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Development of Management Practices Against Sugarcane Grasshopper in Faridpur Sugar Mills Area of Bangladesh

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A b s t r a c t

The field experiment was conducted at Masordia, Madukhali, Faridpur Sugar Mills area, Faridpur during the cropping season of 2014-2017 to find out the development of management practices against sugarcane grasshopper for commercial cultivation of sugarcane. The experiment was designed in a Randomized Complete Block Design (RCBD) with three replications and comprised of six treatments. In three cropping season, the highest efficacy was found in treatment T4 –(Weeding and mulching at once month interval + Nitro 505 EC @ 3.0 L.ha-1) of 86.23%, 82.72% and 82.34% respectively followed by 82.53%, 80.91% and 78.44% respectively whereas the lowest efficacy was found from T1- (Weeding and mulching at once month interval) of 4.32%, 7.79% and 7.53% respectively Nevertheless, the three consecutive cropping seasons Bio-control agent treated plot showed 24.83%, 33.67% and 34.77% efficacy. This study revealed that Weeding and mulching + Nitro 505 EC insecticides application management practices best effective control against grasshopper in sugarcane cultivation. This technique will also be applied in others sugarcane growing areas of Bangladesh.

Keywords: Sugarcanegrasshopper, management practices, insecticides and effective control.

Introduction

Sugarcane (*Saccharum officinarum* L.) is a perennial crop that is grown as a source of sugar primarily in the tropical and subtropical areas of the world, including Bangladesh. Sugarcane is an important cash and industrial crop of Bangladesh. Sugarcane yield is markedly influenced by many factors like soil fertility, climate, variety, cultural practices, prevalence of insect pests and diseases and environmental stress. Among them, pests are known to inflict considerable loss in cane yield as well as sugar output. Sugarcane is a long duration crop of 10-18 months and therefore is liable to be attacked by several insect pests and diseases. According to an estimate, sugarcane production declined by 20.0 and 19.0% by insect pests and diseases, respectively. Among the various factors, incidence of insect pests plays a vital role in low productivity and sugar recovery. About 103 insects were associated with the sugarcane crop (Kumarasinghe, 1999). Economic loss in sugarcane has been estimated to be 20 per cent in cane yield and 15 percent in sugar recovery due to the ravages of the insect pests (Avasthy, 1977).

Many grasshopper species of are well adapted to the habitats created by western agricultural practices (Pfadt 1994). Since the inception of agriculture, gra sshoppers have been one of the most important pests of agriculture in almost every part of the world (Gangwere *et al.,* 1997, Weiland *et al.,* 2002). Grasshoppers belong to the super family, Acridoidea and Pyrgomorphoidea of the order Orthoptera and suborder Caelifera. Acridoidea shows maximum diversity and constitutes only one family, i.e., Acrididae whereas pyrgomorphoidea also has only one family i.e., Pyrgomorphidae, widely distributed in India. Grasshoppers are of great economic importance, because they constitute an important group of pests and pose a constant threat to cereal crops, pulses, vegetables, orchards, grassland and forest plantations worldwide. Grasshoppers cause significant damage to tree seedlings and crops (Joshi *et al*., 1999), hence considered oligophagous and, according to host preferences classified as graminivorous, forbivorous and ambivorous or mixed feeders (Mulkern 1967). Therefore, conservation of grasshoppers is highly necessary in forest ecosystem. Once ecosystems are disturbed, the population of particular group of animal may be increases or decreases. The low population of grasshopper's effect on food chain and High population of grasshoppers effect on rapid loss of vegetation, cause increase runoff, soil erosion and destruction of food sources for many animals. In balanced ecosystem have self-ability to maintain suitable level of population. Grasshopper recognized

have agriculture crop pest. Hence, nobody thinks about conservation of grasshoppers. Grasshoppers are found throughout the year, some species of grasshoppers are dominant in winter, some are in rainy, and some are in summer season. Species divers depends on climatic condition like temperature, rainfall, humidity, type of soil and type of vegetation. Acridid grasshoppers are exclusively Phytophagus, they feed on variety of vegetations, mostly prefer small surface vegetations, like different grasses, sugarcane, vegetables, pulses, cereals, and some species prefer plants also.

