DAMAGE ASSESSMENT AND MANAGEMENT OF ARMYWORM [*Mythimna separata*, Walker] IN WINTER MAIZE AT RAMPUR, CHITWAN.

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ABSTRACT

Mythimna separata Walker commonly known as armyworm (Rice Ear-Cutting Caterpillar), belonging to Lepidoptora: Noctuidae is one of the major insect pests of maize in Nepal. Application of selective pesticide is mostly used approach to control the pest population to minimize its possible damage. A field experiment was carried out to find out the loss by armyworm in maize field (variety RML32/17) during winter season of 2016/17. The experiment was laid under Randomized Complete Block Design with eight treatments and three replications in the research field of National Maize Research Program (NMRP), Rampur. The treatments consisted of: i)*Metarrhizium anisopliae* ii)Nuclear Polyhedrosis Virus iii)Spinosad iv)Furadon v)Magik vi)Lara-909 vii)Multineem viii)Control. The treatments were applied three times at 30DAS, 45DAS and 60DAS for each replication and armyworm damaged plants were counted after a week of application among the 30 sample plants tagged in each plot. Number of damaged plants by armyworm after each spraying and maize yield in each plot were recorded and analyzed by GenStat. It was found that least number of plants were damaged in plots applied with treatments Lara-909, subsequently followed by Spinosad while more plants were damaged successively in control and *M. anisopliae*. The highest average yield (6.73 ton/ha) was found in Lara-909 treated plot followed by Spinosad (6.67 ton/ha) which were significant with the lowest average yield found in control (5.76 ton/ha) but only statistical at par with rest of the treatments. Spinosad (Natural product of *Saccharopolyspora spinosa*) was found to be the best alternative of chemical pesticides for the eco-friendly management of armyworm.

Key words: Damage, Lara-909, *Mythimna separata*, Spinosad, Treatment.

INTRODUCTION

Maize (*Zea mays* L.) is one of the chief staple food crop grown in Nepal and rank as the second most important crop in terms of area and productivity after rice where it covers an area and productivity of 8.49 million hectares and 2.3 t/ha, respectively (MoAD, 2013). Both biotic and abiotic constraints have played a major role in limiting grain production per unit area as compared to other developed nations. Nepalese farmers are facing a lot of problems due to the incidence of insect-pest at different stages of plant growth which limits the potentiality of maize production in Nepal (Rana and Plumb, 1973; Gyawali, 1974; Joshi, 1978). *Mythimna separata* (Noctuidae, Lepidoptera) is one of the important polyphagous insect of erratic occurrence and due to its unimpeded multiplication results in epidemics which results in heavy loss of young and tender foliage (Bai *et al.,* 1990). Basically, armyworm attack in maize along with others crops like rice, sorghum, sugarcane, oats, wheat etc may cause the damage of foliage parts upto 44% (Hill and Atkins, 1983). Under natural conditions, loss in grain yield may inflicts 39.76 to 55.66% (Giranddi, 1982). Therefore, a field experiment is essential to detect level of pest infestation before they become damaging level. There is need to use less hazardous, environmentally safe and economically cheap insecticides with due precautions which is essential for the management of insect-pests of maize. To overcome the harmful effects of chemical residues to animal and human health, several studies have been conducted to explore the most efficient control methods without using pesticides. Botanicals are comparatively less toxic, less expensive and also safe for beneficial organisms. Similarly, successful use of the natural enemies for insect control depends on understanding the biology and the ecology of pest and the beneficial organisms operating on it. The present investigation was carried out with the objective to study on the efficacy of some bio rational alternatives (chemical, botanical and biological) as insecticides against Armyworm (*Mythimna separata*) and accessing on farm losses and extent damages of maize under field conditions at NMRP, Rampur.

MATERIALS AND METHODS

The experiment was conducted in National Maize Research Programme Rampur, Chitwan in winter season of 2016/17. It was located at 27º 40' North latitude and 84º 19' East longitudes with an elevation of 228m above sea level and it possessed acidic, light textured and sandy loam soil. (NMRP, 2012). The weather condition of the study site is presented below (figure 1).

