

Effect of varieties and fungicide spray on productivity of potato in North Eastern hill region

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ABSTRACT

A field experiment was conducted during 2009-10 to 2010-11 at Central Potato Research Station, Shillong to evaluate the effect of varieties and protective spraying of fungicide on productivity of potato in north eastern hill region of India. Kufri Megha recorded highest marketable (20.3 t/ha) and total tuber yield (22.5 t/ha); net returns (Rs.367.3x10³) and B:C ratio (4.6) as compared to other varieties. Spraying of fungicides recorded significantly higher plant stand (11.5%), marketable yield (23.9%) and total tuber yield (14.9%), consequently the maximum net profit (Rs.301.1x10³) and B:C ratio (3.5) over non sprayed crop. Highest improvement in potato yield was observed due to the spraying of fungicides on Kufri Giriraj (33.1%) followed by Kufri Jyoti (22.0%) over the non spray. However, very narrow enhancement in productivity of potato were found with same level of spray of fungicides on Kufri Megha (4.5%) and Kufri Girdhari (5.3%) over the non sprayed. Hence, cultivation of Kufri Megha along with spraying of fungicide is crucial to enhance the profitability of farming community for north eastern hill region.

Key words: Fungicide, Late blight, Potato, Varieties.

INTRODUCTION

The potato (*Solanum tuberosum* L.) crop forms an important part of prevailing cropping systems as well as the dietary food habits of the people of the North Eastern Region in India especially the hilly tracts, where the crop is grown under rainfed conditions (Sah *et al.*, 2011). Among diseases, late blight of potato caused by *Phytophthora infestans* is the most serious and devastating disease which appears every year in epiphytotic proportions causing heavy loss in tuber yield. Besides late blight, early blight, scab and bacterial wilt is also found in some place but damages are not as prominent compared to late blight. These losses can be prevented either by cultivating late blight resistant varieties or by means of giving prophylactic sprays with suitable fungicides (Kaushik *et al.*, 2007; Joseph *et al.*, 2011). Crop resistance against diseases in most of the potato varieties is broken within few years of their cultivation due to genetic erosion against that particular pathogen or emergence of a new pathogen under variable environmental condition (Chakraborty and Mazumdar, 2012). Hence, the only option left is the use of need based effective fungicides for the management of potato diseases (Singh *et al.*, 2003). Keeping this in mind a field experiment was conducted to evaluate the effect of varieties

varying in degree of resistance to late blight and protective spraying of fungicide on productivity of potato in north eastern hill region of India.

MATERIALS AND METHODS

A field experiment was conducted during summer season of two consecutive years from 2009-10 to 2010-11 at Central Potato Research Station, Shillong, Meghalaya, India. The geographical co-ordinates of experimental field were 25°53' N latitude and 91°84' E longitude and an altitude of 1739 meters above mean sea level. The soil was sandy loam in the texture with pH 5.0, moderately fertile, being high in organic carbon (1.70%), medium in available nitrogen (292.0 kg/ha), low in available phosphorus (14.4 kg/ha) and high in available potassium (317.0 kg/ha). The trial was laid out in factorial randomized block design, replicated thrice, with four varieties *viz.*, Kufri Giriraj, Kufri Girdhari, Kufri Jyoti and Kufri Megha followed by two spraying schedule for management of late blight of potato as sprayed and non-sprayed. Kufri Megha and Kufri Girdhari are resistant while Kufri Jyoti and Kufri Giriraj are susceptible to late blight disease. The spray schedule for late blight management consisted of a prophylactic spray with the fungicides

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mancozeb when the canopy of two adjacent rows touches each other followed by four sprayings alternately with mancozeb and curzate (cymoxanil 8% + mancozeb 64%) at fifteen days interval. Potato was planted as per treatments in the net plot of 4.0x3.6 meters with spacing of 60x20 cm. Well-decomposed farm yard manure (0.53% N, 0.29% P and 0.61% K) collected from a nearby farm was applied into the plots at 15 tonnes/ha. The recommended dose of N, P₂O₅ and K₂O was taken as 140, 120 and 60 kg/ha for potato. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. Half of N while whole of phosphate and potash were applied at planting of the crop. Rest half of nitrogen was applied at the time of earthing up. Recommended package and practices for disease and insect management for potato crop were followed. Earthing up was done at 45 days after planting to provide loose soils around the plants for proper development of tubers at the stolen tips. Weeding was also done during earthing up with the help of a small spade. All the plants from net plot area were harvested manually at maturity. All the tubers were dried and graded in shade and their weight and number were recorded as marketable (25-75 g) and non-marketable (< 25 g). The tuber yield of different plots were estimated and converted into tonnes per hectare. The late blight disease severity was recorded at seven days interval and the area under the disease progress curve (AUDPC) was calculated in accordance to Shaner and Finney (1977) and further converted to relative area under disease progress curve (rAUDPC) following Campbell and Madden (1990) to compare the reaction of potato accessions against late blight over years. All observations for each character were subjected to statistical analysis according to the standard method (Panse and Sukhatme, 1978). The calculated values of the treatments and error variance ratio were compared with Fisher and Yates F table at 5% level of significance. The differences between significant treatment means were tested against C.D. at 5 per cent probability.

