Effects of New Organophosphate and Synthetic Pyrethroid Insecticides in Controlling Sugarbeet Caterpillar of Bangladesh

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ABSTRACT

The experiment conducted at Bangladesh sugarcrop research institute farm and North Bengal Sugar Mills farm during 2015-2016 and 2016-2017 cropping seasons with a view to find out the effective insecticides against sugarbeet caterpillar, *Spodoptera litura* Fab. in tropical sugarbeet cultivation. The experiment was laid out in a Randomized Complete Block Design with three replications and comprised of eight treatments viz., T_1 - Nanoplus 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval, T_2 - Agent 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval, T_3 - Virtako 40 WG @ 150 gm ha^{-1} (March + April) applied at 15 days interval, T_4 - Tata 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval, T_5 - Selection 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval, T_6 - Acemix 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval T_7 - Nitro 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval and T_0 - Control (untreated) were tested in eight different chemical insecticides against sugarbeet caterpillar. The highest efficacy (88.61%) was observed in Nitro treated plot, the highest pol% 13.38% was found in Virtako treated plot and the highest yield 78.0 t ha^{-1} was recorded in Nitro treated plot at NBSM location in the cropping season 2015-16. In the cropping season 2016-17, the highest efficacy (86.41%) was observed in Nitro treated plot, the highest pol% 13.45% was found in Virtako treated plot and the highest yield 82.67 t ha^{-1} was recorded in Nitro treated plot at NBSM location.

Key words: Tropical sugarbeet, chemical control, *Spodoptera litura*

INTRODUCTION

Tropical sugarbeet, *Beta vulgaris* L. is a temperate crop under family of Chenopodiaceae is the second important sugarcrop after sugarcane, producing about 35-40% of sugar annually all over the world (Wu *et al.,* 2004; Amr and Gaffer, 2010 and Wu *et al.,* 2016) and recently sugarbeet becoming an important biofuel alternative to fossil fuel energy (Zhang *et al.,* 2008). Kapur and Kanwar (1990) stated that sugarbeet can be grown successfully as a winter crop in subtropical. It is widely distributed throughout tropical and temperate Asia, Australia, Sudan, Pakistan and the Pacific Islands sugarbeet processing can be done from 270 to 300 days per year (Kranz *et. al.,* 1997 and Asadi, 2007). Now sugarbeet varieties are being produced successfully in tropical and subtropical countries including India, Pakistan and Bangladesh. Wide agro-climatic diversity of Bangladesh is a suitable for

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sugarbeet cultivation including saline areas. According to FAO (1982) per capita 13 kg sugar or 17 kg *'goor'* are required for balanced human diet and as such our requirement is about 2.08 million tons but we produced of 0.15 million tons and 0.40 million tons of sugar and goor respectively. Sugarbeet can produce 2-3 times higher sugar yields per hectare in a short period (4-6 months) as compared to sugarcane which needs 12-16 months (Baloach *et al.,* 2002). Therefore, the shortage of sugar/goor may be covered through cultivation of sugarbeet to achieve the requirement and uplit economic condition of the country.

Being a new crop, several constraints are noticed in cultivation of sugarbeet and severe incidence of insect pests and diseases is a major (Patil *et al.,* 2007). Sugarbeet insect pests can cause yield loss of 18 t ha^{-1} (Anon. 2011-12). Insect pests is one of the main problems for sugarbeet production in Bangladesh. Eight insect pests viz., sugarbeet caterpillar, cutworm, aphids, red mite, grass hopper, hairy caterpillar, flea beetle and webworm have been reported. Sugarbeet caterpillar, *Spodoptera litura* is the most destructive pests of sugarbeet (Nakasuji and Mastsuzaki, 1997). This caterpillar is a cosmopolitan and polyphagous pest, affecting several crops like cotton, pulses, oil seeds, vegetables, ornamental plants and weed species as well (Zhou *et. al.,* 2010 and Navasero, 2011). Female adult moths lay eggs in masses on the lower surface of leaves. The eggs hatch in about 6-8 days. Soon after hatching, the young larvae start feeding on the epidermis of the leaves. Initially, the caterpillars are a translucent green with a dark thorax. They feed gregariously in the early stages and damaged leaves appear skeletonized. The larger caterpillar is voracious feeder which consumes 10-15 gm per day and the crop may be completely defoliated within a week (Rao *et. at.,* 2004). Two, four and eight larvae per plant reduced sugarbeet yield by 24, 44.2 and 50.4%, respectively (Patel *et. al.*, 1971).

