Research Paper :

Evaluation of *Trichoderma* compatibility with fungicides, pesticides, organic cakes and botanicals for integerated management of soil borne diseases of soybean [*Glycine max* (L.) Merril]

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SUMMARY

Compatibility tests were conducted under *in vitro* condition to find out safer fungicides, pesticides, different cakes and botanicals against *Trichoderma.* For this different fungicide, pesticides, cakes and botanicals were tested against *Trichoderma harzianum (*Th 09) and *Trichoderma viride* (Tv 11). Results indicate that among the fungicides tested, thiram (0.2%), copper oxychloride (0.2%) and mancozeb (0.2%) were found comparatively safer against *Trichoderma harzianum* and *Trichoderma viride* as compared to other fungicides. *Trichoderma* was most sensitive to captan, tebuconazole, vitavax, propiconazole and chlorothalonil. But *Trichoderma* was tolerant to all the pesticides and weedicides tested. None of the pesticide and weedicide inhibited the growth of *Trichoderma*. Among the botanicals tested, 10% fresh leaf extract of karanj leaves (*Pongamea pinnata*) and cumin leaves inhibited 32.19 % 27.15% growth of *Trichoderma,* respectively as compared to control. Another intresting thing observed that, neem oil (5%), neem leaves extract (10%), wild sorghum leaves extract (10%), neem cake, castor cake and mustard cake extract (10%) enhanced the growth of *Trichoderma*. This finding indicates that seed treatment or furrow applications of *Trichoderma* would be compatible with thiram, copper oxychloride, mancozeb, pesticides, weedicides, neem oil, neem leaves extract, wild sorghum leaves extract, neem cake, castor cake and mustard cake extracts for the integrated management of soil borne diseases of groundnut.

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Soybean [*Glycine max* (L.) Merill] is an important edible oilseed crop of Maharashtra, mostly grown in Marathwada region and continues to be the major source of protein and edible oil in the world. It yields more protein per hectare than most other crops and accounts for more than 63% of high protein meal and 28% of the total edible oil supply worldwide (Golbitz, 2000). The combination of low oil content and the relatively high protein content of fresh green soybean seeds make them particularly desirable to the health conscious people seeking low fat, high protein snacks (Brar and Carter, 1993). This crop is damaged by a number of soil borne fungal pathogens *viz*., *Phytophthora sojae, Rhizoctonia solani* and *Sclerotium rolfsii.* These fungi reside in the seed or the soil and are found in all agricultural soils. These fungi commonly cause root rot and stem rot. Diseases caused by these pathogens may be suppressed, but not eliminated by chemical treatment. These diseases usually result in the occurrence of dead or dying soybean plants and lower the yield. These soil-borne pathogens are very difficult and uneconomical to control with chemicals alone. Soybean seed treatments with fungicides can protect soybean seed and seedlings from fungal attack early in the season. They do not, however, guarantee that it will not have stand loss from fungal pathogens later. Fungicides for seed treatment, although some are systemic, have a limited time period in which they are effective. *Trichoderma* spp. are important potential bioagents against these soil-borne diseases. For the management of these diseases, farmers are using different fungicides as seed treatments before sowing but farmers are not getting satisfactory results. Therefore, farmers are applying talk. based *Trichoderma* in soil with castor cake or neem cake or farm yard manure for biological control of these soil-borne diseases. For the use of these biocontrol agents in an integrated disease management programme, the bioagents must be compatible with the fungicides, pesticides and botanicals commonly used in soybean.

The fungal contamination of seeds and

grains during storage and the metabolites produced by them are of considerable importance in reducing the seed germination and sprouting. Seed and seedling diseases cause severe seedling mortality resulting in “patchy” crop stand and ultimately reduce the yields. Therefore, cost effective technology for integrated management of these disease is most essential. Recently, many botanicals are reported to control the plant diseases caused by fungal pathogens (Natarajan and Lalithakumari, 1987; Dubey, 1991). Further, to minimise use of chemical fungicides, compatibility of *Trichoderma* with fungicides, pesticides, cakes and botanicals was studied as part of an integrated disease management programme.

