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Effect of different fungicide, bio agent, and botanical on yield and disease severity of potato against early blight of potato

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Abstract

All the treatments reduced the disease severity of *Alternaria solani* compared to control. Least disease severity of 12.33% was observed in T₂- (ST with *T. harzianum* + 2 FS Tilt @ Ist at Ist disease Seen IInd at 15 days interval), followed by the T₁- (ST with *T. harzianum* + 2 FS Bavistin @ Ist at Ist disease Seen IInd At 15 days interval) of 14.40%, T₇- (ST with *T. harzianum* + 2 FS Zinger Extract 10% @ Ist at Ist disease Seen IInd At 15 days interval) of 42.53% showed least effective in comparison to all the treatments but was significantly superior over control (65.84%). Highest yield were recorded in T₂- (ST with *T. harzianum* + 2 FS Tilt @ Ist at Ist disease seen IInd at 15 days interval) (455 gm/pot) and percent increase in yield 97.57%, followed by T₁- (ST with *T. harzianum* + 2 FS Bavistin @ Ist at Ist disease seen IInd at 15 days interval) (405gm/pot and 75.70%), T₃ and T₄. Among the all treatments T₂ responsible for yield increase as well as reduced disease severity in potato plants experiment.

Keywords: Disease, *Alternaria*, food, pathogen, bio agents, plant extract

Introduction

The potato (*Solanum tuberosum* L.) Is a world food crop and can be compared only with rice, pulses, wheat and coarse grain for its contribution towards securing the food and nutrition, and avoiding the hunger, especially in developing countries in Africa and Asia where food is continually on demand to feed the rising population living with inherent social and political conflict. India is the 2nd largest producer of vegetables in world accounting for 11 percent of the world's production. India produced 53457 thousands MT of potatoes over an area of 3116.9 thousands ha. in the year of 2022-23. Uttar Pradesh with 42 and West Bengal 26 percent accounted for more than 80 percent of total production in India. The major potato producing states are U.P., West Bengal, Assam, Maharashtra, and Tamil Nadu. In Uttar Pradesh potato is cultivated in 0.532 million hectare with the production of 10.65 million ton and productivity potatoes of 18.80 tonnes/hectare (Singh and Gupta 1953) [5]. Potato has been identified as staple food in the many part of the world and richest source of energy. It is used as vegetable only and used as mixed with other vegetables such as cauliflower and tomato etc. Production of potato in the world is low due to different biotic and abiotic stresses. Potato is affected by 95 diseases all over the world caused by fungi, bacteria, viruses and nematodes. These diseases cause heavy losses to the potato crop. Among the all biotic stress fungi causes destructive losses in potato. Fungi diseases play a significant role in reducing the yield of the potato crop. Among the fungal diseases, early blight of potato caused by *Alternaria solani* which survives, in infected leaf and stem tissues on or in the soil. This fungus is universally present in fields as well as storage where these crops have been grown. Early blight can develop rapidly in mid to late season and is more severe when plants are poor nutrition, drought, or other pests (Agrios 2005) [8]. Infection of potato tubers by the *Alternaria solani* occurs through natural openings on the skin and through injuries, potato tubers may come in contact with fungal spores during harvest and lesions may continue to develop in storage condition (Sallam and Elyousr 2012) [6].

Conidia are large, dark brown, long, or muriform, and multicellular, with transverse and longitudinal cross walls or septa. Early crop variety, change in cropping pattern, crop management and change in environmental conditions have influence on the severity of early blight of potato in recent years Smitha and Abraham (2014) [7].

Materials and Methods

Experiments were conducted at net house of the Plant Pathology Department in C.S. Azad University of Ag. and Technology, Kanpur. Field trials were laid out during Rabi season 2017-18.

Isolation of pathogen

Naturally infected leaves collected from infected field of Kanpur rural location showing typical symptom of *Alternaria* blight were collected randomly at different stages of crop growth. Washed diseased materials with sodium hypochloride and distilled sterilized water and were cut into small pieces consisting of diseased with healthy parts with the help of a sterilized sharp blade. The pieces were then transferred aseptically on sterilized (PDA) Petri- plates. The inoculated plates were incubated in incubator at 25 C for 3 days. As soon as the mycelial growth of fungus was visible around these pieces after 7 days

