Phytotoxicity of some fungicides and their compatibility study with a potential biocontrol agent *Trichoderma harzianum*

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The term phytotoxic effect could be expressed as an injurious effect of any fungicide or their mixture in any form under any environmental condition when they are applied at their recommended doses on field crops or on any other crops. In view of such phytotoxic effect use of a chemical even being an excellent fungicide, is limited by such undesirable characters. Reduced rates of some fungicides resulted in loss of efficiency to control disease but increased rates of application caused phytotoxicity (Litterich *et al.,* 1993). A number of symptoms like reduced emergence, twisted and thickened leaves, stunted roots and tops have been observed using different fungicides on different crops (Goulart, 1993, Seymour *et al.,* 1994). Similarly, many fungicides showed phytotoxicity to different field crops under various conditions of their application (Singh *et al.,* 2003, Ali and Archer, 2003). There are hardly any fungicides, which is not injurious to field or nursery crops at any stage of their growth and condition of treatment. It therefore, could be considered that study of phytotoxic effects of pesticides is very important for their safer application on crop plants. At the same time the compatibility of fungicides has been considered to be a most important criterion with regards to Integrated Pest Management.

The compatibility is desirable not only with other fungicides but also with agrochemicals including fertilizers and biocontrol agents with a view to reduce their cost of application. A number fungicides have been tested for their compatibility with with a most commonly used fungal antagonist namely, *Trichoderma sp* of which many of them have been reported to be compatible with *Trichoderma hazianum* (Desai and Schlosser 1993; Sharma *et al.,* 2001).In the present investigation the study on compatibility was mainly restricted to their combining ability with a most commonly used fungal antagonist namely *Trichoderma harzianum*.Keeping these ideas in view, the present work was undertaken to find out the phytotoxic effect of some chemical compounds on different types of crops and their compatibility with a potential biocontrol agent with the objective of integrated application under field condition for plant disease management.

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Short communication

In the study of phytotoxicity of fungicides, the suspension/emulsion of four test fungicides namely propineb 70 WP, prochloraz 45 EC, difenoconazole 25 EC and flusilazole 40 EC at their recommended doses(0.25%, 0.15%, 0.15% and 0.1% respectively) were prepared in tap water. This suspension/emulsion were separately sprayed on the foliage of different crops namely mungbean, mustard and rice under field condition. The application of fungicides were started when the plants attended an age of 30 days. Each fungicides applied thrice at 10 days interval. Symptoms if any developed on the foliage of treated crop plants were noted and considered as the indication for the presence of phytotoxicity of test fungicide. The checks were maintained with water spray without fungicides.

A test under laboratory condition was undertaken to determine the compatibility of these fungicides with a bio-control agent, (*Trichoderma harzianum*, a fungal anatogonist) to determine the suitability of these fungicides in IPM system following poisoned food technique (Fisher,1969) The PDA medium ammended with a series of concentrations (8.0, 16.0, 32.0, 64.0 and 128.0 ppm) of test fungicides in petriplates with replicated treatments were inoculated at their centres with 4 mm diameter mycelial discs of freshly growing cultures of *T. harzianum* taken from the periphery of culture plate. The inoculated plates were incubated at a fixed temperature of 28 ± 1^0C in a BOD incubator. Observations were recorded on the radial mycelial growth when the fungus attended a full growth on control plate(3 days after inoculation) and extent of sporulation of *T. harzianum* in fungicide ammended culture plates were recorded at 24 hours interval. Checks were maintained with PDA medium without fungicides.

The results on the phytotoxic effects of four test fungicides revealed that except propineb 70 WP on mungbean none of the fungicides had any phytotoxic effect on either of mustard or rice. However, propineb 70 WP on mungbean (Plate 1) had phytotoxic effect in the form of chlorosis of young leaves followed by marginal schorching, reduction of size of newly emerged leaves and shortening of

internodal length, thereby causing a stunted appearance of the treated plant.The phytotoxic effect started appearing 2 days after second application of fungicide when the plants were 42 days old. The schorched leaf margins gradually converted into necrotic areas followed by death at 48 to 50 days old plants. The fungicide, prochloraz has been reported to have severe phytotoxic effect on winter wheat (Tvaruzek *et al*., 1995), but it has also been reported to be free from phytotoxic effect in some other crops (Minto *et al*., 2000, Liberator and Tatagiba, 2001). The triazole fungicides, flusilazole and difenoconazole has been claimed to have no phytotoxic effect for field crops (Corbas, 1995; Pavlik and Jandurova, 2000).

