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EVALUATION OF NEW INSECTICIDES AGAINST SUCKING PESTS OF *Bt* COTTON

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ABSTRACT: The efficacies of new insecticides against sucking insect pest viz., aphid, jassid, thrips, whitefly and mealy bugs in cotton were determined. Nine insecticides *viz*., Spiromesifen 240 SC, Acetamiprid 20% SC, Trizophos 40% SP, Fipronil 45% SC, Spinosad 45% SC, Thiamethoxam 25% WG, Clothianidin 50% WDG, Fenpropathrin 30% EC and NSKE 5% were sprayed at an interval of 20 days to ascertain the number of pests of Bt cotton sown at Department of Agricultural Entomology, College of Agriculture, VNMKV, Parbhani during 2013. All the treatments are superior to untreated check. Among the treatments clothianidin 50% WDG was found most superior in reducing aphids, jassids and mealy bug population on 3rd, 7th and 14th days after 1st and 2nd spray. However the next best treatments were acetamiprid 20% SP and thiamethoxam 25% WG. Whereas, the treatment fipronil 5 % SC was found most superior in reducing thrips population on 3rd, 7th and 14th days after 1st and 2nd spray. The treatment Spiromesifen 240 SC was found more superior in reducing whiteflies population on 3rd, 7th and 14th days after 1st and 2nd spray.
Key words: insecticides, *Bt* cotton, efficacy, sucking pests.

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INTRODUCTION

Cotton popularly known as one of the most important commercial cash and fiber crop of global significance cultivated in more than seventy countries with an enormous potential of employment generation both in rural and urban sectors. Cotton belong to the family 'Malvaceae' and genus '*Gossypium*' cotton crop as commercial commodity plays an important role in industrial electivity of nation and has a unique place in Indian economy and social affairs. In terms of both employment generation and foreign exchange and hence it's popularly known as 'White Gold' and 'Friendly Fiber'. Main losses in cotton production are due to its susceptibility to about 162 species of insect pests and a number of diseases (Dhaliwal and Arora, 1998) [1]. The losses in cotton due to sucking pets, bollworms and both together have been reported as 11.60%, 44.50%, and 52.10 %, respectively (Dhawan and Sindu, 1986) [2]. After introduction of Bollgard technology (Bt) in 2002, the productivity of cotton is increased, losses due to insect pests are decreased and the insecticide use is also reduced. Transgenic *Bt* cotton can effectively control specific lepidopetrous species, but there is lack of resistance against sucking insect pest (Hofs *et al*., 2004 [3]; Sharma and Pampathy, 2006 [4]).

The sucking pests of major significance are aphids (*Aphis gossypii* Glover), Jassids (*Amrasca bigattula* Ishida), whiteflies (*Bemesia tabaci* Gennadius), thrips (*Scirtothrips dorsolis* Hood) and mealy bugs (*phenococcus spp*) cause severe damage and serious threat to the crop at early stage of the crop growth and can also affect the crop stand and yield of cotton. Heavy infestation at times reduces the crop yield to the extent of 21.2 per cent (Patil, 1998 [5] and Dhawan and Sidhu, 1986) [6]. Therefore chemical control is necessary to keep the population of sucking pests below ETL. In the present study some new insecticides have been used to test their efficacy against the sucking pests.

MATERIALS AND METHODS

The experiment was conducted at Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS) during *kharif* season 2013. The experiment was laid out in a randomized block design (RBD) with ten treatments each replicated for three times. All together there were 30 plots with plot size of 5.50 x 4.70 m^2 each. Row to row and plant to plant distance was maintained at 90 and 60 cm respectively. All agronomic practices were followed as per the package of practices recommended by the Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS).

