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Bio-efficacy of new insecticidal molecules against insect-pests of cotton

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ABSTRACT

Field evaluation of new insecticidal molecules was conducted against sucking pests and bollworms of cotton. The new molecules tested were methomyl (Lannate 40 SP), thiodicarb (Larvin 75 WP), triazophos (Hostathion 40 EC), lamda cyhalothrin (Karate 40 EC), profenofos + cypermethrin (Polytrin-C 44 EC), triazophos + deltamethrin (Spark 36 EC), indaxocarb (Auvant 14.5 SP), chlorpyriphos + cypermethrin (Chop 55 EC), endosulfan (Endocel 35 EC) and dimethoate (Rogor 30 EC). Methomyl recorded the lowest (2.00) aphid population which was on par with thiodicarb (2.69) followed by other insecticdes. Thiodicarb recorded the lowest (4.17) thrips population followed by indoxacarb and other treatments. The insecticidal treatment chlorpyriphos + cypermethrin recorded minimum (1.2 per plant) number of larvae and was significantly superior over triazophos + deltamethrin (4.2 larvae per plant) but on par with rest of the treatments in three days after first spray during first season. Methomyl recorded the lowest (0.87) bollworm population and was significantly superior over profenofos + cypermethrin (3.47), endosulfan (4.00) and control (13.20), but was on par with rest of the treatments during three days after fourth spray. The cost benefit ratio was maximum in methomyl (1:2.68) followed by chlorpyriphos + cypermethrin, profenofos + cypermethrin and indoxacarb.

Key Words : Bio-efficacy, sucking pests, bollworms, methomyl, thiodicarb, triazophos, indoxacarb, deltamethrin, endosulfan, dimethoate.

INTRODUCTION

Cotton is one of the most important cash crops playing a key role in the economy of Indian farmers. In India cotton is grown in an area of 89.60 lakh hectares with a production of 232 lakh bales and productivity of 440 kg lint/ha as against world average production of 682 kg lint/ha (Anon 2005). In India about 156 species of insect pests have been reported to be associated with cotton and among them only a dozen of pests cause economic damage to the crop (Sundaramurthy 1985). The major pests are aphids (*Aphis gossypii*), leaf hoppers (*Amrasca*

biguttula biguttula), white flies (*Bemesia tabaci*), thrips (*Thrips tabaci*), spotted bollworms (*Earias vittella* and *E. insulana*), pink bollworms (*Pectinophora gossypiella*) and American bollworm (*Helicoverpa armigera*). A wide range of insecticides have proved as effective weapons in reducing the pest population. However, negligence of the principles in the crop protection, indiscriminate and extensive use of synthetic pesticides led to problems like insecticidal resistance, pest resurgence, and destruction of natural enemies. Therefore, to overcome the above problems the present field evaluation of new molecules was undertaken either alone or in combination with some of the synthetic pyrethroids available in the market for the management of sucking pests and bollworm complex of cotton.

MATERIAL AND METHODS

Two field trials were carried out at Zonal Agricultural Research Station, Hiriyur during 2001-2002 to assess the bio-efficacy of newer insecticides against insect pests of cotton. The recommended agronomical practices were followed as per the package of practices for cotton. The cotton variety DCH 32 with a plot size of 7.0 x 2.0 m and a spacing of 150 x 120 cm was maintained.

Sucking pests

Ten insecticidal molecules viz, methomyl (Lannate 40 SP), thiodicarb (Larvin 75WP), triazophos (Hostathion 40 EC), lamda cyhalothrin (Karate 40 EC), profenofos + cypermethrin (Polytrin-C 44 EC), triazophos + deltamethrin (Spark 36 EC), indoxacarb (Auvant 14.5 SP), chlorpyriphos + cypermethrin (Chop 55 EC), endosulfan (Endocel 35 EC) were evaluated against sucking pests (aphids and thrips) and bollworms with dimethoate (Rogor 30 EC) as standard check. The experiments were laid out in Randomised Complete Block Design (RCBD) with eleven treatments and three replications. A total of four sprays were given at ten days interval using a high volume hydraulic sprayer. The observations on the number of aphids and thrips were made on ten randomly selected plants in each plot. The number of aphids and thrips per leaf was calculated based on the number of insects on three leaves, each taken from top, middle and bottom portion of each plant. The observations were made a day before, three and five days after spraying for sucking pests.

Bollworms

After initiation of flowering, all the above mentioned insecticides except dimethoate (Rogor 30EC) were evaluated against bollworms with endosulfan as standard check. The experiment included ten treatments with three replications. Observations on the number of bolls damaged per plant were recorded before, three and ten days after each spray. The

data so collected was subjected to statistical analysis after suitable transformation. The treatment means were compared by Duncan's Multiple Range Test (DMRT).