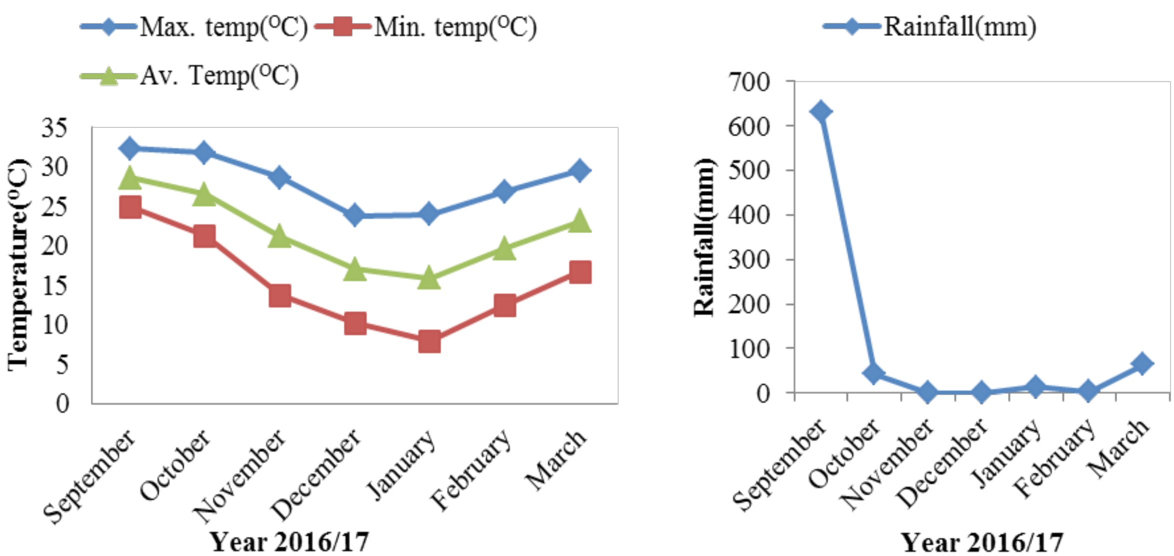

Figure 1: Temperature (left) and rainfall pattern(right) during the experiment period at NWRP, Rampur, Chitwan

There was wide variation in the weather condition during the period of experiment i.e after sowing to before harvesting. All the weather data were taken from the agro-meteorological data recorder of NMRP, Rampur. The experiment was conducted from beginning of September to mid of March. During this period, the temperature was found to be ranged from minimum of 7.86º C (in January) to maximum of 32.32º C (in September). Similarly, there was also variation in rainfall pattern during different growth stages of plants. Highest rainfall occurs in September (631.4 mm) while no rainfall during the month November and December. Depending upon the rainfall and critical growth stages, irrigation water has been provided to meet the water requirement of plants.

Table 1: Details about the Treatments

S.N	Name of Treatment	Dose	Symbol
1.	*Metarrhizium anisopliae*	0.25 ml/lit water	T1
2.	Nuclear Polyhedrosis Virus	2.5 ml/lit water	T2
3.	Spinosad	0.2 ml/lit water	T3
4.	Furadan	3,4 granules/whorl	T4
5.	Magik(Imidachloropid-17.8%)	0.5 ml/lit water	T5
6.	Lara-909(Chlorophyriphos 50EC + Cypermethrin 5EC)	1 ml/lit water	T6
7.	Multineem	2 ml/lit water	T7
8.	Control	Not treated	T8

A hybrid maize RML32/17 was taken for the experiment and was conducted under Randomized Complete Block Design (RCBD) with three replications and 8 treatments. Individual plot size of 5×4.8 m^2 with eight rows having 25 plants each was maintained and planting was done by line sowing using planter on September 5, 2016. Crop geometry of 60×20 cm was considered for row to row and plant to plant spacing. 30 plants from inner six rows (5 for each row) were randomly selected as sample plants. All the agronomic practices such as fertilizer application, weeding, top-dressing, and other necessary management practices were done as per the standard protocol to grow a good crop stand except any application of plant protection measure.

Treatments were sprayed using the Knapsack sprayer after the thorough mixing of pesticides with water following recommended dilution except for Furadan. As Furadan is in granular form, 3 to 4 granules were directly applied into the whorl of the plant. As armyworm is nocturnal pest, spraying was done after the mid-day i.e after 2 pm avoiding cloudy and windy day for the possible raining and contamination. Treatments were applied for three times at 30DAS, 45DAS and 60DAS. Harvesting was done on March 27, 2017.

Number of damaged plants were counted a week after the application of treatments. Similarly, plant and ear height, number of kernels, ear area and average yield for each treatment were also recorded for determining the extent of damage caused by armyworm infestation and efficacy of treatments. MS Excel was used for data input, table, charts, graphs and simple statistical analysis. For more detailed statistical analysis, GenStat and SPSS were used and analyzed data were subjected to Tukey for mean comparison. Yield of grain was determined using the formula adopted by Carangal *et al.* (1971) and Shrestha *et al.* (2015) in which grain moisture was maintained at 15% and yield was obtained in kg per hectare.

$$\text{Grain Yield (kg/ha)} = \frac{\text{Field weight (kg)} \times (100 - \text{moisture \%}) \times S \times 10{,}000}{(\text{Net harvested area } m^2 \times 85)}$$

Where, F.W. = Fresh weight of ear in kg per plot at harvest, Moisture (%) = Grain moisture content at harvest,85= Required moisture percentage 15%, S= Shelling co-efficient (0.80). Harvested area= net harvested plot size, m^2

RESULT AND DISCUSSION

There was no significant difference in the damaged plants by armyworm for all the plots before the application of treatments i.e. until first 30 days after sowing. Then, treatments were applied at 30DAS and data were taken after a week of application. Again, no significant difference was found for first spraying. The damage caused by armyworm was found to be significant for the second spraying (45DAS) while highly significant for the third or last spraying (60 DAS).