The fungal antagonist, *Trichoderma harzianum* was used in the present study and poisoned food technique was adopted for evaluation with respect to nature of compatibility of four fungicides viz., propineb 70 WP, prochloraz 45 EC , difenoconazole 25 EC and flusilazole 40 EC at five concentrations (8.0, 16.0, 32.0, 64.0 and 128.0 ppm). All the fungicides were found to have inhibitory effect towards the antagonist except propineb 70 WP irrespective of its concentrations assayed (Fig.1 & 2). The antagonist showed little growth (21.00 mm) at 32.0 µl/l concentration against difenoconazole 25 EC, but no growth was recorded above this concentration. Prochloraz 45 EC and flusilazole 40 EC totally inhibited the growth of *T.harzianum* even at 8.0 µl/l. Difenoconazole 25 EC appeared to be partly tolerated by *T. harzianum* only at lower concentrations.

Spore formation was delayed in 48 hrs in case of propineb 70 WP as compared to control. Although spore appeared in difenoconazole 25 EC much later than the appearance of spore in propineb 70 WP, most of the spores (phialospore) failed to germinate in 0.1% sugar solution. Both in the cases of propineb 70 WP and difenoconazole 25 EC initiations of numerous branches in germ tube at short intervals were noted.

The differential response of antagonistic flora to various fungicides might be due to their inherent resistance to most fungicides and their ability to degrade chemicals (Lifshitz *et al*., 1985, Papavizas, 1985). Propineb was found effective against several pathogens but was non-inhibitory to the antagonist, *Gliocladium virens*(Mukherjee and Tripathi, 2000). The triazole fungicides hexaconazole, propiconazole and penconazole were found highly inhibitory against *T. harzianum* at various concentrations (Narayana Bhat and Srivastava, 2003). On the other hand difenoconazole was found less inhibitory against *T. harzianum* (Cilliers *et al.,* 2003).

So, the most significant information that generated in this experiment was the compatibility of propineb 70 WP, a member of the dithiocarbamate group of fungicides appeared to be compatible with *T. harzianum* and might be a easy selection for Integrated Disease Management.

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Plate 1: Phytotoxicity of propineb 70 WP on mungbean

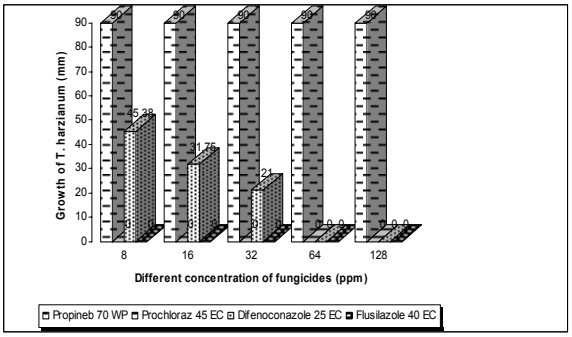

Fig 1 : Growth of *Trichoderma harzianum* at different concentrations of fungicides

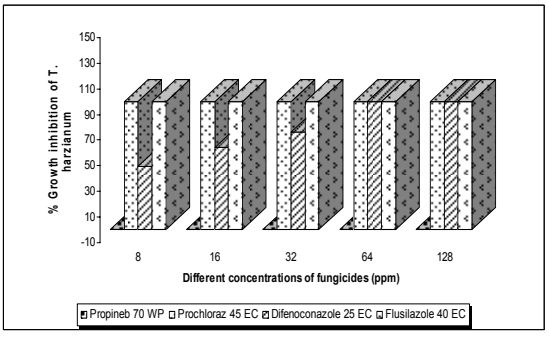

Fig. 2 : Growth inhibition of *Trichoderma harzianum* at different concentrations of fungicides