Yield

The yield data was collected by harvesting cotton from five randomly selected plants per plot and converting into yield per hectare. The data so collected was subjected to statistical analysis after suitable transformation and the treatment means were compared by Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The results on bio-efficacy of newer insecticides against sucking pests of cotton are presented in Table 1.

Aphids

The incidence of aphids was observed about 35 days after sowing. The population ranged from 23.98 to 40.86 per leaf before spraying. All the treatments did not differ significantly a day before spray (Table 1).

Methomyl recorded the lowest (2.00) aphid population which was on par with thiodicarb (2.69), but these two treatments differed significantly with rest of the treatments. Similar to present results, Kharboutli and Allen (1998) reported methomyl to be effective in controlling aphids in cotton. Further, the insecticides triazophos, lamda cyhalothrin, profenofos + cypermethrin, triazophos + deltamethrin, indoxacarb and dimethoate were on par with each other but differed significantly with endosulfan and untreated control. The present results are more or less similar to studies conducted by El-Shahawy et al (1991) where they reported dimethoate to be more effective over other insecticides and gave satisfactory control of sucking pests of cotton when sprayed at 20 days interval. However, all the insecticidal treatments were superior over control. The insecticides methomyl and thiodicarb recorded lowest aphid population even 5 days after spray. Both the insecticides were significantly superior over all the treatments. Further, the same trend of aphid population continued as in the previous observations (Table1).

Thrips

Thrips population ranged between 9.00 and 15.36 per leaf, a day before spraying. There were no significant differences among the treatments with respect to mean number of thrips per leaf. Thiodicarb recorded the lowest (4.17) thrips population followed by indoxacarb (4.39), chlorpyriphos + cypermethrin (4.42), triazophos + deltamethrin (5.00), methomyl (5.03) and profenofos + cypermethrin (5.30), which were on par

Table 1. Bio-efficacy of different insecticides against sucking pests of cotton during 2000-01

Treatments	No of aphids/leaf			No of thrips/leaf		
	Pre-treatment	3 DAS	5 DAS	Pre-treatment	3 DAS	5 DAS
Methomyl	34.69 (5.92)	2.00 (1.56)[a]	0.67 (1.06)[a]	13.86 (3.78)	5.03 (2.34)[ab]	2.36 (1.66)[a]
Thiodicarb	40.86 (6.27)	2.69 (1.78)[a]	0.73 (1.10)[a]	9.00 (3.06)	4.17 (2.15)[a]	2.29 (1.67)[a]
Triazophos	33.79 (5.82)	10.68 (3.33)[b]	2.76 (1.79)[b]	15.36 (3.97)	11.71 (3.46)[c]	5.03 (1.68)a
Lamda Cyhalothrin	23.98 (4.94)	12.30 (3.54)[bc]	2.84 (1.84)[b]	14.00 (3.79)	7.34 (2.79)[b]	4.49 (2.22)[a]
Profenofos + Cypermethrin	40.53 (6.29)	10.76[b] (3.34)	2.89 (1.97)[b]	11.49 (3.46)	5.30 (2.40)[ab]	3.36 (1.94)[a]
Triazophos + Deltamethrin	37.14 (6.11)	9.89[b] (3.22)	3.71 (2.04)[b]	11.53 (3.46)	5.00 (2.32)[ab]	3.73 (2.04)[a]
Indoxacarb	32.72 (5.69)	10.71 (3.33)[b]	9.19 (3.10)[c]	9.32 (3.12)	4.39 (2.20)[ab]	4.03 (2.13)[a]
Chlorpyriphos+ Cypermethrin	33.44 (5.82)	19.40 (4.45)[d]	15.64 (4.00)[d]	10.64 (3.33)	4.42 (2.21)[ab]	2.80 (1.80)[a]
Endosufan	29.36 (5.45)	16.07 (4.07)[cd]	13.00 (3.67)[cd]	11.04 (3.39)	12.78 (3.63)[c]	13.67 (3.75)[b]
Dimethoate (Standard Check)	32.19 (5.70)	13.87 (3.78)[bc]	12.33 (3.58)[cd]	11.17 (3.39)	22.59 (4.79)[d]	22.62 (4.79)[c]
Untreated Control	34.39 (5.88)	39.33 (6.28)[e]	32.20 (5.68)[e]	9.41 (3.15)	20.59 (4.55)[d]	24.21 (4.95)[c]
F-test	NS	*	*	NS	*	*

