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PERFORMANCE OF SOME FUNGICIDES IN CONTROLLING LATE BLIGHT OF POTATO

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ABSTRACT

The experiment was conducted during 2007-2008 cropping season to determine the effectiveness and frequency of fungicidal spray for minimizing the incidence of late blight of potato. Fungicides, viz. Acrobat MZ (0.2%), Metaril 72 WP (0.2%), Nuben 72 WP (0.2%), Ridomil gold 68 WP (0.2%) and Secure 600 WG (0.1%) were included to study. All the fungicides significantly reduced the plant infection and PDI value over control. The lowest plant infection was recorded from Ridomil gold 68 WP spray. PDI decreased over control were 82.62, 81.46, 82.43, 81.66 and 84.36% for Acrobat MZ, Metaril 72 WP, Nuben 72 WP, Secure 600WG and Ridomil gold 68 WP, respectively. Maximum plant infection was found in single spray and the minimum was in triple sprayed plots.

Key words: *Late blight, Potato, Fungicide, Control*

INTRODUCTION

In Bangladesh, potato *(Solanum tuberosum)* is the third important food crop (Rahman, 2008). It plays an important role in supplying vegetables in the country through out the year and can solve the nutritional problems to a great extent for the lower income group of people. The production of potato was about 60 lac metric tons from 4 lac hectare of land according to Bangladesh Bureau of Statistics (BBS, 2009) during 2008-2009. The national tuber yield is about 15.0 t/ha, which is lower as compared to other potato growing countries of the world (Rahman, 2008).

The major constraints in potato production are the incidence of diseases. A total of 57 diseases (both biotic and abiotic) of potato have been recorded in Bangladesh (Hossain *et al.*, 2007). Out of them, late blight caused by *Phytophthora infestans* (Mont.) de Bary is the most serious disease of potato throughout the world (CIP, 1984). Late blight is also an important disease of potato in Bangladesh and it is considered to be the major limiting factor to potato production. Reduction of yield due to late blight in every year is more than 25% in the country ((Rahman, 2008). It occurs sporadically every year in Bangladesh and in some years it causes complete crop failure (Bari, 1986). Due to polycyclic nature of *Phytophthora infestans*, frequent race development is the common phenomenon of the organism. So far, 20 races of *Phytophthora infestans* have been identified in the country (Dey, 2004). Pathogenic variability makes this disease difficult to control. Although, resistant sources is the best weapons to combat the disease but the resistance in cultivar is not stable against the pathogen for long time (Singh 2000). At present, all the commercial varieties are susceptible to the late blight disease in Bangladesh. So, chemical control is the alternative approach to control or minimize the disease. Limited work on prevalence and chemical control of late blight have been done in Bangladesh (Fakir and Ahmad, 1974; Ali and Khan, 1990; Alam *et al.*, 1991; Hossain *et al.*, 1991 and Kabir *et al.*, 1991). Both contact and systemic fungicides continue to play an important role in managing potato late blight in sub-tropics. But indiscriminate use of fungicides resulted new races of *Phytophthora infestans* which are resistant against the fungicides. So, judicial, proper and appropriate number of spray schedule are urgently need to overcome such alarming disease and to save the crop. So, the study was undertaken to determine the effectiveness of the fungicides available to control late blight of potato in Bangladesh.