Table 2: Armyworm damaged plants before and after spraying of treatments

Treatment	Before Spray	After First Spray	After Second Spray	After Third Spray
Metarrhizium anisopliae	4.33[a]	7.67[a]	10.0[ab]	11.67[ab]
Nuclear Polyhedrosis Virus	4.00[a]	7.00[a]	8.67[ab]	11.00[ab]
Spinosad	4.00[a]	5.67[a]	7.00[b]	7.33[bc]
Furadon	4.00[a]	5.33[a]	7.00[b]	8.67[bc]
Magik (Imidachloropid-17.8%)	5.00[a]	6.67[a]	8.33[ab]	10.00[bc]
Lara-909 (Chlorophyriphos 50EC + Cypermethrin 5EC);	3.00[a]	4.33[a]	4.67[b]	5.00[c]
Multineem;	4.00[a]	5.67[a]	7.33[ab]	9.67[bc]
Control;	5.33a[a]	9.00[a]	13.67[a]	16.33[a]
F-test	NS	NS	*	**
s. e. d	1.524	2.047	1.816	1.676
CV%	44.3	38.8	26.7	20.6
$LSD_{0.05}$	3.268	4.391	3.895	3.595

Actual damage plants after treatments application

From this experiment, it was recorded that highest percent of plants were damaged by armyworm in control or untreated (36.66%) plots while lowest plants were damaged for treatment Lara-909 (6.67%) followed by Spinosad (11.1%). Efficacy of Lara-909 to control the damage percentage was found to be significant with all the treatments except Spinosad which was at statistical par with it. Similarly, efficacy of Spinosad was significant with the control and biological treatments (*M. anisopliae*, NPV and Multineem) while statistical at par with the chemical treatments (Lara-909, Magik and Furadan).

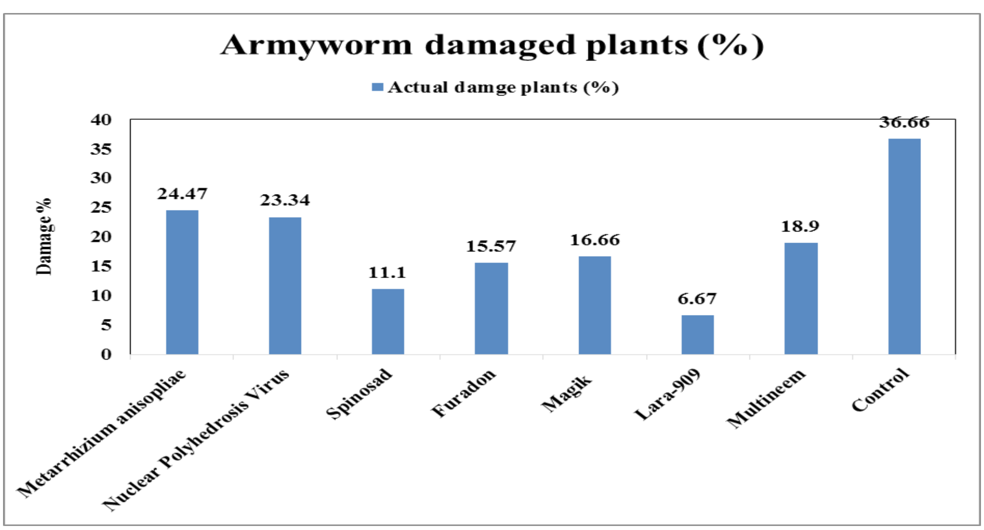

Figure 2: Percentage of damaged plants for different treatments

This experiment showed that armyworm has damaged about 37% of the maize leaves in the field condition of NMRP without any control measures. Studies had indicated that on the severe condition armyworm could damage up to 44% of the maize foliage parts (Hill and Atkins, 1983), which was more or less similar with our study.

