

Efficacy of Selective Insecticides Against Tobacco Caterpillar *Spodoptera litura* Fab in Castor

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Abstract Efficacy of selective insecticides against tobacco caterpillar, *Spodoptera litura*, indoxacarb 14.5% SC @ 0.015% was found to be the most effective resulting in 81.25% mortality when sprayed two times at 15 days interval. This is followed by thiodicarb 75 WP @ 0.05% (58.90), acephate 75 SP @ 0.075% (60.19%), novaluron 10 EC @ 0.01% (57.22%) monocrotophos 36% SL @ 0.05% (52.11%) and Profenophos 50 EC @ 0.05% with 49.31% mortality. Among the biopesticides, *Bacillus thuringiensis* 5% WP 9.0×10^9 spores / g was effective with a record of 38.10% mortality and *Beauveria bassiana* 1.15% WP @ 4.23×10^9 conidia / ml with 25.64% mortality.

Keywords *Bacillus thuringiensis*, Biopesticides, Castor, Efficacy, *Spodoptera litura*.

Introduction

Castor (*Ricinus communis* Lin.) is an important non-edible oilseed crop which is grown in arid and semi-arid regions. In India, castor is sown during July or

August and harvested around December or January. More than 20 species of insect pests were found associated with castor, but many of them were highly irregular in occurrence over years, distributed in patches with low population causing no remarkable damage to the crop. Most of the insect pests were either defoliators or sucking pests [1]. The major pest problems in castor include the defoliators, semilooper, *Achaea janata* L., tobacco caterpillar, *Spodoptera litura* Fab. capsule borer, *Conogethes punctiferalis* Guen. and the sucking pests, leafhopper, *Empoasca flavescens* Fab. thrips, *Retithrips syniacus* Mayet and whitefly, *Trialeurodes ricini* Misra [2]. In view of the economic significance attached to these insect pests, the present investigations were undertaken to evaluate the efficacy of selected insecticides and find out a suitable pest management strategy.

Materials and Methods

Evaluation of efficacy of selective insecticides against tobacco caterpillar, *Spodoptera litura* Fab was conducted at student farm, College of Agriculture, Rajendranagar, Hyderabad during *kharif* season 2013 and experiment was laid out in randomized block design method with nine treatments and three replications. Castor plants were grown in well ploughed field with a spacing of 90 × 60 cm and raised as per the recommended agronomic practices. First spraying was taken up when pest crossed the ETL and a second spray was taken up at 15 days interval. Tobacco caterpillar population was recorded as number of larvae per plant before 24 h and 1, 3, 7 and 14 days after

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Table 1. Mortality (%) of tobacco caterpillar, *Spodoptera litura* during first spray. Figures in parentheses are arcsine values, SEM = Standard error of mean, CD ($p = 0.05$) = Critical Difference at 5% level of significance, DBS = Day before spraying, DAS = Days after spraying.

Treatments	1 DBS	1 DAS		3 DAS	
	Mean larvae/plant	Mean larvae/plant	% Mortality	Mean larvae/plant	% Mortality
Thiodicarb 75 WP @ 0.05%	10.00 (18.38)	5.33 ^c (13.30)	46.66 (27.64)	4.00 ^b (11.48)	60.00 (37.55)
Indoxacarb 14.5 SC @ 0.015%	8.00 (16.43)	2.00 ^a (7.95)	75.00 (51.63)	1.00 ^a (4.62)	87.50 (71.86)
Novaluron 10 EC @ 0.01%	10.00 (18.42)	5.67 ^c (13.76)	46.66 (25.30)	3.67 ^b (10.86)	63.33 (41.03)
Profenophos 50 EC @ 0.05%	8.00 (16.41)	5.00 ^c (12.88)	37.50 (21.52)	3.67 ^b (11.02)	54.16 (32.87)
Acephate 75 SP @ 0.075%	6.00 (14.18)	3.33 ^b (10.50)	44.44 (25.98)	2.00 ^a (7.95)	66.66 (43.95)
Monocrotophos 36 SL @ 0.05%	12.00 (20.26)	9.00 ^d (17.44)	25.00 (13.90)	7.67 ^c (16.05)	38.11 (20.78)
<i>Bacillus thuringiensis</i> 5 WP @ 9.0 × 10 ⁹ viable spores/g	10.00 (18.43)	8.33 ^d (16.75)	16.66 (9.13)	6.67 ^c (14.90)	33.33 (19.19)
<i>Beauveria bassiana</i> 1.15 WP @ 4.23 × 10 ⁹ conidia/ml	8.00 (16.41)	7.00 ^d (15.32)	12.50 (6.66)	6.00 ^b (14.15)	25.00 (13.79)
Control	7.00 (15.34)	7.00 ^d (15.34)	0.00 (0.00)	8.00 ^c (16.43)	0.00 (0.00)
SEm	0.49	0.71		1.18	
CD ($p = 0.05$)	1.46	2.12		3.54	

