

Evaluation of insecticides for the management of jute hairy caterpillar, *spilosoma obliqua* walk. (Lepidoptera: Arctiidae) in jute (*Corchorus Olitorius*)

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Abstract

The experiment was carried out on roof at Entomology Department of Bangladesh Jute Research Institute (BJRI), Dhaka for the selection of dosages and in the field of two different locations viz. Jute Agriculture Experimental Station (JAES), Manikganj and Jute Research Sub-Station, Tarabo, Narayanganj for evaluation of four insecticides against jute hairy caterpillar during the jute growing season (April-July) 2019 following Randomized Complete Block Design (RCBD) with three replications. Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin) and Key 70 WG (Imidacloprid 70 %) @ 750 gm/ha, 200 ml/ha, 550 ml/ha and 30 gm/ha respectively were found effective against jute hairy caterpillar giving 86.13, 81.51, 74.11, 76.39 percent reduction of infestation in Manikganj and 86.21, 82.32, 77.53, 78.64 percent reduction of infestation in Narayanganj respectively. In case of yield contributing characters at both locations, Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin) and Key 70 WG (Imidacloprid 70 %) were found effective significantly giving more than plant height (2.87m), base diameter (14mm), fibre weight (2.82 t/ha) and stick weight (6.12 t/ha) respectively. Percent Reduction, plant height, base diameter, fibre weight and stick weight were found highest in the plot treated with Heping 10WDG (Emamectin Benzoate) and the lowest was found in control plot. The degree of statistical relationship between percent reduction and fibre weight; fibre weight and stick weight in both locations have been found significant relationship at 5 % level of probability. All tested insecticides can be recommended for controlling jute hairy caterpillar and in respect of higher yield contributing characters.

Keywords: jute, jute hairy caterpillar, insecticides, effectiveness and yield contributing attributes

Introduction

Jute, a principal fibre crop in the world, is the most important cash crop and the biggest foreign exchange earner of Bangladesh. It ranks second to the cotton among all the natural fibre production [24].

Bangladesh is the second largest producer of jute in the world, with annual production estimated at 1.349 million tonnes. Nonetheless, Bangladesh remains the world's largest exporter of jute fibre, accounting for as much as 70% of global jute exports. The jute fibre produced in Bangladesh is often considered the best quality in the world. Total area under jute crop has been estimated at 18, 52, 479 acres (7, 79, 658 hectares) and total jute crop production has been estimated at 85,76,087 bales in 2018-19 year. Average yield rate has been estimated at 4.63 bales per acre (11.440 bales per hectares [2]. The countries with the highest volumes of jute production in 2018 were India (2.1M tons) and Bangladesh (1.6M tons), with a combined 93% share of global production. Bangladesh dominates jute exports structure, reaching 229K tons, which was near 79% of total exports in 2018. In value terms, Bangladesh (\$158M) remains the largest jute supplier worldwide, comprising 74% of global exports.

Jute is attacked by various insect and mite pests. More than 40 species of insects and mites are considered to be the pests of jute in Bangladesh [14]. All parts of the plants are subject to attack. Among the jute pests *Spilarctia obliqua* popularly known as jute hairy caterpillar, is the worst one [21-15]. The

Bihar hairy caterpillar, *Spilarctia obliqua* (Walker) (Arctiidae: Lepidoptera), is a widely distributed, serious polyphagous pest [19]. The pests cause loss in yield and quality of fibres [19]. *Spilarctia obliqua* walker vernacularly known as jute hairy caterpillar, is a highly polyphagous and sporadic pest infesting approximately 126 plants species in 24 families [22]. This insect eats all types of young and matured leaves. The female moth lays eggs on the dorsal surface of the leaves in batch. The young larvae, after hatching, remain on the dorsal leaf surface in groups up to 6- 7 days of hatching. Thereafter, they spread all over the plant. The larvae eat the green portions of leaves when they are in groups and the leaves look like white thin membranes, which are easily observed from the far. They eat the young twigs when the infestation is severe. The third and onward instar larvae cause serious damages and significant reduction in yield [11-9].

