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Effect of different insecticides molecules as poison bait against *Spodoptera litura* (Fab.) in groundnut

K. R. SHANKARAGOUDA, SOMESEKHAR, A. PRABHURAJ AND A. C. HOSAMANI

Department of Agricultural Entomology, College of Agriculture, Raichur
University of Agricultural Sciences, Raichur - 584 104, Karnataka, India
E-mail: kr4856@gmail.com

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Abstract: The laboratory study was conducted during 2013-14, at the University of Agricultural Sciences, Raichur to evaluate the new insecticide molecules as poison bait against *Spodoptera litura* (Fab.) in groundnut. Two sets of insecticides (Set-1: lambda cyhalothrin 5 EC, profenofos 50 EC, chlorpyriphos 20 EC, novaluron 10 EC, methoxyfenozide 20 SC; Set-2: indoxacarb 14.5 SC, chlorfenapyr 10 SC, fipronil 5 SC, spinosad 45 SC and chlorantraniliprole 18.5 SC) along with the standard insecticidal check monocrotophos 36 SL were tested in the poison baits, at levels higher and lower than their recommended dosages for spray in the field. In each set four concentrations of five insecticide molecules were studied. The results revealed that chlorfenapyr 10 SC at all four dosages (100, 75, 50 and 25 per cent of recommended dosage) recorded cent per cent mortality and was significantly superior over all other treatments at 72 hours after exposure of larvae to the baits followed by chlorpyriphos 20 EC, monocrotophos 36 SL and profenofos 50 EC.

Key words: Chlorfenapyr, Groundnut, Poison bait, *Spodoptera litura*

Introduction

Groundnut belongs to the family leguminacae and designated as "wonder legume" in the sense that after flowering, fertilization and fruit set, the pegs (gynophore) elongate and penetrate into the soil where the pods develops and mature in soil. It is an annual legume native to South America. *Spodoptera litura* (Fab.), commonly known as tobacco caterpillar is a major polyphagous pest which attacks variety of economically important crops namely, cotton, groundnut, rice, tomato, tobacco, and other vegetables (Hill, 1993). Dhir *et al.* (1992) reported that one larva of *S. litura* per groundnut plant at seedling and flowering stages could cause a significant yield loss. At seedling stage, one larva per plant consumed about 54.7 per cent leaf area and reduced pod yield by 25.8 per cent. At flowering, one larva per plant consumed 49.1 per cent leaf area and reduced the yield by 19 per cent. At pegging, one larva per plant consumed about 38.8 per cent leaf area and resulted in a yield loss of 5.7 per cent.

Management practices includes spraying of the insecticides against early instar larvae which harbour/remain on foliage and poison baiting against grown up larvae as they hide during day near the base of the plants and bunds and cause damage during night. Therefore, insecticidal sprays will not reach the target pest and fail in bringing mortality. Baiting is a technique that comprises an attractive food along with an insecticide to lure insect pests. Baiting tends to be more selective and less environmentally disruptive than conventional pesticide applications. Monocrotophos is the lone insecticide recommended for poison baiting against *S. litura* in groundnut. However, the recent development of keeping of monocrotophos under restricted use in some crops by Central Insecticide Board and Registration Committee (Anon., 2005) and arrival of less toxic insecticides for use in pest management necessitates investigations on efficacy of alternate toxicant molecules to be used in the preparation of poison baits.

Material and methods

The experiments were conducted at the Main Agricultural Research Station, Raichur during 2013-14. Bait preparation procedure adopted by Hiremath *et al.* (1990) was followed with alterations in terms of the toxicant insecticide. As per the procedure, poison bait required for one hectare consisted of 50 kg rice bran, 625 ml of monocrotophos 36 SL and four kg of jaggery dissolved in eight liters of water. Fifty kg of rice bran was spread on the hard floor and four kg of jaggery was dissolved in two liters of water and sprinkled on the bran evenly. Thereafter, the required quantity of poison was dissolved in two liters of water and sprinkled on the bran. Afterwards, four liters of water was poured into the mixture and mixed thoroughly. Later, this mixture was transferred to gunny bags and kept for 48 hours for fermentation.

