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Bioefficacy of newer insecticides against sucking pests and natural enemies on transgenic cotton

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ABSTRACT : Foliar application of acetamiprid 20 SP @ 0.004 per cent was most effective against aphids upto 14 days after treatment, its lower dose (0.002 %) and thiamethoxam 25 WG @ 0.01 per cent were effective against aphids upto 10 days after treatment. Acetamiprid 20 SP @ 0.004 per cent and thiamethoxam 25 WG @ 0.01 per cent were consistently found most effective against leafhoppers upto 14 days after treatment. While the lower doses of acetamiprid 20 SP and thiamethoxam 25 WG were equal and next effective in reducing leafhopper population upto 14 days after treatment. Imidacloprid 17.8 SL @ 0.008 per cent and thiamethoxam 25 WG @ 0.01 per cent were equally effective against thrips. Acetamiprid 20 SP @ 0.004 per cent, imidacloprid 17.8 SL @ 0.008 per cent and thiamethoxam 25 WG @ 0.01 per cent were equal and most effective from 3 to 14 days after treatment against whitefly. During study there were no deleterious effects of insecticidal treatments were found on natural enemies such as lady bird beetle (adult and grubs), Chrysopa larvae and spiders. With treatment of Acetamiprid 20 SP @ 0.004 per cent highest seed cotton yield was obtained and it was equal with thiamethoxam 25 WG @ 0.01 per cent and imidacloprid 17.8 SL @ 0.008 per cent. Thereby, treatment of acetamiprid 20 SP @ 0.004 per cent recorded highest ICBR (1: 18.50) indicating most economically viable treatment followed by acetamiprid 20 SP @ 0.002 per cent (1:16.67), imidacloprid 17.8 SL @ 0.004 per cent (1:12.86) and 0.008 per cent (1:12.35). Lowest ICBR of (1:5.84) was noted in thiamethoxam 25 WG @ 0.01 per cent.

Key words: *Bemisia tabaci,* bioefficacy, cotton, sucking pests, *Thrips tabaci*

Cotton is the major cash crop known as "King of Fibres" and plays an important role in agriculture and industrial activities of the nations. It provides livelihood for about 4 million farming families. It also provides 65 per cent raw material to textile industry (Mayee and Rao, 2002). Cotton hybrids and high yielding varieties are more susceptible to insect pests like bollworms and sucking pests. Thus, the problem of sap sucking pests after bollworms, has also become quite serious from seedling stage, their heavy infestation at a time reduces the crop yield to great extent. With the introduction of transgenic cotton hybrids known to be resistant to bollworms, the bollworms became minor however sucking pests problems still serious. The sucking pests *viz.,* aphids (*Aphis gossypii* Glover), leafhoppers (*Amrasca biguttula biguttula* Ishida), whiteflies (*Bemisia tabaci* Gennadius) and thrips (*Thrips tabaci* Lindeman) are most serious and destructive pests of regular occurrence. Among these sucking pests, aphids alone are reported to cause about 19 per cent yield loss. The loss caused by whiteflies was reported between 25 to 40 per cent (Banerjee, 2002) reported nearly 25 per cent of the world's insecticide are used in cotton farming for control of pests (Khadi, 2003). By considering the importance of sucking pests on transgenic cotton, it is important to search the new molecules of the insecticides and hence the present study has been carried out.

Field experiment was conducted during *kharif* 2011-2012 at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in randomized block design with 8 treatments and 3 replications. The

seeds of transgenic cotton variety JAI BG II were sown by dibbling method on 09-07-2011 after receiving sufficient rain. The gross plot size was 7.2 x 4.8 m and spacing was 90 x 60 cm. Distance between two replications was 1.5 m and between two treatment plots was 1 m. Total area of the experiment was 1124.04 m^2.

The observations on the infestation of various sucking pests were recorded at one day before spray as pre treatment observation and as post treatment observations recorded at 3, 5, 7, 10 and 14 days after each spray. The total number of leafhoppers, aphid (nymphs), thrips and whiteflies were recorded on 3 leaves (one each from top, middle and bottom) from each of randomly selected 5 plants in each plot. Likewise the observations on predators *i.e.* lady bird beetles (eggs, grubs and adult), Chrysopa larvae and spider were recorded at the specified time of pest count after spray on randomly selected 5 plants from each net plot on whole plant. The data recorded on population of sucking pests at 3, 5, 7, 10 and 14 days after each treatment spray were averaged. Cumulative average population of aphids and whiteflies of two spray whereas leafhoppers and thrips after third spray were computed.

