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Assessment of performance of different fungicides to control late blight disease of potato in farmers' field of Hooghly district

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ABSTRACT

Potato is the most profitable crop of Hooghly district, determining the livelihood of most of the farmers' of the district. Many years, the farmers face havoc loss due to severe infestation of late blight disease of potato caused by Phytophthora infestans which results drastic reduction of production. Though there are several effective fungicides available in the market to manage the disease, but due to not having the proper knowledge about the mode of action and proper spray schedule of different fungicides many of the farmers were unable to manage this disease when it appears in epiphytotic form. After surveying a good number of farmers and realizing the significance of controlling the devastating disease for the sustainability of potato production and ensuring the more profit, Hooghly Krishi Vigyan Kendra conducted a field experiments as On Farm Trial mode for two years during 2008-09 and 2009-10 in farmers' field of Hooghly district of West Bengal, India during Rabi season to assess the performance of different fungicides to control late blight disease of potato. Details of technologies assessment/refinement includes, spray of Copper Oxychlorides @ 4g l^{-1} starting from 30 DAP alternating with Metalaxyl-Mancozeb @ 2.5g l^{-1} at 10-15 days intervals, seed treatment with Mancozeb @ 2g kg^{-1} of seed and spray of Mancozeb @ 2g l^{-1} starting from 30 DAP alternating with Cymoxanil-Mancozeb 3g l^{-1} at 10-15 days intervals, Seed treatment with Trichoderma viride @ 5g kg^{-1} of seed and spray of Mancozeb @ 2g l^{-1} starting from 30 DAP alternating with Dimethomorph @ 1g l^{-1} + Mancozeb 2g l^{-1} at 10-15 days intervals along with Farmers Practice i.e. spray with Mancozeb @ 2.5gl^{-1} starting from onset at 10 days intervals. It has been observed that during both the years of experimental period TO-II (seed treatment with Mancozeb @ 2g kg^{-1} of seed and spray with Mancozeb @ 2g l^{-1} starting from 30 DAP alternating with Cymoxanil-Mancozeb 3g l^{-1} at 10-15 days intervals) was found as the best treatment because it was most effective to prevent and manage the late blight disease of potato than any other treatments resulting lowest disease severity, highest yield, highest net return, and highest incremental C:B ratio of 16.78 %, 32.35 t ha^{-1}, Rs. 65,375.00 and 16.94 respectively.

***Keywords*:** Fungicides, late blight, management, potato, yield.

Potato is the most profitable crop of Hooghly district, determining the livelihood of most of the farmers' of the district. Many years, the farmers face havoc loss due to severe infestation of late blight disease of potato caused by *Phytophthora infestans* which results drastic reduction of production. It was first noticed in Darjeeling district in 1883. In the plains, it was first observed during 1898-1900 in Hooghly district of West Bengal. Today, late blight is a recurring feature in plains of West Bengal. It occurs in mild to moderate form in every year but some times it appears in epidemic form resulted total crop failure. In Hooghly potato produced around 3.43 million ton annually from the area of 94,800 ha. Yield losses in plains have been estimated around 10-75% (Dutta, 1979). Application of need based effective fungicides for the management of late blight of potato (Singh *et al.*, 2003). Though there are several effective fungicides available in the market to manage this disease, but due to not having the proper knowledge about the mode of action and proper spray schedule of different fungicides many of the farmers were fail to manage this disease when it appears in epiphytotic form. After surveying a good number of farmers and realizing the significance of controlling the devastating disease for the sustainability in potato production and thus ensuring more profitability. Keeping all these views in mind the present experiment was carried out.

MATERIALS AND METHODS

The experiment was conducted at the farmers' field of Hooghly district, West Bengal as 'On Farm Trial' mode for two years during 2008-09 and 2009-10 in *Rabi* season when there was severe incidence of this late blight disease. The planting was done during 2nd week of November and the variety *Kufri Jyoti* is used for this experiment. The experiment was conducted in a Randomized Block Design with 5 replication and 4 treatments with recommended agronomic practices. The plot size of each treatment was 5m x 5m and spacing was maintained 60cm x 20cm each for row to row and plant to plant. The crop was harvested during last week of February. The details of technologies assessment/refinement, farming situation, area of intervention and technology option was presented in table 1.

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To record the late blight incidence, ten plants per plot were randomly selected and disease scoring was done with the help of disease scoring scale (0-9 scale) (Mc Kinney, 1923).

$$PDI \quad \frac{\text{Sum of all numerical ratings}}{\text{Total no. of plant examined x maximum rating scale}} \text{x100}$$

The data on Percent Disease Index (PDI) of late blight was recorded upto 70 DAP at every 7 days intervals. Two years data collected on PDI and percent infection of disease was also converted into angular transformed value and tuber yield of potato were pooled and statistically analysed as per method suggested by Panse and Sukhatme (2000).