The treatments comprised of Spiromesifen 240 SC, Acetamiprid 20% SP, Triazophos 40% EC, Fipronil 5% SC, Spinosad 45% SC, Thiamethoxam 25% WG, Clothianidin 50% WDG, Fenpropathrin 30% EC, NSKE 5% and untreated control. All insecticides were evaluated against sucking insect pests *viz*., aphids (*Aphis gossypii* Glover), Jassids (*Amrasca bigattula* Ishida), whiteflies (*Bemesia tabaci* Gennadius), thrips (*Scirtothrips dorsolis* Hood) and mealy bugs (*phenococcus spp*) on Bt cotton variety Bunny Bt (BG-II). The insecticides used in the experiment were obtained from the local market. Two sprays were carried out. The insecticides were sprayed whenever the population of pest reached the economic threshold level. The ETL for sucking insect pests were considered as 10 aphids per leaf, 2 to 5 leafhoppers per leaf, 8 to10 thrips per leaf and 8-10 whiteflies per leaf. Spray applications were made with hand operated knapsack sprayer. Observations were made on top, middle and bottom leaves of 5 randomly selected plants from each plot. Population of insect pests was recorded at three, seven and fourteen days after the treatment. The mean population of sucking insect pests was worked and the data were arc sine transformed and subjected to Anova to determine treatment effects.

RESULTS AND DISCUSSION

Efficacy of insecticides against aphid (*Aphis gosssypii* Glover)

The data on aphid population on first and second spray was presented in Table 1. Three days after first spray Clothianidin 50% WDG recorded lowest population (1.90 aphid/3 leaves), which was significantly superior over rest of the treatments. Acetamiprid 20% SP (3.70 aphid/3 leaves), Thiamethoxam 25% WG (4.23 aphid/3 leaves) and Spiromesifen 240 SC (5.63 aphid/3 leaves) are the next best insecticides. Seven days after first spray the treatment of clothianidin 50% WDG was recorded lower incidence of aphids (9.43 aphid/3 leaves), which was significantly superior over rest of the treatments. Acetamiprid 20% SP (13.67 aphid/3 leaves), Fenpropathrin 30% EC (15.07 aphid/3 leaves) are the next best insecticides. Fourteen days after first spray 20.70 aphids/3 leaves population with clothianidin 50% WDG was significantly superior than 26.13 aphids/3 leaves population with Acetamiprid 20% SP, 28.50 aphids/3 leaves population with Thiamethoxam 25% WG, 31.50 aphids/3 leaves population with Spiromesifen 240 SC, 32.03 aphids/3 leaves population with Fenpropathrin 30% EC, 40.20 aphids/3 leaves population with Fipronil 5% SC, 43.60 aphids/3 leaves population with Triazophos 40% EC and 52.23 aphids/3 leaves population with NSKE 5% (Table 1). Three days after second spray Clothianidin 50% WDG recorded lowest population (1.67 aphids/3 leaves), which was significantly superior over rest of treatments. The next best treatments were in ascending order of aphid population as following ways, Acetamiprid 20% SP (3.63 aphid/3 leaves), Spinosad 45% SC (3.77 aphid/3 leaves), Spiromesifen 240 SC (3.80 aphid/3 leaves), Thiamethoxam 25% WG (4.17 aphid/3 leaves). Seven days after second spray Clothianidin 50% WDG recorded lowest population (5.87 aphids/3 leaves), which was significantly superior over rest of insecticide treatments. Acetamiprid 20% SP (6.67 aphid/3 leaves), Thiamethoxam 25% WG (6.87 aphid/3 leaves), Fenpropathrin 30% EC (8.53 aphid/3 leaves) are the next best treatments. Clothianidin 50% WDG recorded aphid population (1.23 aphids/3 leaves), which was significantly superior over rest of insecticide treatments. The next best treatments were in ascending order of aphid population as following ways, Thiamethoxam 25% WG (1.73 aphids/3 leaves), Acetamiprid 20% SP (2.30 aphids/3 leaves), Spiromesifen 240 SC (3.37 aphids/3 leaves). The present findings are in agreement with the reports of Monika and Adarsh (2007) on Imidacloprid (45 g a. i. /ha) and Acetamiprid (50 g a. i. /ha) indicates their effectiveness in controlling aphid population. The reports of Vadodaria *et al.* (2004) who reported Fenpropathrin (500 ml/ha) was found to be effective in reducing the aphids and are in support with the present findings.

