HOST-PARASITE RELATIONS OF BIPOLARIS HALODES (DRECHS.) SHOEMAKER ON THE COCONUT PALM

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ABSTRACT

The frequent association of leaf rot with the root (wilt) disease resulting in serious decline on the productivity of the coconut palms has been observed in the root (wilt) affected tracts of Kerala. The initial focus of infection is the tendermost unopened leaf of the palm and the organism causing the disease has been identified as *Bipolaris halodes* (Drechs.) Shoemaker. Studies on the preference for tendermost leaves as sites of infection revealed that the thickness of the epidermal layer of the leaf increased with age, the tendermost leaf having a mean thickness of 6.95 μ as against 9.54 μ in the matured leaf. The percentage of moisture content was maximum in the tendermost leaf (77.95) and it reduced to 61.33 in matured leaf. Results of tissue analyses indicated higher concentrations of total nitrogen, non-protein and protein nitrogen in the tendermost leaf (2.08 mg/g; 1.71 mg/g; 0.37 mg/g respectively on oven dried basis) and it came down to 1.05 mg/g; 0.87 mg/g and 0.18 mg/g respectively in fully matured leaf. A field experiment conducted to investigate whether proper nutrition of coconut seedlings with N, P, K, Ca and Mg nutrients could provide any tolerance to infection by *B. halodes* revealed that although the leaf tissue took up infection, the severity of the same was only minimal in the seedlings receiving treatments of NPK with calcium and magnesium as compared to that in seedlings receiving other treatments. This result also indicates the importance of *Ca* and *Mg* nutrition of coconut palms in disease affected tracts.

INTRODUCTION

Leaf rot of coconut palms caused by *Bipolaris halodes* (Drechs.) Shoemaker is commonly occurring in palms affected by the root (wilt) disease (Menon and Nair, 1947; Lal and Radha, 1964) (Fig. I). The initial symptom is observed as brown lesions on the unopened tendermost leaf. These lesions subsequently enlarge and coalesce resulting in rotting of the infected tissues (Fig. II). As the leaf matures, further spread is arrested. It has also been reported that the matured leaf of coconut is comparatively resistant to leaf rot while tender leaf is highly susceptible (Lily, 1960). Intensity of leaf rot was observed to be higher in root (wilt) affected palms than in apparently healthy palms (Radha and Lal, 1969). Hence a study on the host-pathogen relationship was undertaken with emphasis on the importance of nutrition of coconut seedlings in a diseased garden.

MATERIALS AND METHODS

Factors like thickness of the epidermal wall, moisture content and nitrogenous constituents of leaves at five different stages of maturity commencing from tender to mature ones were studied. Representative leaf samples were drawn from four 8-year old apparently healthy palms and an equal number of root (wilt) affected palms growing identical conditions. The thickness of the epidermal wall was measured in sections (12 μ thickness) of freshly collected leaves. The moisture content was determined by noting the differences between the wet and dry weights of leaf tissues. The estimation of total water soluble nitrogen, non-protein and protein nitrogen was carried out as per the method suggested by Ganapathy *et al.* (1958).

A field experiment was conducted to study the effect of N, P, K, Ca and Mg applications on the host in relation to the infection by *B. halodes*. The experiment was conducted on two year old seedlings. The seedlings received 2/3 of the normal dose recommended for the adult palms, viz., 500 g. N as Ammonium sulphate, 320 g P_2O_5 as Superphosphate, 1200 g K_2O as Muriate of potash, 500 g MgO as Magnesium sulphate and 1 kg slaked lime. From the second year onwards the full dose of fertilizers was given. The effect of nutrient application was noted by comparing the increase in the girth at collar and height of the treated seedlings with those of seedlings under the untreated control. After two years of treatment shoots of uniform age were inoculated with a spore suspension of *B. halodes* (6000 spores/ml.). Seedlings were kept under observation for the development of symptoms.

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Fig I

RESULTS AND DISCUSSION

The variation in thickness of the epidermal wall from tender to mature ones ranged from 6.95 μ to 9.5 μ in apparently healthy as against 4.72 μ to 7.06 μ in root (wilt) affected palms (Table I). This was found to be very much reduced in wilt affected palms as evidenced by the thin epidermal wall of tender leaf—4.72 μ in comparison to 6.95 μ in apparently healthy palms. It is thus evident that *B. halodes* in its pathogenicity favours tender leaf as a good substratum for its penetration (Lily, 1960) and hence the severity of its infection in root (wilt) affected palms. Thus a relative increase in thickness of the epidermal wall seems to be one of the factors responsible for the mechanical resistance of the host to infection.