Grasshopper can damage rice and sugarcane in all stage of crop growth. Both nymphs and adults can feed on leaves by cutting the edges of leaves. When found in greater number can feed even midribs and total leaves and cause extensive defoliations. The incidence of grasshopper was observed all-round the year. The maximum incidence of 9.75 per cent was recorded in village Dawaguri area and the average incidence ranged from 2.25 to 5.15 the maximum incidence of 6.75 per cent was recorded at Dawaguri and the average per cent incidence ranged from 1.81 to 5.07. Vastrad, 1986 and Akhtar *et al.,* 2012 reported that short horned grasshoppers were more abundant during the month of September.

Among these, Grasshopper *Atractomorpha crenulata*(F), *Atractomorpha psittacina* De Haan, *Crotogonus trachypterus* (Blanch.),*Hieroglyphus banian* (F.) are most damaging (Biswas, 2014).Sugarcane shorthorned grasshopper, *Hieroglyphus banian* (Fabricius)(Orthoptera : Acridoidea) is one of the main species of acridids and widely found in Bangladesh, Cambodia, China, India,Laos, Myanmar, Pakistan, Sri Lanka, Thailand and Vietnam (CABI, 1999).Primary hosts of *H. banian* are rice (*Oryza sativa*), Sugarcane, Sorghum (*Sorghum bicolor*), millet (*Panicum miliaceum*) and maize (Zea mays) (CABI, 1999). This shorthorned grasshopper attacks on rice in India and Pakistan (Chatterjee and Debgoswami, 1981; Garg and Chaudhary, 1979). Meshrm *et al.* (1990) recorded that *H. banian* is a pest of germinating seedlings of various forest trees.

The sugarcane grasshopper, *Aularches miliaris* L. is considered as a occasional pest of sugarcane in Bangladesh. One of the most serious grasshopper pest species in North America is the migratory grasshopper, *Melanoplus sanguinipes* F, which is responsible for more damage in crops and grasslands in the United States than any of the other grasshopper species (Pfadt 1994, Otte 1995).The American grasshopper a bird wing grasshopper named *Schistocerca americana*, occasionally causes serious damage to sugarcane. Adult and nymph grasshoppers eat the blades down to the midrib of the leaves in jagged, irregular patterns, finally it leaves only the leaf midrib and removing valuable photosynthetic tissue from the plant. But in the cropping season 2012-2013 its infestation became havoc inMasordia, Madukhali, Faridpur Sugar Mills area Bangladesh. This may happen due to climate change. About 500 acres of sugarcane field had 80-100% infestation. Migratory grasshoppers have one generation per year. A swarm, also known as locust, might cause severe damage to sugarcane, affecting the yield. Therefore, the present experiment was undertaken to find out suitable management practices against grasshoppers in the sugarcane field**.**

Materials and Methods

The field experiments were conducted for three consecutive years during the cropping season 2014-15, 2015-2016 and 2016-2017 at Masordia, Madukhali, Faridpur Sugar Mills area, Faridpur. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The plot size was 20 × 18m. The sugarcane variety Isd 39 was conventionally planted in December 2014, 2015 and 2016 respectively. Intercultural operations like weeding, mulching, detrashing, earthing up etc. were done as and when required (Rahman and Pal, 2003). Fertilizers were applied as per recommended dose, method and time (FRG, 2012) use fertilizer dose. There were six (6) treatments T_1 – Weeding and mulching at once month interval (March-July), T_2 – T_1 + Bio-neem plus @ 2.5L.ha^{-1} (May-July), T_3 – T_1 + Cypermethrin 10 EC @ 4.0 L.ha^{-1}(May-July), T_4 – T_1 + Nitro 505 EC @ 3.0 L.ha^{-1}(May-July), T_5 – T_1 + *Metarhizium anisopliae* @ 5.0 kg ha^{-1}(May-July) and T_0 – Control (Untreated) including one control.

