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RESEARCH ARTICLE

RELATIVE TOXICITY OF SOME CHEMICAL PESTICIDES AGAINST JUTE HAIRY CATERPILLAR (*SPILOSOMA OBLIQUA* W.) IN TOSSA JUTE (*CORCHORUS OLITORIUS* L.)

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ABSTRACT

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. Fifteen insecticides were investigated to select their effective and economic doses against Hairy caterpillar in a Tossa Jute variety during April-October' 2020 at the Department of Entomology, Manikganj and Narayanganj, Bangladesh Jute Research Institute (BJRI), Bangladesh following Randomized Completely Block Design with three replications. All new insecticides with a standard were found effective for controlling jute hairy caterpillar giving 95.38, 94.55, 95.19, 92.85, 93.59, 94.22, 93.49, 93.62, 89.84, 95.72, 93.56, 93.38, 94.42, 95.39, 91.34 and 95.41 % at Manikganj; 95.78, 93.32, 93.97, 93.18, 92.09, 92.49, 93.74, 92.93, 92.29, 93.69, 93.95, 93.17, 95.31, 94.99, 92.11 and 94.53 % reduction of infestation at Narayanganj at 5th day after spray over control plot respectively. In Manikganj, the highest fibre yield (3.66 t/ha) was found in the plot treated with Rock 20 EC and the lowest (2.96t/ha) was found in Reset 20WDG treated plot. In case of Narayanganj, the highest fibre yield (3.85 t/ha) was found in the plot treated with Proxy 20 EC and the lowest (2.79t/ha) was found in Daman treated plot. These insecticides can be recommended for the farmer's use to control jute hairy caterpillar.

KEYWORDS

effectiveness, insecticides, jute hairy caterpillar, jute, yield.

1. INTRODUCTION

Jute is a principal fibre crop in the world. It 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 (Talukder et al., 1989). 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 (Kabir, 1975). All parts of the plants are subject to attack. Among the jute pests Spilarctia obliqua commonly known as jute hairy caterpillar, is the worst one (Kabir and Khan, 1968; Sharif, 1962). The Bihar hairy caterpillar, Spilarctia obliqua (Walker) (Arctiidae: Lepidoptera), is a widely distributed, serious polyphagous pest (Gupta and Bhattacharya, 2008). The pests cause loss in yield and quality of fibres (Rahman and Khan, 2010). Spilosoma obliqua (walker) belongs to the family Arctiidae of Lepidoptera order is a polyphagous insect causing serious damage to a variety of crops (Bhattacharya et al.,1995). Different insects and mite pest attack jute during the growing season. Jute hairy caterpillar, Spilarctia obliqua (walker) under the family Arctiidae of lepidoptera order is one of these destructive insect pests of jute that can reduce up to 18.5% fibre yield depending on their intensity of infestation. There are many synthetic insecticides available in the local market to control jute hairy caterpillar but all are not available in all over the country and all are not equally effective. Moreover, indiscriminate and repeated use of same chemical might lead to develop resistance in target pest. Therefore, new chemical pesticides were needed to include in the recommendation list, which will help to overcome the resistance problem of pest against insecticides. When more insecticides will be available in the market, farmers will have a chance to choose insecticides according to the availability and affordability.

There are many manmade insecticides existing in the local market to control jute hairy caterpillar but all are not available through the country and all are not likewise effective. Moreover, haphazard and recurrent use of same chemical might lead to development of resistance in target pest. Therefore, more number of chemical pesticides should be encompassed in the reference lists, which will help to overcome the resistance problem of pest against insecticides. Furthermore, farmers will have a chance to choose insecticides according to accessibility and cost. So, an experiment was taken following two objectives (i). to estimate the efficacy of some

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insecticides against jute hairy caterpillar under natural condition at field level and compare with a standard chemical insecticide, (ii). to select operative and cost-effective doses of these chemical insecticides for the jute cultivator's use

2. Materials and Methods

2.1 Location and design of the experiment

The investigation was carried out as two parts viz. effective and economic dose fixation of 15 pesticides under laboratory condition at BJRI, Dhaka (23°45'30.1356"N, 90°22'45.642"E) and application of their selected doses on Jute hairy caterpillar in field condition of Jute crop at Manikganj (23°53'27"N, 90°1'0"E) and Narayanganj (23°37'24"N, 90°30'4"E) District of Bangladesh during the jute growing season (April-October, 2020). The experiments were conducted in Randomized Complete Block Design with three replications.