Percent Increase in Yield (PIY) over control was calculated based on the following formula

$$\text{PIY} \quad \frac{\text{Treatment yield - Control yield}}{\text{Control yield}} \text{x100}$$

Yield obtained was recorded plot wise and incremental C:B ratio of different treatment was worked out by dividing the net returns from total cost of fungicides.

Table 1: Technology option assessed during 2008-09 and 2009-10

Problem area	Important cause	Production system	Micro farming situation
Low productivity of potato	High infestation of late blight disease	Rice based (Rice-Potato-Sesame)	Irrigated medium land with clay to clay loam soil
Intervention plan			
Farmers' practice	Spray of Mancozeb @ 2.5g l^{-1} starting from onset of the disease at 10-15 days interval.		
Technology option – I	Spray of Copper oxychlorides @ 4g l^{-1} starting from 30 DAP alternating with Metalaxyl-Mancozeb @ 2.5g l^{-1} at 10-15 days intervals.		
Technology option – II	Technology option – IIIseed treatment with Mancozeb @ 2g kg^{-1} of seed and spray of Mancozeb @ 2g l^{-1} starting from 30 DAP alternating with Cymoxanil-Mancozeb 3g l^{-1} at 10-15 days intervals. Seed treatment with *Trichoderma viride* @ 5g kg^{-1} of seed and spray of Mancozeb@ 2g l^{-1} starting from 30 DAP alternating with Dimethomorph 1g + Mancozeb 2g l^{-1} at 10-15 days intervals.		

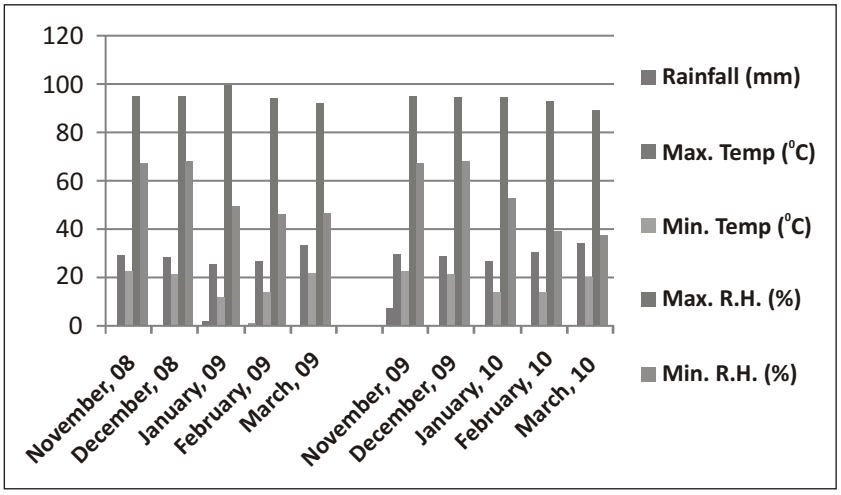

Fig. 1: Meteorological parameters at different months during field experiment.

RESULTS AND DISCUSSION

The experiment results (pooled data for 2008-09 and 2009-10) are presented in Table 2. During the experiment it was observed that the late blight disease first appear in experimental plot around one month after planting. However the occurrence of late blight disease was significantly influenced with the different fungicides (Table 3). Weather condition of the first year experimentation was more favorable for developments of late blight disease of potato (Fig. 1). The difference in PDI is might be due to the significant role of weather.

Effect of different fungicides on disease severity (PDI).

In both the season it was found that at initial stage the disease severity varies from Farmers' practice with

Technology options. Among the Technology options it was revealed that at 42 DAP PDI values were different in respect to with and without seed treatment. Seed treatment was done with Mancozeb @ 2g $kg^{-1}$of seeds performed better than *Trichoderma viride.* Application of different plant protection chemicals used in the experiment had significant effect on disease severity of late blight. The crop which was practiced by farmers himself as his own choice suffers severely from this disease. The results (Table 2) indicated that the lowest percent disease index (16.78%) was recorded in Technology options –II these findings are also similar to that of the observations of Debnath and Nath, 2009, throughout the crop season. While the maximum percent disease index (98.80%) was found in Farmers' Practice followed by Technology options-I (45.00%) and Technology options-III (21.60%). The use of systemic and contact fungicides alternatively showed better efficiency in controlling the *Phytophthora infestans*. The results corroborated with the findings of Baider and Cohen (2003). Seed treatment plays a vital role for prevent the initial appearance of the disease. These findings are also in line with earlier observation (De and Sengupta, 1988 and 1991). Mancozeb and combined product of systemic and contact fungicides may have synergistic effect against *Phytophthora infestans*. Similar type of observation were reported earlier *i.e.* combination of Mancozeb with Beta Amino Butyric Acid had synergistic effect against *Phytophthora infestans* in potato and tomato than earlier of them alone (Baider and Cohen, 2003).

