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Evaluation of the effect of different fungicides against *Phytophthora infestans* (Mont) de Bary *(In vitro)*

Vinay Kumar, Ramesh Singh, RK Doharey and Satendra Kumar

Abstract
Late blight of potato caused by *Phytophthora infestans* (Mont.) de Bary is one of the the most serious disease of potato. Several management practices have been adopted for so for to minimize the disease. Butin the present investigation based on Laboratory condition. The efficacy of six different fungicides tested on mycelial growth of the *Phytophthora infestans* (Mont.) de Bary that minimum radial growth with 0.75 mm in diameter was recorded at 300 ppm concentration which was followed by 200 ppm, and 100ppm and 50 ppm. However, nomycelial growth recorded at 400 ppm. As per concern of percent inhibition the highest with 100 % inhibition was recorded from 400 PPM concentration of Metalaxyl. . Hence, the use of fungicides is the very effective method for management of plant disease and continuous use both systemic and even protective fungicides of fungicides may supressed growth of a develop strain of the *Phytophthora infestans* (Mont.) de Bary.

Keywords: Phytophthora, Late blight, Mycelium, Fungicides, Radial growth, ppm

Introduction
Potato (Solanumtubersom L) ranks third in importance as a food crop, following wheat and rice belonging to the family Solanaceae (Hawkes, 1989) [2]. It is considered as a good source of energy and proteins, sodium, potassium, thiamin, calcium, phosphorus, magnesium, vitamin B, folic acid and other vitamins. Late blight of potato caused by *Phytophthora infestans* (Mont.) de Bary is one of the most serious and destructive diseases of potato all over world, including India. The great Irish famine in 1845, due to late blight is one of the most dramatic episodes caused by a plant pathogen in human history (Khurana *et al*., 1998 [3]. Worldwide losses due to late blight of potato are estimated to exceed $5 billion annually and thus the pathogen is regarded as a threat to global food security. The disease caused yield losses ranging from 31-100%.The use of fungicides is the very effective method for management of plant disease. Several management practices have been adopted for so for to minimize the disease. But in the present investigation condition use of six different fungicides tested on mycelial growth of the *Phytophthora infestans* (Mont.) de Bary. In India, late blight pathogen attacked the potato crop in severe form wherever it is grown. However, it is comparatively more devastating in Himalayan and Nilgiri hills and causes severe crop losses. In Indo-Gangetic plains, depending upon prevailing weather conditions, the early appearance of late blight of potato may seriously damage the potato crop and causing heavy loss of potato growers.

Materials and Methods
The present investigations based on Glasshouse experiment was undertaken at Department of Plant Pathology, Chandra Shekhar Azad University of Agriculture and Technology Kanpur during crop season 2016-18. The procedure and techniques applied during the course of investigations were elucidated as below:

Isolation, purification, identification and maintenance of *Phytophthora infestans* (Mont) de Bary Collection of infected plant samples
Late blight infected leaves were collected from the potato field at Vegetable Research Farm, C. S. Azad University of Agriculture and Technology, Kanpur. Infected leaves with sporulation lesions were taken from the field and washed in sterilized water. The leaves were then placed in a humidity chamber with the leaf an axial side up. They were incubated at 18±1^{0}C in BOD, until sporulation appeared. Small pieces of infected tissue along with healthy portion from the sporulating border were cut and placed under potato slices in empty sterilized Petri-plates. The Petri-plates were incubated at 18± 1^{0}C for 10 days until there was a growth of abundant

mycelium on the upper side of the slice. Mycelium was taken from the tuber slices by using sterilized needle and transferred on the selective medium

Culture media

The *Phytophthora infestans* (Mont) de Barycauses late blight of potato belongs to Class Oomycetes and generally not grown on Potato Dextrose Agar Media. Therefore, following selective culture media are being used to isolate the fungus.

Tomato based specific media

Tomato juice medium:

Tomato juice	-	250ml
Calcium carbonate	-	0.04g
Agar powder	-	20gm
Distilled water	-	1000ml
Dextrose	- 20 g.	

The tomato dextrose agar medium prepared was sterilized at121.6℃, 15 psi. for 15 minutes in an autoclave.

Procedure

Fresh and healthy tomato were collected from market and washed thoroughly in running tap water and then distilled water to remove dust and foreign matter from the surface. 250 gm tomato was taken and cut into the small pieces and grinding with electric mixer or Oster food blender. The obtained slurry was passed through a sieve with a pore size of 1.5×1.5mm to remove large pieces of tissues. The filtrate was measured in a measuring cylinder and final volume made up to 1lt by adding more distilled water. It was again poured in sauce pan and heated. 20 gm agar powder was added slowly in heating juice. The solution was boiled for some time till it tends to solidify on cooling. The prepared media was then poured in four conical flask of about 200 ml. 10 ml of media was poured in 10 culture tubes. Both conical flask and culture tubes were plugged with non-absorbent cotton and mouth was wrapped with butter paper and rubber band. The culture tubes were placed vertically in wire baskets. The media in flask and culture tubes were then autoclaved at 15 lb/inch^{2}pressure (15 psi) for 20 minutes at 121.6^{0}C.

Isolations of pathogen

A small piece of infected leaf from border of sporulating lesion along with some healthy green tissue was cut and dipped in mercuric chloride solution (0.1%) for 30 seconds rinsed in sterilized distilled water thrice and dried off with sterilized filter paper. The small pieces were then placed on tomato extract based media which was previously pour in sterilized in Petri plates. The plates were then incubated at 18± 1^0 C. The Petri plates were observed daily to find out the presence of mycelium around the leave bits. As soon as the mycelia growth is notices around the bits, the pathogen was purified by hyphal tip culture method.

