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CHEMICAL CONTROL OF ROOT and STEM ROT OF BROAD BEAN

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ABSTRACT

The mycelium of *Macrophomina pha eolina* was the most sensitive to Tilt, Benlate and Brassicol and least sensitive, in descending order, to Captan, Dithane M—45 and Vitavax, with intermediate sensitivity to Daconil. Sicarol was ineffective in inhibiting the mycelial growth of *M. phaseolina*. During fungicidal drench of broad bean in pots, Tilt being phytotoxic reduced 62 per cent seedling emergence, whereas Vitavax increased 21 per cent seedling emergence over the nondrenched control. Tilt, Vitavax Benlate, Daconil, Brassicol and Captan drenches caused respectively, 28, 23, 25, 20, 19 and 17 per cent stunting in plant height of broad bean. Tilt and Captan drenches increased 35 and 45 per cent flowers, respectively, whereas Vitavax drench gave 48 per cent decrease in flowers. Sicarol proved ineffective in cen rolling the root and stem rot of broad bean caused by *Macrophomina phaseolina*. The most effective fungicidal drenches in controlling root and stem rot were those of Tilt, Daconil and Brassicol followed by less effective drenches of Vitavav. Captan, Dithane M—45 and Benlate.

INTRODUCTION

Broad bean (*Vicia faba* L.) is an ancient Egyptian fodder and vegetable crop which is now grown in Egypt, Italy, Spain, UK and USA for food, feed and green manuring. Being a source of low cost vegetable protein, its cultivation has increased in Pakistan (Aslam *et al.*, 1980) and efforts are being diverted towards testing its adaptability in arid zones of Pakistan. In rainfed areas, the broad bean, if well adapted, can replace gram crop (*Cicer arietinum* L.) which severely suffers form epiphytotics of blight (*Ascochyta rabiei*) resulting in its

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complete failure. Unfortunately, broad bean in Pakistan, is known to suffer from some pathological disorders, economically important being the root and stem rot caused by *Macrophomina phaseolina* (Tassi) Goid, (Anonymous, 1981). The disease appears on maturing plant and causes heavy losses to the crop. Since resistance against this disease in the available broad bean germplasm is missing, attempts have been made to control the disease chemotherapeutically.

MATERIALS AND METHODS

In Vitro Sensitivity of *Macrophomina phaseolina to Different Fungicides*

M. phaseolina mycelium sensitivity to 5, 10, 20 and 50 μg/ml of each of the eight fungicides, i. e., Tilt, Vitavax., Sicarol, Benlate, Daconil, Brassicol, Captan and Dithane M−45 was studied using a modified technique of Borum and Sinclair (1968). The *in vitro* fungicide concentrations were obtained by adding an appropriate amount of each fungicide stock solution to autoclaved (15 lb psi/15 min) potato dextrose agar (PDA) cooled to about 50 °C. PDA without fungicide served as control. Fifteen ml of non−amended (control) or amended PDA for each treatment were poured into each of the four 9 cm culture plates. After the agar had solidified, 6 mm diameter agar plugs containing *M. phaseolina* mycelium were cut from 10 day old PDA culture plates using a sterilized cork borer and placed in the centre of each test plate. The mean diameter of mycelial growth was measured after 96 hours of incubation. The data were subjected to statistical analysis using factorial design.

Effect of Fungicide Drench on Charcoal Rot Development

In order to evaluate the comparative effectiveness of soil application, (*i. e.*, drenching) of fungicides on seed germination, plant height, disease incidence, etc. The experiment was conducted in pots. Twenty seeds of broad bean were sown in each of the 72 earthen pots each containing 15 kg of sclerotia infested field soil (approximately 8000 sclerotia/gm of soil). Eight pots divided into four replications (each replication with 2 pots) were drenched with each of the eight test fungicides at the rate of 50 μg/gm of soil. Eight non−treated water drenched pots served as control. At the time of drenching, the calculated amount of each fungicide for each pot was dissolved in 2 litre water and was applied to all as a drench immediately after sowing of broad bean seeds The germination (seedling emergence) counts were recorded after one month of sowing. Observations on the numb(r of flowers per plant were recorded at blooming whereas plant height and per cent plant infection were recorded when the plants were at physiological maturity stage. The data were analysed statistically through the analysis of variance using Duncan's Multiple Range Test (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

In Vitro Sensitivity of Macrophomina phaseolina to Different Fungicides

M. phaseolina mycelium varied in its sensitivity to the eight fungicides tested (Table 1). Except for Sicarol, there was significant decrease in mycelial growth with increase in fungicide. *M. phaseolina* was the most sensitive to Tilt, Benlate and Brassicol and least sensitive, in descending order, to Captan, Dithane M – 45 and Vitavax, with intermediate sensitivity to Daconil. Sicarol was ineffective in inhibiting the mycelial growth at all the applied rates. Tilt exhibited the same effectiveness at 20 and 50 μg/ml dosage rate, whereas Brassicol was as effective at 10 μg/ml as at 20 μg/ml dosage rate. Daconil and Vitavax at 5 and 10 μg/ml exhibited the same effectiveness aga nst *M phasaolina.* However, the magritu.e of effect of these fungicides was different. Benlate, Daconil and Brasicol at 50 μg/ml were statistically as effective in inhibiting the mycelial growth of *M. phaseolina* as Tilt at 5 μg/ml. This differential behaviour of the sensitivity of *M. phaseolina* towards these fungicides may be due to the differential mode of action or uptake of these fungicides or due to the different mechanisms of the fungus, involved in the detoxification of these fungicides. Such a differential fungitoxic spectrum of various fungicides on the *in vitro* growth of *M. phaseolina* has also been reported by Ilyas *et al.* (1975) and Majid and Ilyas (1982).

