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MANAGEMENT OF LATE BLIGHT OF POTATO THROUGH FUNGICIDE SCHEDULING

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ABSTRACT: Late blight of potato caused by oomycetes pathogen *Phytophthora infestans*, is a disease of major concern all over the world responsible for 20-75 % yield loss. For more than a decade, management of late blight has become increasingly demanding because of emergence of aggressive and more resistant new strains of the pathogen. In present studies, potential management of late blight has been studied with a view to develop an effective and safe spray schedule for management of late blight of potato. Results revealed that minimum disease intensity and disease incidence were reported from prophylactic spray with fungicide Chlorothalonil 75 % WP @ 0.25 % followed by Dimethomorph 9 % + Mancozeb 60 % WP @ 0.3 % and one more spray with Chlorothalonil 75 % WP @ 0.25 % treated plots. Minimum tuber yield was reported from control plots while maximum tuber yield (42.60 t/ha in K.Khyati and 34.50 t/ha in K.Bahar) were also recorded from the same treatment i.e. treatment Chlorothalonil 75 % WP @ 0.25 % followed by Dimethomorph 9 % + Mancozeb 60 % WP @ 0.3 % and one more spray with Chlorothalonil 75 % WP @ 0.25 %. This treatment proved as the best fungicide scheduling treatment for management of late blight of potato by providing the maximum returns and highest B:C ratio.

Key words: Potato, late blight, *Phytophthora infestans*, fungicide scheduling, Chlorothalonil

INTRODUCTION

Potato (*Solanum tuberosum L.*) mainly vegetative propagated by seed tubers, is affected by many diseases. Among various fungal diseases, late blight of potato is considered as one of the most dreaded disease, is responsible for considerable economic losses. This disease is weather dependent and mostly appears on regular basis in epiphytotic proportion in all over the country. It is responsible to cause considerable reduction in quality and tuber yield. If fungicides are not applied at right time, it will not provide adequate control. Even there is chances of development of new races which showed resistant reaction to systemic fungicides. Moreover, there is high risk of development of fungal races resistant to systemic fungicides. So, combination of systemic and contact fungicides may be use as one of the options to manage this problem. Mixture of different fungicides have different mode of action which may delay the build-up of resistance. The present studies were conducted with the aim to develop an effective and safe spray schedule for management of late blight of potato.

MATERIALS AND METHODS

A field experiment was conducted for consecutive two years during *rabi* season at Vegetable Research Centre (VRC), Pantnagar. Two potato cultivars namely Kufri Bahar and K. Khyati were planted in the last week of October with purpose to expose the potato crop to extremely congenial atmospheric situation for late blight disease development. The experiment was laid out in randomized block design with plot size 3 × 2 m^2 plot size. Total four treatments with four replications were given to the crop. The treatments comprised of sprays of fungicides either alone or in combinations.

These treatments are fungicide Chlorothalonil 75 % WP @ 0.25 % followed by 2 more sprays at weekly interval (T1),

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Prophylactic spray (just at the time of canopy closure) with Chlorothalonil 75 % WP @ 0.25 % followed by Dimethomorph 9 % + Mancozeb 60 % WP @ 0.3 % and one more spray with Chlorothalonil 75 % WP @ 0.25 % (T2), prophylactic spray (just at the time of canopy closure) with Mancozeb 75 % WP @ 0.2 % followed by Dimethomorph 9 % + Mancozeb 60 % WP @ 0.3 % and one more spray with Mancozeb 75 % WP @ 0.2 % (T3) and Control (T4). All the fungicides were sprayed at the time of appearance of late blight. Total three fungicides i.e. Chlorothalonil 75 % WP (0.875 -1.250 % ai per hac), Dimethomorph 9 % + Mancozeb 60 % WP (ai 90 g/kg and 600 g/kg) and Mancozeb 75 % WP (ai 1.125-1.5 kg/hac) either alone or in combinations were used.

The first appearance of disease was noticed at second week of December. Disease incidence was recorded at 10 days interval. Tuber yield (kg/plot) was recorded at the time of harvesting and then converted into t/ha. B:C ratio were calculated at the market rate of fungicides i.e. Mancozeb (Rs 500/kg), Chlorothalonil (Rs 1400/kg) and Dimethomorph +Mancozeb (Rs 1300/kg). Sale price of produce were Rs 5/kg.

RESULTS AND DISCUSSION

Effect of fungicides on disease incidence

Pooled data of two cropping seasons revealed **(Table 1)** that, maximum disease incidence (100 %) was recorded in control plots of potato cultivar K. Bahar and all the test treatments (T1, T2, T3) were significantly superior to control. Treatment Chlorothalonil 75 % WP @ 0.25 % three sprays at weekly interval (T1) recorded 80 % disease incidence while treatment prophylactic spray (just at the time of canopy closure) with Chlorothalonil 75 % WP @ 0.25 % followed by Dimethomorph 9 % + Mancozeb 60 % WP @ 0.3 % and one more spray with Chlorothalonil 75 % WP @ 0.25 % (T2) reported 55 % and treatment prophylactic spray (just at the time of canopy closure) with Mancozeb 75 % WP @ 0.2 % followed by Dimethomorph 9 % + Mancozeb 60 % WP @ 0.3 % and one more spray with Mancozeb 75 % WP @ 0.2 % (T3) recorded 88 % disease incidence in case of potato cultivar K. Bahar. The percent reduction in disease over control were 20 %, 45 % and 12 % in treatment T1, T2 and T3 respectively over control.

