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Full Length Research Paper

Management of bacterial wilt disease of potato in coastal plains of Odisha

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Bacterial wilt and brown rot caused by *Ralstonia solanacearum* is one of the most dreaded diseases causing 30 to 70% yield loss in India. The disease is both tuber and soil borne. A field trial was conducted following split plot design in the year 2008 to 09 and 2009 to 10 under All India Co-ordinated Potato Research Project in Central Farm, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, India with chemical soil amendments in main plots (M1 = application of bleaching powder 7 days prior to planting, M2 = application of bleaching powder at the time of planting, M3 = no bleaching powder application) and different physical, chemical and bio-agent treatments in the subplots (T1 = large sized tuber, T2 = tuber treatment with *Bacillus subtilis* (10^6 cfu/ml),T3 = tuber treatment with boric acid, T4 = tuber treatment with *Bacillus subtilis* + boric acid, T5 = tuber treatment with streptocycline (0.015%), and also 4 times basal drenching with streptocycline (0.015%), T6 = control). Observations on plant wilt at 75 days after planting and yield of healthy and rotten tubers at harvest were recorded. Soil application of bleaching powder at the rate of 12.5 kg/h irrespective of other treatments significantly reduced wilting of plants in comparison to control. Among the treatments, tuber treatments with streptocycline combined with basal application of the same antibiotics at 10 days interval for four times after planting resulted in minimum wilting (3.83%) of plant and significant increase in tuber yield (18.21t/h) followed by tuber treatment with *B. subtilis* along with 3% boric acid (17.31t/h) recoded to be the second best treatment in reducing the wilting (9.55%) and increase in yield over control.

Key words: Bacterial wilt, disease, management, coastal plains.

INTRODUCTION

Potato (*Solanum tuberosum*) is one of the most popular and abundant food crop over the world after rice (*Oryza sativa*), maize (*Zea mays*) and wheat (*Triticum aestivum*). It plays classic role in food security system of the world because of changing life styles and mind set of the population for secure food and climate system (CGIAR, 2012; Nayar, 2014). About 22% of potatoes are lost per year due to fungal, bacterial, viral diseases attacking potato plant and potato tubers. Among them mainly there were six bacterial, 24 fungal and 27 bacterial diseases. The bacterial wilt incited by *Ralstonia solanacearum* is a devasting disease distributed all over the world including tropical subtropical and temperate regions (http, Wikipedia).

In India, the disease is endemic in west coast from Thiruvanthapuram in Kerala to Khera in Gulurat, in

Karnatak, in Western Maharastra and Madhya Pradesh in eastern plains of Assam, Odisha, and West Bengal, in Chota Nagpur Pleateau and in Andaman and Nicober islands. The disease was found endemic in North-Western Kumaon hills, 2300 masl (meter above mean sea level), in eastern hills of West Bengal, Meghalaya, Manipur, Tripua, Mizorum and Arunachal Pradesh and in Nilgirs, Annamalai and Palni hills of Tamil Nadu. The disease has not been noticed in the North –western high hills excluding Kumaon hills and the Mlawa region of Madhya Pradesh (Ranjan et al., 2015; Sagar et al., 2013).

In West Bengal, the disease was recorded from fifteen economically important crops mainly potato, tomato, brinjal, chilli, banana etc. and twelve wild plants like *Amaranthus spinosus, Amaranthus viridis, Croton sparsiflorus (*Mondal et al., 2014). The disease may damage the crop in two different ways, that is, pre-mature wilting of the crop and rotting of tubers both in fields and stores. The disease is both tuber and soil borne. Hence, the effectiveness of both soil and tuber treatments were evaluated against the disease.

MATERIALS AND METHODS

A field trial was conducted following split plot design in the popularly grown variety Kufri Jyoti under All India Co-ordinated Potato Research Project in Central Farm, Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, India with chemical application in soil in main plots (M1=application of bleaching powder 7 days prior to planting, M2=application of bleaching powder at the time of planting,M3=No bleaching powder application) and different physical, chemical and biological treatments in the sub plots. Treatment details:

Main plot (Methods of bleaching powder application=3)

M_1= Soil application of Bleaching Powder at 12.5 kg /h 7 days prior to planting,
M_2= Soil application of Bleaching Powder at 12.5 kg /h at the time of planting,
M_3= Bleaching powder not applied.

