EFFICACY OF DIFFERENT BIO-PESTICIDES AGAINST SUCKING PESTS OF *Bt* COTTON

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ABSTRACT

Field studies were undertaken at Entomology Research Farm, BACA, AAU, Anand to study the comparative bio-efficacy of Brahmastra, Agniastra and Neemastra at two doses, 10 and 20 per cent along with Neem Seed Kernel Suspension (NSKS) 5 per cent against sucking pests of cotton and its safety to natural enemies during Kharif 2013-14 and 2014-15. Brahmastra at 20 per cent was found highly effective in suppressing the sucking pest's viz., aphid, leafhopper, thrips and whitefly followed by Agniastra and Neemastra at 20 per cent and it had no adverse effects on the natural enemies. Highest seed cotton yield (27.74 q/ha) was recorded in plots treated with Brahmastra at 20 per cent followed by Agniastra at 20 per cent (25.12 q/ha) and Neemastra at 20 per cent (23.99 q/ha).

KEY WORDS: Bio-pesticides, cotton, sucking pests

INTRODUCTION

Cotton is an important commercial crop unanimously designated as '*King of Fibre Crops'* and '*White Gold'*. India total cotton production was recorded as 352 lakh bales from the 118.81 lakh ha of total cultivated area and 503 kg/ha productivity (Anonymous, 2015). Cotton is always an attractive host for several insect pests from sowing to harvesting and globally, 1326 species of insect have been recorded (Hargreaves, 1948). Of these, greater than 162 species have been recorded in India (Dhaliwal *et al*., 2004). Among them, sap feeders aphids, *Aphis gossypii* (Glover), leafhopper, *Amrasca biguttula biguttula* (Ishida), thrips, *Thrips tabaci* (Lindeman) and whitefly, *Bemisia tabaci* (Gennadius) are deadly pests in *Bt* cotton cultivated areas. The estimated loss due to sucking pests complex was up to 21.20 per cent (Dhawan *et al.*, 1988). Whitefly causes great damage by sucking the cell sap, secreting the honey dews and transmitting the leaf curl viral disease to cotton (Khan and Ahmad, 2005). Despite long role of effective control by agrochemical insecticides, a number of factors are threatening the efficacy and continued use of these products. These include the development of insecticides resistance and use-cancellation or de-registration of some insecticides due to health hazard and environmental concerns. The eco-friendly alternative is the need for improvement in pest

control strategies represents one method to generate higher quality and greater quantity of agricultural products. Therefore, there is a need to use bio-pesticides which are effective, biodegradable and do not leave any harmful effect on environment. To minimize ill effects of synthetic insecticides, it is now high time to use bio-pesticides. Three new bio-pesticides *viz.*, Brahmastra, Agniastra and Neemastra, extract from the neem, ipomoea, *Calotropis, Annona squamosa*, garlic, chilli, tobacco, etc. with cow urine and cow dung have been evaluated against cotton sucking pests.

MATERIALS AND METHODS

Field experiment was conducted during *Kharif* 2013-14 and 2014-15 to evaluate the bio-efficacy of bio-pesticides in a Randomized Block Design at Entomology Research Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. For the purpose, RCH 2 BG II was raised in plots of size 6.0 × 3.6 m with a spacing of 90 × 60 cm with recommended standard agronomical package of practices for the state except plant protection. There were eight treatments and replicated three times. The bio-pesticides treatments included Brahmastra, Agniastra and Neemastra @ 10 and 20 per cent and standard check *viz.*, Neem Seed Kernel Suspension (NSKE) at 5 per cent and untreated control. The respective bio-pesticides were sprayed on cotton when sucking insect pest population reached to or crossed 5 per leaf on the crop. Altogether, four sprays were made at 10 days interval during both the seasons. The observations on population of sucking pests *(A. gossypii, A. biguttula biguttula, B. tabaci* and *T. tabaci)* were recorded on five plants selected randomly in each plot. On each plant, three leaves were selected randomly from top, middle and bottom canopy and population counts were made before the first spray as well as 3, 5, 7 and 10 days after each spray. Seed cotton yield was recorded plot wise and converted in to q/ha. To ascertain the effect of different bio-pesticides on natural enemies in the field condition, the observations on natural enemies were also made on three plants selected randomly in each plot. The population counts on larvae of *Chrysoperla zastrowi sillemi*, grubs and adults of coccinellids and spiders were made on randomly selected plant. The observations were made at 5 and 10 days after each spray. The data on population of the pests and natural enemies were subjected to square root transformation before statistical analysis (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Aphid

