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Effect of biocontrol agents and fungicides against anthracnose of French bean caused by *Colletotrichum lindemuthianum* (Sacc. and Magn.) in mid-hill of Garhwal Himalaya

N Pandey and S RaviDOI: <https://doi.org/10.22271/chemi.2020.v8.i2aj.9101>**Abstract**

Evaluated the efficacy of different bioagents and fungicides used as seed treatment and foliar spray, tested alone and in the combination. Ten treatments including control were tested against French bean anthracnose caused by *Colletotrichum lindemuthianum*. Among all these treatments minimum per cent disease incidence (PDI) and per cent severity index (PSI) were recorded in alone Carbendazim (8.33, 11.66 and 18.30%) and in combination Carbendazim + *P. fluorescens* (16.00, 26.33 and 39.33%) at 55, 75 and 95 DAS. Minimum (PSI) at 55, 75 and 95 DAS were recorded in alone i.e. (4.58, 7.41 and 10.11%) and in combination (9.11, 16.54 and 21.00%). Highly PDI and PSI had observed in the control compare to all other treatments.

Keywords: French bean, anthracnose, *Colletotrichum lindemuthianum*, bioagents, fungicides, PDI, PSI**Introduction**

French bean (*Phaseolus vulgaris* L.) is an important legume crop in tropical regions. It is noticed as a good source of proteins and vitamins Mohammed *et al.* (2013) ^[10]. This crop is also known as common bean and Rajmash. Bean is used as a pulse as well as a green vegetable. French bean is mainly cultivated in Himanchal Pradesh, hills of Mahabaleshwar, Jammu & Kashmir Maibam *et al.* (2015) ^[9]. Bean crop is affected by many diseases like common bacterial blight (*Xanthomonas campestris* pv. *phaseoli*), Rust (*Uromyces appendiculatus*), Anthracnose (*Colletotrichum lindemuthianum* (Sacc. and Magnus) Amin *et al.* (2014) ^[3]. The fungus *Colletotrichum lindemuthianum* is often present in or on the seed of the infected pods. Infected pods may show yellowish to brown sunken lesion. Agrios (2005) ^[2]. Among all anthracnose which is caused by the fungus *Colletotrichum lindemuthianum* (Sacc. and Magnus) causes severe economic loss in French bean. Loss due to anthracnose is greater in temperate region as compare to tropics. Anthracnose is a seed borne disease of bean and infested soil and debris are primary source of inoculum Mohammed *et al.* (2013) ^[10]. Due to anthracnose 100% yield reduction was recorded by Fernandez *et al.* (2000) ^[8]. Anthracnose disease is favoured by high temperature (19-25 °C) high humidity (<70%) Aggarwal *et al.* (2017) ^[11]. The first step for the management of disease is to reduce the pathogen inoculum from the field. Management practices to minimize the seed borne infection by biological control and chemical control methods. Foliar spray with Carbendazim and Hexaconazole were effective to reduce disease, observed by Mohammed *et al.* (2013) ^[10]. In biocontrol agents *Trichoderma harzianum* and *Pseudomonas fluorescence* were effective and reported by Padder *et al.* (2010) ^[11].

Materials and Methods

Field experiment was conducted at Vegetable Research and Demonstration Block, College of Horticulture, Bharsar during 2017. About 58 km away from Pauri city, situated at an altitude of 1900 meters above mean sea level. Geographical position of experimental site lies between latitude 29° North and of 78° East longitudes under western himalayan zone of Uttarakhand.

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Evaluation of treatments: Ten treatments were observed under the field condition namely; Alone Hexaconazole (5% SC) 1 ml/L, Captan (50% WP) 2.5 gm/kg seed, Carbendazim (50% WP) 2.5 gm/kg seed, *Bacillus cereus* (5gm/kg of seed), *Trichoderma harzianum* (5 gm/kg of seed) and *Pseudomonas fluorescens* (5gm/kg of seed). Three combination treatments viz., Hexaconazole + *Bacillus cereus* @ 0.5 ml/L +1.25 gm/kg seed, Captan + *Trichoderma harzianum* @ 1.25 gm/L +2.5 gm/kg seed and Carbendazim + *Pseudomonas fluorescens* @ 1.25 gm/L +2.5 gm/kg seed.

