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EVALUATION OF INSECTICIDES AGAINST *AMRASCA BIGUTTULA BIGUTTULA* (ISHIDA) IN COTTON

Pritam Kumari, Anil Jakhar* and Sindhu

Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar 125004, Haryana, India
*Email: aniljakhad@gmail.com (corresponding author)

ABSTRACT

This field experiment on the evaluation of insecticides against cotton leafhopper *Amrasca biguttula biguttula* (Ishida) in *Gossypium hirsutum* L. was conducted at Hisar (Haryana) during kharif 2019. Based on mean of both sprays, the least counts of nymphs and adults was observed with flonicamid 50%WG @ 150 g ha^{-1} (0.84 nymphs and 1.73 adults/ 3 leaves) followed by dinotefuran 20%SG @ 150 g ha^{-1} (1.49 nymphs and 2.06 adults/ 3 leaves) and diafenthiuron 50%WP @ 500 g ha^{-1} (1.65 nymphs and 2.25 adults/ 3 leaves). Imidacloprid 17.8%SL @ 100 ml ha^{-1}, thiacloprid 21.7% SC @ 125 ml ha^{-1}, thiamethoxam 25% WG @ 100 g ha^{-1} and buprofezin 25% SC @ 1000 ml ha^{-1} were moderately effective. Insecticide sprays reduced the occurrence of natural enemies (spiders, coccinellids and *Chrysoperla*) only insignificantly. The maximum seed cotton yield was obtained with flonicamid (21.60 q ha^{-1}) followed by dinotefuran (20.99 q ha^{-1}), diafenthiuron (20.71 q ha^{-1}), imidacloprid (20.41 q ha^{-1}), thiacloprid (20.12 q ha^{-1}), buprofezin (19.87 q ha^{-1}), thiamethoxam (19.83 q ha^{-1}) and monocrotophos (19.37 q ha^{-1}). The incremental cost-benefit ratio was maximum with imidacloprid (1:6.36) followed by thiacloprid (1:5.64), thiamethoxam (1:5.29), monocrotophos (1:4.74), dinotefuran (1:4.38), flonicamid (1:3.99), buprofezin (1:3.86) and diafenthiuron (1:3.19).

Key words: *Gossypium hirsutum*, *Amrasca biguttula biguttula*, efficacy, flonicamid, dinotefuran, spiders, coccinellids, *Chrysoperla*, seed cotton yield, cost-benefit ratio

Globally cotton is grown in >32.29 m ha, of which India has 12.66 million ha with a productivity of 386 kg ha^{-1} (Anonymous, 2020). Insect pests and diseases are among the major constraints. The insect pest spectrum being quite complex, the losses are more due to the 162 species (Manjunath, 2004). The transgenic cotton played an important role aginst bollworm infestation but the problem of sucking pests emerged. Among the sucking pests, *Amrasca biguttula biguttula* (Ishida) (Hemiptera: Cicadellidae) is an important one. Many insecticides are recommended against these sucking pests, but their arbitrary use has resulted in insecticide resistance, resurgence, secondary pest outbreaks, and many other non-target effects. This necessitates the rotational use of different insecticides, use of synergists, use of insecticides having novel mode of action, etc. The present study evaluates the field efficacy of some insecticides against *A. biguttula biguttula* in cotton.

MATERIALS AND METHODS

The field experiment was conducted at the Cotton Research Area, Department of Genetics and Plant Breeding, CCS HAU, Hisar (29.09° N, 75.43° E, 215.2 masl) during kharif, 2019. The trial was laid out in a randomized block design with nine treatments (including untreated control) and three replications with plot size of 4.05x 4.80 m. The Ganganagar Ageti, an American cotton variety susceptible to sucking pests was sown on 8.05.2019 with a spacing of 67.5x 30 cm and all the recommended agronomic practices were followed (Anonymous 2019). The commercial formulations of buprofezin 25%SC, diafenthiuron 50%WP, dinotefuran 20%SG, imidacloprid 17.8%SL, flonicamid 50%WG, monocrotophos 36%SL, thiacloprid 21.7%SC and thiamethoxam 25%WG were used. Two sprays of each of these were given when the incidence crossed the economic threshold (6 nymphs/ 3 leaves) with a knapsack sprayer up to the point of runoff. Counts of nymphs and adults were made one day before and 1, 3, 5 and 10 days after each spray on 3 leaves/ plant (one each from upper, middle and lower canopy) from five randomly tagged plants. Likewise counts of *Chrysoperla* larvae, spiders and coccinellids/ plant were made. The seed cotton yield/ plot was recorded at the time of picking and expressed in q ha^{-1}. The data were subjected to statistical analysis using OPSTAT software (Sheoran et al., 1998).