Growth parameters

The tubers of potato variety 'Kufri chandramukhi' was treated with different plant extracts, antagonistic bio agrnts, fungicides separately and sown in 30 cm earthen fill pots, which were previously filled with a mixture of sterilized sandy loam soil and FYM in the ratio of 2:1. In each pot 6 tubers were sown and irrigated regularly. Three replications and three pots were sown with untreated seed tubers served as control. Observations to effect of different treatments on the growth of plant was recorded at different days of interval up to 35 days age of plants.

$$\text{Germination \%} = \frac{\text{Number of germinated seed tubers}}{\text{No. of total seeds}} \times 100$$

Yield parameters and disease severity

The field trials were conducted during 2017-18 crop seasons in Rabi (CRD) with three replications using kufri chandramukhi highly susceptible cultivar to early blight of potato. Three different fungicides viz., Propiconazole, Carbendazim (Bavistin) and Mancozeb. And four plant extracts based products like wise Garlic, Neem, Datura and Zinger and *Trichoderma harzianum*. Were evaluated as Tuber Treatment and foliar application in potato plants. All the recommended agronomical practices like Preparation of field, irrigations and intercultural operations were done to raise a good crop. The list of different fungicides and botanicals have been given in Table. Propiconazole (0.05%), Carbendazim (0.1%) and Mancozeb (0.25%) and Plant extracts Garlic (5%), Neem (5%), Datura (5%) and Zinger (5%) and *Trichoderma harzianum*. were sprayed twice at 15 days of interval. The first spray of fungicides and botanicals was given just after first appearance of disease symptom then after two subsequent sprays were given at 15 days intervals. Control condition pots were sprayed with same volume of water, Disease severity was recorded using 0-5 rating scale. First observations on disease severity was recorded before the beginning of first spray of different fungicides, plant extracts and *Trichoderma* spp. based products. Following observations were recorded before each spray and finally disease severity was recorded 15

days after last spray. Tuber yield (q/ha) parameter and percent increase in yield over control were also recorded.

$$\text{Disease severity percentage (DSP)} = \frac{\text{Total of Numerical Ratings}}{\text{No. of Plants Scored} \times \text{Maximum Score on scale}} \times 100$$

Treatment details

T ₁ - Seed Treatment with <i>T. harzianum</i> + 2 FS Bavistin @ I st at Ist disease Seen IInd At 15 days of interval
T ₂ - Seed Treatment with <i>T. harzianum</i> + 2 FS Tilt @ I st at Ist disease Seen IInd At 15 days of interval
T ₃ - Seed Treatment with <i>T. harzianum</i> + 2 FS Mancozeb @ I st at Ist disease Seen IInd At 15 days of interval
T ₄ - Seed Treatment with <i>T. harzianum</i> + 2 FS Garlic Extract 10% @ I st at Ist disease Seen IInd At 15 days of interval
T ₅ - Seed Treatment with <i>T. harzianum</i> + 2 FS Neem Extract 10% @ I st at Ist disease Seen IInd At 15 days of interval
T ₆ - Seed Treatment with <i>T. harzianum</i> + 2 FS Datura Extract 10% @ I st at Ist disease Seen IInd at 15 days of interval