Different pest management practices like resistant varieties, cultural practices, mechanical control, biological and chemical control methods have so far been recommended to control sugarbeet insect pests. However chemical control method can give quick and visible results. Chemical control also considered to be the last resort in IPM approach for pest control where its use can not be ignored. So far, no chemical insecticide are recommended against sugarbeet caterpillar. Thus, the present experiment was conducted to find out appropriate and effective chemical insecticides against this pest for commercial cultivation of tropical sugarbeet in Bangladesh.

MATERIALS AND METHODS

The field experiment was conducted at the experimental farm of Bangladesh Sugarcrop Research Institute (BSRI) Ishurdi, Pabna and also include NBSM trial during the cropping seasons 2015-16 and 2016-17. The experiment consisted of eight treatments in cropping seasons including one control. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The individual plot size was 5m 4m. Block to Block distance was 2 m with a border of 1.5 m. Line to line spacing and seed sowing was 50 cm 20 cm. The experiment was located in High Ganges River Flood Plain soils under Agro-ecological Zone-11 with medium high land of typical sandy loam soil having 7.6 p^H.

The experiment was comprised of eight treatments as follows:

T_1: Nanoplus 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval
T_2: Agent 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval
T_3: Virtako 40 WG @ 150 gm ha^{-1} (March + April) applied at 15 days interval
T_4: Tata 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval
T_5: Selection 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval
T_6: Acemix 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval
T_7: Nitro 505 EC @ 4.5 L ha^{-1} (March + April) applied at 15 days interval
T_0: Control (untreated)

The experimental plot was prepared with plowing thoroughly because sugarbeet being deep-rooted crop requires a good tilth of soil free from clods for its proper growth. Fertilizer dose of MOC, Urea, TSP, MOP, Gypsum, Zinc Sulphate and Boric Acid were applied at the rate of 450 kg, 250 kg, 120 kg, 22 5kg, 100 kg, 10 kg and 20 kg per hectare respectively (Anon., 2001 and 2005). Total MOC was applied at the time of final land preparation. TSP, MOP, Gypsum, Zinc sulphate, Boric Acid and ⅓ Urea was applied in the line before ridge preparation. Rest amount of Urea was applied in two installments at 30 and 60 days after sowing. Seed of tropical sugarbeet genotype (Shubhra) was sown on light ridge soil at 3-4 cm depth on month of November with the spacing of 50 cm 20 cm. Light irrigation was done immediately after sowing to ensure uniform sugarbeet seed emergence. Sex pheromone trap was also placed @ 45 traps per hectare in the field to attract male insects. Parasitoid *Bracon hebetor* was also released from last February at 15 days intervals in the field to control *Spodoptera litura.* To ensure optimum soil moisture, irrigation was done twice in a month continued up to March. All types of intercultural operations like weeding, mulching and fertilizer application were done timely. To control of *Spodoptera litura* chemical insecticides were evaluated. All the insecticides of the form Emulcifiable Concentrate @ 4.5 liter ha^{-1} were applied at 15 days intervals in March and April. For data collection, five plants were randomly selected in each plot. Larval population was randomly collected in each line. Beet pol% was recorded after 150 DAS (days after sowing). Data on *Spodoptera litura* infesting larval population was recorded in sugarbeet leaf in the month of March and April. Total weight was calculated (ha^{-1}) from each plot and statistically analyzed with the help of Statistic-10 program with LSD test at 5% level of significance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

From the Table 1 it revealed that in BSRI farm, statistical significant difference was observed in control plot and treated plot but there was no significant difference among them. The highest efficacy of 85.0% was observed in Nitro 505 EC followed by Agent 505 EC (83.76%). All the insecticides showed the desired level of control upto 80% efficacy. In NBSM farm, the highest efficacy (88.61%) was found in Nitro 505 EC followed by Virtako 40 WG (87.98%) and all the insecticides here also showed the desired level of control upto 80% efficacy. Rathi and Gopalakrishan (2006) stated that insecticidal effects reduced the infestation of sugarbeet caterpillar in commercial cultivation of subtropical sugarbeet.