Table 1. Continued.

Treatments	7 DAS		14 DAS	
	Mean larvae/plant	% Mortality	Mean larvae/plant	% Mortality
Thiodicarb 75 WP @ 0.05%	2.00 (7.95) ^b	80.00 (56.75)	5.00 (12.75) ^b	50.00 (30.65)
Indoxacarb 14.5 SC @ 0.015%	0.00 (0.00) ^a	100.00 (100.00)	3.33 (10.50) ^a	58.33 (36.12)
Novaluron 10 EC @ 0.01%	3.00 (9.88) ^c	70.00 (46.36)	4.00 (11.28) ^a	60.00 (38.75)
Profenophos 50 EC @ 0.05%	2.00 (7.95) ^b	75.00 (51.57)	4.67 (12.36) ^a	41.66 (24.69)
Acephate 75 SP @ 0.075%	1.33 (5.42) ^b	77.77 (61.77)	2.67 (9.36) ^a	55.55 (33.99)
Monocrotophos 36 SL @ 0.05%	3.67 (10.86) ^c	69.44 (46.38)	8.00 (16.41) ^c	33.33 (18.99)
<i>Bacillus thuringiensis</i> 5 WP @ 9.0 × 10 ⁹ viable spores/g	3.33 (10.50) ^c	66.66 (43.07)	7.00 (15.32) ^b	30.00 (16.91)
<i>Beauveria bassiana</i> 1.15 WP @ 4.23 × 10 ⁹ conidia/ml	4.33 (12.00) ^c	45.83 (26.88)	6.67 (14.90) ^b	20.83 (9.22)
Control	10.00 (18.43) ^d	0.00 (0.00)	13.00 (21.34) ^d	0.00 (0.00)
SEm	1.17		1.02	
CD ($p = 0.05$)	3.50		3.06	

imposition of treatments and converted into per cent mortality.

Results and Discussion

Experiment was carried out to evaluate efficacy of

five chemical insecticides and two biopesticides along with untreated control against tobacco caterpillar, *Spodoptera litura* and first spray taken up at 75 days after sowing and data presented in the Table 1 revealed that one day after spraying, highest mortality of 75.00% was recorded from the treatment, indoxacarb where least mortality of 12.50% was re-

Table 2. Mortality (%) of tobacco caterpillar, *Spodoptera litura* during second spray. Figures in parentheses are arcsine values, SEM = Standard error of mean, CD ($p = 0.05$) = Critical Difference at 5% level of significance, DBS = Day before spraying, DAS = Days after spraying.

Treatments	1 DBS	1 DAS		3 DAS	
	Mean larvae/plant	Mean larvae/plant	% Mortality	Mean larvae/plant	% Mortality
Thiodicarb 75 WP @ 0.05%	4.00 (11.54)	2.67 ^c (9.36)	33.35 (18.87)	1.67 ^b (7.33)	58.33 (36.44)
Indoxacarb 14.5 SC @ 0.015%	4.00 (11.54)	1.00 ^a (5.74)	75.00 (50.25)	0.00 ^a (0.00)	100.00 (100.00)
Novaluron 10 EC @ 0.01%	5.00 (12.88)	3.67 ^d (11.02)	26.66 (14.46)	2.33 ^c (8.74)	53.33 (32.10)
Profenophos 50 EC @ 0.05%	4.00 (11.54)	2.67 ^c (9.36)	33.33 (18.87)	2.00 ^b (8.13)	50 (29.53)
Acephate 75 SP @ 0.075%	3.00 (9.97)	2.00 ^b (8.13)	33.33 (18.49)	1.00 ^b (4.62)	66.66 (53.65)
Monocrotophos 36 SL @ 0.05%	6.00 (14.05)	2.33 ^b (8.74)	61.11 (37.75)	1.33 ^b (5.42)	77.77 (61.42)
<i>Bacillus thuringiensis</i> 5 WP @ 9.0 × 10 ⁹ viable spores/g	4.00 (11.54)	3.00 ^c (9.97)	25.00 (13.55)	2.67 ^c (9.36)	33.33 (18.87)
<i>Beauveria bassiana</i> 1.15 WP @ 4.23 × 10 ⁹ conidia/ml	5.00 (12.92)	4.33 ^d (12.00)	13.33 (7.14)	3.67 ^c (10.86)	26.66 (15.93)
Control	13.00 (21.23)	13.00 ^e (21.33)	0.00 (0.00)	15.00 ^d (22.79)	0.00 (0.00)
SEm	0.81	0.84		1.29	
CD ($p = 0.05$)	1.52	1.01		3.85	