Table 1: Efficacy of insecticidal treatments against cotton aphid

Sl. No.	Treatments	1 DBS	Number of aphids/3 leaves after first spray			Number of aphids/3 leaves after second spray		
			3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Spiromesifen 240 SC 500 ml/ha	75.67 (8.72)	5.63 (2.47)	16.53 (4.12)	31.50 (5.65)	3.80 (2.07)	8.67 (3.02)	3.37 (1.96)
T_2	Acetamiprid 20% SP 100 g/ha	77.53 (8.83)	3.70 (2.04)	13.67 (3.76)	26.13 (5.16)	3.63 (2.03)	6.67 (2.67)	2.30 (1.67)
T_3	Triazophos 40% EC 500 ml/ha	74.13 (8.63)	6.40 (2.62)	21.50 (4.69)	43.60 (6.64)	7.43 (2.81)	9.57 (3.17)	4.30 (2.19)
T_4	Fipronil 5% SC 1000 ml/ha	75.67 (8.72)	5.90 (2.52)	19.60 (4.48)	40.20 (6.37)	5.73 (2.49)	8.80 (3.04)	3.37 (1.96)
T_5	Spinosad 45% SC 45 ml/ha	75.20 (8.70)	7.30 (2.79)	18.43 (4.35)	38.20 (6.22)	3.77 (2.06)	8.77 (3.04)	4.07 (2.13)
T_6	Thiamethoxam 25% WG 250 g/ha	78.20 (8.87)	4.23 (2.17)	15.30 (3.97)	28.50 (5.38)	4.17 (2.15)	6.87 (2.71)	1.73 (1.49)
T_7	Clothianidin 50% WDG 250 g/ha	75.67 (8.72)	1.90 (1.54)	9.43 (3.15)	20.70 (4.60)	1.67 (1.47)	5.87 (2.52)	1.23 (1.31)
T_8	Fenpropathrin 30% EC 120 ml/ha	74.80 (8.67)	6.17 (2.58)	15.07 (3.94)	32.03 (5.70)	4.17 (2.15)	8.53 (3.00)	4.10 (2.14)
T_9	NSKE 5% 2500 ml/ha	74.33 (8.65)	12.07 (3.54)	25.27 (5.07)	52.23 (7.26)	9.63 (3.18)	10.70 (3.34)	5.43 (2.43)
T_{10}	Untreated control	77.60 (8.83)	82.93 (9.13)	87.87 (9.40)	92.93 (9.66)	64.43 (8.05)	67.47 (8.24)	25.57 (5.10)
SE +		0.057	0.027	0.020	0.021	0.039	0.044	0.030
CD at 5%		NS	0.082	0.059	0.063	0.115	0.131	0.091

DBS- Day before spray, DAS- Days after spray, Figures in the parenthesis are square root transformed values

Table 2: Efficacy of insecticidal treatments against cotton jassids

Sl. No.	Treatments	1 DBS	Number of jassids/3 leaves after first spray			Number of jassids/3 leaves after second spray		
			3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Spiromesifen 240 SC 500 ml/ha	25.00 (5.04)	3.30 (1.94)	8.47 (2.99)	13.33 (3.71)	3.67 (2.03)	7.37 (2.80)	6.50 (2.64)
T_2	Acetamiprid 20% SP 100 g/ha	25.20 (5.06)	2.93 (1.85)	7.17 (2.76)	9.33 (3.13)	1.87 (1.53)	3.77 (2.06)	6.53 (2.65)
T_3	Triazophos 40% EC 500 ml/ha	26.60 (5.20)	5.37 (2.42)	9.43 (3.15)	10.77 (3.35)	4.10 (2.14)	7.67 (2.85)	10.67 (3.34)
T_4	Fipronil 5% SC 1000 ml/ha	24.47 (4.99)	4.10 (2.14)	9.27 (3.12)	10.97 (3.38)	3.07 (1.88)	6.70 (2.68)	9.60 (3.17)
T_5	Spinosad 45% SC 45 ml/ha	24.67 (5.01)	4.37 (2.20)	6.57 (2.64)	9.23 (3.11)	2.90 (1.84)	6.17 (2.58)	9.10 (3.09)
T_6	Thiamethoxam 25% WG 250 g/ha	26.00 (5.14)	3.07 (1.88)	10.00 (3.24)	12.07 (3.54)	3.60 (2.02)	5.20 (2.38)	8.30 (2.96)
T_7	Clothianidin 50% WDG 250 g/ha	23.93 (4.94)	0.50 (0.99)	4.93 (2.33)	6.83 (2.70)	1.03 (1.23)	2.57 (1.75)	5.50 (2.44)
T_8	Fenpropathrin 30% EC 120 ml/ha	23.27 (4.87)	3.57 (2.01)	9.20 (3.11)	12.07 (3.54)	2.90 (1.84)	3.63 (2.03)	8.63 (3.02)
T_9	NSKE 5% 2500 ml/ha	26.47 (5.19)	7.40 (2.81)	11.23 (3.42)	14.63 (3.89)	4.87 (2.31)	8.60 (3.01)	11.80 (3.50)
T_{10}	Untreated control	25.40 (5.08)	32.67 (5.75)	37.40 (6.15)	39.60 (6.33)	22.30 (4.77)	23.93 (4.94)	21.70 (4.71)
SE ±		0.077	0.050	0.067	0.023	0.035	0.018	0.021
CD at 5%		NS	0.150	0.198	0.071	0.106	0.053	0.062

