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Management of defoliator insect pest, *Noorda blitealis* Walker (Lepidoptera: Crambidae) in drumstick

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Abstract
Studies on management of leaf eating caterpillar, *Noorda blitealis* Walker was conducted on drumstick at College of Agriculture, Vijayapur during 2018-19 by using different insecticides and botanicals were evaluated against leaf eating caterpillar, *N. blitealis*. Among these insecticides, Chlorantraniliprole 18.5 SC @ 0.15 ml/l was superior and it was as effective as that of Spinosad 45 SC @ 0.1 ml/l, Indoxacarb 15.8% EC @ 0.3 ml/l, Emamectin benzoate 5 SG 0.2 g/l and among botanicals, *Prosopis juliflora* leaf extract @ 5% reducing larval incidence, per cent defoliation and recorded higher yield and B:C ratio.

Keywords: Insecticides, botanicals, drumstick, leaf eating caterpillar, *Prosopis juliflora*, *Moringa oleifera*, *Pongamia pinnata*

Introduction
Moringa oleifera L. starts flowering four to twelve months after planting and the seeds germinate in two weeks (Ramachandran *et al.,* 1980) [8]. A single tree in India can yield up to 600 pods in a year with two crop seasons and some varieties have pods up to 120 cm long (Radovich, 2009) [7]. India placed in a largest producer of drumstick with an annual production of 1.1–1.3 million tonnes of tender fruits and area of 38,000 hectare. Among the different states, Andhra Pradesh stands first place in production and area (15,665 hectare), followed by Karnataka (10,258 hectare) and Tamil Nadu (7,408 hectare) whereas, some other states occupy an area of 4,613 hectare (Singh, 2011) [9].
Leaf eating caterpillar, *Noorda blitealis* Walker is considered as a serious pest of moringa, it occurs throughout the year and causes severe crop damage (David and Kumarswamy, 1982). In some conditions *N. blitealis* causes upto 100 per cent foliage loss. Early instars of *N. blitealis* scrape the chlorophyll content of leaves and causes into papery form, later on instars feed the leaves completely and leaving only veins behind. Female moth deposits creamy oval eggs on beneath the leaf surface, later larvae starts feeding on leaves by scrapping (Kalia and Joshi, 1997; Munj *et al*., 1998a; Mahesh and Kotikal, 2014) [2, 5, 4].

Materials and Methods
The experiments were conducted in Krishi Vigyan Kendra (KVK) at College of Agriculture Vijayapur campus to evaluate the bio-efficacy of different botanicals, conventional and new insecticides against defoliators. Eight insecticides and four botanicals were prepared by measured quantity of water and respective insecticides and mixed thoroughly before application. The treatments were imposed when the defoliator population was at peak incidence. Two sprays were taken on the basis of damage by the leaf eating caterpillar. The average of five branches *viz.,* four branches from different directions and one from the middle were considered for assessing the bio-efficacy of different insecticides and botanicals. In each branch, the number of caterpillars found feeding were assessed just before imposing treatment and also after one, three, five, seven, ten and fifteen day of the treatment. Similar procedure was continued before second schedule of treatments at fortnight interval. Observations on number of larvae and per cent defoliation were recorded on five randomly selected branches from each treatment a day before and 1, 3, 5, 7 and 10 days after each spray.

Results and Discussion
The larval population was ranged from 5.83 to 6.77 per branch before first spray but there was

no significant difference between the treatments with respect to mean number of larvae per branch.

One day after the spray there was a significant difference among the treatments where in the population of *N. blitealis* larvae ranged between 1.30 to 6.90 larvae per branch, treatment with Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded least number of larvae per branch (1.30) which was statistically on par with Spinosad 45 SC @ 0.1 ml/l (1.32), Indoxacarb 15.8% EC @ 0.3 ml/l (1.67) and emamectin benzoate 5 SG @ 0.2 g/l (1.74). The next best treatments were Flubendiamide 480 SC @ 0.2 ml/l (2.54), *Prosopis juliflora* leaf extract @ 5% (2.56) and NSKE @ 5% (2.65) were on par with each other. Lufenuron 5.4% EC @ 1 g/l (4.23), Malathion 50 EC @ 2 ml/l (4.29) *Pongamia pinnata* seed extract @ 5% (4.32), Nimbecidine 1500 ppm @ 5 ml/l (4.59) and Alphamethrin 10 EC @ 0.5 ml/l (4.81) were at par with each other (table 1).

