Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(4): 580-584

Received: 10-05-2019
Accepted: 12-06-2019

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Alternation of insecticide sprays for the management of thrips (*Thrips tabaci*) and whitefly (*Bemisia tabaci*) pest of *Bt* cotton and foliage losses caused by sucking pests of *Bt* cotton in Malwa region of Madhya Pradesh

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Abstract
The experiment entitled Alternation of insecticide sprays for the management of thrips (*Thrips tabaci*) and whitefly (*Bemisia tabaci*) and foliage losses caused by sucking pests of *Bt* cotton in malwa region of Madhya Pradesh conducted during *kharif* 2014-2015 in the Department of Entomology, at College of Agriculture, Indore (M.P.) under All India Coordinated Cotton Improvement Project, In randomized block design. The population reduction of thrips was found maximum in T5- Spiromesifen (22.9%SC) @ 144 g*ai*/ha & Deltamethrin (2.8%EC) @ 15 g*ai*/ha (77.78%) and treatment T5- Spiromesifen (22.9%SC) @ 144 g*ai*/ha & Deltamethrin (2.8%EC) @ 15 g*ai*/ha was found effective in reducing the whitefly population (78.00%) received maximum net return (Rs.121313) with maximum cost benefit ratio (1:2:81) at par with T6- Fipronil (5%SC) @ 100 g*ai*/ha & Lambdacyhalothrin (4.9%EC) @ 15 g*ai*/ha. In which (3105kg/ha) yield was recorded and second highest net return (112092) and cost benefit ratio (1:2.60) was noticed.

Keywords: Crop, population, *Bt* cotton, thrips, whitefly, insecticides

1. Introduction
Cotton (*Gossypium* sp.) is an important *Kharif* cash and fibre crop of India. Cotton is known as the "white gold", Belongs to family *Malvaceae*. The new world cotton viz., *G. hirsutum* (L.) Cultivated in about 60 countries in the world. With the production of cotton is 29.59 million bales (Dhawan *et al.* 2011) [9]. In India, cotton is grown in almost all parts of the country but it is produced mostly in the black soil areas and also to a considerable extent in the upper part of the Indo-Gangetic alluvium. In Madhya Pradesh cotton is mainly grown in Nimar and Malwa Plateau, Besides being the main source of raw material for textile industry in the country, it also provides cotton seeds of high industrial value. Important insect pests of cotton crop are bollworm complex and sucking pests. Among the sucking pests, aphid (*Aphis gossypii* Glover), leafhopper (*Amrasca biguttula biguttula* Ishida), thrips (*Scirtothrips dorsalis* Hood) and whitefly (*Bemisia tabaci* Gennedius) attack at the early stage of the crop, while bollworms viz., spotted bollworm (*Earias vittella* Fabricius and *Earias insulana* Boisduval), American bollworm (*Helicoverpa armigera* Hubner) and pink bollworm (*Pectinophora gossypiella* Saunders) are the most serious pests during the fruiting stage of the crop (Sharma *et al* 2008). The continuous cultivation of *Bt* cotton reduces the infestation of boll worms and increases the activities of sucking pests. It is also in tradition that a numbers of sprays of various insecticides are required to control pests. The continuous and repeated application of various insecticides has created many fold resistance against insecticides (Sayyed *et al.* 2011) [4]. To avoid the resistance against pesticides, repeated spray of same insecticide is not recommended and insecticides should always be used alternatively viewing the above facts the present study is planned to use two insecticides alternatively in one treatment (Singh R. and Jaglan, R. S. 2005) [5].

2. Materials and Methods
The experiment was carried out in Randomized Block Design (RBD) with eight treatments and 3 replications, In this experiment seven insecticidal treatments (two insecticides in each

treatment) were evaluated along with one untreated check. Thus eight treatments were evaluated. Each insecticides were used alternatively i.e. the insecticides used in first spray was again applied in third spray repeated in fifth spray. The treatments were T1- Similarly second spray insecticide was repeated in fourth spray and again sixth spray. 6 continuous application at 10 days interval. Foliar application with knapsack sprayer fitted with a duromist nozzle. 500-750 liter water per ha.

