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Research Articles

REMISSION OF SYMPTOMS OF ROOT (WILT) DISEASE OF COCONUT INJECTED WITH OXYTETRACYCLINE – HCL

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ABSTRACT

Ninety root (wilt) diseased coconut palms having uniform intensities of disease were treated with 1, 2, 3 and 6 gm. active ingredient of oxytetracycline-HCL (Terramycin 20% soluble powder) and 3,000,000 units of Penicillin for 36 months at quarterly intervals using a pressure injection device. Terramycin treated palms showed reduction of disease index score. Untreated palms and palms injected with penicillin deteriorated. Remission of symptoms in response to injection with terramycin supports mycoplasmal etiology of the disease.

INTRODUCTION

The root (wilt) disease of coconut *(Cocos nucifera* L.) now prevalent in 410,000 ha. of coconut plantations in Kerala, is causing an estimated annual loss in yield of about 968 million nuts (Anonymous, 1986). The diagnostic symptom of the disease is the rib–like bending of leaflets termed flaccidity. yellowing and necrosis are other associated symptoms (Radha and Lal, 1972). The cause of the disease has long been enigmatic. Report on the detection of mycoplasma-like organism (MLO) in the sieve tubes of tender rachillae and root tips of root (wilt) diseased palms but not of the healthy (Solomon, Govindankutty and Neinhaus, 1983) gained significance as the presumptive causal agent of this disease. This paper deals with the results of a large scale field experiment undertaken to see if remission of symptoms could be achieved by administering tetracycline antibiotics to diseased palms so as to lend further support to the etiological role of MLOs in the disease.

MATERIALS AND METHODS

Experimental material

a) *Plants:* Ninety West Coast Tall palms, 14–16 years old, in the early

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stage of disease development were selected during June, 1984 in two agroclimatic locations – Agriculture Department farms at Mavelikkara and Vyttila. The pre-treatment disease index score recorded according to George and Radha (1973), varied from 20–30.

b) *Antibiotics:* oxytetracycline-HCL (OTC) (Terramycin 20% soluble powder) of M/s. Pfizer Ltd., Thane, Bombay, India and Penicillin G sodium (Commercial product) of M/s. Hindustan Antibiotics, Pimpri, Pune, were used. The dose of OTC was fixed as 1, 2, 3 and 6 gm active ingredient on the basis of the results of a preliminary experiment carried out earlier in which doses higher than 6 g. a. i. proved phytotoxic (Anonymous, 1983).

Administration of antibiotics

a) *Mode of application:* OTC (Terramycin 20% soluble powder) was dissolved in distilled water to yield 1, 2, 3 and 6 g a. i. and was directly injected into palm trunk at the bole region, using the pressure injector devised by Gopinathan Pillai and Raju (1985).

b) *Frequency and duration of application:* The frequency of injection was once in every quarter. This was based on the report of the residues of the chemicals persisting upto three months in the foliage (Anonymous, 1983). Each time injections at both centres were completed within five days and were continued for 36 months, the period required for complete replacement of the canopy.

Experimental layout

There were altogether six treatments, each with 15 palms randomly distributed in the two locations. Treatment one to five were 1, 2, 3 and 6 g a. i. of terramycin and 3,000,000 units of penicillin respectively. Palms in treatment six were injected with distilled water to serve as untreated control.

Observations

Detailed observations on the conditions of palms relating to number of leaves, disease index score factors (flaccidity, yellowing and necrosis) compounding disease intensity and yield for individual palms were recorded prior to first application in June 1984 and subsequently at half yearly intervals. Disease intensity score was computed for each of the palms based on the method suggested by George and Radha (1973) at each round of observation. Final observations were recorded after the tendermost leaf tagged at the commencement of the experiment had shed.

Analysis

Since the pretreatment observations were recorded in June, the data collected during June every year were subjected to statistical analysis for the significance of the differences between treatments, using the analysis of variance techniques. As the values observed in 1984 at the two different centres did not differ considerably, they were considered together for the purpose of analysis. In order to adjust for the marginal differences in the initial disease status of the palms under different treatments, covariance analysis was also attempted, using the data of June 1984 as the ancillary variable.

