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Studies on the Root Rot of Groundnut Caused by *Sclerotium rolfsii* Sacc*.

BY

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ABSTRACT

From a study to fix the exact site of infection, it was found that the hypocotyl of groundnut was the most vulnerable site of infection as this region yielded the pathogen more frequently than other parts near the soil surface. In a pathogenicity experiment, maize seeds as a medium of inoculum was found to be better than barley seed and wheat seed inoculum and was superior to sand maize inoculum in causing quick and high mortality. On evaluating four systemic fungicides and PCNB against *S. rolfsii*, vitavax at 10 ppm and plantvax at 25 ppm inhibited the fungus growth to the maximum and prevented sclerotial formation. As regards control, plantvax 25 ppm followed by vitavax 10 ppm were highly efficacious.

INTRODUCTION

Groundnut or peanut (*Arachis hypogaea* L.) is an important oilseed crop cultivated extensively in India. Among the many fungal diseases affecting groundnut, sclerotial root rot caused by *Sclerotium rolfsii* is very important. The occurrence of this disease was first reported from India by Shaw and Ajrekar (1915). Recently sclerotial root rot is becoming increasingly important in parts of Coimbatore Salem, North Arcot and South Arcot districts. Subramanian (1960) initiated investigations on few aspects like factors influencing pathogenicity, physiology of the fungus, varietal susceptibillity and host range. Considering the importance of this disease, further investigations were taken up in this laboratory during 1971-73. One of the common methods of testing the pathogenicity of soil-borne fungi like *S. rolfsii* is by using inoculum grown on sand incorporated with maize meal. However, it is pertinent to indicate that use of sand maize inoculum may not simulate field conditions where the inoculum of root infecting fungi is discontinuous and sparse. Moreover, use of large inoculum in pathogenicity experiment is also a laborious process. Therefore studies on other methods of inducing the disease under conditions of artificial inoculation were explored and the results are presented in this paper. *S. rolfsii* is soil-borne and with the onset of the disease the plant collapses rapidly. In order to know the exact site at which the pathogen infects the groundnut plant, a study was taken up.

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The control of sclerotilal diseases was a problem till PCNB (Pentachloronitrobenzene) was discovered to be effective against such diseases (Cooper, 1953, Harrison, 1961 1966). For the chemotherapeutic control of plant diseases, the present trend is to explore the possibility of using systemic fungicides. Hence, an attempt was made to study the efficiency of four systemic fungicides in comparison with PCNB which is specific against many sclerotial diseases. The results of the above studies are also presented in this paper.

MATERIALS AND METHODS

For the study on pathogenicity, the fungus was grown for six days on sand maize medium (Sand : Maize = 95:5), and on moist seeds of wheat (*Triticum vulgare* L.), barley (*Hardeum vulgare* L.) maize (*Zea mays* L.) and also on wooden tooth picks (5 cm x 0.1 mm) after autoclaving. Twenty groundnut plants of variety TMV 2, 15 days after sowing were inoculated for each treatment and the soil moisture of the pots was maintained at 40 per cent M. W. H. C. Sand maize inoculum was applied adopting the method of Shanmugam (1971). Inoculum of barley, maize and wheat seeds, were placed in juxtra-position to the hypocotyl. When tooth picks were used one tooth pick was slightly inserted into the hypocotyl of each plant. After inoculation, the hypocotyls were covered with sterilized soil.

The site of initial infection of groundnut plants by *S. rolfsii* was determined following the method of Govindaswamy (1961). Twenty-day old groundnut plants (variety TMV 2) were inoculated with six-day old culture of the organism in sand maize medium adopting a soil : inoculum ratio of 1 : 5. On the 8th day after inoculation, portions of the epicotyl, hypocotyl and roots of the inoculated plants were cut into bits and planted on oats agar. The percentage of the bits yielding the pathogen from each portion of the plant was assessed.

In the fungicidal trial the following five fuugicides were used:

i) Vitavax (5, 6-dihydro-2-methyl 1, 4-oxathiin-3-carboxanilide)

ii) Plantvax (2, 3-dihydro-5- car boxinilido-6 - methyl-1, 4-oxathiin-4-4-dioxide).

iii) Thiabendazole (2-(4 - thiozolyl) benzimidazole).

iv) Benlate (methyl-1-benzimidazole carbamate) 50 per cent WP.

v) PCNB (Pentachloronitrobenzene)

The efficacy of these fungicides were screened *in vitro* by the poisoned food technique (Nene, 1971). The fungicides at concentrations from 5000 ppm to 10 ppm were amended in oat agar medium and the radial growth of the fungus was measured. The number of sclerotia formed *in vitro* in the various treatments were assessed after incubation for 30 days. Evaluation of these fungicides was also done under pot culture conditions. TMV 2 groundnut plants were grown in pot filled with sterile soil. Five plants were grown in each pots and four pots formed a replication. The plants were inoculated using maize seed inoculum as described above in the pathogenicity experiment. Three days before inoculation the pots were drenched with the respective fungicides at the concentration found effective, from *in virto* studies. Observations on the mortality of plants were recorded 20 days after inoculation.

RESULTS AND DISCUSSION

The results on the mortality of plants are presented in Table 1.