Effect of different fungicides on yield of potato

All the treatment of fungicides proved significantly superior in increasing the yield of potato (Table 3) by effectively controlling the late blight disease in comparison to Farmers' Practice. The highest yield of potato was recorded in Technology option – II (32.35t ha^{-1}) which is 55.38% more than Farmers' practice (20.80t ha^{-1}) followed by Technology option – III (30.60t ha^{-1}) and Technology option –I (23.90t ha^{-1}). These results are in agreement with the findings of Chakraborty and Mazumder (2012) who recorded highest yield of 24.10t ha^{-1}. Significant increase in yield of potato (30.60t ha^{-1}) by Technology option –III was obtained in present findings and get partially support from the work of Chakraborty and Mazumder (2012). The significant increase in yield in Technology option –II might be due to effective control of late blight disease starting from seed treatment with Mancozeb which prevent the pathogen to attack at initial stage and later alternate spray schedule of two fungicides can check the spread of the disease by suppressing the growth and sporulation of the pathogen. By this way plant remains healthy and resulting more yield.

Economics and incremental Cost Benefit (C:B) ratio of different treatments

The Cost Benefit ratio was worked out by dividing the net returns from total cost of fungicides (Table 3). The highest net return was recorded from the treatment of Technology option –II ₹65,375 ha^{-1} and it was followed by Technology option –III ₹ 63,500 $ha^{-1}$and Technology option –I ₹ 37,700 ha^{-1}in order of merit. The present findings are in agreement with the results of Chaurasia (2005). The lowest gross return was obtained in Farmers' Practice plot ₹ 24,399 ha^{-1}.The incremental C:B ratio of different treatments showed that maximum incremental C:B ratio of 16.94 was obtained from the treatment Technology option-III 15.62 and Technology option –15.73.

Thus looking to the economics of different treatments it can be concluded that the severe late blight disease can effectively controlled by adopting proper fungicides with prophylactic measures like Seed

Table 2: Effect of different fungicides for management of late blight disease of potato

Treatments	Percent Disease Index				
	42 DAP	49 DAP	56 DAP	63 DAP	70 DAP
Farmers' practice	19.80 (26.35)	29.86 (33.02)	40.96 (39.71)	63.60 (52.84)	98.80 (83.21)
Technology option - I	11.20 (19.51)	19.80 (26.35)	29.60 (32.95)	38.60 (38.38)	45.00 (42.06)
Technology option - II	5.40 (47.22)	12.90 (21.03)	13.00 (21.10)	15.20 (22.76)	16.78 (24.07)
Technology option - III	7.20 (57.99)	16.12 (23.64)	16.40 (23.82)	18.00 (24.83)	21.60 (27.64)
S. Em (±)	**0.45**	**0.47**	**0.64**	**0.58**	**0.51**
LSD (0.05)	**1.39**	**1.47**	**2.00**	**1.80**	**1.59**

Note: Figure in the parenthesis are angular transformed value. DAP - Days after planting.

Table 3: Economics and incremental C: B ratio of different treatment

Treatments	Yield (t ha^{-1})	Increase over Farmers' practice (%)	Cost of cultivation (Rs. ha^{-1})	Cost of fungicides sprayed (Rs. ha^{-1})	Added yield over control (t ha^{-1})	Gross Return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Cost of added yield (Rs. ha^{-1})	Incremental C:B ratio
FP	20.80	-	90000	2550	-	114400	24399	-	-
TO-I	23.90	14.80	93750	2975	3.10	131450	37700	17050	5.73
TO-II	32.35	55.38	112550	3750	11.50	177925	65375	63525	16.94
TO-III	30.60	47.11	105000	3450	9.80	168500	63500	53900	15.62
S.Em (±)	0.45	-	-	-	-	-	-	-	-
LSD(0.05)	1.39	-	-	-	-	-	-	-	-

treatment with Mancozeb @ 2g kg^{-1} of seed and spray of Mancozeb @ 2g l^{-1} starting from 30 DAP alternating with Cymoxanil-Mancozeb 3g l^{-1} at 10-15 days intervals (Technology option-II) recorded low disease severity, higher yield, net return and incremental C:B ratio. In Farmers' practice recorded highest disease severity, lower yield, net return and incremental C:B ratio was found to be less effective for the control of late blight of potato.

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