Results and Discussion

The effect of potato tuber treatment and spray with different plant extract, *Trichoderma* and fungicide on tuber percent increase in yield over control was studied after harvesting. It is result from the data presented in (Table 1) that during the year 2017-18, all the treatments significantly reduced the disease severity compared to control. However, the magnitude of reduction varied from treatment to treatment. The range of disease severity in treatments varied from 12.33 to 42.53% in comparison with 65.84% recorded in check. Minimum disease severity of 12.33% was observed in T₂- (ST with *T. harzianum* + 2 FS Tilt @ Ist at Ist disease Seen IInd at 15 days interval). This was followed by the T₁- (ST with *T. harzianum* + 2 FS Bavistin @ Ist at Ist disease Seen IInd At 15 days interval) of 14.40%, T₃- (ST with *T. harzianum* + 2FSMancozeb @ Ist at Ist disease Seen IInd at 15 days interval) of 19.67%, T₄- (ST with *T. harzianum* + 2 FS Garlic Extract 10% @ Ist at Ist disease Seen IInd At 15 days interval) of 26.42%, T₅- (ST with *T. harzianum* + 2 FS Neem Extract 10% @ Ist at Ist disease Seen IInd at 15 days interval) of 33.75%, T₆- (ST with *T. harzianum* + 2 FSDatura Extract 10% @ Ist at Ist disease Seen IInd at 15 days interval) of 37.90% and T₇- (ST with *T. harzianum* + 2 FS Zinger Extract 10% @ Ist at Ist disease Seen IInd At 15 days interval) of 42.53% proved lowest effective in comparison to all the treatments but was significantly superior over control (65.84%). Data represented in table;1, Highest yield were recorded in T₂- (ST with *T. harzianum* + 2 FS Tilt @ Ist at Ist disease seen IInd at 15 days interval) (455 gm/pot) and percent increase in yield 97.57% followed by T₁- (ST with *T. harzianum* + 2 FS Bavistin @ Ist at Ist disease seen IInd at 15 days interval) (405gm/pot and 75.70%), T₃- (ST with *T. harzianum* + 2 FS Mancozeb @ Ist at Ist disease Seen IInd at 15 days interval) (390.55gm/pot and 69.44%), T₄- (ST with *T. harzianum* + 2 FS Garlic Extract 10% @ Ist at Ist disease Seen IInd at 15 days interval) (360.80gm/pot and 56.52%), T₅- ST with *T. harzianum* + 2 FS Neem Extract 10% @ Ist at Ist disease Seen IInd At 15 days interval (325.75gm/pot 41.32%), T₆- (ST with *T. harzianum* + 2 FS Datura Extract 10% @ Ist at Ist disease Seen IInd At 15 days interval) (295.20gm/pot and 28.07%). Least yield was recorded from the T₇- (ST with *T. harzianum*+ 2 FS Zinger Extract 10% @ Ist at Ist disease Seen IInd at 15 days interval) of with the value of 236.66 gm only, and percent increase in yield 18.69% due to very slow growth of plant. Botanical extract of plant spp. were also evaluated in-vitro

against the pathogen, amongst these plant extracts. Show that maximum inhibition was obtained by Garlic (76.44% reduction) followed by neem (68.11%), Datura (64.89%), and Zinger (52.78%), Lantana (46.50%), Onion (40.44%), *Parthenium histophorous* (32.33%) similar findings were also reported by Singh and Kumar (2004). Chaudhari and Patel (2002) reported that (ST with *T. harzianum* + Mancozeb @) give (400gm/pot yield and 80.44% increase over control. The effect of potato tuber treatment and foliar spray with various plant extracts, *Trichoderma* and fungicide on plant height of potato were studied under wire house complex in pot culture experiment. The observations of plant height were taken at 15 days, 30 days and 45 days after sowing. The data presented in (Table 2) shows that the plant height of potato was maximum in T₁ (36.50cm.) which is significantly higher than control. The seed tubers treated with *Trichoderma harzianum*. Second highest in case of plant height recorded in T₂ with the value of

35.40 cm. From the table, it is also cleared that all the treatments showed a significant percent increase in plant height over control. The result in (Table 2), indicated that the highest germination percentage is noted in Propiconazole 25 EC and Carbendazim 50 WP (100%) followed by Mancozeb and *Trichoderma harzianum* (95%) Curzate and *Trichoderma viride* (90%), Copper oxychloride and Garlic extract (85%), Lantana and Onion (80%), Neem (75%), Zinger and Datura (70%) and *Parthenium hystrophorus* (65%) in case of different treatment. From the table, it is also cleared that all the treatments showed a significant increase in germination percentage over control. An investigation shows that the plant height of potato was maximum in *T. harzianum* + Bavistin treated seed tubers (26.00 cm.) which is significantly higher than Control (Maheshwari and Mehta 1993) [4]. Similar findings were reported by Khurana and Paul.

Table 1: Effect of potato tuber treatment with different fungicide, bio agent, and botanical extract on tuber germination percent and yield of potato during 2017-2018.

Treatments	Disease severity%	Disease control% over control	Yield g/pot	Increase yield% over control	Total no. of tuber sown in each pot	Average number of tuber germinate	Germination%
T ₁	14.40	78.13	405.00	75.70	5	5	100
T ₂	12.33	81.27	455.40	97.57	5	5	100
T ₃	19.67	70.12	390.55	69.44	5	4	90
T ₄	26.42	59.87	360.80	56.52	5	4.75	95
T ₅	33.75	48.74	325.75	41.32	5	4.50	85
T ₆	36.90	43.96	295.20	28.07	5	4.75	95
T ₇	42.53	35.40	273.60	18.69	5	4.5	90
T ₈	65.84	-	230.50	-	5	4.25	80
S.Em±	0.23		5.59				
C.D. at 5%	0.69		17.12				

