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Comparative efficacy of different insecticides against cotton thrips *Thrips tabaci* (Thysanoptera: Thripidae) under field conditions

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Abstract

Three types of containers and four storage periods were used as experimental treatments. The experiment was laid out by Completely Randomized Design (CRD) with four replications. Seed quality factors *viz.*, moisture content, germination percentage, vigor index, percentage of abnormal seedling, normal seedlings and dead seed were recorded every 15 days interval. The initial moisture content of seed in plastic container, poly bag, and gunny bag were 9.25%, 9.22% and 10.33%, respectively, but it was increased with increasing storage time after 60 days (10.00%, 10.6% and 14.00%). The germination percentage was higher at 15 days after storage (DAS) for different containers like plastic containers (85%), poly bag (79%) and gunny bag (78%) than after 60 DAS (69%, 61% and 56%), respectively. The percentage of abnormal seedling was increased from 10 to 24%, 14 to 31%, and 15 to 33% in plastic container, poly bag, and gunny bag, respectively, from 15 DAS to 60 DAS. The percentage of dead seed was increased from 4 to 6%, 7 to 8% and 8 to 12% in plastic container, poly bag and gunny bag respectively, from 15 DAS to 60 DAS. The vigor indexes of seedling were 14.58, 12.85 and 10.92 at 15 DAS in plastic container, poly bag and gunny bag, respectively, which attained at 10.39, 10.26 and 10.08 at 60 DAS, respectively. Several fungal infection and lesion was found during seed health tests.

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Introduction

Cotton, *Gossypium hirsutum* L., is an important fibrous crop of Pakistan which plays a major role in earning foreign exchange and serves as back bone of country's economy. The crop production accounts for 1% in GDP and 5.2% in agriculture value addition (Anonymous, 2017). It comprises 69.5% share in national oil production and acts as a cash crop that provides livelihood to millions of people (Awan, 1994). During 2016-17, the crop was grown over an area of 2489 thousand hectares with production of 10671 million bales (Anonymous, 2017).

Cotton crop is infested by a wide range of insect pests at various growth stages (Uthamasamy, 1994). Among these, Jassid (*Amrasca devastans)*, thrips (*Thrips tabaci*) and whitefly (*Bemisia tabaci*) are very serious (Ali, 1992).Due to significant change in cropping scheme with the introduction of Bt varieties of cotton (Ahsan and Altaf, 2009; Abdullah, 2010) resulted in the increased attack of sucking pests. Thrips are minute plant feeding insects belong to the family Thripidae of order Thysanoptera that produce scars on leaves, flowers and fruit surface (Mahesh *et al*., 2010). Due to its attack on cotton, silvery marks appear first on cotyledonous leaves and later on lower side of true leaves which become ragged and crinkled, and its attack increases in dry weather. According to a study in Pakistan, its attack (14.6 leaf^{-1}) combined with Jassid (4.6 leaf^{-1}) causes 37.6% yield loss of seed cotton (Attique and Ahmad, 1990).

Transgenic Bt cotton is almost resistant to specific lepidopteron pests attack (Arshad *et al*., 2009) but lack resistance against sucking pests (Sharma & Pampapathy, 2006). The crop is threatened due to these pests at early stage, and need to be controlled from beginning of the crop (Kilpatrick *et al*., 2005). The use of growth regulators and neonictiniods replaced the insecticides previously used that proved ineffective (Aheer *et al*., 2000; Aslam *et al*., 2004; Solangi and Lohar 2007; Asi *et al*., 2008; Frank 2012) due to resistance. Neonictiniods are considered less toxic to the predators and non-target insects than conventional insecticides as demonstrated in laboratory tests (Michaud and Grant 2003; Balakrishnan *et al*., 2009; Sahito *et al*., 2011; Sabry and El-Sayed, 2011).

Chemical control for crop protection is necessary and unavoidable part of IPM (Mohyuddin *et al*., 1997) but it should only be used as last resort (Korejo *et al*., 2000). Agrochemicals alone, contribute about 50% of the present cotton yields in world (ICAC, 1998). Keeping in view the importance of insecticides in cotton production, the present studies were conducted with the objective to compare the efficacy of various insecticides including neonictiniods and conventional insecticides available in market in order to control thrips population.