Figure 1. Adult grasshopper at Masordia, Madukhali, FSM, Faridpur

Figure 2. Grasshopper infested field at Masordia, FSM, Faridpur

Application of liquid insecticides: When the sugarcane plants are five to six months old, i.e. from May to July, the presence of Grasshopper's adult or Nymph in the sugarcane field, I sprayed liquid insecticide through foot spray pump at noon. The whole sugarcane plants were counted randomly five lines per plot. Estimated as the grasshopper infested leaf on the youngest top ten green leaves of these same five lines. Data on the sugarcane grasshopper infested leaf was recorded on plant basis in the month of May and July. The collected data were converted to percent infestation to measure the level of incidence and analyzed for comparison by using LSD at 0.05 levels interpretation. For efficiency study, percent infestation was computed by total and infested canes for individual plot and percent infestation was computed by using the following formula:

$$\%\ \text{Grasshopper infestation} = \frac{\text{Number of infested canes}}{\text{Total number of canes}} \times 100$$

Results and Discussion

From the Table 1 in cropping season 2014-15, Sugarcane grasshopper infestation was collected five line/plot. The two months data were observed statistically significant differences among the treatments. From May`15 data, the highest efficacy

(91.11%) was found in T_4 (Weeding and mulching at once month interval + Nitro 505 EC @ 3.0 L.ha^{-1}) treated plot followed (84.34%) by T_3 (Weeding and mulching at once month interval + Cypermethrin 10 EC @ 4.0 L.ha^{-1}) plot. The insecticides treated plot showed the desired level of 80% efficacy up to control plot. In July`15 data, the highest efficacy (81.36%) was found in Nitro 505 EC followed by Cypermethrin 10 EC (80.71%). The insecticides treated plot here also should the desired result of 80% efficacy up to control plot. The both data expressed that the lowest efficacy (7.04%), (1.60%) in T_1 (weeding and mulching at once month interval) over control against grasshopper infestation followed by the month of May`15 and July`15 data. The pool data indicated that the highest grasshopper infestation was found (82.39%) in untreated control plot (T_0) and the lowest grasshopper infestation was 11.15% in Nitro 505 EC treated plot (T_4) followed by 14.33% in Cypermethrin 10 EC treated plot (T_3). The percent increased efficacy over control ranged from 4.32%- 86.23%. The highest efficacy percent over control was (86.23%) recorded in Nitro 505 EC treated plot (T_4) followed by (82.53%) in Cypermethrin 10 EC treated plot (T_3) whereas 24.83% was found in bio-agent *Metarhizium anisopliae* @ 5.0 kg ha^{-1}treated plot (T_5).

Table 1. Effects of different treatment on Sugarcane Grasshopper infestation in Masordia, Madukhali, Faridpur Sugar Mills area, Faridpur, 2014-2015

Treatments	Percent sugarcane grasshopper infestation (Five line/plot)					
	May 15	% efficacy over control	July 15	% efficacy over control	Pool Data	% efficacy over control
T_1	80.22b*	7.04	77.22a	1.60	78.72	4.32
T_2	62.92c	27.09	65.65b	16.34	64.29	21.72
T_3	13.51d	84.34	15.14c	80.71	14.33	82.53
T_4	7.67e	91.11	14.63c	81.36	11.15	86.23
T_5	58.31c	32.43	64.96b	17.22	61.64	24.83
T_0	86.30a	-	78.48a	-	82.39	-
LSD (0.05)	5.7627	-	7.6022	-	-	-

Means within the same column followed by the same letter (s) are not significantly different at 5% level according to LSD test

Abbrevations: T_1- Weeding and mulching at once month interval (March-July), T_2 - T_1 + Bio-neem plus @ 5 L.ha^{-1}(May-July), T_3 - T_1 + Cypermethrin 10 EC @ 4.0 L.ha^{-1} (May-July), T_4 - T_1 + Nitro 505 EC @ 3.0 L.ha^{-1}(March-July), T_5 - T_1 + *Metarhizium anisophle* @ 5.0 kg ha^{-1}(May-July) and T_0-Control

