The Pharma Innovation Journal 2023; 12(9): 1711-1713

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 1711-1713

www.thepharmajournal.com
Received: 01-06-2023
Accepted: 05-07-2023

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Management of sesame diseases: An organic approach

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Abstract
Field trial were conducted to manage a variety of sesame diseases, especially the *Macrophomina* stem and root rot (MSR) by few bio-control agents like *Trichoderma virid*e and *Pseudomonas fluoroscens vis-a-vis* two chemical checks. Among the organics, seed treatment with *T. virid*e @ 10 g/kg + Furrow application (FA) of enriched *T. viride* (2.5 kg of *T. viride* + 100 kg vermicompost) @ 250 kg/ha followed by rhizosphere inoculation of *T. viride* at thinning and spray at flowering and capsule stage @ 5 g/l (T_3) was found most effective in inducing lowest incidence of MSR (12.85%), *Cercospora* leaf spot(14.38 PDI), *Phytophthora* blight (12.20 PDI) as well as sustaining highest seed yield (460.65 kg/ha) and maximum BC ratio (2.01). It was further recorded that the organics could reduce 25.45 to 51.12% MSR infection with a corresponding 15.53 to 27.53% increase in yield over control. However, both the chemical checks were superior in minimizing disease incidence resulting in higher grain yield *vis-à-vis* the organic treatments. Among all the treatments, ST with carbendazim @ 3 g/kg + spray of tebuconazole 50% + trifloxystrobin 25% @ 0.5 g/l at flowering initiation stage (45 DAS) followed by a spray at capsule formation stage (60 DAS) recorded minimum incidence (10.29%) of stem and root rot as well as maximum yield (492.6 kg/ha).

Keywords: Sesame, stem and root rot, *Trichoderma viride,* organic management

Introduction
Sesame (*Sesamum indicum* L.) is one of the oldest oilseed crops (Bedigian, 2010) [4]. It is considered largely as an under exploited oilseed crop unlike groundnut, mustard, linseed and sunflower. Hitherto cultivated as a much neglected crop, it has now received significant attention from all the stake holders of the oilseed industry due to consumer awareness about its nutritional and pharmacological properties. The sesame seed, rich in protein (20%) and edible oil (50%), also contains natural antioxidants and phytochemicals. It is also loaded with many health promoting attributes. In India, sesame area and production are 17.73 lakh hectares and 8 lakh tones, respectively. However, the production and productivity has declined in traditional oilseed growing tracts owing to a number of diseases (Gupta *et al*., 2018) [7]. The crop suffers heavily due to a number of diseases such as *Macrophomina* stem and root rot (MSR)/ Charcoal rot (*Macrophomina phaseolina*), *Alternaria* leaf spot (*Alternaria sesami*), phyllody (*Mycoplasma*), powdery mildew (*Erysiphe cichoracearum*) and *Cercospora* leaf spot (*Cercospora sesame*). The reason of low production level of sesame crop has also been attributed to many factors including plant diseases (Ashri, 1998) [2]. In Odisha and elsewhere in India, MSR is reported to be the most destructive disease affecting the crop in almost all stages of the growth severely reducing the yield. Yield loses ranging from 5 to 100% have been reported (Vyas, 1981; Maiti, 1988) [13]. The infection increases many fold in high temperature and water stress conditions. Many fungicides are found effective in managing sesame diseases. As the modern day agriculture dissuades the use of chemical fungicides ostensibly due to their hazardous effects on environment and human health, the focus has shifted to safer alternatives such as organic/biological fungicides to combat crop diseases. This has special relevance in sesame considering the fact that sesame seed and oil are of great export potential and the sesame products need to be free from residual toxicity. The objective of the current study was to determine the effect of few bio-agents *vis-a-vis* the standard chemical checks in managing major diseases of sesame.

