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Efficacy of *Trichoderma* spp. and garlic extract against Alternarial leaf blight of mustard (*Brassica juncea* L.)

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Abstract

Field experiment was conducted at the research plot of the Department of Plant Pathology, SHIATS, Allahabad, U. P. during the Rabi season of 2014-15 to test, by seed treatment and foliar spray of certain fungicides, plant extract and bioagents. Per cent disease intensity on leaves at 45, 60 and 75 DAS were recorded. Results showed that the foliar spray of SAAF (Mancozeb 63%+carbendazim 12%) (fs) significantly reduced Alternaria blight, increased yield and cost/benefit ratio and was most effective treatment, followed by seed treatment with SAAF (Mancozeb63%+carbendazim12%) 3g/kg, foliar sprays of *Trichoderma viride* (fs) 2%, *Trichoderma harzianum* (fs) 2%, seed treatment *Trichoderma harzianum* @ 2%. foliar spray of *Allium sativum* 10%. However seed treatment and foliar spray of SAAF (Mancozeb 63%+carbendazim12%) most effective treatment have shown results at par with the foliar spray of SAAF (Mancozeb 63%+carbendazim12%) in increasing the yield. The maximum plant height (cm) was recorded at *Trichoderma viride* (foliar spray) @ 2%.

Keywords: Alternaria blight, *Trichoderma* spp., fungicides, SAAF (Mancozeb + carbendazim) *Allium sativum*

Introduction

Indian mustard (*Brassica juncea* L.) is important oilseed crop which occupies almost 80 per cent of the million hectares cropped under oilseed Brassica crops in India. The estimated area, production and productivity during 2013-14 of rapeseed- mustard in the world were 34.19 m ha, 63.09 million tones and 1850 kg/ha, respectively (Anonymous, 2014) [2]. Globally, Indian accounts for 19.29 percent and 11.18 percent of the total acreage and production (USDA, 2012) [26]. Rapeseed- mustard contributed around 24.20 percent of total oilseed area and production in Indian (Anonymous, 2014) [2]. The average yield of rapeseed-mustard 2013-14 was 1176 kg/ha as compared to 969 kg/ha of total oilseed (Anonymous, 2014) [2]. Alternarial blight of mustard is one of the most important and widespread disease of all mustard growing areas of the Uttar Pradesh. It appears in the epiphytotic form causing rapid blighting and death of leaves under high humidity and moderate temperature. Two species of *Alternaria* viz. *brassicae* and *brassicicola* have been reported involved in causing alternarial blight of mustard. The taxonomy and nomenclature of *Alternaria* have been further revised and published time to time by different authors. Genus *Alternaria* first proposed by Nees (1817) [13] with *Alternaria tenuis* as the type species. Berkley (1836) [3] firstly reported *Alternaria brassica* on cruciferous plant as *Macrosporium brassica*. In 1924, Bolle made detailed study of the fungus and named it as *Alternaria brassicae* (Berk.) Bolle.

There were only two species of *Alternaria* pathogenic to brassica. The first was *Alternaria brassica* (Berk.) Saac. earlier designated as *Microsporium brassica* by Berkley (1836) [3] and the second were commonly known as *Alternaria circinus* (Berk. And Curt.) Bolle. Or *Alternaria oleraceae* (Milbarth) which he finally named *Alternaria brassicicola* (Schw.). *Alternaria brassicicola* has been reported from India (Vishwanath and Kolte, 1997) [24].

Materials and Methods

The present investigation on *Alternaria brassicicola* causing Alternaria blight of mustard was carried out in the central farm of the Department of Plant Pathology, Sam Higginbottom Institute of Agriculture, Technology & Sciences (Deemed to be University) Allahabad. The mustard (*Brassica juncea* L.) variety Laxmi susceptible to Alternaria blight was used for investigation.

Spraying

The required dose of fungicides, bio agents and botanicals are collect and weight.