Purification of *Phytophthora infestans (*Mont) de Bary

The white mycelial bits of *Phytophthora infestans (*Mont) de Bary was removed from the margin of fungal colony and then transferred to another Petri-plate which was previously poured with sterilized tomato extract based medium. After purification, the pure culture of *Phytophthora infestans (*Mont) de Bary was transferred on slant medium and incubated at 15-18^{0}C in darkness till full growth. The culture was then transferred into the incubator at 10-12^{0}C for further use.

Identifications and Maintenance of *Phytophthora infestans* (Mont) de Bary

The isolated pathogen was identified on the basis of its morphological and cultural characters and pathogenic behaviour towards the host. *Phytophthora infestans* (Mont) de Bary belong to the class Oomycetes. The vegetation is mycelium characterized by the absence of cross walls, along with both asexual and sexual reproduction occurs. The sporangiophores and sporangia emerge at asexual reproduction phase. The sporangia are lemon shape, measurement of 21- 38µm× 12-23µm.Sporangia develop at the end of these sporangiophores. Oospores are found at sexual reproduction. When mycelia of different mating types of the fungus grow together, one of them may from antheridia and the other oogonia. The oogonium grows through the antheridium, allowing fertilization. The fertilized oogonium develops into a thick – walled oospore, while the oospore is orange red, nearly round – shaped, measurement of 28-32µm. The pathogen was found to produce the characteristics leaf spot symptoms on the affected plants. The isolation pathogen was identified on the basis of its morphological and cultural characters and pathogenic behaviour towards the host.

After confirmation of isolated pathogen *Phytophthora infestans* (Mont) de Bary The pure culture was transferred on media slant and maintain in the BOD at 10 - 12℃ for further study.

Pathogenicity test

The pathogenicity test of isolated fungus was conducted on healthy potato plants in order establish the pathogenic nature of the fungus. The pathogenicity was tested according to Koch's postulates (1882).

The earthen pots of 30cm diameter were taken to conduct the present experiment. Initially the pots were filled with sterilized soil and water was added to bring the soil under good tilt condition. The healthy tubers of potato variety *Kufri Pukhraj* were placed in these pots and were allowed to grow for one month. The homogenized spore suspension was prepared in sterilized water from 7 days old culture of *Phytopthora infestans (*Mont) de Bary. The suspension was sprayed on one month old potato plants @ 2ml/plant. The inoculated plants were placed on the bench of glass house. After 2-3 days, the plants began to show the symptoms of blight. The inoculated plants showed pale to dark green spots occur at the leaf tips and margins that change into brown or black lesions lair. These lesions are not delimited in size and enlarged rapidly in a favourable weather. On the lower side of leaves, a white mildew appears on the surface of lesions where the pale land purplish tissues join. These symptoms confirmed that the blighting was caused by *Phytophthora infestans (*Mont) de Bary.

3.6. *In vitro* activity of fungicides against *Phytophthora infestans (*Mont) de Bary

Three fungicides belonging to different groups were screened, against the pathogen under laboratory conditions to find out their relative efficacy in inhibiting the growth of the pathogen in culture by the "Food Poison Technique"(Schmitz, 1930) [4]**.** Required quantity of each fungicide was incorporated in already prepared two per cent tomato extract medium prior to solidification and thoroughly mixed them by shaking prior to pouring in sterilized Petri plates. The medium was allowed to solidify and then 5 mm. bits of fungal culture from seven days old culture were placed at the centre of Petri plates. The fungal disc was reversed so that the pathogen could come in

direct contact with the medium. Three replications were kept for each treatment. The Petri plates were incubated at 18±1°C. One set of control was maintained in which the medium was not mixed with any fungicide but simply inoculated with the pathogen. The data on radial growth of fungal colony was measured in mm. after every 24 hours till the control petriplates were not filled up. The per cent inhibition over control was calculated by the following formula as given by Bliss (1934).

$$I = \frac{C - T}{C} \times 100$$

Where,
I= Percent inhibition in mycelia growth
C = Growth of pathogen in control plates.
T = Growth of pathogen in dual culture plates.

Experimental finding

The investigation on carried out on "Studies on late blight of potato caused by *Phytophthora infestans* (Mont.) de Bary".
The details of the experiment on symptomatology, isolation, purification, pathogenicity test, identification, technique described under material and methods. The experiments were carried *in-vitro*. The results of the experiment are presented below:-