After three days of spray the larval population ranged between 0.47 to 7.14 larvae per branch. The least number of larvae per branch were recorded in Chlorantraniliprole 18.5 SC @ 0.15 ml/l (0.47), which was statistically on par with Spinosad 45 SC @ 0.1 ml/l (0.83), Indoxacarb 15.8% EC @ 0.3 ml/l (1.23) and Emamectin benzoate 5 SG @ 0.2 g/l (1.34). The next best treatments were Flubendiamide 480 SC @ 0.2 ml/l (2.30), *Prosopis juliflora* leaf extract @ 5% (2.56) and NSKE @ 5% (2.43). Lufenuron 5.4% EC @ 1 g/l (4.15), Malathion 50 EC @ 2 ml/l (4.23) *Pongamia pinnata* seed extract @ 5% (4.28), Nimbecidine 1500 ppm @ 5 ml/l (4.56) and Alphamethrin 10 EC @ 0.5 ml/l (4.78) were satatistically on par with each other.

At five days after the spray, treatment with Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded significantly least number of larvae per branch (0.04), compared to Spinosad 45 SC @ 0.1 ml/l (0.53), Indoxacarb 15.8% EC @ 0.3 ml/l (0.85) and Emamectin benzoate 5 SG @ 0.2 g/l (0.97). The next best treatments were Flubendiamide 480 SC @ 0.2 ml/l (2.08), *Prosopis juliflora* leaf extract @ 5% (2.32) and NSKE @ 5% (2.48). Lufenuron 5.4% EC @ 1 g/l (4.08), Malathion 50 EC @ 2 ml/l (4.17), *Pongamia pinnata* seed extract @ 5% (4.22), Nimbecidine 1500 ppm @ 5 ml/l (4.50) and Alphamethrin 10 EC @ 0.5 ml/l (4.76) were inferior than the other treatments.

After seven days of spray the larval population was slightly increased compared to previous days due to reduction in efficiency of treatments, plot imposed with Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded least number of larvae per branch (0.08), which was significantly superior than Spinosad 45 SC @ 0.1 ml/l (0.73), Indoxacarb 15.8% EC @ 0.3 ml/l (0.98) and Emamectin benzoate 5 SG @ 0.2 g/l (1.01). Flubendiamide 480 SC @ 0.2 ml/l (2.10), *Prosopis juliflora* leaf extract @ 5% (2.60) and NSKE @ 5% (2.68) were at par with each other. Lufenuron 5.4% EC @ 1 g/l (4.50), Malathion 50 EC @ 2 ml/l (4.61), *Pongamia pinnata* seed extract @ 5% (4.61), Nimbecidine 1500 ppm @ 5 ml/l (4.81) and Alphamethrin 10 EC @ 0.5 ml/l (5.01) were on par with each other.

After ten days of spray the larval population was increased compared to seven days, treatment with Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded least number of larvae per branch (0.10), which was statistically superior than Spinosad 45 SC @ 0.1 ml/l (0.98), Indoxacarb 15.8% EC @ 0.3 ml/l (1.18), Emamectin benzoate 5 SG @ 0.2 g/l (1.20). The next treatments were the Flubendiamide 480 SC @ 0.2 ml/l (2.31), *Prosopis juliflora* leaf extract @ 5% (2.93), NSKE @ 5% (2.98) at par with each other. Lufenuron 5.4% EC @ 1 g/l (4.71), Malathion 50 EC @ 2 ml/l (4.90), *Pongamia pinnata* seed extract @ 5% (4.98), Nimbecidine 1500 ppm @ 5 ml/l (4.98) and Alphamethrin 10 EC @ 0.5 ml/l (5.50) were statistically inferior than the other (table1).

The larval population was ranged from 2.34 to 6.65 per branch before second spray but there was no significant difference between the treatments with respect to mean number of larvae per branch (table 2).

One day after the spray there was a significant difference among the treatments where in the population of *N. blitealis* larvae ranged between 0.50 to 6.81 larvae per branch, treatment with Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded least number of larvae per branch (0.50) which was statistically on par with Spinosad 45 SC @ 0.1 ml/l (1.53), Indoxacarb 15.8% EC @ 0.3 ml/l (1.60) and Emamectin benzoate 5 SG @ 0.2 g/l (1.80). The next best treatments were Flubendiamide 480 SC @ 0.2 ml/l (1.98), *Prosopis juliflora* leaf extract @ 5% (2.00), NSKE @ 5% (2.28), Lufenuron 5.4% EC @ 1 g/l (2.33), Malathion 50 EC @ 2 ml/l (2.40) *Pongamia pinnata* seed extract @ 5% (2.50), Nimbecidine 1500 ppm @ 5 ml/l (2.68) and Alphamethrin 10 EC @ 0.5 ml/l (2.93) on par with each other (table 2).