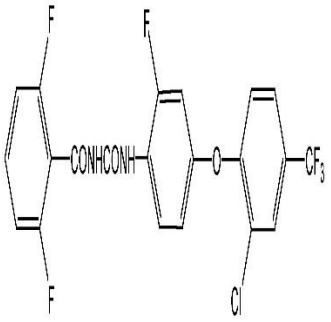
2.2 Test materials and their chemical structure

Fifteen insecticides of different generic groups were collected from different pesticide companies and used in this experiment (Table 1).

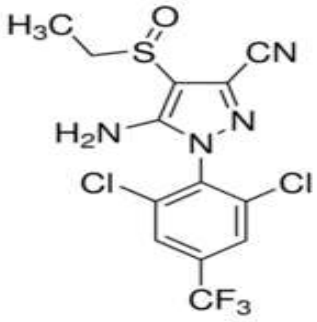
Table 1: Insecticides used as test materials

Serial No.	Common/Trade name	Generic name [Active ingredient(s)]
1	Symazine 80WDG	Cyromazine 80%
2	Reset 20WDG	Flufenozuron 10% + Ethiprole 10%
3	Virtako 40WG	Chlorantraniliprole + Thiamethoxam
4	Laida 2.5EC	Lamda-cyhalothrin
5	Proxy 20 EC	Proxifen 5% + Fenpropathrin 15%
6	Rock 20 EC	Pyriproxifen 5% + Fenpropathrin 15%
7	Daman	Beauvaria bassiana
8	Pulser 20EC	Pyriproxifen 5% + Fenpropathrin 15%
9	Dynamite 60WDG	Dihalo-pyrazole amid 40% + Thiamathoxam 20%
10	Nishan 20EC	Pyriproxiyfen 5%+ Fenpropathrin 15%
11	Foringout 80WDG	Nitenpyrum 20%+ Pymetrozine 60%
12	Triple 33 WDG	Emamectin Benzoate 15% + Lufenuron 3%
13	Veto 20SL	Imidaclopride
14	Starlux 25 EC	Quinalphos 25%
15	Foni plus 12SC	Chlorfenapyr 10% +Emamectin Benzoate 2%
16	Hayzinon 60 EC (Standard)	Diazinon

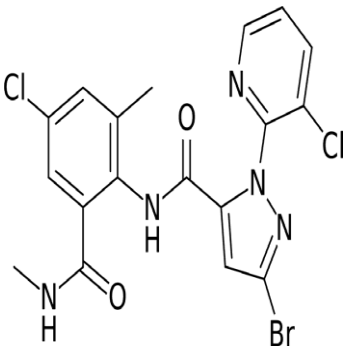
Its chemical structure was collected from internet (Fig. 1).



