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Potentiality of bioagents on growth, yield and late blight disease of potato

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With the objectives of studying the potentiality of different types of bioagents on growth, yield and late blight disease of potato, nine treatments including control were selected for testing in this trial during the winter season of 1999-2000 and 2000-2001 in Hooghly area of West Bengal. Though all these treatments more of less proved to be superior over control, but seed dressing with *Trichoderma viride* +*Pseudomonas fluorescens* @ 2.5 g /kg each, gave significantly highest seed germination (95.0%). reduced late blight severity (10.0%) and increased the yield (265.7 q/ha), through enhancing plant growth in terms of plant weight (average, 375.0 g), tuber number/plant (average, 15.0), and tuber yield / plant (average, 525.0 g) as compared to control in all respect. Next best results was obtained due to seed treatment with *Azotobacter* @ 10.0g /kg, where *Azotobacter* not only exhibited higher seed germination (90.0%) and plant growth, but also increased the yield (260.0 q/ha), through reducing the late blight disease (8.0%) to a considerable level. On the other hand, all other treatments did not response so remarkably. Hence, it can be recommended that, bioagents like *T. viride* + *P. fluorescens* or *Azotobacter* may be used as seed treatment at the time of planting of potato for managing late blight disease and maintaining good plant growth and marketable yield of tubers particularly for this agroclimatic zone of West Bengal.

Key words : *Trichoderma* sp., *Pseudomonas* sp., *Azotobacter* sp., potato crop, growth, yield, disease.

INTRODUCTION

In West Bengal, potato is an important field crop next to cereals, occupying 315.90,000 ha cultivated area and total production 7482.30,000 tonnes during the year 1999-2000. In this state 80 % of the total production comes from the districts like Hooghly, Burdwan and Midnapore. Late Blight disease caused by *Phytophthora infestans* (Mont.) de Bary, is one of the most important diseases of potato in West Bengal. Average annual yield loss due to this disease is approximately 2-75 % of the total production (De and Basu, 2002). Pathogen mainly survives in seed tubers in the plains (Hector, 1925). On the other hand, the intensive cultivation practices with large doses of agrochemicals has resulted into pollution of environment and degradation of soil health. In this situation, an ecofriendly approach towards disease management practices should be adopted to maintain the sustainability of potato production. From this point of view, the impact of bioagents should be assessed in the same manner as we think about plant pathogens. Because bioagents like *T. Viride* acts as hyperparasite towards *R. solani* and *S. rolfsi,* causing death and lysis of cells (Dennis and Webster, 1971; Durrel, 1966). *Pseudomonas fluorescens* being bacterial antagonist, inhibits *R. solani* pathogen through antibiosis (Lin *et al.*, 1992). In addition to these, application of biofertilizers as supplementary source of nutrition has been well established nowadays. *Azotobactor* and *Azospirillium* help in nitrogen fixation and supply to the crops (Marwaha, 1995). Again *Phosphobacteria* helps in making available soil phosphorus to the crops. Plant growth promoting bacteria like *Bacillus* spp.significantly increase root masses, root volume and tuber yield. Therefore, the

use of bioagents is an ecofriendly approach against existing chemical management practices for seed and soil borne diseases (Adam, 1990).

Hence, present investigation was carried out to test the potentiality of some bioagents viz. *Trichoderma viride, Pseudomonas fluorescens, Azotobactor, Azospirillium Phosphobacteria* and *Bacillus* spp. against late blight disease of potato caused by *Phytophthora infestans* (Mont.) de Bary.

MATERIALS AND METHODS

The trial was conducted under field condition during winter season of 1999-2000 and 2000-2001 at Adisaptagram Block seed farm, Hooghly, West Bengal. The experiments were designed in RBD with four replications having plot size 3.0 m × 2.0 m using seeds of susceptible cultivar Kufri Chandramukhi. The planting was done in the middle of November every year after treatment at 60 × 20 cm spacing. Potato tubers of Kufri Chandramukhi having apparently 10 % late blight infections were sown for producing diseased plants. Data on growth parameters i.e., average plant weight(g), average number of tuber / plant, average tuber weight / plant(g). percent disease index (PDI) and yield of tuber(q/ha) were taken into account for this study. The percent disease index (PDI) was calculated by using formula given by Mc Kinney (1923), where,

$$\text{Percent disease index (PDI)} = \frac{\text{sum of numerical ratings}}{\text{number of leaves examined} \times \text{maximum disease rating}} \times 100$$

where disease ratings was done in a 9 point scale designed by Malcolmson (1970).1 = trace of infection, 2 = 11-25 % area infected, 3 = 26-40 % area infected, 4 = 41-50 % area infected, 5 = 51-60 % area infected, 6 = 61-70% area infected, 7 = 71-80 % area infected, 8 = 81-90 % area infected, 9 = collapsed. There were nine treaments including control in this trial, where, *Trichoderma viride* ($2x10^7$cfu/g), *Pseudomonas fluorescens* (10^9cfu/g), *Azotobacter* ($2x10^7$cfu/g), *Azospirillium*, ($2x10^7$cfu/g), *Phosphobacteria* ($2x10^8$cfu/g), *Bacillus subtilis* (10^9cfu/g) and *Bacillus cereus* (10^9cfu/g) were collected from diferent sources like Central Potato Research Insitute, Shimla and Anu Biotech Limited, Delhi. These treatments were treated with infected seeds at specific rates at the time of planting. The bioagents after mixing with sticker and sand were distributed evenly in the furrow. The results of the trial are presented in Tables 1 and 2.