DAS : Days After Spray NS : Non Significant

* Significant at p = 0.05 by DMRT

Values followed by letters along the coloumn are not significantly different

Values in parentheses are square root transformed values (“x + 0.5)

with each other but differed significantly with lamda cyhalothrin (7.34), triazophos (11.71), endosulfan (12.78) and dimethoate (22.59). Kadam et al (2003) reported triazophos (0.05%) and triazophos + deltamethrin as effective treatments in controlling the sucking pests. Kazi et al (2004) reported profenophos + cypermethrin as an effective chemical treatment to reduce population of thrips, followed by chlorpyriphos + cypermethrin. Similar trend was observed even on fifth day after spraying, however all the treatments differed significantly with dimethoate, endosulfan and control, but on par with each other (Table 1).

Bollworms

First Season (2000-01)

The population of cotton bollworms ranged between 3.4 and 5.2 per plant a day before spraying (Table 2).

The insecticidal treatment chlorpyriphos + cypermethrin recorded minimum (1.2 per plant) number of larvae and significantly superior over triazophos + deltamethrin (4.2 larvae per plant) but on par with rest of the treatments, three days after first spray. Similarly Kazi et al (2004) reported profenophos + cypermethrin and chlorpyriphos + cypermethrin to be effective in reducing the boll worms population. All other remaining treatments were on par with each other.

All the treatments were found to be superior over check (1.4 larvae per plant) after 10 days of first spray. However, the treatments triazophos and profenofos + cypermethrin recorded minimum number of larvae (0.8 per plant), followed by methomyl and lamda cyhalothrin (both with 0.9 larvae per plant), triazophos + deltamethrin (1.1), chlorpyriphos + cypermethrin (1.3), endosulfan (1.4) and thiodicarb (2.1) when observations were recorded ten days after first spray. The present results are in agreement with Rawale et al (2002) where they reported profenophos + cypermethrin with lowest bollworm infestation in cotton bolls and locules.

On third day after second spray all the treatments were found to be superior over control (2.4 larvae per plant). Triazophos recorded minimum number of larvae (0.8) but results were found on par with all other treatments. On ten days after second spray also all the treatments were superior over control (2.00 larvae per plant) but with statistically non significant variations among each other.

All the treatments were superior over check (2.00 larvae per plant) on third day after third spray. However, lamda cyhalothrin recorded minimum (0.6) number of larvae per plant. Triazophos + deltamethrin recorded the minimum number of larva (1.1) per plant on ten days after third spray and was on par with rest of the

treatments. Significant synergism of deltamethrin + triazophos against cotton bollworm , *H armigera* was reported by Martin et al (2003).

Thiodicarb recorded minimum number of larvae per plant (0.5) and was statistically on par with other treatments on three days after fourth spray. On tenth day, all the treatments were superior over control (2.6). Methomyl recorded its supermacy by recording lowest number of larvae (0.5) but statistically with non significant results in comparison to other treatments (Table 2). Studies carried out by Sandeep et al (2006) revealed deltamethrin + triazophos, cypermethrin + chlorpyriphos, indoxacarb 4.5 EC and endosulfan 35 EC as effective insecticides to significantly reduce bollworm damage and thereby to increased cotton yield.

Second season (2001-02)

The bollworms incidence was noticed on the crop 45 days after sowing and prevailed throughout the cropping period. The bollworm damage ranged from 6.23 to 8.80 bolls per plant a day before the first spray. There were no significant differences in the number of bolls damaged among the treatments during three days after first spray. The same trend continued on ten days after first spray. Three days after second spray also all the treatments were on par with each other. The bollworm damage was lowest (3.40) in methomyl and indoxacarb treated plots and highest in control (9.00) during 10 days after second spray. All the insecticidal treatments were significantly superior over control but on par with each other. Three days after third spray all the insecticidal treatments were superior over control but on par with each other. More or less same trend was observed even on ten days after third spray. Similarly Gupta and Lal (1998) reported deltamethrin 12.5 g ai/ha, endosulfan 750 g ai/ha, cypermethrin 60 g ai/ha and triazophos 600 g ai/ha were effective in controlling cotton pests and increasing seed cotton yield. Methomyl recorded the lowest (0.87) boll damage and was significantly superior over profenofos + cypermethrin (3.47), endosulfan (4.00) and control (13.00), but was on par with rest of the treatments during three days after fourth spray (Table 3). Mansoor ul Hassan et al (2000) reported Lannate 40 SP to be more effective in reducing eggs of *H armigera* over other treatments. Similarly Song Quing Ping and Chen-Hong (2000) reported thiodicarb 75 WP and 20 per cent methomyl as effective insecticides to control cotton bollworm and safer to natural enemies.