For the evaluation of bio-efficacy, two sets of insecticides were selected (Tables 1 and 2). In each set four concentrations of five insecticide molecules were studied in comparison with the untreated control and standard check (monocrotophos 36 SL). Larvae of *Spodoptera litura* (Fab.) were collected from the field and reared in the laboratory on artificial diet. The fourth instar larvae were used for the experimentation (Renju *et al.,* 2009).

Poison baits each weighing 100 g was prepared at four levels of concentrations of each insecticide molecules. Poison baits were spread into the plastic boxes with meshed lid and the laboratory reared fourth instar larvae of *S. litura* were released into each box @ 15 larvae per box and 100 g mixture of rice bran and jaggery without insecticide was also kept as control. Observations were recorded on larval mortality at 12, 24, 48 and 72 hours after the release of larvae into the boxes containing poison baits. Mortality percentages were worked out and data were analyzed after angular transformation by Duncan's multiple range test .

Results and discussion

The data presented in Table 3 indicate that mortality of *S. litura* after 72 hours after treatment, in set-I revealed that

Table 1. Insecticides used for the preparation of poison baits for laboratory experiments (Set-I)

Insecticides	Recommended Dosages for Sprays in field	Recommended Dosages for poison bait (100%)	Amount of chemicals used for preparation 100 g of poison bait		
			75%	50%	25%
Lambda cyhalothrin 5 EC	0.50 ml/l	0.625 ml/100 g	0.468 ml	0.312 ml	0.156 ml
Profenophos 50 EC	2.00 ml/l	2.5 ml/100g	1.875 ml	1.25 ml	0.625 ml
Chlorpyriphos 20 EC	2.00 ml/l	2.5 ml/100g	1.875 ml	1.25 ml	0.625 ml
Novaluron 10 EC	0.75 ml/l	0.930 ml/100 g	0.703 ml	0.468ml	0.234 ml
Mehoxyfenozide 20 SC	1.00 ml/l	1.25 ml/100 g	0.937 ml	0.625 ml	0.312 ml
Monocrotophos 36 SL	1.00 ml/ l	1.25 ml/100 g	0.937 ml	0.625 ml	0.312 ml
Control	-	-	-	-	-

Table 2. Insecticides used for the preparation of poison baits for laboratory experiments (Set-II)

Insecticides	Recommended Dosages for sprays in field	Recommended Dosages for poison bait (100%)	Amount of chemicals used for preparation 100 g of poison bait		
			75%	50%	25%
Indoxacarb 15 EC	0.30 ml/l	0.375 ml/100 g	0.28 ml	0.187 ml	0.093 ml
Chlorfenpyr 10 SC	1.0 ml/l	1.25 ml/100 g	0.937 ml	0.625 ml	0.312 ml
Fipronil 5 SC	1.0 ml/l	1.25 ml/100 g	0.937 ml	0.625 ml	0.312 ml
Spinosad 45 SC	0.2 ml/l	0.25 ml/100g	0.187 ml	0.125 ml	0.062 ml
Chlorantriniprol 18.5 SC	0.25 ml/l	0.312 ml/100 g	0.23 ml	0.156ml	0.0781 ml
Monocrotophos 36 SL	1.0 ml/ l	1.25 ml/100 g	0.937 ml	0.625 ml	0.312 ml
Control	-	-	-	-	-

Control- 100 g mixture of rice bran and jaggery without insecticide

Table 3. Bio-efficacy of different insecticide molecules as poison baits with rice bran against larvae of *Spodoptera litura* (Set-I)