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MATERIALS AND METHODS

The experiment was conducted in experimental field of Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh during 2007-2008 cropping season to determine the performance of fungicides in minimizing the incidence of late blight of potato. The experimental plot was prepared by ploughing and cross ploughing followed by laddering to have a good tilth. Urea, triple super phosphate (TSP), Muriate of potash (MP), Gypsum, Zinc Sulphate and Boric acid were used at the rate of 325, 220, 250, 120, 14 and 6 kg per hectare, respectively. Whole quantity of TSP, MP, Gypsum, Zinc sulphate and Boron were applied at the time of final land preparation, while urea was applied in three installments; 50% at final land preparation and the rest 50% at 30 and 50 days after sowing. Apparently healthy tubers of variety Diamond were planted on November 23, 2007 maintaining spacing of row to row and tuber to tuber were 50 cm and 20 cm, respectively. The unit plot size was 2.5m×2.5m. The experiment was laid out in a Randomized complete Block Design (RCBD) with three replications. Weeding was performed twice at an interval of 30 days. Earthing up and irrigation was executed two times; one at 30 days and another at 50 days after planting. A total of five fungicides Acrobat MZ (Dimethomorf-9% + Mancozeb-60%) @ 0.2%, Metaril 72 WP {Methyle D, L-N-(2, 6 dimethyl phenyl)-N (2-methoxyacetyl)-alaninate}@ 0.2%, Nuben 72 WP (Metalaxyl 8% + Mancozeb 64%) @ 0.2%, Ridomil gold 68 WP {N-(2,6-Dimethyl phenyl)-N-methoxyacetyl)-D-alanine methyle ester + Mancozeb} @ 0.2%, Secure 600 WG (5-5-Methyl-2-methylio-5-Phenyl-3 Phonylamino-3,5-dihydro-4H-Imidazol-4-one) @ 0.1%, and control were included to study the effectiveness of fungicides. Fungicidal solutions were prepared by dissolving definite amount of the chemicals in required quantity of plain water. Spray was initiated just after the detection of late blight symptoms in the experimental area and repeated thrice at an interval of 10 days. In control treatment, equal amount of plain water was sprayed.

In another test, Acrobat MZ, Secure 600 WG and Ridomil gold 68 WP were used to find out the number of spray to control the disease. Single, double and triple spray were scheduled for each fungicide at 10 days interval. Care was taken during spraying to ensure both the upper and lower surface of leaves as well as stems were well covered by fungicidal solution. The experiment was carried out in split plot design with three replications.

For both the experiments, data collected after ten days of last spray on %plant infection, disease severity (1-9 scale, Henfling 1987) and PDI (Percent Disease Index) were analyzed using MSTAT-C computer program. Means were compared following Duncan's Multiple Range Test (DMRT)

RESULTS AND DISCUSSIONS

Determination of the effectiveness of fungicides in controlling late blight of potato

All the fungicides significantly reduced the plant infection and PDI value over control. The plant infection due to application of different treatment ranged from 13.50 to 90.00 where the lowest and the highest plant infection were recorded from Ridomil gold 68 WP and control (where no fungicide was applied), respectively. Although Ridomil gold 68 WP gave the minimum plant infection numerically among the treated fungicides but it showed statistically similar to Acrobat MZ and Metaril 72 WP (Table 1). Acrobat MZ (14.20%) ranked next to Ridomil gold 68 WP in reducing plant infection due to *phytophthora infestans*, which was followed by Metaril 72 WP (16.24%), Nuben 72 WP (16.88%) and Secure 600WG (17.52%). Among the fungicides, although Secure 600 WG appeared the lower one but showed statistically similar effect in reducing plant infection with Metaril 72 WP and Nuben 72 WP which differed significantly with control. Regarding PDI, all the fungicides significantly reduced PDI value of late blight over control. In ascending order reduced PDI value of the fungicides may be arranged as Ridomil gold 68 WP, Acrobate MZ, Nuben 72 WP, Secure 600 WG and Metaril 72 WP. The PDI value ranged from 20.27 to 61.16. Significantly lower PDI was estimated in Ridomil gold 68 WP and it showed statistically insignificant with rest of the fungicides (Table 1).

Table 1. Effectiveness of fungicide against late blight of potato

Fungicides	Dose (%)	% Plant infected	PDI value	PDI reduction compare to control
Acrobat MZ	0.2	14.20 d (6.06)	21.40 b (13.33)	82.62
Metaril 72 WP	0.2	16.24 bcd (7.88)	22.16 b (14.22)	81.46
Nuben 72 WP	0.2	16.88 bc (8.48)	21.50 b (13.48)	83.43
Secure 600 WG	0.1	17.52 b (9.09)	21.99 b (14.07)	81.66
Ridomil gold 68 WP	0.2	13.50 d (5.45)	20.27 b (12.00)	84.36
Control	-	90.00 a (100.00)	61.16 a (76.74)	-

Means followed by the same letter within the same column do not differ significantly at 5% level of probability, Figure in parenthesis indicate squire root transformed value

Percent Disease Index (PDI) decreased over control(82.62%, 81.46%, 82.43%, 81.66% and 84.36%) were estimated for Acrobat MZ, Metaril 72 WP, Nuben 72 WP, Secure 600WG and Ridomil gold 68 WP, respectively.

