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TRANSMISSION OF COCONUT ROOT (WILT) DISEASE—REACTION OF 170 TEST PLANTS

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ABSTRACT

Experiments to study the transmission of coconut root (wilt) disease under normal environmental conditions, employing mechanical inoculation (with leaf and root extracts, partially purified preparations, root exudates and soil suspension), soil transmission, leachates and insect feeding were conducted on 22,160 plants of 170 species and cultivars belonging to 30 families. *Impatients balsamina, Lycopersicon esculentum* cult. San Marzano, and *Physalis minima* showed very low percentage of infection when mechanically inoculated with diseased leaf extracts. Plants which were earlier reported as suspects did not show any symptoms in these trials. Cowpea (*Vigna sinensis* Endl.) reported earlier as an indicator host also failed to show symptoms consistently.

INTRODUCTION

The root (wilt) disease of coconut is a very serious malady of uncertain etiology. Nagaraj and Menon (1956) and Shanta, Menon, and Patchu Pillai (1960) reported reproduction of symptoms of the disease in healthy palms by mechanical inoculation with crude extracts of tender leaves and roots of diseased palms. Shanta, Joseph, and Lal (1964) reported transmission of the disease to coconut seedlings under insect proof screen house mechanically and through the lace bug *Stephanitis typicus* Distant. In these cases, flaccidity of leaves appeared within 8-12 months of initial inoculation. Because of this long incubation period in the primary host, the necessity for having a secondary host with a short incubation period has been felt. Shanta and Menon (1960) reported cowpea (*Vigna sinensis* Endl.) as a diagnostic test plant for the disease. They reported that the first trifoliate leaf was malformed when the primary leaves were mechanically inoculated or when cowpea seedlings were raised in infective soil. Holmes, Lal, and Shanta (1965) corraborated this result. However, subsequent studies (Lal, 1968; Shanta, Vijayalakshmi, and Lal, 1970) showed that these results on cowpea were inconsistent and susceptibility was highly influenced by temperature. No truly diagnostic test plant, uniformly susceptible to the disease, has been reported so far although *Phaseolus mungo, Dolichos biflorus, Tephrosia candida, Areca catechu, Capsicum annum*, and *Lycopersicon pimpinellifolium* have been reported to be susceptible to the disease agent (Shanta and Menon, 1961). Symptoms produced on them varied from malformation of leaves in the legumes to slight stunting in others.

In the present study, 170 species, and cultivars and weeds growing in coconut gardens and belonging to 30 families (total: 22,160 plants), were screened as possible diagnostic test plants by inoculating them mechanically

with infective coconut tissue/soil extracts and through insect feeding. The results are reported here.

Materials and Methods

Experimental plants were raised from seeds in steam sterilised soil in pots in an insect-proof screen house under natural conditions of temperature and light. They were watered twice a week with Hoagland's nutrient solution containing double the dose of nitrogen. Legumes and cucurbits were inoculated at the cotyledonary stage and others at 3-4 leaf stage. A pre-inoculation incubation in the dark for 24 hr was given uniformly. A post-inoculation incubation for 48 hr at 26°C was also tried. Mostly, M/15 phosphate buffer at pH 8.0 was used as extraction medium to prepare tender root and leaf extracts of diseased trees. Other buffers tried were borate (0.1 M, pH 7.0), tris-HCl (0.01 M, pH 7.5), glycine-NaOH (0.05 M, pH 7.5), and KH_2PO_4-NaOH (0.01 M, pH 7.0). Reducing agents, augmenters, accelerators, and tannin inhibitors, which protect unstable viruses from inactivation at the time and following extraction were also added to the extraction media in some cases. They were 0.01 M sodium diethyl-dithiocarbamate, 0.1% thioglycolic aicd, 0.01 M ascorbic acid, 0.001 M cysteine hydrochloride, 0.01 M sodium sulphite, 0.1% 2-mercaptoethanol, nicotine sulphite, and caffeine, and 3% egg albumin. The expressed sap was filtered through cotton wool before using for inoculation. The tissue extracts prepared above were further fractionated by methods commonly employed for purification of viruses of different groups (e.g. polyhedral/spherical particles, rods, and free ribonucleic acids).

