Effect of different treatments of fungicides and bioagents on collar rot disease of soybean and its grain yield

Konde S.A., R.B. Kothikar* and Mina Koche

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.), India. *Corresponding author's E-mail: rajkumarkothikar@gmail.com
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ABSTRACT

Soybean is the important source of vegetable oil and proteins and cultivated on a large scale in all over the world. Several yield losses were reported which reduces quality and quantity of seed yield in soybean. Collar rot caused by *Sclerotium rolfsii* is one of the most important disease of soybean and as the pathogen is soil-borne, it is difficult to control with fungicidal and bioagents application. Therefore, the present study was undertaken with 14 treatments of fungicides, bioagents, alone and in combination as seed treatment and soil application in randomized block design replicated thrice to know the effect of these treatments on germination, mortality and grain yield of soybean. The present studies revealed that, seed treatment with carbendazim + *Trichoderma viride* recorded significantly maximum seed germination (94.44%). Seed treatment with carbendazim + thiram reported minimum per cent mortality (3.33%) with highest per cent disease control (72.43%) while highest grain yield (1808 kg ha^{-1}) was observed with the soil application of *Trichoderma viride* + *Trichoderma harzianum*.

Key words: Fungicides, bioagents, collar rot, *Sclerotium rolfsii*, soybean, yield.

Soybean (*Glycine max* L.) the 'golden bean' is cultivated in most of the parts of the world and is a primary source of vegetable oil and rich in proteins. It is consumed as prominent source of edible oil and 40 per cent of the world supply of edible oil comes from soybean. Soybean meal or soybean cake resulting from the oil extraction processes is used in feeding livestock, poultry and household pets. Soybean contains about 20 per cent oil and 40 per cent proteins. This important crop suffers from various fungal, bacterial and viral diseases which reduces the quality and quantity of seed yield. Fourteen to 74 per cent yield losses due to collar rot caused by *Sclerotium rolfsii* (Cooper, 1961) was reported in soybean. It is difficult to control the pathogen, as pathogen is soil borne in nature. Biological control is becoming an important component of integrated disease management and there are several examples of fungi that are able to manage the plant pathogens. Of these, *Trichoderma* spp. has provided one of the first antagonistic control, have been studied to the greater extent (Papavizas, 1985). The inhibitory effects of bioagents against pathogen may probably due to competition, antibiosis and mycoparastism. Therefore, the present study was conducted for eco-friendly and economical management of soybean collar rot disease by using fungicides and bio-agents and its effect on grain yield of soybean.

MATERIALS AND METHODS

The experiment was conducted at the field of Plant Pathology Department, Dr. PDKV, Akola in RBD with 14 treatments replicated thrice with plot size 2.25 m x 2.15 m, spacing of 45 cm x 15 cm and cultivars TAMS-38. Sorghum sand medium was used for developing inoculum. It was prepared by mixing 500 g sorghum and 200 g dry sand with 500 ml distilled water in 2000 ml capacity conical flask and autoclaved at 1.05 kg sq.cm-^{1} for 30 min. for two consecutive days. Autoclaved grains were then inoculated with pure culture of *Sclerotium rolfsii* separately in isolation chamber.

The inoculated flasks were incubated at room temperature for two weeks. This mass inoculum was used for experiment. This prepared inoculum was mixed in the field soil to test the efficacy of fungicides and bioagents against *S. rolfsii*. For mass inoculum of *Trichoderma viride* and *T. harzianum*, potato dextrose broth was prepared and 100 ml broth was poured in each flask of 500 ml capacity and autoclaved at 1.05 kg sq.cm^{-1} for 20 min. Autoclaved broth was inoculated with *T. viride* and *T. harzianum*

in separate flasks containing 100 ml broth in each. The inoculated flasks were incubated for 10 days at room temperature. Then, fungal mat of bioagents were separated from the broth and homogenized with the help of stirrer. These homogenized cultures were mixed with the sterilized talc powder at the ratio 1:3. The colony counts of both bioagents were taken by standard plate count method up to 6.0 x 10^7 colonies g^{-1} product. These prepared products were used for seed treatments in the experimental studies.

Table 1. details of the treatments

Seed treatment with		**Dose @**
T_1	Carbendazim	1 g kg^{-1}
T_2	Thiram	3 g kg^{-1}
T_3	*Trichoderma viride*	4 g kg^{-1}
T_4	*Trichoderma harzianum*	4 g kg^{-1}
T_5	*T. viride* + *T. harzianum*	2+2 g kg^{-1}
T_6	Carbendazim + *T. viride*	1+4 g kg^{-1}
T_7	Carbendazim + *T. harzianum*	1+4 g kg^{-1}
T_8	Thiram + *T. viride*	1.5+4 g kg^{-1}
T_9	Thiram + *T. harzianum*	1.5+4 g kg^{-1}
T_{10}	Carbendazim + Thiram	1+2 g kg^{-1}
Soil application with		**Dose @**
T_{11}	*T. viride*	2 kg ha^{-1}
T_{12}	*T. harzianum*	2 kg ha^{-1}
T_{13}	*T. viride* + *T. harzianum*	2 kg ha^{-1}
T_{14}	Control	-