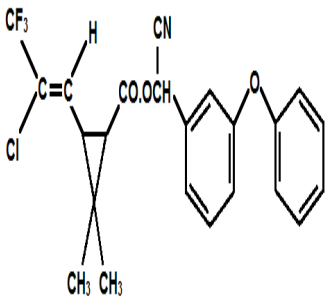
Flufenozuron



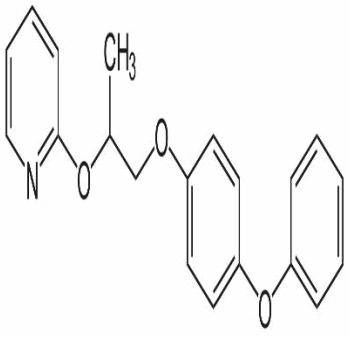
Ethiprole



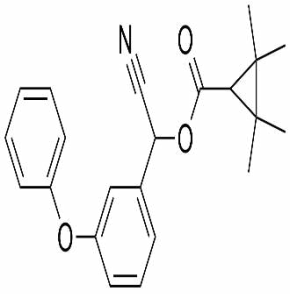
Chlorantraniliprole



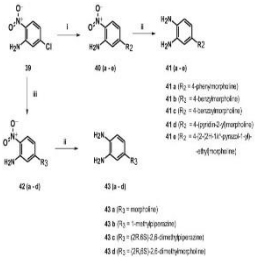
Lamda-cyhalothrin



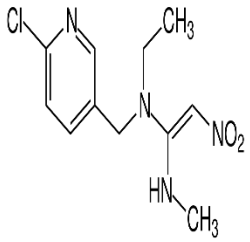
Proxifen



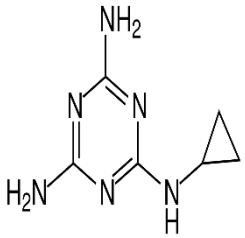
Fenpropathrin



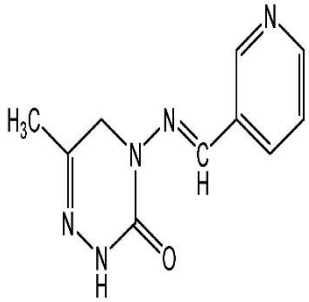
Dihalo-pyrazole amid



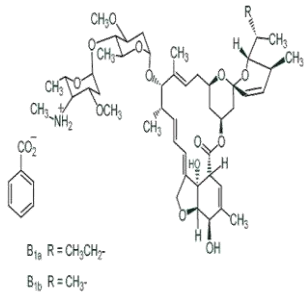
Nitenpyrum



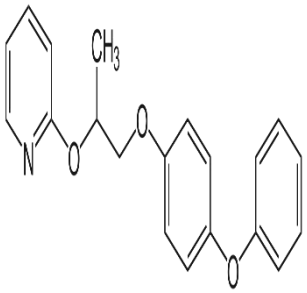
Cyromazine



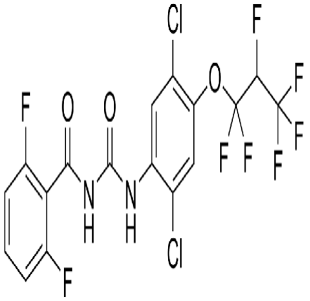
Pymetrozine



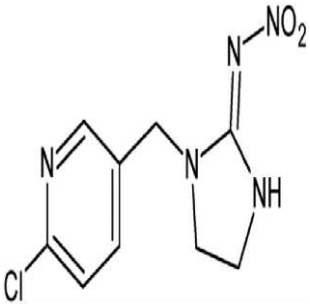
Emamectin Benzoate



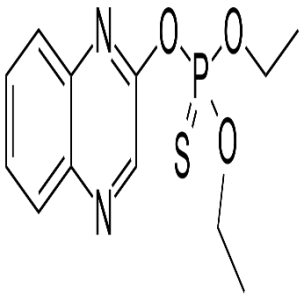
Pyriproxifen



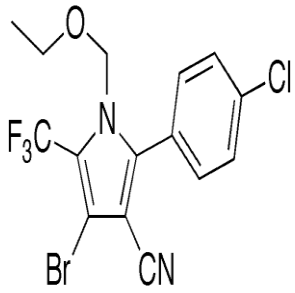
Lufenuron



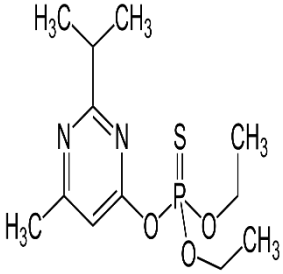
Imidaclopride



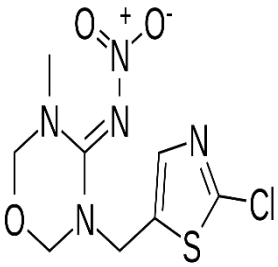
Quinalphos



Chlorfenapyr



Diazinon



Thiamethoxam

Figure 1: Chemical structure of different generic group insecticides

2.3 Fixation of chemical dose under artificial condition

Dose fixation experiment was conducted at laboratory of Entomology Department, BJRI, Dhaka following Randomized Complete Block Design with three replications. 3rd instar of 20 jute hairy caterpillars were kept in each plastic pot (Figure 2). Then, 15 leaves of jute plant spraying with selective insecticides with their respective doses were kept in each pot (Figure 3).

Figure 2: Jute hairy caterpillar

Figure 3: Laboratory trial of insecticides

Then each pot was wrapped with cloths. The untreated pot was used as control. Three different doses of each insecticide were applied to fix effective and economic dose (Table 2).