Suspensions of infective soil, prepared according to Holmes et al. (1965), 'root sap' from diseased trees (Nagaraj and Davis, 1956), and soil leachates collected from potted diseased coconut seedlings were also tried as inocula. The inoculum was applied on the upper leaf surface by the abrasion method (Rawlins and Tompkins, 1936) using 400 mesh carborundum. Leachates from infective soil were tested for infectivity by dipping the plants in them for periods up to 24 hr after trimming the roots.

Adults of *Stephanites typicus* collected from coconut palms in the field were maintained in the laboratory on leaflets of apparently healthy coconut palms. In all tests, 24 hr acquisition feeding and 18 hr transmission feeding were uniformly given. Experiments were done both with and without pre-acquisition starvation for 6 hr.

Results and Discussion

Although a large number of plants were tested for their susceptibility to the coconut root (wilt) disease, none of them was found to be uniformly sasceptible and therefore diagnostic. These are listed below:

Anonaceae: *Anona squamosa.*

Crucuferae: *Brassica oleraceae* vars. *botrytis, capitata.*

Capparidaceae: *Cleome monophylla; C. viscosa.*

Malvaceae: *Abelmoschus esculentus; Bombax malabaricum; Sida cordifolia; S. rhombifolia; Urena lobata.*

Geraniaceae: *Impatiens balsamina**.

Sapindaceae: *Cardiospermum halicacabum*

Leguminosae: *Arachis hypogaea; Canavalia ensiformis; Cassia tora; Cicer arietinum; Clitoria ternatea; Crotalaria juncea; C. striata; Cyamopsis tetragonolobas; Dolichos biflorus; D. lablab; Mimosa pudica; Phaseolus aureus; P. lunatus; P. mungo; P. vulgaris; Tephrosia candida; T. purpurea; Vigna sinensis* cultivars Brancho, Local, N 5, New Era, NP 2, NP 3, Philippine Bush, Pusa Phalguni, Pusa-Do-Fasli.

* Denotes symptom expression

Cucurbitaceae: *Benincasa cerefera; Cucurbita maxmima; C. pepo; Cucumis melo; C. sativus; Lagenaria vulgaris; Luffa acutangula; Trychosanthes anguina.*

Aizoaceae: *Gisekia pharnaceoides.*

Umbelliferae: *Daucus carota.*

Rubiaceae: *Borreria hispida; Mitracarpus verticillatus; Oldenlandia corymbosa.*

Compositae: *Ageratum conyzoides; Blainvillea latifolia; Chrysanthemum coronarium; Eclipta alba; Emilia zonchifolia; Eupatorium odoratum; Gynura lycopersicifolia; Tridax procumbens; Vernonia cinerea.*

Apocynaceae: *Vinca rosea.*

Asclepiadaceae: *Hemidesmus indicus.*

Convolvulaceae: *Ipomaea pestigridis.*

Solanaceae: *Capsicum annum* cultivars EC 1617, EC 31219, EC 31660, Local; *Datura stramonium; Lycopersicon esculentum* cultivars Beefsteak, Bonny Best, Homestead No. II, Local, Molokai, Pearson; Rutgers, San Marzano;* *L. pimpinellifolium; Nicotiana bigelovii; N. clevlandii; N. glauca; N. glutinosa; N. longiflora; N. longsdorffii; N. paniculata; N. rapanda; N. rustica; N. sylvestris; N. trygonophylla; Nicotiana tabacum* cultivars DD 413, Delcrest, Havana IIC, Japan Xanthi, Red Russian, S. 20, Turkish, White Russian, Xanthi; *Petunia hybrida; Physalis minima;** *P. peruviana; Scopolia sinensis; Solanum melongena; S. nigrum.*

Scrophulariaceae: *Antirrhinum majus; Scoparia dulcis.*

Pedaliaceae: *Pedalium murex.*

Verbenaceae: *Lantana camara; Stachetarpheta indica; Clerodendron infortunatum.*

Labiatae: *Hyptis suaveolens; Leucas aspera Ocimum sanctum.*

Nictaginaceae: *Boerhaavia repens; Mirabilis jalapa.*

Amarantaceae: *Amarantus caudatus; A. viridis; Celosia cristata; Gomphrena globosa.*

Chenopodiaceae: *Beta vulgaris; Chenopodium amaranticolor; C. filifolium; C. murale; C. quinoa.*

