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Research Article

Management of Alternaria blight of cumin caused by *Alternaria burnsii* by biocontrol agents, *Trichoderma* and *Pseudomonas*

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ABSTRACT: Studies on the relative efficacy of biocontrol agents under *in vitro* and *in vivo* conditions showed that combined treatment of *Trichoderma harzianum* + *Pseudomonas fluorescens* was most effective followed by *T. viride* + *P. fluorescens in management of Alternaria blight of cumin*. *Pseudomonas fluorescens* when treated alone was least effective. *Trichoderma harzianum* + *P. fluorescens* recorded 40.86 per cent disease intensity with 35.95 per cent disease control and realization of seed yield of 3.63 q/ha which was 100.55 per cent more than that obtained in control.

KEY WORDS: Alternaria blight, bioagents, cumin *Pseudomanas, Trichoderma*

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INTRODUCTION

India is one of the largest producers, consumers and exporters of seed spices (Peter *et al.,* 2000). Among the seed spices, cumin (*Cuminum cyminum* L.) is one of the important crops and is also locally known as "*Zeera*" in Hindi. It belongs to the order Umbellales and the family *Umbelliferae* and is believed to have originated in Egypt (Edison and Kallupurackal, 1989).

Cumin is popularly used for flavouring food and as herbal medicine and culinary for flavouring vegetables, pickles, soups, etc. Its seeds contain 17.7 per cent protein, 23.8 per cent fat, 35.5 per cent carbohydrates and 7.7 per cent minerals. In addition, cumin seeds also contain 6.2 per cent moisture, 0.09 per cent calcium, 0.45 per cent phosphorus, 0.048 per cent iron, 1.6 per cent sodium, 2.1 per cent potassium and also vitamins B_1, B_2, niacin, vitamin A, vitamin C etc. (Shankaracharya and Natrajan, 1971; Chadha, 2006). Cumin seeds are aromatic and nutty-flavoured. Volatile oil from cumin seeds is used in the perfumery, liquor, flavouring and cardinals and it is known to have stimulatory, carminative, stomatic, antidiarrheal and dyspepsia medicinal properties (Patel, 1993).

The blight of cumin was first reported from Bombay province and the causal agent was identified as *Alternaria* spp. (Uppal, 1933) and later named *Alternaria burnsii* (Uppal *et al.,* 1938). Alternaria blight caused by *A. burnsii* is one of the most dreaded diseases and a major production constraint for the successful cultivation of cumin crops. The disease is now widespread in all the cumin-growing states of India as well as in Pakistan (Shakir *et al.,* 1995). The blight pathogen *A. burnsii* is internally and externally seed-borne (Swarup and Mathur, 1972). The disease leads to serious yield losses under favourable weather conditions (Patel and Desai, 1971). Seed losses to the extent of 83 per cent due to blight have been reported. Persistent cold and cloudy weather are congenial for blight development (Gemawat and Prasad, 1969, Bhatnagar *et al.,* 1995).

MATERIALS AND METHODS

The inhibitory effect of fungicides was tested on a Potato Dextrose Agar (PDA) medium, using Poisoned Food-Technique. The fungicides were tested at three concentrations i.e., 100, 300 and 500 ppm. A suitable quantity of fungicide was added to sterile and molten potato dextrose agar medium to get desired concentration, just before pouring in sterilized Petri dishes and was allowed to solidify. The mycelial disc of

five mm diameter taken from the periphery of seven-day-old actively growing culture of *A. burnsii* was transferred at the centre of agar surfaces in Petri dishes. The inoculated Petri dishes were kept in a BOD incubator at 25±1^{0}C for seven days. Three replications were kept for each treatment. The experiment was conducted in a Completely Randomized Design (CRD). The mycelial growth was recorded after seven days i.e., when the full growth of the pathogen was recorded in control Petri dishes. The potato dextrose agar without fungicide was severed as control. The inhibition of mycelial growth of *A. burnsii* was calculated as follows: (Vincent, 1947)

$$\text{Percent mycelial growth inhibition} = \frac{C-T}{C} \times 100$$

Where,

C = Mycelial growth observed in control

T = Mycelial growth observed in treatment

Per cent disease control was calculated by the following formula :

$$\text{Per cent disease control} = \frac{\text{Disease intensity in control} - \text{Disease intensity in treatment}}{\text{Disease intensity in control}} \times 100$$

Disease intensity in control Disease grade was recorded on ten randomly selected plants from each plot. The seed yield was recorded in different treatments after the harvest of the crop.