After three days of spray the larval population ranged between 0.25 to 9.16 larvae per branch. The least number of larvae per branch were recorded in chlorantraniliprole 18.5 SC @ 0.15 ml/l (0.25), which was statistically on par with spinosad 45 SC @ 0.1 ml/l (1.31), indoxacarb 15.8% EC @ 0.3 ml/l (1.42) and emamectin benzoate 5 SG @ 0.2 g/l (1.48). The next best treatments were flubendiamide 480 SC @ 0.2 ml/l (1.73), *Prosopis juliflora* leaf extract @ 5% (1.81), NSKE @ 5% (2.08). Lufenuron 5.4% EC @ 1 g/l (2.18), malathion 50 EC @ 2 ml/l (2.24) *Pongamia pinnata* seed extract @ 5% (2.30), nimbecidine 1500 ppm @ 5 ml/l (2.66) on par with each other. Alphamethrin 10 EC @ 0.5 ml/l (2.92) was inferior to other treatments.

At five days after the spray, treatment with Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded least number of larvae per branch (0.07), which was statistically on par with Spinosad 45 SC @ 0.1 ml/l (1.08), Indoxacarb 15.8% EC @ 0.3 ml/l (1.16) and Emamectin benzoate 5 SG @ 0.2 g/l (1.39). Next best treatments were Flubendiamide 480 SC @ 0.2 ml/l (1.69), *Prosopis juliflora* leaf extract @ 5% (1.69), NSKE @ 5% (1.81), Lufenuron 5.4% EC @ 1 g/l (2.07), Malathion 50 EC @ 2 ml/l (2.21) and *Pongamia pinnata* seed extract @ 5% (2.23) on par with each other. Nimbecidine 1500 ppm @ 5 ml/l (2.65) and Alphamethrin 10 EC @ 0.5 ml/l (2.91) were on par with each other.

Seven days after the spray the larval population was slightly increased compared to previous days due to reduction in efficiency of treatments, Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded least number of larvae per branch (0.10), which was statistically on par with Spinosad 45 SC @ 0.1 ml/l (1.10) and Indoxacarb 15.8% EC @ 0.3 ml/l (1.21). The next treatments were emamectin benzoate 5 SG @ 0.2 g/l (1.56), Flubendiamide 480 SC @ 0.2 ml/l (1.78), *Prosopis juliflora* leaf extract @ 5% (1.85), NSKE @ 5% (1.90), Lufenuron 5.4% EC @ 1 g/l (2.19), Malathion 50 EC @ 2 ml/l (2.50) and *Pongamia pinnata* seed extract @ 5% (2.51). Nimbecidine 1500 ppm @ 5 ml/l (2.71) and Alphamethrin 10 EC @ 0.5 ml/l (2.98) were inferior to the other.

After ten days of spray the larval population was increased compared to seven days, treatment with Chlorantraniliprole 18.5 SC @ 0.15 ml/l recorded least number of larvae per

branch (0.46), which was statistically on par with Spinosad 45 SC @ 0.1 ml/l (1.21), Indoxacarb 15.8% EC @ 0.3 ml/l (1.51), Emamectin benzoate 5 SG @ 0.2 g/l (1.88) and Flubendiamide 480 SC @ 0.2 ml/l (2.00). Next treatments were *Prosopis juliflora* leaf extract @ 5% (2.00), NSKE @ 5% (2.00) and Lufenuron 5.4% EC @ 1 g/l (2.31) statistically at par with each other. Malathion 50 EC @ 2 ml/l (2.84) *Pongamia pinnata* seed extract @ 5% (2.98), Nimbecidine 1500 ppm @ 5 ml/l (3.00) and Alphamethrin 10 EC @ 0.5 ml/l (3.20) were on par with each other (table 2).

Among the three botanicals *Prosopis juliflora* leaf extract @ 5% was more effective than the NSKE @ 5% followed by *Pongamia pinnata* seed extract @ 5% at 1, 3, 5, 7 and 10 DAS, respectively.

