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NATURE AND EXTENT OF DAMAGE CAUSED BY SPINDLE BUG OF ARECANUT, *CARVALHOIA ARECAE* MILLER AND CHINA

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ABSTRACT

The feeding suppressed the emergence of spindle leaf partly or fully depending on the period of occurrence of damage. Total suppression of spindle leaf emergence even choked further growth of the palm. Injury caused by oviposition was observed in detail for the first time. Characteristic "Pox marks" made on the rachis of the leaf and internal damage also were noted in detail for the first time.

Histological observations of the leaf along the feeding marks showed that the bug resorted to "lacerate and flush" feeding. Formation of water soaked areas soon after stylet insertion, continuance of plasmolysis after the removal of the insect from the feeding spot and later discolouration and collapse of cells indicated that the action of the saliva would have caused the injury.

The bug affected the growth and vigour of transplanted seedlings. About 26 to 30% of the unprotected young palms up to the age of 5 years were seen withered and dead due to the infestation.

INTRODUCTION

The spindle bug *Carvalhoia arecae* Miller and China is an important pest of arecanut. The nature and extent of damage caused by this pest has been described in brief by earlier researchers (Khandige, 1955; Pillai and Kurian, 1959; Nair and Das, 1962; Nair and Menon, 1963; Nair, 1964; Anonymous, 1982). However, detailed information on the nature and extent of damage is not available. Therefore, a detailed investigation on these aspects was conducted and the results are presented in this paper.

MATERIALS AND METHODS

The gross damage done by the pest was observed in detail, in the Institute farm and nearby farmers' fields. Histological changes in the leaf caused by the feeding of the bug was studied by confining, overnight starved, adult bugs on tender leaves of potted areca seedlings, using glass vials and cotton plugs. When water soaked lesions were formed on the leaflet due to the feeding, the bug was moved on to a fresh area of the leaflet. Each feeding mark was labelled noting the time of formation. This facilitated the collection of leaf tissues at different intervals after the occurrence of injury. The feeding spots together with a portion of the healthy tissues around, were collected at 0.25, 0.5, 1, 2, 4, 6, 8, 10 and 120 hours after the formation of the lesion. Hand sections of the material were taken and mounted in glycerine jelly and examind under a microscope.

To assess the extent of damage caused to the areca palms by the bug, a field trial was conducted by planting nine months old areca seedlings of South Kanara variety in 0.12ha. The planting and maintenance of the palms was done as per the normal package of practices adopted by CPCRI. Half of the palms were kept free from the bug incidence using phorate sachet technique (Jacob, 1985). At the end of five years, vigorous and nonvigorous palms could be distinctly identified in the protected and unprotected plots of palms. The bug population, height and girth of palms, number and length of leaves and length of leaflets of protected and unprotected palms in vigorous and nonvigorous categories were assessed separately for estimating the effect of pest incidence on the general growth of the palms. The data were statistically analysed.

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RESULTS AND DISCUSSION

Nature of damage

The feeding behaviour of the insect was observed in the laboratory under a microscope. The bug briskly moved on the leaf tapping the surface with the tip of the protracted labium and antenna. Then it settled on a selected spot and thrust the stylets into the leaf lamina shaking the head and bending the proboscis backwards.

Immediately after the puncture on the leaflet a discoloured area around the point of insertion could be seen denoting the onset of feeding. If the insect found the location suitable, it continued to imbibe the content up to a maximum of 20 minutes and then moved on to a fresh spot and fed. An insect may cause several such feeding marks in succession. The feeding spots measured 5 mm to 30 mm in length and 2 mm to 4 mm in width. In some cases several such feeding marks were formed and they coalesced to form extensive, contiguous areas of damaged leaf lamina. In the centre of each feeding mark a green island which turned yellow and black in due course could be observed. The leaf tissue around the point of insertion of the egg also developed brownish discoloration and it also turned black gradually.

