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EFFECT OF AMITRAZ AND SELECTED INSECTICIDES ON BOLLWORMS AND COTTON PLANTS*

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Two field experiments were conducted to study the effect of amitraz and selected insecticides either alone or their combinations on the growth and yield components of cotton when used for pest control. In the first experiment, amitraz 0.04%, 0.06% and 0.08% treatments recorded the highest percentage of increase in yield over untreated control and the lowest percentage of shedding of reproductive parts due to bollworms as compared to standard [monocrotophos 0.1%]. Amitraz treatments were effective in increasing both vegetative and reproductive growth of cotton plant and were also effective in inducing early maturity. In the second experiment, growth and yield components were high in endosulfan 0.05%+amitraz 0.03%, monocrotophos 0.05% + amitraz 0.03% and carbaryl 0.1% + amitraz 0.03% treatments as compared to endosulfan 0.1%, monocrotophos 0.1% and carbaryl 0.2% alone respectively. Endosulfan 0.05% + amitraz 0.03% recorded the lowest percentage of shedding of reproductive parts due to bollworms. None of the insecticides/ insecticide combination tested was phytotoxic to cotton plant.

Cotton seems to be a favourite plant for pests, and is known to be attacked by 200 species of insects and mites apart from various diseases (Anon., 1981). Variety of pesticides have been tried from time to time for the effective control of cotton pests The effect of these pesticides on the growth of cotton plant has not been much emphasised. However, carbaryl was found to reduce the plant height (Zaki and Rafie, 1968). Murugesan *et al.*, (1979) reported that, permethrin, cypermethrin and decamethrin had increased the height of the MCU9-cotton plants. Thimmiah (1980) also reported the increase in the height of 'Varalaxmi' cotton plants due to carbofuran at 0.75 kg per ha. Amitraz is a new insecticide/acaricide belonging to 'triazapentadiene' (Formamidine) group. It has not been tested for its effect on plant growth and yield components of cotton when used for pest control. Therefore, two field experiments were conducted during 1980-81 at Agricultural College, Dharwad,, to study the effect of amitraz alone

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Table 1 Effect of amitraz and monocrotophos on the growth of cotton

Treatments	Concentration (%)	Average plant height (cm)		Average number of leaves per plant		Average number of branches per plant at 180 DAS		
		120 DAS	180 DAS	120 DAS	180 DAS	Monopodials	primary sympodials	Secondary sympodials
Amitraz 20 EC	0.04	116.75	134.00	129.25	18.15	4.70	20.20	25.75
Amitraz 20 EC	0·06	112.55	139.80	129.95	13.25	4.90	21.60	26.20
Amitraz 20 EC	0.08	129.55	147.25	130.05	9.35	4.90	23.40	27.55
Monocrotophos 40EC*	0.10	135.65	151.10	140.90	39.70	5.20	25.80	32.20
Untreated control	—	96.15	106 35	99.00	35.78	4.30	19.40	23.60
S.Em ±	—	1.38	2.18	1.14	0.70	0.12	0.29	0 36
C. D. at 5%	—	4.23	6.74	3.50	2.16	0.36	0.91	1.11

*Applications were made at 14 days interval.
DAS = Days after sowing.

and in combination with few conventional insecticides on growth and yield components of cotton when used for pest control.

MATERIAL AND METHODS

Both the experiments were laid out in randomised block design with four replications on black cotton soils having uniform fertility levels The plot size of each treatment was 10m x 10 m and consisted of following treatments

Experiment 1 :

(1) Amitraz 0.04%
(2) Amitraz 0.06%
(3) Amitraz 0.08%
(4) Monocrotophos 0.1% and
(5) Untreated control.

Experiment 2 :

(1) Endosulfan 0.1%
(2) Monocrotophos 0.1%
(3) Carbaryl 0.2%
(4) Endosulfan 0 .05+Amitraz 0.03%
(5) Monocrotophos 0.05% + Amitraz 0.03%
(6) Carbaryl 0.1%+Amitraz 0.03%and
(7) Untreated control

'Varalaxmi' hybrid cotton was used for both the experiments and uniform plant population was maintained in all the treatments. All the treatments received a recommended dose of fertilizer (60 : 30 : 30 Kg NPK/ acre). Soil application of carbofuron 3% granules @ 8 kg per acre was

Table 2. Effect of amitraz and monocrotophos on boll worms, yield and yield components of cotton.