Table 2: Three different doses of each insecticide tested for dose fixation

Sl. No.	Name of insecticides	Dose/ha	Dose/ Litre
1	Cyromazine 80%	600gm/ha	1.2 gm
		500gm/ha	1 gm
		400gm/ha	.8 gm
2	Flufenozuron 10% + Ethiprole 10%	400gm/ha	0.8 gm
		300gm/ha	0.6 gm
		200gm/ha	0.4 gm
3	Chlorantraniliprole + Thiamethoxam	125gm/ha	0.25 gm
		100gm/ha	0.2 gm
		75gm/ha	0.15 gm
4	Lamda-cyhalothrin	600ml/ha	1.2 ml
		500ml/ha	1 ml
		400ml/ha	0.8 ml
5	Proxifen 5% + Fenpropathrin 15%	700ml/ha	1.4 ml
		650ml/ha	1.3 ml
		600ml/ha	1.2 ml
6	Pyriproxifen 5% + Fenpropathrin 15%	700ml/ha	1.4 ml
		650ml/ha	1.3 ml
		600ml/ha	1.2 ml
7	*Beauvaria bassiana*	2.75 kg /ha	0.0055 kg
		2.5kg /ha	0.005 kg
		2.25kg /ha	0.0045 kg
8	Pyriproxifen 5% + Fenpropathrin 15%	600 gm/ha	1.2 gm
		500 gm/ha	1 gm
		400 gm/ha	0.8 gm
9	Dihalo-pyrazole amid 40% + Thiamathoxam 20%	100gm/ha	0.2 gm
		75gm/ha	0.15 gm
		50gm/ha	0.1 gm
10	Pyriproxiyfen 5%+ Fenpropathrin 15%	30gm/ha	0.06 gm
		21gm/ha	0.042 gm
		15 gm/ha	0.03 gm
11	Nitenpyrum 20%+ Pymetrozine 60%	150 gm/ha	0.3 gm
		100 gm/ha	0.2 gm
		50 gm/ha	0.1 gm
12	Emamectin Benzoate 15% + Lufenuron 3%	150gm/ha	0.3 gm
		125gm/ha	0.25 gm
		100gm/ha	0.2 gm
13	Imidaclopride	250ml/ha	0.5 ml
		200ml/ha	0.4 ml
		150ml/ha	0.3 ml
14	Quinalphos 25%	2.0 lit/ha	0.004 lit
		1.68 lit/ha	0.00336 lit
		1.25 lit/ha	0.0025 lit
15	Chlorfenapyr 10% +Emamectin Benzoate 2%	800 ml/ha	1.6 ml
		700 ml/ha	1.4 ml
		600 ml/ha	1.2 ml

Population of caterpillar pot^{-1} were recorded at 3rd and 5th day after spray. Percent reduction of insect population at 3rd and 5th days after spray were calculated (Equation.i) according to Abbott's formula (1925).

$$\text{Corrected mortality (\%)} = \left(1 - \frac{Number\ of\ insects\ after\ treatement}{Number\ of\ insects\ in\ control}\right) \times 100 \ldots\ldots (i)$$

2.4 Field Experiment

A standard tossa jute variety O-9897 was grown in the field of Manikganj and Narayanganj during the jute-growing season (April-August, 2020). Unit plot size was 2x2.1m^2 with three replications. Randomized Complete Block Design (RCBD) was followed (Gomez and Gomez,1984). Normal agronomical practices were followed. Recommended doses of fertilizers were applied in the experimental plots. Natural infestation of second and third instar of jute hairy caterpillar was allowed to build up in the plot (Rahman and Khan, 2010). In July, when maximum infestation was found in the field fifteen new insecticides Symazine 80WDG, Reset 20WDG, Virtako 40WG, Laida 2.5EC, Proxy 20 EC, Rock 20 EC, Daman, Pulser 20EC, Dynamite 60WDG, Nishan 20EC, Foringout 80WDG, Triple 33 WDG, Veto 20SL, Starlux 25 EC, Foni plus 12SC @ 500 gm/ha, 300 gm/ha, 100 gm/ha, 500 ml/ha, 650 ml/ha, 2.5kg/ha, 500gm/ha, 75 gm/ ha, 21 gm/ ha, 100 gm/ ha, 125 gm/ha, 200ml/ha, 1.68 litre/ha, and 700 ml/ha respectively were sprayed along with a standard insecticide Hayzinon 60EC@ 550ml/ha (Figure 4).

Figure 4: Field trial of insecticides

Control plots were remained untreated. Population of caterpillar/plot was recorded before spray and at 5th day after spray. Data of percent reduction of insect population at 5th day after spray were calculated (Equation. i) according to Abbott's formula (Abbott's, 1925).

2.5 Data analyses

The data were collected sincerely and compiled using Microsoft Excel Program (2010) and were analyzed in Statistical Analysis Software (Statistix10).

3. Results and Discussion

3.1 Dose fixation

Three doses of all insecticides were applied at each plastic pot, 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 (Table 3).