The data on the effect of different insecticides on sucking pests *viz.,,* aphids, leafhoppers, thrips and whitefly are given in Table 1.

Aphids : As per the cumulative data on aphid population of two sprays the average population of aphids (nymphs/leaf) in all treated plots after second spray revealed significantly lower (0.96 to 3.12) than the untreated control (5.72). Minimum population (0.96) was recorded in treatment of acetamiprid 20 SP @ 0.004 per cent and it was significantly superior to the other treatments. Thiamethoxam 25 WG @ 0.01 per cent ranked second in reducing aphid population though it was at par with its lower concentration 0.005 per cent and imidacloprid 17.8 SL @ 0.008 per cent. Superiority of acetamiprid 20 SP @ 0.004 per cent and thiamethoxam 25 WG @ 0.01 per cent was noticed against aphids upto14 days after treatment whereas these treatments were equal in efficacy with acetamiprid 20 SP @ 0.002 per cent at 10 days after treatment and imidacloprid 17.8 SL @ 0.008 per cent at 7 days after treatment. Thiamethoxam 25 WG @ 0.005 per cent was also effective against aphids upto 5 days after treatment. Dimethoate 30 EC @ 0.05 per cent was found least effective in checking aphid population. Kolhe *et al.,* (2009) reported the superiority of acetamiprid 20 SP @ 0.003 per cent and thiamethoxam 25 WG @ 0.005 per cent against aphids up to 10 days after treatment.

Leafhopper : The cumulative data on leafhopper population of three sprays were averaged and presented in Table 1. The average population of leafhopper (nymph/leaf) in all treated plots was significantly lower (0.75 to 1.45) than untreated control (1.83). The minimum population was recorded in treatment of acetamiprid 20 SP @ 0.004 per cent and it was significantly superior to other treatments. Thiamethoxam 25 WG @ 0.01 per cent ranked second and it was *on par* with imidacloprid 17.8 SL @ 0.008 per cent. Dimethoate 30 EC @ 0.05 per cent was the least effective. Kolhe *et al.,* (2009) reported effectiveness of acetamiprid 20 SP @ 0.003 per cent and imidacloprid 17.8 SL@ 0.008 per cent against leafhoppers. Patil *et al.,* (2009) reported the superiority of acetamiprid 20 SP @ 0.008 per cent against leafhoppers at 5 DAT.

Thrips : The average population of thrips after third spray in all treated plots (0.45 to 0.78) was significantly lower than untreated plot (1.01). The lowest population was recorded in imidacloprid 17.8 SL @ 0.008per cent and it was superior to remaining treatments. Acetamiprid 20 SP @ 0.004 per cent ranked second and it was at par with thiamethoxam 25 WG 0.01 per cent and imidacloprid 17.8 SL @ 0.004 per cent.

Table 1. Cumulative effect of insecticidal treatments on aphids, leafhoppers, thrips and whitefly on cotton