Table 3: Plant and Ear Height of plant for different treatments

Treatments	Plant Height (cm)	Ear Height (cm)	No. of Kernel	Ear Area (cm^2)
Metarrhizium anisopliae;	159.7[a]	76.3[ab]	318[ab]	56.37[a]
Nuclear Polyhedrosis Virus;	165.7[a]	79.7[ab]	329[ab]	56.73[a]
Spinosad;	176.0[a]	86.7[b]	351[b]	59.07[a]
Furadon;	168.7[a]	80.7[ab]	342[ab]	56.93[a]
Magik (Imidachloropid-17.8%);	164.7[a]	81.0[ab]	344[ab]	58.10[a]
Lara-909 (Chlorophyriphos 50EC + Cypermethrin 5EC);	172.7[a]	87.0[b]	356[b]	59.07[a]
Multineem;	174.0[a]	86.3[b]	346[ab]	59.07[a]
Control	155.0[a]	69.0[a]	302[a]	55.50[a]
F-test	NS	*	*	NS
s. e. d	6.38	4.75	12.87	1.866
CV%	4.7	7.2	4.7	4.0
$LSD_{0.05}$	13.69	10.19	27.6	4.003

The F-test value showed that out of the data taken for yield attributing characters only ear height and number of kernels showed the significant result while plant height and area of ear showed non-significant result for the different treatments used.

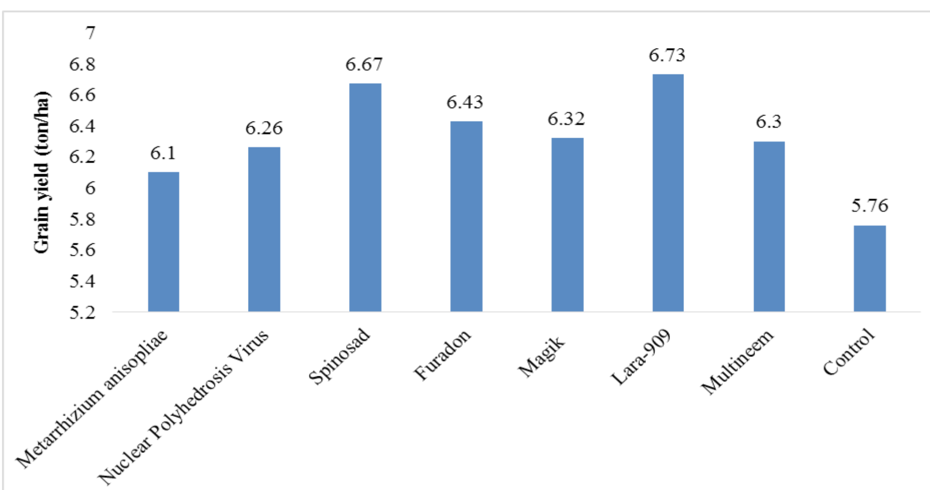

Figure 3: Average maize grain yield for different treatments

The F-test value showed significant result for the average grain yield of maize. The grain yield of maize for the treatments Lara-909 and Spinosad were significant with the grain yield for the treatment control (untreated plot) while only statistical at par with the rest of the treatments. The highest grain yield was found for Lara-909 (6.73 t/ha) followed by Spinosad (6.67 t/ha) which were significant with the yield obtained for control (5.76 t/ha) but only statistical at par with the remaining treatments. There was the yield gap of around 1 t/ha between the highest and lowest yield obtained from this study. So, infestation of armyworm could cause the loss in yield of about 17% in the field condition of Rampur.The minimum yield was increased by around 6% with the application of *Metarrhizium anisopliae.*

Studied has indicated that a natural population of the armyworm *M. separata*, attacking maize at the time of silking caused a significant reduction in yield only on plants suffering greater than 67%

defoliation. At this level of leaf loss, yield was reduced by 44%, mainly because of a reduction in seed weight (Hill and Atkins, 1982).

CONCLUSION

It was concluded that infestation of armyworm in maize field caused the significant loss in the yield while the treatments applied gave highly significant result in the management of armyworm and their damage through defoliation of leaves. Lara-909 was found to be the best one in terms of both highest yield and reducing loss through the plant damage. It was studied that chemical pesticides causes phytotoxicity, resistance of the pest, destruction of beneficial organisms, disruption of agro-ecosystem, human health hazard and environmental pollution. It was recorded that Spinosad gave the significant result in yield and armyworm management following Lara-909 with both of them at statistical at par with each other. In comparison to control water, the yield of maize was increased by 17% with the application of Lara-909 whereas minimum increase in yield (6%) was found with the response of *Metarrhizium anisopliae* in the maize against the armyworm. Spinosad (Natural product of *Saccharopolyspora spinosa*) was found to be the best alternative of chemical pesticides for the eco-friendly management of armyworm. However, the research on toxicity of the various treatment against useful insects, microorganisms, human and environment should be carried out before recommendation for the practice in the field.

ACKNOWLEDGEMENT

The authors express gratitude to all the helping hands for their continuous support and precious guidelines. The authors were grateful to National Maize Research Program, Rampur, Chitwan for technical support.

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