There are several constraints in increasing the productivity of fibre crops, of which the losses due to insect pests is one of the major concerns. Among the insect, *S. obliqua* is one of the major which causing substantial yield loss as well as fibre quality [20]. Timely management of this pest is very important as delay may lead to even complete defoliation of crop [16]. Although many insecticides are effective against this pest, chemical control is not desirable and moreover, the acute toxicity and relative resistance of *S. obliqua* to chemical pesticides were also reported [5].

Pesticides have been a major contributor to the growth of

agricultural productivity and food supply. Pesticides were a key factor in significant agricultural productivity growth during the last century and continue to be a critical factor in reducing crop damage [23].

Usually, chemical control is more effective method, especially during the emergency when the insect population exceeds the economic threshold level. Moreover, indiscriminate and repeated use of same chemical might lead to development of resistance in target pest. From the above mentioned importance of jute, it is very much important to control this pest. It is known fact that jute hairy caterpillar showed certain levels of behavioral resistance to different class of insecticides, hence successful control of this pest is to some extent difficult. Keeping this in view, studies were under taken to test the effectiveness of four insecticides against jute hairy caterpillar in jute (*Corchorus Olitorius*).

2. Materials and methods

The experiment was conducted at three different locations. Pot experiment was conducted on roof at Entomology Department

of Bangladesh Jute Research Institute (BJRI) and field experiment was conducted at Jute Agriculture Experimental Station (JAES), Manikganj and Tarabo, Narayanganj during the jute growing season (April-July) 2019. Four insecticides of different generic group were used in this experiment which as follows

1. Heping 10WDG (Emamectin Benzoate)
2. Lamtech 2.5 EC (Lambda cyhalothrin)
3. Fair Kill 10 EC (Cypermethrin)
4. Key 70 WG (Imidacloprid 70 %)
5. Newril 85 WP (Carbaryl) was used as standard.

2.1 Pot experiment

Corchorus Olitorius Jute variety O-9897 was grown in earthen pot conducted on roof at Entomology Department of Bangladesh Jute Research Institute (BJRI), Dhaka. Seeds were sown in pot and pots were set following Randomized Complete Block Design (RCBD) with three replications [7]. Five - six plants in each pot were allowed to grow. When the plant age was sixty, 3rd instar jute hairy caterpillar larva were collected from the jute field and released on the potted plants. Four insecticides such as Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin) and Key 70 WG (Imidacloprid 70 %) at their respective doses were sprayed. Three different doses (table 1) of each insecticide were tested for the fixation of the effective and economic dose.

Table 1: Three different doses of each insecticide tested for dose fixation

SL. No.	Name of insecticides	Dose/ha	Dose/ Litre
1	Heping 10WDG (Emamectin Benzoate)	1000gm/ha	2 gm
		750 gm/ha	1.5 gm
		500gm/ha	1 gm
2	Lamtech 2.5 EC (Lambda cyhalothrin)	300 ml/ha	0.6 ml
		200 ml/ha	0.4 ml
		100 ml/ha	0.2 ml
3	Fair Kill 10 EC (Cypermethrin)	800 ml/ha	1.6 ml
		550 ml/ha	1.1 ml
		250 ml/ha	0.5 ml
4	Key 70 WG (Imidacloprid 70 %)	40gm/ha	0.08 gm
		30 gm/ha	0.06 gm
		20gm/ha	0.04 gm

Control pots were kept untreated. Population of caterpillar/pot was recorded before spray and at 3rd and 5th day after spray. Data of % reduction at 5th day after spray were analyzed. Percent reduction of infestation over control was calculated following Abbott (1925) [1] formula given below:

$$\% \text{ Reduction over control} = \frac{A - B}{A} \times 100$$

Where, A= no. of insects in control plot
B= no. of insects in treated plot

Data were analyzed by Statistix 10 software and means were separated by LSD.

