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Efficacy of insecticides against whitefly, *Bemisia tabaci* in cotton

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ABSTRACT : The whitefly is highly polyphagous in nature and causes direct and indirect damage by feeding on leaves as well acting virus vector. In view of its significant damage potential, a few number of insecticides were evaluated against the whitefly under field conditions. Study on efficacy of insecticides shows that Spiromesifen (22.9% SC) (Oberon 240 SC) @ 600 ml/ha (137.4 g a.i./ha) had significantly lower population of whitefly in comparison to other treatments (dimethoate (30% EC) and imidacloprid (17.8% SL). Maximum seed cotton yield 20.17 and 31.33 q/ha and incremental cost (12.91 and 4.37) was observed in spiromesifen (22.9% SC) (Oberon 240 SC) @ 600 ml/ ha (137.4 g a.i./ha) during 2015 and 2016, respectively which was significantly higher than rest of the treatments.

Key words: Cotton, efficacy, incremental cost, population, whitefly

Cotton (*Gossypium* spp.) is a major commercial crop also known as "White Gold", unanimously designated as “King of Fibres” and has a global significance which is grown for both lint and seed. India is the only country where all four cultivated species (*G. hirsutum*, *G. barbadense*, *G. arboreum* and *G. herbaceum*) of cotton are grown on commercial scale. The important insect pests that affect cotton production are whitefly, leafhopper, aphids and thrips among the sap sucking pests and boll worms (American, Pink and Spotted) and *Spodoptera* among the leaf eating caterpillars. Prior to introduction of *Bt* cotton, the crop was under a severe threat of Lepidopteron pests (Spotted bollworm, American bollworm, Pink bollworm and Tobacco caterpillar). Few years later, a very high population of sap sucking insects (thrips, leafhopper, whitefly, aphid and mealy bug) was witnessed on *Bt* cotton which is the major constraint in cotton production.

Whitefly, *Bemisia tabaci* belongs to family Aleyrodidae of Hemiptera order was first observed in the late 1920s and early 1930s by (Misra and Lamba, 1929) in northern India. Whitefly is a cosmopolitan pest of several crops, including cotton and vegetables. This pest causes damage directly by sucking cell sap. In heavy infestation it has the potential to remove significant amounts of phloem sap resulting in the reduction of plant vigour and honeydew excreted by the insect which interfere in normal photosynthesis with growth of sooty mould. It also reduces the quality and marketability of harvest products (Oliveira *et al.*, 2001). Cotton leaf curl virus disease is also transmitted through the whitefly, which causes significant yield losses if it occurs in the early stages of crop growth (Duffus, 1987). The population build up of this pest largely depends upon abiotic factors. Temperature and humidity had a significant role in population build up of this pest (Mehra and Rolania, 2017; Rolania *et al.*, 2018). For management of whitefly a number of insecticides have been recommended. Frequent and indiscriminate use of these insecticides, tolerance to these insecticides starts appearing in the insects. The insecticides with novel mode of action including neonicotinoids and growth regulators have been proved to be most effective against sucking pests as compared to the conventional insecticides. The study was

initiated to compare the efficacy of some conventional and new insecticides on the sucking insect pests of cotton. It was reported that spiromesifen is safe on beneficial organisms and has a favorable environmental profile (Nauen *et al.*, 2002). Therefore of spiromesifen (22.9% SC) (Oberon 240 SC), imidacloprid (17.8% SL) and (diamethoate 30% EC) was evaluated on cotton for management of whitefly, *Bemisia tabaci.*

MATERIALS AND METHODS

The two year research trial were conducted at Cotton Research Area of CCS Haryana Agricultural University, Hisar during *kharif*, 2015 and 2016 to evaluate the efficacy of spiromesifen (22.9% SC) (Oberon 240 SC), imidacloprid (17.8% SL) and diamethoate (30% EC) against whitefly in cotton. The experiment contain of four treatments with five replications in a plot size of 24m^2 in a randomized block design with row to row spacing of 67.5 cm. and plant to plant spacing was 30 cm. All agronomic practices were followed to raise a healthy crop. The crop was sprayed when population of the above pest crossed economic threshold level. The plots were sprayed with different insecticides using 500 water/ha. Observations on the pest population before spray and after spray were recorded by counting the number of whitefly (adult) on 5 randomly selected plants/plot taking three leaves from upper, middle and lower canopy of the plant. Nymphal count was made before spray and 3, 7 and 10 days after spray from the tagged leaves. The crop was harvested at maturity and yield/plot was recorded. Thereafter, yield converted in q/ha was worked out. The population data were subjected to square root transformation before processing for analysis of variance.

RESULTS AND DISCUSSION

Adult population of *B. tabaci* in cotton, before spray and after spray at different intervals and seed cotton yield in different treatments are presented in Table 1 and 3. Before spray the data revealed that population of whitefly in different treatments did not differ significantly.

