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Estimation of Yield and Quality of Banana Fruit Affected by Banana Leaf and Fruit Beetle, *Nodostoma viridipennis* (Coleoptera: Eumolpidae) in Bangladesh

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Abstract: The study was made to evaluate the yield and quality of banana fruit affected by banana leaf and fruit beetle, *Nodostoma viridipennis* Mots, in an orchard and laboratory of Bangladesh Agricultural University, Mymensingh from October, 1997 to October, 1998. The beetle damaged the newly formed fruits in the hand having cluster of 13 bananas each showing 33-57 scars in seven days by 5 beetles, but the mean number of scars on fruits increased in second week after their emergence. The fruit size was also significantly reduced by caging insects after emergence and 15 days after emergence with more reduced size of the former fruit. The damage done by this beetle had tremendous influence on both quantity and quality of banana. Ripening duration of damaged fruits was prolonged significantly and fruit weight also reduced in comparison with beetle free fruits. The quality of infested banana with especial reference to skin colour and thickness, taste, smell and pulp of fruit was not normal, considerably affecting the consumption value.

Key words: Estimation, yield, banana leaf, fruit beetle

Introduction

The banana (*Musa* spp.) is a leading tropical fruit in the world market with highly organized and developed industry (Anonymous, 1979). As food value of banana is easily digestible and rich in carbohydrate and minerals such as K, Ca, Mg, Na and P and even richer in caloric value than potato (Bhan, 1977). One hundred grams of edible portion of banana contain 27.2% carbohydrate, 1.2% protein and 0.8% minerals (Gopalan *et al.*, 1977). This comprises nearly 42% of the total fruit production of this country (Haque, 1988) and its financial return of the crop is very high (Haque, 1983). Amrita sagar is the best table banana among four important commercial varieties in Bangladesh (Ahmed, 1963). In Bangladesh 633645 tons of banana was produced from an area of 97935 acres, having an acreage yield of 6.47 tons per acre in 1995-96 (Anonymous, 1997). This is in fact very low yield as compared to that of other banana growing countries like Argentina (34 t/ha), Costa Rica (33 t/ha), Paraguay (32 t/ha), Senegal (32 t/ha) and Honduras (30 t/ha) (Samson, 1986). The low yield of banana is influenced by so many natural and field factors, banana leaf and fruit beetle pest being major among them.

The banana leaf and fruit beetle has two species, *Nodostoma subcostatum* Jacoby and *N. viridipennis*t. The former species is found in some parts of India and latter is the most destructive pest of banana in Bangladesh (Ahmed, 1963). This beetle also attacks banana in China and India (Hill, 1983). Among different varieties of banana Bihar, Alpan, Champa and Malbhog, are seriously affected by this beetles (Sen and Prasad, 1953). Serious damage occurs in Amrita sagar variety in Bangladesh by banana leaf and fruit beetle (Ahad *et al.*, 1987). The grub of the beetle feed on roots and the adults feed on epidermis i.e., the green portion of the ventral and dorsal surface of the leaves and makes irregular patches. The feeding areas dried out, showing spot like structure known as scars and due to this damage photosynthesis is reduced and ultimately growth and yield is affected (Ahmed, 1963). The beetle also attack on fruit causing heavy damage, fruits become blemished and market value is reduced (Ahmed, 1963).

Besides the above, no research works have been found on *N. viridipennis*. The information on this insect pest is about scanty. The present study was undertaken to know different parameters of the infested fruit in comparison to uninfested fruit. These parameters are very much necessary to estimate the yield and quality of banana and also very much essential whether the pest management practices should be applied or not.

Materials and Methods

Experiments were conducted in banana orchard, Bangladesh Agricultural University, Mymensingh from October, 1997 to October, 1998. The experiment was followed in a randomized complete block replicating three times having plot size of the orchard 320 m^2 and the plants were spaced 2 x 2m^2. The planting system was hexagonal. The commercial variety "Amrita sagar" was grown. Sword suckers of 2-3 kg in weight with the age of 3-4 months were used as planting materials. The base of the suckers was cleaned, mostly by pruning the old roots and kept in shade for 2 days for drying up the wound areas. Selected sword suckers were planted in the prepared pit (0.70 x 0.4m^2) on 23rd October, 1997. Manures and fertilizers were applied as for the recommended doses and methods. Necessary intercultural operations such as shallow mulching, pruning of new suckers, bunches propping were done on proper time. Irrigation and insecticides were not applied. The weekly mean temperature ranged from 15.2 °C to 30.9 °C, relative humidity 67.7% to 93.4% and total rainfall 0.0 mm to 324.8 mm.

For the damage estimation of banana fruits, three hands each of 13 bananas in three plants were caged with nylon net just after emergence in the orchard. Five orchard collected beetles *N. viridipennis* irrespective of sex of were released in a cage just after caging, five beetles released in the caged hand after 15 days of caging and a caged hand without beetles was used as control. The caged hands with beetles were examined weekly to determine the number of scars caused by the beetles which fed on the skin of fruits. The data on the number of scars were taken from the individual fruits until the death of beetles. The caged hands were kept up to harvest of the fruit.