Seed treatment have done with two bioagents *P. fluorescence* and *B. cereus* @ (5 gm/kg of seed) and one contact fungicide Captan (2.5 gm /kg seed) were soaked in 1 L of water for 24 hours before sowing. All the treatments were treated separately overnight before sowing. Seed treatments have done, 24 seeds for each plot Amin *et al.* (2014) [3].

Foliar spray have done namely Carbendazim 2.5 gm/kg seed, Captan 2.5 gm/kg seed and Hexaconazole 1 ml/L. Contender variety of bean was used for the experiment and seeds were sown in the beds with Randomized Complete Block Design (RCBD) with three replications in plot size of 1.35m x 1.20m (Chaudhary and Dhaka, 2003) [6]. The plant was spaced at 45 cm x 15 cm and twenty four plants per plot.

Per cent disease incidence (PDI)

PDI was calculated with the help of the formula which is given by Wheeler (1969) [14]. It was calculated at 55, 75 and 95 DAS after sowing from five randomly tagged plants.

$$\text{Per cent disease incidence} = \frac{\text{Number of infected pods}}{\text{Total number of pods examined}} \times 100$$

Per cent severity index (PSI): PSI was calculated by using standard scale (1-9) of CIAT, from five tagged plants at 55, 75 and 95 DAS then it was calculated by help of the formula given by Wheeler (1969) [14].

$$\text{Per cent severity index} = \frac{\text{Sum of all numerical rating} \times 100}{\text{No. of plant scored} \times \text{maximum score on scale}}$$

The rating scale was given by CIAT (1987) [7].

Rating scale	Per cent infection
1	No infection
3	Up to 1% pod surface area
5	Up to 5% pod surface area
7	Up to 10% pod surface area
9	More than 25% pod surface area

The data had obtained and analyzed by using simple randomized complete block design (RCBD) and performed with the help of OPSTAT.

Results and Discussion

Present investigation was carried out to evaluate ten treatments have been observed.

PDI at 55, 75 and 95 days after sowing (DAS): The observation had recorded in (Table 1 and Fig.1) showed significant differences between treatments and control. Among these alone Carbendazim at (55, 75 and 95 DAS) the most effective, minimum anthracnose per cent disease incidence was recorded (8.33, 11.66 and 18.30%) and maximum in *Bacillus cereus* ie. (34.32, 49.53 and 59.05%). In combination minimum in Carbendazim+ *P. fluorescens* (16.00, 26.33 and 39.33) and maximum in Captan + *T. harzianum* (21.28, 34.33 and 50.62%) and maximum PDI was recorded in control comparison to all treatments.

Mohammed *et al.* (2013) [10] also observed that foliar spray with Carbendazim is effective in reduce disease in field condition and they found i.e. (18.9 and 16.1%) at 52 and 60 DAS. Vivekanand *et al.* (2018) [13] also found effective and low per cent disease index (PDI) at 75, 90 and 105 DAT, in alone Mancozeb and Captan; in combination *T. harzianum* + Captan and followed by *P. fluorescens* + Carbendazim against chilli anthracnose (*Colletotrichum capsici*). Chavan and Suryawanshi (2014) [5] found the fungicides i.e. Carbendazim (0.1%) and Mancozeb (0.2%) against soyabean anthracnose (*Colletotrichum truncatum*) and among these, Carbendazim (0.1%) was found most effective in the reduction of disease intensity with highest yield i.e. 2525 kg/ha.