During, 2015 three days after spray, population of whitefly was significantly lower in spiromesifen (22.9% SC) (137.4 g a.i./ha) treated plots in comparison to other treatments followed by Imidacloprid (17.8% SL) treated plots had significantly lower population of whitefly (19.06 adults/leaf) than the Dimethoate (30% EC) (24.22 adults/leaf). After 5 day of spray spiromesifen (22.9% SC) @ 600 ml/ha (137.4 g a.i./ha) had significantly lower population of whitefly adult in

Table 1. Effect of different insecticides on adult population of whitefly, *B. tabaci* (2015)

S. No.	Treatment	Dose (ml /ha)	Before spray	Population of whitefly (adult/leaf) (DAS) 3	5	7	10	Seed cotton yield (q/ha)	Incremental cost
1	Spiromesifen (22.9% SC)	600	32.57 (5.73)	8.90 (3.13)	18.77 (4.44)	23.49 (4.94)	27.46 (5.33)	20.17	12.91
2	Imidacloprid (17.8% SL)	100	33.20 (5.85)	19.06 (4.46)	31.88 (5.73)	40.83 (6.46)	42.98 (6.63)	10.99	8.05
3	Dimehtoate (30% EC)	300	28.78 (5.44)	24.22 (5.02)	27.53 (5.34)	32.68 (5.80)	34.12 (5.91)	11.02	8.06
4	Control (without spray)	-	28.87 (5.46)	26.33 (5.23)	33.67 (5.88)	44.50 (6.74)	55.34 (7.51)	9.41	0
CD (p = 0.05)		(NS)	(0.41)	(0.33)	(0.42)	(0.30)	1.45	-	

*Figures in parentheses are square root transformed values.
DAS- Days After Spray

Table 2. Effect of different insecticides on nymphal population of whitefly, *B. tabaci* (2015)

S. No.	Treatment	Dose (ml /ha)	Before spray	Population of whitefly (nymph/leaf) (DAS) 3	7	10	Seed cotton yield (q/ha)
1	Spiromesifen (22.9% SC)	600	42.00 (6.55)	2.60 (1.88)	5.60 (2.55)	13.00 (3.73)	20.17
2	Imidacloprid (17.8% SL)	100	41.60 (6.52)	36.80 (6.14)	39.20 (6.34)	41.80 (6.54)	10.99
3	Dimehtoate (30% EC)	300	43.40 (6.66)	35.80 (6.06)	41.20 (6.49)	46.40 (6.88)	11.02
4	Control (without spray)	-	40.60 (6.44)	42.20 (6.57)	48.00 (7.00)	67.60(8.28)	9.41
CD (p = 0.05)			(NS)	(0.39)	(0.42)	(0.39)	1.62

*Figures in parentheses are square root transformed values.
DAS- Days After Spray

Table 3. Effect of different insecticides on adult population of whitefly, *B. tabaci* (2016)

S. No.	Treatment	Dose (ml /ha)	Before spray	Population of whitefly (adult/leaf) (DAS) 3	5	7	10	Seed cotton yield (q/ha)	Incremental cost
1	Spiromesifen (22.9% SC)	600	11.02 (3.46)*	1.76 (1.66)	1.92 (1.70)	1.98 (1.72)	2.10 (1.75)	31.33	4.37
2	Imidacloprid (17.8% SL)	100	9.98 (3.31)	3.64 (2.15)	3.74 (2.16)	3.96 (2.22)	4.20 (2.27)	28.34	3.03
3	Dimehtoate (30% EC)	750	10.60 (3.40)	3.60 (2.14)	3.64 (2.15)	3.86 (2.20)	4.00 (2.23)	28.79	3.37
4	Control (without spray)	-	10.80 (3.43)	9.80 (3.28)	10.20 (3.33)	10.60 (3.39)	11.00 (3.46)	27.75	0
CD (p = 0.05)			(NS)	(0.20)	(0.41)	(0.33)	(0.22)	1.99	-

*Figures in parentheses are square root transformed values.
DAS- Days after spray

comparison to other treatments followed by dimethoate (30% EC) (27.53 adults/leaf) which was significantly differed with imidacloprid (17.8% SL) (31.88 adults/leaf) that had non-significant difference with control. Similar trend of bioefficacy was observed after 7th days of spray. Data indicated that after 10th days of spray all the treatments were significantly superior over control. Minimum whitefly population (27.46 adult/leaf) was observed in spiromesifen (22.9% SC) @ 600 ml/ ha (137.4 g a.i./ha) which had significant difference with rest of the treatments. Highest population (42.98 adults/leaf) was observed in control (55.34 adults/leaf).

