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ESTIMATION OF LEAF DAMAGE OF BANANA AFFECTED BY BANANA LEAF AND FRUIT BEETLE, *NODOSTOMA VIRIDIPENNIS* MOST. (COLEOPTERA: EUMOLPIDAE) IN BANGLADESH

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The study was made to evaluate the nature, extent of damage and susceptibility of banana leaf (furled leaf, freshly open leaf and mature leaf) affected by leaf and fruit beetle, *Nodostoma viridipennis* Most. in an orchard in Bangladesh Agricultural University, Mymensingh from October, 1997 to October, 1998. The beetle produced damage symptom with the sign of scars and dried feeding areas on banana leaf. The greatest damage was done to furled leaf bearing 69.8 scars which was 1.3 and 2.0 times higher than freshly open and mature leaf, respectively. The furled leaf being suitable feeding was more susceptible than other categories of leaf and seemed to be the target of colonization of leaf and fruit beetle in the orchard. The growth and development of banana leaf was affected by the damage of *N. viridipennis*. There was significant reduction in size of infested furled leaf. The difference of leaf size in case of freshly open and mature leaf was not so marked.

Key words: Banana leaf, *Nodostoma viridipennis*, Leaf damage.

Introduction

The banana (*Musa* spp.) is a leading tropical fruit in the world market with highly organized and developed industry (Anonymous 1979). As food banana is easily digestible and rich in carbohydrate and minerals (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 greatly love, fruit comprises nearly 42% of the total fruit production of this country (Haque 1988) and its financial return is very high (Haque 1983). 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 compared with 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 yield of banana is affected by so many natural and field factors, banana leaf and fruit beetle pest being major among them.

The banana leaf and fruit beetle have two species namely *Nodostoma subcostatum* Jacoby and *N. viridipennis* Most. The former specie is found in some parts of India and latter is the most destructive pest of banana in Bangladesh (Ahmed 1963). This beetle also attacks on banana in China and India (Hill 1983). Different varieties of banana such as Bihar, Alpan, Champa and Malbhog, are seriously affected by this beetle (Sen and Prasad 1953). Serious damage occurs in the 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 the epidermis i.e. the green portion on the ventral and dorsal surface of the leaves and makes irregular patches. The feeding areas dry 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 attacks the fruit causing heavy damage, fruits become blemished and their market value is reduced (Prasad and Singh 1987).

Besides the above works, no further information has been found on *N. viridipennis*. Information on this insect pest is thus scanty in Bangladesh. Therefore, the present study was undertaken to know the nature and extent of damage and susceptibility of banana leaf (furled leaf, freshly open leaf and mature leaf) to *N. viridipennis.*

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Materials and Methods

Experiments were conducted in the banana orchard of the Bangladesh Agricultural University, Mymensingh from October, 1997 to October, 1998. The experiment was followed in a randomized complete block design replicating 3 times having plot size of the orchard 320 m^2 (20m x 16m) and the plants were spaced 2m x 2m. The planting system was hexagonal. Thus, there were 90 plants in this orchard. The commercial variety "Amrita sagar" was grown in the orchard for the present study. Sword suckers of 2-3 kg in weight with 3-4 months of age 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. Thus the suckers became ready for planting in the orchard. Selected sword suckers were planted in prepared pits on 23rd October, 1997. Manure and fertilizers were applied according to the recommended doses and methods. Necessary intercultural operations were done at proper time. Irrigation and insecticides were not applied during the study period in the banana orchard. Weekly average temperature, relative humidity and rainfall were recorded from the weather yard located about 1km away from the experimental orchard. The weekly mean temperature ranged from 15.2°C to 30.9°C, relative humidity 67.7% to 93.4% and total rainfalls 0.0 mm to 324.8 mm.

Leaf damage done by *N. viridipennis* was clearly seen as scars on the leaves of growing banana. To measure such damage, three kinds of banana leaves namely, furled, freshly open and mature leaves were chosen to determine their comparative susceptibility. The sampling was made in a complete randomized design with three kinds of leaves as treatments. Three banana leaves as replicates of each kind were used for data collection. Three banana leaves without the insects were included as a control. Each replicate leaf was selected from an individual plant in the orchard.

When the banana leaf began to emerge and remained unopen referred to furled leaf which was caged with nylon net supporting with a bamboo stick free from any pest attack. In this caged furled leaf five orchard collected beetles of *N. viridipennis*, irrespective of sex were released to measure the damage done by them. Freshly open leaf of 8 days old and mature leaf of 16 days old were also caged in the similar manner as mentioned above and five orchard collected beetles were released per leaf. There was control for furled, freshly open and mature leaf without release of insect.