The insect lived in the first two or three leaf axils feeding and also ovipositing on the emerging spindle. As a result of this, the spindle often suffered serious injury. If the feeding commenced with the emergence of the spindle the damage occurred from the very tip of it. As a result, the whole spindle got dried and often the spindle failed to open up. This affected the emergence of succeeding leaves also and thus choked the very growth of the palm. Complete decay and death of the spindle occurred during rainy season. Saprophytic flies, *Lamorolonchaea* sp., *Silba* sp., *Drosophila melanogaster* Megen, *Atherigona pallidipalpis* Malloch (Order Diptera) and the fungi *Fusarium* sp., *Colletotrichum* sp. and the bacterium *Pseudomonas* sp. were seen associated with the dead spindle. Persistent incidence of the pest on the crown resulted in severe damage to the leaves and they showed black spots and holes.

The feeding by the insects caused the development of typical pox marks on the surface of rachis. In some palms it was seen along the entire length of the rachis on the back side. When such a leaf stalk was split open extensive portions of necrotic dead tissues were seen around each feeding/egg laying spot (Fig. 1). This type of damage adversely affected the translocation of food material leading to the yellowing of leaflets and gradual death of the leaves.

Histological changes in the leaf

Histological profile of normal leaflet has an upper epidermis consisting of a single layer of small rectangular cells in transverse section with a thick cuticle. The lower epidermis is similar in structure to the upper epidermis except that there are stomata (Fig. 2). In between the two epidermis is the mesophyll composed of two to three layers of palisade parenchyma and spongy parenchyma. The palisade layer is made up of small slightly elongated hexagonal cells while the spongy parenchyma is made up of larger cells. Both palisade and spongy cells contain abundant chloroplasts arranged along the cell walls. The vascular bundles are surrounded by a layer of parenchyma cells or bundle sheath which is devoid of chloroplasts.

Soon after the insertion of the stylets into the plant tissue for feeding, an irrregularly shaped discoloured dull green area became visible around the spot indicating the onset of plasmolysis of the palisade and spongy parenchyma cells. The protoplasm got detached from the cell walls and started shrinking.

At four hours after commencement of feeding (Fig. 3) the affected portion was seen shrunk to about 5/7th thickness of the healthy area. The cells were almost fully plasmolyzed and the rolled up protoplasm was seen to fill only half the area within the cell walls. At that stage the upper and lower epidermis and the vascular bundles remained almost intact.

At 120 hours after feeding also, the vascular bundles were distinct in transverse section though the bundle sheath became black in colour. By that time the mesophyll or the entire area had dried up and turned almost dark

Fig. 1 A Pox marks on rachis and injury of the areca leaf caused by *C. arecae*

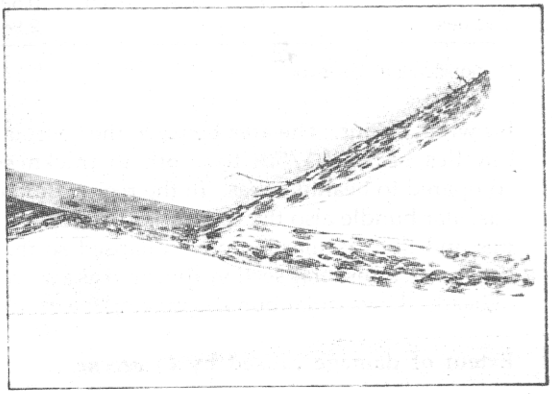

Fig. 1 B Surface of the rachis split open showing the internal damage

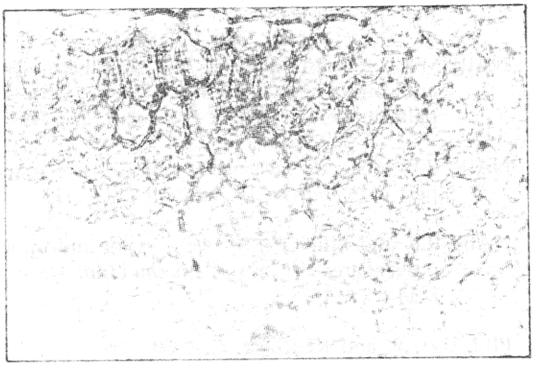

Fig. 2 Transverse section (40x) of healthy areca leaf.