2.2 Field experiment

Two different locations viz. In JAES, Manikganj and sub-station, Tarabo, Narayanganj were selected to conduct field experiment. The jute variety O-9897 was grown in unit plot

size of 2 x 2.1 m² with three replications following Randomized Complete Block Design (RCBD) (Gomez, K.A. and Gomez, A.A. 1984). Natural infestation of second and third instar of jute hairy caterpillar was allowed to build up in the plot [19]. Four different insecticides group along with one standard group insecticide such as Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin), Key 70 WG (Imidacloprid 70 %) and Newril 85 WP @ 750 gm/ha, 200 ml/ha, 550 ml/ha, 30 gm/ha and 1.7 kg/ha respectively were sprayed after 60 days of sowing when sufficient infestation was found in the plot naturally. No insecticide was sprayed in control plots. Population of caterpillar in each plot was recorded before spray and at 3rd and 7th day after spray. Percent reduction of infestation over control was calculated following Abbott (1925) [1] formula given below:

$$\% \text{ Reduction over control} = \frac{A - B}{A} \times 100$$

Where, A= no. of insects in control plot
B= no. of insects in treated plot

3. Results

Three doses of all insecticides were applied at roof pot condition, where the second one was proposed by respective companies and the other two doses were higher one and lower one from the proposed dose. The results revealed that

the higher doses were little more effective than proposed dose or similarly effective in respect of mortality but these doses were not cost effective and lower doses were less effective than the proposed doses. So, proposed doses were selected for the field trial. Detailed results are given in table 2.

Table 2: Preliminary dose fixation trial on roof at Entomology Department of Bangladesh Jute Research Institute (BJRI), Dhaka, 2019

Sl. No.	Name of insecticides	Dose/ha	Dose/ Litre	Number of caterpillar/ plot before spray	% Reduction of infestation after spray	
					at 3 rd day	at 5 th day
1	Heping 10WDG (Emamectin Benzoate)	1000gm/ha	2 gm	20	61.67	85.00
		750 gm/ha	1.5 gm	20	68.33	90.00
		500gm/ha	1 gm	20	56.67	83.33
2	Lamtech 2.5 EC (Lambda cyhalothrin)	300 ml/ha	0.6 ml	20	55.00	86.67
		200 ml/ha	0.4 ml	20	65.00	88.33
		100 ml/ha	0.2 ml	20	60.00	85.00
3	Fair Kill 10 EC (Cypermethrin)	800 ml/ha	1.6 ml	20	66.67	90.00
		550 ml/ha	1.1 ml	20	68.33	93.33
		250 ml/ha	0.5 ml	20	58.33	85.00
4	Key 70 WG (Imidacloprid 70 %)	40gm/ha	0.08 gm	20	56.67	90.00
		30 gm/ha	0.06 gm	20	66.67	91.67
		20gm/ha	0.04 gm	20	63.33	85.00

At field experiment, Four different insecticides group along with one standard group insecticide such as Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin), Key 70 WG (Imidacloprid 70 %) and Newril 85 WP @ 750 gm/ha, 750 gm/ha, 200 ml/ha, 550 ml/ha, 30 gm/ha and 1.7 kg/ha respectively were sprayed applied for controlling jute hairy caterpillar. These insecticides were found effective against jute hairy caterpillar giving 86.13, 81.51, 74.11, 76.39 and 76.15 reduction of infestation over control plot, respectively, at JAES, Manikganj as shown in Table 3. The highest reduction 86.13% was obtained from the plot treated with Heping 10WDG (Emamectin Benzoate) which was statistically different with other insecticides and standard Newril 85 WP (Carbaryl). The lowest reduction 74.11% was obtained from the plot treated with Fair Kill 10 EC (Cypermethrin) that was statistically similar with Key 70 WG (Imidacloprid 70 %) and standard Newril 85 WP (Carbaryl).

