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BIOEFFICACY OF A NEWER INSECTICIDE EMAMECTIN BENZOATE 5% EC AGAINST COTTON BOLLWORMS

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ABSTRACT

Field trials were conducted during *kharif* seasons, 2004 and 2005 with American cotton variety Pusa 8-6 to determine the bioefficacy of a newer insecticide, emamectin benzoate 5% EC against bollworms in cotton. Emamectin benzoate EC formulation was evaluated at various doses along with its water soluble granule (WSG) formulation and a another semi-synthetic novel insecticide, spinosad. The EC formulation of emamectin benzoate at the dose of 11 g ai/ha was effective in reducing the incidence of bollworm complex and increased the yield of seed cotton by 97.3% and 89.4% over untreated control during 2004 and 2005 respectively. The WSG formulation of emamectin benzoate was also effective at the same dose (11 g ai/ha) in protecting the crop and increased the yield of seed cotton by 89.8 and 98.1% during both the years. The results suggest that the EC formulation of emamectin benzoate could be recommended as a component of sustainable management of bollworms in cotton.

Key words: Bollworms, emamectin benzoate formulation, spinosad, cotton yield

Cotton is a leading commercial crop grown world wide. India occupies largest area but ranks third in production in the global scenario. The major hindrance in attaining high production of seed cotton is damage inflicted by insect pests. The pest spectrum is quite complex and have been reported to attack at different stages of crop growth. Of these, bollworm complex *viz., Helicoverpa armigera* (Hub), *Earias vittella* (Fab.) and *Pectinophora gossypiella* (Saund.) are key insect pests accounting for an average yield reduction of seed cotton up to 59-98% (Gupta, 1996). The destructive action of cotton bollworms are known to cause total crop failures in various regions where farmers are becoming victims of pest menace resulting in socio economic calamities. The conventional insecticides in vogue include broad spectrum insecticides such as organophosphates and synthetic pyrethroids at frequent intervals during the growing season, due to which the bollworms in particular *H. armigera* have developed resistance to these insecticides (Kranthi *et al.*, 2001 and Ramsubramanian and Regupathy, 2004). These have resulted in renewed interest in the research for exploring the opportunities of using newer molecules to combat these pests. Keeping in view, the present study was taken-up to evaluate the efficacy of EC formulation of a newer insecticide, emamectin benzoate 5% EC, against cotton bollworms under field conditions.

MATERIALS AND METHODS

Present investigation was carried out at the Indian Agricultural Research Institute, New Delhi, during *kharif* season 2004 and 2005 (May-Dec.) with American cotton (*Gossypium hirsutum* L. var. Pusa 8-6), to evaluate the bio-efficacy of different dosages of EC formulation of emamectin benzoate along with spinosad against bollworm complex. The trials were laid in Randomized Block Design with 8 treatments including control, replicated thrice during both the years. The crop was sown on May 25 in 2004 and May 26 in 2005 in 30 sq m plots maintaining a spacing of 75 cm and 30 cm between rows and plants respectively. All the agronomic practices were followed for raising the crop under irrigated conditions. Since sucking pests were below the prescribed economic threshold level, no initial control measures were taken for these pests. However, to protect the crop from the attack of bollworms, spraying of different doses of insecticides were given with high volume knapsack sprayer (spray fluid 450-850 litres/ha approx.) starting from 50 per cent flowering stage and repeated at regular intervals as suggested by Gupta and Agarwal (1985). A total of three rounds of spraying were given during both the years to protect the crop from the attack of bollworms.

All the shed reproductives (squares, flowers, small bolls and big green bolls) from treated and untreated plots were collected and examined for bollworms incidence. Fifteen green bolls were plucked from randomly selected plants in each plot preferably in the interior rows and dissected for recording infestations of bollworms on loculi basis. Three plants from each plot were randomly selected in the interior five rows and the incidence of bollworms in open bolls was recorded from all the harvestable bolls on the selected plants. Each open boll was examined for recording the incidence of bollworms on loculi basis before each picking. Two pickings of cotton were done from each plot and seed cotton yield of both the pickings in each plot were added for computing total yield per hectare. The data generated were subjected to statistical analyses following standard methods using Indostat Statistical Software®, Hyderabad.