3. Results and Discussion

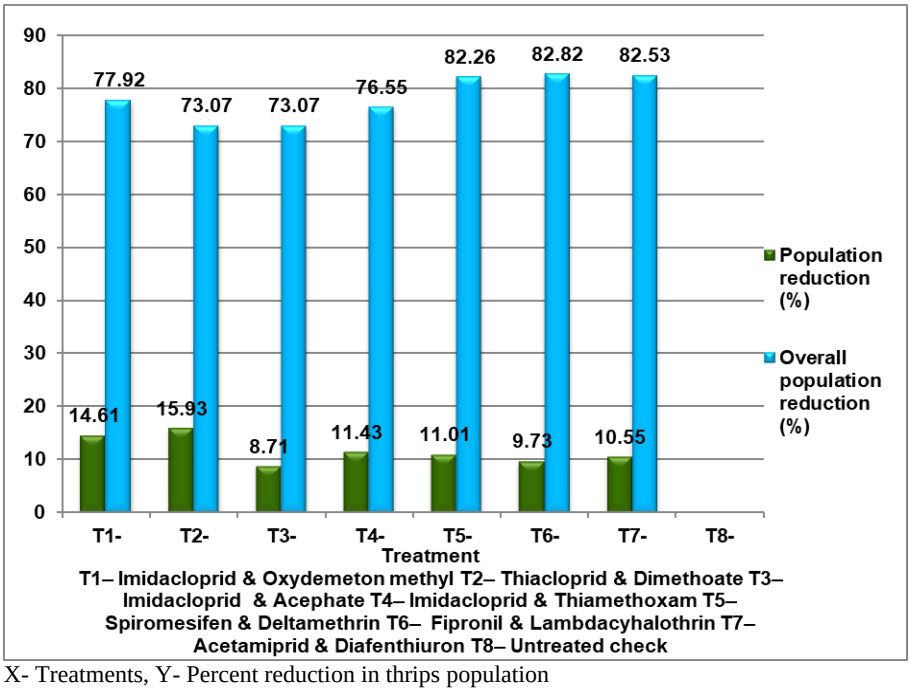
3.1 Efficacy of insecticides against thrips pests of *Bt* cotton

The present experimental finding thrips population (Tab.1.Fig.1.) expressed that T5- Spiromesifen (22.9%SC) @ 144 g*ai*/ha & Deltamethrin (2.8%EC) @ 15 g*ai*/ha (77.78%) maximum effectiveness in reduction of thrips population followed by T6- Fipronil (5%SC) @ 100 g*ai*/ha & Lambdacyhalothrin (4.9%EC) @ 15 g*ai*/ha (76.20%), T2- Thiaclorprid (21.7%SC) @ 30 g*ai*/ha & Dimethoate (30%EC) @ 250 g*ai*/ha (76.20%), T1- Imidacloprid (70%WG) @ 24.5 g*ai*/ha & OxydmetonMethyl (25%EC) @ 250 g*ai*/ha (72.96%), T7- Acetamiprid (20%SP) @ 30 g*ai*/ha & Difenthiuran (50%WP) @ 300 g*ai*/ha (67.49%) and T3- Imidacloprid (17.8%SL) @ 25 g*ai*/ha & Acephate (75%SP) @ 250 g*ai*/ha -(67.32%). The minimum reduction was found in T4- Imidacloprid (30.5%SC) @ 26.25 g*ai*/ha & Thiamethoxam (25%WG) @ 37.5 g*ai*/ha - (64.11 %). The present finding supported by Khan (2011) [2], Sreekanth and Reddy (2011) [7] and Ahmed *et al.* (2014) [1] *i.e.* Varietal performance and chemical control used as tactics against sucking insect pests of cotton.

Table 1: Efficacy of insecticide combination against thrips in *Bt* cotton.

