Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 2597-2602

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-11 pp. 2597-2602**
Journal homepage: http://www.ijcmas.com

Original Research Article

Potential Study of Plant Extracts, Bio Agents and Fungicides on *Alternaria solanica* using Early Blight in Potato

Vikash Kumar Yadav[1*], Manish Kumar Maurya[1], Ajay Kumar[2] and Abhimanyu[3]

[1]Department of Plant Pathology, College of Horticulture, V.C.S.G. Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri-Garhwal-246123, India
[2]Amar Singh P.G. College, Lakhaoti, Bulandshahar-203407, U.P., India
[3]Krishi Vigyan Kendra, Farrukhabad, CSA University of Agriculture and Technology, Kanpur-208002, India
**Corresponding author*

A B S T R A C T

Early blight is one of the most important soil and seed borne disease of potato. This disease is very destructive resulting in heavy (20-24%) yield losses. The aim of the study to check the potential of chemical, bio agents and plant extracts against early blight of potato in the Department of Plant Pathology, College of Horticulture, Bharsar, Uttarakhand. Ten treatments were taken *viz*; Hexaconazole (T_1),Mancozeb (T_2), Carbendazim (T_3), *Trichoderma viride* (T_4), *T. harzianum* (T_5), *Pseudomonas fluorescens* (T_6), Neem leaf extract (T_7), Garlic extract (T_8), Onion extract (T_9) and T_{10} (Check) to evaluate their efficacy on early blight disease of potato. Results revealed that the minimum radial growth (3.00mm) was observed in T_1 (Hexaconazole) at 3000 ppm concentration followed by Mancozeb (3.16mm), carbendazim (4.36mm), *T. harzianum* (4.88mm) and Neem leaf extract (5.58mm). The maximum radial growth was observed in Onion extract (5.75 mm) except check. However, the *in vitro* per cent inhibition result revealed that the Hexaconazole (80.03%) inhibition was observed at 3000 ppm concentration followed by Mancozeb (78.97%), Carbendazim (70.97%) and *T. harzianum* (67.53%). Among the all treatments except check, the minimum (61.74%) per cent growth inhibition was observed in onion extract (T_9). It can be concluded that hexaconazole is highly effective against *Alternaria solani* to managing the disease.

Keywords

Bio-Agents, Early Blight, Efficacy, Extracts, Potato

Introduction

Potato (*Solanum tuberosum*) is one of the most important vegetable crops in the world, belonging to the family solanaceae and is an important starchy food crop in both sub-tropical and temperate regions. Even in tropical regions it is widely grown during winter season. Potato is a native of South America (Hijmans and Spooner, 2001). In India the potato has been cultivated since its introduction in the early part of the 17th century. In India potato is grown in almost all the states under diverse climatic conditions except Kerala and 82% of potatoes are grown in plains during the short winter days from October to March. Potato is the most popular crop in West Bengal next to cereals (Chakraborty, 2012).

Potato plants are subjected to attack by numerous diseases wherever the crop is

grown. Among them, early blight of potato caused by *Alternaria solani*(Ellis and Martin) Jones and Grout is of major cause of concern in potato production at present. The disease causes losses to crop productivity in the field and to tuber quality in storage. Average annual yield loss of potato due to this disease was approximately 75% of the total production depending upon the nature of the disease, weather condition and type of variety grown (Dey and Chakraborty, 2012).

The wide and indiscriminate use of chemical fungicides has been the cause of development of resistance among plant pathogens, leading to the occurrence of serious diseases. Due to this, there is an increasing interest to obtain alternative antimicrobial agents (bio-control agents) and plant extracts for using in plant disease control systems. Plant products of recognized antimicrobial spectrum could appear in food conservation systems as main antimicrobial compounds or as adjuvant to improve the action of other antimicrobial compounds (Kaur and Arora, 1999). The development of such disease resistance to the pathogens and problems of environmental pollution due to excessive reliance on pesticides are the major causes today. Therefore, to avoid or minimize these problems, experiments have been conducted on management of early blight of potato by using the natural products such as plant extracts and bio control agents during 2016 crop seasons. The objectives of present investigations were to study the potential of selected fungicide, bio control and plant extract.

Materials and Methods

Kufri Sutlej variety of potato is susceptible to early blight disease. The diseased specimens of early blight were collected from potato growing areas of Tigaddu vegetable research block Bharsar. The infected tissues of leaves and stem showing typical symptoms of early blight and tuber rot were cut in to small pieces of 1-2 mm size. The surface sterilized with sodium hypochlorite solution (1%) for 2 min, rinsed thrice with sterile distilled water, blot dried and placed on PDA medium. Pathogen was identified following the cultural and morphobiometric characteristics criteria (Ellis, 1971; Barnet and Hunter, 1972). Cultural characteristics were observed directly by pigmentation on medium and mycelial growth pattern on PDA plates.

Identification of pathogen

A. solani was isolated from infected potato leaves. Pure cultures of *A. solani* were maintained by sub culturing of pure culture and pathogenicity test was done for the conformation of the pathogen.