RESULTS AND DISCUSSION

Incidence of bollworms

It is evident from the tables (1 and 2) that all the insecticidal treatments were significantly effective in suppressing the bollworms incidence as compared to untreated control during both the years and conversely increasing the total yield of seed cotton significantly. It is apparent from table 1 that the insecticidal treatments were effective in checking the bollworms incidence from 30 Sep. to 30 Oct. Bollworms incidence in shed reproductives in 2004 crop season shows that all the doses of emamectin benzoate differed significantly from the untreated check. The incidence was significantly less in plots treated with higher dose (22 g ai/ha). In green bolls and open bolls on loculi basis, emamectin benzoate significantly suppressed the incidence of bollworms, 47.1 and 42.1% at both the observations on 13 Oct. and 30 Oct. respectively and the higher dose (22g ai/ha) was at par with emamectin benzoate 14.5 and 11g ai/ha, followed by spinosad 45% SC (61.2 and 45.2% respectively on these dates). The higher doses of emamectin benzoate 5% EC (22.0, 14.5 and 11 g ai/ha) were more effective against bollworm complex than its lower doses, without causing any phytotoxic effects in the plants. It is also clear from the table that emamectin benzoate 5% EC and its 5%WSG formulation at the dose 11g ai/ha were equally effective in suppressing the incidence of bollworms in cotton and both were significantly at par.

During *Kharif* 2005, observations on bollworms incidence in shed reproductives taken on 7 Sep. and 23 Sep. showed that emamectin benzoate at higher doses (14.5 and 22 g ai/ha) were significantly superior to all other treatments and recorded 25.6 and 18.8% incidence of bollworms respectively on 7 Sep. However, its lower dose (11g ai/ha) was at par with its higher doses. It is evident from the table that the insecticidal treatments were significantly effective in suppressing the incidence of bollworms as compared to untreated control. It is clearly evident from the data that the higher doses of emamectin benzoate 5% EC (11, 14.5 and 22.0g ai/ha) were more effective in suppressing the incidence of bollworms in green bolls on loculi basis (40.5, 36.6 and 27.0% respectively) which were at par with each other and spinosad 45 SC (35.8%). It is also seen from the table that emamectin benzoate 5% EC formulation was equally effective as its 5% WSG formulation. These treatments were superior in controlling the bollworms incidence on open bolls also. Emamectin benzoate 11g ai/ha (45.5%) was at par with its higher doses, and spinosad (38.4%) followed by its lower doses, whereas in control the incidence of bollworms in open bolls on loculi basis was 63.4 per cent.

YIELD OF SEED COTTON

The data of cotton yield recorded during 2004 and 2005 (Tables 1 and 2) showed that all the insecticidal treatments yielded significantly more than control. During 2004 crop season, higher dose of emamectin benzoate 22g ai/ha recorded the highest yield of seed cotton (2494.6 kg/ha) which was at par with 14.5g ai/ha (2185.8 kg/ha) followed by its lower dose (11g ai/ha; 2055.0 kg/ha), which was as effective as spinosad (2191.3 kg/ha). However, the untreated control recorded only 1041.6 kg/ha of seed cotton. As such the highest dose of emamectin benzoate (22g ai/ha) showed 139.5% increase in yield over untreated control, followed by its lower doses. The same trend was also noticed in 2005 crop (Table 2). Emamectin benzoate at its highest dose realized yield of 1861.1 kg/ha seed cotton with 111.4% increase in yield over control. Its EC formulation (11g ai/ha) was equally effective as its WSG formulation (1788.8 kg/ha and 1802.7 kg/ha respectively). The yield in untreated control was 944.4 kg/ha.

Emamectin benzoate is a novel semi-synthetic derivative of the natural product abamectin in the avermectin family. The bioefficacy of this epi-methyl amino derivative against a broad spectrum lepidopteran pests is well documented due to its photostability and translaminar movement, field efficacy and lack of cross-resistance with other commercially used pesticides (White *et al.*, 1997). Though the mode of

Table 1. Bioefficacy of emamectin benzoate 5% EC against bollworms and yield response in cotton, 2004

