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Effectiveness of weeding and bunch covering in controlling banana leaf and fruit beetle, *Nodostoma viridipennis* mots

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Abstract

The experiment was conducted to investigate the effectiveness of weeding and bunch covering in controlling banana leaf and fruit beetle, *Nodostoma viridipennis* Mots. Weeding effectively reduced the infestation of *N. viridipennis.* In the weed infested banana garden percent of fruit infestation was almost three times higher (96.42 ± 1.82) than that of weed free orchard (32.54 ± 1.49). The weight per infested fruit after ripening was 142.04 ± 1.47g in infested orchard while it was 152.70 ± 0.96g in weed free garden. Number of banana per bunch increased about 15.13% due to weeding. Bunch covering with Decis impregnated nylon net protected the banana completely from the attack of banana leaf and fruit beetle. The weight of banana of the bunch covered with Decis impregnated nylon net was higher than polyethylene bagging. However, the cost-benefit ratio of bunch covering with Decis impregnated nylon net was slightly lower (2.11) than polyethylene bag (2.14). After thirty days from emergence of spadix, removal of all bunch covering gave complete protection from attack of banana leaf and fruit beetle.

Keywords: Weeding, Bunch covering, Banana leaf and fruit beetle

Introduction

Banana (*Musa* sp.) belonging to the family Musaceae is one of the most popular and important year round fruit crop considering total production 561770 MT in an area of 39459.5 hectares in Bangladesh (BBS,2001). This greatly loved fruit comprises nearly 43% of the total fruit production of this country and is a remunerative cash crop to the farmers (Haque, 1983). 'Amritasagar', 'Shabri' and 'Champa' are the leading commercial varieties of banana in Bangladesh. This delicious and cash crop is attacked by different insect pests. Among them, Banana leaf and fruit beetle, *Nodostoma viridipennis* Mots.(Eumolpidae: Coleoptera) is an alarming one for banana cultivation in Bangladesh (Ahmed, 1963). The variety 'Amritasagar' and 'Shabri' are very much susceptible to banana leaf and fruit beetle infestation. This pest is associated with the plant from the sucker stage till fruiting. Only young leaves and fruits are attacked by this beetle. The beetle feeds on their surface superficially in irregular patches. As a result, the mature fruit is disfigured by dark irregular scars and its size is somewhat affected depending on the extent of attack. The quality of the fruit may also be affected. The beetle appears in May and causes the greatest destruction in August and September when huge plantations are done in this time and disappears by March (Sen and Prasad, 1953). The market value may be reduced up to 50% due to attack of this pest and 100% banana may be attacked if no control measure is undertaken (Alam *et al.* 2000).

Ecologically sound and environmentally safe method of the pest control is of prime importance now. Considering the need for increased production and highest market value of banana on a sustainable basis, weeding and covering of banana with polyethylene bag, nylon net and insecticide impregnated nylon net were investigated in controlling banana leaf and fruit beetle, *Nodostoma viridipennis* Mots.

Materials & Methods

The experiment was conducted in six farmer's field of Mymensingh district during October 2000 to November 2001 cropping season. Three fields were considered as weed infested and another three were considered as weed free. Continuous weeding was practiced to keep the three fields weed free. Each field was 1.5-2 km apart from each other. Hexagonal planting system was followed on both orchards and the plants were spaced 2m ×2m. Comparative studies were done among weed infested and weed free orchards. To study the effect of bunch covering in controlling banana leaf and fruit beetle four treatments viz. bunch covering with transparent polybag, bunch covering with nylon net, bunch covering with Decis 2.5 EC impregnated nylon net and uncovered bunch were used in weed infested field in a randomize complete block design (RCBD) with three replications. Each replicate comprised of ten sample plants. When the spadix emerged out from the plant it was covered by both side open transparent polyethylene covers or nylon nets (42"× 30"). The upper end of the cover was tightened with shaft of spadix by the rope and bottom end remained open. Thirty to forty tiny holes were made with an ordinary pin in the polyethylene cover to maintain the respiration of banana within the polyethylene cover. Under such condition, the whole banana bunch was covered for 30 days. The dead spathe were removed from the polyethylene cover and nylon net in the morning in every two days interval. The data on the fruit infestation was collected when the fruits were harvesting condition. A banana with any spot by the leaf and fruit beetle was considered as infested fruit. No sign of attack was considered as healthy fruit. Therefore, the total number of healthy fruits and the total number of infested fruits from each treated bunch were counted and recorded. To determine the period required protecting the bunch from the attack of *N. viridipennis,* twenty both sides open white polyethylene bags were used and four covering periods e.g. 15, 20, 25 and 30 days were observed. Market values of bananas of different treatments were evaluated from the fruit market of banana and Horticulture farm. Total production cost of different treatments were calculated considering total input cost, total overhead cost and treatment cost. Net income of different treatments were also calculated to determine cost-benefit ratio of different treatment using the following formula:

$$\text{Cost-benefit Ratio (CBR)} = \frac{\text{Net income}}{\text{Total production cost}}$$