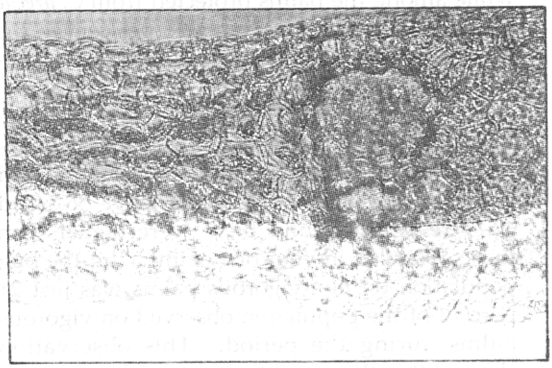

Fig. 3 Transverse section of areca leaf tissue 4 hours after feeding by *C. arecae* (40x)

Table I. Effect of *C. arecae* incidence on the growth of areca palms

Treatments	Percentage of palms observed 5 years after commencement of treatment			Bug count/ palm/12 monthly observations	Palm height (cm)	Palm girth (cm) at		Leaf characters		
	healthy	withering	dead			collar	crown	number/ palm	length (cm)	length of leaflet (cm)
Vigorous palms										
pest infested	43.50	26.1	30.43	90.410	391	41.0	12.0	5.0	122	56
pest controlled	93.59	5.13	1.28	1.739	684	61.0	24.0	8.0	197	84
T values				19.660**	5.31**	3.82**	6.96**	6.53**	5.21**	4.23**
Non-vigorous palms										
pest infested	21.05	36.8	42.11	19.420	187	22.0	10.0	4.0	103	42.0
pest controlled	66.66	16.66	16.66	0.528	404	42.0	18.0	7.0	154	72.0
T values				2.946**	10.23**	8.06**	4.0**	5.72**	8.02**	7.67**

** significant at 1% level

brown in colour. The area between the vascular bundles became 1/5th to 1/6th in thickness compared to healthy areas. In the region on the vascular bundle also the cells other than epidermis and the vascular bundles collapsed so that the area in transverse section appeared as a string of beads, the vascular bundles making the beads.

Extent of damage caused by *C. arecae*

Persistent occurrence of C. *arecae* on areca palms affected the growth and vigour of the palms and the incidence even caused total death of the palms. The results obtained from a maximum protection trial are presented in Table I. Among vigorously growing bug infested palms, 26.1 and 30.4 per cent plams were seen in withering and dead stages respectively in the course of first five years after transplanting while among the palms protected from C. *arecae* incidence was just 5.13 and 1.28 per cent in the withering and dead stages at the time of observation.

Among the non-vigorous palms left unprotected the percentage of withered and dead palms, at the end of five years, were 36.8 and 48.11 respectively and these were higher than those observed in vigorous palms. But the bug population on non-vigorous palms was just 21 percent of the population observed on vigorous palms during the period. This observation showed that the possible damage from C. *arecae* incidence will be more in plantation poorly maintained and in which the palms are not vigorously growing. As seen from the data the growth of the surviving palms indicated by the stem height, girth at collar, girth at crown, number of leaves, length of leaves, length of leaflets also suffered highly significant suppression due to the persistent attack of C. *arecae*.

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DISCUSSION

R. CHANDRA MOHANAN : You have mentioned that *Fusarium, Colletotrichum* and *Pseudomonas* are associations with rotting. What is the role f these organisms in accelerating the rotting? *Fusarium* is always associated with *Phytophthora* infected tissue. Can you attribute all the rotting, etc. to spindle bug damage?

S.A. JACOB : The role of the fungus could not be worked out. As the evidences show the pest opens the way and the secondary organisms one by one or together do their part in the total destruction of the spindle. Individual role has to be worked out.

B. CHANDRA MOULI : When do you actually notice *Colletotrichum, Fusarium* invasion? Are they seen immediately on pest damaged tissue or at advanced stages of pest infestation?

S.A. JACOB : Secondary infestations are seen on severely affected, unopened spindle leaves during rainy seasons only. They are not noticed immediately but after sufficient aquisition and incubation period of the organisms preceding the pest infestation.