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Fungicides, bio agents and botanicals are separately dissolved in a small amount of water and then the quantity of spray solution for different treatments are maintain in calculated amount of water. The prepared solution spray by using nape sack sprayer of 10 lit capacities. Spraying was done when the wind was calm to avoid drift from spray plot to neighbor plot. The spraying was done thrice. The first spray was given as soon as symptoms of disease appeared. Second and third spray was given at 10 and 20 days after first spray.

Methods of observations

Five plants per plot were randomly selected and tagged for observation. The observations were recorded on tagged plants after appearance of disease till harvesting of the crop at weekly interval by visual counting.

Disease intensity

Per cent disease intensity was recorded at 45, 60 and 75 days after intensity of Alternarial blight. The initial infections or incidence was recorded in the experimental field at 60 days after sowing.

The per cent disease index (PDI) was computed using the 0-9 scale (Wheeler, 1969) [25] according to the formula given below.

Disease intensity

Disease intensity (%) was calculated by using the following formula:

$$\text{Disease intensity (\%)} = \frac{\text{Sum of all disease ratings}}{\text{Total number of rating} \times \text{Maximum disease grade}} \times 100$$

(Mc Kinneys, 1923) [10]

The disease intensity was recorded after first appearance of the disease at regular intervals at ten days intervals.

Results and Discussion

The result revealed that all the treatments were statistically significant and increased plant height as compared to control. The maximum plant height (144.07cm) was recorded at 75 days after Sowing in T₁- *Trichoderma viride* (foliar spray) 2% followed by T₂- *T. harzianum* (foliar spray) 2% (141.90cm), T₄ *T. harzianum* (Seed treatment) 2% (140.37cm), T₅. SAAF (Mancozeb63%+carbendazim12%) (fs) (139.17 cm), T₆-SAAF (Mancozeb 63%+carbendazim12%) (st) 3g/kg (138.23cm), T₃- Garlic extract 10% (136.30cm) as compared to T₀- control (131.07cm). Among the treatments most effective was T₁- *T. viride* 2% (144.07cm). Similar findings were reported by Rini and Sulochana (2006) who evaluated the efficacy of biocontrol agents used (alone or in various combinations) against alternaria leaf spot and promoting plant growth of Naga king mustard as well as field conditions. Maximum plant height observed in *T. viride* because inhibitory effect of bioagents due to hyper parasitism/mycoparasitism, competition for space and nutritional source and antagonistic chemical produced by them. *T. viride* have been reported to produce antibiotic compounds (Trichodermin) extracellular enzymes (chitinase, cellulase) unsaturated monobasic acids (Dermadine) and peptides that may have damaged plant pathogen (Mamgain *et al.*, 2013; Rehman *et al.*, 2013) [8, 19].

The result revealed that all the treatments were statistically significant and increased disease intensity as compared to control. The minimum disease intensity (51.87%) was recorded at 75 DAS in T₅ – SAAF (Mancozeb 63%+carbendazim12%) (fs) followed by T₆-SAAF (Mancozeb 63%+carbendazim12%) (st) (53.85%), T₁ - *Trichoderma viride* (fs) 2%(54.85%), T₂-*Trichoderma harzianum* (fs) 2% (55.78%), T₄- *Trichoderma harzianum* (st) 2% (57.11%), T₃ - *Allium sativum* (fs) 10% (57.90%) as compared to T₀ - control (60.62%). Among the treatments most effective was T₅ – SAAF (Mancozeb 63%+carbendazim12%) (fs) (51.87%).