To estimate the yield and quality of banana fruits, the bananas were harvested from the above caged hands of all the three treatments and brought to the laboratory of the Department of Entomology, Bangladesh Agricultural University, Mymensingh for further investigation. They were kept hanged for ripening and several tests were done on the individual bananas of each caged hand treatment. These are:- I) duration of ripening, the longevity of ripening for different hands treatments was keenly observed and recorded, ii) different physical parameters viz., weight, length and breadth were taken and enlisted, iii) colour

of the ripening fruits was observed in the shinny time of the day, iv) the thickness of fruit skin after peeling and quality of pulp were observed after ripening, v) taste and smell were taken, eating by 10-12 persons in an expert panel. The data on infestation were analyzed statistically and mean difference was adjusted by Duncan's Multiple Range test.

Results and Discussion

The fruit length and breadth of banana measured under caging insects after emergence of fruits, caging insects 15 days after emergence of fruits and caging without insects of fruits are given in Table 1. The mean length of banana decreased when caging insects after emergence of fruits was found 18.5 cm which was by 3.9 cm less than caging without insects. The difference in length of fruit was little, when compared caging insects 15 days after emergence of fruits (20.8 cm) with caging without insects of fruits. The mean breadth per fruit under these three treatments was 10.6 cm, 12.4 cm and 13.6 cm respectively.

Table 1: Fruit size of banana on three treatments of *N. viridipennis*.

Treatments	Mean length (cm)	Mean breadth (cm)	Mean size (cm^2)
Caging insects after emergence of banana fruits	18.5	10.6	196.1 c
Caging insects 15 days after emergence of banana fruits	20.8	12.4	257.9 b
Caging insects free of banana fruits (Control)	22.4	13.6	304.6 a

Fruit size = length × breadth
Means with different letters differed significantly at 0.1% level.

Table 2: Mean value of ripening duration (days) and weight (g) of banana fruits

Treatments	Ripening duration (days)	Weight (g)
Caging insects after emergence of banana fruits	10.1 a	156.2 c
Caging insects 15 days after emergence of banana fruits	7.9 b	163.8 b
Control	6.7 c	168.4 a

Table 3: Quality of infested and uninfested banana fruits after ripening.

Parameters	Treatments		
	Caging insects after emergence of banana fruit	Caging insects 15 days after emergence of banana fruits	Control
Skin colour	Mixture of light yellow and dark reddish colour	Mixture of light yellow and dark reddish colour	Yellow
Skin thickness	Very thin	Thin	Thick
Taste	Very distasteful	very unpleasant	Delicious
Smell	very unpleasant	Unpleasant	Pleasant
Pulp	Decaying	Not so decaying	Fresh

Table 4: Analysis of variance for size (cm), ripening duration (days) and weight (g) of banana fruits.

Source of variance	df	Mean square values of size (cm)	Ripening duration (days)	Weight (g)
Treatment (A)	2	131681.241***	118.188***	1585.393***
Fruit in cage (B)	12	2884.304***	4.225***	480.465***
A × B	24	1590.439***	2.420***	268.728***
Error	78	301.691	0.214	3.284
CV		6.86 %	5.60 %	1.11%

*** Significant at 0.1% level.

The analyses of variance of size (length x breadth) of fruit differed significantly among treatments ($p < 0.001$) and interaction between the treatments were also significantly different (Table 4). The analyses showed that banana fruits were affected in size due to leaf and fruit beetle damage and this was significantly noticeable on the attack after 15 days of fruit emergence. Fruit size of banana was not normal under infested condition as compared to uninfested fruits. Ahmed (1963) stated that as a result of damage by *N. viridipennis* the fruit is disfigured by dark irregular scars affecting its size, depending on the extent of attack. Batra (1952) reported rectangular patches from the epidermis of leaves and fruits made by eating of beetles which not only disfigure the fruits but also interfere with their normal development.

The yield on the basis of ripening duration and weight estimated are presented in Table 2. The banana fruits ripened at variable dates in the three treatments. The mean duration among the treatments differed significantly ($P < 0.001$) (Table 4) with lowest duration on caging insects 15 days after emergence of fruits. The difference in weight of fruits was little when compared caging insects 15 days after emergence of fruits with caging without insects of fruits. The analysis of variance in weight of fruits differed significantly between treatments ($P < 0.001$) and interaction between the treatments were also significantly different (Table 4). The infestation by *N. viridipennis* prolonged ripening duration and reduced the fruit weight. This might be due to the fact that banana fruits lost their normal vigour.

The quality estimates, as fruits skin colour, skin thickness, taste, smell and pulp were observed (Table 3). On the caging after emergence of fruits, after ripening, the skin colour were observed in shiny time as mixture of light-yellow and dark-reddish colour, the fruit skin was very thin, fruits were very distasteful, their smell was very unpleasant and pulp was decaying. On the caging insects 15 days emergence of fruits, the skin colour was a mixture of light-yellow and dark-reddish colour, the fruit skin was thin, the fruits were distasteful, their smell was unpleasant and pulps were not so decaying. On the caging of fruits without insect, the skin colour was yellow, the fruit skin was thick, the fruits were delicious and tasteful, their smell was very pleasant and pulps were fresh.

The infested fruits lose their market value (Ahmed, 1963). It is also observed that the market value of unscarred fruits is much higher than that of scarred ones.

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