Indian J. agric. Sci. 42(5): 410–413, May 1972

Diagnostic symptoms of root (wilt) disease of coconut

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Received: January 1, 1971

ABSTRACT

Symptoms of the root (wilt) disease of coconut (*Cocos nucifera* L.) are complex and variable. Of the visual symptoms, flaccidity of leaves or ribbing of leaflets, yellowing of leaves and marginal necrosis of leaflets are frequently associated with the advanced stages of the disease. A comparative assessment of the importance of these foliar symptoms was made on over 7,000 palms of varying age, growing under different soil conditions. Flaccidity or ribbing of leaflets was the common symptom. In a majority of young palms at an early stage of the disease, this appeared to be the only symptom. Foliar yellowing and marginal necrosis were not typical of the disease but they set in with the advancement of age and disease, which ultimately completed the disease syndrome. Foliar yellowing was considered to be a delayed expression of nutrient deficiency. Marginal necrosis of leaflets was attributed to fungal infection.

The name root (wilt) is suggestive of the complex symptom picture of the disease. The symptoms reported by Menon and Nair (1951) include general yellowing and drooping of the outer whorl of leaves, sickly pale-yellow colour of the inner leaves, curling of leaflets and flaccidity of leaves, shedding of immature nuts, reduction in the number and size of leaves and rotting of roots. The disease is pathogenic and is perhaps caused by a plant virus. But other factors, pathogenic and nutritional, are reported to be associated with the complex disease syndrome. Clarification of the symptoms caused by the primay pathogen and secondary associated factors was therefore considered necessary for a better understanding of the nature of the disease as well as its diagnosis. A qantitative evaluation of the foliar symptoms based on the frequency of occurrence and their association with each other in a large number of palms growing under varying ecological conditions was hence taken up.

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MATERIALS AND METHODS

Three important types of soils, viz. laterite, in the interior hilly areas in Kottayam district, reclaimed clayey soil (water-logged) of Kuttanad, sandy-loam soil in the coastal tract at Kayangulam and at Vypeen Islands, where the water-table is high, were selected for study. In large groups of palms (over 900 to 2,000 in each area) aged 35 years and above, including healthy palms, the foliar condition was recorded during the dry months (January to April) to avoid possible interference caused by seasonal factors. Occurrence of the foliar symptoms—flaccidity, yellowing and marginal necrosis—singly or in combination with each other were noted.

Similar observations were recorded on 2 groups of younger palms—one below 10 years and another 15 years—in the sandy-loam soil at Kayangulam during the same period.

RESULTS AND DISCUSSION

Foliar symptoms in relation to soil type

Healthy palms: The occurrence of healthy palms ranged from 2·6 per cent in Kuttanad (reclaimed clayey soil) to

28·2 per cent at Vypeen Islands (sandy-loam with high water-table) with 16·0 to 17·0 per cent at Kayangulam (sandy-loam soil) and Thodupuzha (laterite soil) respectively.

Diseased palms: The foliar symptoms of the disease varied in the different areas both in the frequency and in their association with each other. From 67 to 97 per cent of the palms exhibited flaccidity, 38 to 76 per cent developed yellowing and 28 to 48 per cent showed marginal necrosis, either singly or in association with other symptoms. The occurrence of flaccidity independent of other symptoms varied from 1·0 per cent in the sandy-loam soil at Kayangulam to 23·0 per cent in the laterite soil at Thodupuzha. Yellowing alone occurred in 2·5 to 7·0 per cent of the palms in the areas other than the reclaimed clayey soil of Kuttanad. Marginal necrosis free of other symptoms was noticed in only 0·1 per cent of the palms at Kayangulam and 6·0 per cent of the palms at Thodupuzha. Thus flaccidity of leaves appears to be the most frequent and common of the 3 symptoms associated with the disease. Foliar yellowing, which is next in frequency, is not a common symptom because 2·3 to 15·0 per cent of the affected palms were free from this condition. At Kuttanad foliar yellowing was at the maximum; yet it existed only in association with flaccidity, whereas 8·9 per cent of the palms in the same areas showed flaccidity without any other symptoms. In contrast, the sandy-loam soil at Kayangulam had foliar yellowing with other symptoms to the same extent as at Kuttanad but also had 7·4 per cent of the palms remaining with yellowing alone. The palms selected at Kayangulam were from the Resarach Station Farm and had received regular manuring with N, P and K fertilizers for over 20 years in contrast to the palms in other areas. Marginal necrosis generally occurred with flaccidity but a very low percentage of palms at Kayangulam and Thodupuzha developed this symptom independently. (Fig. 1).

Statistical examination of 5,960 palms growing under varying conditions, except those from Kayangulam, revealed that

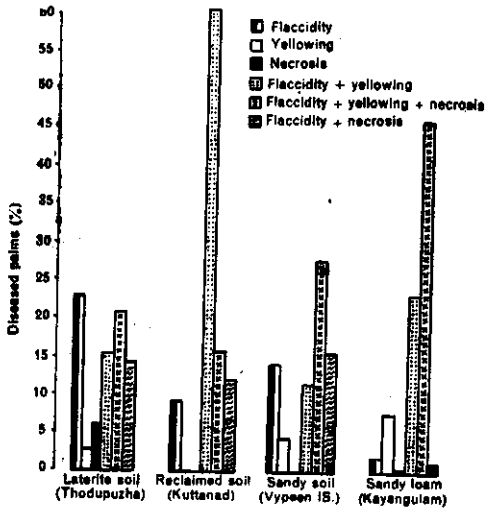

Fig. 1. Foliar symptoms of root (wilt)-affected coconut plants (per cent) in different age groups.