RESULTS AND DISCUSSION

The effect of bioagents was tested against *Alternaria burnsii* under *in vitro*. *Trichoderma harzianum, Pseudomonas fluorescens* and *Trichoderma viride* were tested individually as well as in combination. Results showed that when tested individually *T. harzianum* and *T. viride* showed high inhibition of mycelial growth (70 to 72 per cent) and were significant to the inhibition exhibited by *P. fluorescens* (52 per cent). When the bioagents were tested in combination *T. harzianum* + *P. fluorescens* showed 75.35% inhibition and were statistically significant to all other treatments.

The efficacy of the above bio-control agents was also evaluated against *Alternaria burnsii* and under field conditions. It is evident from the data that all the bio-agents tested reduced disease intensity significantly over control. Results of the pooled analysis showed that minimum disease intensity was recorded in combination with the treatment of *T. harzianum* + *P. fluorescens* (40.86 per cent) followed by *T. viride* + *P. fluorescens* (41.58 per cent) and was on par with *T. harzianum* and *T. viride* single treatments. Control and *P. fluorescens* treatments were on par with each other and hence *P. fluorescens* when treated alone were ineffective (60.62 per cent disease intensity).

Two years of pooled analysis of seed yield data indicated that the highest seed yield was recorded in *T. harzianum* + *P. fluorescens* (3.63 q/ha) followed by *T. viride* + *P. fluorescens* (3.60 q/ha) and were on par. Lower yield was obtained with individual treatments of *Trichoderma harzianum* (3.11 q/ha) and *T. viride* (2.94 q/ha). Per cent increase in seed yield was 98 to 100 in combination treatments indicating its effectiveness. The seed yield of *P. fluorescens* was significantly lowest (2.69 q/ha) (Table 2).

Bio-control agents have been proven to be very effective, especially against seed and airborne pathogens. In the present investigation combined treatments of *T. harzianum* + *P. fluorescens, T. viride* + *P. fluorescens* and individual treatments of *T. harzianum*, *T. viride* and *P. fluorescens* were tested under *in vitro* and field conditions against the blight pathogen *Alternaria burnsii*. Among the treatments, the combined application of *T. harzianum* + *P. fluorescens* was found most effective as it showed 75.35 per cent inhibition of the pathogen, this was followed by the combined treatment of *T. viride* + *P. fluorescens* (74.05 per cent inhibition) when tested under *in vitro*. Combination treatments were also found to be effective when tested under field conditions and the treatment *T. harzianum* + *P. fluorescens* was most effective with 35.95 per cent disease control and it also gave the maximum seed yield of 3.63 q/ha (100 per cent increase over control). Overall, species of *Trichoderma* revealed relatively better biocontrol potential as compared to *P. fluorescens* in the present investigation. However, combined treatment *T. harzianum* + *P. fluorescens* was the most potent. This might be due to the more powerful antagonistic activity of *Trichoderma* to *A. burnsii* and in presence of metabolites secreted by *P. fluorescens* there was enhanced inhibition. Also, *Trichoderma* can grow very fast and thereby mighty can better inhibit *A. burnsii* needs however this needs further investigation. Sharma and Pandey (2013) tested antagonists against *A. burnsii.* Out of the 4 antagonists screened, *T. harzianum* showed significant maximum growth inhibition (82.02 per cent) followed by *T. virens* (76.07 per cent). In the case of bacterial antagonists, *P. aeruginosa* showed a significant maximum growth inhibition of 56.18 per cent followed by *P. fluorescens* (51.17 per cent).

Table 1. Effect of bio-agent against mycelial growth of *Alternaria burnsii* after 7 days of incubation at 25±1^{0}C

Biocontrol agent	Inhibition of mycelial growth * (%)
Trichoderma harzianum	72.40 (58.31)
Trichoderma viride	70.15 (56.88)
Pseudomonas fluorescens	52.00 (46.15)
Trichoderma harzianum + Pseudomonas fluorescens	75.35 (60.23)
Trichoderma viride + Pseudomonas fluorescens	74.05 (59.38)
Control	0.00 (0.00)
SEm±	1.22
CD (p=0.05)	3.77

*Average of four replications
Figures in parentheses are angular transformed value