Material and Methods
The trial was conducted to determine the management of *Macrophomina* stem and root rot (MSR), phyllody, *Cercospora* leaf spot and *Phytophthora* blight diseases of sesame through an organic approach as well as seed yield *vis-à-vis* the chemical checks comprising of carbendazim, tebuconazole 50% + triloxystrobin 25% and carbendazim 12% + mancozeb 63

%). Seed treatment with bioagents and chemicals were done 24 h before sowing. The trials were laid down at RRTTS, Mahisapat, Dhenkanal during *Kharif* 2020 and *Kharif* 2022.The experiment included eight treatments (Table 1) and three replications in a randomized block design using local variety Smarak. Prior to 24h of sowing in the field, seeds were treated with chemicals and bio-agents separately. Standard agronomic practices for growing sesame crop were followed. Disease incidence (%) for MSR, phyllody, and diseases intensity (PDI) for leaf spots was recorded at the physiological maturity of the crop. The grain yield (kg/ha) was also recorded. All the data were subjected to standard statistical interpretation.

Results and Discussion

The bioagents and chemicals were effective in significantly suppressing the incidence of MSR and increasing seed yield over untreated control (Table 2). Among the organics, seed treatment T_3 induced lowest incidence of stem and root rot (12.85%), *Cercospora* leaf spot (14.38 PDI), *Phytophthora* blight (12.20 PDI), highest seed yield (460.65 kg/ha) and maximum BC ratio (2.01). This treatment resulted in 51.12% reduction in *Macrophomina* infection and enhancement of 27.53% in productivity over control. The organics could reduce 25.45 to 51.12% MSR infection with corresponding 15.53 to 27.53% increase in yield compared to control. *Trichoderma* species have also been effective in reducing many soil borne diseases (Balode, 2010; Elewa *et al*., 2011; Ali *et al*., 2012) [3, 5, 1]. They have been gaining momentum as an important biocontrol agent for management of plant diseases in present day green agriculture due to their eco-friendly nature, minimizing the use of chemicals and giving a cheaper and more efficient alternative to the chemical pesticides. The principles guiding the effectiveness of *Trichoderma* against plant pathogens are competition, mycoparasitism, as well as the induction of host resistance (Xin Yao *et al*., 2023) [15]. It was further revealed from the study that both the chemical checks were superior in minimizing disease incidence resulting in higher grain yield *vis-à-vis* the organic treatments. Among all the treatments, T_6 recorded minimum incidence (10.29%) of MSR as well as maximum yield (492.6 kg/ha). Ostensibly, maximum disease (22.2% MSR) and minimum yield (361.20 kg/ha) were reported in the treatment where neither any bio-control agent nor any chemical was used. In fact, Goswami *et al*., 2018) [9] suggested the use of fungicides along with biocontrol agents for minimizing soil borne pathogens. There was no incidence of phyllody across the treatments.

With emphasis on organic farming and clean environment, the farmers should be sensitized about the use of safe, effective and environment friendly plant protection measures. In this context, the use of bio control agents are being encouraged as a safe alternative to the chemical pesticides to combats the harmful effects of disease causing microorganisms. *Trichoderma*, as an effective bio-control agent for a variety of crop diseases has been reported (Zheng *et al*., 2021) [14]. Gupta and Ranganath (2014) [8] also found that Trichoderma provides an effective and economical management option against the stem rot disease of sesame. The bio-agent is mainly used to control soil-borne diseases in various plants and some leaf and spike diseases (Vicente *et al*., 2020) [12]. *Trichoderma* can combat many plant diseases, promote plant growth, improve nutrient utilization efficiency, enhance plant resistance, and repair agrochemical pollution (Fontana *et al.*, 2021) [6]. It is known that *Trichoderma* can be utilized as an effective weapon against many soil borne pathogens including *Macrophomina*.

