Evaluation of certain fungicides in soil against *Ganoderma lucidum* (Leys) Karst pathogenic on arecanut*

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INTRODUCTION

GANODERMA LUCIDUM (Leys) Karst, a soil borne pathogen, besides infecting coconut, oil palm, mango etc. also attacks arecanut palm (**Areca catechu** L.) and cause a severe malady called the 'Anabe' disease. The disease is more in old, ill-drained and highly neglected areca gardens. The disease was first recorded by Butler (1906) while recording the betelnut plague in Sylhet, later by Watt (1909) and Coleman (1911). Venkatarayan (1936) estimated that upto 5% of arecanut trees died annually in an area while Naidu **et al.** (1966) recorded 1-2% loss on an average due to 'Anabe' disease.

Studies were initiated in artificial media to test the efficacy of some fungicides in arresting the growth of **G. lucidum** before using them in the field. Menon (1963) reported that Bordeaux mixture, Dithane, sulphur and Microcop were inefficient in controlling the fungal growth. Nair and Rao (1965) recorded the inhibitory activity of mercurised copper oxychloride (MCO), MCO plus zinc, Blitane, Fycol 8E and Flit 406. Lalithakumari (1969) observed complete inhibition of mycelial growth in 2 ppm concentration of cycloheximide. On the otherhand, Nambiar and Radhakrishnan Nair (1972) found that Aureofungin sol. up to 200 ppm was ineffective whereas mercuric chloride, Captan, Difolatan and Vitavax were fungicidal and Ceresan wet, Thiram and Leytosel were fungistatic when tested against **G. lucidum**. According to Domsch (1964), the screening procedure on artificial media with fungicide-fungus combinations has certain disadvantages which will become apparent when the same chemicals are tested in different media and further many substances which are highly promising in artificial media may fail in field experiments. The present investigation was therefore undertaken with the object of finding out the efficacy of certain fungicides against the survival of *G. lucidum* directly in the soil itself at different moisture levels in order to evolve a suitable control programme for efficient use in the field against the disease.

MATERIALS AND METHODS

Eight fungicides **viz.,** Aureofungin sol. (Heptaene antibiotic) plus copper sulphate, Benomyl (Methyl 1-(butylcarbamoyl) -2- benzimidazolecarbamate), Captan (N-trichloromethylthio-4-cyclohexene-1, 2-dicarboximide), Ceresan wet (2-methoxyethyl mercury chloride), Difolatan (Cis-N-(1, 1,2,2-tetrachloroethyl-thiol)-4-cyclohexane-1, 2-dicarboximide), Plantvax (2, 3-dihydro -5- carboxanilido -6- methyl-1, 4-oxathiin-4, 4-dioxide), Vitavax (5, 6-dihydro-2-methyl-1, 4-oxathiin-3-carboxanilide) and Thiram (Tetramethylthiuram disulphide) were tested for their toxicity against **G. lucidum.** Areca garden land soil (Sandy clay loam — pH 5.36; organic carbon 0.77%) of known field capacity was taken, air dried for 24 hr, powdered in an iron mortar with pestle and sieved to 420 μ size. The percentage moisture in the soil was then determined by oven drying it at 105°C until constant weight was obtained. From this the volume

TABLE — 1

EFFECT OF FUNGICIDES ON *GANODERMA LUCIDUM* IN SOILS OF DIFFERENT MOISTURE LEVELS

Fungicide	Concentration (%)	Average growth of fungal disc (mm)* Available Soil Water (%) 50	75	100**	150
Aureofungin sol plus Copper sulphate	0.03 plus 0.02	37.9	46.1	0.0	0.0
Benomyl 50%	0.10	39.5	30.9	0.0	0.0
Captan 83 WDP	0.25	14.3	19.6	36.5	21.8
Ceresan wet	0.25	39.8	41.3	31.0	29.4
Difolatan 80 W	0.20	24.0	27.1	0.0	0.0
Plantvax 75 W	0.10	34.3	31.9	0.0	0.0
Vitavax 75 W	0.10	30.3	36.9	0.0	0.0
Thiram 75 WDP	0.25	20.0	17.8	0.0	0.0
Control (No fungicide)	—	40.0	40.6	20.8	21.0

* As determined on Waksman's agar medium after keeping 72 hr. in the soils.

** 100% Available Soil Water is equivalent to 40% moisture in soil on oven dry weight basis.

of liquid to be added to the soil to obtain soils of 50%, 75%, 100% and 150% Available Soil Water (A.S.W.) was calculated.