In the same way, Chlorantraniliprole 18.5 SC @ 0.15 ml/l treated plants recorded least per cent defoliation which was statistically on par with Spinosad 45 SC @ 0.1 ml/l, Indoxacarb 15.8% EC @ 0.3 ml/l and Emamectin benzoate 5 SG @ 0.2 g/l at 5, 10, and 15 days after first spray and per cent defoliation increased at 20 and 25 days due to reduced efficacy of insecticides (table 3). Similar trend was noticed during second spray, where all above mentioned insecticides recorded lowest per cent defoliation at different intervals after second spray. Chlorantraniliprole 18.5 SC @ 0.15 ml/l, Spinosad 45 SC @ 0.1 ml/l, Indoxacarb 15.8% EC @ 0.3 ml/l and Emamectin benzoate 5 SG @ 0.2 g/l showed more efficacies only up to 15 days after spraying

From the present investigation, it is clear that Chlorantraniliprole 18.5 SC @ 0.15 ml/l treated plants recorded lowest larval population (1.30, 0.47, 0.04, 0.08 and 0.10 larvae per branch) which was statistically on par with Spinosad 45 SC @ 0.1 ml/l, Indoxacarb 15.8% EC @ 0.3 ml/l and Emamectin benzoate 5 SG @ 0.2 g/l at 1, 3, and 5 days after first spray and later larval population increased at 7 and 10 days due to reduced efficacy of insecticides (Fig. 3). Similar trend was noticed during second spray, where all above mentioned insecticides recorded highest larval mortality at different intervals after second spray. Chlorantraniliprole 18.5 SC @ 0.15 ml/l, Spinosad 45 SC @ 0.1 ml/l, Indoxacarb 15.8% EC @ 0.3 ml/l and Emamectin benzoate 5 SG @ 0.2 g/l showed more efficacies only up to 5 days after spraying. The results are in agreement with Kumari *et al.* (2015) [3] reported that ten insecticides were tested against the defoliator, *N. blitealis.* Among them, Indoxacarb 15.8 EC @ 0.3 ml/l, Emamectin benzoate 5 SG @ 0.25 g/l and Fipronil 5 SC @ 1 ml/l were effective throughout the period of investigation. The results are also similar with Patel (2009) [10] recorded that out of twelve insecticides tested against leaf eating caterpillar, Spinosad 45 SC @ 0.002 per cent, Indoxacarb 15.8% EC @ 0.01 per cent and Emamectin benzoate 5 SG @ 0.001 per cent recorded the lower population and minimum percentage defoliation.

Table 1: Efficacy of insecticides and botanicals on leaf eating caterpillar, *Noorda blitealis* Walker (First spray)

