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INTEGRATED APPROACHES FOR MANAGEMENT OF ANGULAR LEAF SPOT (*PHAEOISARIOPSIS GRISEOLA*) OF FRENCH BEAN

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Abstract: Angular leaf spot caused by *Phaeoisariopsis griseola* (Sacc.) Ferraris is one of the most important fungal foliar diseases of French bean in mid hills of Himachal Pradesh. The integrated disease management studies conducted under field conditions revealed that combination of seed treatment with *Trichoderma harzianum* followed by pre-sowing soil application of *T. harzianum* @ 2.5 kg/50 kg FYM/ ha and two periodic sprays of mycobutanil @ 0.2% at fifteen days interval started with the first appearance of disease proved most efficacious in limiting the angular leaf spot disease and enhanced the green pod yield.
Keywords: Angular leaf spot, *Phaeoisariopsis griseola,* integrated disease management, *Trichoderma*, Neemajal.

Introduction

French bean (*Phaseolus vulgaris* L.) is one of the most important leguminous vegetable crop, grown throughout the world for its green pods as well as dry beans (rajmah) having its origin in South Mexico and Central America. It has gained increasing popularity due to its quality proteins and nutritional balance besides certain medicinal properties. In India, it occupies an area of 137.54 thousand hectares with a production of 1370.21 thousand MT (Anonymous, 2014). It is commercially grown in Himachal Pradesh over an area of 3436 hectares with production of 40879 MT (Anonymous, 2014). Angular leaf spot caused by *Phaeoisariopsis griseola* (Sacc.) Ferraris, is one of the major constraints in French bean cultivation. According to the Commonwealth Mycological Institute (CMI), the disease occurs in more than 60 countries (Sartorato and Rava, 1994) and, under favourable environmental conditions, yield losses may reach upto 80 per cent (Ponnappa *et al.,* 1976; Gupta and Shyam, 1988; Shukla and Sharma, 2009). The disease affects foliage and pods throughout the growing season and is particularly destructive in areas where warm, moist conditions are accompanied by abundant inoculums from infected plant residues and contaminated seed. Most of the cultivars of French bean are susceptible to the angular leaf spot disease (Sharma *et al*., 2000; Adikshita and Sharma, 2016). Considering the economic importance of French

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bean and yield losses incited by *Phaeoisariopsis griseola*, the present investigation was undertaken to device integrated disease management strategy by combining fungicides, bio-control agents and commercially available plant origin botanicals for the management of angular leaf spot of French bean.

Materials and Method

The trail was laid out in Randomised Block Design in the experimental farm of Department of Plant Pathology, Dr YS Parmar University of Horticulture & Forestry, Nauni with three replications during 2015 crop season where natural build up of the angular leaf spot disease had been much high in the previous crop seasons. The plot size was 3.0 × 2.0 m^2 with spacing of 30 × 10 cm. The fungicides, bio-control agents and plant extracts were applied either as seed treatment or soil application or foliar spray. The various treatments included under study were as follows: T_1 [*Trichoderma harzianum* (seed @ 0.5%) + soil @ 2.5kg/50kg FYM/ha)], T_2 [Neemazal (spray @ 0.25%)], T_3 [mycobutanil (seed @ 0.3% + spray @ 0.2%)], T_4 [*T. harzianum* (seed + soil) + Neemazal (spray)], T_5 [*T. harzianum* (soil) + mycobutanil (spray)], T_6 [mycobutanil (seed) + Neemazal (spray)], T_7 [*T. harzianum* (soil) + + Neemazal (one spray) + mycobutanil (one spray)], T_8 [*T. harzianum* (seed) + *T. harzianum* (soil) + mycobutanil (spray)], T_9 [*T . harzianum* (seed) + *T. harzianum* (soil) + Neemazal (one spray) + mycobutanil (one spray)], T_{10} [untreated control]. Two periodic sprays of fungicide/botanicals were given at 15 days interval started with the first appearance of disease in the respective treatment plots. Observations on disease severity in all treatment plots were taken as per the scale given by Muhuku *et al.,* 2003 and per cent disease index was calculated according to McKinney (1923). The green pod yield records were also taken to work out the relative efficacy of different treatments.