Table 1. Effects of different insecticides in controlling sugarbeet caterpillar the cropping season, 2015-16

Treatments	Larval population (5 plants/plot)			
	BSRI farm, Ishurdi		NBSM farm, Natore	
	Mean	% efficacy	Mean	% efficacy
T_1: Nanoplus 505 EC @ 4.5 L ha^{-1} (March + April)	4.67b*	82.49	9.00b	82.91
T_2: Agent 505 EC @ 4.5 L ha^{-1} (March + April)	4.33b	83.76	9.67b	81.64
T_3: Virtako 40 WG @ 150 gm ha^{-1} (March + April)	4.67b	82.49	6.33b	87.98
T_4: Tata 505 EC @ 4.5 L ha^{-1} (March + April)	5.00b	81.52	10.00b	81.01
T_5: Selection 505 EC @ 4.5 L ha^{-1} (March + April)	5.33b	80.01	10.33b	80.39
T_6: Acemix 505 EC @ 4.5 L ha^{-1} (March + April)	5.00b	81.52	7.67b	85.44
T_7: Nitro 505 EC @ 4.5 L ha^{-1} (March + April)	4.00b	85.00	6.00b	88.61
T_0: Control (untreated)	26.67a	-	52.67a	-
LSD (0.05)	3.96		7.96	

*Figures accompanied by same letter are not significantly different at 5% level as per LSD test

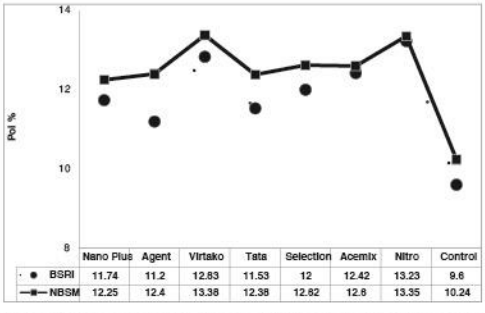
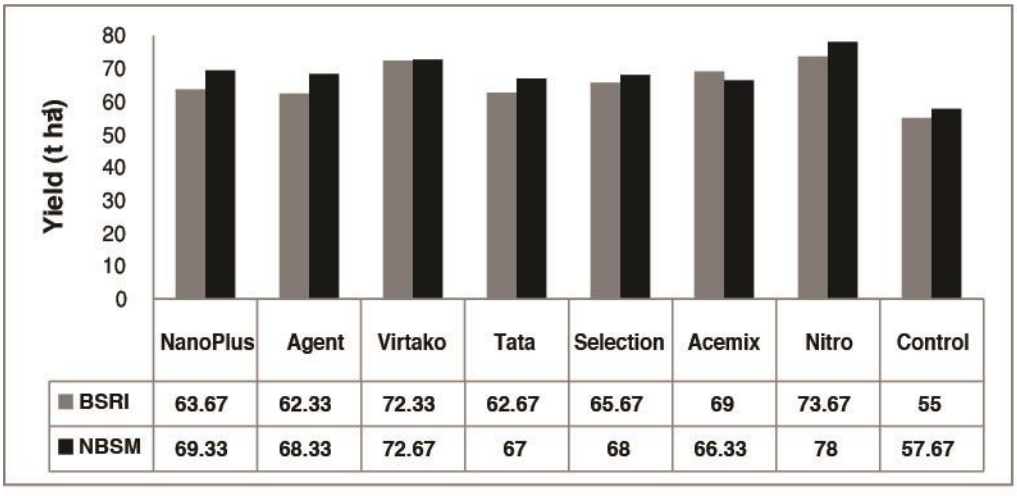


Figure 1. Effects of different insecticides on Pol % present in sugarbeet plant in cropping season, 2015-16

From the Figure 1 it was found that the highest pol% 13.38 was recorded in Virtako 40 WG at NBSM location followed by Nitro 505 EC (13.35%). The highest pol% 13.23 was recorded in Nitro 505 EC treated plot at BSRI location followed by Virtako 40 WG (12.83%). Higher pol% in beet was recorded in NBSM location than BSRI location for every insecticidal treatment. The lowest pol% were found both in control plots at BSRI (9.6%) and NBSM (10.24%) compared to treated ones proving that insecticides affected positively on pest control and pol% increase.