In the present study, the minimum disease intensity on leaves was recorded by the use of SAAF (Mancozeb63% + carbendazim12%) foliar sprays. Similar finding was reported by Vanakataramanamma *et al.* (2014) [22] in which combination of seed treatment with SAAF@3g/kg of seed + Mancozeb75%WP@0.2% at 30 and 45 days after sowing recorded least per cent disease intensity with highest yield. Roopa *et al.* (2014) suggested that the bio assay of fungicides, botanicals and bio agents forms the prerequisite for the field evaluation. In vitro evaluation of twelve fungicides, six bioagents and ten botanicals against *Alternaria solani* causing early blight of tomato revealed that contact fungicide mancozeb @ 0.2%, systemic fungicide, hexaconazole @ 0.1 % and the combination fungicide Hexaconazole 4% + Zineb 68% @ 0.2% recorded the maximum inhibition of 87.21% 88.88%, 88.88% mycelial growth respectively. Among the bioagents tested *Trichoderma harzianum* found effective in inhibiting the mycelial growth (77.50%) followed by *T. viride* (75.14%). Khan *et al.* (2007) also suggested the inhibition of *Alternaria* spp. by minimum disease intensity in mancozeb + carbendazim because chemical fungicides has a direct antimicrobial effect and is involved in cross-linking in cell walls, induction of gene expression, hypersensitive cell death, phytoalexin production and induced systemic resistance. Present result is supported by Sunkad *et al.* (2012) [21] and Sharma *et al.* (2010) [20].

Cost benefit ratio found best and most economical treatment was T₅. (1:1.76) among all the treatments as compared to T₆ – SAAF (Mancozeb 63%+carbendazim12%) (st) 3g/Kg (1:1.66), T₁ – *Trichoderma viride* @ 2% (1:1.60), T₂ - *Trichoderma harzianum* (fs) @ 2% (1:1.44), T₄- *Trichoderma harzianum* (st) @ 2% (1:1.38), T₃- *Allium sativum* @ 10% (w/v) (1:1.21) and T₀ – Control (1:1.08). Similar finding was made by Vanakataramanamma, *et al.* (2014) [22] who reported that combination of seed treatment with SAAF@3g/kg of seed + Mancozeb75%WP@0.2% at 30 and 45 days after sowing recorded least per cent disease intensity with highest yield. The similar result found by (Khan *et al.*, 2007; Sunkad *et al.*, 2012) [21].

Conclusion

Based on the result it was observed that seed treatment and foliar spray with mancozeb + carbendazim 3g/l proved to be most effective against early blight of mustard showing minimum disease intensity producing maximum yield, and benefit cost ratio. *Trichoderma viride* @ 2% as seedling root dip treatment recorded maximum plant height (cm). The use of macro nutrients increases the health problems and decreases the soil fertility as well as increases the resistance in pathogens. So, the fungicides are responsible for increasing soil fertility but are harmful for human health.

Table 1: The data of plant height and effect of treatment against alternaria spp.

Treatments	Plant height (cm)				Disease intensity %			Benefit cost ratio
	30 DAS	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS	
T ₀ Control	26.33	61.13	91.97	130.07	32.63	47.86	60.62	1:1.08
T ₁ <i>Trichoderma viride</i> (fs)	31.57	75.73	104.33	144.07	26.79	41.13	54.85	1:1.60
T ₂ <i>Trichoderma harzianum</i> (fs)	31.2	74.10	102.60	141.90	27.58	42.46	55.78	1:1.44
T ₃ <i>Allium sativum</i> (fs)	28.33	66.13	95.87	136.30	30.08	45.34	57.90	1:1.21
T ₄ <i>Trichoderma harzianum</i> (st)	29.93	73.30	101.57	140.37	29.15	44.81	57.11	1:1.38
T ₅ Mancozeb63%+carbendazim12% (fs)	29.37	70.97	100.50	139.17	23.15	38.91	51.87	1:1.76
T ₆ Mancozeb63%+carbendazim12%(st)	28.63	68.70	98.63	138.23	24.31	40.23	53.85	1:1.66
F- test	S	S	S	S	S	S	S	
S. Ed. (±)	1.15	1.30	1.10	1.08	0.69	0.71	0.96	
C. D. (P = 0.05)	2.51	2.92	2.40	2.35	1.50	1.55	2.09	

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