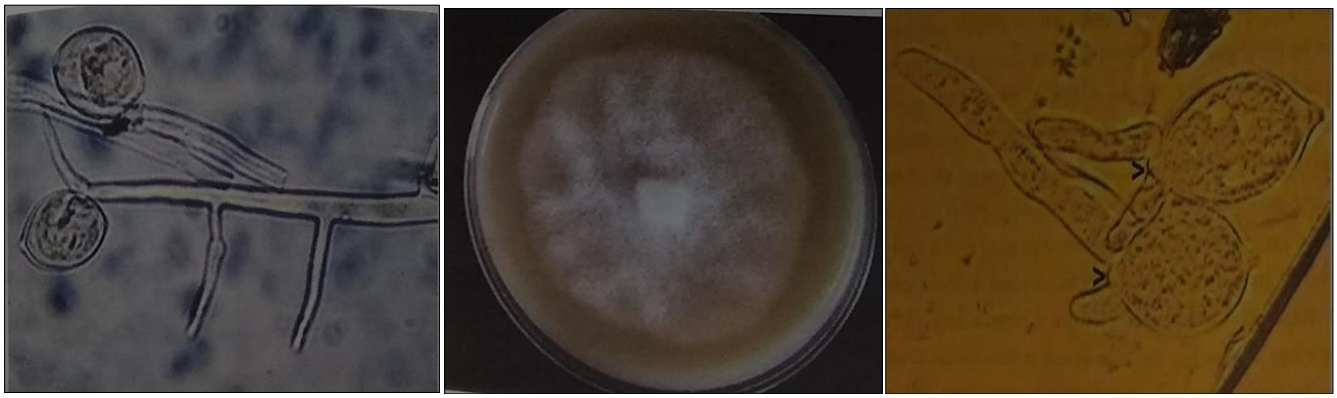
4.0. Collection, isolation, purification and identification of pathogen.

4.1. Symptomatology

Symptoms appear at first as water-soaked spots, usually at the edges of the lower leaves. In moist weather, the spots enlarge rapidly and form brown, blighted areas with indefinite borders. A zone of white, downy mildew growth of 3 to 5 millimeters wide appears at the border of the lesions on the undersides of the leaves. Soon entire leaves are infected, die, and become limp. Under continuously wet conditions, all tender, above ground parts of the plants blight and rot away giving off a characteristic odor. Entire potato plants and plants in entire fields may become blighted and die in a few days or a few weeks. In dry weather, the activities of the pathogen are slowed or stopped. Existing lesions stop enlarging, turn black, curl, and wither and no mycelial growth appears on the underside of the leaves.
When the weather becomes moist again the mycelial growth resumes its activities and the disease once again develops rapidly. Affected tubers at first show purplish or brownish blotches consisting of water-soaked, dark, somewhat reddish brown tissue that extends 5 to 15 millimeters into the flesh of the tuber. Later the affected areas become firm and dry and somewhat sunken. Such lesions may be small or may involve almost the entire surface of the tuber without spreading deeper into the tuber interior. The rot, however, continues to develop after the tubers are harvested. Infected tubers may be subsequently covered with sporangiophores and spores of the pathogen or become invaded by secondary fungi and bacteria, causing soft rots and giving the rotting potatoes a putrid, offensive odor.

4.2. Isolation and identification of the pathogen

The isolation pathogen was identified on the basis of its morphological and cultural characteristic as described by Akhtar *et al*., (2005) [5]**.** The sporangia are multinucleate (7-30 nuclei), thin – walled, hyline, oval or pear shaped with a definite papilla at the apex. They measure 22-33µm × 16-24µm. Sporangia develop at the end of these sporangiophores. The fertilized oogonium develops into a thick – walled oospore, while the oospores are orange red, nearly round – shaped, measurement of 28 - 32µm (Fig. 1).



A: Sporangium B: Mycelial growth C: Germinated sporangia

Fig 1: Morphological characteristic of *Phytophthora infestans*

change into brown or black lesions later. These lesions are not delimited in size and enlarged rapidly in a favorable weather. On the lower side of leaves, a white mildew appears on the surface of lesions where the pale and purplish tissues join. These symptoms confirmed that the blighting was caused by *Phytophthora infestans* (Mont. de Barry). (Fig: 2).Re-inoculations were made from infected plant and culture was compared with original cultures to confirm the identity and pathogenicity of the pathogen.

4.4. *In vitro* studies of different fungicide against *Phytophthora infestans* (Mont. de Barry)

Six fungicide ware tested at different concentrations i.e. 200, 400, 600, 800 and 1000 ppm under *in vitro* condition by using 'Poison Food Technique' to find out the inhibitory effect of these fungicides on mycelial growth of *Phytophthora infestans*. (Mont. de Barry).

Symptoms on Stem Symptoms on leaves

Fig 2: Pathogensity test

The experimental findings are as below:

4.4.1. Effect of Potassium paramagnet on radial growth of *Phytophthora infestans* (Mont. de Barry) **at 72 hrs.** Potassium paramagnet was evaluated *in vitro* against *Phytophthora infestans* (Mont. de Barry) by Poison Food Technique at 200, 400, 600, 800 and 1000 ppm concentrations after 72 hrs. of incubation.

Table 1: Effect of Potassium paramagnet on radial growth of *Phytophthora infestans* (Mont. de Barry) at 72 hrs

Concentration(ppm)	Radial growth(mm)	Inhibition %
200	45.00	15.61
400	43.33	18.75
600	39.33	26.25
800	36.0	32.49
1000	32.66	38.75
Control	53.33	-
CD (0.05)	3.057	-
SE(d)	1.425	-
C.V.%	4.894	-

Data presented in Table 1 indicated that minimum radial growth (32.66 mm) with 38.75% inhibition was recorded at 1000 ppm concentration, followed by 800 ppm (36.00 mm, 32.49%), 600 ppm (39.33 mm, 26.25 %) , 400 ppm (43.33 mm, 18.75%), 200 ppm(45.00 mm, 15.61%), respectively as compare to control. From the table 1 it is cleared that Potassium permagnet is moderately compatible with *Phytophthora infestans* (Mont. de Barry) at recommended dose. Statistical analysis of the data revealed that each treatment varied in variably and significantly.