	NanoPlus	Agent	Virtako	Tata	Selection	Acemix	Nitro	Control
BSRI	63.67	62.33	72.33	62.67	65.67	69	73.67	55
NBSM	69.33	68.33	72.67	67	68	66.33	78	57.67

Figure 2. Effects of different insecticides on Beet yield in sugarbeet plants in the cropping season, 2015-16

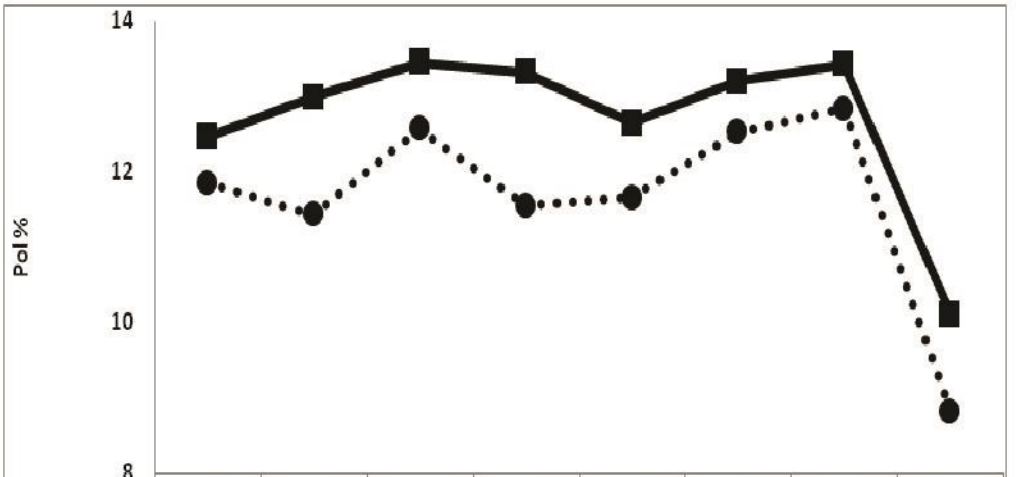
From the Figure 2 it is observed that the highest yield 78 tha^{-1} was found in Nitro treated plot followed by Virtako 40WG 72.67 t ha^{-1} in NBSM location where as control plot was 55 t ha^{-1}. In BSRI location, the highest yield 73.67 t ha^{-1} was found in Nitro treated plot followed by Virtako 40WG 72.33 t ha^{-1} where as in control plot it was 57.67 t ha^{-1}. Higher beet yield was recorded in NBSM location than in BSRI location in every insecticidal treatment. The results found in 2015-16 season revealed that insecticide application decreased pest population, increased pol% and yield of beet. Also recorded that effect of insecticides were comperatively better at NBSM location.

Table 2. Effects of different insecticides in controlling sugarbeet caterpillar during the cropping season, 2016-17

Treatments	Larval population (5 plants/plot)			
	BSRI farm, Ishurdi		NBSM farm, Natore	
	Mean	% efficacy	Mean	% efficacy
T_1: Nanoplus 505 EC @ 4.5 L ha^{-1} (March + April)	3.00b*	82.00	5.33b	80.26
T_2: Agent 505 EC @ 4.5 L ha^{-1} (March + April)	3.33b	80.00	5.00b	81.48
T_3: Virtako 40 WG @ 150 gm ha^{-1} (March + April)	3.00b	82.00	4.00b	85.19
T_4: Tata 505 EC @ 4.5 L ha^{-1} (March + April)	3.33b	80.00	5.00b	81.48
T_5: Selection 505 EC @ 4.5 L ha^{-1} (March + April)	2.67b	83.98	5.33b	80.26
T_6: Acemix 505 EC @ 4.5 L ha^{-1} (March + April)	3.33b	80.02	4.00b	85.19
T_7: Nitro 505 EC @ 4.5 L ha^{-1} (March + April)	3.00b	82.20	3.67b	86.41
T_0: Control (untreated)	16.67a	-	27.00a	-
LSD (0.05)	2.0535	-	8.6922	-

*Figures accompanied by same letter are not significantly different at 5% level as per LSD test

Table 2 showed that in BSRI farm, the highest efficacy (83.98%) was observed in Selection 505 EC followed by Nitro 505 EC (82.20%) but all the insecticides controlled more than pests 80% control. The efficacy ranged from 80.26 – 86.41% in the location NBSM farm. The highest efficacy (86.41%) was observed in Nitro 505 EC followed by Virtako 40WG (85.19%). Nayak and Chiber (2003) reported that insecticidal toxicity reduced the infestation of sugarbeet caterpillar in commercial cultivation of subtropical sugarbeet.