Table 1: Effect of treatments on per cent disease incidence (PDI) at 55, 75 and 95 days after sowing (DAS) at different doses against *C. lindemuthianum*

Treatments	PDI		
	55 DAS	75 DAS	95 DAS
Control	38.27 (57.22)	51.19 (45.66)	70.72 (57.22)
Hexaconazole	11.50 (25.95)	15.26 (22.96)	23.07 (28.68)
Captan	27.00 (45.33)	38.33 (38.23)	55.66 (48.23)
Carbendazim	8.33 (23.81)	11.66 (19.93)	18.30 (25.31)
<i>Bacillus cereus</i>	34.32 (50.19)	49.53 (44.71)	59.05 (50.19)
<i>Trichoderma harzianum</i>	25.33 (48.23)	38.52 (38.34)	53.66 (47.08)
<i>Pseudomonas fluorescens</i>	30.00 (47.08)	40.33 (39.40)	57.22 (49.13)
Hexaconazole + <i>B. cereus</i>	20.71 (44.31)	32.33 (34.64)	48.85 (44.31)
Captan+ <i>T. harzianum</i>	21.28 (49.10)	34.33 (35.83)	50.62 (45.33)
Carbendazim + <i>P. fluorescens</i>	16.00 (38.81)	26.33 (30.89)	39.33 (36.44)
CD (p=0.05)	4.24	3.88	4.02

() –Value in parentheses are angular transformed

PDI – Per cent disease incidence, DAS- Days after sowing

PSI at 55, 75 and 95 days after sowing (DAS): The observation had recorded in (Table 2 and Fig. 2) showed that minimum severity index, among these alone Carbendazim at (55, 75 and 95 DAS) i.e. (4.58, 7.41 and 10.11%) and maximum in *B. cereus* (18.24 and 38.66%) 55 and 95 DAS, in *T. harzianum* was recorded (28.52%) at 75 DAS. In combination minimum was recorded (Carbendazim+ *P. fluorescens*) at (55, 75 and 95 DAS) ie. (9.11, 16.54 and 21.00%) and maximum was recorded in (Captan +*T. harzianum*) i.e. (12.33 and 18.51) at 55 and 75 DAS and other way at 95 DAS i.e. Hexaconazole + *B. cereus* (25.74%) and maximum PSI was recorded in control comparison to all treatments.

Mohammed *et al.* (2013) [10] also observed the per cent severity index (PSI) ie. (13.3% and 19.0%) when foliar spray with Carbendazim against anthracnose of common bean (*Colletotrichum lindemuthianum*). Bhardwaj and Thakur (1991) [4] found that Carbendazim (0.1%) against anthracnose of urdbean was found effective to reduce disease severity. Vivekanand *et al.* (2018) [13] also found effective and low disease fruit rot severity, in alone Captan and Mancozeb; in combination *T. harzianum* + Captan and followed by *P. fluorescens* + Carbendazim against chilli anthracnose (*Colletotrichum capsici*). Sileshi *et al.* (2014) [12] observed the

severity and incidence of anthracnose increased with time from the 39 DAS onwards. Disease incidence data showed the highly significant difference ($P < 0.01$) among treatment at (39 and 67 DAS). There were no significant difference in disease incidence among treatments at (95 DAS). Bioagents,

treated with *T. viride* and *P. fluorescens* showed the least disease incidence (38.5%) at the plots initial date (39 DAS) disease assessments, *P. fluorescens* showed the least disease incidence at 39, 53, 67 and 81 DAS.

Table 2: Effect of treatments on per cent severity index (PSI) at 55, 75 and 95 days after sowing (DAS) at different doses against *C. lindemuthianum*

Treatments	PSI		
	55 DAS	75 DAS	95 DAS
Control	22.33 (28.16)	29.09 (32.61)	42.77 (40.82)
Hexaconazole	5.62 (13.71)	8.52 (16.93)	21.18 (20.34)
Captan	13.33 (21.40)	19.87 (26.43)	32.54 (34.76)
Carbendazim	4.58 (12.34)	7.41 (15.74)	10.11 (18.52)
<i>Bacillus cereus</i>	18.24 (25.26)	28.51 (32.26)	38.66 (38.41)
<i>Trichoderma harzianum</i>	12.75 (20.79)	28.52 (27.59)	31.33 (34.02)
<i>Pseudomonas fluorescens</i>	16.49 (23.92)	26.85 (31.19)	34.18 (35.75)
Hexaconazole + <i>B.cereus</i>	10.00 (18.41)	18.43 (25.39)	25.74 (30.45)
Captan + <i>T. harzianum</i>	12.33 (20.46)	18.51 (25.43)	24.63 (32.32)
Carbendazim + <i>P. fluorescens</i>	9.11 (17.54)	16.54 (23.89)	21.00 (27.21)
C.D _(p=0.05)	3.01	4.31	4.22