The collected data on various parameters were analyzed statistically. The mean for all the treatments were calculated and analysis of variances for all the characters were performed by F-test. The significance of the mean difference was adjusted by the Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effectiveness of weeding

The effectiveness of weeding in controlling banana leaf and fruit beetle, *Nodostoma viridipennis* is presented in Table 1. Percent fruit infestation in weed infested garden was higher (96.42 ± 1.18) than weed free garden (32.55 ± 1.49). Number of scars per square inch of banana in weed infested garden and weed free one were 19.96 ± 0.75 and 1.36 ± 0.18 respectively. Higher value indicates more infestation and lower value indicates less infestation. Infestation by *N. viridipennis* depends on weed because weed acts as alternative

host of the pest and the larvae survive feeding on roots of banana and weed. Simmonds (1958) pointed out that the larval population can sufficiently be reduced to procure effective control by weeding and cleanings of drains. Feakin (1971) also viewed the similar result. Weight per fruit before and after ripening in weed infested garden were 159.04 ± 1.32 and 142.04 ± 1.47 but in weed free orchard 170.91 ± 0.74 and 152.70 ± 0.97 respectively (Table 1). Comparatively higher values indicate good quality fruit. Fruit size and fruit weight depend on nutrients, water and light but weed competes with banana plant for that component (Feakin, 1971). Therefore, weights of bananas in weed infested garden are lower than the banana of weed free garden.

Table 1. Effect of weeding on fruit infestation by banana leaf and fruit beetle, *N. viridipennis*.

Parameters	Orchard		T-values
	Weed infested field Mean ± S.E.	Weed free field Mean ± S.E.	
Percent of fruit infestation	96.42 ± 1.18	32.55 ± 1.49	34.35**
No. of scars/sq. inch	19.96 ± 0.75	1.36 ± 0.18	23.58**
Wt./fruit in gram (before ripening)	159.04 ± 1.32	170.91 ± 0.74	-8.93**
Wt./fruit in gram (after ripening)	142.04 ± 1.47	152.70 ± 0.97	-7.04**
No. of banana / bunch	60.80 ± 1.52	70.00 ± 1.34	-4.54**

** Significant at 1% level of probability

Number of banana per bunch in weed infested garden i.e. 60.80 ± 1.52 was lower than the value of weed free garden i.e. 70.00 ± 1.34. Higher value indicates higher fruit yield and lower value indicates lower fruit yield. Weeds are the main cause of lower yield. Weeds compete with crop plants for nutrients, water and light; they harbour pests and diseases. Monthly weeding produced more rapid growth and higher fruit yields than unweeded plots (Feakin, 1971).

Effectiveness of Bunch Covering

The efficacy of bunch covering in controlling banana leaf and fruit beetle is presented in Table 2.

Weight of banana : The weight of banana before ripening varied from 158.96 g to 172.34 g. The highest value (172.34 g) was observed in treatment bunch covering with Decis 2.5 EC impregnated nylon net. Significantly lowest value (158.96 g) was observed in uncovered bunch. The weight of banana before ripening under bunch covering with nylon net and polybag are lower than the weight of banana under bunch covering with Decis impregnated nylon net but higher than uncovered bunch. So, it was clear that weight of banana was influenced by the attack of *N. viridipennis* because lowest weight was observed under uncovered bunch where control measures were not taken and comparatively higher values were observed where bunch covering were taken. Ganry (1975) revealed that weight of banana increased under bunch covering with polyethylene bag. Berrill (1956) and Perumal *et al.* (1968) also recorded that bunch weight increased wherever bunch covers were utilized.

The weight of banana after ripening decreased from the weight of banana before ripening and varied among different treatments of weight of banana after ripening from 142.52 g to 152.06 g. Significantly highest value (152.06 g) was observed in bunch covering with Decis impregnated nylon net. Significantly lowest value (142.52 g) was observed in uncovered bunch treatment.

