	64.06 (80.90)	0.200000	76.91 (94.89)	0.240000	80.56 (97.32)	0.4000	78.38 (95.96)	0.01780000	66.76 (84.46)
3.	0.030000	56.22 (69.12)	0.100000	70.83 (89.25)	0.120000	75.61 (93.84)	0.2000	72.51 (90.98)	0.00890000	62.96 (79.35)
4.	0.015000	49.04 (57.06)	0.050000	63.28 (79.81)	0.060000	71.89 (90.36)	0.1000	65.84 (83.29)	0.00445000	52.84 (63.54)
5.	0.007500	37.46 (37.01)	0.025000	47.57 (54.52)	0.030000	56.42 (69.44)	0.0500	50.52 (59.60)	0.00222500	42.31 (45.33)
6.	0.003750	28.40 (22.64)	0.012500	35.43 (33.64)	0.015000	41.05 (43.17)	0.0250	37.56 (37.20)	0.00111250	31.29 (26.99)
7.	0.001875	22.82 (15.05)	0.006250	26.36 (19.77)	0.007500	29.59 (24.41)	0.0125	26.21 (19.53)	0.00055625	22.51 (14.69)
Mean		47.19 (53.23)	-	57.73 (67.24)	-	63.58 (74.08)	-	60.14 (69.51)	-	50.39 (58.12)
SEm±		0.25	-	0.55	-	0.56	-	0.37	-	0.52
CD (*p*=0.05)		0.77	-	1.68	-	1.72	-	1.14	-	1.61
CV %		0.92	-	1.64	-	1.52	-	1.06	-	1.80

Note: Figures in parentheses are original values, those outside are arc sine transformed values; HAT= Hours After Treatment buprofezin 25 SC at 72 hours after exposure. The lowest to highest (0.00625 to 0.40%) concentration of buprofezin 25 SC recorded 19.77 to 98.79% mortality of thrips at 72 hours after exposure. At recommended concentration of buprofezin 25 SC, the mortality of thrips was recorded 79.81% at 72 hours after exposure. The higher mortality of thrips population (98.79%) was recorded at highest concentration (0.40%) of buprofezin 25 SC and the lowest mortality (19.77%) at lowest concentration (0.00625%). The mortality of thrips in diafenthiuron 50 WP varied from 24.41 to 100.00% from lowest to highest (0.0075 to 0.48%) concentrations at 72 hours after exposure. At recommended concentration of diafenthiuron 50 WP (0.06%), the mortality of thrips was recorded 90.36% at 72 hours after exposure. The diafenthiuron 50 WP was found susceptible at recommended concentration. The absolute 100% mortality of thrips population was recorded at highest concentration (0.48%) of diafenthiuron 50 WP and the lowest mortality (24.41%) at lowest concentration (0.0075%).

There was significant difference in mortality of thrips at 72 hours after exposure. The mortality of thrips varied from 19.53 to 100.00% from lower to higher concentrations at 72 hours after exposure to profenophos 50 EC. The cumulative mortality of thrips recorded at 72 hours after exposure to profenophos 50 EC was found highest (100%) at highest concentration (0.80%) followed by next higher concentrations. At recommended concentration of profenophos 50 EC, the mortality of thrips population was recorded 83.29% at 72 hours after exposure. The thrips population was found susceptible against profenophos 50 EC at recommended concentration. The absolute 100% mortality of thrips was recorded at highest concentration (0.80%) of profenophos 50 EC and the lowest mortality (19.53%) at lowest concentration (0.0125%). The lowest to highest concentration of imidacloprid 17.8 SL recorded 14.69 to 92.44% mortality at 72 hours after exposure. The mortality of thrips was found highest (92.44%) at highest concentration (0.0356%) followed by next higher concentrations. At recommended concentration of imidacloprid 17.8 SL being recorded as 63.54% at 72 hours exposure. The highest mortality of thrips (92.44 %) was recorded at highest concentration (0.0356%) of imidacloprid 17.8 SL and the lowest mortality (14.69%) at lowest concentration (0.00055%).

The results on the susceptibility of cotton thrips, *T. tabaci* to various insecticides in the present investigation is in accordance with Bajya et al. (2016) who harmonized with the results of present investigation. They found that diafenthiuron 47.8 SC at 286.8 g a.i. ha^{-1} was highly effective in suppressing the cotton thrips population (88.30 and 87.97% reduction). Similar results were also recorded by Bhanderi et al. (2017). They showed that diafenthiuron 50 WP at 300 g a.i. ha^{-1} was most effective and recording lowest population of thrips followed by buprofezin 25 SC at 250 g a.i. ha^{-1}. The results are in tune with Kalola et al. (2017) who found that profenophos 50 EC at 0.05% was most effective against thrips and recorded maximum bulb yield of garlic (4016 kg ha^{-1}). Similar results have also been reported by Matharu and Tanwar (2020). They showed that, spinetoram 11.7 SC and diafenthiuron 50 WP were highly effective in reducing thrips population as 3.03 and 8.70 thrips per leaf, respectively.

4. Conclusion

From the results of present investigation, it was concluded that diafenthiuron was highly effective in reducing thrips population followed by profenophos and buprofezin whereas, thrips population was less susceptible to fipronil and imidacloprid and develop resistance against these insecticides.

5. References

Abbott, W.S., 1925. A method of computing the effectiveness of an insecticide. Journal of Economic Entomology 18, 265–267.

Anonymous, 2018. ICAR-AICRP (Cotton) Annual Report (2017-18). ICAR - All India Coordinated Research Project on Cotton, Coimbatore, Tamil Nadu. p. E-9.

Anonymous, 2021. ICAR-AICRP (Cotton) Annual Report (2020-21). ICAR - All India Coordinated Research Project on Cotton, Coimbatore, Tamil Nadu. pp. A1–A4.

Bajya, D.R., Ranjith, M., Lakharan, M.C., Raza, S.K., 2016. Efficacy of diafenthiuron 47.8 SC against sucking pests of cotton and its safety to natural enemies. Indian Journal of Entomology 78(1), 15–23.

Barik, A., 2010. Indian Cotton and quantitative analysis of cotton development under MM II of TMC. In: National Conference on Paradigm shift in cotton research and cultivation, October, 19–21, Main Cotton Research Station, Surat, Gujarat, p. 3

Bhanderi, G.R., Patel, R.D., Desai, H.R., Patel, R.K., 2020. Assessment of yield losses due to mealybug (*Phenacoccus solenopsis* Tinsley) infestation in the cotton farmers' field of south Gujarat. Journal of Entomology and Zoology Studies 8(2), 73–79.

Bhanderi, G.R., Patel, R. D., Desai, H.R., Solanki, B.G., 2017. Evaluation of different chemicals, botanicals and microbial pesticides against sucking pest complex and its natural enemies in *Bt* cotton under south Gujarat condition. Pestology 41(4), 37–42.

Kalola, N.A., Patel, V.N., Bhadani, D.J., 2017. Efficacy of different insecticides on garlic thrips. Journal of Entomology and Zoology Studies 5(6), 1505–1509.

Matharu, K.S., Tanwar, P.S., 2020. Bioefficacy of novel insecticides against cotton thrips, *Thrips tabaci* (Thysanoptera: Thripidae). International Journal of Chemical Studies 8(3), 1167–1170.

Rakesh, R.C., Kathane, T.V., 1989. Cotton marketing federation and export of cotton in India (1980-81 to 1987-88). Cott. Dev., 18(3-4), 1-18.