Yield

Methomyl treated plots recorded highest yield (21.36 q/ha) followed by indoxacarb (19.25 q/ha), thiodicarb (17.22 q/ha), profenofos + cypermethrin (15.62 q/ha), chlorpyriphos + cypermethrin (15.55q/ha), lamda cyhalothrin (11.97 q/

Table 2. Bio-efficacy of different insecticides against boll worms of cotton during 2000-01

Treatments	Pre-treatment count	Post-treatment counts/No. of larvae per plant							
		I[t] Spray		II Spray		III Spray		IV Spray	
		3 DAS	10 DAS	3 DAS	10 DAS	3 DAS	10 DAS	3 DAS	10 DAS
Methomyl	4.00 (2.10)	1.60 (1.42)	0.90 (1.19)	1.60 (1.44)	1.10 (1.26)	1.10 (1.27)	1.20 (1.32)	0.60 (1.04)	0.50(1.01)
Thiodicarb	4.00 (2.11)	2.80 (1.77)	2.10(1.61)	1.00 (1.24)	1.10 (1.26)	1.10 (1.26)	1.50 (1.42)	0.50 (1.01)	0.60 (1.04)
Triazophos	5.20 (2.36)	2.10 (1.56)	0.80 (1.13)	0.80 (1.15)	1.20 (1.29)	1.40 (1.40)	1.30 (1.34)	0.70 (1.10)	0.70 (1.10)
Lamda Cyhalothrin	3.50 (1.99)	2.60(1.74)	0.90 (1.18)	1.20 (1.32)	1.00 (1.24)	0.60(1.04)	1.20 (1.32)	0.90 (1.19)	0.80 (1.13)
Profenofos + Cypermethrin	5.20 (2.32)	3.00 (1.82)	0.80 (1.15)	1.80 (1.50)	1.30 (1.34)	0.90 (1.19)	2.00 (1.59)	0.90 (1.19)	1.60 (1.46)
Triazophos + Deltamethrin	4.80 (2.27)	4.20 (2.17)	1.10 (1.27)	1.40 (1.39)	1.00 (1.20)	1.40 (1.37)	1.10(1.27)	0.70 (1.10)	1.00 (1.24)
Indoxacarb	4.40 (2.18)	3.10 (1.89)	1.80 91.50)	1.40(1.40)	0.80 (1.16)	1.40 (1.36)	1.60 (1.42)	0.90 (1.19)	1.00 (1.22)
Chlorpyriphos+ Cypermethrin	3.70 (2.02)	1.20 (1.32)	1.30(1.34)	1.50 (1.42)	0.90 (1.18)	1.20 (1.29)	1.30 (1.34)	1.10 (1.27)	1.20 (1.30)
Endosufan	3.80 (2.03)	3.20 (1.89)	1.40 (1.37)	1.90 (1.54)	1.00 (1.21)	1.00 (1.21)	1.40 (1.37)	1.20 (1.32)	1.40 (1.37)
Untreated Control	3.40 (1.89)	3.40 (1.98)	2.40 (1.71)	2.40 (1.71)	2.00 (1.58)	2.00 (1.58)	2.20 (1.66)	2.40 (1.71)	2.60(1.76)
Sem	0.58	0.70	0.30	0.30	0.20	0.20	0.20	0.10	0.10
CD@5%	1.70	2.20	NS	NS	NS	NS	NS	NS	NS

DAS : Days After Spray

Values in parentheses are square root transformed values (“x + 0.5)

Table 3.: Bio-efficacy of different insecticides against boll worms of cotton during Kharif 2002