MATERIALS AND METHODS

Fungicides:

Seven fungicides *viz*., Orthocide (0.02%), Propiconazole (0.03%), Mancozeb (0.2%), Chlorothalonil (0.20%), Tebuconazole (0.2%), Carboxin 37.5% +Thiram 37.5% (0.2%) and Hexaconazole (0.2%), were tested under *in vitro* condition.

Insecticides and weedicides:

Four insecticides *viz*., Monocrotophos (0.05%), Imadachloroprid (0.008%), Chloropyriphos (0.2%), Profenofos (0.05%), Carbosulfan 25% EC (0.05%), and three weedicides *viz*., Glyphosate, Turga Super and Basalin were tested at recommended doses against *Trichoderma* under *in vitro* condition.

Botanicals:

Eight botanicals *viz*., neem leaves extracts, karanj leaves extract, wild sorghum leaves extract, cumin leaves extract, castor cake extract, neem cake extract mustard cake extract and neem oil were tested under *in vitro* condition. Fresh leaves of these plants were collected, washed in tap water. For preparation of respective extracts, 100g fresh leaves of each plant were grinded in a blender separately and distilled water was added in the ratio of 1:1 (W/V). Then the extract was strained through the double layered muslin cloth and filtrate was collected as 100 per cent standard stock extract. It was further diluted in water to get 5 and 10 per cent leaves extract. The plant extracts were kept in refrigerator for further study.

Compatibility test:

Two species of *Trichoderma viz., T. harzianum* and *T. viride* were used in the present investigations. This was done on Potato-dextrose agar medium using poisoning food technique. A weighed quantity of each fungicide was amended in the PDA medium after autoclaving. For this 20 ml of PDA medium was amended with recommended doses of fungicides, pesticides, weedicides and 10 % aqueous leaf extract of botanicals in 90 mm culture plates. After solidification the agar medium in the culture plates is seeded with the *T. harzianum* and *T. viride* (5 mm culture disks of three days old culture) in the center of petriplates and five replications were maintained for each treatment. The plates without any amendment were served as control. The plates were incubated at 28ºC in BOD. After 3 days of incubation the diameter of the mycelial growth of both *T. harzianum* and *T. viride* was measured and average mycelial growth was recorded. The data from the replicated plates were averaged and the result was expressed as per cent inhibition of mycelial growth over the control.

The percentage growth inhibition of *Trichoderma* was obtained by using the following formula:

$$\text{Percentage growth inhibition} = \frac{A - B}{A} \times 100$$

where

A = Area covered by test organism in control (mm)

B= Area covered by test organism in different treatments (mm)

RESULTS AND DISCUSSION

The experimental results (Table 1) indicated that among the fungicides tested, Thiram (0.2%), Mancozeb (0.2%) and Copper oxychloride (0.2%) were found to be compatible and comparatively safer to *T. harzianum* and *T. viride* as compared to other fungicides. Orthocide exhibited intermediate effect on both species of *Trichoderma*. *Trichoderma* was most sensitive to Benomyl, Tebuconazole, Carboxin 37.5% + Thiram 37.5%, Propiconazole Chlorothanil and Hexaconazole. These seven fungicides effectively suppressed 100 % growth of both species of *Trichoderma*. But *Trichoderma* was tolerant and compatible to all the pesticides and weedicides tested. None of the pesticides and weedicides inhibited the growth of *Trichoderma* above 10 %. Among the botanicals, tested 10% fresh leaf extract of karanj leaves (*Pongamea pinnata*) inhibited 46.7 and 54.4% growth of *T. harzianum* and *T. viride,* respectively. Other all botanicals and cakes were found to be compatible with *Trichoderma.* Another interesting thing was observed that, neem oil (5%), neem leaves extract (*Azadirata indica*) (10%), wild sorghum leaves extract (10%), neem cake, castor cake and mustard

Table 1 : Effect of fungicides, pesticides, weedicides and aqueous leaf extract of botanicals on growth of *T. harzianum* and *T. viride*