Table 1. Efficacy of insecticides against *A. biguttula biguttula* and its natural enemies in cotton

Insecticides	Dose (ml or g ha^{-1})	No. of leafhopper nymphs/ 3 leaves					No. of leafhopper adults/ 3 leaves					No. of natural enemies*/ plant				
		1st spray		2nd spray		Mean	1st spray		2nd spray		Mean	1st spray		2nd spray		Mean
		Before	After#	Before	After#		Before	After#	Before	After#		Before	After#	Before	After#	
Buprofezin 25% SC	1000	10.80 (2.12)	5.29 (2.50)	9.90 (3.27)	4.28 (2.21)	4.79 (2.40)	7.16 (2.85)	3.04 (1.97)	8.57 (3.09)	3.29 (2.04)	3.16 (2.04)	2.93 1.98)	1.74 (1.64)	3.50 (2.12)	2.33 (1.81)	2.03 (1.74)
Diafenthiuron 50% WP	500	10.40 (2.10)	2.13 (1.77)	8.00 (2.99)	1.18 (1.44)	1.65 (1.62)	6.83 (2.79)	1.86 (1.67)	6.90 (2.81)	2.65 (1.87)	2.25 (1.80)	2.97 (1.98)	2.44 (1.84)	3.57 (2.14)	2.25 (1.80)	2.35 (1.83)
Dinotefuran 20% SG	150	13.00 (2.31)	1.45 (1.56)	11.16 (3.45)	1.52 (1.56)	1.49 (1.58)	11.16 (3.49)	1.49 (1.56)	10.33 (3.35)	2.64 (1.86)	2.06 (1.74)	3.00 (1.96)	2.12 (1.76)	3.63 (2.14)	2.08 (1.75)	2.10 (1.76)
Imidacloprid 17.8% SL	100	12.40 (2.26)	3.33 (2.08)	8.67 (3.10)	2.52 (1.83)	2.93 (1.98)	7.26 (2.87)	2.33 (1.79)	9.45 (3.20)	2.82 (1.91)	2.57 (1.89)	3.03 (1.97)	2.16 (1.76)	2.90 (1.97)	2.27 (1.80)	2.21 (1.79)
Flonicamid 50% WG	150	13.60 (2.35)	0.99 (1.41)	12.73 (3.69)	0.69 (1.28)	0.84 (1.36)	9.33 (3.21)	1.38 (1.53)	7.00 (2.80)	2.09 (1.73)	1.73 (1.65)	3.10 (1.98)	2.62 (1.89)	3.77 (2.18)	2.17 (1.77)	2.39 (1.84)
Monocrotophos 36% SL	437	8.60 (1.96)	5.68 (2.58)	7.33 (2.88)	4.33 (2.22)	5.01 (2.45)	9.66 (3.17)	3.20 (2.01)	11.67 (3.54)	3.55 (2.10)	3.37 (2.09)	2.87 (1.95)	1.73 (1.62)	3.53 (2.09)	2.41 (1.83)	2.07 (1.74)
Thiacloprid 21.7% SC	125	10.40 (2.11)	4.22 (2.28)	8.43 (3.07)	2.81 (1.87)	3.51 (2.12)	8.83 (3.12)	2.49 (1.83)	10.9 (3.44)	3.31 (2.03)	2.90 (1.97)	2.90 (1.93)	2.05 (1.73)	3.30 (2.07)	2.17 (1.77)	2.11 (1.76)
Thiamethoxam 25% WG	100	16.80 (2.57)	5.33 (2.51)	13.00 (3.72)	3.07 (1.95)	4.20 (2.27)	6.20 (2.65)	2.98 (1.96)	14.00 (3.83)	3.66 (2.1)	3.32 (2.08)	3.13 (2.02)	1.73 (1.64)	3.47 (2.11)	2.24 (1.78)	1.98 (1.73)
Untreated check	-	14.00 (2.36)	9.65 (3.26)	11.53 (3.52)	8.69 (3.08)	9.17 (3.19)	10.67 (3.41)	6.25 (2.67)	11.67 (3.51)	8.23 (3.03)	7.24 (2.87)	4.00 (2.23)	3.10 (2.02)	4.19 (2.28)	2.96 (1.98)	3.03 (2.01)
SE(m)±		(0.12)	(0.06)	(0.23)	(0.13)	(0.07)	(0.26)	(0.06)	(0.26)	(0.06)	(0.05)	(0.21)	(0.04)	(0.12)	(0.06)	(0.06)
C.D. $_{(P=0.05)}$		(NS)	(0.17)	(NS)	(0.38)	(0.24)	(NS)	(0.17)	(NS)	(0.17)	(0.16)	(NS	(0.13)	(NS)	(NS)	(NS)

*Coccinellids, *Chrysoperla* larvae and spiders; #Mean incidence 1, 3, 5 and 10 days after spray; Figures in parentheses square root transformed values

Table 2. Economics of insecticides evaluated against *A. biguttula biguttula* in cotton