Table 3: Preliminary dose fixation trial at laboratory in Entomology Department of Bangladesh Jute Research Institute (BJRI), Dhaka, 2020

Sl. No.	Name of insecticides	Dose/ha	Dose/ Litre	Number of caterpillar/ plot before spray	% Reduction of caterpillar after spray	
					at 3rd day	at 5th day
1	Cyromazine 80%	600gm/ha	1.2 gm/ha	20	70	90
		500gm/ha	1 gm/ha	20	75	95
		400gm/ha	0.8 gm/ha	20	60	75
2	Flufenozuron 10% + Ethiprole 10%	400gm/ha	0.8 gm/ha	20	70	90
		300gm/ha	0.6 gm/ha	20	75	90
		200gm/ha	0.4 gm/ha	20	65	75
3	Chlorantraniliprole + Thiamethoxam	125gm/ha	0.25 gm/ha	20	65	90
		100gm/ha	0.2 gm/ha	20	75	95
		75gm/ha	0.15 gm/ha	20	60	70
4	Lamda-cyhalothrin	600ml/ha	1.2 ml/ha	20	65	95
		500ml/ha	1 ml/ha	20	70	85
		400ml/ha	0.8 ml/ha	20	55	70
5	Proxifen 5% + Fenpropathrin 15%	700ml/ha	1.4 ml/ha	20	70	90
		650ml/ha	1.3 ml/ha	20	75	95
		600ml/ha	1.2 ml/ha	20	60	70
6	Pyriproxifen 5% + Fenpropathrin 15%	700ml/ha	1.4 ml/ha	20	75	95
		650ml/ha	1.3 ml/ha	20	70	100
		600ml/ha	1.2 ml/ha	20	50	65
7	*Beauvaria bassiana*	2.75 kg /ha	0.0055 kg /ha	20	70	95
		2.5kg /ha	0.005 kg /ha	20	75	90
		2.25kg /ha	0.0045 kg /ha	20	50	70
8	Pyriproxifen 5% + Fenpropathrin 15%	600 gm/ha	1.2 gm/ha	20	75	95
		500 gm/ha	1 gm/ha	20	80	100
		400 gm/ha	0.8 gm/ha	20	50	75
9	Dihalo-pyrazole amid 40% + Thiamathoxam 20%	100gm/ha	0.2 gm/ha	20	65	95
		75gm/ha	0.15 gm/ha	20	75	90
		50gm/ha	0.1 gm/ha	20	60	75
10	Pyriproxiyfen 5%+ Fenpropathrin 15%	30gm/ha	0.06 gm/ha	20	65	100
		21gm/ha	0.042gm/ha	20	75	95
		15 gm/ha	0.03 gm/ha	20	60	70
11	Nitenpyrum 20%+ Pymetrozine 60%	150 gm/ha	0.3 gm/ha	20	75	95
		100 gm/ha	0.2 gm/ha	20	75	90
		50 gm/ha	0.1 gm/ha	20	55	70
12	Emamectin Benzoate 15% + Lufenuron 3%	150gm/ha	0.3 gm/ha	20	70	95
		125gm/ha	0.25 gm/ha	20	70	95
		100gm/ha	0.2 gm/ha	20	55	65
13	Imidaclopride	250ml/ha	0.5 ml/ha	20	60	100
		200ml/ha	0.4 ml/ha	20	70	95
		150ml/ha	0.3 ml/ha	20	60	75
14	Quinalphos 25%	2.0 lit/ha	0.004 lit/ha	20	70	100
		1.68 lit/ha	0.00336 lit/ha	20	70	95
		1.25 lit/ha	0.0025 lit/ha	20	65	75
15	Chlorfenapyr 10% +Emamectin Benzoate 2%	800 ml/ha	1.6 ml/ha	20	65	90
		700 ml/ha	1.4 ml/ha	20	70	90
		600 ml/ha	1.2 ml/ha	20	55	70
16	Diazinon	650ml/ha		20	65	95
		550ml/ha		20	65	95
		450ml/ha		20	50	70
17	Control (water)	-		20	20	40
		-		20	25	45
		-		20	25	35