Treatments	Dosage g.a.i./ha	Pre-treatment	Thrips population /25 leaves			Population reduction (%)	Overall Population reduction (%)
			3 DAS	7 DAS	10 DAS		
T1-	250-24.5	11.29 (3.43)	8.67 (3.03)	6.29 (2.61)	9.64 (3.18)	14.61	72.96
T2-	250-30.0	10.67 (3.34)	7.34 (2.80)	4.28 (2.19)	8.97 (3.08)	15.93	75.05
T3-	250-25.0	11.36 (3.44)	10.27 (3.28)	8.27 (2.96)	10.37 (3.30)	8.71	67.32
T4-	37.5-26.25	13.47 (3.74)	11.53 (3.47)	8.96 (3.08)	11.93 (3.53)	11.43	64.11
T5-	15-144.0	8.63 (3.02)	6.29 (2.61)	4.55 (2.25)	7.68 (2.86)	11.01	77.78
T6-	15-100.0	8.74 (3.04)	5.59 (2.47)	4.07 (2.14)	7.89 (2.90)	9.73	76.2
T7-	300-30.0	13.17 (3.70)	11.39 (3.45)	8.57 (3.01)	11.78 (3.50)	10.55	67.49
T8-	---	47.23 (6.91)	48.8 (7.02)	48.25 (7.04)	49.12 (7.04)	–	–
S Em±		0.08	0.07	0.09	0.08		
CD at 5 %		0.24	0.21	0.29	0.25		
CV %		7.15	6.92	9.05	7.01		

The values in parentheses are square root transformed values.
DAS = Days after spray.



X- Treatments, Y- Percent reduction in thrips population

Fig 1: Overall per cent reduction thrips population in *Bt* cotton.

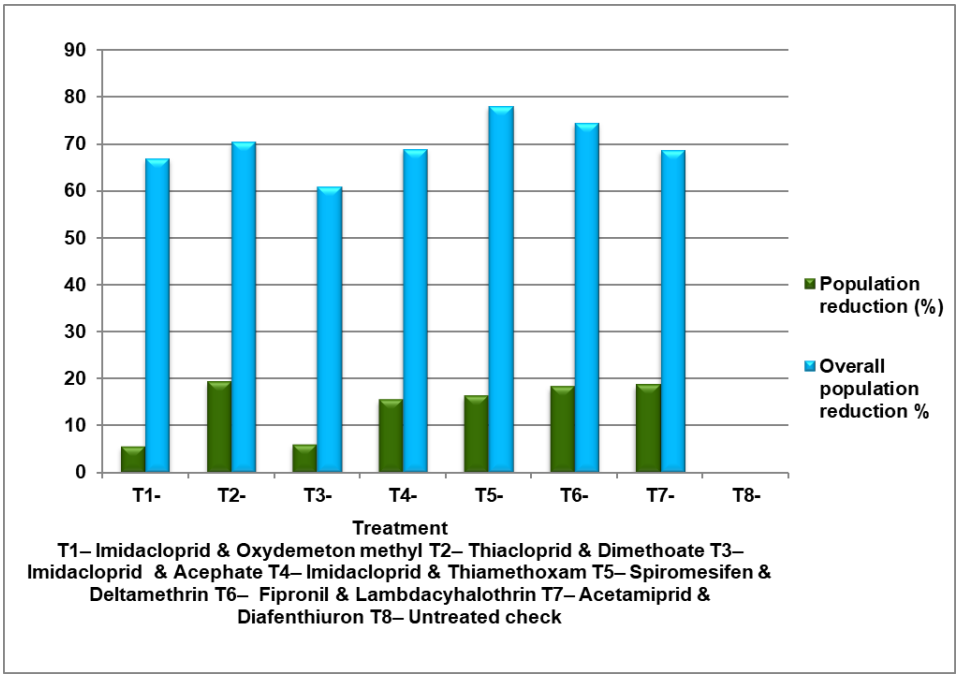
3.2 Efficacy of insecticides against whitefly pests of *Bt* cotton