Sl. No.	Treatments	Dose (ml/g/l)	Mean number of larvae/branch (n=5)					
			1 DBS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS
1	Flubendiamide 480 SC	0.2	6.43	2.54	2.30	2.08	2.1	2.31
			(2.73)	$(1.88)^{ab}$	$(1.82)^{bcd}$	$(1.75)^{bcd}$	$(1.76)^{bc}$	$(1.82)^{bc}$
2	Spinosad 45 SC	0.1	6.47	1.32	0.83	0.53	0.73	0.98
			(2.73)	$(1.52)^{a}$	$(1.35)^{ab}$	$(1.24)^{a}$	$(1.32)^{ab}$	$(1.41)^{ab}$
3	Emamectin benzoate 5 SG	0.2	5.89	1.74	1.34	0.97	1.01	1.2
			(2.62)	$(1.65)^{a}$	$(1.53)^{abc}$	$(1.40)^{abc}$	$(1.42)^{ab}$	$(1.48)^{abc}$
4	Alphamethrin 10 EC	0.5	6.04	4.81	4.78	4.76	5.01	5.5
			(2.65)	$(2.41)^{bc}$	$(2.40)^{f}$	$(2.40)^{g}$	$(2.45)^{f}$	$(2.55)^{e}$
5	Chlorantriniloprole 18.5 SC	0.15	6.72	1.30	0.47	0.04	0.08	0.1
			(2.78)	$(1.52)^{a}$	$(1.21)^{a}$	$(1.02)^{a}$	$(1.04)^{a}$	$(1.05)^{a}$
6	NSKE	5%	5.98	2.65	2.56	2.48	2.68	2.98
			(2.64)	$(1.91)^{ab}$	$(1.89)^{cde}$	$(1.87)^{def}$	$(1.92)^{cde}$	$(1.99)^{cd}$
7	Nimbecidine 1500 ppm	5	6.03	4.59	4.56	4.50	4.81	4.98
			(2.65)	$(2.36)^{bc}$	$(2.36)^{ef}$	$(2.35)^{g}$	$(2.41)^{ef}$	$(2.45)^{de}$
8	Indoxacarb 15.8% EC	0.3	6.77	1.67	1.23	0.85	0.98	1.18
			(2.79)	$(1.63)^{a}$	$(1.49)^{abc}$	$(1.36)^{ab}$	$(1.41)^{ab}$	$(1.48)^{abc}$
9	*Pongamia pinnata* seed extract	5%	5.99	4.32	4.28	4.22	4.61	4.98
			(2.64)	$(2.31)^{bc}$	$(2.30)^{def}$	$(2.28)^{fg}$	$(2.37)^{def}$	$(2.45)^{de}$
10	*Prosopis juliflora* leaf extract	5%	6.34	2.56	2.43	2.32	2.6	2.93
			(2.71)	$(1.89)^{ab}$	$(1.85)^{cd}$	$(1.82)^{cde}$	$(1.90)^{cd}$	$(1.98)^{cd}$
11	Malathion 50 EC (standard check)	2	5.83	4.29	4.23	4.17	4.61	4.9
			(2.61)	$(2.30)^{bc}$	$(2.29)^{def}$	$(2.27)^{fg}$	$(2.37)^{def}$	$(2.43)^{de}$
12	Lufenuron 5.4% EC	1	6.05	4.23	4.15	4.08	4.5	4.71
			(2.66)	$(2.29)^{bc}$	$(2.27)^{def}$	$(2.25)^{efg}$	$(2.35)^{def}$	$(2.39)^{de}$
13	Untreated check	..	6.54	6.90	7.14	7.67	8.07	8.57
			(2.75)	$(2.81)^{c}$	$(2.85)^{g}$	$(2.94)^{h}$	$(3.01)^{g}$	$(3.09)^{f}$
	S.Em±		NS	0.16	0.15	0.14	0.15	0.16
	CD at 5%			0.47	0.44	0.40	0.44	0.47
	CV at 5%			13.59	13.21	12.31	13.06	13.74

Figure in the parentheses are √(X+1) transformed values, DBS-Day before spray, DAS – Day after spray

Table 2: Efficacy of insecticides and botanicals on per cent defoliation due to leaf eating caterpillar, *Noorda blitealis* Walker (First spray)

Sl. No.	Treatments	Dose (ml/g/l)	Per cent defoliation/ branch (n=5)					
			1 DBS	5 DAS	10 DAS	15 DAS	20 DAS	25 DAS
1	Flubendiamide 480 SC	0.2	70.93	40.36	39.56	39.16	41.67	42.00
			(57.37)	(39.44)^{ab}	(38.97)^{ab}	(38.73)^{ab}	(40.20)^{abc}	(40.39)^{ab}
2	Spinosad 45 SC	0.1	74.25	29.49	27.14	26.36	27.54	28.96
			(59.53)	(32.88)^{a}	(31.39)^{a}	(30.88)^{a}	(31.64)^{a}	(32.54)^{a}
3	Emamectin benzoate 5 SG	0.2	67.45	34.01	32.52	32.16	33.56	34.56
			(55.24)	(35.66)^{a}	(34.75)^{a}	(34.53)^{a}	(36.00)^{ab}	(36.00)^{a}
4	Alphamethrin 10 EC	0.5	69.35	58.25	57.99	57.89	60.35	64.75
			(56.42)	(49.76)^{b}	(49.61)^{c}	(49.55)^{c}	(52.17)^{d}	(53.58)^{c}
5	Chlorantriniloprole 18.5 SC	0.15	72.33	27.64	25.84	25.10	26.45	28.75
			(58.27)	(31.70)^{a}	(30.55)^{a}	(30.06)^{a}	(30.95)^{a}	(32.41)^{a}
6	NSKE	5%	68.69	42.14	41.52	41.21	42.75	43.98
			(55.99)	(40.47)^{ab}	(40.11)^{abc}	(39.92)^{abc}	(40.81)^{abc}	(41.54)^{ab}
7	Nimbecidine 1500 ppm	5	68.12	56.33	56.05	55.89	57.22	62.35
			(55.63)	(48.64)^{b}	(48.47)^{bc}	(48.39)^{bc}	(49.15)^{cd}	(52.16)^{c}
8	Indoxacarb 15.8% EC	0.3	75.89	33.36	32.45	31.79	32.26	33.86
			(60.64)	(35.27)^{a}	(34.71)^{a}	(34.28)^{a}	(35.14)^{a}	(35.57)^{a}
9	*Pongamia pinnata* seed extract	5%	66.85	54.66	54.35	54.15	55.12	57.36
			(54.85)	(47.68)^{b}	(47.50)^{bc}	(47.38)^{bc}	(47.94)^{cd}	(49.24)^{bc}
10	*Prosopis juliflora* leaf extract	5%	70.78	40.89	40.17	39.81	42.00	43.22
			(57.29)	(39.74)^{ab}	(39.32)^{ab}	(39.10)^{ab}	(40.39)^{abc}	(41.10)^{ab}
11	Malathion 50 EC (standard check)	2	66.31	53.78	53.41	53.17	54.68	56.68
			(54.54)	(47.17)^{b}	(46.96)^{bc}	(46.82)^{bc}	(47.69)^{cd}	(48.85)^{bc}
12	Lufenuron 5.4% EC	1	69.78	52.56	52.16	51.89	52.23	55.23
			(56.67)	(46.47)^{b}	(46.24)^{bc}	(46.08)^{bc}	(46.28)^{bcd}	(48.01)^{bc}
13	Untreated check	..	73.64	77.09	81.23	85.63	89.47	92.33
			(59.13)	(61.48)^{c}	(64.38)^{d}	(67.74)^{d}	(71.26)^{e}	(73.94)^{d}
	S.Em±		NS	3.28	3.08	3.01	3.22	3.46
	CD at 5%			9.57	8.99	8.77	9.40	10.09
	CV at 5%			13.27	12.54	12.23	12.73	13.30