From the Table 2 it was revealed that in cropping season 2015-16, Sugarcane grasshopper infestation was collected five lines/plot. The times, collected data were observed statistically significant difference among the treatments. From May`16 data, the highest efficacy of (83.14%) was found in Nitro 505 EC treated plot followed by Cypermethrin 10 EC (80.88%). The insecticides treated plot showed the desired level of 80% efficacy up to control plot. In July`16 data, the highest efficacy (82.30%) was found in Nitro 505 EC followed by Cypermethrin 10 EC (80.94%)and the insecticides treated plot here also showed the desired level of 80% efficacy up to control plot. The both data expressed that the lowest efficacy (3.86%), (11.72%) in T_1 (weeding and mulching at once month interval) over control against grasshopper infestation followed by the month of May`16 and July`16 data. The pool data indicated that the highest grasshopper infestation was found (65.19%) in untreated control plot (T_0) and the lowest grasshopper infestation was 11.30% in Nitro 505 EC treated plot (T_4) followed by 12.44% in Cypermethrin 10 EC treated plot (T_3).The percent increased efficacy over control ranged from 7.79%- 82.72%. The highest efficacy percent over control was (82.72%) recorded in Nitro 505 EC treated plot (T_4) followed by (80.91%) in Cypermethrin 10 EC treated plot (T_3) whereas 33.67% was found in bio-agent *Metarhizium anisopliae* @ 5.0 kg ha^{-1}treated plot (T_5).

Table 2. Effects of different treatment on Sugarcane Grasshopper infestation in Masordia, Madukhali, Faridpur Sugar Mills area, Faridpur, 2015-2016

Treatments	Percent sugarcane grasshopper infestation (Five line/plot)					
	May 16	% efficacy over control	July 16	% efficacy over control	Pool Data	% efficacy over control
T_1	55.54a*	3.86	64.09ab	11.72	59.82	7.79
T_2	50.98a	11.75	54.10bc	25.48	52.54	18.62
T_3	11.04c	80.88	13.84d	80.94	12.44	80.91
T_4	9.74c	83.14	12.85d	82.30	11.30	82.72
T_5	39.32b	31.94	46.91c	35.39	43.12	33.67
T_0	57.77a	(-)	72.60a	(-)	65.19	
LSD (0.05)	10.108	-	12.843		-	-

Means within the same column followed by the same letter (s) are not significantly different at 5% level according to LSD test

Abbrevations: T_1- Weeding and mulching at once month interval (March-July), T_2 - T_1 + Bio-neem plus @ 5 L.ha^{-1}(May-July), T_3 - T_1 + Cypermethrin 10 EC @ 4.0 L.ha^{-1} (May-July), T_4 - T_1 + Nitro 505 EC @ 3.0 L.ha^{-1}(March-July), T_5 - T_1 + *Metarhizium anisophle* @ 5.0 kg ha^{-1}(May-July) and T_0-Control

The data presented in Table 3, it was observed that in cropping season 2016-17, Sugarcane grasshopper infestation was collected five line/plot. The times, collected data were observed statistically significant difference among the treatments to reducing thegrasshopper infestation over the control plots. From May`17 data, the control efficacy ranged from 5.39 to 82.00%. The highest efficacy of (80.00%) was found in Nitro 505 EC treated plot followed by Cypermethrin 10 EC (75.97%). The insecticides treated plot showed the desired level of 80% efficacy up to control plot. In July`17 data, the highest efficacy (82.68%) was found in Nitro 505 EC followed by Cypermethrin 10 EC (80.91%)and the insecticides treated plot here also showed the desired level of 80% efficacy up to control plot. The both data expressed that the lowest efficacy (5.39%), (9.66%) in T_1 (weeding and mulching at once month interval) over control against grasshopper infestation followed by the month of May`17 and July`17 data. The pool data indicated that the highest grasshopper infestation was found (55.59%) in untreated control plot (T_0) and the lowest grasshopper infestation was 9.81% in Nitro 505 EC treated plot (T_4) followed by 11.93% in Cypermethrin 10 EC treated plot (T_3).The percent increased efficacy over control ranged from 7.53%- 82.34%. The highest efficacy percent over control was (82.34%) recorded in Nitro 505 EC treated plot (T_4) followed by (78.44%) in Cypermethrin 10 EC treated plot (T_3) whereas 43.38% was found in bio-neem plus @ 5.0 L ha^{-1} treated plot (T_2).

