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THE MOVEMENT OF BANANA BUNCHY TOP VIRUS IN THE PLANT

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Systemic symptoms of virus infection develop as a consequence of multiplication and movement of the virus from the site of its entry. The first signs of systemic infection in plants appear on the youngest leaves, far away from the point of inoculation. This indicates that the virus moves through the cells and reaches the growing point.

The movement of sap-transmissible viruses in plants has been studied by a number of workers like Holmes (1930), Samuel (1934), Gapoor (1949) and Sheila (1964). The movement of non-sap-transmissible viruses has, on the other hand, not received adequate attention. The translocation of aster yellows, a virus belonging to the above category was, however, studied by Maramorosch *et al* (1962). It is in the above context that a study of the movement of the virus which causes the bunchy top disease in banana (*Musa paradisiaca* L.) was undertaken. This is a non-sap-transmissible virus which is transmitted by the banana aphid, *Pentalonia nigronervosa* Coq. Banana plant has elongated petioles which form a tall pseudostem with an underground stem (rhizome). A more or less accurate assessment of the time taken by the virus to traverse the pseudostem and reach the underground rhizome from the region of inoculation was therefore possible.

Material and Methods

A very highly susceptible variety of banana known locally as Nendran was used for the studies. Vigorously growing plants, 8-5 to 10 cm tall, were inoculated at the neck region with the help of the vector, *Pentalonia nigronervosa.* Non-viruliferous aphids, reared on healthy banana plants, were fed on infected plants for three days to acquire the virus. After the acquisition feeding, the insects were collected and starved for four hours. Twenty such aphids were released at the neck region of each plant and they were allowed to feed for 24 hours after which they were destroyed by spraying the plants with 0.02 percent endrin emulsion. Since 20 aphids were used, the virus might have been introduced in the plant at more than one point. The pseudostems of the inoculated plants were then cut and removed 5, 10, 15 and 20 days after releasing the infective aphids. In one set of plants, the pseudostems were cut 15 cm above the ground level, and in another set the pseudostems were cut 15 cm below the neck (Fig. 1, B. G,). In a similar