Table 2. Continued.

Treatments	7 DAS		14 DAS	
	Mean larvae/plant	% Mortality	Mean larvae/plant	% Mortality
Thiodicarb 75 WP @ 0.05%	0.33 (1.91) ^a	91.66 (83.42)	2.00 (7.95) ^a	50.00 (31.11)
Indoxacarb 14.5 SC @ 0.015%	0.00 (0.00) ^a	100.00 (100.00)	1.67 (7.15) ^a	83.33 (38.02)
Novaluron 10 EC @ 0.01%	0.33 (1.91) ^a	86.66 (85.15)	3.00 (9.88) ^b	40.00 (23.28)
Profenophos 50 EC @ 0.05%	1.33 (6.54) ^b	66.66 (43.35)	3.00 (9.97) ^b	25.00 (13.55)
Acephate 75 SP @ 0.075%	0.33 (1.91) ^a	88.88 (80.82)	1.67 (7.33) ^a	44.44 (26.48)
Monocrotophos 36 SL @ 0.05%	0.33 (1.91) ^a	94.44 (86.38)	2.00 (8.13) ^a	66.66 (42.13)
<i>Bacillus thuringiensis</i> 5 WP @ 9.0 × 10 ⁹ viable spores/g	1.67 (7.33) ^b	58.33 (36.44)	2.00 (7.95) ^a	25.00 (31.11)
<i>Beauveria bassiana</i> 1.15 WP @ 4.23 × 10 ⁹ conidia/ml	2.67 (9.27) ^b	46.66 (28.29)	4.00 (11.48) ^b	20.00 (11.17)
Control	15.00 (22.79) ^c	0.00 (0.00)	16.00 (23.58) ^c	0.00 (0.00)
SEm	1.39		0.90	
CD ($p = 0.05$)	4.01		2.68	

recorded from the biopesticide treatment, *Beauveria bassiana*. At three days after spraying, significantly maximum mortality of 87.50% was observed in indoxacarb where least mortality of 25.00% was recorded in the biopesticide treatment, *Beauveria bassiana*. Mortality of more than 50.00% i.e. 66.60,

66.60, 63.33, 60.00 and 54.16% was observed in the treatments, acephate, novaluron, thiodicarb and profenophos respectively. At seven days after spraying 100% mortality was recorded from treatment indoxacarb and least mortality of 45.83% was recorded in the treatment, *Beauveria bassiana*. The

Table 3. Cumulative mortality (%) of *Spodoptera litura*. Figures in parentheses are arcsine values, SEM = Standard error of mean, CD ($p = 0.05$) = Critical Difference at 5% level of significance.

Treatments	Pooled mean before spray		Pooled mean after spray		Overall mortality (%)
Thiodicarb 75 WP @ 0.05%	7.00	(15.31) ^b	2.88	(9.55) ^c	58.93 (50.55)
Indoxacarb 14.5 SC @ 0.015%	6.00	(14.14) ^b	1.13	(5.05) ^a	81.25 (68.24)
Novaluron 10 EC @ 0.01%	7.50	(15.88) ^b	3.21	(10.16) ^c	57.22 (49.35)
Profenophos 50 EC @ 0.05%	6.00	(14.14) ^b	3.04	(9.92) ^c	49.31 (44.65)
Acephate 75 SP @ 0.075%	4.50	(12.23) ^a	1.79	(7.53) ^b	60.19 (51.22)
Monocrotophos 36SL @ 0.05%	9.00	(17.43) ^c	4.29	(11.76) ^d	52.31 (46.52)
<i>Bacillus thuringiensis</i> 5 WP @ 9.0×10 ⁹ viable spores / g	7.00	(15.31) ^b	4.33	(11.90) ^d	38.10 (37.77)
<i>Beauveria bassiana</i> 1.15 WP @ 4.23×10 ⁹ conidia / ml	6.50	(14.76) ^b	4.83	(12.65) ^d	25.64 (29.80)
Control	10.00	(17.26) ^b	12.13	(20.52) ^e	0.00 (0.00)
SEm	1.74		1.69		7.60
CD ($p = 0.05$)	0.57		0.58		2.59