Table 2. Effect of biocontrol agents on cumin blight and seed yield

Bio-agent	Per cent disease intensity*			Decrease in PDI over control (%)	Yield (q/ha)			Increase in yield over control (%)
	2014-15	2015-16	Pooled		2014-15	2015-16	Pooled	
Trichoderma harzianum	41.15 (39.90)	42.33 (40.59)	41.74 (40.25)	34.57	3.24	2.97	3.11	71.82
Trichoderma viride	42.00 (40.40)	44.20 (41.67)	43.20 (41.09)	32.28	3.11	2.76	2.94	62.43
Pseudomonas fluorescens	59.45 (50.45)	61.80 (53.83)	60.62 (51.13)	4.98	2.84	2.53	2.69	48.62
Trichoderma harzianum + Pseudomonas fluorescens	40.21 (39.35)	41.51 (40.11)	40.86 (39.73)	35.95	3.72	3.55	3.63	100.55
Trichoderma viride + Pseudomonas fluorescens	41.07 (39.86)	42.10 (40.45)	41.58 (40.15)	32.47	3.69	3.51	3.60	98.90
Control	62.50 (52.24)	65.10 (53.79)	63.80 (53.01)	-	1.90	1.72	1.81	
SEm±	1.56	1.93	1.58		0.31	0.33	0.31	
CD (*p*=0.05)	4.79	5.95	4.86		0.96	1.01	0.96	
CV	6.34	7.54	6.30		6.43	6.93	6.50	

*Average of three replications
Figures in parentheses are angular transformed value

Deepak *et al.* (2008) observed the effect of several antagonistic fungi on the growth of two cumin fungal pathogens under *in vitro* and field conditions, they observed that maximum inhibition (85.45 per cent) of the mycelial growth of *A. burnsii* by *T. harzianum* and under field conditions, minimum blight disease (36.15 per cent) was also observed.

CONCLUSION

Studies on the relative efficacy of biocontrol agents under *in vitro* and *in vivo* conditions showed that combined treatment of *Trichoderma harzianum* + *Pseudomonas fluorescens* was most effective followed by *T. viride* + *P. fluorescens*. *Trichoderma harzianum*+ *P. fluorescens* recorded 40.86 per cent disease intensity which was less than other treatments with 35.95 per cent disease control.

REFERENCES

Bhatnagar K, Kant U, Sharma BS. 1995. Assesment of losses by *Alternaria burnsii* on cumin. *J. Indian Bot Soc,* **11**: 169-171.

Chadha KL. 2006. Handbook of Horticulture. 713-714pp.

Deepak P, Saran L, Lal G. 2008. Control of wilt and blight diseases of cumin through antagonistic fungi under in vitro and field conditions. *Not Bot Hort Agrobot Cluj,* **36**(2): 91-96.

Edison S, Kallupurackal LA. 1989. New varieties to improment productivity of seed spices. Indian Cocoa. *Arecanut and spice,* **13**(4): 121-123.

Gemawat PD, Prasad N. 1969. Control of Alternaria blight and powdery mildew of cumin (Zeera). *Hindustan Antibio Bull,* **11**: 169-171.

Patel RJ. 1993. Alternaria blight and powdery mildew of cumin (*Cuminum cyminum L.*) and their management. M.Sc. (Ag.) Thesis, G.A.U., Anand, Gujarat.

Patel RM, Desai MV. 1971. Alternaria blight of *Cuminum cyminum* and its control. *Indian Phytopath,* **20**(4): 16-22.

Shankaracharya NB, Natrajan CP. 1971. Chemical composition and used of cumin. *Indian Food Packer,* **25**: 28-28.

Shakir AS, Mirza JH, Sahi ST, Ansar M. 1995. First report of *Alternaria burnsii*. The causal organism of cumin blight in Pakistan. *Pakistan J Phytopath,* **7**(2): 219.

Sharma S, Pandey RN. 2013. Survival, epidemiology and management of Alternaria blight of cumin in Gujarat. J *Life Sci,* **10**(2b): 639-642.

Swarup J, Mathur RS. 1972. Seed microflora of some umbelliferous spices *(Trachyspermum amni)* Coriander, Cumin, Dill, Fennel. *Indian Phytopath,* **25**: 125.

Uppal BN. 1933. International Bulletin of Plant Protection from Bombay. VII pp. 103-104.

Uppal BN, Patel MK, Kamat MN. 1938. Alternaria blight of *Cuminum cyminyum* L. *Indian J Agri Sci,* **7**: 49-62.

Vincent JM. 1947. Distortions of fungal hyphae in the presence of certain inhibitors. *Nature,* **150**: 850. https://doi.org/10.1038/159850b0 PMid:20343980