Insecticides	Dose (ml or g ha^{-1})	Seed cotton yield (q ha^{-1})	Incremental yield (q ha^{-1})	Cost of incremental yield (Rs ha^{-1})	Cost of protection (Rs ha^{-1})	Net profit (Rs ha^{-1})[#]	ICBR*
Buprofezin 25%SC	1000	19.87	2.65	13925.75	3608.00	100808.85	1:3.86
Diafenthiuron 50%WP	500	20.71	3.49	18339.95	5744.00	103087.05	1:3.19
Dinotefuran 20%SG	150	20.99	3.77	19811.35	4523.00	105779.45	1:4.38
Imidacloprid 17.8%SL	100	20.41	3.19	16763.45	2636.00	104636.07	1:6.36
Flonicamid 50%WG	150	21.60	4.38	23016.90	5774.00	107734.00	1:3.99
Monocrotophos 36%SL	437	19.37	2.15	11298.25	2384.70	99387.13	1:4.74
Thiacloprid 21.7%SC	125	20.12	2.90	15239.5	2704.00	103026.60	1:5.64
Thiamethoxam 25%WG	100	19.83	2.61	13715.55	2594.00	101595.13	1:5.29
Untreated check	-	17.22	-	-	-	-	-
C.D (p=0.05)	-	2.21	-	-	-	-	-
SE(m)±	-	0.73	-	-	-	-	-

[#]On the basis of cost of protection; *ICBR= Incremental cost benefit ratio; Price of seed cotton = Rs 5255/q; No. of labour required/ spray/ ha = 2; labour charges = Rs 476/head/day; Maximum retail price of insecticides: buprofezin 25% SC @ Rs 426/500 ml, diafenthiuron 50% WP @ Rs 960/250 g, dinotefuran 20% SG @ Rs 873/100 g, imidacloprid 17.8% SL @ Rs 3660/1000 ml, flonicamid 50% WG @ Rs 1935/150 g, monocrotophos 36% SL @ Rs 550/1000 ml, thiacloprid 21.7% SC @ Rs 800/250 ml, thiamethoxam 25% WG @ Rs 3450/1000g

RESULTS AND DISCUSSION

Based on mean of both sprays, all the insecticides were observed to significantly reduce the nymphs and adults (Table 1); the least counts (0.84 nymphs/3 leaves) was observed with flonicamid, being at par with dinotefuran (1.49 nymphs/ 3 leaves) followed by diafenthiuron (1.65 nymphs/ 3 leaves). Imidacloprid and thiacloprid were moderately effective insecticides, both being at par. Monocrotophos was least effective insecticide followed by buprofezin and thiamethoxam, all being at par with each other. Similarly, adult counts revealed that flonicamid was most effective (1.73 adults/3 leaves) followed by dinotefuran (2.06 adults/ 3 leaves) and diafenthiuron (2.25 adults/ 3 leaves), all being at par. Imidacloprid, thiacloprid and buprofezin were moderately effective. The least effective were monocrotophos and thiamethoxam. These observations corroborate with those of Ghelani et al. (2014) on flonicamid 0.02% and those of Chandi et al. (2016). Sreenivas et al. (2015) observed that dinotefuran 20SG @ 30 g a.i. ha^{-1} was the best against jassid, thrips, aphids and whiteflies compared to imidacloprid 17.8 SL and thiamethoxam 25 WG. Gaurkhede et al. (2015) observed that dinotefuran 20SG @ 0.008% and @ 0.006%, fipronil 5SC @ 0.015%, acetamiprid 20SP @ 0.004%, imidacloprid 30.5SC @ 0.005% and flonicamid 50WG @ 0.02% did not differ significantly in suppressing leafhoppers. The results of Shivanna et al. (2011) on the efficacy of diafenthiuron against jassids corroborate the present ones. Shinde et al. (2011), Abbas et al. (2012) and Begum et al. (2016) observed that imidacloprid 17.8SL @ 40 g a.i. ha^{-1} was the most effective against leafhopper. Bharpoda et al. (2014) revealed that thiamethoxam 25WG @ 0.0125% was significantly superior.

Non-significant differences were observed in the occurrence of spiders, *Chrysoperla* larvae and coccinellids (Table 1); maximum counts (3.03/ plant) was in untreated check followed by flonicamid (2.39), diafenthiuron (2.35), imidacloprid (2.21), thiacloprid (2.11), dinotefuran (2.10), monocrotophos (2.07), buprofezin (2.03) and thiamethoxam (1.98). These observations agree with those of Gaurkhede et al. (2015). Similarly, Jansen et al. (2011) concluded that flonicamid 50 WG @ 80 g ha^{-1} was safer to natural enemies. Rohini et al. (2012) with coccinellids and spiders found that imidacloprid and fipronil are relatively safe. Nemade et al. (2017) also observed similar effect of insecticides. Significantly maximum seed cotton yield (21.60 q ha^{-1}) was obtained with flonicamid followed by others. These results agree with those of Nemade et al. (2017) on flonicamid 50 WG and others. Incremental cost-benefit ratio (ICBR) was maximum with imidacloprid (1:6.36) followed by others Bharpoda et al. (2014) obtained such maximum ICBR (Table 2) with imidacloprid. Thus, it is concluded that flonicamid 50% WG, dinotefuran 20%SG and diafenthiuron 50% WP can be utilized in rotation with other insecticides.

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