Treatment	Dosage (%)	Per cent mortality at different hours			
		12 hr	24 hr	48 hr	72 hr
Lambda cyhalothrin 5 EC	100	15.56 (23.23)^{h}	40.00 (39.23)^{h}	57.78 (49.48)^{g}	68.89 (56.10)^{h}
	75	11.11 (19.47)^{i}	28.89 (32.51)^{i}	42.22 (40.52)^{j}	55.55 (48.19)^{l}
	50	6.67 (14.96)^{k}	20.00 (26.57)^{k}	33.33 (35.26)^{l}	44.44 (41.81)^{o}
	25	4.44 (12.17)^{l}	13.33 (21.41)^{l}	24.44 (29.63)^{n}	33.33 (35.26)^{p}
Profenophos 50 EC	100	28.89 (32.51)^{e}	68.89 (56.10)^{b}	80.00 (63.43)^{d}	88.89 (70.53)^{d}
	75	22.22 (28.13)^{g}	57.77 (49.47)^{d}	71.11 (57.48)^{e}	80.00 (63.44)^{e}
	50	8.89 (17.35)^{j}	31.11 (33.90)^{i}	46.67 (43.09)^{i}	60.00 (50.77)^{k}
	25	2.22 (8.57)^{m}	22.22 (28.12)^{j}	37.78 (37.92)^{k}	46.67 (43.09)^{no}
Chlorpyriphos 20 EC	100	53.33 (46.91)^{a}	73.33 (58.91)^{a}	86.67 (68.58)^{a}	100.00 (89.67)^{a}
	75	44.44 (41.81)^{b}	60.01 (50.77)^{d}	79.93 (63.38)^{d}	100.00 (89.67)^{a}
	50	35.56 (36.60)^{d}	44.45 (41.81)^{g}	57.78 (49.48)^{g}	73.34 (58.91)^{g}
	25	24.44 (29.63)^{f}	31.11 (33.90)^{i}	44.44 (41.81)^{i}	66.66 (54.73)^{i}
Novaluron 10 EC	100	40.00 (39.23)^{c}	51.11 (45.63)^{e}	62.21 (52.07)^{f}	77.77 (61.87)^{f}
	75	33.33 (35.26)^{d}	44.44 (41.81)^{g}	53.34 (46.91)^{h}	64.45 (53.40)^{j}
	50	22.22 (28.13)^{g}	37.78 (37.93)h	42.22 (40.52)^{j}	51.11 (45.64)^{m}
	25	8.89 (17.35)^{j}	22.22 (28.12)^{j}	28.89 (32.51)^{m}	35.55 (36.60)^{p}
Methoxyfenozide 20 SC	100	0.00 (0.00)^{n}	6.67 (14.96)^{m}	35.55 (36.60)^{kl}	80.00 (63.43)^{e}
	75	0.00 (0.00)^{n}	6.67 (14.96)^{m}	26.67 (31.09)^{mn}	64.44 (53.39)^{j}
	50	0.00 (0.00)^{n}	4.44 (12.16)^{n}	20.00 (26.57)^{o}	48.89 (44.36)^{mn}
	25	0.00 (0.00)^{n}	2.22 (8.57)^{o}	8.89 (17.34)^{p}	35.55 (36.60)^{p}
Monocrotophos 36 SL	100	53.33 (46.91)^{a}	68.86 (56.08)^{b}	84.44 (66.77)^{b}	97.78 (81.44)^{b}
	75	44.44 (41.81)^{b}	66.67 (54.74)^{c}	81.89 (64.82)^{c}	95.56 (77.83)^{c}
	50	40.00 (39.23)^{c}	57.78 (49.48)^{d}	68.89 (56.10)^{e}	80.00 (63.43)^{e}
	25	33.33 (35.26)^{d}	46.67 (43.09)^{f}	57.78 (49.48)^{g}	62.22 (52.08)^{j}
Control - (Rice bran + jaggery)	-	0.00 (0.00)^{n}	0.00 (0.00)^{p}	0.00 (0.00)^{q}	0.00 (0.00)^{q}
S.Em.±	-	0.440	0.432	0.417	0.564
C.D. (P=.0.01)	-	1.321	1.297	1.253	1.694