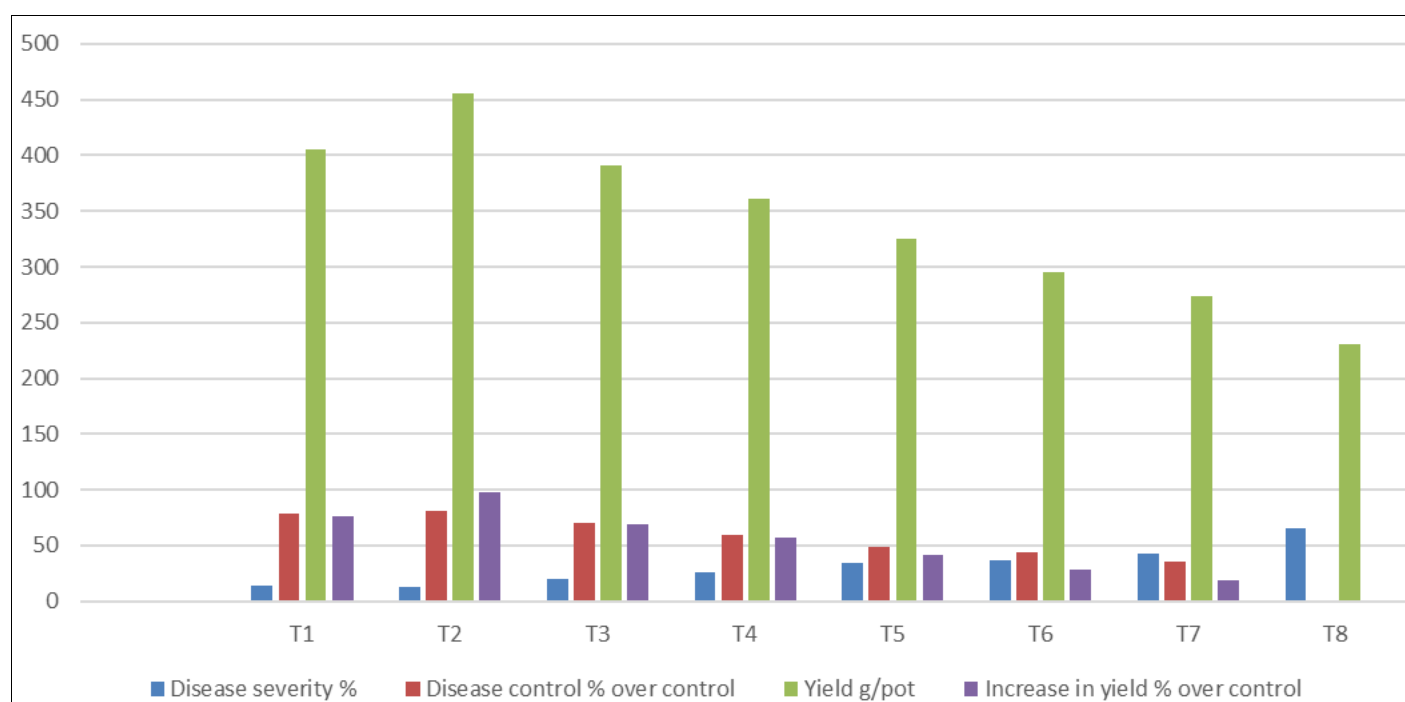
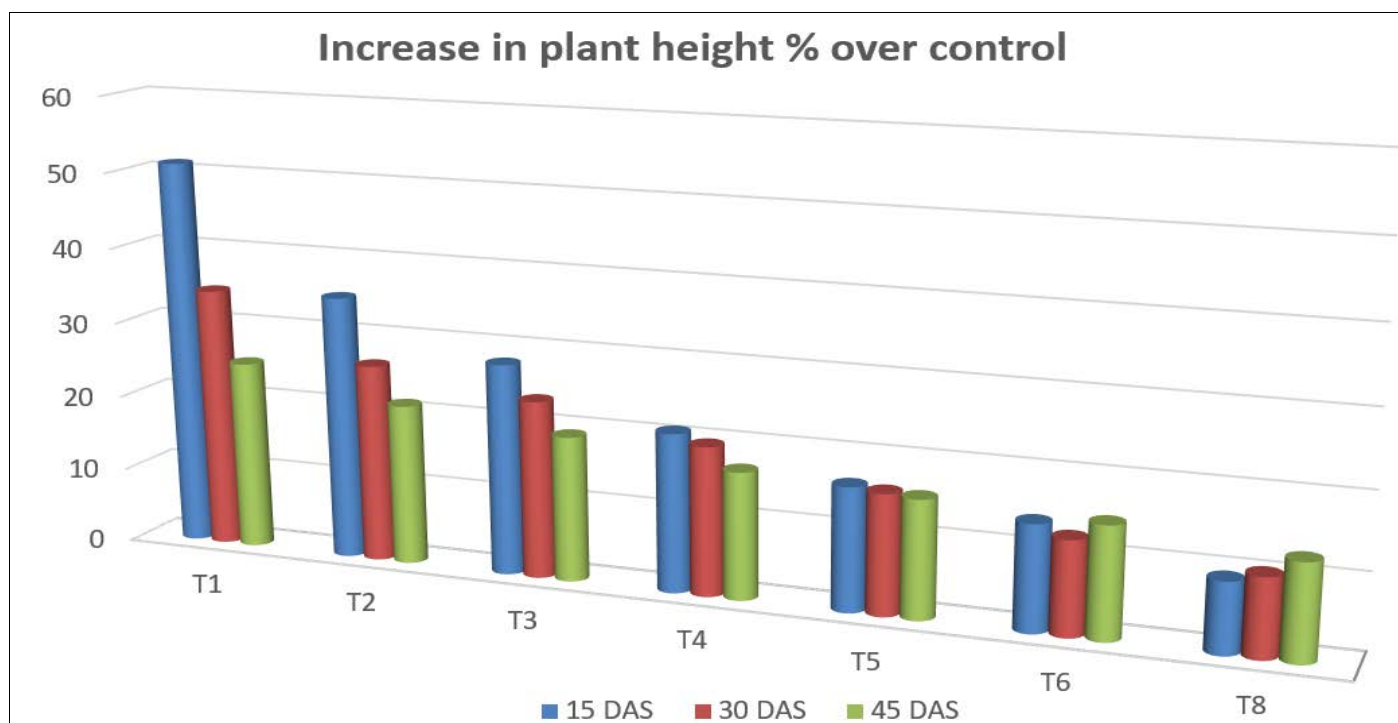