In case of Tarabo, Narayanganj, Four different insecticides group along with one standard group insecticide such as Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin), Key 70 WG (Imidacloprid 70 %) and Newril 85 WP @ 750 gm/ha, 750 gm/ha, 200 ml/ha, 550 ml/ha, 30 gm/ha and 1.7 kg/ha respectively were applied for controlling jute hairy caterpillar giving 86.21, 82.32, 77.53, 78.64 and 77.73% reduction of infestation over control plot respectively, as shown in Table 3. Among these insecticides, the highest percent reduction of jute hairy caterpillar (86.21%) was obtained from the plot treated with Heping 10WDG (Emamectin Benzoate) which was statistically different with other insecticides and standard Newril 85 WP (Carbaryl). The lowest reduction 77.53% was obtained from the plot treated with Fair Kill 10 EC (Cypermethrin) that was statistically similar with Key 70 WG (Imidacloprid 70 %) and standard Newril 85 WP (Carbaryl).

Table 3: Evaluation of insecticides against jute hairy caterpillar at JAES, Manikganj and Tarabo, Narayanganj in 2019 under field condition.

Sl. No.	Treatment	Dose/ha	% Reduction of infestation after spray, JAES, Manikganj			% Reduction of infestation after spray, Tarabo, Narayanganj		
			Number of caterpillar/ plot before spray	at 3 rd day	at 7 th day	Number of caterpillar/ plot before spray	at 3 rd day	at 7 th day
1	Heping 10WDG (Emamectin Benzoate)	750gm	50.00	69.71a	86.13a	50.22	70.37a	86.21a
2	Lamtech 2.5 EC (Lambda cyhalothrin)	200ml	50.33	59.06bc	81.51b	52.56	60.73b	82.32b
3	Fair Kill 10 EC (Cypermethrin)	550ml	39.11	64.10ab	74.11c	45.44	60.80b	77.53c
4	Key 70 WG (Imidacloprid 70%)	30gm	47.55	67.15a	76.39c	47.56	70.08a	78.64bc
5	Newril 85 WP (Standard) (Carbaryl)	1.7 kg	42.89	57.80c	76.15c	50.89	69.13a	77.73c
6	Control (Untreated)		44.34	19.66d	37.82d	45.55	21.37c	39.09d
LSD (5%)				5.84	2.96		5.21	3.82
SE				2.62	1.33		2.34	1.72

In case of yield contributing characters at JAES, Manikganj; the highest plant height (3.63 m), base diameter (17.07 mm), fibre weight (3.71 t/ha) and stick weight (10.59 t/ha) were found in the plot treated with Heping 10WDG (Emamectin Benzoate) which was statistically different with other

insecticides and standard Newril 85 WP (Carbaryl). The lowest plant height (2.87 m), base diameter (14.22 mm), fibre weight (2.82 t/ha) and stick weight (6.12 t/ha) were found in the plot that was treated with Fair Kill 10 EC (Cypermethrin) which was better than control plot (Fig. 1).

