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INTEGRATED DISEASE MANAGEMENT FOR LATE BLIGHT AND BACTERIAL WILT IN POTATO AT DIFFERENT LOCATIONS OF ARUNACHAL PRADESH

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ABSTRACT : The demonstration programme of bio-control based IPM in potato was carried out at three locations of East Siang district of Arunachal Pradesh. Potato variety Kufri Pukhraj was used. The crops were planted at 4th, 10th and 15th November in the Farmer's practice, untreated control plot and IPM practice, at Jhampani. At Oyan, the crop was planted on 31st October in the Farmer's practice, 5th November in both untreated control plot and IPM practice and at Sille the crop was planted on 19th, 20th and 20th October in the IPM practice, Farmer's practice and untreated control plot, respectively. The crop was harvested at 90 days after planting. However, at 50 DAP, no significant difference was observed between the three treatments at Jhampani and between farmer's practice (4.00%) and control (10.00%) at Sille. Farmer's practice field recorded significantly lower incidence of late blight than the other two treatments in all the three locations at both 50 and 60 DAP. Highest incidence of the disease (70.07 per cent leaf area damage) was observed in untreated control (Sille) at 60 DAT. IPM practice recorded 20.60, 15.87 and 44.67 per cent leaf area damage at 60 DAP at Jhampani, Oyan and Sille and were significantly lower than the untreated control in their respective locations. The outcome compared with all the locations, Oyan was found better and also significantly superior over rest of the location against bacterial wilt incidence of potato.

Keywords: *Integrated disease management, late blight, bacterial wilt, potato.*

Potato (*Solanum tuberosum* L.) is one of the most important food crop after wheat, maize and rice; historically contributing to food and nutritional security in the world (Pandey *et al*., 9). It is used as vegetable, stock feed and in industries for manufacturing starch, alcoholic beverages and other processed products. Potato is also an important crop in the NEH region of India comprising the states of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. NEH region covers almost 9% of the area of the country and about 4.5% of its population. Potato crops suffer from several diseases at different stages of its growth. All the parts of the plants such as the branch, leaf, petioles and tubers are attacked by a number of pathogens including fungi, bacteria and viruses.

Late blight of potato caused by *Phytophthora infestans* is one of the most important and devastating diseases affecting potato crops (*Solanum tuberosum* L.) in different countries of the world (Fernandez-Northcote *et al*., 3; Namanda *et al*., 8). Historically, the disease has often resulted in destructive consequences and the most documented event is the great famine caused by this disease in Ireland (1845) when almost half of the potato crop was destroyed (Fernandez-Northcote *et al*., 3).

This disease is favoured by wet conditions with high humidity (> 90%) but this fungus has great ability to adopt to variety of environments (Ahmad and Mirza, 1) that is why it is found in temperate as well as in subtropical regions. During moist weather, whole plants may be killed in a short time. (George and Preston, 5) and it spread very rapidly if kept unchecked (Khan *et al*., 7).

Bacterial wilt of potato is most serious disease caused by soil borne plant pathogen *Ralstonia solanacearum* E.F. Smith (Yabucchi *et al*., 11), cause a considerable amount of damage to potato and many other crops in tropical, subtropical and warm temperate region of the world (Ji *et al*., 6). The pathogen invades through wounds in roots, lateral root emergence points or stomata and colonizes the intercellular spaces of the root cortex and vascular parenchyma, eventually entering the xylem vessels. In the xylem vessels the pathogen dissolves the cell walls and produce highly polymerized polysaccharides that increase the viscosity of the xylem and results in plugging. Blocking of vessels by bacteria is the major cause of wilting. It is a very destructive pathogen that causes wilt on potato and many other solanaceous crops with incidence on potato as high as 63% in major potato growing areas (Bekele, 2).

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The present study was designed to assess the effects of various IPM based bio-control management for the bacterial wilt and late blight of potato in various locations and find out the best treatment for managing both the disease in such locations.