Treatments	Concentration (%)	Average number of green bolls per plant*	Averge number of bolls picked per plant	Average weight of seed cotton per boll (g)	Yield of seed cotton per plant (g)	Yield of seed cotton (g/ha)	Increase in the yield of seed cotton over untreated control (%)	Sheeding of squares, flower buds and bolls due to bollworms (%)
Amitraz 20 EC	0.04	75.30	56.30	2.90	160.20	21.74	187.95	49.64[a] (58.05)[b]
Amitraz 20 EC	0.06	85.35	62.20	3.00	181.15	24.48	224.24	48.68 (56.40)
Amitraz 20 EC	0.08	86.45	63.55	3.10	189.35	25.58	238.81	47.85 (54.63)
Monocrotophos 40 EC**	0.10	71.35	51.60	2.50	132.60	17.34	129.67	50.52 (59.58)
Untreated control	—	40.40	32.50	1.80	55.75	7.55	—	61.73 (77.55)
S. Em ±	—	0.48	0.50	0.08	0.51	0.60	—	0.56
C. D. at 5%	—	1.48	1.54	0.26	1.58	1.85	—	1.73

*At peak boll formation stage (i. e. at 120 days after sowing).

**Applications were made at 14 days interval.

a-Arc sin $\sqrt{\text{percentage}}$ values.

b-Original values.

done at the time of sowing to control the sucking pests of cotton in the early stages. At 25 days after sowing, soil drenching and foliar application of endosulfan 0.1 per cent was made against cutworms. The treatments were started after 40 days from sowing. One spray according to treatments was given at 40 days after sowing in both the experiments. In the first experiment, amitraz was sprayed 11 times at weekly interval starting from 55th day after sowing in comparison with monocrotophos which was sprayed 6 times at an interval of 14 days starting from 55th day after sowing. In the second experiment, the crop was given 6 sprays at 14 days interval starting from 55th day after sowing.

In each treatment, five randomly selected plants were tagged and all the observations regarding the plant characters were made on these plants. The plant height and number of leaves per plant were recorded at 120 and 180 days after sowing. The number of branches (monopodials, primary sympodials and secondary sympodials) were recorded at 180 days after sowing. The number of green bolls per plant was recorded at peak boll formation stage i.e., at 120 days after sowing. Shed squares, flower buds and young bolls were collected from three fixed inter-row space per plot at every 15 days interval starting from 55th day after sowing till the boll opening. The collected shed squares, flower buds and young bolls were carefully sorted out and shedding due to the boll worms and other causes was recorded. Number of bolls picked per plant, weight of seed cotton per boll and yield of seed cotton per plant were also recorded. Yield of seed cotton obtained from each treatment was expressed in quintals per hectare. The data was statistically analysed.

RESULTS AND DISCUSSION

Experiment 1 :

The plant height, number of leaves per plant and number of branches per plant recorded on different days are presented in (Table 1) and yield and yield components are presented in Table-2. The results indicated that the growth of the plants was significantly better in all the insecticidal treatments as compared to the untreated control. The poor growth of the untreated plants can be attributed to the severe pest attack which resulted in the loss of plant parts. The amitraz treatments (0.04, 0.06 and 0.08%) resulted in significantly increased vegetative growth of cotton plants upto peak boll formation stage as compared to untreated control (Table 1). Similarly amitraz treatments also resulted in significantly increased reproductive growth of cotton plant upto peak boll formation stage as compared to standard (monocrotophos 0.1%) and untreated control (Table 2). Further, the square formation was drastically reduced and there was early defoliation in case of the

Table 3 Effect of selected insecticides individually and in combination with amitraz on the growth of cotton.

Treatments	Concentration (%)	Average plant height (cm)		Average number of leaves per plant		Average number of branches per plant at 180 DAS		
		120 DAS	180 DAS	120 DAS	180 DAS	Monopodials	Primary sympodials	Secondary sympodials
Endosulfan 35 EC	0.10	128.85	144 05	131.05	14.35	4.90	25.80	28.40
Monocrotophos 40 EC	0.10	135.65	151 10	140.90	39.70	5.20	25.30	32.20
Carbaryl 50 WP	0.20	130.25	140.60	129.85	29.95	4 80	23.60	27.40
Endosulfan 35EC+Amitraz 20 EC	0.05+0.03	139.80	150 60	135.70	17.18	4.90	26.40	29.55
MOnocrotophos 40EC+ Amitraz 20EC	0.05+0.03	141.25	189.10	144.40	44.20	5.35	27.60	33.40
Carbaryl 50 WP+Amitraz 20EC	0.10+0.03	138.65	147.35	134.90	32.65	4.90	24.20	28.40
Untreated countrol	—	96.15	106 35	99 00	35.78	4.30	19.40	23.60
S. Em.±	—	1.12	2.98	1.17	0.56	0 10	0.20	0.16
C. D. at 5%	—	3.34	8.85	3.48	1.67	0.31	0.60	0.56

DAS = Days after sowing.

amitraz treatments. Thus, the plants in amitraz treatments appeared more dry thereby indicating early maturity as compared to that of the standard and the untreated control. The early defoliation had facilitated in early picking of seed cotton. However, in case of monocrotophos treatment, the vegetative growth continued even after the peak boll formation stage (Table-1). The plants appeared green and there was continuous square formation in monocrotophos treatment even upto 180 days after sowing indicating delayed maturity. The early maturity of the amitraz treated plants may be helpful in overcoming the moisture stress in the later part of the season, particularly in case of rainfed cotton.