The overall reduction in whitefly population (Tab.2.Fig.2.) as far as whitefly is concerned it was observed that T5- Spiromesifen (22.9%SC) @ 144 g*ai*/ha & Deltamethrin (2.8%EC) @ 15 g*ai*/ha (78.00%) showed maximum effectiveness and followed with T6- Fipronil (5%SC) @ 100 g*ai*/ha & Lambdacyhalothrin (4.9%EC) @ 15 g*ai*/ha (76.20%), (74.49%), T2- Thiaclorprid (21.7%SC) @ 30 g*ai*/ha & Dimethoate (30%EC) @ 250 g*ai*/ha (70.43%),T4- Imidacloprid (30.5%SC) @ 26.25 g*ai*/ha & Thiamethoxam (25%WG) @ 37.5 g*ai*/ha (68.97%), T7- Acetamiprid (20%SP) @ 30 g*ai*/ha & Difenthiuran (50.WP) @ 300 g*ai*/ha (68.81%), T1 Imidacloprid (70%WG) @ 24.5 g*ai*/ha. & OxydmetonMethyl (25%EC) @ 250 g*ai*/ha (66.91%). the minimum population reduction was observed in T3 Imidacloprid (17.8%SL) @ 25 g*ai*/ha & Acephate (75%SP) @ 250 gai/ha (60.94%). The present finding supported by Raghuraman *et al.* (2008) [3], Khan (2011) [2], Singh *et al.* (2013) [6], Ahmed *et al.* (2014) [1].

Table 2: Efficacy of insecticide combination against whitefly in *Bt* cotton.

Treatments	Dosage	Pre-treatment	Whitefly population /25 leaves			Population reduction (%)	Overall Population reduction (%)
	g.a.i./ha		3 DAS	7 DAS	10 DAS		
T1-	250-24.5	12.31 (3.58)	11.21 (3.42)	7.23 (2.78)	11.62 (3.48)	5.61	66.91
T2-	250-30.0	9.58 (3.17)	7.23 (2.78)	5.39 (2.43)	7.74 (2.87)	19.21	70.43
T3-	250-25.0	11.35 (3.44)	9.47 (3.16)	6.74 (2.69)	10.67 (3.34)	5.99	60.94
T4-	37.5-26.25	12.96 (3.67)	9.92 (3.23)	5.33 (2.41)	10.96 (3.39)	15.43	68.97
T5-	15-144.0	11.74 (3.50)	8.72 (3.04)	4.28 (2.19)	9.82 (3.21)	16.35	78.00
T6-	15-100.0	11.24 (3.43)	8.81 (3.05)	4.62 (2.26)	9.19 (3.11)	18.24	74.49
T7-	300-30.0	13.92 (3.80)	12.52 (3.61)	8.29 (2.96)	11.33 (3.44)	18.61	68.81
T8-	---	49.39 (7.08)	52.2 (7.30)	53.5 (7.35)	54.2 (7.40)	–	–
S Em±		0.09	0.06	0.09	0.06		
CD at 5 %		0.26	0.19	0.28	0.18		
CV %		7.62	5.52	8.76	5.39		

The values in parentheses are square root transformed values.
DAS = Days after spray.



X- Treatments, Y- Percent reduction in white fly population

Fig 2: Overall per cent reduction whitefly population in *Bt* cotton.

3.3 Foliage losses caused by sucking pest

From all the observation it was revealed that infestation of all the sucking pest like jassid, aphid, thrips and whitefly increased continuously starting from the first observation as 7.8 per cent and reached up to 37.92 per cent on the *Bt* cotton variety NCS 927 (Tab.3.Fig.3.). It is established that due introduction of *Bacillus thrungiensis* (*Bt*) bacteria in cotton, On other side the load of sucking pest population increased

year after year continuously. The speedy multiplication of sucking pest on *Bt* cotton compelled the researchers to apply various insecticides of traditional and new groups which ultimately created the insect resistant to all these insecticides. Similar finding were reported by Singh and Jaglan (2005) [5] and Saiyad *et al.* (2011) [4] they expressed the cross resistance in insecticides against sucking insect pest. Thirasack (2001) [8] showed that without any pest control, the development of the plants was very low and yield losses reached almost 70% of the potential production. The insecticide spraying reduced the incidence of the pests but was not enough to ensure the required production.

