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To evaluate *in-vivo* efficacy of fungicides, bio-agents and phyto-extracts against sudden death syndrome (wilt) of soybean caused by *Fusarium oxysporum* f. sp. *virguliforme*

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Abstract

Sudden death syndrome (wilt) of soybean caused by *Fusarium oxysporum* f. sp. *virguliforme*. *In-vivo* evaluation of effective fungicides, bioagents and phyto-extracts (in field condition), per cent seed germination with effective treatments was ranged from 95.72 to 100 per cent. The effective treatment with Azoxystrobin and Propiconazole shown 100 per cent seed germination and Garlic clove extract was found less effective which shown comparatively less germination *i.e.* 95.72 per cent, where as in case of control it was least *i.e.* 93.76 per cent. The wilt disease incidence in field condition was ranged from 8.60 to 43.30 per cent. The least wilt disease incidence was recorded with Azoxystrobin *i.e.* 8.60 per cent and Garlic clove extract was found highest percentage of wilt disease incidence *i.e.* 43.30 per cent.

Keywords: Soybean, *in-vivo*, *Fusarium oxysporum*, fungicides, bioagents and phyto-extracts

Introduction

Soybean [*Glycine max* (L.) Merrill] is a native of northern China and is the most important legume crop in the world. Soybean is called 'Golden bean,' 'Miracle bean' and 'Crop of planet.' The crop thus, improves soil fertility and economizes crop production not only for themselves but also for the next crop grown in rotation especially, cereal crops (Nassiuma and Wasike, 2002) [6]. Soybean is nutritious, easily digestible and is considered as one of the richest and cheapest source of proteins, hence called as 'Poor man's meat' and also substitute for milk. India, it is grown on an area of 11.25 million hectare with a production of 14.22 million metric tonnes and productivity of 1263 kg/ha in the year 2017 (Anonymous, 2017) [1]. Amongst the soybean producing nation India occupies dismal fifth position in production though we are third after USA and China in area. Among the different states in India, Madhya Pradesh ranks both in area and production. Soybean crop can be attacked by more than 100 pathogens (Sinclair and Schurtleff, 1975) [13]. About 35 pathogens were reported to infect soybean in India (Gupta *et al.*, 2001) [5]. Fungi, nematodes, viruses, bacteria, and phytoplasmas are known to cause diseases of soybean. The soybean crop is presently suffered due to one of the important disease known as sudden death syndrome. The sudden death syndrome disease is called as wilt of soybean. The soybean wilt is caused by *Fusarium oxysporum* f. sp. *virguliforme* (Aoki 2003) [2]. *Fusarium* genus is a soil borne fungus that causes wilt of many crops. In many cases the fungus causing wilt in a particular crop is specific to that crop. In case of soybean, sudden death syndrome caused by the soil borne pathogen *F. solani* f. sp. *glycines* formerly called *Fusarium virguliforme* sp. in recent days which was first observed in Arkansas during 1971 (Roy *et al.* 1997) [11]. It can cause great damage, as it may reduce the average yield of soybean by up to 59 per cent (Sinclair and Backman 1989) [12].

Material and Methods

With an object to develop an economical and holistic disease management practice present field experiment was planned and undertaken. In the present studies, those fungicides (systemic and combined), bio-control agents (fungal and bacterial) and phyto-extracts which were found effective against *Fusarium oxysporum* f. sp. *virguliforme* during *in vivo* evaluation for the management of wilt of soybean in field conductions.

The field experiment was conducted at Plant Pathology section of Agricultural Research Station, Badnapur during *Kharif* 2018-19 by using susceptible soybean variety JS 20-34 with RBD design. Sowing was done in such manner that each plot has six lines and each line had forty seeds with proper spacing and experiment was conducted under natural field condition where solution of 106 CFU of *Fusarium oxysporum* f. sp. *virguliforme* poured into each rhizosphere of plant once at vegetative stage of soybean

Result and Discussion

The field experiment was conducted at field section of Plant Pathology, Agricultural Research Station, Badnapur during *Kharif* 2018-19 by using susceptible variety viz., JS 20-34.

Five fungicides, two bioagents and two plant extracts which were resulted most effective against *Fusarium oxysporum* f. sp. *virguliforme* *in vivo* were used for disease management to control the disease as applied through seed treatment under natural field conditions. The results were recorded in Table 1 and depicted in the (PLATE XII, Fig. 1)

Per cent seed germination: All the treatments improved per cent germination as compared to control and it was ranged from 95.72 per cent to 100 per cent. Among all treatments, seed treated with fungicides Azoxystrobin and Propiconazole shown 100 per cent seed germination. These were followed by Thiophanate methyl (99.50%), Carbendazim (98.23%), Carbendazim 12% WP + Mancozeb 63% WP (97.90%), *Trichoderma viride* (97.53%), *Trichoderma harzianum* (96.86%) and Neem (96.55%) The seed treated with clove extract of garlic found least effective for seed germination 95.72 per cent and still significantly superior over the control.

Per cent wilt / SDS disease incidence

All the treatments were found effective against disease and significantly reduced the disease incidence over the control and it was ranged from 8.60 per cent by the seed treatment with (Azoxystrobin) to 43.30 per cent (Garlic).

Amongst of all treatments, seed treatment with Azoxystrobin was found most effective with least mean disease incidence (8.60%) followed by seed treatment with Propiconazole (9.46%), Thiophanate methyl (11.43%), Carbendazim (21.40%), Carbendazim 12% WP+ Mancozeb 63% WP (26%), *Trichoderma viride* (32.10%), *Trichoderma harzianum* (31.50%), Garlic (43.30 %) and Neem (38.76%).

