Biology and Bionomics of *Stephanitis typica* (Distant)

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Direct and indirect evidence is available on *Stephanitis typica* (Distant) (Tingidae) transmitting Coconut Root (wilt) disease in Kerala, responsible for an annual loss in yield of 34 crores nuts. The lace bug, originally recorded from banana, is polyphagous. On coconut foliage, the bug completes its life cycle in about 25 days with an average incubation period of 12 days and a total nymphal period of 13 days covered under five instars. Both the imago and nymphs drain the contents of the mesophyll tissue. There are two peak periods of abundance in March–May and September–October. Fluctuations in populations are directly correlated to temperature and sunshine, inversely to relative humidity and rainfall. On individual palms, abundance increases from outer to the tender leaves. On each leaf, they occur in greater numbers in middle leaflefts. Diseased palms harbour more insects than the healthy. The insect is preyed upon by a mirid bug. The pest is easily controlled by praying carbaryl.

Key Words: Biology of lacebug vector of coconut root (wilt)

Introduction

Cocount Root (wilt) is a debilitating disease estimated to cause an annual decline in yield of about 34 crores nuts (George et al. 1976) from an area of 250,000 ha in which it is prevalent in different degrees of intensity in Kerala State (Gopinathan Pillai et al. 1973). Known to spread at a slow pace of about 2–4 km/yr (Gopinathan Pillai et al. 1979) through soil (Menon & Shanta 1962, Shanta et al. 1972, Mathen et al. 1976) and by mechanical means (Nagaraj & Menon 1956, Shanta et al. 1959), the disease is also transmitted by the lace wing bug *Stephanitis typica* (Distant) (Nagaraj & Menon 1956, Shanta et al. 1964, Joseph et al. 1972), reported as a pest of only minor importance on coconut foliage in Singapore (Anonymous 1915), in Coimbatore (Fletcher 1917), in Malaya (Corbett 1932) and in Kerala (Nirula 1955). Indirect evidence on the transmission of the disease by the bug was presented by Shanta et al. (1959) who reported a lower percentage of incidence of the disease in palms sprayed with 0.2% DDT to ward off the insect than in unsprayed palms kept as check. The role of the tingid as vector of the Coconut Root (wilt) disease invited detailed investigations on its biology and bionomics as well as control. The results of these studies are reported here.

Life History

The insect completes its life cycle on coconut leaflets in about 25 days with an average incubation period of 12 days and a total nymphal period of 13 days covered under five instars comprising, on an average, respectively, 3, 2, 2, 2 and 4 days (temperature range: 24.5–33°C; relative humidity range: 63–91%) (Mathen 1960). The nymphs exhibit congregational habit, characteristic of the group, more pronounced up to the third instar. Maximum longevity under laboratory conditions was 25 days for females and 21 days for males. Each female laid on an average 30 eggs, with a pre- and post-oviposition period varying from 1–4 days. The process of mating lasts for 30–45 min usually taking place in an end to end position, rarely at near right angle to each other. The latter enables a second male to engage its parameres. Occasionally a median female could therefore be observed moving about with two males on either side. This happens probably because of the slight preponderance of males in the field in the ratio 1.28:1. Eggs are laid inserted into the mesophyll tissue and are completely buried beneath the lower epidermis. Eggs are located with the help of the operculum, which is seen flush with the lower surface of the leaflet. Process of eclosion occupies 22–25 min. Molting, initiated by a mid-dorsal split along a Y-shaped ecdysal streak, is completed in less than half an hour.

Food Plants

Originally recorded from banana (Distant 1903), *Stephanitis typica* has been reported from 16 different plants under 8 families with identification indicated for 15 species, under 10 genera (Mathen 1978). It completed its life cycle without any appreciable changes in duration of the different stages on banana, coconut and East Indian Arrowroot. Adults collected from coconut preferred to feed on coconut leaflet, but they also accepted arrowroot, jack and colocasia as food plants under experimental conditions, more readily and in greater numbers when coconut leaflet was not provided.

Feeding Habits

Both imago and nymphs of all the five instars feed from the lower surface of the leaf. As a result of feeding, permanent dechlorophylled yellow marks are left on the adaxial surface. These marks, making their appearance within 2–3 hr from the time of stylet insertion, when observed after 24 hr, vary from small pinpricks to coalesced chlorotic blotches, ranging in area from 0.0032–0.612 mm^2 with an average of 0.112 mm^2. Mean number of feeding marks produced by a single adult in 24 hr was 80 (range of 10 observations 61.0–104.3). An adult therefore is capable of impeding photosynthesis in about 9 mm^2 leaf area in 24 hr by draining the chlorophyll estimated to be 0.096 mg per 50 adults in 24 hr (Mathen et al. 1979). At a selected feeding site, an adult bug may feed for about 10–30 min. Joseph et al. (1972) observed that the insect acquired the pathogen in about 2 hr but reported maximum efficiency with a feeding of 6 hr. Transmission feeding time ranged between 16 and 48 hr. The pathogen was retained up to 20 hr as reported from a study of lapse feeding on the test plant cowpea (*Vigna sinensis* Endl.). The adult could not survive beyond 24 hr without food. The insect leaves no visible marks of stylet insertion on the lower leaf surface. The internal damage is indicated by a sparse distribution of chloroplasts in the component cells of the palisade in the leaflet fed by the insect. These cells stain less intensely than those of the normal leaflet and appear to have been emptied by the insect. They, however, retained their shape. Immediately inner to the lower epidermis, small cavities are noticed. They are formed probably by the rupture of the cell wall as a result of intracellular penetration of the stylets. No salivary sheath was made out. Because of the absence of any noticeable rupture of the lower epidermal cells either in epidermal peelings or in transections, there is reason to believe that insertion of stylet is intercellular.