During 2013-14, the lowest (5.36/leaf) aphid population (Table 1) was recorded in the plots treated with Brahmastra at 20 per cent and remained at par with Agniastra at 20 per cent. Agniastra at 20 per cent and Neemastra at 20 per cent stood next in order and also found effective compared to rest of the other treatments. The NSKS at 5 per cent and Brahmastra at 10 per cent found equally effective against *A. gossypii*. Among the bio-pesticidal treatments under study, the highest (12.97/leaf) aphid population was observed in Neemastra at 10 per cent and it was at par with Agniastra and Brahmastra at 10 per cent. Sprays results of 2014-15 (Table 1) showed that significantly the lowest (2.09/leaf) aphid population in the plots treated with Brahmastra at 20 per cent than all the tested bio-pesticides. Agniastra at 20 per cent (2.96/leaf) and Neemastra at 20 per cent (3.62/leaf) were stood in next

order and also found effective compared to rest of the other bio-pesticides. The NSKS at 5 per cent recorded significanlty lower (4.61/leaf) aphid population as compared to the lower doses (10%) of the bio-pesticides. Brahmastra at 10 per cent (6.05/leaf), Agniastra at 10 per cent (6.90/leaf) and Neemastra at 10 per cent (7.79/leaf) treated plots recorded singnificanlty higher population of aphid and found less effective against aphid control. Pooled data (Table 1) revealed that all the bio-pesticides significantly superior to control. Brahmastra at 20 per cent recorded lowest (3.58/leaf) aphid population followed by Agniastra and Neemastra both at 20 per cent. The NSKS at 5 per cent showed mediocre in its effectiveness against the pest. Brahmastra (8.68/leaf), Agniastra (9.42/leaf) and Neemastra at 10 per cent (10.19/leaf) recorded higher population and showed less effective against aphid in cotton.

Leafhopper

During 2013-14, pooled data (Table 2) indicated that Brahmastra at 20 per cent (1.96/leaf), Agniastra at 20 per cent (2.46/leaf), Neemastra at 20 per cent (3.11/leaf) and NSKS at 5 per cent differed significantly to each other and found more effective than lower doses of Brahmastra, Agniastra and Neemastra. Among the tested bio-pesticides, the highest (7.01/leaf) leafhopper population was noticed in plots treated with Neemastra at 10 per cent and it was at par with Agniastra at 10 per cent and Brahmastra at 10 per cent. The data on sprays of 2014-15 revealed that Brahmastra at 20 per cent was found significantly superior and recorded the lowest (2.46/leaf) leafhopper population than the rest of the bio-pesticides. Agniastra at 20 per cent, Neemastra at 20 per cent and NSKS at 5 per cent treated plots registered leafhopper population between 4.04 and 5.45 per leaf. Brahmastra, Agniastra and Neemastra all at 10 per cent exhibited less effective against the leafhopper. The highest (9.68/leaf) leafhopper population was observed in plots treated with Neemastra at 10 per cent followed by Agniastra at 10 per cent and Brahmastra at 10 per cent. Looking to the pooled data (Table 2), significantly the lowest (2.19/leaf) leafhopper population was registered in the treatment of Brahmastra at 20 per cent than all the tested bio-pesticides. Agniastra at 20 per cent (3.22/leaf) and Neemastra at 20 per cent (3.95/leaf) also exhibited lower population of leafhopper and found equally effective. The treatment of NSKS at 5 per cent (5.21/leaf) observed mediocre in its effectiveness. Among the evaluated bio-pesticides, Brahmastra, Agniastra and Neemastra all at 10 per cent recorded higher leafhopper population and found less effective.