Effect of Fungicide Drench on Seedling Emergence, Plant Height, Number of Flowers per Plant and Disease Incidence of Bread Bean in Greenhouse Evaluation

Fungicides varied in their effectiveness on bread bean seedling emer-

Table 1. *Average colony diameter (cm) of macrophomina phaseolina at different concentrations of fungicides in PDA at 30 °C*

Treatments	Dosage				
	5 μg/ml	10 μg/ml	20 μg/ml	50 μg/ml	Treatment means
Tilt	1.3 op*	0.8 q	0.6 r	0.5 r	0.82 g
Vitavax	5.7 b	5.7 bb	5.5 o	5.4 d	5.57 b
Sicarol	9.0 a	9.0 a	9.0 a	8.9 a	8.98 a
Benlate	1.9 i	1.7 mn	1.6 n	1.3 op	1.62 f
Daconil	3.7 g	3.7 g	1.7 mn	1.4 o	2.63 e
Brassicol	2.3 k	1.8 lm	1.8 lm	1.2 p	1.75 f
Captan	4.4 f	3.8 g	2.8 i	2.4 k	3.37 d
Dithane M−45	4.9 d	4.6 e	3.1 h	2.6 j	3.32 c
Control	9.0 a	9.0 a	9.0 a	9.0 a	9.00 a
Dosage means	4.15 a	3.89 b	3.26 e	2.99 d	—

* Figures with the same letters are not significantly different from each other at 5% level.

gence (Table 2). Except for Tilt and Vitavax, none of the test fungicidal drenches exhibited any deleterious or beneficial effect on seedling emergence. Vitavax drench significantly increased seedling emergence, whereas Tilt drench significantly decreased seedling emergence. Vitavax drench showed 20.7 per cent increase and Tilt drench being phytotoxic gave 62.0 per cent decrease in seedling emergence over the non-drenched control. Tilt induced phytotoxicity and its negative effect on seedling emergence of sunflower has been reported by Majid and Ilyas (1982).

Fungicidal drenches also varied in their effectiveness on average plant height and number of flowers per plant. Except for Sicarol and Dithane M−45, all fungicide drenches induced plant stunting and Tilt, Vitavax, Benlate, Daconil, Brassicol and Captan caused 28, 23, 25, 20, 19 and 17 per cent decrease in

Table 2: *Effect of fungicide drench on seedling emergence, plant height, number of flowers and disease incidence of broad bean*

Treatments	Seedling emergence	Average plant height (cm)	Number of flowers per plant	Per cent disease incidence
Tilt	22.0 c	54 d	14.66 ab	20.0 d
Vitavax	70 5 a	58 bcd	5.66 d	33.3 c
Sicarol	59.0 b	65 abc	12.98 bc	83.3 a
Benlate	52.5 b	56 cd	11.34 bc	40.0 d
Daconil	61.5 ab	60 bcd	9.26 cd	20.8 d
Brassicol	62.0 ab	61 bcd	11.60 bc	25.0 d
Captan	62.5 ab	62 bcd	15.74 a	37.5 c
Dithane M−45	54 5 b	66 ab	12.86 bc	41.6 c
Control	58.0 b	75 a	10 86 c	83.3 a

*Figures with the same letters are not significantly different from each other at 50% level

plant height over the non-drenched control. Growth regulating effect of Tilt and Benlate in stunting sunflower plants has also been reported (Majid and Ilyas, 1982). This reduction in size is probably either on account of the mutagenic effect of fungicides on germinating seed or seedlings (Zutshi and Kaul, 1975) or due to an interference with mitosis occurring in the broad bean cells during growth process (Richmond and Phillips, 1975).

Sicarol, Benlate, Daconil, Brassicol and Dithane M−45 drenches had no effect on the average number of flowers per plant. However, Tilt and Captan drenches significantly increased (35 and 45 per cent) flowers per plant, respectively, whereas Vitavax drench gave 48 per cent decrease in flowers over the non-drenched control.

Fungicide drenches also varied in their effectiveness in controlling the root and stem rot disease incidence on mature plants. Except for Sicarol, all fungicide drenches lowered the incidence of root and stem rot development.

The ineffectiveness of Sicarol in controlling root and stem rot is probably on account of the *in vitro* insensitivity of *M. phaseolina* to this fungicide (Table 1). The most effective drenches in lowering the disease incidence were those of Tilt, Daconil and Brassicol, although statistically they exhibited the same effectiveness. The next less effective drenches were those of Vitavax, Captan and Dithane M-45, which were statistically at per with each other. The Benlate drench was the least effective in controlling root and stem rot of sunflower caused by *M. phaseolina* has already been reported (Majid and Ilyas, 1982).

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