RESULTS AND DISCUSSION

During the experimental period, three palms died, one in T_2 and two in T_4 due to bud-rot infection/red palm weevil infestation. From the tabulation of the disease status of the individual palms under the experiment, the mean values have been calculated for net increase/decrease in the overall Disease Index Score (DIS) and Flaccidity Index Score (FIS) for each treatment and presented in Table I. Since the number of palms surviving at the end of the experiment varied in different treatments, the percentage of mean values has also been provided for the sake of comparison. The number and percentage of palms showing reduced DIS and FIS have also been indicated. It may be seen that one palm in Penicillin treated lot (T_5) and two palms in distilled water injected lot (T_6) had shown slight reduction in DIS. Therefore improvement of disease condition or remission of symptoms has been reckoned as reduction of DIS over the highest reduction in control. Similarly, three palms each in T_5 and T_6 also showed reduced FIS. Percentage of palms showing higher decrease in FIS has also been taken to determine improvement in the flaccid condition. Thus 53.3 and 53.9% palms showed improvement for DIS for T_3 and T_4 respectively, while the corresponding values of FIS were 60 and 46.1 per cent. The mean values of decrease in DIS and FIS were progressively higher in T_1 to T_4 (Table I). The difference between treatment and control is significant. Untreated palms deteriorated showing a higher FIS (+17.1) while terramycin treated palms had reduced FIS (—5.1 to —14.8 in T_1 to T_4). Penicillin treated palms also had increased FIS. This trend is reflected in DIS also. However, in T_2 the average value of decrease in DIS, percentage of palms showing improvement in DIS and FIS show slight deviation from the general trend.

Analysis of variance carried out for the data on disease index recorded every year, showed that treatment differences were significant during 1985, 1986 and 1987 (Table II). During 1987, among the different treatments, T_4 (Terramycin 6 g a. i.) showed the lowest intensity of disease and T_5 and T_6 (Penicillin and distilled water controls) registering significantly higher values than the rest. Comparable results were observed in the earlier years also. Comparison of data over the years revealed remission of symptoms for the palms receiving terramycin, whereas the palms in penicillin and control were showing steady deterioration. It is evident from Table II that palms under T_4 and T_6 showed a difference of 1.7 point only at the commencement of the experiment in 1984. It was around 6.2 points in 1985 and 1986 and the gap further widened to 10.1 points by 1987.

Results of covariance analysis of the data recorded in 1985, 1986 and 1987 were also in agreement with the results of analysis of variance, except that in 1986 the treatment differences were not statistically significant, though the trend was similar to those of other years.

As flaccidity is reckoned as the decisive and diagnostic symptom of the disease, the index score for flaccidity was also analysed separately using the

Table I. *Effect of Oxytetracycline – HCL on DIS and FIS of the experimental palms*

Treatment		T_1	T_2	T_3	T_4	T_5	T_6	Remarks
Total No. of palms		15	14	15	13	15	15	one palm in T_2 & two palms in T_4 dead due to bud rot
Palms showing reduced DIS*	a) Number	9	11	9	11	1	2	
	b) Percentage	60.0	78.6	60.0	84.6	6.7	13.3	
Average value of decrease (–)/ increase (+) of DIS	a) Average	–1.2	–0.9	–2.1	–4.2	+2.0	+4.3	
	b) Percentage	–4.6	–4.7	–7.6	–16.9	+7.6	+15.8	
Percentage of palms showing improvement in DIS (over control)		33.3	21.3	53.3	53.9	nil	nil	
Palms showing reduced FIS**	a) Number	10	9	10	12	3	3	
	b) Percentage	66.7	64.3	66.7	92.3	20.0	20.0	
Average value of decrease (–)/ increase (+) of FIS	a) Average	–0.4	–1.0	–1.7	–3.0	+1.3	+3.0	
	b) Percentage	–5.1	–7.6	–12.2	–14.8	+5.5	+17.1	
Percentage of palms showing improvement in FIS (over control)		33.3	28.6	60.0	46.1	nil	nil	

* DIS = Disease Index Score ** FIS = Flaccidity Index Score

analysis of variance and co–variance techniques, to assess the improvement in disease symptoms. The results were in conformity with those of the total disease index, with the minimum score in T_4 and widening difference between T_4 and T_6 as years passed by.

Analysis of data on yield did not reveal any statistically significant differences between treatments. Since all the palms were receiving uniform fertilizer doze, this is not unexpected also.