The treatment Garlic were found least effective with highest percentage of disease incidence 43.30 per cent and untreated control was shown the highest wilt incidence i.e. 52.43 per cent.

The application of fungicides, bioagents and phyto-extracts found most effective against *Fusarium oxysporum* f. sp. *virguliforme*. It minimized the per cent disease incidence and increased seed germination too.

Present investigations are in agreement with those earlier studied by Poddar *et al.* (2004) [9] reported that seed treatment with *Trichoderma harzianum* mutant UM2R + carbendazim (1.25g kg⁻¹) resulted in the maximum seed yield (4.6 g plant⁻¹) and lowest disease incidence (2.5 %) of wilt of chickpea. Nikam *et al.* (2007) [7] reported that combined soil application of *T. viride* and ground nut cake followed by Neem cake had given good control against chickpea wilt caused by *Fusarium oxysporum* f. sp. *ciceri*. Other scientist like Prasad *et al.* (2002) [10], Patil *et al.* (2015) [8], Bana *et al.* (2017) [3] and Ghante *et al.* (2018) [4] also observed the same results.

Table 1: Effect of seed treatment of fungicides, bioagents and phyto-extracts against per cent wilt disease incidence

Tr. No.	Treatment	Per cent Germination*	Per cent Wilt incidence
T1	Azoxystrobin	100 (90)	8.60 (17.05)
T2	Propiconazole	100 (90)	9.46 (17.91)
T3	Thiophanate methyl	99.50 (85.94)	11.43 (19.76)
T4	Carbendazim	98.23 (82.35)	21.40 (27.55)
T5	Carbendazim 12 % WP+ Mancozeb 63 % WP	97.90 (81.66)	26.00 (30.65)
T6	<i>Trichoderma viride</i>	97.53 (80.55)	32.10 (34.51)
T7	<i>Trichoderma harzianum</i>	96.86 (79.79)	31.50 (34.14)
T8	Garlic	95.72 (78.06)	43.30 (41.14)
T9	Neem	96.55 (79.29)	38.76 (38.50)
T10	Control (Untreated)	93.76 (75.53)	52.43 (46.39)
	SE±	0.86	2.47
	CD at 5%	2.59	7.38

*Mean of three replications

Figures in parenthesis are arcsine transformed values



Plate 1: Soybean sudden death syndrome wilt disease management trial during

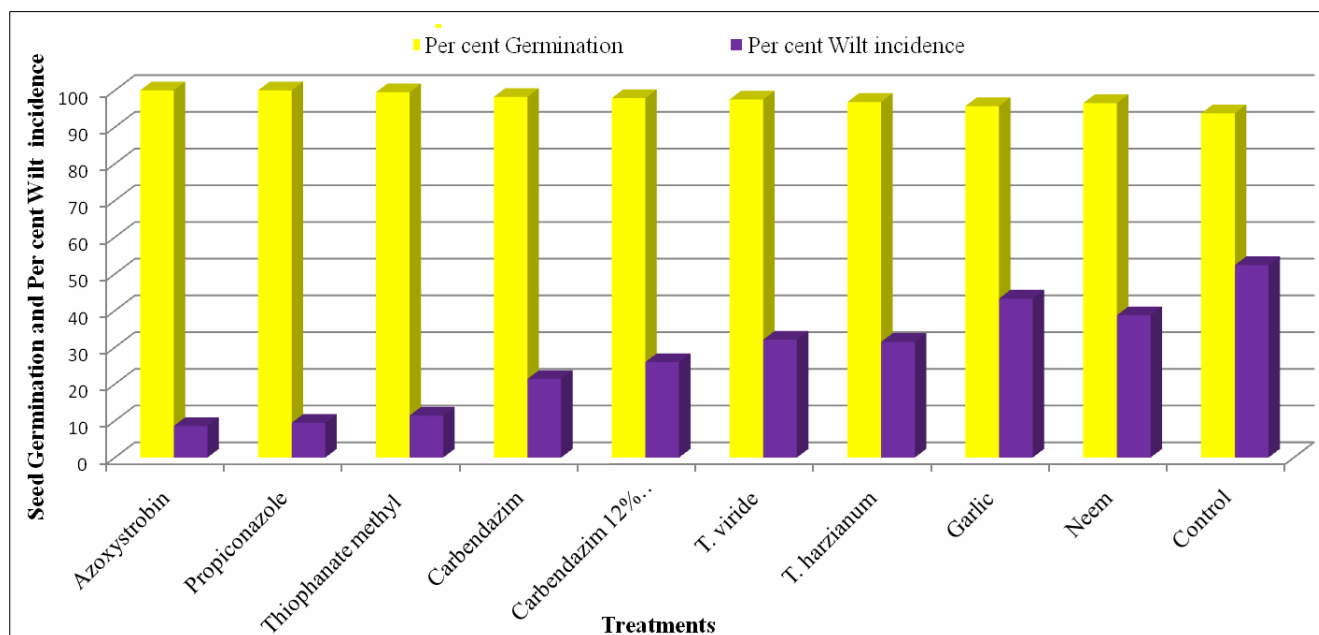


Fig 1: Effect of seed treatments of fungicides, bioagents and phyto-extracts on per cent seed germination and SDS (wilt) incidence in soybean field condition

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