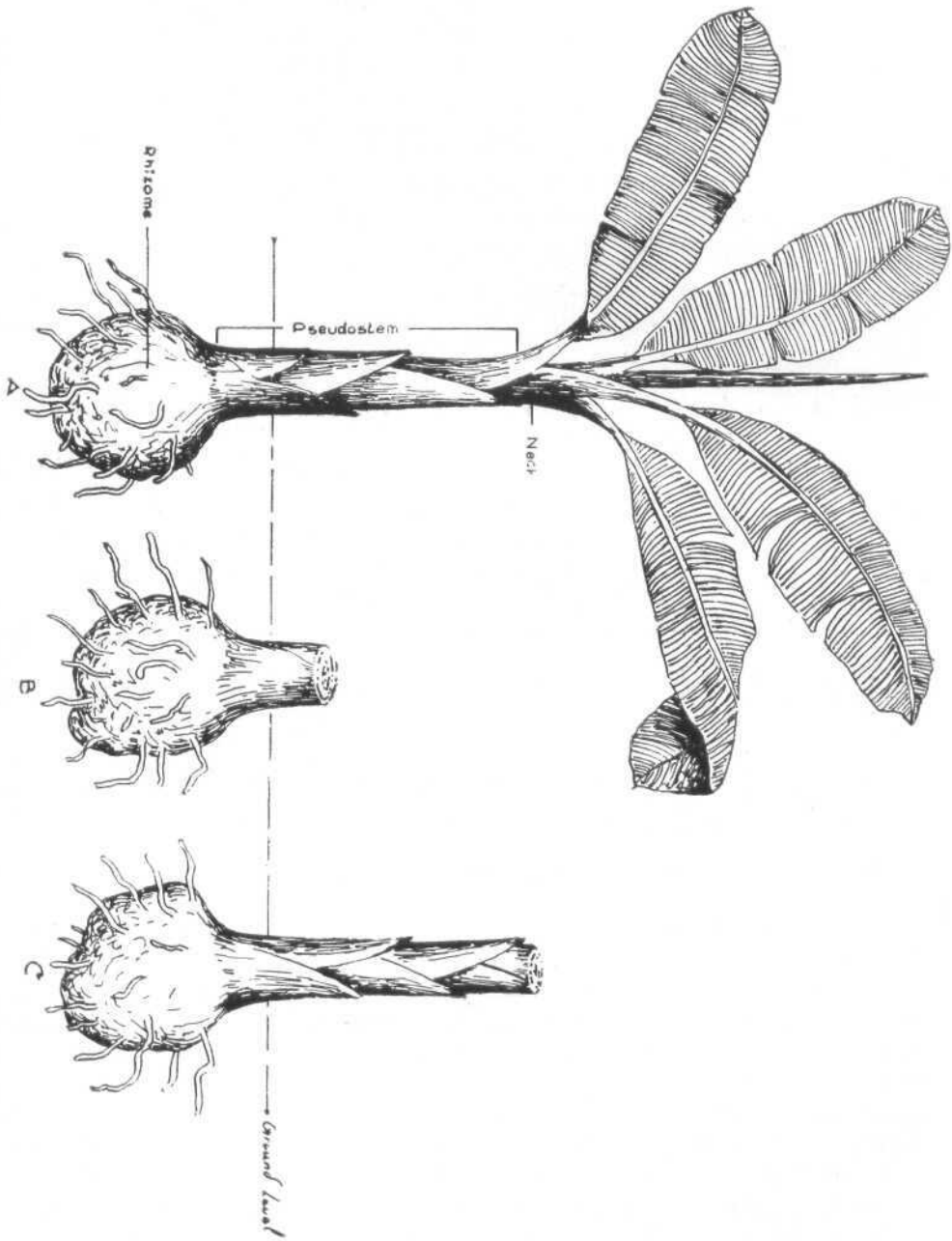

Fig. I Diagram illustrating the levels at which the pseudostems of banana pfants were cut after inoculation.

A. Whole plant B. 15 cm above ground level C. 15 cm below the neck region

experiment the pseudostems of inoculated plants were cut in the above manner, 4, 5, 6 and 8 days after inoculation. Healthy as well as inoculated controls were maintained. New leaves emerging from the cut plants were perioidically observed for the development of bunchy top symptoms.

Table I

Effect of removal of pseudostems at different intervals after inoculation with bunchy top virus, on infection of banana plants

Intervals of pseudostem removal after inoculation (days)	Level at which the pseudostems were removed A = 15 cm below the neck B = 15 cm above ground	No. of plants inoculated /infected	Percentage infection
	Experiment I		
5 days	A	20/0	0
	B	20/0	0
10 days	A	20/17	85
	B	20/14	70
15 days	A	20/18	90
	B	20/19	95
20 days	A	20/17	85
	B	20/18	90
Inoculated control	Pseudostems not removed	20/18	90
Uninoculated control	do	20/0	0
	Experiment II		
4 days	A	10/0	0
	B	10/0	0
5 days	A	10/0	0
	B	10/0	0
6 days	A	10/5	50
	B	10/3	30
8 days	A	10/5	50
	B	10/5	50
Inoculated control	Pseudostems not removed	10/9	90
Uninoculated control	do	10/0	0

Results

New leaves were put forth by all the plants whose pseudostems were cut. Symptoms of the bunchy top disease were noted on 70 to 95 percent of the test plants whose pseudostems were removed 110, 15 and 20 days after inoculation in the first experiment. Symptoms appeared 30 to 40 days after the treatment. No symptoms were seen on plants whose pseudostems were removed on the fifth day after inoculation (Table 1).

In the second experiment also no symptoms were noted on plants whose pseudostems were cut on the fourth and fifth days after inoculation. Symptoms, however, developed on 30 to 50 percent of the plants whose pesuodstems were cut 6 and 8 days after inoculation (Table 1). It is thus evident that the virus did not reach the pseudostem within five days of inoculation. The virus seems to have remained at the site of inoculation for five or more days before it started moving. In plants whose pseudostems were cut 6 and 8 days after inoculation, the percentage of disease incidence was lower as compared to those whose pseudostems were cut 10, 15 and 20 days after inoculation (Table 1).

Discussion

The symptoms of bunchy top disease normally appear 30 to 40 days after inoculation. This period includes the time taken by the virus to move from the site of inoculation to the meristematic region of the pseudostem from where new leaves are formed and then the time taken by the tender leaves to fully develop and emerge out of the pseudostem.

It is seen that the virus took a minimum of five days to move downwards to the rhizome after inoculation at the neck region of the pseudostem. But it was not possible to make an accurate assessment of the actual time taken by the virus to traverse the pseudostem. While none of the plants whose pseudostems were cut either at the neck region or above the ground level on the fourth and fifth days after inoculation developed symptoms. 50 percent of the plants whose pseudostems were cut at the neck region and 30 percent of the plants whose pseudostems were cut above the ground level 6 days after inoculation developed symptoms. Based on these observations it can be inferred that the time taken by the virus to traverse the pseudostem when once it started moving was less than a day, possibly only a few hours or less.

A similar phenomenon was noted by Maramorosch *et al* (1962) with regard to the aster yellows virus on aster plants. They found that the virus remained at the site of inoculation

for at least six hours and removal of inoculated leaves during the initial two to six hour period prevented the translocation of the virus to the other parts of the plant. Occasional infection was noted when the leaves were removed 8 or 16 hours after inoculation while the movement of the virus was increasingly frequent between 24 to 48 hours and quite evident within 64 hours. The bunchy top virus of banana, however, was found to take a longer time before it started moving, the minimum being five days and the maximum being 10 to 15 days.

Since there was a stagnation period of at least five days before the virus started moving downwards, it is considered possible that the virus might have multiplied at the site of inoculation before it started moving.

Summary

The banana bunchy top virus, when inoculated at the neck region of banana plants with the help of the vector *Pentalonia nigronervosa* took a minimum period of five days before it started moving downwards, the maximum being ten to fifteen days. The time taken by the virus to traverse the pseudostem, once it started moving, was found to be less than a day probably only a few hours or less. It is considered possible that the virus might have multiplied at the site of inoculation before it started moving. The systemic spread of the virus can be prevented if the pseudostem is cut and removed either at the neck region or near the ground level within five days after inoculation.

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