RESULTS AND DISCUSSION

Plant stand: Plant stand after 45 days of planting did not differ significantly among the varieties (Table 1). Based on the mean values of two years the highest plant stand by 84.3 per cent was recorded under Kufri Girdhari which was at par to other varieties. Similarly spray schedule has no any effect on plant stand after 45 days of planting. However, the plant survival at harvest differs significantly among varieties. Based on the mean value of two years the highest plant stand was recorded under Kufri Girdhari (74.8%) followed by Kufri Megha (74.5%) which were at par to each other but significantly superior over Kufri Jyoti and Kufri Giriraj. The maximum reduction in plant population was found under Kufri Jyoti (64.2%) through biotic factor followed by the Kufri Giriraj (67.8%). This might be due that lower resistant of Kufri Jyoti and Kufri Giriraj to late blight than Kufri Girdhari and Kufri Megha.

Similarly, plants stand significantly varied during the harvest of potato due to the effect of spray schedule. Rate of mortality was found to be the higher by 11.5 per cent in those plants where the fungicides were not sprayed. Lowest reduction in plant stand was noticed under sprayed plot as compared to non-sprayed ones. This was due to the efficacy of fungicide spray in managing late blight of potato; consequently the mortality was negligible under treated plot than non-sprayed (Struik, 2010).

Late blight disease development: The effect of varieties as well as spraying schedule on spread of late blight incidence was significant (Table 1). The rAUDPC values for late blight resistant varieties Kufri Megha and Kufri Girdhari were significantly less than late blight susceptible varieties Kufri Giriraj and Kufri Jyoti. This is due to inherent resistant against late blight in these varieties which prevents spread of disease even under environmental conditions suitable for disease development. In Meghalaya, potato is cultivated during

TABLE 1: Effect of different treatment on plant stand and yield attributes of potato

Treatment	% Germination			Plant stand at harvest			No. of tubers /plant			Weight of tuber/plant(g)			rAUDPC*		
	2009-10	2010-11	Mean	2009-10	2010-11	Mean	2009-10	2010-11	Mean	2009-10	2010-11	Mean	2009-10	2010-11	Mean
Varieties															
Kufri Giriraj	81.5	84.0	82.8	67.6	68.0	67.8	7.6	6.8	7.2	254.0	271.7	262.8	0.643	0.611	0.627
Kufri Girdhari	83.0	85.5	84.3	75.0	74.5	74.8	11.5	10.5	11.0	267.2	287.7	277.4	0.009	0.009	0.009
Kufri Jyoti	81.8	84.7	83.2	63.2	65.2	64.2	9.3	8.4	8.8	172.5	184.0	178.3	0.656	0.272	0.464
Kufri Megha	82.2	84.7	83.4	75.4	73.6	74.5	10.9	10.7	10.8	280.6	288.3	284.5	0.123	0.117	0.120
SEm±	0.8	0.8	0.8	1.2	2.1	1.7	0.4	0.4	0.4	4.9	5.5	5.2	0.004	0.003	0.004
CD(P=0.05)	NS	NS	NS	3.7	6.3	5.0	1.1	1.2	1.1	14.6	16.4	15.5	0.013	0.011	0.012
Spray Schedule															
Sprayed	81.6	84.1	82.9	74.2	75.1	74.6	10.3	9.7	10.0	262.5	276.1	269.3	0.282	0.145	0.214
Non sprayed	82.6	85.3	83.9	66.4	65.5	66.0	9.3	8.5	8.9	224.6	239.8	232.2	0.434	0.360	0.397
SEm±	0.6	0.6	0.6	0.9	1.5	1.2	0.3	0.3	0.3	3.4	3.9	3.7	0.006	0.005	0.006
CD(P =0.05)	NS	NS	NS	2.6	4.5	3.5	NS	NS	NS	10.3	11.6	11.0	0.018	0.016	0.017

*Relative Area Under Disease Progress Curve

summer season and peak growth period coincide with monsoon rains and mild temperature which serve as ideal condition for occurrence of late blight in epiphytotic proportion (Srivastava *et al.*, 2012).

The late blight disease first appeared in the susceptible cultivars Kufri Jyoti and Kufri Giriraj by middle of May in both the years. This coincided with mild temperature (22-25 °C maximum and 15-16.5 °C minimum), >80% relative humidity and cloudy weather (Fig 1). *Phytophthora infestans* sporangia is usually produced between 8.5 and 26°C with an optimum of 19-22°C and its survival and spread is facilitated by high humidity and cloudiness (Arora *et al.*, 2014). The weather remained gloomy leading to rapid progression of disease to 100% in susceptible cultivars within 2-3 weeks.