Remission of symptoms in diseased plants consequent to the application of tetracycline is accepted as evidence of MLO etiology. Results of the present experiment support the role of MLO as causal agent in coconut root (wilt) disease. Before the association of MLO with root wilt disease was reported by Solomon et al (1983), a preliminary field experiment with single dose of terramycin by Mathew George (1983) had shown ameliorating effect on the diseased condition in a limited number of palms. The present experiment has been conducted on an elaborate scale incorporating four doses of the antibiotic (1, 2, 3 and 6 g a. i) besides Penicillin on 15 palms in each treatment at two localities of different agro–climatic conditions. Deterioration of palms in distilled water injected and Penicillin treated ones with improvement in OTC administered palms clearly supports an MLO–etiology for root (wilt) disease.

Monitoring the uptake and translocation of OTC in injected palms by bio–assay had indicated presence of

Table II. *Effect of antibiotic therapy on the remission of symptoms of root (wilt) disease*

Treatment	No. of palms	1984	1985	1986	1987	1985	1986	1987
		(original values)				(adjusted values)		
		Disease index						
1	15	24.6	22.4	24.0	23.3	23.4	25.2	24.4
2	14	25.6	23.9	25.3	24·7	24.0	25.5	24.8
3	15	26.4	25.7	26.6	24.6	25.1	26.0	24.0
4	13	25.0	22.8	23.9	20.9	23.5	24.7	21.6
5	15	26.2	26.6	27.5	28.2	26.2	27.1	27.8
6	15	26.7	29.0	30.0	31.0	28.1	29.0	30.1
Gen mean		25.78	25.05	26.22	25.43	25.1	26.2	25.4
S. E./plot		2.48	3.82	5.19	4.99	3.10	4.50	4.37
C. V. (%)		9.61	15.25	19.79	19.64	12.37	17.14	17.17
Reg. Coefficient						0.91**	1.06**	1.00**
F ratio		1.61	6.41**	2.97*	7.56**	4.80**	1.67	6.43**
C. D.		N. S.	2.87	3.90	3.75	2.34	N. S.	3.30
		Score for flaccidity (=10 F/L)						
1	15	16.2	14.1	15.8	15.8	15.1	16.8	16.9
2	14	17.1	15.3	16.8	16.1	15·5	17.1	16.4
3	15	18.5	17.6	18.2	16.8	16.6	17.2	15.8
4	13	17.3	15.6	15.8	14.3	15.6	15.8	14.4
5	15	17.4	17.4	18.1	18.8	17.3	18.1	18.7
6	15	17.9	19.2	20.4	21.0	18.9	19.9	20.5
Gen. Mean		17.38	16.50	17.50	17.12	16.5	17.5	17.1
S. E./plot		2.07	2.64	3.63	3.86	2.00	3.16	3.36
C. V. (%)		11.90	16.02	20.72	22.53	12.11	18.05	19.61
Reg. Coefficient						0.84**	0.88**	0.94**
F ratio		1.99	7.39	3.43	5.41**	6.86**	2.79*	5.98**
C. D.		N.S	1.99	2.73	2.90	1.50	2.37	2.52

residues in all the leaves of the treated palms except spear leaf 24 h after injection (Anonymous 1984).

McCoy (1972 and 1973) and Maramorosch (1978) in Florida and Hunt, Dabek and Schinling, (1974) in Jamaica, reported similar remission of MLO caused lethal yellowing disease of coconut. Symptom remission in such cases was in the form of growth of new healthy inflorescences and green fronds three to four months after initial treatment with OTC, while in root (wilt) disease, continuous treatment was necessitated as remission of symptoms is contributed by emergence of new leaves devoid mainly of flaccidity, which is expressed by the leaves of the middle and outer whorls, the inner leaves of diseased palms being free of the symptoms.

The result reported here of a three year study showed significant remission of foliar symptoms compared to previous years' rating. Remission of symptoms after prolonged infusion with OTC was recorded in Pear decline by McIntyre et al. (1979). Dabek and Martin (1987) also made repeated trunk injections with OTC over 27 months period and recorded significant retardation in the rate at which clove trees died from sudden death disease in Zanzibar.

High dose of tetracyclines have been used to prolong the state of disease remission in lethal yellowing affected palm (McCoy 1975). The result obtained herein is also in agreement with the above findings as palms receiving 3 and 6 g a. i. of OTC yielded the best result and the remission of symptoms could be prolonged for 36 months by repeated treatments as indicated. Contrary to McCoy's observation, doses higher than 6 g was found to be phytotoxic.

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