RESULTS AND DISCUSSION

The results in Table 1, showed that all the nine treatments proved to be superior over control in all respect. But out of these, it is clearly noticed that, seed treatment with *T. viride + P.fluorescens* @ 2.5g/kg each gave best and significant results, where, this treatment increased the seed germination (95 %), lowered the disease severity (10.0 %) and increased the yield (265.7q/ha) as compared to control and other treatments. Next best performance was exhibited by *Azotobacter* seed treatment @ 10 g/kg, where the treatment increased seed germination (90.0 %), lowered the disease severity (8.0 %) and increased the marketable yield of potato (260.0 q/ha), in comparison to other treatments including control. From the Table 2, it is evident that, the plant growth of potato was also influenced by seed treatment with these bioagents. But, seed treatment with *T.viride + P.fluorescens* exhibited maximum plant growth in terms of average plant weight (375.0g), average tuber number /plant (15.0) and average tuber yield /plant (525.0g), as compared to control including other treatment with *Azotobacter* enhanced the plant growth in terms of average plant weight (350.0g), average tuber number/plant (15.0) and average tuber yield /plant (495.0g) in comparison to other treatments.

Therefore, from this study on bioagents, it is observed that, seed dressing with *T. viride + P.fluorescens* not only reduced the late blight severity, but also increased the plant stand and yield of tubers. Besides this, the seed treatment with *Azotobacter* also increased the plant growth and yield of tubers by reducing disease severity.

Mukhopadhyay (1994) and Basu *et al.*, (2001), reported that biological seed treatment not only reduces the disease but also increases the plant stand. It may be possible as a result of suppression of pathogen population through inhibitory effect

due to production of antibiotics (Allen *et al.*, 1935), which is actually happened in case of *T. viride* and *P. fluorescens*. On the other hand, Bhattacharya *et al.*, (2000) reported that seed treatment with *Azotobacter* in case of vegetables, increased the plant growth and yield, reducing disease severity, which can be ascribed to addition through biological N fixation, production of horomones like IAA, gibberelline and vitamin like biotin, folic acid and diferent B groups vitamins.

Table 1 : Effect of seed treatment with bioagents on late blight disease and yield of potato under field condition.

Treatment	Dose (g/kg)	Average Germination (%)	Average intensity of late blight disease (%)	% disease over control	Average yield (q/ha)	% increase over control
T. viride	5.0	85.0 (67.21)*	15.0 (22.8)*	73.21	250.6	44.13
P. fluorescens	2.5	82.7 (65.42)	20.7 (27.0)	63.0	238.7	41.34
T. viride + *P. fluorescens*	2.5+2.5	95.0 (77.08)	10.0 (18.43)	82.14	265.7	47.30
Azotobacter	10.0	90.0 (71.57)	8.0 (16.43)	85.71	260.0	45.15
Azospirillium	10.0	75.0 (60.00)	15.0 (22.8)	73.21	170.0	17.64
Phosphobacteria	10.0	80.0 (63.43)	12.7 (20.88)	77.32	175.0	17.64
B. subtilis	15.0	75.0 (60.00)	20.8 (27.23)	62.85	210.0	33.33
B. cereus	15.0	70.0 (56.79)	25.0 (30.0)	55.35	198.7	29.54
Infected control	—	50.0 (45.00)	56.0 (48.45)	—	140.0	—
CD (P = 0.05)		4.5	2.78		6.25	

*Figures in parenthesis are transformed angular values

Table 2 : Effect of seed treatment with bioagents on growth of potato plant under field condition.

Treatment	Average plant weight(g)	% increase over control	Average number of tubers/plant	% increase over control	Average yield/ plant(g)	% increase over control
T. viride	250.0	50	11.0	63.63	400.0	57.50
P. fluorescens	220.0	43.18	9.0	55.55	320.0	46.90
T. viride + *P. fluorescens*	375.0	66.66	15.0	73.33	525.0	67.60
Azotobacter	350.0	64.30	15.0	73.33	495.0	65.65
Azospirillium	211.5	40.90	10.8	63.00	275.0	38.20
Phosphobacteria	225.0	44.44	11.6	65.50	300.0	43.33
B. subtilis	238.2	47.52	9.0	55.55	225.0	32.35
B. cereus	228.5	45.30	8.0	50.00	210.5	19.23
Infected control	125.0	—	4.0	—	170.0	—
CD (P = 0.05)		4.82	2.75		4.38	

Hence, it can be inferred that, the late blight of potato can be effectively managed either through treating the seeds with *T. viride* + *P. fluorescens* or *Azotobacter* without disturbing plant growth and marketable yield of potato.

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