3.2 Field evaluation of insecticides

Fifteen new insecticides Symazine 80WDG, Reset 20WDG, Virtako 40WG, Laida 2.5EC, Proxy 20 EC, Rock 20 EC, Daman, Pulser 20EC, Dynamite 60WDG, Nishan 20EC, Foringout 80WDG, Triple 33 WDG, Veto 20SL, Starlux 25 EC, Foni plus 12SC, and a standard Hayzinon 60 EC @ 500 gm/ha, 300 gm/ha, 100 gm/ha, 500 ml/ha, 650 ml/ha, 2.57 kg /ha, 500 gm/ha, 75 gm/ ha, 21 gm/ ha, 100 gm/ ha, 125 gm/ha, 200ml/ha, 1.68 litre/ha, 700 ml/ha and 550ml/ha respectively, were found effective for controlling jute hairy caterpillar giving more than 89.84% reduction of infestation in at JAES, Manikganj and Tarabo sub-station, Narayanganj at 5th day after spray (Table 4). In case of Manikganj, fifteen different insecticides group along with a standard group insecticide were found effective for controlling jute hairy caterpillar giving 95.38, 94.55, 95.19, 92.85, 93.59, 94.22, 93.49, 93.62, 89.84, 95.72, 93.56, 93.38, 94.42, 95.39, 91.34 and 95.41 % reduction of infestation over control plot respectively (Table 4). This result is an agreement with that result of sultan *et. al.* (2019) who tested Fusion 20SL (Imidacloprid 20 SL), Pilarmit 10 SL (Nitenpyrum), Lama 24 SC (Thiacloprid 24% SC) and Thipro 18%SC

(Thiamethoxam 12% + Fipronil 6%) @ 500 ml/ha, 300 ml/ha, 120 ml/ha and 100ml/ha respectively and found effective against jute hairy caterpillar giving 91.09, 89.41, 93.32 and 93.24 % reduction of infestation over control plot respectively. The highest reduction 95.72% was obtained from the plot treated with Nishan 20EC (Pyriproxiyfen 5%+ Fenpropathrin 15%) which was statistically similar with other insecticides over control plot. The lowest reduction 89.84% was obtained from the plot treated with Dynamite 60WDG (Dihalo-pyrazole amid 40% + Thiamathoxam 20%). In case of Tarabo, Narayanganj, fifteen different insecticides group along with one standard group insecticide were found effective for controlling jute hairy caterpillar giving 95.78, 93.32, 93.97, 93.18, 92.09, 92.49, 93.74, 92.93, 92.29, 93.69, 93.95, 93.17, 95.31, 94.99, 92.11 and 94.53 % reduction of infestation over control plot respectively (Table 4). A group researchers tested 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 and 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 (Rahman et al., 2020). Among these insecticides, the highest percent reduction of jute hairy caterpillar (95.78%) was obtained from the plot treated with Symazine 80WDG (Cyromazine 80%) which was statistically similar with other insecticides. The lowest reduction 92.09% was obtained from the plot treated with Proxy 20 EC (Proxifen 5% + Fenpropathrin 15%). All insecticides showed statistically similar result except control plot. Similar result was found by who worked with Celeron 50 EC and Nokon 60 EC against jute hairy caterpillar and found 92.50% and 90.70% reduction of infestation respectively (Polan et al., 2009). Some researchers worked with Quinalphos 25 EC and Dianzinon 60 EC against jute hairy caterpillar and found 96.73 and 95.46% reduction of infestation, respectively (Banu et al., 2007). Zaman worked with Pyriphos 20EC @ 0.025% a.i. and found 86.67% reduction of jute hairy caterpillar after 72 hours of spray (Zaman, 1990). Similar experiment with some organophosphorus insecticides was done by (15) found 93.3% mortality after 72 hours of spray when he worked with Biocyp 10EC @ 0.75 cc/lit against jute hairy caterpillar in the laboratory. They also worked with Karate 2.5EC @0.01872% a.i. in the field and found 97.7% and 97.4% reduction in two locations. Some researchers reported that emamectin benzoate 5 SG showed most toxicity to the 3rd instar larvae of *S. obliqua* (Nair et al., 2007). Devi and Srivastava reported that imidacloprid showed same percent reduction of hairy caterpillar infestation (Devi and Srivastava, 2018). Salim and Abed conducted an experiment on chemical control against *Spilosoma obliqua* on cabbage where he reported that Cypermethrin (0.07%) significantly increased population reduction of *Spilosoma obliqua* (Salim and Abed, 2015).