Figures in parentheses are arc sin transformed values

Means in the column followed by same alphabet(s) do not differ significantly by DMRT

chlorpyriphos 20 EC at 100 and 75 per cent of recommended dosage (2.5 ml and 1.875 ml/100 g, respectively) were found statistically superior over all other treatments giving cent per cent mortality. Next to follow were monocrotophos 36 SL at 100 and 75 per cent of recommended dosage (1.25 ml and 0.937 ml/ 100 g, respectively), profenofos 50 EC at 100 per cent of

recommended dosage (2.5 ml/100 g), monocrotophos 36 SL at 50 per cent of recommended dosage (0.625 ml/100 g), methoxyfenozide 20 EC at 100 per cent of recommended dosage (1.25 ml/100 g), novaluron 10 EC at 100 per cent of recommended dosage (0.930 ml/100 g), chlorpyriphos 20 EC at 50 per cent of recommended dosage (1.25 ml/100 g) and lambda cyhalorthin 5 EC at 100 per cent of recommended dosage (0.625 ml/100 g). The present finding is in agreement with Renju *et al.* (2009) on efficacy of chlorpyriphos 20 EC bait against *M. separata* under laboratory conditions. They could get cent per cent mortality of larvae when exposed for 48 hours to chlorpyriphos bait and also observed increase in mortality with increase in time of exposure. Similar results were also observed by Viswanadham *et al.* (1986) and Chandrasekhar (1992) using spray of chlorpyriphos 20 EC under laboratory conditions against *S. litura.*

The standard check, monocrotophos 36 SL bait which consistently gave higher mortality at 100 and 75 per cent of recommended dosage (1.25 ml and 0.937 ml/100 g, respectively) was next only to chlorpyriphos 20 EC at 100 and 75 per cent of recommended dosage (2.5 ml and 1.875 ml/100 g, respectively) in giving maximum mortality but not cent per cent mortality. However, earlier report by Chandrasekhar (1992) from Bengaluru, under laboratory conditions against *S. litura* where cent per cent mortality was observed at 72 hours of exposure of larvae to the monocrotophos 36 SL poison bait. But, Viswanadham *et al.* (1986) observed 100 per cent mortality of larvae of *S. litura* at 48 hours after exposure of larvae to the monocrotophos 36 SL poison bait. The variation in the present investigation may be due to change in the bait composition. They used a rice bran-jaggery proportion of 8:2 with high concentration of monocrotophos 36 SL (2%) whereas in the present study, rice bran and jaggery was in the proportion of 25:2 and monocrotophos 36 SL was at a lower concentration (0.45%).

The data presented in Table 4 indicate that mortality of *S. litura* after 72 hours after treatment, in set-II revealed that all four dosages of chlorfenapyr 10 SC (1.25, 0.937, 0.625 and 0.312 ml/100 g) were found superior recording cent per cent mortality. Next to follow were monocrotophos 36 SL at 100, 75 and 50 per cent of recommended dosage (1.25 ml, 0.937 ml and 0.625 ml/100g, respectively) with 97.78, 95.56 and 80.00 per cent mortality, respectively; indoxacarb 15 EC at 100 cent of recommended dosage (0.375 ml/100 g) with 75.56 per cent mortality, chlorantraniliprole 18.5 SC at 100 per cent of recommended dosage (0.312 ml/100 g) with 68.89 per cent mortality, spinosad 45 SC at 100 per cent of recommended dosage (0.25 ml/100 g) with 66.67 per cent mortality, monocrotophos 36 SL at 25 per cent of recommended dosage (0.312 ml/100 g) with 62.22 per cent mortality and indoxacarb

Table 4. Bio-efficacy of different insecticide molecules as poison baits with rice bran against larvae of *Spodoptera litura* (Set-II)

