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Divya bharathi AR
Department of Plant Pathology, University of Agricultural and Horticultural Sciences, Shimoga, Karnataka, India

Xiaodong Dong
Department of Plant Pathology, University of Agricultural and Horticultural Sciences, Shimoga, Karnataka, India

Correspondence
Divya bharathi AR
Department of Plant Pathology, University of Agricultural and

In vitro efficacy of different fungicides against *Sclerotium rolfsii* sacc. Causing stem rot of tuberose (*Polianthes tuberosa* L.)

Divya bharathi AR and Narayanaswamy H

Abstract
The bio assay of fungicides forms the prerequisite for the field evaluation. In this study efficacy of four systemic fungicides (Carbendazim, Thiophanate methyl, Tricyclazole, Hexaconazole) and four non-systemic fungicides (Captan, Mancozeb, Chlorothalonil, Copper oxy-chloride) were evaluated at four different concentrations *viz.*, 100, 200, 300 and 400 ppm, against *Sclerotium rolfsii* causing stem rot of tuberose under *in vitro* condition. The results revealed that among the systemic fungicides Hexaconozole showed 100 percent inhibition of mycelia growth at all the concentrations tested. This was followed by Tricyclozole which showed 100 per cent inhibition of mycelia growth only at higher concentration i.e., 600 ppm. Among the non systemic fungicides Mancozeb was highly effective as it showed hundred per cent inhibition of mycelial growth at 200, 400 and 600 ppm respectively. Whereas Copper oxychloride did not show any inhibition of the mycelial growth at all the four concentrations tested

Keywords: Fungicides, *Sclerotium rolfsii*, tuberose

Introduction
Tuberose (*Polianthes tuberosa* L.) is one of the most important bulbous ornamental crops of tropical and subtropical areas. It is commercially cultivated for cut and loose flower trade and also for the extraction of highly valued natural flower oil. Among the several diseases affecting the crop, stem rot caused by *Sclerotium rolfsii* is one of the most serious problems in tuberose growing areas of Karnataka. The fungus is a polyphagous, ubiquitous and has an extensive host range. The disease results in uneven crop stand, loss of plant population and subsequently yield, in case of severe attack no flowering shoots are obtained (Das, 1961) [1] In the present study four systemic and four non systemic fungicides with four different concentrations were evaluated against *S. rolfsii* under *In vitro* condition.

Material and Methods
The fungus, *S. rolfsii* was isolated from the diseased samples obtained from stem rot infected tuberose plant using standard tissue isolation procedure. Pathogenicity was proved by following Koch's postulates. The effect of eight fungicides *viz.*, Carbendazim, Thiophanate methyl, Tricyclazole, Hexaconazole, Captan, Mancozeb, Chlorothalonil and Copper oxy-chloride at different concentrations like 100, 200, 400 and 600 ppm on growth of *Sclerotium rolfsii* was studied using poisoned food technique (Nene and Thapliyal, 1982) [2]. Potato dextrose agar was prepared and 100 ml of the medium was taken in 250 ml of conical flasks and sterilized. To the molten cooled sterile medium requisite quantity of the fungicides were added and thoroughly mixed so as to get the required concentrations for each of the fungicide.
Twenty ml of poisoned medium was poured in to each of the 90 mm sterilized petri plates. Each plate was inoculated with five mm of mycelium at the center and incubated at $27+10^0$ C. Three replications were maintained for each treatment. Potato dextrose agar medium without any of the fungicide served as control. The plates were incubated at room temperature for seven days. Mean colony diameter in each case was recorded by taking the diameter of the colony in two directions. The per cent inhibition of the growth over control was calculated by following the equation given by (Vincent, 1927) [3].