Table 4: Field efficacy evaluation of new insecticide against jute hairy caterpillar at Manikganj and Narayanganj, 2020

SL No	Trade name	Generic Name	Dose/ha	Manikganj, 2020		Tarabo, 2020	
				No. of caterpillar/ plot before spray (average)	% Reduction of infestation after 5 days of spray	No. of caterpillar/ plot before spray average)	%Reduction of infestation after 5 days of spray
1.	Symazine 80WDG	Cyromazine 80%	500gm/ha	76.33	95.38a	73.00	95.78a
2.	Reset 20WDG	Flufenozuron 10% + Ethiprole 10%	300gm/ha	72.33	94.55a	68.67	93.32a
3.	Virtako 40WG	Chlorantraniliprole + Thiamethoxam	100gm/ha	91.67	95.19a	88.33	93.97a
4.	Laida 2.5EC	Lamda-cyhalothrin	500ml/ha	85.67	92.85a	88.33	93.18a
5.	Proxy 20 EC	Proxifen 5% + Fenpropathrin 15%	650ml/ha	81.67	93.59a	78.33	92.09a
6.	Rock 20 EC	Pyriproxifen 5% + Fenpropathrin 15%	650ml/ha	96.67	94.22a	86.00	92.49a
7.	Daman	Beauvaria bassiana	2.5kg /ha	78.33	93.49a	70.00	93.74a
8.	Pulser 20EC	Pyriproxifen 5% + Fenpropathrin 15%	500 gm/ha	81.33	93.62a	77.67	92.93a
9.	Dynamite 60WDG	Dihalo-pyrazole amid 40% + Thiamathoxam 20%	75gm/ha	64.00	89.84a	70.33	92.29a
10.	Nishan 20EC	Pyriproxiyfen 5%+ Fenpropathrin 15%	21gm/ha	95.00	95.72a	79.33	93.69a
11.	Foringout 80WDG	Nitenpyrum 20%+ Pymetrozine 60%	100gm/ha	98.67	93.56a	85.00	93.95a
12.	Triple 33 WDG	Emamectin Benzoate 15% + Lufenuron 3%	125gm/ha	78.67	93.38a	81.67	93.17a
13.	Veto 20SL	Imidaclopride	200ml/ha	70.00	94.42a	71.67	95.31a
14.	Starlux 25 EC	Quinalphos 25%	1.68 lit/ha	76.33	95.39a	79.67	94.99a
15.	Foni plus 12SC	Chlorfenapyr 10% +Emamectin Benzoate 2%	700 ml/ha	72.33	91.34a	76.67	92.11a
16.	Hayzinon 60 EC (Standard)	Diazinon	550ml/ha	95.00	95.41a	90.00	94.53a
17.	Control (water)			70.00	23.13b	66.67	19.20b
18.	$LSD_{(5\%)}$				6.69		7.22

3.3 Effects of insecticides on jute fibre and stick yield production

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 (Steven et al., 2007). Jute fibre yield is damaged up to 15% due to the attack of jute hairy caterpillar. Due to the application of fifteen insecticides with their respective dose, jute fibre yield was varied from each other. In Manikganj, the highest fibre yield (3.66 t/ha) was found in the plot which was treated with Rock 20 EC followed by Foni plus 12SC (3.65t/ha). The lowest (2.96t/ha) fibre yield

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was found in Reset 20WDG treated plot which was higher over control plot (Figure 5). In case of Narayanganj, the highest fibre yield (3.85 t/ha) was found in the plot which was treated with Proxy 20 EC followed by Foni plus 12SC (3.84t/ha). The lowest (2.79t/ha) fibre yield was found in Daman treated plot which was higher over control plot. This result is agreement 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 (Rahman and Khan, 2010).

Some researchers in his two separate experiments, found similar fibre yield after insecticides and acaricides spraying in *Corcorus olitorius* jute (Rahman et al., 2020). A group researcher also stated similar fibre yield after insecticides application in his experiment (Sultan et al., 2019). In other hand, some study showed same result when they tested eight Tossa Jute (*Corchorus olitorius* L.) for the analyses of variability, Euclidean clustering and principal components for genetic diversity of some olitorius varieties in his study (Mukul et al., 2020). Some researchers also 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 (Mandal et al., 2013). All plots treated with insecticides showed higher fibre yield than the plot with no insecticide sprayed/control plot. From the result, it was noticed that insecticides have positive impact on jute fibre yield production.

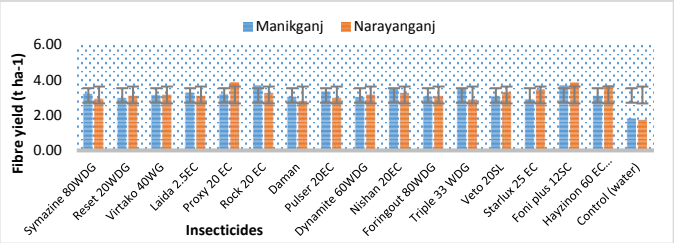

Figure 5: Effect of insecticides on fibre yield production of *Corchorus olitorius*.