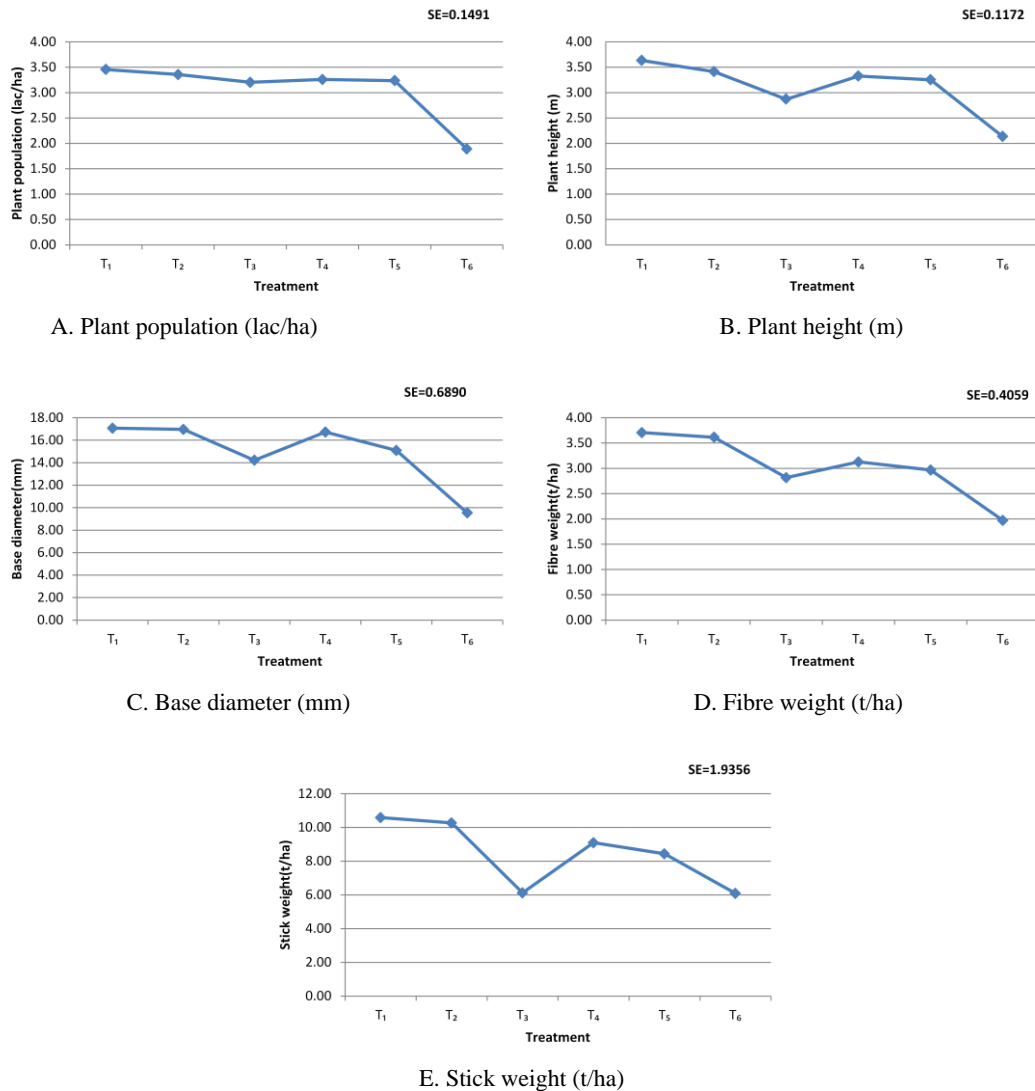
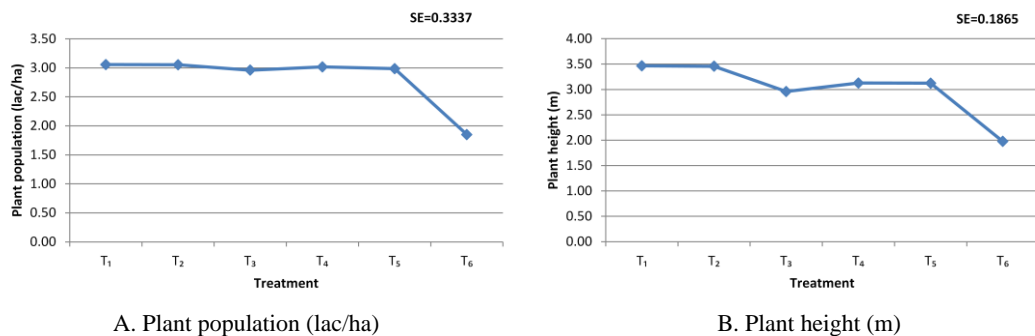


Figure 1: Yield contributing attributes response to selective insecticides, Manikganj. A. Plant population (lac/ha), B. Plant height (m), C. Base diameter (mm), D. Fibre weight (t/ha) and E. Stick weight (t/ha)

At the same time, in case of Tarabo, Narayanganj; plot treated with Heping 10WDG (Emamectin Benzoate) showed the highest plant height (3.47 m), base diameter (16.86 mm), fibre weight (3.78 t/ha) and stick weight (13.12 t/ha).

With Fair Kill 10 EC (Cypermethrin) treated plot revealed the lowest plant height (2.99 m), base diameter (14.00 mm), fibre weight (3.16 t/ha) and stick weight (7.56 t/ha) which was higher than untreated plot (Fig. 2).