Figures in the parentheses are arc sine transformed values, DBS – Day before spray, DAS – Day after spray

Table 3: Efficacy of insecticides and botanicals on leaf eating caterpillar, *Noorda blitealis* Walker (Second spray)

Sl. No.	Treatments	Dose (ml/g/l)	Mean number of larvae/branch (n=5)					
			1 DBS	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS
1	Flubendiamide 480 SC	0.2	6.40	1.98	1.73	1.69	1.78	2.00
			(2.72)	(1.73)^{b}	(1.65)^{bc}	(1.64)^{bcd}	(1.67)^{bc}	(1.73)^{bc}
2	Spinosad 45 SC	0.1	4.48	1.53	1.31	1.08	1.10	1.21
			(2.34)	(1.59)^{ab}	(1.52)^{b}	(1.44)^{b}	(1.45)^{b}	(1.49)^{ab}
3	Emamectin benzoate 5 SG	0.2	2.34	1.80	1.48	1.39	1.56	1.88
			(1.83)	(1.67)^{ab}	(1.57)^{bc}	(1.54)^{bc}	(1.60)^{bc}	(1.70)^{bc}
4	Alphamethrin 10 EC	0.5	3.16	2.93	2.92	2.91	2.98	3.2
			(2.04)	(1.98)^{b}	(1.98)^{c}	(1.98)^{d}	(1.99)^{c}	(2.05)^{c}
5	Chlorantriniloprole 18.5 SC	0.15	3.55	0.50	0.25	0.07	0.10	0.46
			(2.13)	(1.22)^{a}	(1.12)^{a}	(1.03)^{a}	(1.05)^{a}	(1.21)^{a}
6	NSKE	5%	4.89	2.28	2.08	1.81	1.9	2.00
			(2.43)	(1.81)^{b}	(1.75)^{bc}	(1.68)^{bcd}	(1.70)^{bc}	(1.73)^{bc}
7	Nimbecidine 1500 ppm	5	3.12	2.68	2.66	2.65	2.71	3.00
			(2.03)	(1.92)^{b}	(1.91)^{bc}	(1.91)^{cd}	(1.93)^{c}	(2.00)^{c}
8	Indoxacarb 15.8% EC	0.3	3.93	1.60	1.42	1.16	1.21	1.51
			(2.22)	(1.61)^{ab}	(1.56)^{bc}	(1.47)^{b}	(1.49)^{b}	(1.58)^{abc}
9	*Pongamia pinnata* seed extract	5%	2.95	2.50	2.30	2.23	2.51	2.98
			(1.99)	(1.87)^{b}	(1.82)^{bc}	(1.80)^{bcd}	(1.87)^{bc}	(1.99)^{c}
10	*Prosopis juliflora* leaf extract	5%	6.65	2.00	1.81	1.69	1.85	2.00
			(2.77)	(1.73)^{b}	(1.68)^{bc}	(1.64)^{bcd}	(1.69)^{bc}	(1.73)^{bc}
11	Malathion 50 EC (standard check)	2	3.22	2.40	2.24	2.21	2.5	2.84
			(2.05)	(1.84)^{b}	(1.80)^{bc}	(1.79)^{bcd}	(1.87)^{bc}	(1.96)^{bc}
12	Lufenuron 5.4% EC	1	5.11	2.33	2.18	2.07	2.19	2.31
			(2.47)	(1.83)^{b}	(1.78)^{bc}	(1.75)^{bcd}	(1.79)^{bc}	(1.82)^{bc}
13	Untreated check	..	5.45	6.81	9.16	11.14	13.17	14.4
			(2.54)	(2.79)^{c}	(3.19)^{d}	(3.48)^{e}	(3.76)^{d}	(3.92)^{d}
	S.Em±		NS	0.15	0.12	0.11	0.13	0.14
	CD at 5%			0.44	0.36	0.33	0.37	0.41
	CV at 5%			14.37	11.87	10.96	11.81	12.64