In the present study, a high correlation is observed between the sprayed and unsprayed treatments of susceptible varieties Kufri Giriraj and Kufri Jyoti with minimum temperature, relative humidity and bright sunshine hours (Table 2). Increase in the minimum temperature, relative humidity and decrease in bright sunshine hours resulted in increased disease development in these varieties. Spraying with fungicides in these susceptible varieties does seem to inhibit disease development resulting in relatively lower correlation coefficient. The late blight resistant varieties Kufri Megha and Kufri Girdhari remain practically unaffected from spray or unsprayed condition with very less disease development. Thus, the spray scheduling can be optimized depending on inherent varietal resistance and existing weather condition.

Yield attributes of potato: The effect of varieties on numbers of tubers per plant and their weight was significant indicating potential of inherent resistance among varieties towards attaining higher yield (Table 1). Mean data of two year

revealed that significantly higher numbers of tuber per plant were produced by both the resistant varieties *i.e.* Kufri Girdhari (11.0) and Kufri Megha (10.8) over the susceptible varieties Kufri Giriraj and Kufri Jyoti. Lowest numbers of tubers (7.2) per plant was recorded for Kufri Giriraj followed by the Kufri Jyoti (8.8). This might be due to the varietal effect with respect to production of tubers per plant. However, the lowest weight of tubers (178.3 g) per plant were noticed under Kufri Jyoti. Similarly the highest weight of tubers (284.5 g) per plant were noticed under Kufri Megha followed by Kufri Girdhari (277.4 g) which were at par with each other but significantly superior over Kufri Jyoti. There was no significant variation between Kufri Girdhari and Kufri Giriraj which were at par to each other but significantly superior over the Kufri Jyoti. Although the numbers of tubers per plant were the lowest (7.2) under Kufri Giriraj but weight per plant (262.8 g) was significantly higher than Kufri Jyoti due to large size of tubers of Kufri Giriraj.

Foliar spray of fungicides has no significant effect on numbers of tubers per plant during both the years. However, higher numbers of tubers per plant was recorded under the sprayed treatment as compare to non-sprayed. Production of the tubers per plant might be the genetic

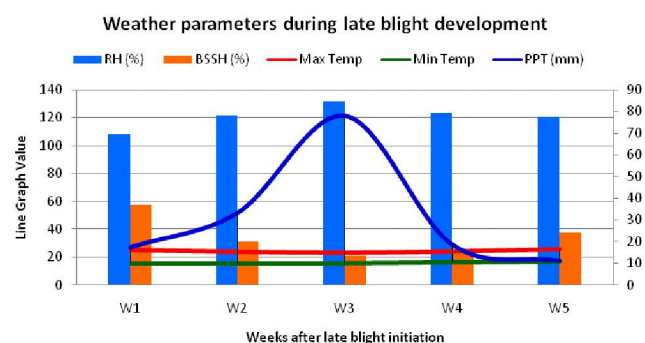


FIG 1: Weather parameters in weeks after late blight initiation in potato crop.

TABLE 2: Correlation coefficient between disease incidence and weather parameters prevalent during disease development

Treatments	Weather parameters*				
	Max T(°C)	Min T (°C)	RH (%)	PPT (mm)	BSSH
Unsprayed Crop					
Kufri Giriraj	-0.23	0.91	0.79	0.23	-0.81
Kufri Girdhari	0.16	0.09	0.09	-0.07	-0.05
Kufri Jyoti	-0.24	0.98	0.80	0.23	-0.83
Kufri Megha	0.24	0.08	0.14	-0.08	-0.09
Sprayed Crop					
Kufri Giriraj	0.19	0.61	0.46	-0.09	-0.47
Kufri Girdhari	0.17	0.05	-0.05	-0.01	-0.04
Kufri Jyoti	0.17	0.68	0.48	-0.07	-0.49
Kufri Megha	0.18	0.08	0.16	-0.04	-0.06

*Max T(°C): Average maximum temperature; Min T (°C): Average minimum temperature; RH (%) : Relative Humidity (%);PPT (mm): Average Rainfall; BSSH: Bright Sunshine Hours.

frequently occurs due to prevalence of congenial climatic condition of the north eastern hill region.

Economics: Potato is highly capital and labour intensive crop (Kushwah and Singh, 2011). Economic feasibility of a technology at a farmer's field depends upon the net return per unit area. The total cost of potato production is generally higher than other vegetables crops because of high input cost especially due to cost of seed tubers (Singh *et al.*, 2011). Highest net returns (Rs. 367.3 x 10³) and B:C ratio (4.6) associated with Kufri Megha was noticed under the investigation as compare to other varieties. The lowest return (Rs. 160.7 x 10³) was associated with Kufri Jyoti. Kufri Megha has higher productivity as compare to the other varieties; hence the net

return was the highest which is directly proportional to productivity of the crop. Maximum profit (Rs.301.1x10³) and B:C ratio (3.5) were associated under sprayed crop because of the highest productivity due to the disease free field condition. Although the cost of cultivation was higher under sprayed treatment over non-sprayed, yet the additional enhancements in profitability due to spray of fungicides was more than the additional cost due to spray of fungicides.

CONCLUSION

It may be concluded that selection of suitable variety of potato like Kufri Megha along with spraying of fungicide is crucial to enhance the profitability of farming community for north eastern hill region.

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