DBS- Day before spray, DAS- Days after spray, Figures in the parenthesis are square root transformed values

Table 3: Efficacy of insecticidal treatments against cotton thrips

Sl. No.	Treatments	1 DBS	Number of thrips/3 leaves after first spray			Number of thrips/3 leaves after second spray		
			3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Spiromesifen 240 SC 500 ml/ha	28.67 (5.40)	3.30 (1.94)	7.30 (2.79)	8.57 (3.01)	3.77 (2.06)	8.63 (3.02)	5.40 (2.42)
T_2	Acetamiprid 20% SP 100 g/ha	30.13 (5.53)	1.97 (1.56)	3.33 (1.95)	5.93 (2.53)	3.90 (2.09)	5.77 (2.50)	3.30 (1.94)
T_3	Triazophos 40% EC 500 ml/ha	30.80 (5.59)	4.60 (2.25)	5.50 (2.44)	6.90 (2.71)	3.83 (2.08)	8.07 (2.92)	6.13 (2.57)
T_4	Fipronil 5% SC 1000 ml/ha	30.20 (5.53)	0.73 (1.10)	2.50 (1.73)	4.83 (2.30)	0.97 (1.20)	2.80 (1.81)	1.27 (1.33)
T_5	Spinosad 45% SC 45 ml/ha	27.67 (5.30)	2.87 (1.83)	6.87 (2.71)	6.87 (2.71)	5.47 (2.44)	7.53 (2.83)	5.27 (2.40)
T_6	Thiamethoxam 25% WG 250 g/ha	29.87 (5.51)	2.30 (1.67)	6.30 (2.60)	8.07 (2.92)	4.93 (2.33)	6.57 (2.65)	4.07 (2.13)
T_7	Clothianidin 50% WDG 250 g/ha	27.67 (5.30)	1.40 (1.37)	2.87 (1.83)	6.03 (2.55)	3.20 (1.92)	4.27 (2.18)	3.30 (1.94)
T_8	Fenpropathrin 30% EC 120 ml/ha	31.27 (5.63)	2.17 (1.63)	3.93 (2.10)	7.90 (2.89)	4.47 (2.22)	6.60 (2.66)	4.57 (2.25)
T_9	NSKE 5% 2500 ml/ha	30.40 (5.55)	6.63 (2.67)	7.57 (2.80)	9.17 (3.10)	6.37 (2.61)	9.30 (3.13)	7.77 (2.87)
T_{10}	Untreated control	28.40 (5.37)	36.13 (6.05)	46.20 (6.83)	39.27 (6.30)	21.80 (4.72)	24.50 (5.00)	21.20 (4.65)
SE ±		0.084	0.040	0.106	0.036	0.039	0.017	0.212
CD at 5%		NS	0.121	0.314	0.109	0.117	0.051	0.630

DBS- Day before spray, DAS- Days after spray, Figures in the parenthesis are square root transformed values