4.4.2. Effect of Bavistin 50% WP on radial growth of *Phytophthora infestans* (Mont. de Barry) **at 72 hrs. (*In vitro*)** Bavistin is a systemic fungicide with protective action. Bavistin evaluated in against *Phytophthora infestans* (Mont. de Barry) by Poison Food Technique at 200, 400, 600, 800 and 1000 ppm concentrations after 72 hrs. of incubation .

Table 2: Effect of Bavistin 50% WP on radial growth of *Phytophthora infestans* at 72 hrs.

Concentration (ppm)	Radial growth(mm)	Inhibition %
200	46.00	16
400	43.00	21
600	35.00	35
800	32.00	41
1000	28.00	48
Control	54.00	
CD (0.05)	3.18	
SE(d)	1.43	
C.V.%	4.38	

Data presented in Table 2 showed that minimum radial growth with 28 mm in diameter was recorded at 1000 ppm concentration followed by 800 ppm (32 mm ,41%) , 600 ppm (35 mm 35%) , 400 ppm (43 mm) , 200 ppm with 46 mm in diameter. From the table, it is cleared that concentration of fungicide with inversely proportion with radial growth of mycelium. On the other hand, per cent inhibition of mycelium growth varied from 16 – 48%. Bavistin is moderately compatible with *Phytophthora infestans* (Mont. de Barry) at recommended dose. Statistical analysis of the data revealed that each treatment varied in variably and significantly.

4.4.3. Effect of Metalaxyal 50% WP on radial growth of *Phytophthora infestans* (Mont. de Barry) **at 72 hrs. (*In vitro*)** Metalaxyal is a non-systemic fungicide with protective and curative action. Metalaxyal was evaluated *in vitro* against *P. infestans* by Poison Food Technique at 50, 100, 200, 300 and 400 ppm concentrations after 72 hrs. of incubation .

Table 3: Effect of Metalaxyal 50% WP on radial growth of *Phytophthora infestans* (Mont. de Barry) at 72 hrs.

Concentration(ppm)	Radial growth(mm)	Inhibition %
50	5.66	91.20
100	4.66	92.75
200	1.36	97.88
300	0.75	98.33
400	0.00	100
Control	64.33	
CD (0.05)	3.980	
SE(d)	1.559	
C.V.%	20.721	

Data presented in Table 3 indicated that minimum radial growth with 0.75 mm in diameter was recorded at 300 ppm concentration which was followed by 200 ppm, 100 ppm and 50 ppm. However, no mycelial growth recorded at 400 ppm. As per concern of per cent inhibition, the highest with 100% inhibition was recorded from 400 ppm concentration of metalxyal (Fig: 3). metalaxyal is not compatible at recommended dose. From the table, it is also cleared that there were significance differences among all the treatments.

4.4.4. Effect of Tubaconazole50% WP on radial growth of *Phytophthora infestans* (Mont. de Barry) **at 72 hrs. (*in vitro*)** Tubaconazole is a systemic fungicide with protective and curative action. Tubaconazole was evaluated *in vitro* against *Phytophthora infestans* (Mont. de Barry)by Poison Food Technique at 200, 400, 600, 800 and 1000 ppm concentrations after 72 hrs. of incubation.