Population Abundance

The lacebug shows two distinct periods of peak abundance, one in March–April–May and another in September–October (Mathen et al. 1968). They brought out that the fluctuations in population over the different months of the year were directly correlated to temperature and sunshine and negatively correlated to rainfall and relative humidity. They also pointed out the influence of interaction of these meteorological factors on the population of the bug, identical for adults and nymphs.

The distribution of the insect on its host plant coconut exhibited a definite pattern, increasing in numbers from the outer to the inner leaves, occurring in greater numbers in the middle leaflets of each leaf than at either end (Mathen et al. 1969).

This definite pattern of distribution proved helpful in devising a simple method for computing the total population within 5% error, from a sample population obtained by counting the pests present on 20% leaflets of 20% leaves on groups of ten palms, thus avoiding the time-consuming and laborious process of direct counting of all insects on all leaflets of all leaves of individual trees (Mathen et al. 1973).

A comparison of population of adults and nymphs of healthy and root (wilt) diseased coconut palms brought out greater congregation of the insect on diseased palms (Mathen 1978).

A count of the insect on young palms under different levels of nutritional treatment with N, P, K, Ca and Mg revealed significant (10% level) reduction in population in palms treated with Mg. Similarly, Phosphorus at the highest level administered also contributed to reduction in insect abundance. Interaction between NP and NK was also found significant at 10 and 5% levels respectively in reducing infestation (Mathen 1978).

Control

The lacebug is preyed upon by a mirid bug *Stethoconus praefectus* (Distant) under field conditions (Mathen et al. 1967, Mathen & Kurian 1972).

S. typica can be successfully controlled with 0.01% carbaryl (Mathen et al. 1972).

Discussion

The report on *Stephanitis typica* transmitting Coconut Root (wilt) disease responsible for huge crop loss has enhanced the insignificant role of a minor pest of coconut foliage to a vector of gross concern in coconut cultivation. Although the vast majority of plant viruses and mycoplamsa diseases are transmitted by Homoptera, the two proven instances of Heteroptera—both belonging to the allied family Piesmatidae: *Piesma quadrata* Fieb. transmitting sugarbeet leaf curl (Wille 1929) and *Piesma cinera* (Say) transmitting beet savoy disease (Coons et al. 1958) lend support to the role of *S. typica* as a vector. The etiology of Coconut Root (wilt) disease has, however, not been determined for certain, but a virus or like agent has been suggested as the causal factor (Shanta & Menon 1960). Shanta et al. (1972) mentioned that the sluggish nature of the insect, not capable of distant flight, the semipersistent nature of the pathogen involved and the low percentage of infective population were responsible for the slow and limited spread of the disease in the field.

Polyphagy in Tingidae is an exception to the general rule, but is not unique for *S. typica*. The wide range of host plant for the insect gains importance from two angles: Any attempt to control the insect on coconut will have to be done on all food plants reported. Secondly, in experiments on transmission on coconut, acquisition of virus particles from other hosts will have to be taken care of. Polyphagy also offers the possibility of a virus-free culture being maintained on suitable alternate food plants provided they do not behave as symptomless virus infected hosts.

According to Joseph et al. (1972), a single insect could accomplish transmission; but the efficiency was increased with groups of ten insects rendered infective by feeding them on diseased coconut leaflets as source of inoculum. More detailed studies on depth of penetration of stylets, actual course of stylets in the leaf tissue and the exact nature of penetration at the epidermis will contribute to a better understanding of the role of the lace-bug as vector. Precise knowledge on the nature and location of the Coconut Root (wilt) pathogen in its host tissue will contribute to stronger evidence of acquisition.

The greater abundance of the insect on diseased palms is significant although it does not answer the basic question whether the palm gets diseased as a result of the congregation of the bug or the diseased palm attracts more numbers. As 16% of the field population was reported as active transmitters (Joseph et al. 1972), the chances are that higher the population infesting a palm, greater the possibility of its being rendered diseased. An experiment monitoring the variations in abundance of the bug before and after a seedling takes up the disease will be helpful in this regard. Correlation of insect abundance on young palms under different levels of nutrition with fresh incidence of disease along with a study of nutritional preferences of the insect will be fruitful in an interpretation of this kind.

The efficiency of the predatory mirid bug as an agent of successful biological control has to be determined with field trials. Insecticidal application will have to be selective to spare the predators.

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