Fig 1: Effect of potato tuber treatment with different fungicide, bio agent, and botanical extract on tuber germination percent and yield of potato during 2017-2018.

Table 2: Effect of Bio-agents, fungicides and different plant extracts, on growth parameter of potato plant at different days of interval (wire house condition) during 2017-2018

Treatments	Plant height at different days after sowing (cm)			Increase in plant height% over control		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
T ₁	6.50	19.50	36.50	51.16	34.48	25.00
T ₂	5.80	18.30	35.40	34.88	26.20	21.23
T ₃	5.50	17.90	34.80	27.91	23.44	19.17
T ₄	5.20	17.35	34.10	20.93	19.65	16.78
T ₅	5.00	16.80	33.75	16.28	15.86	15.58
T ₆	4.90	16.30	33.50	13.95	12.41	14.72
T ₇	4.70	16.00	32.90	9.30	10.34	12.67
T ₈	4.30	14.50	29.20	-	-	-
S.Em±	0.09	1.01	0.47			
C.D. at 5%	0.27	0.33	1.45			

**Fig 2:** Effect of Bio-agents, fungicides and different plant extracts, on growth parameter of potato plant at different days of interval (wire house condition) during 2017-2018

Conclusion

In conclusion, the study evaluated the efficacy of potato tuber treatment and foliar spray with various plant extracts, *Trichoderma*, and fungicide on disease severity, yield, plant height, and germination percentage. Results showed significant reductions in disease severity across all treatments compared to the control, with varying degrees of effectiveness. Treatments combining *Trichoderma harzianum* with fungicides or plant extracts exhibited the highest yield increase and disease suppression. Botanical extracts such as Garlic, Neem, and Datura demonstrated substantial inhibition of the pathogen *in vitro*. Moreover, treatments led to increased plant height and germination percentage, particularly in *Trichoderma harzianum*-treated tubers. These findings underscore the potential of integrated pest management strategies involving biological agents and botanical extracts to enhance potato yield and disease resistance. Further research is warranted to optimize application methods and dosages for maximizing the benefits of these treatments in potato cultivation.

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