treatments, thiodicarb, acephate, profenophos, novaluron and monocrotophos recorded a mortality of 80.00, 77.77, 75.00, 70.00 and 69.44% respectively. In case of *Bacillus thuringiensis*, 66.66% larval mortality was observed. At 14 days after spraying, novaluron was superior with 60.00% mortality. Least mortality of 20.83% was recorded from *Beauveria bassiana* and mortality of 58.33, 55.55 and 50.00% was recorded from the treatments, indoxacarb, acephate and thiodicarb respectively.

Second spraying was done at 15 days interval of first spraying and highest mortality of 75.00% was recorded in indoxacarb followed by monocrotophos with 61.11% mortality. Least mortality of 13.33% was recorded with *Beauveria bassiana*. The insecticides, thiodicarb, profenophos and acephate are on par with each other with 33.35, 33.33 and 33.33% mortality respectively. At three days after spraying significantly highest mortality of 100% was recorded from indoxacarb whereas least mortality 26.66% was recorded from *Beauveria bassiana*. The treatments, monocrotophos, acephate, thiodicarb and novaluron recorded mortality of 77.77, 66.66, 58.33 and 53.33% respectively. However, profenophos could result in causing 50.00% mortality. At seven days after spraying, 100% mortality was recorded from indoxacarb where least mortality of 46.66% was recorded in the treatment, *Beauveria bassiana*. However, the remain-

ing treatments, monocrotophos, thiodicarb, acephate, novaluron and profenophos remained on par with each other recording mortality of 94.44, 91.66, 88.88, 86.66 and 66.66% respectively. Among the biopesticide, only *Bacillus thuringiensis* could cause 58.33% mortality. Significantly highest mortality of 83.33% was recorded from the treatment, indoxacarb where least mortality of 20.00% was recorded from the biopesticide treatment, *Beauveria bassiana* at 14 days after spraying and more than 50.00% mortality i.e. 66.66 and 50.00 was observed in monocrotophos and thiodicarb respectively (Table 2). From both the sprays it was clear that there was gradual increase in mortality up to seven days after spraying and there after drastic reduction was observed due to low persistence of insecticides and environmental conditions.

Cumulative mortality data presented in the Table 3 revealed that indoxacarb was most effective causing 81.25% mortality ; these results are on par with results reported by Satyanarayana et al. [3] though other insecticides viz., acephate, thiodicarb, novaluron and monocrotophos could result in mortality of more than 50.00% i.e. 60.19, 58.93, 57.22 and 52.31% respectively. However, profenophos could cause nearly 50.00% mortality of *S. litura* i.e. 49.10%. Similar to *A. janata* both *Beauveria bassiana* and *Bacillus thuringiensis* could cause mortality ranging from 25.64

to 8.10% of *S. litura*. Similar results were reported for biopesticides earlier [4, 5]. Indoxacarb being oxadiazine group member affect voltage dependent sodium channels of axonic transmission that could immediately result in paralysing the larval body. Similarly thiodicarb, the next best insecticide against defoliators which belongs to carbamate group affect the acetylcholine esterase enzyme which lead to paralysis followed by novaluron which belongs to benzoylphenyl urea group affecting the chitin synthetase enzyme during chitin formation. Biopesticides are least effective because they need time to cause death of the larvae unless larvae feed on the pesticide sprayed foliage in case of *Bacillus thuringiensis*, no mortality of the larvae could be observed. Hence it has resulted in low mortality. Against *Spodoptera litura* indoxocarb was superior followed by thiodicarb, acephate, novaluron, monocrotophos and profenophos. Similar results were reported earlier [6].

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