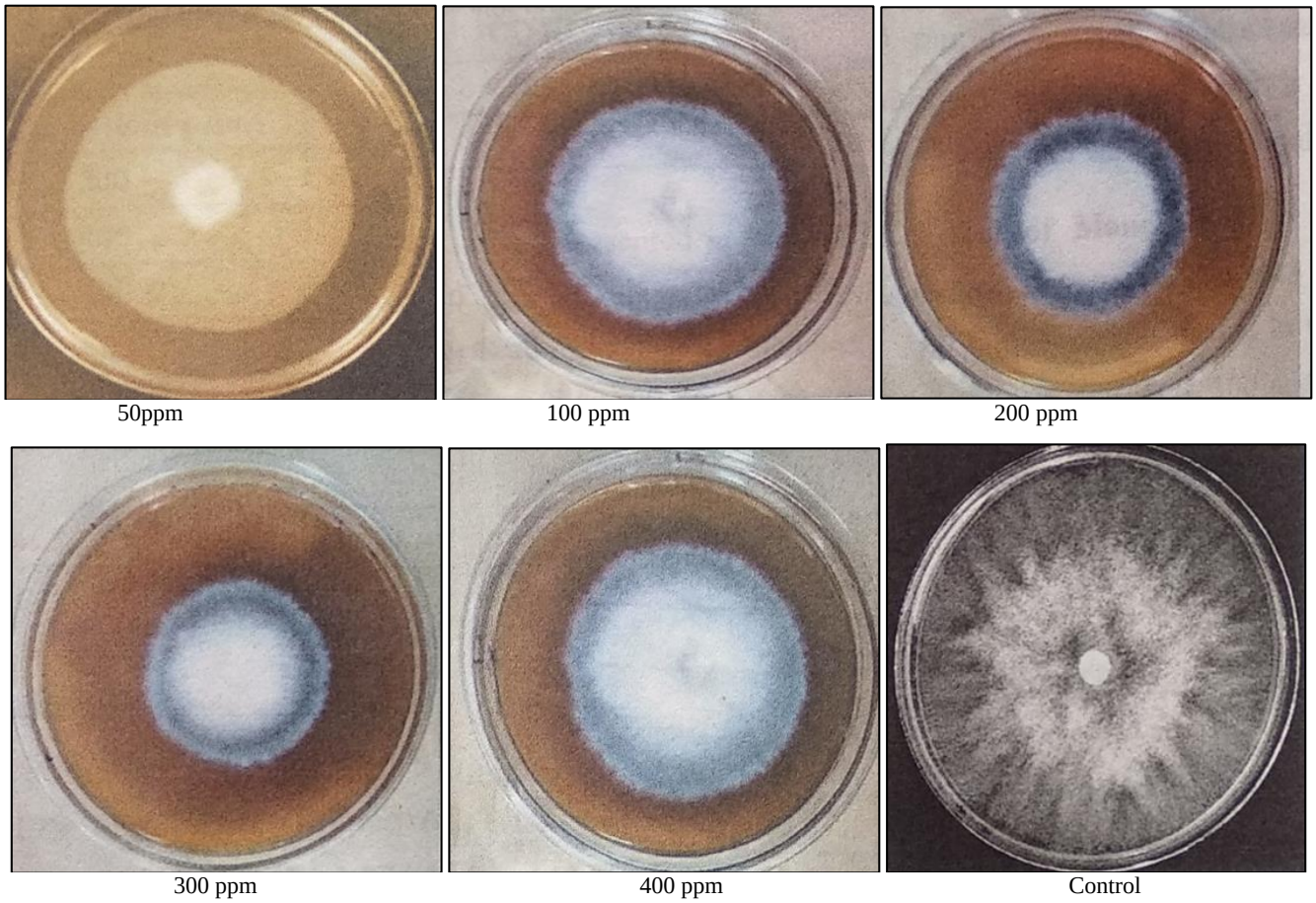


Fig 3: Effect of different concentration of Metalaxyal on mycelial growth of *Phytophthora infestans* (Mont. de Barry)

Table 4: Effect of Tubaconazole 50% WP on radial growth of *Phytophthora infestans* (Mont. de Barry) at 72 hrs.

Concentration(ppm)	Radial growth(mm)	Inhibition %
200	40.33	3.19
400	37.33	10.39
600	34.33	17.59
800	32.00	23.18
1000	29.33	29.59
Control	41.66	
CD (0.05)	6.405	
SE(d)	2.986	
C.V.%	11.909	

Data presented in Table 4 indicated that minimum radial growth with 29.33 mm in diameter of mycelium growth was recorded at 1000 ppm concentration, which is inhibited by 29.59% over control. The rest of the treatments like 800 ppm, 600 ppm, 400 ppm and 200 ppm also inhibited the mycelium gr owth of fungi, showing 32.33 mm, 34.33 mm, 37.33 mm and 40.33 mm respectively. Tubaconazole is moderately compatible with *Phytophthora infestans* (Mont. de Barry) at recommended dose. It is also cleared from the table that each treatment varied in variably and significantly.

4.4.5. Effect of Mancozeb 75% WP on Radial growth of at 72 hrs *Phytophthora infestans* (Mont. de Barry) **(*in vitro*)** Mancozeb was evaluated in vitro against *Phytophthora infestans* (Mont. de Barry)by Poison Food Technique at 50, 100, 200, 300 and 400 ppm concentrations after 72 hrs. of incubation.

Table 5: Effect of Mancozeb 75% WP on radial growth of *Phytophthora infestans* (Mont. de Barry) at 72 hrs.

Concentration(ppm)	Radial growth(mm)	Inhibition %
50	9.66	85.36
100	7.00	88.89
200	3.00	92.93
300	4.00	95.45
400	1.00	96.72
Control	59.00	
CD (0.05)	4.82	
SE(d)	2.24	
C.V.%	20.764	

Data presented in Table 5 indicated that minimum radial growth (1.00 mm) with 96.72% inhibition was recorded at 400 ppm concentration followed by 300 ppm (4.00 mm, 95.45%), 200 ppm (3.00 mm, 92.93%), 100 ppm (7.00 mm, 88.89), 50 ppm (9.66 mm, 85.36%) respectively as compare to control (Fig: 4). Mancozeb is moderately compatible with *Phytophthora infestans* (Mont. de Barry) at recommended dose. It is also cleared from the table that each treatment varied in variably and significantly.

4.4.6. Effect of Tricyclozole 75% WP on Radial growth of *Phytophthora infestans* (Mont. de Barry) **at 72 hrs (*in vitro*):** Tricyclozole is a systemic fungicide with protective and curative action. Tricyclozole was evaluated *in vitro* against *Phytophthora infestans* (Mont. de Barry) by Poison Food Technique at 200, 400, 600, 800 and 1000 ppm concentrations after 72 hrs. of incubation .