Table 4: Efficacy of insecticidal treatments against cotton whiteflies

Sl. No.	Treatments	1 DBS	Number of whitefly/3 leaves after first spray			Number of whitefly/3 leaves after second spray		
			3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Spiromesifen 240 SC 500 ml/ha	5.33 (2.41)	0.97 (1.20)	1.93 (1.55)	4.13 (2.15)	5.30 (2.40)	7.60 (2.84)	8.37 (2.97)
T_2	Acetamiprid 20% SP 100 g/ha	4.93 (2.32)	2.63 (1.76)	4.97 (2.33)	5.03 (2.35)	7.03 (2.74)	8.80 (3.04)	11.37 (3.44)
T_3	Triazophos 40% EC 500 ml/ha	5.27 (2.40)	6.00 (2.54)	6.07 (2.56)	4.80 (2.30)	8.40 (2.98)	11.20 (3.42)	13.43 (3.73)
T_4	Fipronil 5% SC 1000 ml/ha	4.87 (2.31)	5.97 (2.54)	5.83 (2.51)	5.70 (2.48)	7.57 (2.83)	10.60 (3.33)	12.27 (3.57)
T_5	Spinosad 45% SC 45 ml/ha	4.73 (2.27)	1.97 (1.56)	4.47 (2.22)	5.57 (2.46)	7.60 (2.84)	10.57 (3.32)	12.90 (3.66)
T_6	Thiamethoxam 25% WG 250 g/ha	5.60 (2.46)	3.30 (1.94)	4.73 (2.28)	6.27 (2.60)	6.33 (2.61)	9.30 (3.13)	12.43 (3.59)
T_7	Clothianidin 50% WDG 250 g/ha	5.80 (2.50)	1.30 (1.33)	3.63 (2.03)	4.30 (2.19)	5.57 (2.46)	8.33 (2.97)	10.60 (3.33)
T_8	Fenpropathrin 30% EC 120 ml/ha	3.93 (2.08)	2.53 (1.74)	5.07 (2.35)	6.03 (2.55)	8.33 (2.97)	10.17 (3.26)	13.20 (3.70)
T_9	NSKE 5% 2500 ml/ha	5.20 (2.38)	6.03 (2.55)	7.90 (2.89)	9.57 (3.17)	10.53 (3.32)	13.57 (3.75)	15.43 (3.99)
T_{10}	Untreated control	6.27 (2.59)	9.67 (3.18)	11.47 (3.45)	10.20 (3.27)	37.33 (6.15)	40.60 (6.41)	44.27 (6.69)
SE ±		0.094	0.042	0.032	0.032	0.032	0.021	0.015
CD at 5%		NS	0.127	0.095	0.095	0.097	0.064	0.045

DBS- Day before spray, DAS- Days after spray, Figures in the parenthesis are square root transformed values

Table 5: Efficacy of insecticidal treatments against cotton mealy bugs

Sl. No.	Treatments	1 DBS	Number of whitefly/3 leaves after first spray			Number of whitefly/3 leaves after second spray		
			3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Spiromesifen 240 SC 500 ml/ha	1.20 (1.28)	0.07 (0.75)	0.24 (0.85)	0.47 (0.98)	1.40 (1.37)	1.40 (1.37)	3.07 (1.88)
T_2	Acetamiprid 20% SP 100 g/ha	1.53 (1.42)	0.07 (0.75)	0.05 (0.74)	0.13 (0.79)	0.80 (1.13)	2.43 (1.71)	3.83 (2.08)
T_3	Triazophos 40% EC 500 ml/ha	1.77 (1.49)	0.23 (0.85)	0.43 (0.96)	0.30 (0.88)	2.33 (1.71)	3.53 (2.00)	3.40 (1.97)
T_4	Fipronil 5% SC 1000 ml/ha	1.50 (1.41)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	1.97 (1.56)	1.67 (1.47)	3.20 (1.92)
T_5	Spinosad 45% SC 45 ml/ha	1.53 (1.42)	0.07 (0.75)	0.07 (0.75)	0.14 (0.80)	1.87 (1.53)	1.70 (1.48)	2.67 (1.77)
T_6	Thiamethoxam 25% WG 250 g/ha	1.90 (1.54)	0.27 (0.87)	0.14 (0.79)	0.57 (1.03)	1.20 (1.30)	2.83 (1.82)	4.30 (2.19)
T_7	Clothianidin 50% WDG 250 g/ha	1.20 (1.30)	0.00 (0.70)	0.05 (0.73)	0.00 (0.70)	0.50 (0.99)	1.60 (1.44)	2.13 (1.62)
T_8	Fenpropathrin 30% EC 120 ml/ha	1.13 (1.26)	0.10 (0.77)	0.44 (0.70)	0.12 (0.78)	1.57 (1.43)	2.83 (1.82)	4.37 (2.20)
T_9	NSKE 5% 2500 ml/ha	1.03 (1.23)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	2.40 (1.70)	3.57 (1.93)	5.10 (2.36)
T_{10}	Untreated control	1.97 (1.57)	0.47 (0.98)	0.73 (1.10)	0.53 (1.01)	5.57 (2.46)	3.63 (2.03)	5.40 (1.94)
SE ±		0.080	0.025	0.023	0.028	0.028	0.033	0.030
CD at 5%		NS	0.076	0.070	0.085	0.083	0.100	0.091