Determination of number of fungicidal spray in controlling late blight of potato

The main effect of fungicides against late blight was not significantly different among plant infection. Numerical data of plant infection were different but statistically they were same. The plant infection ranged from 19.84 to 27.29, where the lowest and the highest plant infection were recorded from Ridomil gold 68 WP and Acrobat MZ, respectively. In case of PDI value, PDI ranged from 21.41 to 24.82. The lowest PDI value 21.41 was recorded from Ridomil gold 68 WP, it differed significantly with Secure 600 WG but insignificant with Acrobat MZ (Table 2). The main effect of doses against late blight showed significant differences among plant infection and PDI. In respect of plant infection, among the different dose level, D_1 (single spray) gave the maximum plant infection (36.85) which was found significantly different with D_2 (double spray) and D_3 (Triple spray) (Table 3). The lowest plant infection was recorded in triple sprayed plots D_3 (12.17) followed by Double sprayed D_2 (18.15) and was found insignificant with each other. PDI ranged from 19.91 to 28.49. The lowest PDI was estimated by D_3 and it differed significantly with D_1 and insignificant with D_2. Interaction effect of fungicides and doses indicated that plant infection ranged from 2.43 to 46.04. The T_3D_3 (Ridomil gold 68 WP × Triple dose) showed minimum plant infection but was found statistically similar to T_3D_2 (Ridomil gold 68 WP × Double dose), T_2D_3 (Secure 600 WG × Triple dose), T_2D_2 (Secure 600 WG × Double dose), T_1D_3 (Acrobat MZ × Triple dose) and T_1D_2 (Acrobat MZ × Double dose) (Table 4). It was found that T_1D_1 (46.06) showed highest plant infection followed by T_2D_1 (36.36) and they were statistically similar. These two treatments differed significantly with rest interactions.

Table 2. Main effect of fungicides

Fungicides	% Plant infected	PDI value
T_1 = Acrobat MZ	27.29 (21.01)	23.50 ab (15.90)
T_2 = Secure 600 WG	24.76 (17.57)	24.82 a (17.63)
T_3 = Ridomil gold 68 WP	19.84 (11.52)	21.41 b (13.33)

Means followed by the same letter within the same column do not differ significantly at 5% level following LSD, Figure in parenthesis indicate actual value

Table 3. Main effect of doses

Fungicides	% Plant infected	PDI value
Single spray (D_1)	36.85 a	28.49 a
	(35.96)	(22.77)
Double spray (D_2)	18.15 b	20.69 b
	(9.70)	(12.49)
Triple spray (D_3)	12.17 b	19.91 b
	(4.44)	(11.60)

Means followed by the same letter within the same column do not differ significantly at 5% level following LSD, Figure in parenthesis indicate transformed value

When PDI was compared among the treatments, the highest PDI value was obtained in T_2D_1 (28.15) followed by T_1D_1 (23.11), T_3D_1 (17.04), T_2D_2 (13.19), T_1D_2 (12.44), T_1D_3 (12.15), T_3D_2 (11.85), T_2D_3 (11.55) and T_3D_3 (11.11). Statistical analysis revealed that significantly lower PDI value was obtained by T_3D_3 and it was statistically similar to T_3D_2, T_2D_3, T_2D_2, T_1D_3 and T_1D_2.

Table 4. Interaction effect of fungicides and doses

Fungicides and dose	% Plant infected	PDI value
T_1 D_1	46.06 a	23.11 b
	(42.74)	(28.74)
T_1 D_2	11.52 cd	12.44 d
	(19.84)	(20.65)
T_1 D_3	5.45 d	12.15 d
	(13.50)	(20.40)
T_2 D_1	36.36 ab	28.15 a
	(37.08)	(32.04)
T_2 D_2	10.91 cd	13.19 d
	(19.29)	(21.28)
T_2 D_3	5.45 d	11.55 d
	(13.50)	(19.87)
T_3 D_1	25.45 bc	:
	(30.29)	)
T_3 D_2	6.67 d	1
	(14.95)	)
T_3 D_3	2.43 d	11.11 d
	(8.94)	(19.47)

Means followed by the same letter within the same column do not differ significantly at 5% level following LSD, Figure in parenthesis indicate actual value.

