Evaluation of tebuconazole and thiophanate-methyl against some problematic soil-borne plant pathogens

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Abstract

Present study was carried out to evaluate the potential of two fungicides namely Tegula (tebuconazole) and Thiomil (thiophanate-methyl) against three problematic soil-borne fungal phytopathogens namely *Macrophomina phaseolina, Fusarium oxysporum* f. sp. *lycopersici* and *Sclerotium rolfsii* isolated from diseased cowpea [*Vigna unguiculata* (L.) Walp.], tomato (*Solanum lycopersicum* L.) and chickpea (*Cicer arietinum* L.), respectively. Both the fungicides were provided by Ali Akbar Group. Different concentrations of these fungicides viz. 335, 70, 105 and 140 ppm were evaluated against the target fungal pathogen using food poisoning technique. All the concentrations of Tegula completely arrested the growth of all the three fungal species. By contrast, Thiomil was generally proved ineffective against all the fungal species.

Keywords: Fungicides, plant pathogens, tebuconazole, thiophanate-methyl.

Introduction

About 8000 species of soil-borne fungal pathogens exist causing disease in a large number of plant species. Many cause diseases in economically important resulting in huge monetary losses to the farmers. Among these *M. phaseolina, S. rolfsii* and *F. oxysporum* are highly important. *Sclerotium rolfsii* causes diseases in a wide range of horticultural and agricultural crop plants. It has 500 hosts species in about 100 plant families (Hegde *et al.*, 2010; Remesal *et al.,* 2013). Diseases are often assigned as southern blight, produced by *S. rolfsii*. Only in US, more than 270 host plants of this fungus have been reported (Farr *et al.*, 2007). It has the ability to produce enormous numbers of sclerotia that may persist in the soil for several years (Sennoi *et al.,* 2013). *M. phaseolina*, is one of the highly damaging phytopathogens in the tropics and subtropics that causes charcoal rot, seedling blight, dry root rot, wilt, leaf blight and ashy stem blight in more than 500 cultivated and wild plant species including economically important crops as soybean, common bean, sorghum, maize, cotton, peanut, cowpea (Hall, 1991; Diourte *et al.*, 1995; Javaid and Saddique, 2011). It forms microsclerotia in senescing shoot tissues and survive in the soil for a long period (Mayek-Pérez *et al.*, 2002). It also causes diseases in softwood forest trees namely *Abies, Pinus* and *Pseudotsuga* (McCain and Scharpf, 1996). *F. oxysporum* f. sp. *lycopersici* is causal agent of Fusarium wilt disease of tomato (Shanmugam *et al.,* 2011; Castano *et al.,* 2013). This pathogen is highly damaging both under field as well as under green house conditions in warm production areas (Kirankumar *et al.,* 2008). The present study was designed to evaluate the antifungal potential of two commercial fungicides namely Tegula and Thiomil against three problematic soil-borne fungal plant pathogens.

Materials and Methods

Ali Akbar Group provided two fungicides for this experiment. These were Thiomil and Tegula containing active ingredients thiophanate-methyl and tebuconazole, respectively. Doses of the fungicides used in this experiment were 35, 70, 105 and 140 ppm. Malt extract agar growth medium was prepared. Eighty milliliters of medium was prepared for each concentration. The medium flasks were autoclaved for sterilization at 121 ^{o}C for 30 minutes. After autoclaving, fungicides were added in the media at about 50-55 ^{o}C. Thiomil was in powder form so measured amount of each concentration was added in its respective medium flask. Tegula was in liquid form so its measured volume was added in the media flasks with the help of micropipette. In one medium flask no fungicide was added and was labeled as control. After addition of fungicides, the medium flasks were shaken well for homogenizing the mixtures. Antibacterial capsules (chloromycine) were also added in each flask. Medium of each concentration was poured in sterilized Petri plates at 20 mL per plate. Four replicates were prepared for each concentration and also for control.

Purified cultures of *M. phaseolina, F. oxysporum* and *S. rolfsii* were used for inoculation. The inoculation was done with the help of 5 mm diameter cork borer. This whole procedure was done in completely sterilized conditions to minimize the chances of any contamination. The inoculated plates were placed in incubator at 25 ^{o}C in a completely randomized design. Fungal radial growth was measured after 4 and 10 days. All the data were analyzed by alallysis of variance (ANOVA) followed by Duncan's Multiple Range to separate the treatment means at 5% level of significance (Steel *et al.,* 1997).

Results and Discussion

The two tested fungicides showed entirely different activity against the three fungal species. Variation in antifungal activity of different fungicides against a fungal species has also been reported in fungicides carbofuran, thiophanate methyl and bavistin (Vipin *et al.,* 2011). Tegula was highly effective in suppressing the growth of the test fungal species. All the concentrations of this fungicide completely controlled the fungal growth after 4 as well as 10 days growth stages (Fig. 1–3). Active ingredient in Tegula is tebuconazole that is among the most common fungicides which are used to control fungal diseases in cereals and other crops in many European countries and has been found very effective against *Fusarium verticillioides* and *Fusarium proliferatum* (Marín *et al.,* 2013). Spolti *et al.* (2012) reported that this fungicide is highly effective against *Fusarium graminearum,* the cause of head blight of wheat in Brazil and around the world. This broad-spectrum, relatively new triazole fungicide is being used for its effectiveness against soil-borne and foliar fungal diseases in nut, fruit, cereal and vegetable crops worldwide (Muñoz-Leoz *et al.,* 2011).