Materials and methods

Study Area

A field experiment was conducted in District Muzaffar Garh, Punjab, Pakistan at a farmer's field in chak (village) No. 598TDA during 2014 & 2015 to evaluate the effectiveness of five insecticides namely, spinosad (Spindor 480Sc), chlorfenpyr (Nathan 36%Sc), dimethoate (Dinadim 40%Ec), acephate (Astene 75%Sp), imidacloprid (Confidor 200SL) against cotton thrips.

Experimental Design and Sowing

Cotton variety selected was MNH-886, sown in April 2014 & 2015 and experiment was laid out in Randomized Complete Block Design (RCBD) with six treatments including control. Each treatment was replicated thrice. There were total 18 plots with 12.5 x198 ft. size of each. Row to row distance was 2.5 feet and plant to plant distance was 0.295 feet. All agronomic practices as recommended for cotton crop in Pakistan were employed.

Data Collection

Insecticides were sprayed when the population of thrips reached the ETL (Economic threshold level) with a hand operated knapsack sprayer by using a pressure of 3 bars through a hollow cone nozzle. Before and after each insecticide spray, population of thrips were counted from upper, middle and lower leaves of seven plants, selected randomly from each plot a day before spray and one, two, three and seven days after spray. The population data was transformed into percentage reduction population by using Abbot's formula. Percentage population reduction = A-B/Ax100. Where Pretreatment population is denoted by A, while Post treatment population is denoted by B.

Data Analysis

Data was analyzed for Analysis of Variance (ANOVA) and means were separated by applying LSD test at 5% level of significance, by using STATISTIX.

Results and discussion

Mean thrips population before and after 1, 2, 3 and 7 days of spray are represented in table 1 for the year 2014 and 2015. Similarly thrips population reduction percentage after 1, 2, 3 and 7 days of spray are represented in table 2.Maximum decrease in thrips population per leaf recorded after 1 day of spray was 4.58 (59.82%) & 4.90 (51%) in 2014 and 3.53 (55.87%) & 4.1(51.19%) in 2015, in plots treated with spinosad and acephate, respectively. These results are different significantly from each other in 2014 and non-significant in 2015. Chlorfenpyr and dimethoate showed less decrease in pest population, as compared to those mentioned above but higher decrease than that for Imidacloprid which remained least effective, resulting in minimum decrease in population per leaf *viz.* 7.91 (15.85%) & 7.1 (18.67%) in 2014 and 2015, respectively.

In 2014, after 2 days of spray, thrips population per leaf in spinosad, chlorfenpyr and acephate treated plots were 4 (64.51%), 4.2 (60%) & 3.7 (63%) respectively and statistically non-significant different from each other. Dimethoate also decreased thrips population but less than spinosad, chlorfenpyr and acephate but more than imidacloprid, which remained least effective after 2 days of spray, resulting in thrips population per leaf 6.1 (35.10%), but imidacloprid reduced thrips population as compared to control where thrips population was counted 11.7/ leaf. In 2015 thrips population per leaf in spinosad, chlorfenpyr, dimethoate, acephate, treated plots were counted after 2 days of spray 2.96 (63%), 4.16 (57.97%), 3.76 (54.86%) and 3.26 (61.19%) respectively, and these were non-significantly different from each other, while imidachloprid remained least effective in controlling thrips population.

After 3 days of spray thrips population per leaf in spinosad and acephate treated plots in 2014 were 0.9 (92.10%) and 1.1(89%) & 0.93 (88.37%) & 1.13 (86.54%) in 2015, and were non-significantly different from each other. Chlorfenpyr also resulted in pest population reduction but it was less than spinosad and acephate, and more than imidacloprid and dimethoate in 2014 and it was non significantly different to dimethoate in 2015. After 3 days of spray, imidacloprid showed more decrease in the pest population (47.87%) in 2014 and (43.52%) in 2015 as compared to 1 & 2 days after spray.