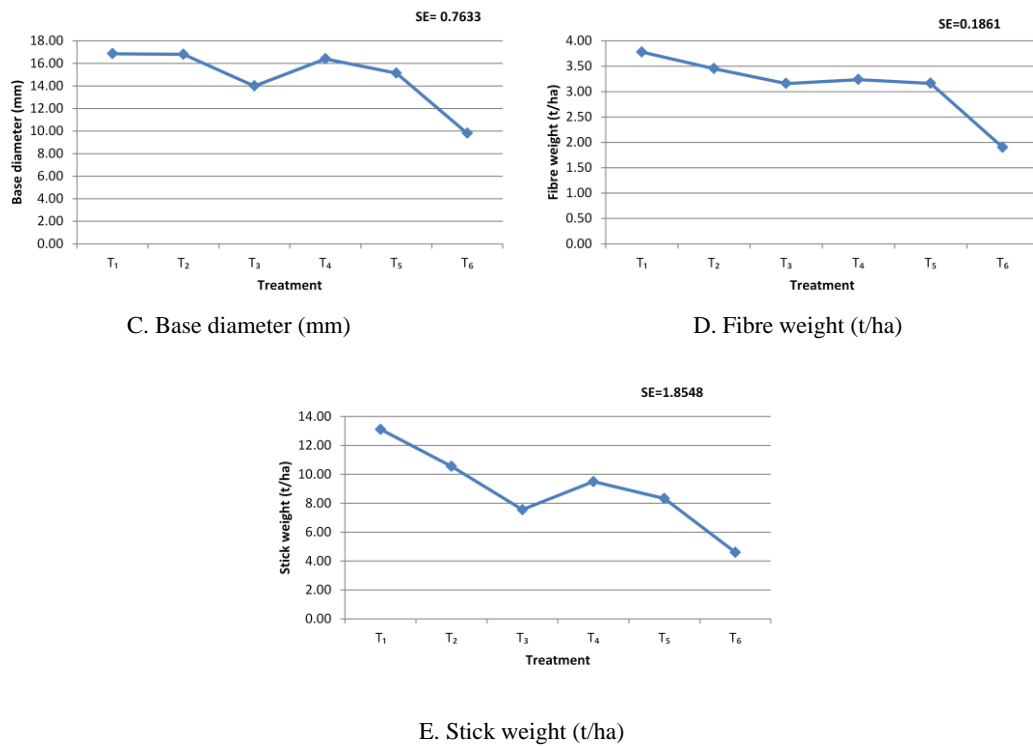


Figure 2: Yield contributing attributes response to selective insecticides, Narayanganj. A. Plant population (lac/ha), B. Plant height (m), C. Base diameter (mm), D. Fibre weight (t/ha) and E. Stick weight (t/ha)

4. Discussion

Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin) and Key 70 WG (Imidacloprid 70 %) @ 750 gm/ha, 200 ml/ha, 550 ml/ha and 30 gm/ha respectively were found effective against jute hairy caterpillar giving 86.13, 81.51, 74.11, 76.39 percent reduction of infestation in Manikganj and 86.21, 82.32, 77.53, 78.64 percent reduction of infestation in Narayanganj respectively (Table 3). It is noticed that Emamectin Benzoate group showed highest percent reduction of infestation followed by Lambda cyhalothrin, Cypermethrin and Imidacloprid 70 % at both locations. The results of the present studies are in conformity with that of Gupta *et al.* (2004)^[8] who reported that emamectin benzoate (proclaim) was more toxic than fenvalerate, indoxacarb, cypermethrin and endosulfan to *Spodoptera litura* (Fabr.). Nair N *et al.* (2007)^[18] reported that emamectin benzoate 5 SG showed most toxicity to the 3rd instar larvae of *S. oblique* followed by cypermethrin 10 AF (0.00013), indoxacarb 14.5 SC, endosulfan 35 EC, fenvalerate 20 EC and fenprothrin 30 EC to *Spodoptera litura* (Fabr.) in castor leaves. Efficacy of imidacloprid40+ethiprole40, when evaluated by Bhanu and Reddy (2012)^[3] against BPH and WBPH @50, 75 and 100g a.i./ha revealed that all the dosages recorded more than 98% reduction in population of both BPH and WBPH over control. Mandal *et al.* (2013)^[6] conducted an experiment on black gram for evaluation of insecticides where he reported that Per cent reduction of hairy caterpillar over untreated plot after final sprays was followed this order of efficacy: triazophos (90.64%) > \ddot{e} -cyhalothrin (83.71%) > indoxacarb (78.76%) > endosulfan (69.53%) > imidacloprid (62.31%) > thiamethoxam (57.40%). Devi and Srivastava. (2018)^[17] reported that imidacloprid showed same Percent reduction of hairy caterpillar infestation. Salim and Abed (2015)^[12] conducted