MATERIALS AND METHODS

The present study was carried out at three locations of East Siang district of Arunachal Pradesh during 2011-12 and 2012-13. Potato variety "*Kufri Pukhraj*" was used. The crops were planted at 15th November, 4th November and 10th November in the IPM practice, Farmer's practice and untreated control plot at Jhampani village. At Oyan village, the crop was planted on 5th Nov., 31st October and 5th November in the IPM practice, Farmer's practice and untreated control plot and at Sille village the crop was planted on 19th, 20th and 20th October in the IPM practice, Farmer's practice and untreated control plot, respectively. The crop was harvested at 90 days after planting at all the villages. The IPM practice included dipping of potato tuber in 2% *Pseudomonas florescence* solution (SU-Mona, Pest Control India, Maharashtra) before planting, spraying of 3% neem oil (Multineem, Multiplex Agricare Karnataka) at 20, 30, 40 and 50 DAP. Farmer's practice included soil treatment with bleaching powder @ 20 kg/ha and spraying of Ridomil (Metalaxyl 8% + Mancozeb 64%, Syngenta, Mumbai, Maharashtra)/ Matco (Metalaxyl 8% + Mancozeb 64%, Indofil Chemicals Company, Mumbai, Maharashtra)@ 2g /lit at 20, 30, 40, 50 and 60 DAP. In all the three locations, three treatments were maintained. The bacterial wilt (*Ralstonia solanecea-rum*) infestation was recorded by randomly selecting 20 plants and counting the total number of wilted plants from 5 different areas of each treatment considering as five replications. The blight infestation was recorded as average of five plants/ plot from 5 randomly selected leaves of each plant as of three different areas of each treatment. The data on disease infection was recorded using 0-9 disease rating scale given by Shutong *et al*. (10) as shown in Table1.

Table 1 : Rating scale for the assessment of late blight severity on potato leaves (Shutong *et al.*, 10)

Disease severity rating grade	Disease incidence (%)	Level of resistance/ Susceptibility
0	0.0	No Disease
1	10%	Small lesion on the inoculated point with the lesion area less than 10 % of the whole leaflet
3	10% and 20%	Lesion area between 10% and 20% of the whole leaflet
5	20% and 30%	Lesion area between 20% and 30% of the whole leaflet
7	30% and 60%	Lesion area between 30% and 60% of the whole leaflet
9	Over 60%	Lesion area over 60% of the whole leaflet

RESULTS AND DISCUSSION

The data were recorded for disease incidence of late blight of potato at all the three locations given in (Table 2) at Jhampani, negligible mean percentage of wilt plant was recorded in the Farmer's practice (2.07 %) followed by in IPM (7.53 %) and maximum (16.47 %) in untreated control. However, highest yield (239.73 q/ha) was obtained in Farmer's practice followed by IPM practices yield (224.41 q/ha) and least yield (186.35 q/ha) and was recorded in untreated control.

At Oyan, mean incidence of late blight was less recorded in Farmer's practice (2.67 %) followed by IPM (5.93 %) and maximum (9.80 %) in untreated control. However, highest yield (250.77 q/ha) was obtained in Farmer's practice followed by IPM practices yield (230.60 q/ha) and lowest yield (200.60 q/ha) and was recorded in untreated control.

At Sille, mean incidence of late blight was less recorded in Farmer's practice (4.33%) followed by IPM (19.29 %) and maximum (36.05 %) in untreated control. However, highest yield (234.95 q/ha) was obtained in Farmer's practice followed by IPM practices yield (193.93 q/ha) and lowest yield quintal / ha (156.51) and was recorded in untreated control. The outcome compared with all the locations, Oyan was found better and also significantly superior over rest of the location against late blight incidence of potato.

However, at 50 DAP, no significant difference was observed between the three treatments at Jhampani and between farmer's practice (4.00%) and control (10.00%) at Sille. Farmer's practice and IPM practice were at par in all the locations. Farmer's practice field recorded significantly lower incidence of late blight than the other two treatments in all the three locations at both 50 and 60 DAP. Highest incidence of the disease (70.07 per cent leaf area damage) was observed in untreated control (Sille) at 60 DAT. IPM practice recorded 20.60, 15.87 and 44.67 per cent leaf area damage at 60 DAP at Jhampani, Oyan and Sille and were significantly lower than the untreated control in their respective locations.

Table 2 : Bio efficacy of IPM against late blight of potato during *Rabi*, 2011-12.