Results and Discussion

The perusal of data (Table 1) indicated that treatment T8 consisting of seed treatment with Trichoderma harzianum followed by pre-sowing soil application of T. harzianum @ 2.5 kg/50 kg FYM/ ha and two periodic sprays of mycobutanil @ 0.2% at fifteen days interval started with the first appearance of disease proved most efficacious in limiting the angular. It was followed by T_9 [*T . harzianum* (seed) + *T. harzianum* (soil) + Neemazal (one spray) + mycobutanil (one spray)] These two treatments i.e. T_5 and T_9 were statistically at par with each other.

Next best in efficacy were T_3 [mycobutanil (seed) + spray) and T_7 [*T. harzianum* (soil) + Neemazal (one spray) + mycobutanil (one spray)] which revealed statistically similar efficacy

Table 1. Integration of of chemical and non- chemical methods against angular leaf spot of French bean under field conditions

Treatment No.	Treatment	Disease index (%)	Green pod yield	
			Kg/Plot	q/ha
T_1	*Trichoderma harzianum* (seed@0.5%) + soil@2.5kg/50kg FYM/ha)	47.3 (43.43)	5.9	78.9
T_2	Neemazal (spray@0.25%)	43.3 (41.13)	6.3	84.5
T_3	Mycobutanil (seed@0.3% + spray@0.2%)	25.9 (30.52)	8.6	114.8
T_4	*T. harzianum* (seed+soil) + Neemazal (spray)	33.6 (35.43)	7.6	101.3
T_5	*T. harzianum* (soil) + mycobutanil (spray)	18.3 (24.85)	9.97	133.0
T_6	Mycobutanil (seed) + Neemazal (spray)	33.0 (35.02)	7.94	105.93
T_7	*T. harzianum* (soil) + Neemazal (one spray) + mycobutanil (one spray)	26.0 (30.61)	8.92	119.0
T_8	*T. harzianum* (seed) + *T. harzianum* (soil) + mycobutanil (spray)	12.7 (20.78)	11.97	159.6
T_9	*T. harzianum* (seed) + *T. harzianum* (soil) + Neemazal (one spray) + mycobutanil (one spray)	22.4 (28.19)	10.2	135.80
T_{10}	Control	70.7 (57.31)	4.5	59.7
$CD_{0.05}$		4.33	0.56	7.43

Figures in the parentheses are arc sine transformed values

against angular leaf spot disease besides exhibiting the similar green pod yield/ha. Mycobutanil belongs to demethylation inhibitors (DMI) fungicide group, which contain the triazole fungicides. The triazole fungicides inhibit one specific enzyme, C14-demethylase, which plays a role in sterol production. Sterols, such as ergosterol, are needed for membrane structure and function, making them essential for the development of functional cell walls. Therefore, these fungicides result in abnormal fungal growth and eventually death (Nene and Thapliyal, 2011). Growth inhibition by the *Trichoderma* spp. could be attributed mainly due to the production of antibiotics, such as trichodermin, trichodermol, trichotoxin and harzianolide which are inhibitory to fungal growth and sporulation (Yonas and Amare, 2008; Dennis and Webster, 1971). Treatment without any foliar spray i.e. T_1 was not very effective in managing the angular leaf spot of French bean. The use of *Trichoderma* spp. as seed treatment or soil application in combination with fungicidal sprays is reported to be effective in managing many fungal foliar plant diseases and improving plant health. Aappreciable control of Cercospora leaf spot of urd bean was achieved through the use of integrated management consisting of use of *T. harzianum* as seed dresser (10 g/ Kg seed) followed by

periodic sprays of carbendazim @ 0.1 per cent in combination with mancozeb @0.25 per cent (Singh, 2010). Singh and Vishunavat, 2010 also obtained significant control of anthracnose of chilies by combined usage of *Trichoderma* (5g/ Kg seed) and vitavax (1.5 g/ kg seed) as seed dresser. Seed treatment and foliar spray with carbendazim and mancozeb either alone or in combination is frequently used for the management of angular leaf spot of beans. But continuous use of these fungicides could result in development of resistance strains and farmers are reporting the ineffectiveness of these fungicides. The present study revealed that sprays of fungicide along with seed and soil treatment with bio-control agents could effectively control the angular leaf spot of French bean as well as increased the green pod yield in comparison to spray of fungicides, botanicals and bio-control agents alone.

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