an experiment on chemical control against *Spilosoma oblique* on cabbage where he reported that Cypermethrin(0.07%) significantly increased population reduction of *Spilosoma oblique*.

In case of yield contributing characters at both locations, Heping 10WDG (Emamectin Benzoate), Lamtech 2.5 EC (Lambda cyhalothrin), Fair Kill 10 EC (Cypermethrin) and Key 70 WG (Imidacloprid 70 %) were found effective significantly giving more than plant height (2.87m), base diameter (14mm), fibre weight (2.82 t/ha) and stick weight (6.12 t/ha) respectively (Fig. 1 & 2). Mandal *et al.* (2013)^[6] conducted an experiment on black gram for evaluation of insecticides where he reported that in case of yield, all the treatments showed significant increase of yield in black gram. Highest grain yield was recorded in triazophos treated plot (13.80 q/ha) closely followed by \ddot{e} -cyhalothrin (13.00 q/ha). In case of azadirachtin treated plot, the yield was comparatively lower (9.41q/ha) than endosulfan (10.04 q/ha) and imidacloprid (10.67 q/ha), whereas in control plot, the yield was severely low (6.80 q/ha). Average fibre yield and stick yield was found 22.19 q/ha and 48.37 q/ha respectively spraying with endosulfan 35 EC at 350 g a.s./ha against pest infestation to Rahman and Khan ^[19]. In this study lowest fibre yield was found in control plot. This result is agreement to Rahman and Khan ^[19] where they reported that the minimum fibre yield was recorded to be 17.96 q/ha from the control plot that was not spraying with chemical. Hath and Chakraborty (2004) ^[10] using the IPM module produced the maximum fiber yield of 30.85 q/ha as compared to the modules against insect and mite pests; against insects and diseases; against mite and diseases and the control plots. This result is also agreement to this study. Selvaraj *et al.* (2015) ^[13] ran an experiment on Toxicity and bioefficacy of individual and combination of diversified insecticides against jute hairy caterpillar, *Spilarctia obliqua*

where they reported that all treatments were found effective in reducing the infestation of *S. obliqua* significantly in comparison to control with maximum fibre yield. They also found that emamectin benzoate was superior to lambda cyhalothrin in respect of percent reduction and yield. Yield contributing attributes of all insecticides were found higher than control which revealed that there was a significant effect of insecticides on yield.

Correlation and regression studies

The degree of statistical relationship between percent reduction and fibre weight; fibre weight and stick weight in both locations have been found significant relationship at 5 % level of probability. The positive slopes exhibited positive relationship.

Relationship between percent reduction and fibre weight

In case of Manikganj, The degree of relationship between percent reduction and fibre weight was studied. The result revealed that percent reduction and fibre weight have a direct significant positive relationship at 5% level of significance which has been confirmed with correlation coefficient $r = 0.9368$ (Figure 3.i). The relationship was more evident by the equation $Y = 25.776x - 6.1701$ increase in percent reduction with the increase of fibre weight.

In case of Narayanganj, The degree of relationship between percent reduction and fibre weight was studied. The result revealed that percent reduction and fibre weight have a direct significant positive relationship at 5% level of significance which has been confirmed with correlation coefficient $r = 0.9832$ (Figure 3.ii). The relationship was more evident by the equation $Y = 26.439x - 8.7861$ increase in percent reduction with the increase of fibre weight.