From Figure 3 the percent grasshopper infestation of three cropping season 2014-15, 2015-16 and 2016-17 data indicated that these was significant difference in sugarcane grasshopper

incidence among the treated with cultural, chemicals and biochemical insecticides.

Table 3. Effects of different treatment on Sugarcane Grasshopper infestation in Masordia, Madukhali, Faridpur Sugar Mills area, Faridpur, 2016-2017

Treatments	Percent sugarcane grasshopper infestation (Five line/plot)					
	May 17	% efficacy over control	July 17	% efficacy over control	Pool Data	% efficacy over control
T_1	50.24a*	(5.39)	52.47a	(9.66)	51.36	(7.53)
T_2	30.50b	(42.56)	32.41b	(44.20)	31.46	(43.38)
T_3	12.76c	(75.97)	11.09c	(80.91)	11.93	(78.44)
T_4	9.56c	(82.00)	10.06c	(82.68)	9.81	(82.34)
T_5	34.31b	(35.39)	38.25b	(34.14)	36.28	(34.77)
T_0	53.10a	(-)	58.08a	(-)	55.59	(-)
LSD (0.05)	8.340		9.241		-	

Means within the same column followed by the same letter (s) are not significantly different at 5% level according to LSD test

Abbrevations: T_1- Weeding and mulching at once month interval (March-July), T_2 - T_1 + Bio-neem plus @ 5 L.ha^{-1}(May-July), T_3 - T_1 + Cypermethrin 10 EC @ 4.0 L.ha^{-1} (May-July), T_4 - T_1 + Nitro 505 EC @ 3.0 L.ha^{-1}(March-July), T_5 - T_1 + *Metarhizium anisophle* @ 5.0 kg ha^{-1}(May-July) and T_0-Control

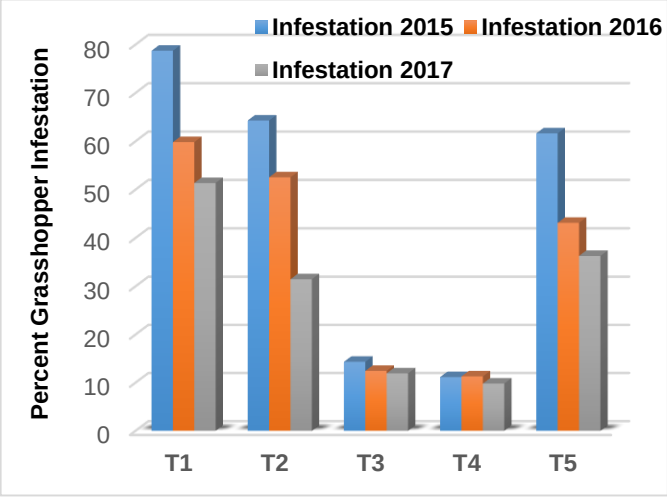

Figure 3. Effects of different treatment on Sugarcane Grasshopper infestation pool data in Masordia, Madukhali, Faridpur Sugar Mills area, Faridpur, 2014-15, 2015-16 and 2016-17 cropping season

Abbrevations: T_1- Weeding and mulching at once month interval (March-July), T_2 - T_1 + Bio-neem plus @ 5 L.ha^{-1}(May-July), T_3 - T_1 + Cypermethrin 10 EC @ 4.0 L.ha^{-1} (May-July), T_4 - T_1 + Nitro 505 EC @ 3.0 L.ha^{-1}(March-July), T_5 - T_1 + *Metarhizium anisophle* @ 5.0 kg ha^{-1}(May-July) and T_0-Control

Grasshopper infestation rate in the first 2014-15 cropping season was comparatively higher than in the second 2015-16 cropping season and third 2016-17 cropping season respectively (Figure 1&2). Grasshopper infestation rates were relatively low in the third 2016-17 cropping season. From this figure it indicated that regular application of chemicals and biochemical has made it possible to reduce grasshopper infestation in sugarcane cultivation.

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