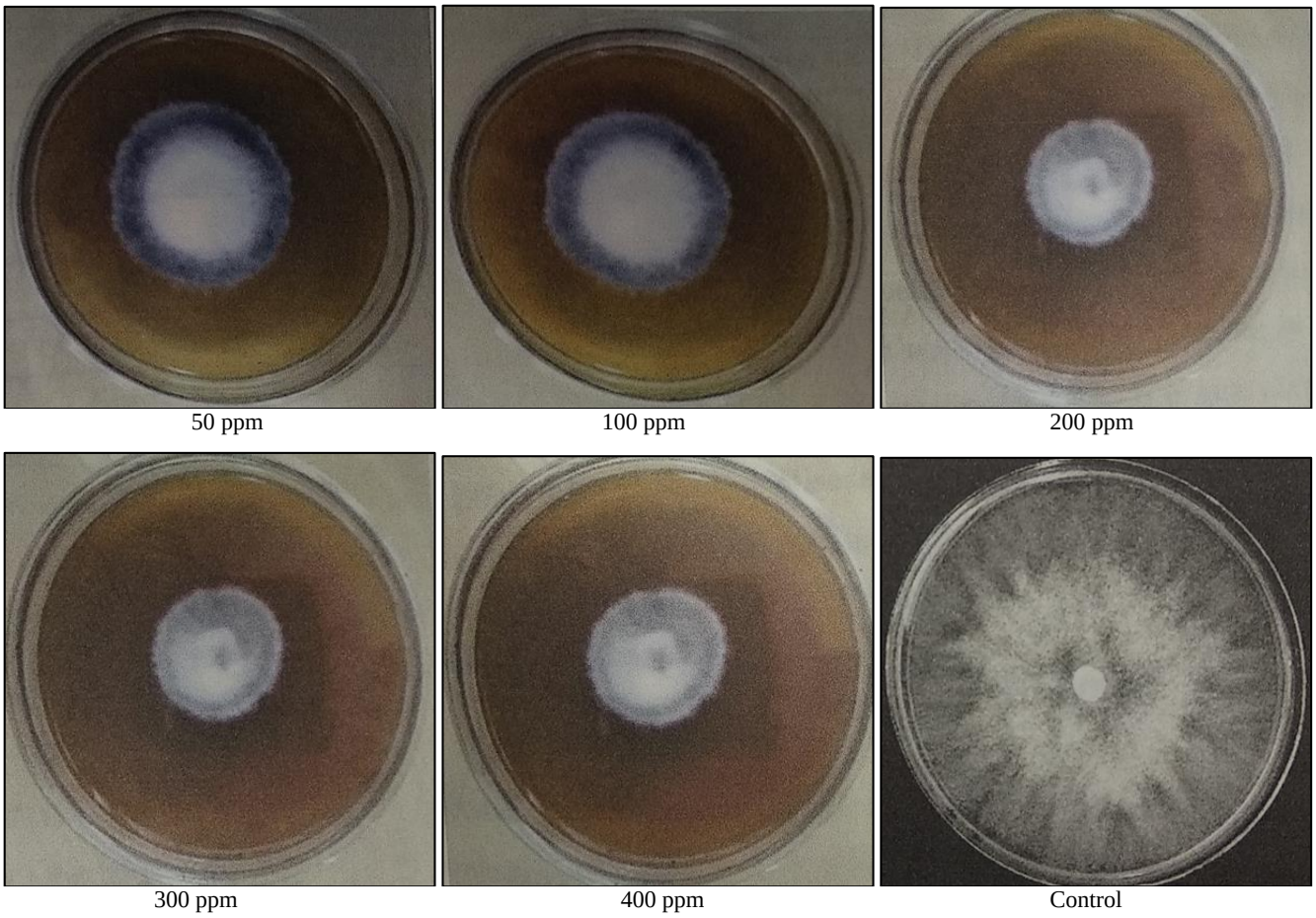


Fig 4: Effect of different concentration of Mancozeb on mycelial growth of *phytophthora infestans* (Mont. de Barry)

Table 6: Effect of Tricyclozole75% WP on radial growth of *Phytophthora infestans* (Mont. de Barry) at 72 hrs.

Concentration(ppm)	Radial growth(mm)	Inhibition %
200	46.66	21.79
400	44.67	25.14
600	41.67	30.17
800	38.00	36.30
1000	33.00	44.60
Control	59.67	
CD (0.05)	14.53	
SE(d)	6.930	
C.V.%	22.534	

Data presented in Table 6 indicated that minimum radial growth with 33.00 mm in diameter of mycelium growth with was recorded at 1000 ppm concentration which is inhibited by 44.60% over control. The rest of the treatments like 800 ppm, 600 ppm, 400 ppm and 200 ppm also on which the mycelium growth of fungi showing 38.00 mm, 44.67 mm, 46.66 mm and 46.66 mm respectively. Tricyclozole is moderately compatible with *P. infestans* at recommended dose. It is also cleared from the table that each treatment varied in variably and significantly.

Discussion

Potato (*Solanumtuberosum* L.) belongs to the family Solanaceae, considered as King of vegetables. It is the most widely cultivated vegetable crop in the country. It can cultivate in a wider range of altitude, latitude and climatic conditions. China stands top at the list with around 23% of the world's potato produce that is around 322 million. Various methods like cultural practice, chemical, biological and use of resistance varieties are used to manage the disease reported by several workers (Singh, 1996; Joshi and Pundhir, 2013; Shailbala and Pundhir, 2008;) [8, 7, 6]. There is no doubt that application of fungicides is a true method for potato protection, but continuous use of fungicides leads to increase in the development resistance strain of *Phytophthora infestans* (Mont. de Barry)to use both systemic and even protective fungicides. Therefore, search for new, eco-friendly and non-conventional method of plant protection is an indispensable need of these days.

The preliminary works on pathogenicity test of isolated fungus was conducted on healthy potato plants in order to establish the pathogenic nature of the fungus. The pathogenicity was tested according to Koch's postulates (1882)

Studied in detail and gave it a generic name *Phytophthora* (plant destroyer) on account of its special feature of indeterminate sympodial sporangiophores with ovoid, detachable and appellate sporangia and the fungus got its final title of *Phytophthora infestans* (Mont. de Barry)these observations are in accordance with Anton de Bary (1876) [1].