The moisture content of leaves ranged from 77.95% to 61.33% in healthy and 86.92% to 71.28% in diseased plams. Maximum moisture content was observed in tendermost leaf showing a decreasing trend as the leaves mature (Table I). It has been reported that natural incidence of leaf rot under varying environmental conditions within the root (wilt) affected tract was more frequent in areas where atmospheric humidity was high (Lal & Radha, 1964). Infection trials under varying degrees of relative humidity also gave evidence that intensity of infection was positively correlated with high humidity (Lily, 1960). The present results also indicate that moisture may be a factor that influences the susceptibility of host tissue, the high moisture content of tender leaves as associated with high disease incidence.

Significant variations existed in the nitrogenous constituents of leaves of healthy and diseased palms. The total soluble nitrogen content was high in tendermost leaf irrespective of the condition of the palms—2.08 mg/g in healthy as against 3.69 mg/g in root (wilt) affected palms. The non-protein nitrogen which formed the major part of the total nitrogen was found to be 1.71 mg/g in healthy and 3.33 mg/g in diseased, the difference being significant. This was found to be decreasing as the leaf matures—the range being 3.33 mg/g to 1.08 mg/g in diseased and 1.7 mg/g to 0.87 mg/g in healthy palms (Table I). Similar observations were reported in the case of tomato also in which the young leaves contained greater percentage of total and soluble nitrogen than that in older leaves and the decrease in nitrogen content was correlated with decrease in incidence of bacterial spot disease of tomato (Navudu and Walker, 1961). Investigations on the etiology of the root (wilt) disease of coconut have also revealed the accumulation of nutrients (Sankarasubramony *et al.*, 1952) and amino acids (Pillai & Shantha, 1963) in the tender leaves. Samborski and Shaw (1957) stated treatments which produce marked metabolic disturbances resulting in accumulation of sucrose, starch and free amino acids particularly glutamine and glutamate in the first leaves of wheat led to increase in susceptibility to rust.

The data on growth measurements revealed that the seedlings receiving NPK, Ca and Mg treatments recorded more vigorous growth as compared to control seedlings with respect to girth at collar and height (Table II).

Fig II

The results of infection trials with *B. halodes* revealed that although the leaf tissues of the seedlings which received NPK, Ca & Mg took up infection, the infection was found to be localised thus preventing further spread of infection and the subsequent rotting. In comparison the seedling under other treatments developed severe rotting of the infected spindle.

From the limited work carried out so far, it has become evident that all conducive factors were noticeable in tender leaves, especially those of wilt affected palms, which render the leaves most susceptible to infection by *B. halodes*. Favourable host-pathogen relationship appears to be the incitant which makes the palm susceptible to the onset of disease.

The present results clearly suggest the importance of proper nutrition to coconut seedlings which also affords rigidity to cells in preventing the spread of the fungal pathogen. Similar reports were published elsewhere also on other crops (Ernest and George, 1938; Shear and Wingard, 1944; Warren and Thorkomme Dahl, 1970). The association of calcium with pectic substance of the cell wall as calcium peetate affording resistance against fungal infection has also been reported (Edington *et al.* 1961). Thus application of Ca and Mg along with NPK to young coconut seedlings offers some degree of tolerance to fungal infection and prevents its further spread in view of the resistance afforded by the hard cell walls which act as a barrier to the entry and spread of the pathogen.

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TABLE I—*Composition of healthy and diseased leaves at different stages of maturity*

Leaf Nos.		Thickness of epidermal wall μ	Moisture content %	Total N (mg/g)	Non-protein N (mg/g)	Protein N (mg/g)
1	H*	6·95	77·95	2·08	1·71	0·37
	D†	4·72	86·92	3·69	3·33	0·36
2	H	7·92	76·97	2·04	1·79	0·25
	D	5·08	85·44	3·59	3·36	0·23
3	H	8·10	73·73	1·77	1·55	0·22
	D	6·29	84·30	3·65	3·34	0·31
4	H	8·58	63·10	1·11	0·80	0·31
	D	6·52	82·22	1·91	1·64	0·27
5	H	9·54	61·33	1·05	0·87	0·18
	D	7·06	71·28	1·46	1·08	0·28

*H—Healthy palm
†D—Diseased palm
1—Youngest
5—Oldest

TABLE II—*Growth parameters of experimental seedlings under different treatments*

	Pre-treatment		Post-treatment	
	Girth at collar Cm	Height of seedlings Cm	Girth at collar Cm	Height of seedlings Cm
NPK	24·07	160·1	42·8	224·5
NPK +Ca	26·10	174·2	48·8	255·0
NPK +Mg	26·80	168·2	45·4	247·7
NPK +Ca +Mg	26·50	174·8	49·2	264 9
Control	24·00	164·2	40·4	209·8