Euphorbiaceae: *Croton sparsiflorus; Euphorbia hirta; E. heterophylla; Jatropha glandulifera.*

Zingiberaceae: *Curcuma angustifolia.*

Musaceae: *Musa paradisiaca.*

Commelinaceae: *Commelina nudiflora;*

Aracaceae: *Areca catechu; Caryota urens; Chrysalidocarpus lutescens; Cocos plumosa; Dictyosperma album; Elaeis guinensis; Kntia macarthurii; Licuala spinosa; Ptychoraphis singaporensis; Ptychosperma macarthurii.*

Pandanaceae: *Pandanus tectorius.*

Graminae: *Chloris incompleta; C. virgata; Dicanthium annulatum; Eleusine coracana; Oryza sativa* cultivars Annapurna, Culture 13, C 19, C 20, C 28, C 32, IR 8, Jaya, Kochuvithu, Mundakan, Padma, PTB 4, PTB 10, PTB 20, PTB 23, Rohini, Tainan 3, Triveni, Vellayani 1; *Panicum maximum; P. miliare; Pennisetum typhoideus; Sorghum vlugare* cultivars Co 12, Co 19, Co 20.

Susceptibility was recorded only in three cases, but the percentage was very low (3-12). *Impatiens balsamina* (5% susceptibility) developed dwarfing, green vein banding and twisting of leaves. *Lycopersicon esculentum* cultivar San Marzano (2.7% susceptibility), and *Physalis minima* (12% susceptibility) produced shoe string, mild mosaic, curling, and tip necrosis of lamina. Plants reported to be susceptible in earlier trials (Shanta and Menon, 1961) did not show any symptoms.

No consistent results were obtained on cowpea which has been reported earlier as an indicator host (Shanta and Menon, 1960). This confirms the numerous subsequent reports and obsevations regarding the erratic behaviour of cowpea (Annual Report, Central Coconut Research Station, 1966–1970). The number of plants taking up infection under mechanical/insect transmis-

* Denotes symptom expression

sion trials varied; the percentage of infection of cowpea growing on infective soil was also unreliable.

In so far as none of the plants tested here can reliably be employed as a diagnostic test plant under normal enviroflmental conditions, the study warrants intensive work, preferably under controlled environment of at least those plants which have shown some promise by way of low infection and mild symptoms. More extensive and meticulous scrutiny of indigenous flora of diseased gardens may also yield fruitful results.

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References

HOLMES, F. O., LAL, S. B., AND SHANTA, P.1965. Cowpea inoculation test for diagnosis of coconut wilt disease in India. *FAO Pl. Prot. Bull.* **13**: 30-34.

LAL, S. B. 1968. Root (wilt) disease—Resume of work done since 1964. *Proc. 3rd Session FAO Tech. Wkg. Pty. Cocon. Prod. Prot. and Processing*, Jogjakarta, 1-11. FAO, Rome.

NAGARAJ, A. N., DAVIS, T. A., AND MENON, K. P. V. 1954. Sap transfusion, a new device for transmission trials in palms. *Indian Coconut J.* **7**: 91-95.

NAGARAJ, A. N. AND MENON, K. P. V. 1956. Note on the aetiiology of the (wilt) root disease of coconut palms in Travancore-Cochin. *Indian Coconut J.* **9**: 161-165.

RAWLINS, T. C. AND TOMPKINS, C. M. 1936. Studies on the effects of carborundum as an abrasive in plant virus inoculations. *Phytopathology* **26**: 578-587.

SHANTA, P., MENON, K. P. V., AND PATCHU PILLAI, K. 1960. Aetiology of the wilt (root) disease: Investigations on its virological nature. *Indian Coconut J.* **13**: 56-66.

SHANTA, P. AND MENON, K. P. V. 1960. Cowpea (*Vigna sinensis* Endl.) an indicator plant for the coconut (wilt) virus. *Virology* **12**: 309-310.

SHANTA, P. AND MENON, K. P. V. 1961. Studies on some properties of the coconut (wilt) virus. *Indian Coconut J.* **15**: 36-45.

SHANTA, P., THOMAS JOSEPH, AND LAL, S. B. 1964. Transmission of root (wilt) disease of coconut. *Indian Coconut J.* **18**: 25-28.