() –Value in parentheses are angular transformed

PSI – Per cent severity index; DAS- Days after sowing

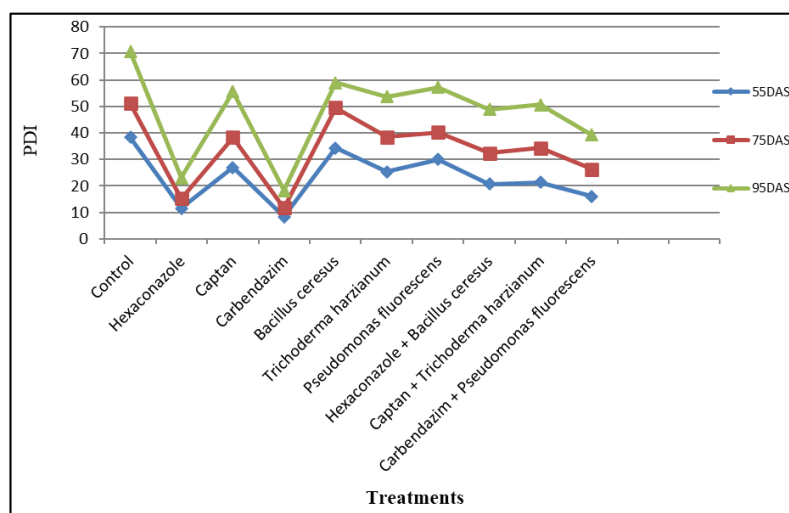


Fig 1: Effect of different treatments on Per cent disease incidence at 55, 75 and 95 DAS of *C. lindemuthianum*

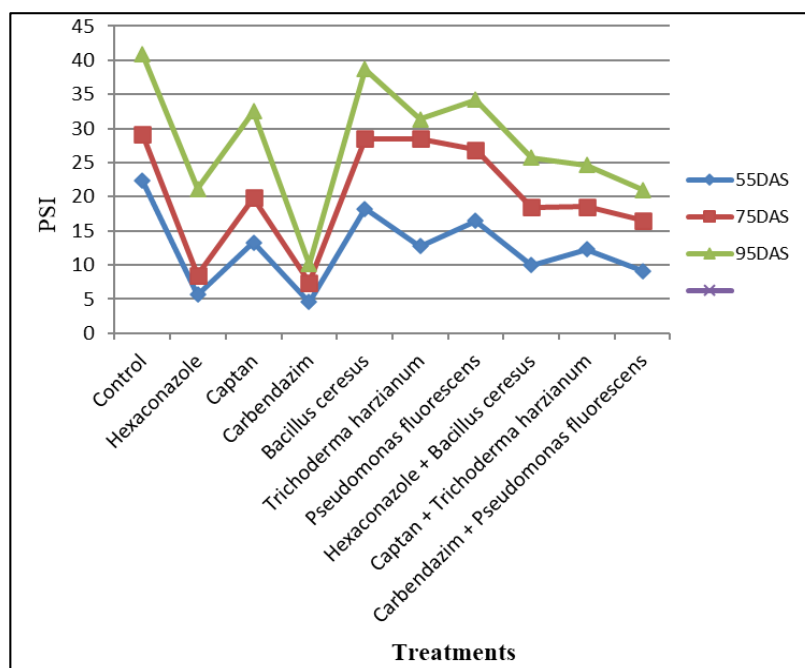


Fig 2: Effect of different treatments on Per cent severity index at 55, 75 and 95 DAS against *C. lindemuthianum*

Conclusion

Management of French bean anthracnose in Bharsar condition. Our study was based on fungicides and bioagents showed that, among all these treatments found minimum per cent disease incidence (PDI) and per cent severity index (PSI), alone Carbendazim and in combination Carbendazim + *P. fluorescens* most effective at 55, 75 and 95 DAS. In other way maximum (PDI) and (PSI) were observed in control comparison to all treatments, also above mentioned treatments gave higher yield.

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