It may be seen that maize seed inoculam is the best of all other types of inocula in causing maximum mortality besides being quickest in inducing the disease. Within six days after inoculation, 75 per cent of the plants were infected. This indicates higher inoculum potential of *S. rolfsii* when grown on maize seeds than in other types of media used. Garret (1960) who postulated the conception of inoculam potential reported that food base is important for creating effective inoculam potential. The importance of this food base has been stressed even previously by many workers like Bliss (1941) who reported failure of inoculation experiments with

TABLE 1. Coparative efficacy of different methods of inoculation of groundnut plants with *S. rolfsii*

Type of inoculum	Inoculum ratio/No. of infested seeds per plant	Per cent mortality Days after inoculation		
		4	6	8
Sand maize medium	1:5	0	25	40
Wheat seeds	5	10	40	70
Barley seeds	10	5	45	60
Maize seeds	2	15	75	85
Tooth pick	1	0	5	30
Uninoculated medium (Control)	---	0	0	0

unsuitable artificial media. Use of maize seeds in the present experiment has evidently supplied the proper food base for creating effective inoculum potential of *S. rolfsii* to infect groundnut besides proving to be an easy method of inoculation. There is a report of Epps *et al.* (1951) who have used a single wheat seed infected by *S. rolfsii* as the inoculum for successful pathogenicity on tomato.

The results on the experiment to find out the site of infection are presented in Table 2.

TABLE 2 Percentage of bits yielding *S. rolfsii* from different regions of inoculated plants.

Parts of plant	Precentage of bits yielding the pathogen
Epicotyl	60
Hypocotyl	70
Portion of the root just below the hypocotyl	35
Portion of deeper roots	0

It was observed that the epicotyl, hypocotyl and roots just below the hypocotyl region were invaded by the organism. But the hypocotyl was the most vulnerable site of infection as this region yielded the pathagen more often. The deeper roots were found to be free from infection. *Sclerotium rolfsii* has been reported to make good growth near the soil surface and this region was found to be more prone to attack by the pathogen (Taubenhaus, 1919; Flados, 1956). Moreover according to Yarborough (1949), the young succulent hypocotyl of groundnut is rich in nutrient reserves and is having only thinner cuticles. All these factors might have contributed in rendering the hypocotyl region as the most vulnerable site of infection. Results on the *in vitro* testing of fungicides are presented in Table 3.

TABLE 3. Effect of fungicides on the radial growth of *S. rolfsii in vitro* (Mean of three replications)

Concentration in ppm.	Colony diameter expressed as percentage over control				
	Thiaben-dazole	Benlate	PCNB	Plantvax	Vitavax
10	100.0	100.0	100.0	42.6	0
25	97.5	100.0	100.0	0	0
50	96.3	100.0	97.5	0	0
100	88.1	94.4	85.9	0	0
500	82.7	60.3	33.9	0	0
1000	82.0	51.4	17.5	0	0
2500	61.6	33.6	0	0	0
5000	53.8	0	0	0	0

Significant at P=0.01; S.E.=0.29; C.D.=0.8

Among the five fungicides tested, vitavax was found to be most effective in inhibiting the growth of the pathogen even at a very low concentration of 10 ppm, followed by plantwax 25 ppm and PCNB 2500 ppm. The effect of these fungicides on the formation of sclerotia in culture were assessed Table 4.

TABLE 4. Effect of different fungicides on sclerotial formation (Mean number of seleroia per dish).

Fungicide	Number of selerotia formed						
	Concentration of fungicides in ppm						
	10	25	50	100	500	1500	2500
Plantvax	3.0	0	0	0	0	0	0
Vitavax	0	0	0	0	0	0	0
PCNB	578.5	520.8	102.0	14.8	3.5	3.5	2.5
Thiabendazole	542.0	522.5	367.0	313.5	259.3	68.3	47.0
Benlate	442.0	424.5	419.0	221.8	208.5	52.3	0
Control (no fungicide)	609.5	609.5	609.5	609.5	609.5	609.5	609.5

Significant at P=0.01 S.E.=20.5 C.D.=40.6

It may be seen from Table 4, that there was no sclerotial production in vitavax 10 ppm followed by plantvax 25 ppm and Benlate 2500 ppm. Among the other fungicides, least sclerotia were formed in PCNB 2500 ppm.

The data on per cent mortality of plants in the evaluation under pot culture conditions are given in Table 5.

TABLE 5. Effect of fungicides on the control of sclerotial root rot

Treatment	Per cent mortality			Mean per cent mortality
	Replication			
	I	II	III	
Vitavax 10 ppm	30	50	40	40.00
Plantvax 25 ppm	30	40	30	33.33
PCNB 2500 ppm	50	40	50	46.67
Thiabendazole 5000 ppm	60	50	50	53.33
Benlate 5000 ppm	60	50	50	53.33
Control (no fungicide)	70	70	70	70.00

Significant at P=0.01, S.E.=5.904 C.D.=13.154

As seen from the data, on mortality maximum control has been obtained with plantvax 25 ppm followed by vitavax 10 ppm and both of them are on par. Good control has also been obtained with PCNB at the concentration of 2500 ppm. These results indicate that the systemic fungicides plantvax and vitavax are highly effective in controlling sclerotial root rot of groundnut. Kiewnick (1969) reported that vitavax is fungistatic at low levels and fungi-toxic at higher levels against *Corticium rolfsii* and *C. solani*. There are many reports about the efficacy of vitavax in controlling diseases caused by *Rhizoctonia* spp. David and Sinclair (1968) proved that vitavax is promising as also fungicide for *Rhizoctonia* on cotton and they also suggested that this fungicide will be effective against other soil-borne fungi in addition to *Rhizoctonia* sp. The present investigation also proved the effectiveness of vitavax and plantvax against sclerotial root rot of groundnut.

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*Original not seen.