Treatments	Per cent infection/ leave				Tuber yield (q/ha)
	40 DAT	50 DAT	60 DAT	Mean	
At Jhampani					
(i) IPM	0.00 (0.00)	2.00 (8.06)	20.60 (26.98)	7.53 (11.68)	224.41
(ii) Farmer's practice	0.00 (0.00)	0.00 (0.00)	6.20 (14.14)	2.07 (4.71)	239.73
(iii) Control	1.47 (6.84)	13.07 (21.10)	35.67 (36.64)	16.74 (21.20)	186.35
At Oyan					
(i) IPM	0.00 (0.00)	1.93 (7.98)	15.87 (23.45)	5.93 (10.48)	230.60
(ii) Farmer's practice	0.00 (0.00)	0.67 (4.63)	7.33 (15.58)	2.67 (6.74)	250.77
(iii) Control	0.00 (0.00)	8.87 (17.21)	20.53 (26.88)	9.80 (14.70)	200.60
At Sille					
(i) IPM	0.00 (0.00)	13.20 (21.30)	44.67 (41.91)	19.29 (21.07)	193.93
(ii) Farmer's practice	0.00 (0.00)	4.67 (12.36)	8.33 (16.69)	4.33 (9.68)	234.95
(iii) Control	4.40 (12.08)	32.67 (34.86)	71.07 (57.62)	36.05 (34.85)	156.51
CD (P=0.05)	1.15	2.47	4.87	11.27	15.15
CV%	28.95	10.06	9.73	39.77	4.11

Table 3 : Bio efficacy of IPM against bacterial wilt of potato during *Rabi*, 2011-12 and 2012-13

Treatments	Per cent wilted plant			Tuber yield (q/ha)
	40 DAT	50 DAT	Mean	
At Jhampani				
(i) IPM	1.00 (2.58)	2.00 (5.17)	1.50 (3.88)	224.41
(ii) Farmer's practice	1.00 (2.58)	2.00 (5.17)	1.50 (3.88)	239.73
(iii) Control	5.00 (9.91)	4.00 (8.86)	4.50 (9.39)	186.35
At Oyan				
(i) IPM	2.00 (5.17)	1.00 (2.58)	1.50 (3.88)	230.60
(ii) Farmer's practice	1.00 (2.58)	1.00 (2.58)	1.00 (2.58)	250.77
(iii) Control	4.00 (8.78)	6.00 (12.54)	5.00 (10.66)	200.60
At Sille				
(i) IPM	2.00 (5.17)	3.00 (6.27)	2.50 (5.72)	193.93
(ii) Farmer's practice	2.00 (5.17)	4.00 (8.86)	3.00 (7.02)	234.95
(iii) Control	8.00 (14.52)	10.00 (16.62)	9.00 (15.57)	156.51
CD (P=0.05)	NS	9.11	5.30	15.15
CV%		90.58	34.41	4.11

**Figures in the parentheses are angular transformed values.*

The data were recorded for disease incidence of bacterial wilt of potato at all the three locations given in (Table 3) at Jhampani, negligible mean percentage of wilt plant was recorded in the IPM as well as Farmer's practice (1.50 %) and maximum (4.50 %) in untreated control. However, highest yield (239.73 q/ha) was obtained in Farmer's practice followed by IPM practices yield (224.41 q/ha) and least yield (186.35 q/ha) and was recorded in untreated control.

At Oyan, mean incidence of bacterial wilt was less recorded in Farmer's practice (1.00 %) followed by IPM

(1.50 %) and maximum (5.00 %) in untreated control. However, highest yield (250.77 q/ha) was obtained in Farmer's practice followed by IPM practices yield (230.60 q/ha) and lowest yield (200.60 q/ha) and was recorded in untreated control.

At Sille, mean incidence of bacterial wilt was less recorded in IPM (2.50 %) followed by Farmer's practice (3.00 %) and maximum (9.00 %) in untreated control. However, highest yield (234.95 q/ha) was obtained in Farmer's practice followed by IPM practices yield (193.93 q/ha) and lowest yield quintal / ha (156.51) and was recorded in untreated control. The outcome compared with all the locations, Oyan was found better and also significantly superior over rest of the location against bacterial wilt incidence of potato.

Delaying the date of planting reduced the bacterial wilt incidence. This was attributes to decreasing temperature during cropping period (French, 4). Among the locations, higher incidence of the disease was recorded at Sille and it may be due to late planting of the crop. In all the locations, higher tuber yield was recorded in Farmer's practice field and it was followed by IPM practice.

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