In contrast to Tegula, Thionil was proved highly ineffective against the test fungal species. All the concentrations of this fungicide exhibited an insignificant effect against *M. phaseolina* and *S. rolfsii* both at 4 and 10 days growth stages (Fig. 1 and 3). On the other hand, lower concentrations (35 and 70 ppm) of this fungicide significantly enhanced the growth of *F. oxysporum* over control after 4 as well as 10 days growth. Higher concentrations, however, showed insignificant effect as compared to control at both the growth stages (Fig. 2).

The present study concludes that soil-borne fungi namely *M. phaseolina, F. oxysporum* and *S. rolfsii* can effectively be managed by application of Tegula.

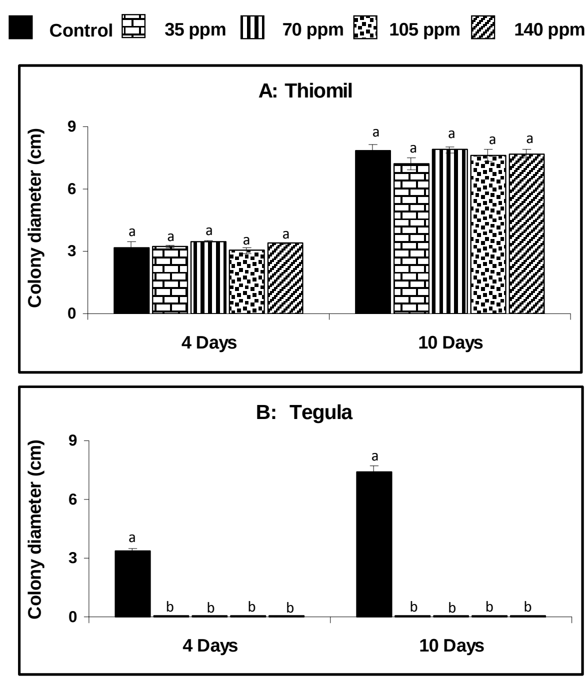

Fig. 1: Effect of different concentrations of fungicides thiomil and tegula on radial growth of *Macrophomina phaseolina.* Vertical bars show standard errors of means of four replicates. Values with

different letters at their top show significant difference (P≤0.05) as determined by Duncan's Multiple Range Test.

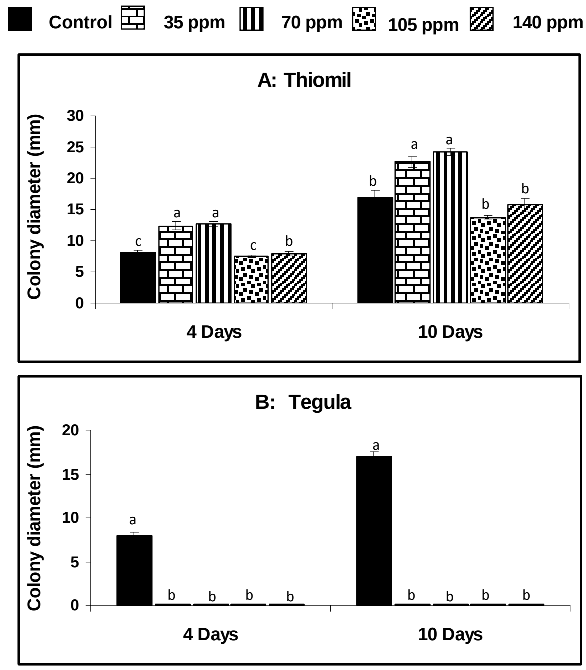

Fig. 2: Effect of different concentrations of fungicides thiomil and tegula on radial growth of *Fusarium oxysporum.* Vertical bars show standard errors of means of four replicates. Values with different letters at their top show significant difference (P≤0.05) as determined by Duncan's Multiple Range Test.

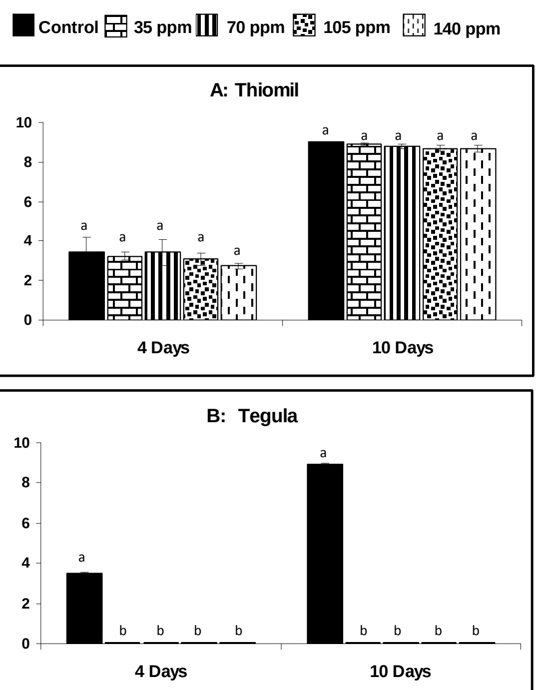

Fig. 3: Effect of different concentrations of fungicides thiomil and tegula on radial growth of *acrophomina phaseolina.* Vertical bars show standard errors of means of four replicates. Values with different letters at their top show significant difference (P≤0.05) as determined by Duncan's Multiple Range Test.

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