DBS- Day before spray
DAS- Days after spray
Figures in the parenthesis are square root transformed values

Efficacy of insecticides against jassid (*Amrasca bigttula bigttula* Ishida)

Three days after first spray the minimum population of 0.50 jassids/ 3 leaves was shown in Clothianidin 50% WDG, which was statistically significant from rest of the treatments. The maximum population of 7.40 jassids/ 3 leaves was found in NSKE 5% which was significantly different from standard check (Table 2). Seven days after first spray the treatment Clothianidin 50% WDG was recorded minimum population of 4.93 jassids/ 3 leaves which was significantly superior to the rest of the treatments. Spinosad 45% SC (6.57 jassids/ 3 leaves), Acetamiprid 20% SP (7.17 jassids/ 3 leaves), Spiromesifen 240 SC (8.47 jassids/ 3 leaves) are the next best treatments which were significant over rest of the treatments.

A slight decrease in the efficacy of the tested insecticides was noticed at fourteen days after first spray as compared to seven days after first spray. Fourteen days after first spray the population of 6.83 jassids/3 leaves in the Clothianidin 50% WDG was significantly better than 9.23 jassids/3 leaves with Spinosad 45% SC, 9.33 jassids/3 leaves with Acetamiprid 20% SP, 10.77 jassids/3 leaves with Triazophos 40% EC, 10.97 jassids/3 leaves with Fipronil 5% SC, 12.07 jassids/3 leaves with Thiamethoxam 25% WG. Minimum population of 0.50 jassids/3 leaves recorded in Clothianidin 50% WDG at three DAT was increased to 6.83 jassids/3 leaves population at fourteen days after first spray treatment (Table 2).

The present findings are inline with the findings of Dhawan and Brar (1995) [9] who reported Fenpropathrin (75 g a. i. /ha) was effective in controlling sucking pests. Similarly the reports of Singh and Kumar (2006) [10] supports the present findings who revealed that Imidacloprid 70 WG 40 g a. i. /ha and Acetamiprid 20 SP 50 g a. i. /ha are effective on Amrasca biguttula biguttula in okra. Muhammad Tayyib *et al.* (2005) [11] reported that Confidor 20 SL @ 250 ml/ha was effective in controlling sucking pests was almost in close comparison with the present study.

Eefficacy of insecticides against thrips (*Scirtothrips dorsolis* Hood)

One day before spray the thrips population ranged from 27.67 to 31.27 per three leaves per plant was statistically non significant (Table 3). Three days after first spray the population of thrips in fipronil 5% SC was lowest (0.73 thrips/3 leaves) which was significantly superior over rest of the other treatments and its efficacy gradually decreased at 7 DAS (2.50 thrips/3 leaves) and 14 DAS (4.83 thrips/3 leaves). 7 DAS fipronil 5% SC recorded the lowest population of thrips (2.50 thrips/3 leaves) which was significantly at par with clothianidin 50% WDG (2.87 thrips/3 leaves) and acetamiprid 20% SP (3.33 thrips/3 leaves).