Relationship between fibre weight and stick weight

In case of Manikganj, The degree of relationship between fibre weight and stick weight was studied. The result revealed that fibre weight and stick weight have a direct significant positive relationship at 5% level of significance which has been confirmed with correlation co-efficient $r = 0.9010$ (Figure 3.iii). The relationship was more evident by the equation $Y = 2.8124x - 0.0974$ increase in stick weight with the increase of fibre weight.

In case of Narayanganj, The degree of relationship between fibre weight and stick weight was studied (Figure 3). The result revealed that fibre weight and stick weight have a direct significant positive relationship at 5% level of significance which has been confirmed with correlation coefficient $r = 0.9290$ (Figure 3.iv). The relationship was more evident by the equation $Y = 4.1731x - 4.0548$ increase in stick weight with the increase of fibre weight.

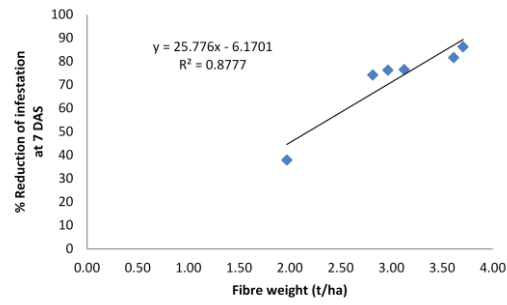


Figure 3.i. Relationship between percent reduction of infestation and fibre weight, Manikganj

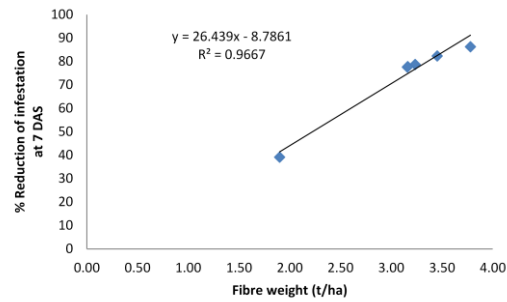


Figure 3.ii. Relationship between percent reduction of infestation and fibre weight, Narayanganj

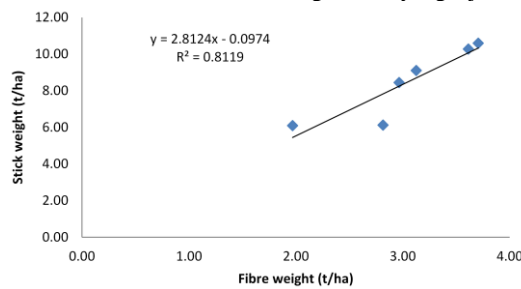


Figure 3.iii. Relationship between fibre weight and stick weight, Manikganj

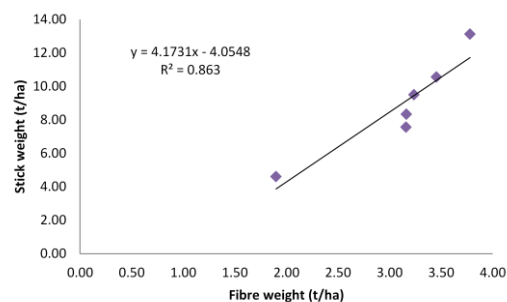


Figure 3.iv. Relationship between fibre weight and stick weight, Narayanganj

5. Conclusion

Based on the findings of present research it can be concluded that all tested insecticides considering percent reduction of infestation over control (> 74.11%) and yield (>2.82 ton/ha) were more or less similar to the standard and better than control. Among the tested insecticides emamectin benzoate performed maximum reduction of infestation and contributed to significant yield production followed by Lambda cyhalothrin, Cypermethrin and Imidacloprid 70 %. So, all the insecticides can be recommended for the farmer's use for management of jute hairy caterpillar at field level.

6. Conflict of interest

The authors have no conflict of interest to disclose.

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