Treatment	Dosage %	Per cent mortality at different hours			
		12 hr	24 hr	48 hr	72 hr
Indoxacarb 15 EC	100	20.00 (26.57)^{j}	53.33 (46.91)^{g}	68.89 (56.10)^{f}	75.56 (60.37)^{e}
	75	15.56 (23.24)^{k}	42.23 (40.53)^{i}	55.56 (48.19)^{h}	62.23 (52.08)^{g}
	50	11.11 (19.47)^{m}	26.67 (31.09)^{k}	44.44 (41.81)^{i}	53.33 (46.91)^{h}
	25	4.44 (12.17)^{o}	15.55 (23.23)^{o}	28.89 (32.51)^{l}	40.00 (39.23)^{j}
Chlorfenapyr 10 SC	100	91.11 (72.66)^{a}	100.00 (89.67)^{a}	100.0 (89.67)^{a}	100.00 (89.67)^{a}
	75	77.78 (61.88)^{b}	100.00 (89.67)^{a}	100.00 (89.67)^{a}	100.00 (89.67)^{a}
	50	55.56 (48.19)^{c}	88.89 (70.53)^{b}	97.79 (81.46)^{b}	100.00 (89.67)^{a}
	25	37.78 (37.93)^{g}	75.56 (60.37)^{c}	91.12 (72.66)^{c}	100.00 (89.67)^{a}
Fipronil 5 SC	100	4.44 (12.16)^{o}	13.32 (21.41)^{p}	22.22 (28.12)^{n}	37.77 (37.92)^{j}
	75	4.44 (12.16)^{o}	8.88 (17.34)^{q}	15.55 (23.22)^{o}	28.88 (32.51)^{k}
	50	0.00 (0.00)^{q}	4.44 (12.16)^{s}	11.11 (19.47)^{p}	17.78 (24.94)^{l}
	25	0.00 (0.00)^{q}	4.44 (12.17)^{s}	8.89 (17.35)^{q}	13.33 (21.42)^{m}
Spinosad 45 SC	100	26.67 (31.09)^{i}	42.22 (40.52)^{i}	55.56 (48.19)^{h}	66.67 (54.74)^{f}
	75	20.00 (26.57)^{j}	28.88 (32.51)^{j}	42.22 (40.52)^{j}	48.89 (44.37)^{i}
	50	13.33 (21.42)^{l}	22.22 (28.12)^{l}	33.33 (35.26)^{k}	40.00 (39.23)^{j}
	25	6.67 (14.96)^{n}	17.77 (24.93)^{n}	22.22 (28.13)^{n}	26.67 (31.10)^{l}
Chlorantraniliprole 18.5 SC	100	6.67 (14.96)^{n}	20.00 (26.57)^{m}	42.22 (40.52)^{j}	68.89 (56.10)^{f}
	75	6.67 (14.96)^{n}	17.77 (24.93)^{n}	28.89 (32.52)^{l}	48.89 (44.36)^{i}
	50	2.22 (8.56)^{p}	13.32 (21.41)^{p}	24.44 (29.63)^{m}	40.00 (39.23)^{j}
	25	0.00 (0.00)^{q}	6.67 (14.97)^{r}	15.56 (23.24)^{o}	26.67 (31.09)^{l}
Monocrotophos 36 SL	100	53.33 (46.91)^{d}	73.33 (58.91)^{d}	86.67 (68.58)^{d}	97.78 (81.44)^{b}
	75	44.44 (41.81)^{e}	68.86 (56.08)^{e}	84.44 (66.77)^{e}	95.56 (77.83)^{c}
	50	40.00 (39.23)^{f}	57.78 (49.48)^{f}	68.89 (56.10)^{f}	80.00 (63.43)^{d}
	25	33.33 (35.26)^{h}	46.67 (43.09)^{h}	57.78 (49.48)^{g}	62.22 (52.08)^{g}
Control - (Rice bran + jaggery)	-	0.00 (0.00)^{q}	0.00 (0.00)^{t}	0.00 (0.00)^{r}	0.00 (0.00)^{o}
S.Em.±	-	0.234	0.247	0.347	0.543
C.D. (P=.01)	-	0.703	0.742	1.042	1.631

Figures in parentheses are arc sin transformed values

Means in the column followed by same alphabet(s) do not differ significantly by DMRT

15 SC at 75 per cent of recommended dosage (0.28 ml/100 g) with 62.23 per cent mortality.

There are no reports available on the efficacy of chlorfenapyr 10 SC bait on the larvae of *S. litura* under laboratory conditions. However, Shashibhushan *et al.* (2010) reported lower tuber damage (6.45%) by chlorfenapyr 10 SC (@ 2 ml/l) against *S. litura* on potato. Similar result was reported by Venkateswarlu *et al.* (2005) who documented that chlorfenapyr 10 SC spray was found effective in reducing the *Spodoptera* damage on potato.

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