After second spray all treatments recorded significantly lower population of thrips than untreated control. Three days after second spray Fipronil 5% SC recorded lowest number of thrips (0.96 thrips/3 leaves) which was significantly superior over rest of insecticides treatments. 14 days after second spray Fipronil 5% SC recorded lowest (1.27 thrips/3 leaves) population of thrisps over rest of treatments, which was at par with acetamiprid 20% SP (3.30 thrips/3 leaves)and clothianaidin 50% WDG(3.30 thrips/3 leaves).

The present findings are inline with the findings of Patil, S. B., *et al.* (2009) [12] who reported fipronil 5% SC @ 800 g/ ha was found to be effective against thrips population.

Efficacy of insecticides against whitefly (*Bemesia tabaci* Gennadius)

Three days after first spray lower population of whitefly was recorded in treatment of spiromesifen 240 SC (0.97 whiteflies/3leaves) which was significantly superior over other treatments (Table 4). The next best treatments were in order of Clothianidin 50% WDG, spinosad 45% SC, fenpropathrin 30% EC, acetamiprid 20% SP, thiamethoxam 25% WG, fipronil 5% SC triazophos 40% EC and NSKE 5%. Seven days after first spray Spiromesifen 240 SC recorded the lowest population of whitefly (1.93 whiteflies/3 leaves) which was significantly superior over other treatments. Fourteen days after first spray population of whitefly in spiromesifen 240 SC was lowest (4.13 whiteflies/3 leaves) which was at par with clothianidin 50% WDG (4.30 whiteflies/3 leaves).

Three days after second spray treatment spiromesifen 240 SC was recorded lowest Population of whitefly (5.30 whiteflies/3 leaves) which was at par with clothianidin 50% WDG. The next best treatments were in order of thiamethoxam 25% WG, acetamiprid 20% SP, fipronil 5% SC, spinosad 45% SC, fenpropathrin 30% EC, triazophos 40 EC and NSKE 5%. Seven days after second spray significant differences among all the treatments. Population of whitefly in spiromesifen 240 SC was lowest (7.60 whiteflies/3 leaves) which was significantly superior over the other treatments. Fourteen days after second spray spiromesifen 240 SC was recorded lowest population (8.37 whiteflies/3 leaves), which was significantly superior over rest of treatments (Table 4).

Dhawan and Brar (1995) [13] reported that Fenpropathrin 75 g a. i/ha was effective in controlling in sucking pests of cotton. Similar types of results are also given by Anuradha and Arjuna Rao (2005) [14]. Singh and Kumar (2006) [15] who reported Acetamiprid 20 SP 20 g a.i. /ha was effective in controlling insect pests of cotton.

Efficacy of insecticides against mealy bugs (*phenococcus spp*)

The population of mealy bug is lowest during three days after first spray that is zero in fipronil 5% SC, clothianidin 50% WDG and NSKE 5% treatments. The next best insecticides were at par with rest of other treatments except untreated control. Seven days after spray populations of mealy bug zero in fipronil 5% SC and NSKE 5% next best insecticide was fenpropathrin 30% EC which was at par with acetamiprid 20% SP and clothianidin 50% WDG. Fourteen days after first spray Populations of mealy bugs zero in fipronil 5% SC, clothianidin 50% WDG and NSKE 5% next best insecticides were at par with each other.

Three days after second spray treatment clothianidin 50% WDG recorded lowest number of mealy bugs (0.50 mealy bugs/3 shoots) which was significantly superior over rest of treatments. Seven days after second spray lowest number of mealy bugs recorded in spiromesifen 240 SC (1.40 mealy bugs/3 shoots) which was at par with fipronil 5% SC and clothianidin 50 WDG. Fourteen days after second spray clothianidin 50% WDG recorded lowest number of mealy bugs (2.13 mealy bugs/3 shoots) which was superior over other treatments (Table 5).

The present findings are inline with the findings of Sahito, Hakim Ali, *et al*. (2011) [16] clothianidin and dinotefuran were shown to be harmful to the citrus mealybug population.

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