In stick yield production at Manikganj, the highest stick yield (13.82 t/ha) was found in the plot which was treated with Hayzinon 60 EC followed by Proxy 20 EC (12.56t/ha). The lowest (5.90t/ha) fibre yield was found in Triple 33 WDG treated plot which was higher over control plot (Figure 6). In case of Narayanganj, the highest stick yield (10.52t/ha) was found in the plot which was treated with Foni plus 12SC and statistically similar to Proxy 20 EC (9.58t/ha), Hayzinon 60 EC (8.85t/ha) and Starlux 25 EC (8.65t/ha). This result is an agreement with that result of (Rahman et al., 2020; Mukul, 2020). Mukul Also found same result when he examined twelve Tossa Jute (Corchorus olitorius L.) genotypes for elucidation of Genotypic Variability, Character Association, and Genetic Diversity for Stem Anatomy (Mukul, 2020). The lowest (6.04t/ha) stick yield was found in Symazine 80WDG treated plot which was higher over control plot. In another study, tested twelve tossa jute (*Corchorus olitorius* L.) genotypes based on variability, heritability and genetic advances for yield and yield attributing morphological traits and found same fibre and stick yield in their research work (Mukul et al., 2020).

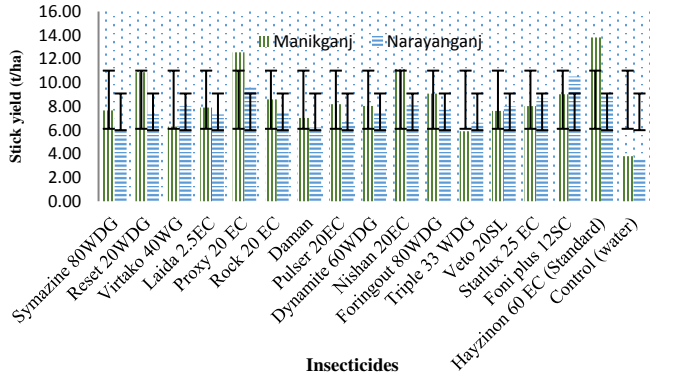

Figure 6: Effect of insecticides on stick yield production of *Corchorus olitorius*.

3.4 Correlation and regression study

The degree of statistical relationship between fibre weight and stick weight in both locations has been found significant relationship at 5% level of probability (P>0.05). The positive slopes exhibited positive relationship. In Narayanganj, the degree of relationship between fibre yield and stick yield was studied (Figure 7). The result revealed that fibre yield and stick yield have a direct significant positive relationship at 5% level of significance which has been confirmed with correlation co-efficient r = 0.9673. The relationship was more evident by the equation Y= and sowing gradual Y = 3.12x – 2.28 increase in stick yield with the increase of fibre yield.

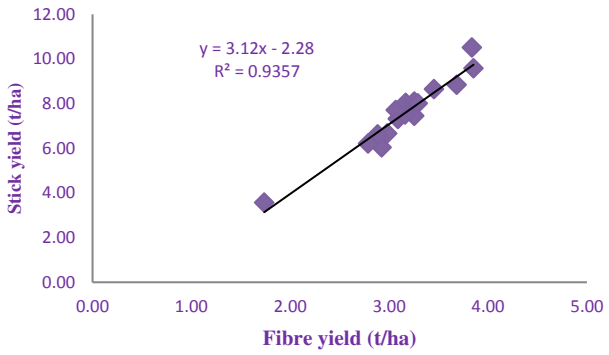

Figure 7: Relationship between fibre yield and stick yield of *Corchorus olitorius* in Narayanganj

4. Conclusion

Based on the findings of present research work, it can be resolved that all tested insecticides considering percent reduction of infestation over control (> 89.84%), fibre yield (>2.79 t/ha) and stick yield (>5.90 t/ha) were more or less similar to the standard and better than control. All chemical insecticides can be suggested for the farmers' use. In this experiment, there were some new combinations of insecticide, which works with low dose on wide range of insects species. These combinations will be effective to solve resistance problem. As well as farmers will have a chance to select alternate chemical insecticides according to availability and affordability.

Authors' Contribution

Md. Sohanur Rahman contributed in research conduction, data analysis, searching journal for publication and finally manuscript writing & processing of this article. Mohammad Sahin Polan and Md. Nazrul Islam conducted the research. Fakhar Uddin Talukder and Md. Mia Mukul helped in research conduction. All the authors were concerned all about the research investigation, reporting, article writing, correction and finally approval for publication.

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