Treatments	Population/ leaf at DAT																							
	Aphids						Leaf hopper						Thrips						Whitefly					
	3	5	7	10	14	**Mean**	3	5	7	10	14	**Mean**	3	5	7	10	14	**Mean**	3	5	7	10	14	**Mean**
Thiamethoxam	0.95	0.37	2.23	2.70	2.80	**1.81**	0.85	1.09	1.10	1.17	1.33	**1.11**	1.62	1.00	1.02	1.27	0.67	**0.74**	0.88	0.92	1.29	1.57	2.24	**1.38**
25 WG	(1.20)	(0.93)	(1.65)	(1.79)	(1.82)	**(1.52)**	(1.16)	(1.26)	(1.26)	(1.29)	(1.35)	**(1.27)**	(1.45)	(1.22)	(1.23)	(1.33)	(1.08)	**(1.12)**	(1.17)	(1.19)	(1.33)	(1.44)	(1.65)	**(1.37)***
(0.005%)																								
Thiamethoxam	0.66	0.21	1.55	2.19	2.25	**1.37**	0.60	0.81	0.87	1.06	0.98	**0.86**	1.40	0.53	1.20	0.98	0.51	**0.61**	0.71	0.63	1.36	1.48	1.71	**1.18**
25 WG (0.01%)	(1.08)	(0.84)	(1.43)	(1.64)	(1.66)	**(1.37)**	(1.05)	(1.15)	(1.17)	(1.24)	(1.22)	**(1.17)**	(1.37)	(1.01)	(1.30)	(1.21)	(1.00)	**(1.05)**	(1.10)	(1.06)	(1.36)	(1.40)	(1.49)	**(1.30)**
Acetamiprid	0.81	0.31	1.86	2.07	2.70	**1.55**	0.84	1.01	1.14	1.27	1.24	**1.10**	1.53	1.18	1.51	1.18	0.53	**0.78**	0.90	1.16	1.58	1.96	2.28	**1.57**
20 SP (0.002%)	(1.14)	(0.90)	(1.53)	(1.60)	(1.79)	**(1.43)**	(1.16)	(1.23)	(1.28)	(1.33)	(1.32)	**(1.26)**	(1.42)	(1.29)	(1.42)	(1.29)	(1.01)	**(1.13)**	(1.18)	(1.29)	(1.44)	(1.56)	(1.66)	**(1.44)**
Acetamiprid	0.46	0.21	0.93	1.48	1.72	**0.96**	0.48	0.67	0.78	0.84	0.97	**0.75**	1.02	1.04	1.27	0.84	0.56	**0.57**	0.60	0.74	1.12	1.36	1.61	**1.09**
20 SP (0.004%)	(0.98)	(0.84)	(1.20)	(1.40)	(1.49)	**(1.21)**	(0.99)	(1.08)	(1.13)	(1.16)	(1.21)	**(1.12)**	(1.23)	(1.24)	(1.33)	(1.16)	(1.02)	**(1.04)**	(1.05)	(1.11)	(1.27)	(1.36)	(1.45)	**(1.26)**
Imidacloprid	1.22	0.36	2.30	3.07	3.61	**2.11**	0.99	1.04	1.19	1.38	1.24	**1.17**	1.11	0.69	1.42	1.11	0.42	**0.67**	1.12	1.10	1.91	1.83	2.12	**1.62**
17.8 SL (0.004%)	(1.31)	(0.92)	(1.67)	(1.89)	(2.03)	**(1.62)**	(1.22)	(1.24)	(1.30)	(1.37)	(1.32)	**(1.29)**	(1.27)	(1.09)	(1.39)	(1.27)	(0.96)	**(1.08)**	(1.27)	(1.26)	(1.55)	(1.53)	(1.62)	**(1.46)**
Imidacloprid	0.89	0.39	1.50	2.96	2.96	**1.74**	0.70	0.93	0.98	0.98	1.07	**0.93**	0.71	0.38	0.82	0.67	0.36	0.45	0.71	0.79	1.17	1.21	1.84	**1.14**
17.8 SL (0.008%)	(1.17)	(0.94)	(1.41)	(1.86)	(1.86)	**(1.49)**	(1.10)	(1.19)	(1.22)	(1.22)	(1.25)	**(1.20)**	(1.10)	(0.94)	(1.15)	(1.08)	(0.92)	**(0.97)**	(1.10)	(1.13)	(1.29)	(1.31)	(1.53)	**(1.28)**
Dimethoate	2.02	2.26	3.87	3.59	3.87	**3.12**	1.06	1.34	1.64	1.53	1.66	**1.45**	1.07	0.89	1.44	1.36	0.69	**0.73**	1.25	1.50	1.71	1.58	2.10	**1.63**
30 EC (0.05%)	(1.58)	(1.66)	(2.07)	(2.01)	(2.07)	**(1.89)**	(1.25)	(1.36)	(1.46)	(1.42)	(1.47)	**(1.39)**	(1.25)	(1.18)	(1.39)	(1.33)	(1.09)	**(1.11)**	(1.32)	(1.41)	(1.49)	(1.44)	(1.61)	**(1.46)**
Control	3.71	4.42	6.93	7.19	6.33	**5.72**	1.39	1.62	1.95	2.13	2.05	**1.83**	1.76	1.04	1.89	1.36	0.84	**1.01**	1.73	1.89	2.25	2.45	3.20	**2.30**
(Unsprayed)	(2.04)	(2.19)	(2.69)	(2.76)	(2.61)	**(2.49)**	(1.38)	(1.45)	(1.56)	(1.62)	(1.60)	**(1.53)**	(1.50)	(1.23)	(1.54)	(1.36)	(1.16)	**(1.23)**	(1.49)	(1.54)	(1.66)	(1.72)	(1.92)	**(1.67)**
	0.03	0.02	0.01	0.03	0.02	**0.01**	0.04	0.05	0.05	0.09	0.04	**0.02**	0.03	0.03	0.04	0.05	0.04	**0.02**						
SE (m) ±	0.07	0.08	0.14	0.11	0.09	**0.05**	0.08	0.07	0.03	0.10	0.07	**0.03**	0.12	0.16	0.16	0.27	0.13	**0.05**	0.10	0.09	0.12	0.15	0.13	**0.06**
CD (P=0.05)	0.22	0.25	0.41	0.33	0.27	**0.15**	3.88	3.14	1.52	4.18	3.15	**1.49**	5.04	7.88	6.67	12.11	7.05	**2.65**	5.12	4.41	4.93	6.14	4.67	**2.58**
CV (%)	9.42	12.27	13.79	9.97	8.09	**5.22**																		