In the present studies (*in vitro*), six different fungicides are used to find out their fungicidal affectivity against *Phytophthora infestans* (Mont. de Barry). On the basis of the fungicidal inhibitory effect on the growth of the pathogen, revealed that the different concentrations of the Potassium permagnet have different types of fungicidal affectivity. The minimum radial growth (32.66mm) with 38.75% inhibition was recorded at 1000 ppm concentration, followed by 800 ppm (36.00 mm, 32.49%), 600 ppm (39.33 mm, 26.25 %) , 400 ppm (43.33 mm, 18.75%), 200 ppm (45.00mm, 15.61%), respectively as compare to control (Fig 6).Thus it is indicated that potassium permagnet is moderately compatible with *P. infestans* at recommended dose. Similarly, different

concentrations of Bavistin indicated that minimum radial growth (28.00 mm)

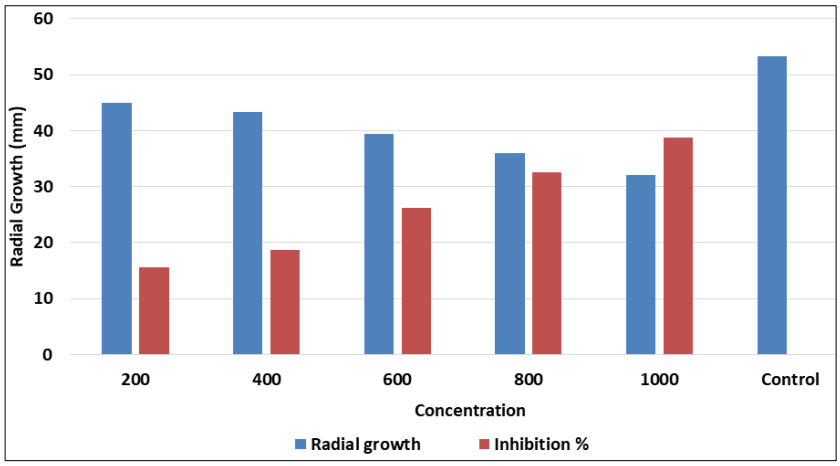


Fig 6: Effect of concentration of Potassium permagnet on mycelial growth of *phytophthora infestans* in diameter

with 48.77% inhibition was recorded at 1000 ppm concentration followed by 800 ppm (32.33 mm , 40.85%) , 600 ppm (35.33mm , 35.36%) , 400 ppm (43.00 mm , 21.33%) , 200 ppm (46.00 mm , 15.84%), respectively as compare to control (Fig: 7). The minimum radial growth (28 mm) with 48.77per cent inhibition was recorded at 1000 ppm concentration as compare to control (Fig: 8). However, no mycelial growth was recorded at 400 ppm. Minimum radial growth with 30.16mm in diameter of mycelium growth with was recorded at 1000 ppm concentration, which is inhibited by 29.59% over control (Fig: 9). The rest of the treatment likes 800 ppm, 600 ppm, 400 ppm and 200 ppm also on which the mycelium growth of fungi shows 32.00mm, 34.33mm, 37.33mm and 40.33mm, respectively. Tubaconazole is moderately compatible with *P. infestans* at recommended dose. It is also cleared from the table that each treatment varied in variably and significantly. In case of Mancozeb minimum radial growth (2.12 mm) with 96.72% inhibition was recorded at 400 ppm concentration followed by 300 ppm (3.00 mm, 95.245%), 200 ppm (4.66 mm, 92.93%), 100 ppm (7.33mm, 88.89, 50 ppm (9.66 mm, 85.36%), respectively as compare to control (Fig: 10). Similarly minimum radial growth (33.0mm) with 44.60 % inhibition was recorded at 1000 ppm concentration followed by 800 ppm (38.00 mm, 36.30%), 600 ppm (41.66 mm, 30.17%), 400 ppm (44.66 mm, 25.14%), 200 ppm (46.66 mm, 21.79%), respectively as compare to control (Fig:11). Metalaxyl is not compatible at recommended dose and there significance differences among all the treatments finding were reported by Basharat *et al.* (2011).

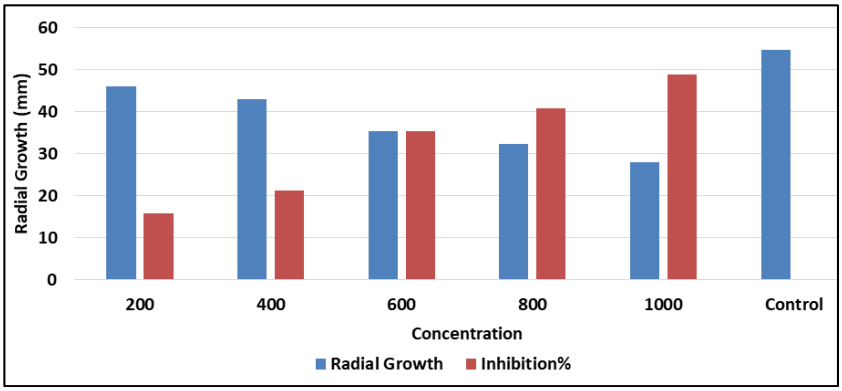


Fig 7: Effect of different concentration of Bavistin on mycelial growth of *phytophthora infestans* (Mont. de Barry) (in diameter)