The fungicides dissolved in water were added to the soil in required volume and mixed thoroughly. Controls were prepared by adding sterile distilled water only. The soils were then packed upto 65 mm height in sterile glass vials of 75 x 20 mm size in quadruplicates. While packing the soil a 5 mm disc of 7 day old **G. lucidum** from Waksman's agar medium was incorporated at about the middle of the height. The mouth of the vial was closed by an aluminum metal foil. The vials were incubated for 72 hr. at room temperature (30±2°), the fungal discs were then removed onto a wire mesh, washed free of soil with sterile distilled water and plated on Waksman's agar medium. Observations were made from 24 hr. onwards and wherever the disc showed positive growth it was recorded as the average of two diameters measured at right angles to one another.

RESULTS AND DISCUSSION

The oven dried areca garden land soil contained 2.7% moisture on an average. The effect of fungicides on **G. lucidum** in soils of different moisture levels is furnished in Table-1. Ceresan wet and captan were not effective at all the moisture levels in the soil. On the other hand Thiram, Difolatan, Benomyl, Plantvax, Vitavax and Aureofungin sol. plus copper sulphate were inhibitory to the fungal disc in soils of 100% and 150% A.S.W. levels, whereas at 50% and 75% A.S.W. levels they were seldom active. This indicates that the low moisture content in the soils has decreased the toxicity of these fungicides towards **G. lucidum.** This may be due to the fact that fungi in soils are more resistant to toxicants in dry than in moist soils (Kreutzer, 1960, 1963) or the solubilized fungicides precipitated and became nontoxic when the water molecules are absorbed by the soil particles or the chemicals themselves are adsorbed onto the soil colloids and decreased in their toxicity (Kreutzer, 1963). Kreutzer (1963) has opinioned that the degree of micelle hydration in the soil is very important factor in determining the degree of adsorption. Cations are readily adsorbed and under certain conditions the anions are also sorbed. The greater the degree of sorption, the lower the efficiency of the introduced toxicant with a corresponding change in its degree of selectivity. Hence for better activity of the introduced fungicide the soil moisture should be higher which is at or above 100% A.S.W. as observed in the present study.

It was concluded that the fungicides Benomyl, Plantvax, Vitavax, Aureofungin sol. plus copper sulphate, Thiram and Difolatan can be used to the best against **G. lucidum** in the plantation fields at or above 100% A.S.W. level in the soils. The results of field experiments to control the 'Anabe' disease will be published separately.

SUMMARY

Eight fungicides were tested against the survival of **Ganoderma lucidum** (Leys) Karst, a pathogen of arecanut, in soil columns at different moisture levels. Ceresan wet and Captan were ineffective. On the other hand Thiram, Difolatan, Benomyl, Plantvax, Vitavax and Aureofungin Sol. plus copper sulphate were inhibitory in soils of 100% and 150% Available Soil Water (A.S.W.), whereas at 50% and 75% A.S.W. levels they were seldom active. It was concluded that for better toxic activity, the latter group of fungicides should be introduced at 100% A.S.W. level into the soil.

REFERENCES

Butler, E.J. 1906. Some disease of palms., **Agri. J. India 1**: 299-310.

Coleman, L.C. 1911. Anabe roga of supari. **Annual Rept. Agril. Chem. Mysore, 6**: 1909-10.

Domsch, K.H. 1964. Soil fungicides **Annu. Rev. Phytopath., 2**: 293-320.

Kreutzer, W.A. 1960. Soil treatment pp. 431-476. In **Plant pathology An Advanced treatise.** eds. Horsfall, J.G. and Dimond, A.E. Academic Press, New York

Kreutzer, W.A. 1963. Selective toxicity of chemicals to soil microorganisms. **Annu. Rev. Phytopath., 1**: 101-26.

Lalithakumari, H. 1969. **Studies on Areca Catechu Linn. with special reference to Ganoderma lucidum, a fungal pathogen of areca palm.** Ph.D. thesis, Indian Institute of Science, Bangalore.

Menon, R. 1963. Studies **in vitro** of **Ganoderma lucidum** Leys. Karst. **Phytopath. Z., 48**: 434-38

Naidu, G.V.B., S.N.S. Kumar and M. Sannamarappa. 1966. **Ganoderma lucidum** (Leys,) Karst — review and further observations. Lalbagh. **20** (11): 14.

Nair, R.B. and K.S.N. Rao, 1965. A note on the efficiency of new fungicides on **Ganoderma lucidum. Arecanut J., 16**: 6-9.

Nambiar, K.K.N. and R. Radhakrishnan Nair, 1972. Investigations on **Ganoderma lucidum** (Leys.) Karst causing 'Anabe' disease of arecanut. 119-123. In : Proc. Ist Nat. Symp. Plantation Crops, Trivandrum, Kerala. Ed. N.M. Nayar, The Bangalore Press, Bangalore.

Venkatarayan. S.V. 1936. The biology of **Ganoderma lucidum** on arecanut and coconut palms. **Phytopathology, 26**: 153-57.

Watt, G.A. 1909. A plague of betelnut palms and the destruction of the tissues by what appears to be a form of tylosis. **Agric. Ledger, 8**: 129-39.