Treatments		Percentage growth inhibition		Compatible/ non-compatible
Trade name	Chemical name	*T. harzianum*	*T. viride*	
Thiram	Thiram	20.2	21.3	C
Captan	Orthocide	46.1	45.5	N
Milzeb – M 45	Mancozeb	13.5	19.1	C
Cobox	Copper Oxychloride	34.8	32.6	C
Benlate	Benomyl	100.0	100.0	N
Raxil	Tebuconazole	100.0	100.0	N
Vitavax	Carboxin 37.5%+ Thiram 37.5%	100.0	100.0	N
Tide	Propiconazole	100.0	100.0	N
Foilcur	Tebuconazole	100.0	100.0	N
Kavach	Chlorothanil	100.0	100.0	N
Control total	Hexaconazole	100.0	100.0	N
Rulout	Glyphosate 41% S.L.	0.0	0.0	C
Turga super	Quizalofop-ethyl 5% EC	16.3	26.3	C
Basalin	Fluchloralin 45% EC	1.1	2.6	C
Amida	Imadachloroprid 17.8 S L	6.30	0.74	C
Monocrotophos	Monocrotophos 36% S L	1.11	4.44	C
Ankurban	Chloropyriphos 20% EC	0.37	0.74	C
Carina	Profenofos 50% EC	0.00	9.63	C
Aayudh	Carbosulfan 25% EC	0.00	1.48	C
Neem oil	-	0.0	0.0	C
Neem leaves extracts	-	2.6	5.2	C
Neem cake	-	0.0	0.0	C
Karanj leaves	-	46.7	54.4	N
Castor cake	-	0.0	0.0	C
Mustard cake	-	0.0	0.0	C
Wild sorghum	-	0.0	0.0	C
Cumin leaf exttract	-	25.2	34.1	C
Control		-	-	
SEM ±		0.09	0.09	
C.D. (P=0.05)		0.25	0.25	
CV		2.24	2.26	

C: Compatible,
N: Non-compatible

cake extract (10%) enhanced the growth of *Trichoderma*.

Similar work has been carried out by Scot *et al.* (1979), Kamerwar Row, (1976), Bashir *et al*. (1985). El-Tobshy *et al*. (1981) found that *Fusarium oxysporum* was very sensitive to fungicides during *in vitro* studies in which this fungus was equally inhibited by Benomyl, Thiabendazole and Thiophenate methyl.

Karthikeyan (1996) reported that neem cake and farmyard manure gave good control of collar rot. Soil application of castor cake at the rate of 500 kg/ha in furrow reduced the incidence of collar rot by 51% and stem rot by 57% (Ghewande *et al*., 2001). Muthamilan and Jeyarajan (1996) reported that *T.harizanum, Rhizobium* and carbendazim reduced the groundnut root rot caused by *S.rolfsii.* Soil application of fresh leaves of *Parthenium hystarophorus, Azadirachta indica, Pongamia pinnatta* and wild sorghum *(S. helpense)* @ 500kg/ha in furrow at the time of sowing reduced the incidence of stem rot considerably and gave higher pod yield as compared to control under field conditions during rainy seasons of 2001-2002 (Ghewande *et al*., 2003). Brown *et al*. (1992) reported that plots treated with combination of Chloropyrifos insecticide and Quintozene, fungicide produced the highest yields and had lowest disease incidence of stem rot than control plots. Application of *T. harzianum* and soil drenching with 0.2% Carbendazim reduced stem rot (Asghari and Mayee, 1991). Gangawane and Patil (1998) reported that leaf extracts of neem (*Azadirata indica*) Datura, tobacco, *Araucaria* gave 100% PCE when used along with Tridemorph. Ghewande and Savaliya (1998) reported seed treatment with carbendazim 2 g/kg seed, *Trichoderma viride* @ 4 g/kg seed gave maximum control (48%) of stem rot. Soil application of castor cake gave 19 % control of stem rot (Ghewande and Savaliya, 1998).

This research indicates that in furrow applications of *Trichoderma* would be compatible with Thiram, Copper oxychloride, Mancozeb, pesticides, weedicides, neem oil, neem leaves extract, cumin leaf extract, wild sorghum leaves extract, neem cake, castor cake and mustard cake extracts and could be integrated with *Trichoderma* for the integrated management of soil borne diseases of soybean. The use of botanicals and organic cakes is eco-friendly without any toxicity to the crop and environment. Above mentioned botanicals and organic cakes are easily available abundantly at low cost and could be used to decrease the production cost. However, further research is needed to work out mode of action and characterization of these botanicals and organic cakes.

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