The observation was taken daily in the morning to record the number of scars and damage symptom, produced by the beetles as a result of feeding on epidermis of the leaf. The size i.e. length and breadth of all the caged leaves was measured daily at the time of taking data. Data collection continued up to the mortality of the insects. The data were analyzed statistically and mean differences were adjusted with Duncan's Multiple Range Test.

Results and Discussion

Result of the experiment on the extent of damage determined on the basis of number of scars on the three categories of banana leaves namely furled, freshly open and mature leaves are given in Table 1. The scars were first observed on the furled leaf on July 18, 1998 and the highest mean number of scars was recorded on August 6, 1998. The mean number of scars were 3.2 per furled leaf on the first day and then increased up to 7 days old (fourth week of July) leaf causing 31.5 scars per leaf. The beetles fed less on the same leaf which tended to open and the accumulated number of scars were 36.9-69.8 on the 8 to 21 days old (fourth week of July to first week of August) leaf, when *N. viridipennis* was allowed to feed on the freshly open leaf, the accumulated mean scars ranged 6.7 to 24.2 from 9-12 days old leaf. The feeding damage of *N. viridipennis* was found less on the mature leaf of age 17 to 30 days old compared to furled and freshly open leaf. Scars observed on the mature leaf ranged from 5.3 to 35.9 scars per leaf. The beetle caused more damage to furled leaf than freshly open and mature leaf. It was possible that the beetle could readily feed on the epidermis of the furled leaf having succulent condition compared to mature leaf. These findings also support the results reported by Batra (1952) who observed that *N. viridipennis* would seem to prefer the central rolled up leaf before in unfurled. Sen and Prasad (1953) reported that the central leaves of banana plant forming the top whorl at the crown are worsely affected than the other leaves. Ahmed (1963) also reported that only young leaves are attacked by this kind of beetle.

The loss of growth in banana leaf as measured by the leaf size of banana plants infested by *N. viridipennis* was compared with uninfested leaf on furled, freshly open and mature condition. The data of daily observation are given in Table 2. On the furled leaves, the initial mean length of two days old infested leaf was 11.7 cm and breadth 3.3 cm which was less than that of uninfested leaf 14.3 and 4.1 (length and breadth, respectively). After first week, the size of 9 days old infested leaf was 61.7 cm in length and 31.0 cm in breadth and the size of same age uninfested leaf was 68.7 cm length and 32.0 cm in breadth. The size of both infested and uninfested leaf continued to increase until they became mature. Finally the size of 22 days old infested leaf as 82.7 cm in length and 34.7 cm in breadth and that of uninfested leaf was 91.7 cm in length and 36.7 cm in breadth. Mean leaf size measured after 9 days old infested freshly open leaf was 69.3 cm in length and 32.0 cm in

Table 1

Damage done by *N. viridipennis* (5 beetles) on three categories of banana leaves. Figures represent mean number of scars recorded daily

Sampling date		Mean scars (accumulated number)					
		Furled leaf		Freshly open leaf		Mature leaf	
		Leaf age (days)	Mean scars (no.)	Leaf age (days)	Mean scars (no.)	Leaf age (days)	Mean scars (no.)
July	18	2	3.2	9	6.7	17	5.3
	19	3	7.5	10	12.9	18	10.1
	20	4	13.5	11	18.7	19	14.3
	21	5	19.7	12	24.2	20	18.1
	22	6	25.7	13	29.2	21	21.5
	23	7	31.5	14	33.7	22	24.5
	24	8	36.9	15	37.7	23	27.2
	25	9	41.9	16	41.3	24	29.6
	26	10	46.3	17	44.6	25	31.7
	27	11	50.3	18	47.4	26	33.4
	28	12	53.9	19	49.9	27	34.8
	29	13	57.3	20	52.0	28	35.8
	30	14	60.1	21	53.5	29	35.9
	31	15	62.7	22	54.9	30	35.9
August	1	16	64.9	23	55.5		
	2	17	66.6	24	55.7		
	3	18	67.9	25	55.7		
	4	19	68.9				
	5	20	69.4				
	6	21	69.8				
	7	22	69.8				

Table 2

Size of infested and uninfested furled leaf, freshly open leaf and mature leaf of banana