	Nano Plus	Agent	Virtako	Tata	Selection	Acemix	Nitro	Control
BSRI	11.85	11.43	12.57	11.55	11.65	12.53	12.84	8.82
NBSM	12.46	12.99	13.45	13.32	12.64	13.2	13.43	10.11

Figure 3. Effects of different insecticides on Pol % present in sugarbeet plant in cropping season, 2016-17

From the Figure 3 it was observed that the highest pol% (13.45) was recorded in Virtako 40 WG at NBSM location followed by Nitro 505 EC (13.43%). At NBSM location, the highest pol% (12.84) was recorded in Nitro 505 EC treated plot at BSRI location followed by Virtako 40 WG (12.57%). The highest pol% beet was found in NBSM location compared to BSRI location in every insecticidal treatment. The lowest pol% (8.82) was recorded in control plot in BSRI location and at NBSM location it was 10.11%. The result is similar as was found in 2015-16 season.

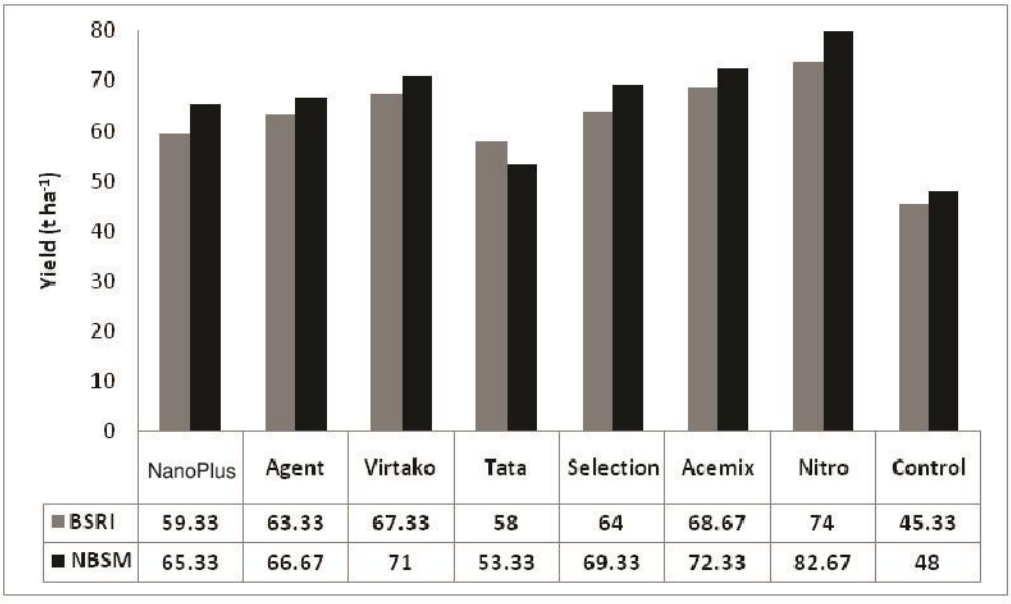


Figure 4. Effects of different insecticides on Beet yield in sugarbeet plants in the cropping season, 2016-17

From the Figure 4 it was found that the highest yield 82.67 t ha^{-1} was observed in Nitro treated plot followed by Acemix 505 EC (72.33 tha^{-1}) in NBSM location where as in control plot it was (48.0 t ha^{-1}). In BSRI location, the highest yield (74.0 t ha^{-1}) was found in Nitro treated plot followed by Acemix 505 EC (68.67 t ha^{-1}) where as in control plot it was (45.33 t ha^{-1}).The highest beet yields was recorded in NBSM location compared to BSRI location in every insecticidal treatment as usual.

- Based on the present findings following conclusions can be made such as to secure yield increase particularly sugarbeet caterpillar should be controlled in pest prone areas.
- Insecticides tested Nitro 505 EC gave satisfactory results (over 80% control) and may be recommended against sugarbeet caterpillar with the doses used and time applied in the experiment.

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