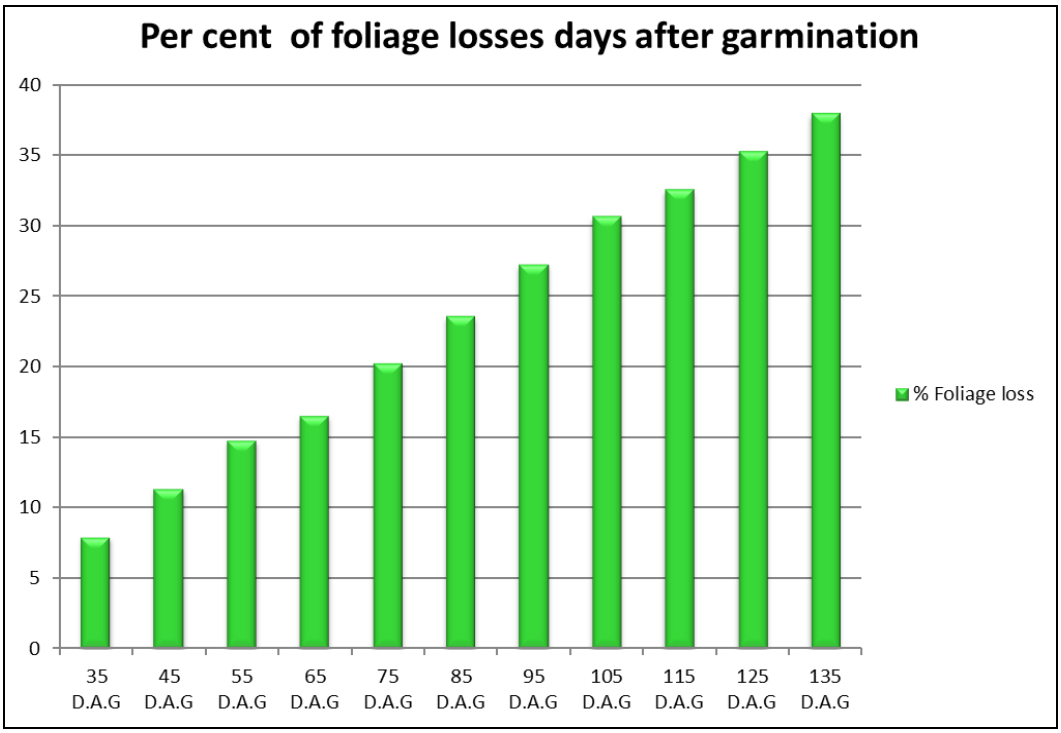
4. Conclusion

- The population reduction of thrips was found maximum in T5 (77.78%). the next best performances were found in T6 (76.20%) followed by T2 (76.20%), T1 (72.96%), T7 (67.49%), T3 (63.32%) while it was noted minimum in T4 (64.11%).
- The overall reduction in white fly population was found in T5 (78.00%), further treatment T6 (74.49%), T2 (70.43%), T4 (68.97%), T7 (68.81%), T1 (66.91%), the minimum reduction of insect population was calculate in T3 (60.94%).
- On 35 days old crop 7.88% foliage loss was noted in Bt. Cotton and it increased continuously up to 110 days as 37.92%.

Table 3: foliage losses caused by sucking pests

S. No.	Observation at	% Foliage loss
1	35 D.A.G	7.88
2	45 D.A.G	11.36
3	55 D.A.G	14.79
4	65 D.A.G	16.53
5	75 D.A.G	20.23
6	85 D.A.G	23.58
7	95 D.A.G	27.25
8	105 D.A.G	30.68
9	115 D.A.G	32.54
10	125 D.A.G	35.21
11	135 D.A.G	37.92

D.A.G. = Days after germination.



X- Days after germination, Y- Percent foliage losses

Fig 3: Foliage losses caused by sucking pests.

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