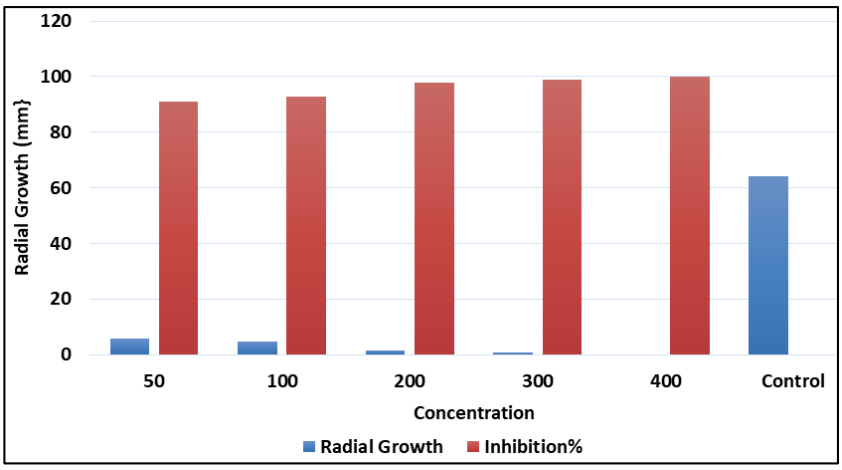


Fig 8: Effect of different concentration of Metalaxyl on mycelial growth of *phytophthora infestans* (Mont. de Barry) (In diameter)

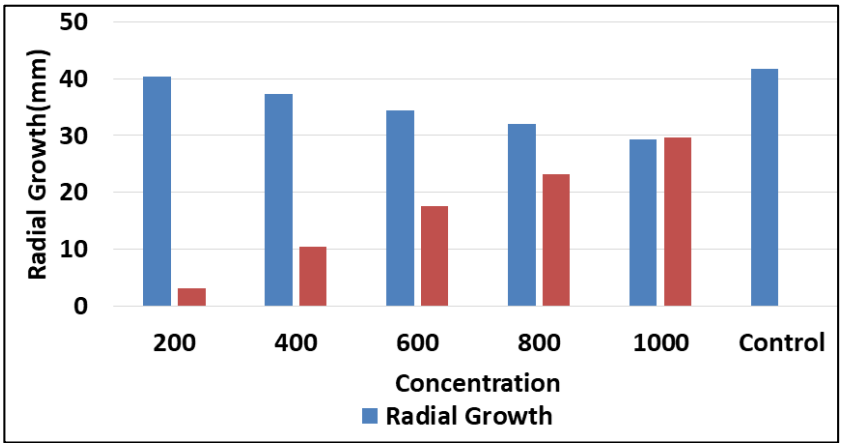


Fig 9: Effect of different concentration of Tubaconazole on mycelial growth of phytopthora infestans (In diameter)

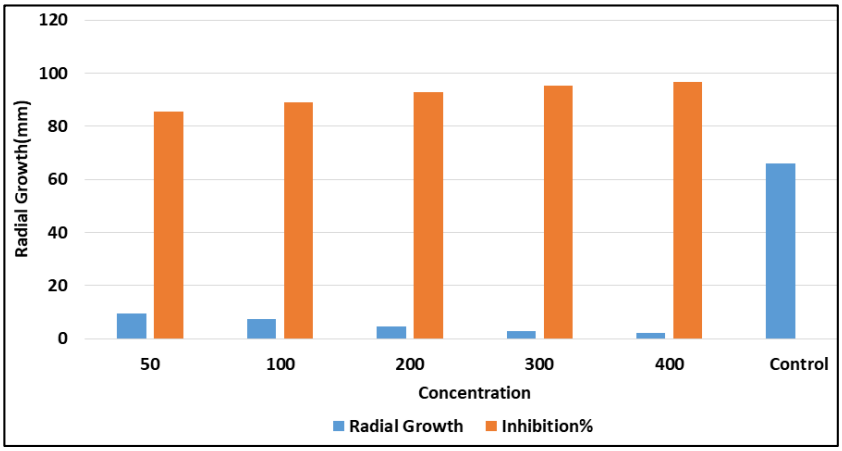


Fig 10: Effect of different concentration of Mancozeb on mycelial growth of *phytophtora infestans* (Mont. de Barry) (in diameter)

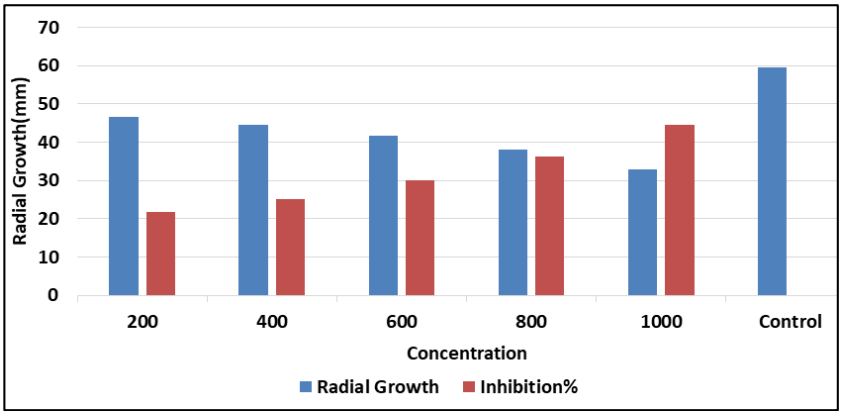


Fig 11: Effect of different concentration of Tricyclozole on mycelial growth of phytophthora infestans (Mont. de Barry) (in diameter)

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