Thrips

During 2013-14 (Table 3), the lowest thrips population was recorded in the plots treated with Brahmastra at 20 per cent and was at par with Agniastra at 20 per cent. Neemastra at 20 per cent and NSKS at 5 per cent stood next in order and also found effective compared to rest of the bio-pesticides. Further, both these bio-pesticides significantly differed to each other. The highest (7.34/leaf) thrips population was noticed in the plots treated with Neemastra at 10 per cent followed by Agniastra at 10 per cent and Brahmastra at 10 per cent. The data of 2014-15 revealed that the significantly lowest population of thrips was noticed in the treatment of Brahmastra at 20 per cent (1.72/leaf) followed by Agniastra at 20 per cent (2.85/leaf) and Neemastra at 20 per

cent (3.66/leaf) and differed with each other. It indicated that bio-pesticides at higher doses found effective against thrips. The NSKS at 5 per cent (4.65/leaf) also recorded lower population of the thrips than lower doses of tested bio-pesticides. The highest (7.01/leaf) thrips population was observed in plots treated with Neemastra at 10 per cent followed by Brahmastra at 10 per cent and Agniastra at 10 per cent. Looking to the data on pooled over periods, sprays and years on thrips, Brahmastra at 20 per cent found significantly superior and recorded the lowest (1.69/plant) population. Agniastra (2.53/leaf) and Neemastra (3.38/leaf) at 20 per cent also recorded significantly lower whitefly population. The NSKS at 5 per cent (4.61/leaf) found mediocre in its effectiveness. Brahmastra, Agniastra and Neemastra all at 10 per cent proved less effective in controlling the thrips. The highest (7.17/leaf) population was observed in the plots treated with Neemastra at 10 per cent.

Whitefly

Whitefly population during 2013-14 (Table 4), Brahmastra at 20 per cent (1.43/leaf) found significantly more effective against whitefly than all the evaluated bio-pesticides. Agniastra at 20 per cent (2.00/leaf) and Neemastra at 20 per cent (2.53/leaf) were equally effective but significantly superior to remaining bio-pesticides. The NSKS at 5 per cent (4.21/leaf) was at par with Brahmastra at 10 per cent and found mediocre. The highest (6.79/leaf) whitefly population was observed in plots treated with Neemastra at 10 per cent followed by Agniastra at 10 per cent and Brahmastra at 10 per cent. Spray results of 2014-15 (Table 4) revealed that Brahmastra (1.43/leaf), Agniastra (2.70/leaf) and Neemastra at 20 per cent (3.74/leaf) differed significantly each other and found more effective treatments against whitefly. The NSKS at 5 per cent (4.61/leaf) was mediocre in its effectiveness against whitefly. The lower doses of the bio-pesticides *viz.*, Brahmastra, Agniastra and Neemastra, all at 10 per cent recorded higher whitefly population and proved less effective. Pooled data of years revealed (Table 4) that treatment of Brahmastra at 20 per cent recorded significantly lowest (1.43/leaf) whitefly population than all the tested bio-pesticides. Agniastra at 20 per cent (2.36/leaf) and Neemastra at 20 per cent (3.11/leaf) found at par with each other and proved effective bio-pesticides. The NSKS at 5 per cent, Brahmastra at 10 per cent and Agniastra at 10 per cent were less effective against whitefly. The plots treated with Neemastra at 10 per cent recorded the highest (6.52/leaf) population of whitefly and was at par with Agniastra at 10 per cent (5.60/leaf).

Earlier workers have proved the effectiveness of various bio-pesticides, but very few of them have worked on Brahmastra, Agniastra and Neemastra in cotton and other crops. As per the Kavitha and Patil (2009) studied field performance of fermented plant products and aqueous extracts vividly showed that NSKE (5%) spray recorded significantly less number of defoliator larvae and significantly highest yield (20.80 q/ha) followed by Agniastra (19.67 q/ha) and Brahmastra spray (19.10 q/ha) in groundnut ecosystem. According to Karthika (2013), spraying of Brahmastra @ 5% was found effective up to seventh day after application with good residual effect against the whitefly, mite, aphid, leafhopper and fruit borer in okra.

Natural enemies

Pooled data (Table 5) of natural enemies *i.e. Chrysoperla* larvae, coccinellids (grubs + adults) and spiders population was homogenous in all the treatments and the difference was non-significant. There was no significant effect of any of the bio-pesticides (Brahmastra, Agniastra and Neemastra) at lower (10%) and higher (20%) doses after 5 and 10 days of application. It clearly indicated that there was no any adverse effect on the population of natural enemies in any of the bio-pesticidal treatments.