Figure in the parentheses are √(X+1) transformed values, DBS-Day before spray, DAS-Day after spray

Table 4: Efficacy of insecticides and botanicals on per cent defoliation due to leaf eating caterpillar, *Noorda blitealis* Walker (Second spray)

Sl. No.	Treatments	Dose (ml/g/l)	Per cent defoliation/ branch (n=5)					
			1 DBS	5 DAS	10 DAS	15 DAS	20 DAS	25 DAS
1	Flubendiamide 480 SC	0.2	41.12	31.36	30.16	29.23	31.16	32.18
			(39.88)	(34.05)^{abc}	(33.31)^{bc}	(32.72)^{bc}	(33.93)^{bcd}	(34.56)^{abcd}
2	Spinosad 45 SC	0.1	37.55	24.15	22.59	21.53	22.96	25.07
			(37.79)	(29.38)^{ab}	(28.36)^{ab}	(27.63)^{ab}	(28.63)^{ab}	(30.01)^{ab}
3	Emamectin benzoate 5 SG	0.2	44.36	30.21	28.39	27.23	28.96	30.3
			(41.76)	(33.34)^{abc}	(32.19)^{bc}	(31.45)^{bc}	(32.54)^{bc}	(33.38)^{abc}
4	Alphamethrin 10 EC	0.5	75.34	53.58	51.23	49.62	50.23	52.23
			(60.27)	(47.05)^{e}	(45.70)^{e}	(44.78)^{e}	(45.13)^{e}	(46.28)^{e}
5	Chlorantriniloprole 18.5 SC	0.15	39.65	18.17	15.45	13.93	15	16.86
			(39.03)	(25.23)^{a}	(23.11)^{a}	(21.91)^{a}	(22.77)^{a}	(24.22)^{a}
6	NSKE	5%	42.71	36.26	35.22	33.82	34.82	36.07
			(40.80)	(37.02)^{bcde}	(36.40)^{bcd}	(35.55)^{bcd}	(36.16)^{bcde}	(36.90)^{bcde}
7	Nimbecidine 1500 ppm	5	64.33	49.60	47.56	46.33	47.33	49.71
			(53.35)	(44.77)^{de}	(43.60)^{de}	(42.89)^{de}	(43.47)^{de}	(44.83)^{de}
8	Indoxacarb 15.8% EC	0.3	35.47	24.49	23.15	22.14	23.83	25.21
			(36.55)	(29.64)^{ab}	(28.75)^{ab}	(28.06)^{ab}	(29.19)^{ab}	(30.13)^{ab}
9	*Pongamia pinnata* seed extract	5%	68.12	43.82	41.22	39.45	42.12	43.67
			(55.62)	(41.45)^{cde}	(39.94)^{cde}	(38.91)^{cde}	(40.46)^{cde}	(41.35)^{cde}
10	*Prosopis juliflora* leaf extract	5%	42.13	34.87	33.77	32.92	34	36.04
			(40.47)	(36.19)^{bcd}	(35.53)^{bcd}	(35.01)^{bcd}	(35.61)^{bcde}	(36.89)^{bcde}
11	Malathion 50 EC (standard check)	2	61.24	42.13	39.99	38.72	41.63	43.53
			(51.53)	(40.46)^{cde}	(39.22)^{cde}	(38.48)^{cde}	(40.18)^{cde}	(41.27)^{cde}
12	Lufenuron 5.4% EC	1	57.85	37.89	35.26	34.51	36	38.75
			(49.52)	(37.98)^{bcde}	(36.43)^{bcd}	(35.97)^{bcd}	(36.86)^{bcde}	(38.49)^{bcde}
13	Untreated check	..	66.36	72.51	80.22	90.17	94.23	99.16
			(54.56)	(58.39)^{f}	(63.62)^{f}	(71.74)^{f}	(76.20)^{f}	(84.87)^{f}
	S.Em±		NS	3.14	2.69	2.62	2.93	3.21
	CD at 5%			9.16	7.85	7.64	8.55	9.36
	CV at 5%			14.28	12.46	12.14	13.17	13.79