During 2016 after three days of spray all the treatments were found significantly superior over control. Minimum whitefly population (1.76 adult/leaf) was observed in spiromesifen (22.9% SC) @ 600 ml/ ha (137.4 g a.i./ha)) which had significant difference with rest of the treatments. Dimethoate (30% EC) (3.60 adults/leaf) and imidacloprid (17.8% SL) (3.64 adults/leaf) had non significant difference with each other. Similar trend of bioefficacy was observed after 5th, 7th and 10th days of spray. Significantly higher seed cotton yield (20.17 and 31.33 q/ha) and incremental cost (12.91 and 4.37) was obtained from spiromesifen (22.9% SC) treated plot in comparison to other treatments. The results pertaining the effect of spiromesifen in present studies are in accordance with the findings of Alam *et al.*, (2014) they reported that spiromesifen 240 SC @ 150 g a.i./ha was significantly second best treatment in reducing whitefly population and recorded highest yield on tomato.

Ghosal *et al.*, (2018) Effect of different insecticides on nymphal population of whitefly showed in Table 2 and 4. The data shows that after three days of spray minimum nymphal population was recorded in spiromesifen (22.9%

Table 4. Effect of different insecticides on nymphal population of whitefly, *B. tabaci* (2016)

S. No.	Treatment	Dose (ml /ha)	Before spray	Population of whitefly (nymph/leaf) (DAS)			Seed cotton yield (q/ha)
				3	7	10	
1	Spiromesifen (22.9% SC)	600	15.00 (3.99)*	2.00 (1.71)	1.20 (1.46)	1.80 (1.66)	31.33
2	Imidacloprid (17.8% SL)	100	14.20 (3.88)	11.60 (3.54)	11.20 (3.47)	10.20 (3.34)	28.34
3	Dimehtoate (30% EC)	750	13.80 (3.83)	11.20 (3.47)	10.60 (3.39)	11.00 (3.45)	28.79
4	Control (without spray)	-	14.40 (3.91)	15.00 (3.99)	15.80 (4.10)	16.60 (4.18)	27.75
CD (p = 0.05)			(NS)	(0.44)	(0.38)	(0.39)	1.99

*Figures in parentheses are square root transformed values.
DAS- Days after spray

SC) @ 600 ml/ha (137.4 g a.i./ha) which had significant difference with dimethoate (30% EC) and imidacloprid (17.8% SL). Data indicated that all the treatments were significantly superior over control to check the nymphal population. Similar trend was observed after 7th and 10th days of spray. Bi and Toscano (2007) conducted a laboratory and field experiments to test the efficacy of spiromesifen against the greenhouse whitefly. The laboratory experiments showed that spiromesifen at 0.5 and 1.0 µg/ml a.i. inhibited egg hatching by 80 and 100 per cent, respectively, whereas at concentrations of 3.1, 3 and 10 µg/ml a.i., this insecticide, respectively, killed 100 per cent of the first, second, and third instar nymphs. Field trials revealed that application of spiromesifen reduced the whitefly egg numbers by 61 to 80 per cent from 2 to 3 weeks post- treatment. Spiromesifen application decreased the numbers of immature whiteflies by 2 to 92 per cent from 1 to 6 weeks post treatment. Also, the efficacy of spiromesifen on suppression of adult numbers was comparable to that of pyriproxyfen or buprofezin. Palumbo (2009) demonstrated that spiromesifen and buprofezin both compounds provided residual control of whitefly nymphs while significantly preventing sooty mold contamination on melons when applications were initiated after populations exceeded a threshold. This study also supports the present findings. The comparative efficacy of five commonly used insecticides *viz.*, acetamiprid, buprofezin, diafenthiuron and imidacloprid against nymph and adult population of cotton whitefly, *B. tabaci* under natural field conditions has been studied. Results showed that buprofezin was the most effective insecticide against nymphal population of whitefly among the tested insecticides where nymphal population of *B. tabaci* was 0.2/leaf after 24h spray as compared to 1.9/leaf in control. Acetamiprid was the most effective against adult population of whitefly (0.3 to 1.3/leaf post 72 h spray, as compared to control with 6.9 to 8.2/leaf) followed by diafenthiuron and imidaclopirid Nadeem *et al.*, (2011). Mohan and Katiyar (2000) who mentioned that imidacloprid was the most effective in reducing whitefly populations. Also, Khattak *et al.*, (2004) reported that imidacloprid gave significant reduction in the whitefly populations after 24, 72 and 120 hours of application. Additionally, Kuhar *et al.*, (2002), reported that imidacloprid gave fast initial effects in reducing whitefly with long residual action and moderate effect.

CONCLUSION

During 2015 there is a havoc of whitefly population and it remained above economic threshold (ET) even after the spray but during 2016 when we apply the insecticidal spray at ET than we manage the whitefly. Spiromesifen (22.9% SC) (Oberon 240 SC) @ 600 ml/ ha (137.4 g a.i./ha) had significantly lower population of whitefly in comparison to other treatments (dimethoate 30% EC and imidacloprid 17.8% SL). Maximum seed cotton yield and incremental benefit was obtained in spiromesifen (22.9% SC) which was significantly higher than rest of the treatments.

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