Yield

Data on seed cotton yield (Table 6) over years (*Kharif* 2013-14 and 2014-15) revealed that significantly the highest (27.74 q/ha) seed cotton yield was harvested from the plots treated with Brahmastra at 20 per cent than all the tested bio-pesticides. The plots treated with Agniastra (25.12 q/ha) and Neemastra at 20 per cent (23.99 q/ha) also recorded higher yield and remained at par with each other. The NSKS at 5 per cent was mediocre and produced 22.58 q/ha yield of seed cotton and it was at par with Neemastra at 20 per cent. Among the bio-pesticides, lowest (19.33 q/ha) seed cotton yield was recorded in Neemastra at 10 per cent treated plots followed by Agniastra (19.98 q/ha) and Brahmastra at 10 per cent (20.50 q/ha).

CONCLUSION

Overall, it can be concluded that Brahmastra at 20 per cent, Agniastra 20 per cent and Neemastra at 20 per cent found more effective against aphid, leafhopper, thrips and whitefly population in cotton. All bio-pesticides, Brahmastra, Agniastra and Neemastra at their lower and higher doses were relatively safer against these natural enemies. Highest seed cotton yield (27.74 q/ha) was recorded in plots treated with Brahmastra at 20 per cent followed by Agniastra at 20 per cent (25.12 q/ha) and Neemastra at 20 per cent (23.99 q/ha).

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Table 1: Effect of bio-pesticides against aphid, *A. gossypii* infesting cotton

Bio-pesticides	Dose (ml/10 lit. water)	Number of Aphid/Leaf		
		2013-14	2014-15	Pooled
Brahmastra at 10%	100	3.49cd(11.68)	2.56d (6.05)	3.03d (8.68)
Brahmastra at 20%	200	2.42a (5.36)	1.61a (2.09)	2.02a (3.58)
Agniastra at 10%	100	3.58d (12.32)	2.72de(6.90)	3.15de (9.42)
Agniastra at 20%	200	2.63ab (6.42)	1.86b (2.96)	2.24ab (4.52)
Neemastra at 10%	100	3.67d (12.97)	2.88e (7.79)	3.27e (10.19)
Neemastra at 20%	200	2.79b (7.28)	2.03b (3.62)	2.41b (5.31)
NSKS at 5%	500 g	3.28c (10.26)	2.26c (4.61)	2.77c (7.17)
Control	-	4.36e (18.51)	3.21f (9.80)	3.79f (13.86)
S. Em. ±	Treatment (T)	0.07	0.07	0.07
	Year (Y)	-	-	0.02
	T × Y	-	-	0.05
C.D. at 5%	T	0.22	0.21	0.23
	Y	-	-	0.04
	T × Y	-	-	0.13
C.V.%		9.06	10.83	10.23

Figures in parentheses are original values; those outside are $\sqrt{X+0.5}$ transformed values

Table 2: Effect of bio-pesticides against leafhopper, *A. biguttula biguttula* infesting cotton

Bio-pesticides	Dose (ml/10 lit. water)	Number of Leafhoppers/Leaf		
		2013-14	2014-15	Pooled
Brahmastra at 10%	100	2.63e (6.42)	2.85d (7.62)	2.74d (7.01)
Brahmastra at 20%	200	1.57a (1.96)	1.72a (2.46)	1.64a (2.19)
Agniastra at 10%	100	2.64e (6.47)	2.93d (8.08)	2.79de(7.28)
Agniastra at 20%	200	1.72b (2.46)	2.13b (4.04)	1.93b (3.22)
Neemastra at 10%	100	2.74e (7.01)	3.19e (9.68)	2.97e (8.32)
Neemastra at 20%	200	1.90c (3.11)	2.31bc (4.84)	2.11b (3.95)
NSKS at 5%	500 g	2.35d (5.02)	2.44c (5.45)	2.39c (5.21)
Control	-	3.36f (10.79)	3.75f (13.56)	3.55f (12.10)
S. Em. ±	Treatment (T)	0.04	0.07	0.06
	Year (Y)	-	-	0.01
	T × Y	-	-	0.04
C.D. at 5%	T	0.12	0.20	0.22
	Y	-	-	0.04
	T × Y	-	-	0.11
C.V.%		10.80	10.32	11.00