Sampling		Infested leaf					Freshly open leaf					Mature leaf				
		Leaf	Infested leaf		Uninfested leaf		Leaf	Furled leaf		Uninfested leaf		Leaf	Infested leaf		Uninfested leaf	
date		age (days)	Length (cm)	Breadth (cm)	Length (cm)	Breadth (cm)	age (days)	Length (cm)	Breadth (cm)	Length (cm)	Breadth (cm)	age (days)	Length (cm)	Breadth (cm)	Length (cm)	Breadth (cm)
July	18	2	11.7	3.3	14.3	4.1	9	69.3	32.0	69.7	32.3	17	87.7	33.7	88.0	34.0
	19	3	19.7	4.4	24.0	4.9	10	73.3	32.7	74.3	32.7	18	88.0	34.3	88.7	34.3
	20	4	28.7	6.1	33.3	6.5	11	76.7	33.0	78.3	33.3	19	88.7	34.3	89.0	34.3
	21	5	36.7	7.9	41.7	8.7	12	79.7	33.3	81.3	33.7	20	89.0	34.3	89.7	35.0
	22	6	43.7	10.7	49.0	12.0	13	81.7	33.7	83.0	33.7	21	89.7	34.7	89.7	35.3
	23	7	50.7	14.6	56.7	16.4	14	83.3	34.0	86.0	34.0	22	89.7	35.3	90.3	35.3
	24	8	56.7	19.0	63.0	24.9	15	84.3	34.0	87.7	34.7	23	90.0	35.3	90.7	35.3
	25	9	61.7	31.0	68.7	32.0	16	85.0	34.3	88.7	34.7	24	90.7	35.3	90.7	36.0
	26	10	66.7	31.7	74.0	32.7	17	85.3	34.7	89.0	35.0	25	90.7	35.7	90.7	36.3
	27	11	70.7	32.0	78.3	33.3	18	86.0	35.0	89.7	35.0	26	90.7	36.3	91.7	36.3
	28	12	73.7	32.3	82.0	33.7	19	86.0	35.0	90.0	35.7	27	91.7	36.3	91.7	36.3
	29	13	76.7	32.7	84.7	33.7	20	86.7	35.0	90.3	36.0	28	91.7	36.3	92.0	37.0
	30	14	78.7	33.3	87.0	34.3	21	87.0	35.3	90.7	36.0	29	91.7	36.7	92.3	37.0
	31	15	79.7	33.3	88.7	35.0	22	87.0	36.0	91.0	36.0	30	91.7	36.7	92.3	37.0
August	1	16	80.7	33.3	89.7	35.3	23	87.7	36.0	91.0	36.7					
	2	17	80.7	33.7	90.3	35.7	24	88.0	36.0	91.3	37.0					
	3	18	81.7	34.3	90.7	36.0	25	88.0	36.0	91.3	37.0					
	4	19	81.7	34.3	91.3	36.3										
	5	20	82.0	34.3	91.7	36.3										
	6	21	82.7	34.7	91.7	36.7										
	7	22	82.7 b	34.7 b	91.7 a	36.7 a										

Means of length and breadth respectively of infested and uninfested furled leaf having different letter differed significantly at 1% and 5% level.

breadth and while it was 69.7 cm in length and 32.3 cm in breadth for the uninfested leaf measured after the same time period. After first week, the size of 16 days old infested leaf was 85.0 cm in length and 34.3 cm in breadth and the size of same age uninfested leaf was 88.7 cm in length and 34.7 cm in breadth. Finally, the leaf size recorded 25 days old infested leaf was 88.0 cm in length and 36.0 cm in breadth and that of uninfested leaf was 91.3 cm in length and 37.0 cm in breadth. On the mature leaves, the first data of leaf size of 17 days old infested leaf was 87.7 cm in length and 33.7 cm in breadth and that of uninfested leaf was 88.0 cm in length and 33.7 cm in breadth (Table 2). The final data of mature leaf size of 30 days old infested leaf was 91.7 cm in length and 36.7 cm in breadth and leaf size of 30 days old uninfested leaf was 92.3 cm in length and 37.0 cm in breadth.

The infestation of *N. viridipennis* did not have significant effect on the size (length and breadth) of infested and uninfested furled banana leaf at all ages except 22 days old furled leaf. The final (22 days old) length of furled leaf differed significantly in infested and uninfested condition and the difference of breadth was also significant (Table 2). There were no significant differences in length and breadth of both freshly open and mature infested and uninfested leaves at all corresponding ages (Table 2). Again the infestation of *N. viridipennis* resulted greatly in the reduction of the size of the furled leaf in comparison with the freshly open and mature leaf. Such results were in agreement with the findings of Prasad and Singh (1987) who reported that only young leaves are attacked by the beetle. They also observed that when the young leaves have unfurled into a sort of funnel or are still compactly rolled and older leaves at fully unfurled condition are not found to be attacked.

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