5,120 were diseased. Among the diseased, 4,808 palms manifested flaccidity either alone or in combination with other symptoms, 3,702 palms had yellowing and 2,417 developed necrosis. The correlation coefficients between the total number of diseased palms and those having flaccidity, yellowing and necrosis were 0·998, 0·972 and 0·968, respectively; all of them were highly significant. The correlation coefficient between the total number of diseased palms and the number of palms developing the different symptoms independant of each other revealed that flaccidity alone is significant; indicating that flaccidity is the important symptom of the disease whereas yellowing and necrosis are of minor importance (Table 1).

Foliar symptoms in relation to age

Palms below 10 years: Out of 860 palms observed in this group, 29·1 per cent were healthy. Of the rest 67·0 per cent manifested flaccidity, 14·3 per cent marginal necrosis and 6·2 per cent yellowing. Frequency of occurrence of these symptoms singly was 52·0 per cent for flaccidity, 1·8 per cent for yellowing, 1·6 per cent for marginal necrosis (Fig. 2).

Table 1. Correlation coefficient between the total diseased palms and different symptoms in adult palms

	Flaccidity	Yellowing	Necrosis	Flaccidity+	Yellowing+	Necrosis+
Correlation coefficient	0·46	-0·9	0·11	0·998	0·972	0·968
Significance	*	NS	NS	**	**	**

*Significant at 5 per cent level of probability; **significant at 1 per cent level of probability; NS, non-significant.

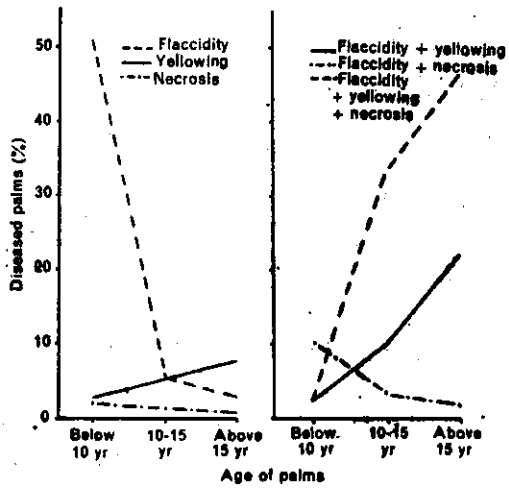

Fig. 2. Foliar symptoms of root (wilt)-affected coconut plants (per cent) in relation to soil conditions.

Palms aged 10–15 years: Although 41·7 per cent of the palms remained healthy in this group, manifestation of symptoms of disease was more intense. Only 4·3 per cent of the palms remained with flaccidity alone out of a total of 50·9 per cent of the affected palms. Foliar yellowing was present in 47·6 per cent of the palms, of which 4·3 per cent were free of other symptoms; and 36·9 per cent exhibited marginal necrosis mainly in association with flaccidity, 0·5 per cent were free of all other symptoms (Fig. 2).

As in the adult palms, 10·6 per cent palms in the age group of 10 years and 3·7 per cent in that of 10–15 years developed flaccidity and necrosis but were free of yellowing.

Analysis of the data on palms of Cane Breeding groups (Table 2) indicated that only 1·4 per cent of the total diseased palms under the age of 5 years developed yellowing, whereas 96·8 per cent had flaccidity. With the increase in the age, the percentage of palms exhibiting yellowing correspondingly increased. Incidence of necrosis also showed a similar trend, whereas flaccidity remained consistently high in all groups.

In general, palms in the advanced stage of disease manifest flaccidity or ribbing of leaves, foliar yellowing and marginal necrosis of leaflets. Yet a critical analysis of these symptoms in adult palms in relation to soil types and in the palms of different age group in one type of soil reveals that flaccidity of leaves is the initial symptom besides being consistent. Foliar yellowing and marginal necrosis, which appear independently in a few palms under favourable conditions, progressively increase with the advancement of age of plant or the disease. Foliar yellowing is high under water-logged soil conditions at Kuttanad, lower in the sandy-loam soil at Kayangulam and Vypeen, and the minimum in the laterite soil at Thodupuzha. This foliar condition is probably owing to nutritional imbalance or deficiency since earlier reports on tissue analysis indicate an association of low magnesium status with the yellowing of leaves (Pillai, Unpublished data). Experimental evidence indicate complete control of foliar yellowing by providing drainage channels in the water-logged soils (CCRS, Kayangulam, 1966). The progressive increase in foliar yellowing with the advancement in the age of palms growing in the sandy-loam soil at Kayangulam, which is of low fertility status (CCRS, Kayangulam,

Table 2. Frequency of occurrence of symptoms as percentages in relation to age of palms

Age of plams (yr)	Total palms (No)	Healthy	Diseased	Percentage of total diseased palms		
				Flaccidity	Yellowing	Necrosis
3–5	495	216	280	96·8	1·4	21·1
4–9	365	59	306	85·0	16·3	19·6
10–15	347	145	202	87·6	81·2	62·9
Above 25	633	144	489	78·1	79·8	56·0

1958), further supports the view that the yellowing of leaves is a delayed expression of nutrient deficiency. According to Prevot and Ollagnier (1963), visual symptoms of deficiency appear long after the internal deficiency is experienced. In the light of the available data it is concluded that flaccidity or ribbing of leaves is the diagnostic visual symptom of root (wilt) disease. Foliar yellowing and marginal necrosis of leaflets may develop owing to other factors, but they are associated with the disease especially in its advanced stages.

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