Figures in parentheses are original values; those outside are $\sqrt{X+0.5}$ transformed values

Table 3: Effect of bio-pesticides against thrips, *T. tabaci* infesting cotton

Bio-pesticides	Dose (ml/10 lit. water)	Number of Thrips/Leaf		
		2013-14	2014-15	Pooled
Brahmastra at 10%	100	2.57d (6.10)	2.48e (5.65)	2.53d (5.90)
Brahmastra at 20%	200	1.48a (1.69)	1.49a (1.72)	1.48a (1.69)
Agniastra at 10%	100	2.66d (6.58)	2.55e (6.00)	2.61de (6.31)
Agniastra at 20%	200	1.65a (2.22)	1.83b (2.85)	1.74b (2.53)
Neemastra at 10%	100	2.80e (7.34)	2.74f (7.01)	2.77e (7.17)
Neemastra at 20%	200	1.89b (3.07)	2.04c (3.66)	1.97b (3.38)
NSKS at 5%	500 g	2.25c (4.56)	2.27d (4.65)	2.26c (4.61)
Control	-	3.28f (10.26)	3.06g (8.86)	3.17f (9.55)
S. Em. ±	Treatment (T)	0.06	0.05	0.07
	Year (Y)	-	-	0.01
	T × Y	-	-	0.04
C.D. at 5%	T	0.17	0.15	0.23
	Y	-	-	NS
	T × Y	-	-	0.11
C.V.%		10.30	10.91	10.75

Figures in parentheses are original values; those outside are $\sqrt{X+0.5}$ transformed values

Table 4: Effect of bio-pesticides against whitefly, *B. tabaci* infesting cotton

Bio-pesticides	Dose (ml/10 lit. water)	Number of Thrips/Leaf		
		2013-14	2014-15	Pooled
Brahmastra at 10%	100	2.31c (4.84)	2.39de (5.21)	2.35c (5.02)
Brahmastra at 20%	200	1.39a (1.43)	1.39a (1.43)	1.39a (1.43)
Agniastra at 10%	100	2.49d (5.70)	2.45e (5.50)	2.47cd (5.60)
Agniastra at 20%	200	1.58b (2.00)	1.79b (2.70)	1.69b (2.36)
Neemastra at 10%	100	2.70e (6.79)	2.60f (6.26)	2.65d (6.52)
Neemastra at 20%	200	1.74b (2.53)	2.06c (3.74)	1.90b (3.11)
NSKS at 5%	500 g	2.17c (4.21)	2.26d (4.61)	2.21c (4.38)
Control	-	3.14f (9.36)	2.99g (8.44)	3.06e (8.86)
S. Em. ±	Treatment (T)	0.06	0.04	0.08
	Year (Y)	-	-	0.01
	T × Y	-	-	0.04
C.D. at 5%	T	0.17	0.13	0.26
	Y	-	-	0.04
	T × Y	-	-	0.10
C.V.%		10.79	11.28	11.23

Figures in parentheses are original values; those outside are $\sqrt{X+0.5}$ transformed values