Treatment	Dose (g ai/ha)	% incidence of bollworms: Shed reproductives		Green bolls (loculi basis)		Open bolls (loculi basis)		Total yield of seed cotton (kg/ha)	% increase in yield over control
		Sept.22	Sept.30	Oct.4	Oct.13	Oct.30	Nov.30		
T_1 Emamectin benzoate 5% EC	7.5	90.2 (71.8)	82.4 (65.4)	79.0 (62.9)	74.3 (59.6)	57.3 (49.3)	92.7 (74.4)	1508.9	44.8
T_2 Emamectin benzoate 5% EC	9.0	86.5 (68.5)	77.1 (61.8)	68.2 (55.8)	71.3 (57.7)	53.6 (47.3)	85.8 (69.1)	1737.2	66.7
T_3 Emamectin benzoate 5% EC	11.0	84.9 (67.4)	74.7 (72.4)	66.0 (54.4)	69.1 (56.4)	50.9 (45.6)	87.1 (69.5)	2055.0	97.3
T_4 Emamectin benzoate 5% EC	14.5	83.5 (66.3)	72.4 (58.5)	48.9 (44.4)	47.3 (43.4)	43.0 (40.8)	84.3 (67.9)	2185.8	109.9
T_5 Emamectin benzoate 5% EC	22.0	82.5 (65.5)	57.3 (49.4)	43.6 (41.3)	47.1 (43.3)	42.1 (40.4)	65.7 (54.4)	2494.6	139.5
T_6 Proclaim® 5% WSG (Emamectin benzoate)	11.0	85.9 (68.0)	73.2 (58.9)	59.9 (50.8)	63.2 (52.8)	46.9 (43.3)	87.5 (67.6)	1977.8	89.8
T_7 Spinosad 45% SC (Tracer®)	50.0	84.8 (67.5)	57.4 (49.2)	57.6 (49.5)	61.2 (51.5)	45.2 (42.2)	77.4 (62.4)	2191.3	110.4
T_8 Untreated control	-	91.5 (73.6)	88.5 (70.3)	84.7 (67.1)	92.0 (73.8)	78.9 (63.2)	95.4 (74.2)	1041.6	-
SEm ±		NS	2.98	3.06	2.65	3.77	NS	77.3	-
CD (P≥0.05)		-	(9.04)	(9.28)	(8.05)	(11.44)	-	(234.4)	-

Figures in parentheses are arcsine transformed values

Table 2. Bioefficacy of emamectin benzoate 5% EC against bollworms and yield response in cotton, 2005

Treatment	Dose (g ai/ha)	% incidence of bollworms: Shed reproductives		Green bolls (loculi basis)		Open bolls (loculi basis)	Total yield of seed cotton (kg/ha)	% increase in yield over control
		Sept.7	Sept.23	Sept.28	Oct.6	Oct.19		
T_1 Emamectin benzoate 5% EC	7.5	44.2 (41.82)	58.3 (49.77)	25.9 (30.42)	61.2 (51.54)	55.2 (48.18)	1433.3	51.7
T_2 Emamectin benzoate 5% EC	9.0	40.7 (39.50)	54.2 (47.41)	24.1 (28.90)	49.4 (44.64)	49.6 (44.74)	1663.8	76.1
T_3 Emamectin benzoate 5% EC	11.0	29.3 (32.31)	52.7 (46.56)	23.0 (27.73)	40.5 (39.36)	45.5 (42.44)	1788.8	89.4
T_4 Emamectin benzoate 5% EC	14.5	25.6 (29.55)	39.7 (39.07)	17.7 (24.82)	36.6 (37.04)	42.1 (40.43)	1861.1	97.1
T_5 Emamectin benzoate 5% EC	22.0	18.8 (25.54)	39.3 (38.53)	11.7 (19.90)	27.0 (31.32)	33.2 (35.14)	1996.9	111.4
T_6 Proclaim® 5% WSG (Emamectin benzoate)	11.0	33.4 (35.14)	48.2 (43.94)	21.6 (27.60)	38.0 (37.99)	44.7 (42.15)	1802.7	98.1
T_7 Spinosad 45% SC (Tracer®)	50.0	21.5 (27.44)	48.3 (44.05)	24.1 (29.33)	35.8 (36.58)	38.4 (38.25)	1961.1	107.6
T_8 Untreated control	-	56.2 (48.59)	64.0 (53.20)	26.4 (30.61)	63.6 (53.52)	63.4 (52.80)	944.4	--
SEm $\pm$		4.38	NS	NS	4.16	2.98	164.2	
CD ($P \geq 0.05$)		(13.29)	--	--	(12.64)	(9.04)	(497.9)	

Figures in parentheses are arcsine transformed values action of emamectin benzoate is similar to abamectin, a GABA and glutamate-gated chloride channel agonist, but the emamectin benzoate is more than 1500 times toxic than abamectin and more than 77 times toxic than spinosad against *Spodoptera litura* under laboratory condition (Dybas *et al.,* 1989 and Suby *et al.,* 2008).

The experiment reveals that application of emamectin benzoate EC formulations (11 g ai/ha) was effective as WSG formulations at the same dose against bollworms. Such compounds can be used in the pest management strategy to achieve the desired control. Making insect management decisions based on established treatments rather than applying treatments based on schedules or presence or absence of pests is a proven method of reducing insect management costs. Effective use of the newer insecticides coupled after intensive scouting of populations of various pest species present in a field will lead to sustainable management of cotton bollworms.

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