$$I = \frac{C - T}{C} \times 100$$

Where

I = per cent inhibition
C = growth in control
T = growth in treatment

Results and discussion

Systemic fungicides

The results revealed that (Table. 1), among the systemic fungicides, Hexaconazole inhibited hundred per cent growth of *Sclerotium rolfsii* and is significantly superior over control. This was followed by Tricyclozole which showed hundred per cent inhibition of mycelia growth only at higher concentration i.e., 600 ppm and also inhibited 85.55 and 89.19 percent at 200 and 400 ppm respectively. Other two fungicides *viz*; Carbendazim and Thiophanate methyl were found to be comparable with control at 100 ppm, however, they were effective at higher concentrations as they inhibited the growth of mycelium up to 38.86 per cent and 55.55 per cent at 600 ppm respectively. The results were in agreement with (Prabhu and Hiremath, 2003) [4] and (Arunasri *et al*., 2011) [5] who reported that the Triazoles (Hexaconazole, Propiconazole, Difenconazole) and combi products containing Triazoles *viz*., Avatar, Merger and Nativo were highly inhibitive to the growth of *Sclerotium rolfsii*. Similarly (Hegde *et al*., 2014) [6] reported that the systemic fungicides like hexaconazole, propiconazole and difenconazole showed complete inhibition of mycelial growth at all concentrations tested. Contact fungicides like mancozeb, chlorothalonil, captan and zineb inhibited the mycelial growth completely at the concentration of 0.1%.

Table 1: Effect of systemic fungicides on mycelial growth of *Sclerotium rolfsii*

Treatments	Per cent inhibition of mycelial growth over control				
	100ppm	200ppm	400ppm	600ppm	Mean
T1: Carbendazim	0.00 (0.00) *	5.55 (13.63)	16.66 (24.09)	38.86 (38.56)	15.26
T2: Thiophanate methyl	0.00 (0.00)	5.55 (13.63)	35.55 (36.6)	55.55 (48.19)	24.16
T3: Tricyclazole	34.66 (36.07)	85.55 (67.66)	89.19 (70.8)	100 (90)	77.35
T4: Hexaconazole	100 (90)	100 (90)	100 (90)	100 (90)	100
Control	0.00	0.00	0.00	0.00	0.00
		Fungicide		Concentration	F X C
S.Em±		0.021		0.021	0.042
C.D at 1%		0.142		0.142	0.164

*Figures in parenthesis are arc sine transformed values

Non-Systemic Fungicides

The per cent inhibition of mycelial growth of *Sclerotium rolfsii* in different non-systemic fungicides was significant. Among the non-systemic fungicides Mancozeb was highly effective as it showed hundred per cent inhibition of mycelial growth at 200, 400 and 600 ppm respectively. This was followed by Captan, which inhibited growth of the mycelium up to 88.22 per cent only at 600 ppm, Chlorothalonil inhibited the pathogen growth up to 8.80 per cent only at 600 ppm, whereas Copper oxychloride did not show any inhibition of the mycelial growth at all the four concentrations tested and were only comparable to control (Table.2). (Vyas and Joshi, 1977) [7] and (Chowdhury *et al*., 1998) [8] reported that, among the different chemicals tested, Thiram and Mancozeb were found to be most effective fungicides against *Sclerotium rolfsii*.

Table 2: Effect of non-systemic fungicides on mycelial growth of *Sclerotium rolfsii*

Treatments	Per cent inhibition of mycelial growth over control				
	100ppm	200ppm	400ppm	600ppm	Mean
T1: Mancozeb	5.54 (13.60)*	100 (90)	100 (90)	100 (90)	76.38
T2: Copper oxy-chloride	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T3: Captan	44.44 (41.8)	66.59 (54.68)	77.77 (61.86)	88.22 (69.92)	69.25
T4: Chlorothalonil	0.00 (0.00)	2.22 (8.56)	4.47 (12.21)	8.80(17.33)	3.87
Control	0.00	0.00	0.00	0.00	0.00
		Fungicide		Concentration	F X C
S.Em±		0.008		0.008	0.016
C.D at 1%		0.032		0.032	0.064

*Figures in parenthesis are arc sine transformed values

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