T_1D_1= Acrobat MZ Single dose
T_1D_2= Acrobat MZ Double dose
T_1D_3= Acrobat MZ Triple dose
T_2D_1= Secure 600 WG Single dose
T_2D_2= Secure 600 WG Double dose
T_2D_3= Secure 600 WG Triple dose
T_3D_1= Ridomil gold 68 WP Single dose
T_3D_2= Ridomil gold 68 WP Double dose
T_3D_3= Ridomil gold 68 WP Triple dose

Results on the investigation of effectiveness of fungicides to minimize the disease incidence of late blight indicated that all the test fungicides (Acrobat MZ, Metaril 72 WP, Nuben 72 WP, Secure 600 WG and Ridomil gold 68 WP) significantly reduced the disease incidence. Out of them; Metaril 72 WP, Nuben 72 WP and Ridomil gold 68 WP contain Metalaxyl and Mancozeb belong to Phenylamides; Acrobat MZ belongs to Dimethomorf and Secure 600 WG belongs to Imidazolinones. The performance of metalaxyl in controlling late blight under present investigation has been supported by many researchers throughout the world (Mantecon and Escande, 1985; Samoucha and Cohen 1986; Mantecon and Escande, 1987; Khanna 1989; Thind *et al.*, 1989; Bhattacharyya *et al.*, 1990; Hossain *et al*. 1990; Alam *et al.*, 1991; Gerasimova *et al.*, 1994; Singh *et al.*, 1998; Singh and Shekhawat, 1999; Mohan *et al.*, 1999; Islam *et al.*, 2000;

Singh *et al.*, 2000; Tsakiris *et al.*, 2002; Mantecon, 2007, Rahman 2008; and Mantecon, 2009). According to Bradshaw (1992), Metalaxyl + Mancozeb delayed disease progress more efficiently than mancozeb alone. For overcoming the late blight situation mixture or alternate use of Metalaxyl and Mancozeb has been suggested in many countries (Mantecon and Escande, 1985 ; Samoucha and Cohen 1986; Mantecon and Escande, 1987; Khanna 1989; Samoucha *et al.*, 1993; Gerasimova *et al.*, 1994; Singh *et al.*, 1998 and Mohan *et al.*, 1999). Matijovic *et al.* (1997) Suggested that systemic fungicides should be applied when *P. infestans* is expected to occur.

The investigation on the role of number of fungicidal sprays in minimizing the incidence of late blight of potato indicates that the number of fungicidal spray had significant influence on late blight incidence. The incidence of late blight infection was highest in single spray of fungicides (Acrobat MZ, Secure 600 WG and Ridomil gold 68 WP) and it decreased gradually with increasing number of fungicidal sprays. The main effect of doses against late blight showed significant differences in plant infection and PDI. Single spray gave the maximum plant infection and triple spray showed minimum plant infection. Among the treatment combinations T_3D_3 showed minimum plant infection (2.43%) and PDI (11.11%) value followed by T_3D_2, T_2D_3, T_2D_2, T_1D_3 and T_1D_2, respectively. To achieve the effective control of late blight of potato, number of spray play a vital role. However, dose, time of application and number of spray is the most important factors that improve the efficacy of fungicidal spray for proper management of late blight of potato. Timely application of fungicide in relation to stage of late blight development significantly influence the efficacy of fungicide was reported by Bruck *et al.*, 1981. Late blight of potato was controlled by 5 to 6 times spraying of fungicide in hills and 2 to 3 times in plain land (Khanna and Sharma, 1981 and Bhattacharyya *et al.*, 1983). Effective control of late blight of potato was suggested by Mantecon and Escande 1987 using fortnight application of Metalaxyl + Mancozeb (0.2 + 0.96 kg/ha).

CONCLUSION

Ridomil gold 68 WP contain Metalaxyl and Mencozeb may be recommended for controlling late blight disease of potato. Ridomil gold 68 WP may be applied by the growers 3 times at 10 days interval just after initiation of disease.

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