In vitro bioassay of different treatments

In vitro experiment was conducted by using ten treatments *viz.* Hexaconazole, Mancozeb, Carbendazim, *Trichoderma viride*, *Trichoderma harzianum*, *Pseudomonas fluorescens*, Neem leaf extract, Garlic extract, Onion extractat different doses *viz*; 1000, 1500, 2000, 2500 and 3000 ppm with three replication and radial growth of pathogen was calculated after 72 hours and data was analysed statistically design simple CRD.

Disease inhibition

In case of poisoned food technique (Nene and Thapliyal, 2000), the inhibitory activity of each treatment was expressed as the per cent growth inhibition which was calculated using the following formula.

$$\text{Growth inhibition \%} = \frac{C - T}{C} \text{ X } 100$$

Where,

C = Control
T = Treatment.

Results and Discussion

Results revealed that all the treatments tested at 1000, 1500, 2000, 2500 and 3000 ppm concentrations which significantly inhibited radial growth of the test pathogen over untreated control. Among the treatment @ 3000 ppm there was minimum radial growth was observed in hexaconazole (3.00mm) followed by mancozeb (3.16mm) and *Trichoderma harzianum* (4.88 mm) in Table 1. The result obtained are also corroborated with the work done by Ganie *et al.,* (2013a), Balai *et al.,* (2016), Kumar *et al.,* (2016), Yadav *et al.,* (2018), Verma *et al.,* (2020) and Garg *et al.,* (2020).

Per cent growth inhibition of *Alternaria solani*

Different treatments were tested against *A. solani in vitro* at 1000, 1500, 2000, 2500 and 3000 ppm concentrations. The result pertinent that hexaconazole at 3000 ppm proved significantly superior to all other treatments exhibiting 80.03 % of per cent growth inhibition of the test fungus. This was followed by mancozeb (78.97 %) and the other treatments in ordered to their efficacy were carbendazim (70.97%), *T. viride* (69.52%), *T. horzianum* (67.53%), *Pseudomonas fluorescens* (66.50%), neem leaf extract (65.90 %), garlic extract (64.58 %) and onion extract (61.74 %). On an overall basis, the extent of per cent growth inhibition by the treatment increased with increase in their concentrations with a minimum inhibition of onion extract (51.84%) at 1000 ppm and increased gradually to 61.74 % at 3000 ppm concentrations recorded and presented in Table 2. Ganie *et al.,* (2013b) evaluated five systemic fungitoxicants *viz*; thiophanate methyl, carbendazim, hexaconazole, fenarimol and difenoconazole under *in vitro* conditions against *A. solani* and found that most effective and exhibited a maximum mean mycelial growth inhibition of 84.19 per cent. Tetarwal and Rai (2007) reported the hexaconazole as best treatment against early blight of potato. Similar results were also reported by Patel and Chaudhary (2010), Sudarshana *et al.,* (2012) and Sadana and Didwania (2015).

Table.1 Effect of different plant extracts, bio agents and fungicides at different concentrations on radial growth of *Alternaria solani*

	Radial growth (mm) of *Alternaria solani* at different concentrations					
	Treatments	**1000 ppm**	**1500 ppm**	**2000 ppm**	**2500 ppm**	**3000 ppm**
T_1	Hexaconazole	4.28	4.08	3.88	3.46	3.00
T_2	Mancozeb	5.33	5.00	4.88	3.75	3.16
T_3	Carbendazim	5.53	5.30	5.11	4.80	4.36
T_4	*Trichodermaviride*	5.76	5.46	5.20	4.83	4.58
T_5	*Trichodermaharzianum*	6.16	6.00	5.35	5.00	4.88
T_6	*Pseudomonas fluorescens*	6.41	6.10	5.50	5.25	5.08
T_7	Neem leaf extract	6.66	6.33	5.66	5.41	5.25
T_8	Garlic extract	6.66	6.58	6.00	5.58	5.41
T_9	Onion extract	7.30	7.00	6.25	6.08	5.75
T_{10}	Check	15.16	15.16	15.16	15.50	15.03
	S.E.(d)	0.44	0.44	0.49	0.57	0.69
	$C.D_{(0.05)}$	0.96	0.95	1.06	1.24	1.49

Table.2 Efficacy of different plant extracts, bio-agents and fungicidesat different concentrations on per cent growth inhibition of *A.solani*

	Per cent growth inhibition of *Alternaria solani* at different concentrations					
	Treatments	**1000 ppm**	**1500 ppm**	**2000 ppm**	**2500 ppm**	**3000 ppm**
T_1	Hexaconazole	71.76	73.08	74.40	77.67	80.03
T_2	Mancozeb	64.84	67.01	67.81	75.80	78.97
T_3	Carbendazim	63.52	65.03	66.29	69.03	70.97
T_4	*Trichodermaviride*	62.00	63.98	65.69	68.83	69.52
T_5	*Trichodermaharzianum*	59.36	60.42	64.70	67.50	67.53
T_6	*Pseudomonas fluorescens*	57.71	59.76	63.72	66.12	66.50
T_7	Neem leaf extract	56.06	58.24	62.66	65.00	65.90
T_8	Garlic extract	56.06	56.59	60.42	64.00	64.58
T_9	Onion extract	51.84	53.82	58.77	60.77	61.74
T_{10}	Check	0	0	0	0	0
	S.E.(d)	0.44	0.44	0.49	0.57	0.69
	$C.D_{(0.05)}$	0.96	0.95	1.06	1.24	1.49

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