The reason is that imidacloprid is a new chemistry insecticide which causes maximum mortality after 2 days although feeding and movement is prohibited after application Nyman *et al.*, 2013. The results obtained from present study are in conformity with those presented by Asi *et al.*, 2008 who reported that imidacloprid (Confidor) showed 87% and 96.12% mortality after 1 and 3 days of spray, respectively. After 7 days of spray thrips population per leaf in spinosad, chlorfenpyr, dimethoate and acephate treated plots were non-significantly different from each other in the year 2014 and significantly different in 2015. Imidacloprid results in population decrease (4.8/ leaf) with mortality percentage (48.93%) as compared to population level (9.4/leaf) before spray but this decrease in population is less than all other insecticides treated in 2014.

Among all the insecticide used for thrips control, Spinosad was found the most effective and Imidachloprid as the least. Our results are in conformity with Lopez *et al.*, 2008 who reported the Spinosad and Imidachloprid as most and least toxic to thrips, respectively. However, our results are in contrast to Wahla et.al. 1997, Asi *et al.*, 2008, Asif *et al.*, 2016 who stated that imidacloprid (Confidor) controlled cotton thrips, effectively.

Table 1. Mean thrips population per leaf one day before and 1, 2, 3 and 7 days after spray at Muzaffar Garh in 2014 and 2015.

Treatments Common Names	Thrips Population / Leaf									
	1 DBS		1 DAS		2 DAS		3 DAS		7 DAS	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Spinosad	11.4	8	4.58 d	3.53 c	4 c	2.96 c	0.9 e	0.93 d	0.8 c	0.63 e
Chlorfenpyr	10.5	9.9	5.9 c	5.2 c	4.2 c	4.16 c	2.8 d	3.1 c	2.4 c	2.43 c
Dimethoate	10.4	8.33	7.31 b	5.03 c	4.5 bc	3.76 c	3.5 c	3.03 c	2.4 c	1.9 cd
Acephate	10.00	8.40	4.9 cd	4.1 c	3.7 c	3.26 c	1.1 e	1.13 d	1 c	0.73 de
Imidacloprid	9.4	8.73	7.91 b	7.1 b	6.1 b	6.43 b	4.9 b	4.93 b	4.8 b	4.5 b
Control	9.08	8.53	10.51 a	9.03 a	11.7a	12.1 a	14.61 a	11.73 a	16.4 a	14.26 a
F (df=2,5)	0.41ns	0.41ns	28.6*	11.57*	27.04*	61.09*	5.26*	122.88*	75.48*	170.76*
P Value	0.83	0.83	0	0.0007	0	0	0.0475	0.0475	0	0
LSD	4.03ns	4.03ns	1.2*	1.89*	1.85*	1.42*	1.9*	1.14*	2.15*	1.25*

Abbreviations used in Table: DBS = Days before Spray; DAS = Days after Spray.

Means followed by the same letters within a column are not statistically different at 5% level of significance,* indicates significant and ns indicates non-significant at 5% level of significance.

Table 2. Percentage thrips population reduction 1, 2, 3 and 7 days after spray at Muzaffar Garh in 2014 and 2015.

Treatments Common Names	Thrips Population Reduction %age								
	Dose/Acre	1 DAS		2 DAS		3 DAS		7 DAS	
		2014	2015	2014	2015	2014	2015	2014	2015
Spinosad	60Ml	59.82	55.87	64.91	63	92.10	88.37	92.98	92.12
Chlorfenpyr	200Ml	43.80	47.47	60	57.97	73.33	68.68	77.14	75.45
Dimethoate	400Ml	29.71	39.61	56.73	54.86	66.34	63.62	76.92	77.19
Acephate	250g	51	51.19	63	61.19	89	86.54	90	91.30
Imidacloprid	250Ml	15.85	18.67	35.10	26.34	47.87	43.52	48.93	48.45

Conclusion

From the findings of present studies it is concluded that Spinosad and Acephate insecticides are highly effective against cotton thrips as compared to other insecticides. These insecticides can be recommended to the growers to manage the cotton thrips population below economic threshold level.

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