Number of scars per square inch : Number of scars per square inch in different treatments varied from zero to 21.18 (Table 2). Zero value indicates no infestation and higher value indicates more infestation by banana leaf and fruit beetle. Zero value i.e. no infestation was found in Decis impregnated nylon net treatment. The lowest value (0.02) was observed in treatment bunch covering with transparent polyethylene bag and the highest value (21.18) was observed in uncovered bunch treatment, which varied significantly from other treatments. From the Table-2 it was clear that bunch covering with Decis impregnated nylon net showed best control of *N. viridipennis*. Choudhury *et al.* (1996) reported that the bunch cover treatments with polyethylene were effective and economic for controlling damage caused by *Nodostoma subcostatum.* Sarma *et al.* (1995) obtained effective result using chemical insecticide Malathion, Chloropyrifos to control banana leaf and fruit scaring beetle.

Length of scars per square inch: Length of scars due to banana leaf and fruit beetle was influenced by the different treatments and varied from zero to 0.90 cm (Table 2). No infestation was found in Decis impregnatd nylon treatment. The lowest value (0.05) was observed in bunch covering with transparent polyethylene bag treatment and the highest value (0.90 cm) was observed in uncovered bunch treatment which varied significantly from other treatments. From the Table 2, it was clear that bunch covering with Decis impregnated nylon net performed best in controlling *N. viridipennis*. On the other hand bunch covering with transparent polyethylene bag and nylon net treatment also gave good control where length of scars were lower compared with uncovered bunch treatment.

Percent of fruit infestation: The different treatments were found to have significantly different results in controlling the banana leaf and fruit beetle. The mean percent fruit infestation varied from zero to 96.11% (Table 2). Zero value indicates no infestation and highest value indicates more infestation by banana leaf and fruit beetle. In that sense bunch covering with Decis impregnated nylon net treatment had no infestation while the lowest (2.21%) was recorded in bunch covering with transparent polybag. Alam *et al.* (2000) stated that 100% banana might be attacked and scared if no control measures was applied. On the other hand, Rovinson (1996) reported that the use of polyethylene bunch covers was almost universal throughout the banana growing world to control banana fruit scaring beetle. Stover and Simmond (1987) found effective control with Diazinon and Dursban impregnated polyethylene covering.

Percent reduction of infestation: The percent reduction of infestation over uncovered bunch ranged from 97.39%to100%. (Table 2). Complete control was observed in case of bunch covering with Decis but 97.39% and 97.70% reduction of infestation were found in bunch covering with nylon net and transparent polybag respectively.

Table 2. Effect of bunch covering on the fruit infestation by banana leaf and fruit beetle, *N. viridipennis*

Treatment	Mean scars/ sq. inch	Mean length of scars (cm)	Mean weight of banana in gram		Percent fruit infestation	% reduction over uncovered bunch	Market Value (Tk./Kg)	Cost-benefit ratio
			before ripening	after ripening				
Bunch covering with transparent polybag	0.02[b]	0.05[b]	169.12[b]	150.18[b]	2.21	97.70	10.00	2.14
Bunch covering with nylon net	0.04[b]	0.08[b]	170.21[ab]	151.02[ab]	2.50	97.39	10.00	2.09
Bunch covering with Decis 2.5 EC impregnated nylon net	0.00[b]	0.00[b]	172.34[a]	152.06[a]	0.00	100.00	12.00	2.11
Uncovered bunch	21.18[a]	0.90[a]	158.96[c]	142.52[c]	96.11	-	6.00	1.03

Means in the same column followed by different letters are significantly different at the 1% level.

Market value: In the context of fruit market, the value of Decis 2.5 EC impregnated nylon net treated banana was highest (12.00Tk./Kg) due to its good quality and the value of uncovered banana was lowest (6.00Tk./Kg) due to its worse quality. Market value depends on fruit quality with size, weight, skin colour, freshness etc. Alam *et al.* (2000) stated that the price of banana might reduce up to 50% due to attack of *N. viridipennis*. Ahmed (1963) also stated that the value of unscarred fruit was much higher than that of scarred ones. Similar trend was reported by Ambrose (1983).