Table 1: Details of treatments included in the experiment

T_1	ST with *Trichoderma viride* @ 10 g/kg + FA of enriched *T. viride* (2.5 kg of *T. viride* + 100 kg vermicompost) @ 250 kg/ha followed by spray of *T. viride* at thinning, flowering and capsule initiation @ 5 g/l
T_2	ST with *Pseudomonas fluorescens* @ 10 g/Kg + FA of enriched *P. fluorescens* (2.5 kg of *P. fluorescens* + 100 kg vermicompost) @ 250 kg/ha followed by spray of *T. viride* at thinning, flowering and capsule initiation @ 5 g/l
T_3	ST with *Trichoderma viride* @ 10 g/kg + FA of enriched *T. viride* (2.5 kg of *T. viride* + 100 kg vermicompost) @ 250 kg/ha followed by Rhizosphere inoculation of *T. viride* at thinning and spray at flowering and capsule stage @ 5 g/l
T_4	ST with *Pseudomonas fluorescens* @ 10 g/kg + FA of enriched *P. fluorescens* (2.5 kg of *P. fluorescens* + 100 kg vermicompost) @ 250 kg/ha followed Rhizosphere inoculation of *P. fluorescens* at thinning and spray at flowering and capsule stage @ 5 g/l
T_5	ST with *Trichoderma* viride @ 10 g/kg + FA of enriched *T. viride* (2.5 kg of *T. viride* + 100 kg vermicompost) @ 250 kg/ha followed by spray of Nimbicidin @ 4 ml/l at thinning, flowering and spray of sulphur at capsule stage @ 2 g/l
T_6	ST with Carbendazim @ 3 g/kg + spray of (Tebuconazole 50% + Trifloxystrobin 25%) at 0.5 g/l at 45 & 60 DAS (Treated check)
T_7	ST with Carbendazim @ 3 g/kg + spray of (Carbendazim 12% + Mancozeb 63% 75WP%) at 2 g/l at 45 and 60 days after sowing(Treated check)
T_8	Untreated check(Water spray)

Table 2: Effect of organics and chemicals on disease incidence and seed yield of sesame

Treatments	MSR (%)	Phyllody	*Cercospora* leaf spot (PDI)	*Phtophthora* blight (PDI)	Yield (Kg/ha)	BC Ratio
T_1	13.40 (21.46)* 39.63**	0.0	14.69	12.50	458.12 (26.83)***	1.98
T_2	15.32 (23.04) 30.99	0.0	17.53	14.20	440.90 (22.06)	1.59
T_3	12.85 (21.01) 51.12	0.0	14.38	12.20	460.65 (27.53)	2.01
T_4	16.55 (24.00)	0.0	19.40	15.36	417.30 (15.53)	1.42

	25.45					
T_5	14.36 (22.25) 35.31	0.0	16.74	13.72	446.80 (23.69)	1.60
T_6	10.29 (18.70) 53.64	0.0	14.30	11.06	492.60 36.37	2.32
T_7	11.19 (19.52) 49.59	0.0	15.73	12.40	484.85 (34.23)	2.29
T_8	22.20 (28.10)	0.0	21.86	18.36	361.20	-
S.Em +-	0.817		-	-	7.548	-
CD(0.05)	2.477		-	-	22.894	-

*Angular transformed value), **Percent reduction in infection over control, ***Percent increase in yield over control, CLS- *Cercospora* leaf spot, ST-Seed treatment, FA-Furrow application

Conclusion

The results of this present investigation can prove to be an effective control measure to combat *Macrophomina* stem and root rot and other diseases. Though the yield obtained with *Trichoderma* application (27.53% increase over control) in comparison to the chemical check (36.37% increase over control) is lower, the long term benefits in terms of soil, plant and human health can be enormous. Different formulations of *Trichoderma* are now globally used for plant disease control.

Acknowledgement

The experiment was conducted under AICRP on Sesame and Niger, Indira Gandhi Krishi Vishwavidyalaya and all authors sincerely acknowledge the financial assistance and other support from the Project Coordinator, IGKVV, Jabalpur for conducting the trial.

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