RESULTS AND DISCUSSION

Significantly differences among the various treatments were observed (Table 2). Maximum per cent seed germination was recorded significantly with the seed treatment of carbendazim + T. viride (94.44%) followed by seed treatment with carbendazim + thiram (91.75%), seed treatment with carbendazim (91.25%), seed treatment with thiram (90.25%), seed treatment with carbendazim + T. harzianum (89.75%) but they were at par with each other. Minimum germination (69.50%) was recorded in control. Seed treatment with carbendazim + thiram (1+2 g kg^{-1}) recorded minimum (3.33%) per cent mortality and was found at par with the treatments of seed treatment with thiram (3.54%), seed treatment with *T. harzianum* (3.74%), seed treatment with *T. viride* (3.75%), soil application with *T. viride* + *T. harzianum* (3.82%), seed treatment with carbendazim (3.96%), seed treatment with carbendazim + *T. harzianum* (4.16%). Soil application with *Trichoderma viride* (4.17%) was effective in reducing the collar rot incidence under sick soil conditions. Maximum per cent mortality was recorded in control (12.08%). Highest per cent disease control was observed in seed treatment of carbendazim + thiram (72.43%) followed by seed treatment of thiram, seed treatment with *T. harzianum*, seed treatment with *T. viride*, soil application with *T. viride* + *T. harzianum* and seed treatment of carbendazim showing 70.69, 69.04, 68.96, 68.38 and 67.22 per cent disease control respectively.

The present results agreed with the findings of Singh and Agrawal and Kotasthane (1991), Saxena and Moly Saxena (1993), Shrivastava and Tripathi (1998), Prajapati *et. al.* (2003), Patil *et al.* (2003). Soil application of *Trichoderma harzianum* reduces rotting incidence due to *S. rolfsii* (Upadhyay and Mukhopadhyay, 1986). Antagonistic potential of *Trichoderma* spp. in reducing the mortality supports the findings of Elad*et.al.* (1980), Papavizas (1985), Theradimani and Hepziba (2003). Efficacy of fungicides in the management of collar rot disease as observed in the present study, supports the results published by El-Deeb *et. al.* (2003) who found the fungicides are more effective than formulation of bioagents. Madhuri and Amrutha Gayatri (2014) soil drenching was done with nine fungicides and found that tebuconazole and combination of carbendazim + mancozeb proved effective in controlling the pathogen while, *T. viride*, *T. harzianum* and *Penicillium* sp. was found to be antagonistic. Zape*et.al.* (2014) tested ten antagonistic and maximum inhibition in radial growth of *Sclerotium rolfsii* was observed with *P. flueorescens* followed by *T. harzianum*, *T. viride* (A) and *Gliocladium virens* (A) and it was minimum with *G. virens* followed by *T. koningii*, *T. viride* and *T. lingorum*. Dwivedi and Prasad (2016) controlled the pathogen through bioagents*T. harzianum*, *T. viride*, *T. asperellum*, *Penicillium* sp., *Bacillus subtilis*, *P. fluoerescens* significantly. Among all the control measures biological, soil solarization and medicinal plant extract were the more significant than chemical control.

Table 2. Effect of different treatments of fungicides and bioagents on % mortality of collar rot and grain yield of soybean

Tt. No.	Treatments	Dose @	Germination percentage	Collar rot (*Sclerotium rolfsii*)		Yield (kg ha^{-1})
				% Mortality	% Disease control	
T_1	Carbendazim	1 g kg^{-1}	91.25 (72.81)	3.96 (2.11)	67.22	1511
T_2	Thiram	3 g kg^{-1}	90.25 (71.82)	3.54 (1.98)	70.69	1402
T_3	*Trichoderma viride*	4 g kg^{-1}	82.85 (65.47)	3.75 (2.06)	68.96	1522
T_4	*Trichoderma harzianum*	4 g kg^{-1}	34.75 (67.03)	3.74 (1.99)	69.04	1763
T_5	*T. viride* + *T. harzianum*	2+2 g kg^{-1}	85.25 (67.42)	4.99 (2.33)	58.69	1780
T_6	Carbendazim + *T. viride*	1+4 g kg^{-1}	94.44 (75.84)	5.63 (2.38)	53.39	1650
T_7	Carbendazim + *T. harzianum*	1+4 g kg^{-1}	89.75 (71.35)	4.16 (2.10)	65.56	1529
T_8	Thiram + *T. viride*	1.5+4 g kg^{-1}	87.25 (69.11)	5.21 (2.37)	56.87	1470
T_9	Thiram + *T. harzianum*	1.5+4 g kg^{-1}	88.75 (68.86)	4.38 (2.18)	63.74	1619
T_{10}	Carbendazim + Thiram	1+2 g kg^{-1}	91.75 (73.34)	3.33 (1.95)	72.43	1532
T_{11}	Soil application of *T. viride*	2 kg ha^{-1}	76.50 (61.04)	4.17 (2.13)	65.48	1636
T_{12}	Soil application of *T. harzianum*	2 kg ha^{-1}	78.50 (62.38)	6.04 (2.56)	50.00	1753
T_{13}	Soil application of *T. viride* + *T. harzianum*	2 kg ha^{-1}	78.75 (62.55)	3.82 (2.04)	68.38	1808
T_{14}	Control	-	69.50 (56.48)	12.08 (3.53)	-	1298
	'F' Test		**Sig.**	**Sig.**		**Sig.**
	SE (M)±		**0.69**	**0.27**		**68.59**
	CD (P=0.05)		**2.06**	**0.78**		**199.40**

Figures in parenthesis are square root transformed values

CONCLUSION

Collar rot caused by *Sclerotium rolfsii* is one of the most important disease of soybean. **S**eed treatment with carbendazim + *Trichoderma viride* showed maximum seed germination. Seed treatment with carbendazim + thiram reported minimum per cent mortality and highest per cent disease control while highest grain yield was noticed with the soil application of *Trichoderma viride* + *Trichoderma harzianum.* Combination of fungicides and bio-agents treatments showed the future basis of research in the management of plant pathogens.

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