Figures in the parentheses are arc sine transformed values, DBS – Day before spray, DAS – Day after spray

Table 5: Influence of different insecticides and botanicals on yield parameters

Sl. No.	Treatments	Dose (ml/ g/l)	Number of pods/ plant	Number of damaged pods/ plant	Pod Length (cm)	Yield (kg/ha)	Leaf yield (kg/plant)	Treatment cost Rs/ha	Other expenditure	Gross income	Net income	B:C Ratio
1	Flubendiamide 480 SC	0.2	64.97	8.53	39.50	1572.19	1000.27	2742	20000	115055	92313	5.06
2	Spinosad 45 SC	0.1	65.77	7.93	42.50	2170.30	1220.27	1645.2	20000	158022	136377	7.30
3	Emamectin benzoate 5 SG	0.2	65.33	8.43	40.00	1724.80	1053.07	548.4	20000	126001	105453	6.13
4	Alphamethrin 10 EC	0.5	57.83	9.47	34.00	1017.87	604.27	182.8	20000	74272	54089	3.68
5	Chlorantriniloprole 18.5 SC	0.15	65.87	7.70	45.00	2318.51	1584.00	2467.8	20000	170215	147748	7.58
6	NSKE	5%	61.50	8.80	37.50	1353.00	894.67	-	20000	99183	79183	4.96
7	Nimbecidine 1500 ppm	5.00	57.90	9.20	34.50	1019.04	616.00	4204.4	20000	74413	50208	3.07
8	Indoxacarb 15.8% EC	0.3	65.53	8.30	42.00	2018.43	1164.53	822.6	20000	147113	126290	7.07
9	*Pongamia pinnata* seed extract	5%	58.97	9.10	35.00	1167.54	618.93	-	20000	84822	64822	4.24
10	*Prosopis juliflora* leaf extract	5%	64.60	8.67	38.00	1563.32	970.93	-	20000	114287	94287	5.71
11	Malathion 50 EC (standard check)	2	59.30	8.93	35.50	1174.14	689.33	584.96	20000	85636	65052	4.16
12	Lufenuron 5.4% EC	1	59.77	8.87	37.00	1314.87	836.00	3199	20000	96221	73022	4.15
13	Control	..	56.61	9.90	33.50	871.74	354.93	-	20000	62797	42797	3.14

Cost of drumstick pod and leaf Rs.70/kg and Rs.5/kg respectively

Flubendiamide 480 SC	750/-50ml	Alphamethrin 10 EC	100/-250ml	Indoxacarb 15.8% EC	600/-200ml
Spinosad 45 SC	1350/-75ml	Chlorantriniloprole 18.5 SC	180/-10ml	Malathion 50 EC (standard check)	160/-500ml
Emamectin benzoate 5 SG	300/-100g	Nimbecidine 1500 ppm	460/-500ml	Lufenuron 5.4% EC	875/-250ml

Conclusions

Different insecticides and botanicals were evaluated against leaf eating caterpillar, *N. blitealis*. Among these insecticides, Chlorantraniliprole 18.5 SC was superior and it was as effective as that of Spinosad 45 SC, Indoxacarb 15.8% EC, Emamectin benzoate 5 SG and botanicals, *Prosopis juliflora* leaf extract @ 5% reducing larval incidence. Among the imposed chemical treatments Chlorantraniloprole 18.5 SC @0.15 ml/l, Spinosad 45 SC @ 0.1 ml/l , Indoxacarb 15.8% EC @ 0.3 ml/l , Emamectin benzoate 5 SG @ 0.2 g/l and botanicals like *Prosopis juliflora* leaf extract @ 5%, NSKE @ 5%, *Pongamia pinnata* seed extract @ 5% recorded highest larval mortality.

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