Cost-benefit ratio: The benefit cost ratio of bunch covering with white polyethylene bag treatment was 2.14 which was highest than all other treatments because total production cost was lower than all other treatments although net income of bunch covering with Decis 2.5 EC impregnated nylon net was highest. Total production cost of bunch covering with Decis 2.5 EC impregnated nylon net was higher due only to the price of nylon net. But it is true that all mosquito nets can be used for the next season, which will reduce the production cost. However, the market value of the banana of this treatment was higher than other treatments due to its size, freshness and skin colour. Ultimately cost benefit ratio of this treatment will be increased. The cost-benefit ratio of untreated control was lowest (1.03) among all other treatments as no control measure was taken.

In the present study the untreated bananas were highly infested by banana leaf and fruit beetle, *N. viridipennis*. The market value of this sort of banana was very low as compared with others. The loses of market value due to infestation of banana leaf and fruit beetle could easily be avoided if covering of the bunch is given in time.

Period required protecting the bunch from the attack of *N. viridipennis*

Number of scars per fruit: The highest attack was observed in 15 days covering period and lowest attack was in 25 days covering period and no infestation was observed in 30 covering period (Fig. 1). It was observed that covering period was a big issue in case of fruit infestation by *N. viridipennis*. Numbers of scars per fruit of 15, 20, 25 and 30 days covering period were 12.88, 2.16, 0.54 and 0.00 respectively which varied significantly in different treatments. Thirty days required with bunch covering to protect the bunch from attack of *N. viridipennis*. The damage by *N. viridipennis* was apparently higher at the early stage of banana fruit reaching highest from 8-15 days old (Alam *et al.* 2000).

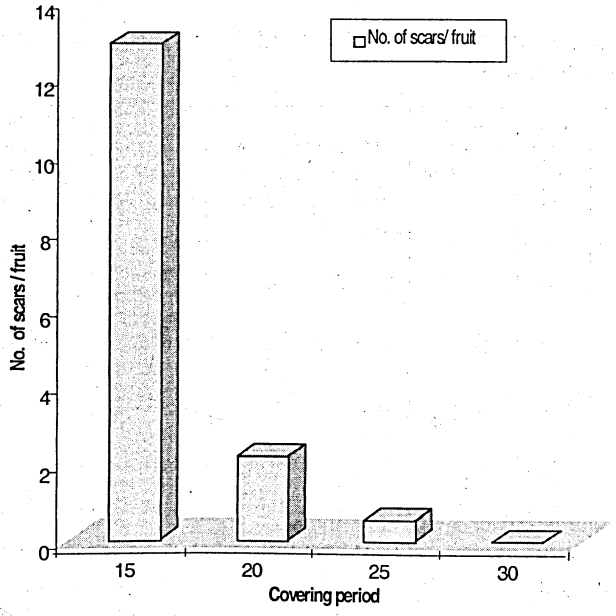

Fig. 1. Number of scars in bananas covered for different durations after emergence.

Scars length: Scars length also influenced by fruit covering period. Scars length caused by *N. viridipennis* was observed longest (0.71 cm) in 15 days covering period and the shortest (0.16 cm) in 25 days covering period (Fig. 2). Scars length per fruit of 15, 20, 25 and 30 days covering period were 0.71 cm, 0.28 cm, 0.16 cm and 0.00 cm respectively which varied significantly with each other.

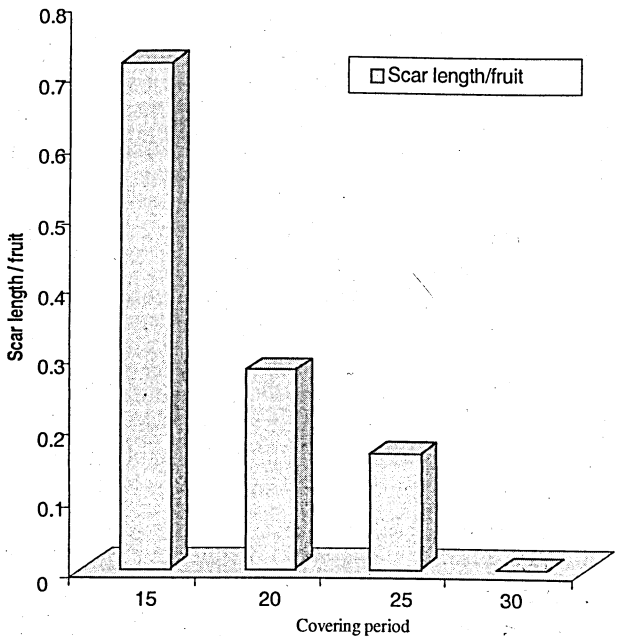

Fig.2 Length of Scar in relation to the covering period of the fruits after emergence.

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