Treatments	Pre-treatment count	Post-treatment counts/No. of larvae per plant							
		I[t] Spray		II Spray		III Spray		IV Spray	
		3 DAS	10 DAS	3 DAS	10 DAS	3 DAS	10 DAS	3 DAS	10 DAS
Methomyl	7.53 (2.90)	7.93 (2.70)	6.20 (2.70)	4.27 (2.10)	3.40 (1.95)[a]	1.93 (1.50)[a]	1.60 (1.30)[a]	0.87 (1.20)[a]	0.53 (1.10)[ab]
Thiodicarb	6.47 (2.61)	6.00 (2.53)	5.93 (2.50)	5.20 (2.36)	3.87 (2.05)[a]	2.13 (1.60)[a]	2.00 (1.60)[ab]	1.00 (1.20)[a]	0.93 (1.10)[ab]
Triazophos	6.23 (2.55)	7.47 (2.80)	7.13 (2.74)	6.13 (2.54)	6.33 (2.50)[ab]	3.80 (2.10)[a]	3.80 (2.10)[ab]	3.20 (1.85)[abc]	3.13 (1.80)[ab]
Lamda Cyhalothrin	6.33 (2.58)	7.13 (2.73)	6.47 (2.60)	3.80 (2.03)	3.80 (2.05)[a]	3.13 (1.90)[a]	3.00 (1.80)[ab]	2.80 (1.80)[abc]	2.47 (1.70)[ab]
Profenofos + Cypermethrin	7.80 (2.85)	7.60 (2.80)	7.20 (2.76)	6.27 (2.50)	4.53 (2.20)[a]	2.87 (1.80)[a]	2.80 (1.80)[ab]	3.47 (1.96)[bc]	3.07 (1.80)[ab]
Triazophos + Deltamethrin	8.00 (2.83)	8.60 (2.96)	7.93 (2.87)	5.20 (2.34)	4.07 (2.10)[a]	4.00 (2.10)[a]	3.80 (1.99)[ab]	1.00 (1.20)[a]	2.53 (1.70)[ab]
Indoxacarb	8.00 (2.90)	7.40 (2.75)	6.93 (2.60)	4.27 (2.20)	3.40 (1.90)[a]	2.00 (1.50)[a]	1.20 (1.40)[a]	1.00 (1.16)[a]	0.80 (0.99)[a]
Chlorpyriphos+ Cypermethrin	6.67 (2.65)	6.00 (2.23)	5.20 (2.31)	4.80 (2.30)	3.80 (2.00)[a]	2.40 (1.70)[a]	2.60 (1.75)[ab]	2.13 (1.60)[abc]	2.00 (1.50)[ab]
Endosufan (Standard Check)	7.80 (2.86)	8.00 (2.63)	7.40 (2.76)	6.00(2.50)	6.27 (2.60)[ab]	4.53 (2.20)[a]	5.00 (2.30)[bc]	4.00 (2.10)[c]	4.13 (2.10)[bc]
Untreated Control	8.80 (3.03)	9.07(3.05)	8.60 (2.98)	8.00 (2.90)	9.00 (3.07)[b]	8.40 (2.99)[b]	8.47 (2.90)[c]	13.00 (3.64)[d]	10.00 (3.00)[c]
F- test	NS	NS	NS	NS	*	*	*	*	*

DAS : Days After Spray NS : Non Significant * Significant at p = 0.05 by DMRT

Values followed by letters along the coloumn are not significantly different

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ha), triazophos (10.06 q/ha), triazophos + deltamethrin (9.38q/ha), endosulfan (7.96 q/ha) and control (2.78 q/ha). The plots treated with methomyl gave significantly higher yield over all other treatments except indoxacarb which was on par. Indoxacarb and thiodicarb were also on par but superior over other treatments. The insecticides thiodicarb, profenofos + cypermethrin and chlorpyriphos + cypermethrin were on par but differed significantly with rest of the treatments. Similarly Rawale et al (2002) reported highest seed cotton yield (11.51 q/ha) in profenophos + cypermethrin treated plots. The cost benefit ratio was maximum in methomyl (1:2.68) followed by chlorpyriphos + cypermethrin (1:1.71), profenofos + cypermethrin (1:1.56), indoxacarb and lamda cyhalothrin (1:1.50 each) and thiodicarb (1:1.39). Triazophos + deltamethrin registered lowest cost benefit ratio of 1:0.67 (Table 4).

Table 4. Yield and Cost : Benefit ratio of new insecticide molecules used in cotton during 2000-01

Treatments	Yield (q/ha)	Added Yield (q/ha)	Total Income (Rs)	Cost of the treatment	Cost Benefit Ratio
Methomyl	21.36a	18.58	20,438	7,600	1:2.68
Thiodicarb	17.22bc	14.44	15,884	11,360	1:1.39
Triazophos	10.06bc	7.28	8,008	8,880	1:0.90
Lamda Cyhalothrin	11.97d	9.19	10,109	6,720	1:1.50
Profenofos + Cypermethrin	15.62c	12.84	14,124	9,040	1:1.56
Triazophos + Deltamethrin	9.38de	6.60	7,260	10,800	1:0.67
Indoxacarb	19.25ab	16.47	18,117	11,560	1:1.56
Chlorpyriphos+ Cypermethrin	15.55c	12.77	14,047	8,200	1:1.71
Endosufan	7.96e	5.18	5,980	6,640	1:0.86
Untreated Control	2.78f	—	—	—	—
F-test	*	*			

NS : Non Significant * Significant at p = 0.05 by DMRT
Values followed by letters along the coloumn are not significantly different

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