Table 1: Effect of fungicidal scheduling on disease incidence of late blight recorded at 10 days interval (Pooled data of two years)

Cultivars	Treatments	Disease incidence (%) at 10 days interval			% Reduction in disease over control
		D1	D2	D3	
Kufri Bahar	T1	21.0	46.0	80	20.0
	T2	8.0	20.0	55	45.0
	T3	32.0	52.0	88	12.0
	T4	55.0	74.0	100	-
Kufri Khyati	T1	10.0	20.0	54.0	40.0
	T2	5.0	12.0	38.0	57.78
	T3	12.0	25.0	60.0	33.33
	T4	15.45	45.50	90.00	-
CD (cultivar)		12.56	13.81	12.86	
CD (treatment)		15.31	18.56	16.57	

In case of potato cultivar K. Khyati, the percent reduction in disease over control were 40 %, 57.78 % and 33.33 % in treatment T1, T2 and T3. Treatment T1 recorded 54 % final disease incidence while treatment T2 and T3 gave 38 % and 60 % final disease incidence. Control plots showed 90 % disease incidence. In Potato cultivar K. Khyati reported less disease incidence as compare to potato cultivar K. Bahar.

Effect of fungicides on tuber yield

Potato cultivar K. Bahar recorded maximum potato yield (34.50 t/ha.) with the

sprays of Chlorothalonil 75 % WP @ 0.25 % followed by Dimethomorph + Mancozeb @ 0.3 % and one more spray with Chlorothalonil 75 % WP @ 0.25 % (T2) followed by treatment T1 which recorded 30.90 t/ha tuber yield. Treatment T3 gave 29.55 t/ha tuber yield. Minimum tuber yield (23.30 t/ha) was reported from control plot. All the treatments were significantly superior to control plots. 32.62 %, 48.07 % and 26.82 % increase in yield over control were recorded from treatment T1, T2 and T3 respectively.

In case of potato cultivar K.Khyati, treatment T2 recorded the highest tuber yield (42.60 t/ha) while control recorded the minimum tuber yield (26.80 t/ha.). Treatment T1 gave 38.20 t/ha while treatment T3 recorded 37.50 t/ha tuber yield. Both cultivars followed the same disease pattern. There were 42.54 %, 58.96 % and 39.93 % increase in tuber yield over control in case of treatment T1, T2 and T3 respectively.

Economics of fungicide spray schedule

An economics of the treatments were calculated at the market price of fungicides as well as potato produce. The cost of cultivation includes labour charges, cost of fertilizer, irrigation, field preparation, land rent, vehicle charges, fungicide charges, sale price of produce etc which was Rs 103000.00 per ha. The economics of fungicide spray schedule **(Table 2)** indicated that treatment T2 gave the highest benefit cost ratio i.e. 1.59 in case of potato cv. K.Bahar with maximum returns (Rs 64050.00 per ha) followed by treatment T1 (1.43 B:C ratio and Rs 46250 per ha net return). The control plots showed the lowest B:C ratio (1.13) with minimum returns (Rs 13500.00 per ha) in case of potato cv. K.Bahar.

In case of potato cultivar K.Khyati, control plots recorded 1.30 B:C ratio with minimum returns (Rs 31000.00 per ha). Treatment T2 showed the maximum gross returns (Rs 213000.00 per ha) as well as net returns (Rs 104550.00 per ha). Treatment T1 showed 1.76 and treatment T3 gave 1.77 B:C ratio respectively. The cultivar K.Khyati showed the more returns and B:C ratio as compare to K.Bahar.

In one study regarding fungicidal scheduling, Chakraborty and Banerjee, (2016) revealed that prophylactic spray with fungicide Mancozeb @ 0.2 % followed by combi products of Fenamidone + Mancozeb @ 0.3% as second spray at the time of appearance of disease followed by third

Table 2: Effect of fungicide scheduling on tuber yield and benefit cost ratio

Cultivars	Treatments	Tuber yield (t/ha)	Percent increase in yield over control	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
K. Bahar	T1	30.90	32.62	108250.00	154500.00	46250.00	1.43
	T2	34.50	48.07	108450.00	172500.00	64050.00	1.59
	T3	29.55	26.82	105950.00	147750.00	41800.00	1.39
	T4	23.30	-	103000.00	116500.00	13500.00	1.13
K. Khyati	T1	38.20	42.54	108250.00	191000.00	82750.00	1.76
	T2	42.60	58.96	108450.00	213000.00	104550.0	1.96
	T3	37.50	39.93	105950.00	187500.00	81550.00	1.77
	T4	26.80	-	103000.00	134000.00	31000.00	1.30
CD (cultivar)		2.20					
CD (treatment)		3.12					

spray with fungicide Mancozeb @ 0.2 % gave the best results against late blight of potato. Gurjar, *et al*., (2019) showed that first prophylactic spray with fungicide Mancozeb @ 0.2 %, second spray with combi product of Dimethomorph + Mancozeb @ 0.3 % and third spray with fungicide Mancozeb @ 0.2 % was found significantly superior for management of disease as disease severity reaches upto 39.44 % at 35 days after appearance of disease. Tiwari, *et al*., (2020) also worked on same problem and revealed that several chemicals are developed to manage various plant diseases by preventing or destroying pathogens causing the disease and their knowledge is important in reducing losses in production.

Cohen and Rubin (2020) revealed that chemical oxathiapiprolin benthiavalicarb or mixture of this chemical can be use as treatment to manage the oomycetes fungus and it provides the systemic protection against disease caused by foliar oomycetes pathogen. Mhatre, *et al*., (2020) reported that combi formulations like M-Cymoxanil + Mancozeb and Chlorothalonil-Ametoctradin + Dimethomorph was highly effective and could considered as the best treatments for southern hills of India against late blight of potato. Tiwari, *et al*., (2021) reported that incorporation of fungicide spray schedule with other practices is the most effective, environment friendly and low-price approach.

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