Table 5: Effect of bio-pesticides on natural enemies of insect pests in cotton

Bio-pesticides	Dose (ml/10 lit. water)	Natural enemies											
		Chrysoperla larvae/ 3 shoots			Coccinellids grubs/plant			Coccinellids adults/plant			Spiders/plant		
		2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
Brahmastra at 10%	100	1.38 (1.40)	1.45 (1.60)	1.42 (1.52)	1.45 (1.60)	1.40 (1.46)	1.42 (1.52)	1.37 (1.38)	1.38 (1.40)	1.38 (1.40)	1.32 (1.24)	1.31 (1.22)	1.32 (1.24)
Brahmastra at 20%	200	1.34 (1.30)	1.43 (1.54)	1.38 (1.40)	1.39 (1.43)	1.35 (1.32)	1.37 (1.38)	1.34 (1.30)	1.33 (1.27)	1.34 (1.30)	1.28 (1.14)	1.28 (1.14)	1.28 (1.14)
Agniastra at 10%	100	1.37 (1.38)	1.44 (1.57)	1.40 (1.46)	1.44 (1.57)	1.38 (1.40)	1.41 (1.49)	1.36 (1.35)	1.37 (1.38)	1.37 (1.38)	1.32 (1.24)	1.30 (1.19)	1.31 (1.22)
Agniastra at 20%	200	1.32 (1.24)	1.41 (1.49)	1.36 (1.35)	1.39 (1.43)	1.33 (1.27)	1.36 (1.35)	1.32 (1.24)	1.33 (1.27)	1.33 (1.27)	1.28 (1.14)	1.27 (1.11)	1.27 (1.11)
Neemastra at 10%	100	1.36 (1.35)	1.43 (1.54)	1.39 (1.43)	1.43 (1.54)	1.38 (1.40)	1.41 (1.49)	1.36 (1.35)	1.36 (1.35)	1.36 (1.35)	1.30 (1.19)	1.28 (1.14)	1.29 (1.16)
Neemastra at 20%	200	1.31 (1.22)	1.41 (1.49)	1.36 (1.35)	1.38 (1.40)	1.32 (1.24)	1.35 (1.32)	1.32 (1.24)	1.31 (1.22)	1.31 (1.22)	1.26 (1.09)	1.27 (1.11)	1.27 (1.11)
NSKS at 5%	500 g	1.35 (1.32)	1.42 (1.52)	1.38 (1.40)	1.42 (1.52)	1.37 (1.38)	1.40 (1.46)	1.36 (1.35)	1.35 (1.32)	1.36 (1.35)	1.30 (1.19)	1.30 (1.19)	1.30 (1.19)
Control	-	1.40 (1.46)	1.46 (1.63)	1.43 (1.54)	1.45 (1.60)	1.41 (1.49)	1.43 (1.54)	1.39 (1.43)	1.38 (1.40)	1.39 (1.43)	1.34 (1.30)	1.32 (1.24)	1.33 (1.27)
S. Em. ±	Treatment (T)	0.03	0.05	0.02	0.03	0.04	0.02	0.03	0.02	0.02	0.02	0.03	0.02
	Year (Y)	-	-	0.12	-	-	0.01	-	-	0.01	-	-	0.10
	T × Y	-	-	0.03	-	-	0.03	-	-	0.03	-	-	0.03
C. D. at 5%	T	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Y	-	-	0.03	-	-	0.03	-	-	NS	-	-	NS
	T × Y	-	-	NS	-	-	NS	-	-	NS	-	-	NS
C. V. %		11.09	11.33	11.35	10.38	9.39	10.01	11.55	10.43	10.93	10.30	10.99	10.58

NS = Non significant, Figures in parenthesis are $\sqrt{X+0.5}$ ***transformation; those outside are retransformed***

Table 6: Effect of diffrent bio-pesticides on seed cotton yield

Bio-pesticides		Seed cotton yield (q/ha)		
		First year (2013-14)	**Second year (2014-15)**	**Pooled (2013-15)**
Brahmastra at 10%		23.25^{cd}	17.75^{de}	20.50^{d}
Brahmastra at 20%		30.15^{a}	25.33^{a}	27.74^{a}
Agniastra at 10%		22.44^{d}	17.51^{de}	19.98^{d}
Agniastra at 20%		27.70^{ab}	22.53^{b}	25.12^{b}
Neemastra at 10%		22.11^{d}	16.56^{e}	19.33^{d}
Neemastra at 20%		26.12^{bc}	21.85^{bc}	23.99^{bc}
NSKS at 5%		25.49^{bcd}	19.67^{cd}	22.58^{c}
Control		17.99^{e}	13.45^{f}	15.72^{e}
S. Em. ±	Treatment (T)	1.12	0.91	0.66
	Year (Y)	-	-	0.36
	T x Y	-	-	1.02
C. D. at 5%	T	3.41	2.76	1.89
	Y	-	-	1.04
	T x Y	-	-	NS
	C. V. %	7.98	8.16	8.11

[MS received: March 27, 2017] *[MS accepted: March 30, 2017]*