*Figures in parenthesis are corresponding square root transformed values

Note- The data for aphids and whiteflies are average of two sprays whereas for leafhopper and thrips of three sprays.

Table 2. Effect of various insecticidal treatments on yield of *Bt* cotton

Sr. No.	Treatments	Concentration (%)	Seed cotton yield (kg/ha)			
			R I	R II	R III	**Mean**
1	Thiamethoxam 25 WG	0.005	652.49	687.21	517.94	**619.21**
2	Thiamethoxam 25 WG	0.01	810.19	633.68	729.75	**724.54**
3	Acetamiprid 20 SP	0.002	761.00	638.02	643.81	**680.94**
4	Acetamiprid 20 SP	0.004	638.02	1061.92	721.93	**807.29**
5	Imidacloprid 17.8 SL	0.004	617.77	606.19	619.21	**614.39**
6	Imidacloprid 17.8 SL	0.008	719.04	695.89	642.36	**685.76**
7	Dimethoate 30 EC	0.05	640.91	581.60	445.60	**556.04**
8	Control (Unsprayed)	-	266.20	331.31	257.52	**285.01**
	SE (m)±CD at (p=0.05) CV (%)		57.36	0173.97	515.98	

Thiamethoxam 25 WG @ 0.005 per cent was least effective and it was *on par* with dimethoate 30 EC @ 0.05per cent. Udikeri *et al.,* (2010) reported the superiority of imidacloprid 350 SC @ 26.25 g ai/ha in checking thrips population. Raghuraman *et al.,* (2008) reported effectiveness of acetamiprid 20 SP @ 40 g ai/ha against thrips. Similarly Agale *et al.,* (2010) noted that acetamiprid 20 SP @ 100 g ai/ha and thiamethoxam 25 WG @ 125 g ai/ha were most effective in controlling thrips population.

Whitefly : The average population of whitefly (adult/ leaf) in all treated plots (1.09 to 1.63) was found significantly lower than untreated control (2.30). Minimum population (1.09) was recorded in acetamiprid 20 SP @ 0.004 per cent and it was *at par* with thiamethoxam 25 WG @ 0.01 per cent and imidacloprid 17.8 SL @ 0.008 per cent. Thiamethoxam 25 WG @ 0.005 per cent ranked second followed by acetamiprid 20 SP @ 0.002per cent, imidacloprid 17.8 SL @ 0.004per cent and dimethoate 30 EC @ 0.05per cent being equal treatments. Similar results were reported by Raghuraman *et al.,* (2008) as acetamiprid 20 SP at its doses 20, 40 g ai/ha was effective in suppressing the population of whitefly. Singh *et al.,* (2003) reported the superiority of thiamethoxam, acetamiprid and imidacloprid against whiteflies.

Natural enemies : Cumulative data on predators recorded from treatment plots at 3, 5, 7 10 and 14 days after each spray revealed non significant differences over untreated control. The population of lady bird beetle (grub and adult), Chrysopa larvae and spider in treated plots including control was in the range of 0.19 to 0.89, 0.06 to 0.21 and 0.26 to 0.42/ plant, respectively. The cumulative data on the population of predators indicated that these insecticides had no adverse effect on the population of predators. Shrinivasan *et al.,* (2004) noted that foliar sprays of imidacloprid and thiamethoxam were safer for coccinellid grubs as compared to others. While, Acetamiprid 20 SP @ 5.0 to 26.25 g a.i./ha was safer to coccinellids and spiders compared to other treatments.

Effect of various insecticidal treatments on yield of *Bt* cotton : Seed cotton yield (kg/ha) in all the insecticidal treatments was revealed significantly higher (556 to 807) than untreated control (258). However, highest seed cotton yield (807) was obtained from acetamiprid 20 SP @ 0.004 per cent though *at par* with thiamethoxam 25 WG @ 0.01 per cent, imidacloprid 17.8 SL @ 0.008 per cent and acetamiprid 20 SP @ 0.002 per cent.

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