Highest percentage of increase in the yield over untreated control was recorded by amitraz treatments (187.95 to 238.81) as compared to standard (monocrotophos 0.1%) Further, the results revealed that the increas in yield by amitraz treatments was due to better control of boll worms as evidenced by less percentage of sheeding of squares, flower buds and young bolls due to boll worms, which resulted in the retention of more number of bolls per plant, more number of bolls picked per plant, more weight of seed cotton per boll and higher yield of seed cotton per plant (Table 2). Hassan *et al.* (1975) opined that in general, the insecticidal treatments increased the proudction of bolls (monocrotophos being the best material in this aspect). There is no information aviailable in the literature on the effect of amitraz on the growth and yield of cotton.

Experiment 2 :

Observations recorded on plant growth are presented in Table-3 and yield and yield components are presented in Table - 4. The results revealed that the growth of the cotton plants was significantly better in all the insecticidal treatments as compared to the untreated control. Further, the growth of the plant was better in endosulfan 0.05% + amitraz 0.03%, monocrotophos 0.05% + amitraz 0.03% and carbaryl 0.1% + amitraz 0.03% as compared to endosulfan 0.1% monocrotophos 0.1% and carbarly 0.2% respectively (Table-3)

Endosulfan 0.05% + amitraz 0.03% and endosulfan 0.1% treatments gave significantly more percentage of increase in the yield over untreated control. (224.77 and 223.31 resoectively) as compared to remaining insecticidal treatments (96.29 to 175.50). Endosulfan 0.05% + amitraz 0.03% treatment recorded the lowest percentage of sheeding of squares, flower buds and young bolls due to boll worms (48.23) and it was on par with endosulfan 0.1% (48.69) and monocrotophos 0.05% + amitraz 0.03% (49.29) treatments. The number of green bolls per plant, number of bolls picked per plant, weight of seed cotton per boll, yield of seed cotton per plant were highest in endosolfan 0.05% + amitraz 0.03% monocrotophos

Table 4 Effect of selected insecticides individually and in combination with amitraz on boll worms, yield and yield components of cotton

Treatments	Concentration (%)	Average number of green bolls per plant*	Average number of bolls picked per plant	Average weight of seed cotton per boll (g)	Yield of seed cotton per plant (g)	Yiel of seed cotton (Q/ha)	Increase in the yield of seed cotton over untreated control (%)	Shedding of squares, flower buds and bolls due to boll worms (%)
Endosulfan 35 EC	0.10	82.55	61.55	2 95	180.40	24.41	223.31	43 69 (56.43,[a] [b]
Monocrotophos 40 EC	0.10	71.35	51.60	2.50	132.60	17.34	129.67	50.51 (59.58)
Carbaryl 50 WP	0.20	65.40	44.60	2.40	110.50	14.82	96.29	55.79 (68.38)
Endosulfan 35 EC+Amitraz 20 EC	0.05+0.03	84.45	61.95	3.00	181.70	24 52	224 77	48.23 (55.63)
Monocrotophos 40EC+Amitraz 20EC	0.05+0.03	75.40	55.45	2.88	158.40	20.80	175.50	49.29 (57.45)
Carbaryl 50WP+Amitraz 20EC	0.10+0.03	72.25	54.55	2.60	141.45	18.65	147.02	54.02 (65.48)
Untreated contral	—	40.40	32.50	1.80	56.00	7.55	—	61.73 (77.55)
S. Em. ±	—	0.41	0.66	0.08	0.58	0 57	—	0.61
C. D. at 5%	—	1.23	1.98	0.23	1.73	1.70	—	1.80

* — At peak boll formation stage (i. e., 120 days after sowing)

a —Arc sin $\sqrt{\text{Percentage}}$ values.

b — Original values.

0 05% + amitraz 0.03% and carbarly 0.1% + amitraz 0.03% as compared to endosulfan 0.1% monocrotophos 0 1% and carbaryl 0.2% ressectively (Table-4).

Phytotoxic effe ct and compatibility :

In the present investigations, none of the insecticide (either alone or in combinations) produced phytotoxic symptoms on the cotton plant at the concentrations they have been tested. Hassan *et al*., (1975) reported that, monocrotophos did not produce significant phytotoxic effect on cotton plant.

Endosulfan 0.05% + amitraz 0.03%, monocrotophos 0.05% + amitraz 0 03% and carbaryl 0.1% + amitraz 0 3% treatments recorded better plant growth as evidenced by high plant height, number of branches number of leaves, number of green bolls, number of bolls picked per plant and yield of seed cotton as compared to endosulfan 0.1% monocrotophos 0 1% and carbaryl 0.2% alone respectively indicating the compatibility and synergetic action of amitraz 0.03% with endosulfan 0.05% monocrotophos 0.05% and carbaryl 0.1%.

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