Sub plot (Management practices = 6)

T_1= 70g size greenish tuber,
T_2= Seed tuber treated with *Bacillus subtilis* (6×10^6 CFU/ml),
T_3= Seed tuber treated with Boric Acid (3%),
T_4= Seed tuber treated with Boric Acid (3%) + *Bacillus subtilis* (6×10^6 CFU/ml),
T_5= Streptocycline treated tuber (0.015%) + basal drenching with stretocycline at (0.015%) for four times at 10 days interval after 1st earthing up,
T_6= Control.

The treatments were replicated thrice. The plot size for each treatment was 6 m × 2 m (12 sq. mtr). The fertilizer dose was given at 150:80:120 kg of N:P:K/ha. The plants were sprayed with adequate fungicides against blight diseases and insecticides against viral diseases, aphids, cut worms and leaf eating cater pillars. The wilt incidence was recorded at, 75 DAP (days after planting) and yield of healthy tubers, and percent of tuber rotting at harvest were recorded.

RESULTS AND DISCUSSION

Results on incidence of wilting revealed there was reduction in wilt in all the treatments in comparison to control (Table 1). Maximum wilting of 33.72% was recorded in untreated control at 75 DAP. Soil application of bleaching powder at the rate of 12.5 kg/h irrespective of other treatments significantly reduced wilting of plants in comparison to control.

However, application of bleaching powder 7 days before planting was more effective than application of same at the time of planting of seed tubers. While considering mean of incidence of wilting, the same trend was noticed in bleaching powder application irrespective of tuber treatments, that is, 13.92, 16.26 and 21.16% respectively (Table 3a and Figure 1).

The disease is both tuber and soil borne. Hence, tuber treatment and soil treatment was very necessary for successful management of the disease. So for tuber treatment streptocycline and for soil treatment, stable bleaching powder was used among different treatments, tuber treatments with streptocycline combined with basal application of the same antibiotics at 10 days interval for four times after planting resulted in maximum reduction of wilting of plant (3.83%).

Tuber treatment with *B. subtilis* along with 3% boric acid was recorded to be the second best treatment in reducing the wilting (9.55%). While considering the mean of incidence of wilting in different types of tuber treatments, soil application of bleaching powder minimum was recorded in streptocycline treatments (6.30%) at 75 DAP as against 27.67% in control (Table 3b, Figure 2).

Soil application of bleaching powder alone at the rate of 12.5 kg/h seven days before planting irrespective of other treatments resulted in significant increase in tuber yield (18.21t/h) as against only 6.7t/h in control (Table 2). Also, there was significant decrease in production of rotten potato tubers from 1.64t/h in control to only 0.57% t/h in the said treatment (Table 2). Application of stable bleaching powder at the time of planting was found to be the second best treatment which resulted in production of 1.08 t/h of healthy tuber and 0.94 t/h diseased tubers.

Among the treatments combinations, soil applications of bleaching powder 7 days before planting along with the seed tuber treatment with streptocycline followed four

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Table 1. Incidennce of bacterial wilt in response to different treatments under field condition at 75 days after planting (Pooled data of the year 2008-09 and 2009-2010).

Treatment	M1*	M2**	M3***	Mean
T1	19.38 (4.52)	21.87 (4.73)	28.02 (5.34)	22.74 (4.86)
T2	17-06 (4.13)	17.73 (4.27)	22.25 (4.77)	17.96 (4.39)
T3	11.82 (3.51)	12.76 (3.71)	18.25 (4.33)	13.94 (3.85)
T4	9.55 (3.17)	10.96 (3.11)	15.18 (3.96)	11.25 (3.48)
T5	3.83 (2.08)	6.58 (2.66)	9.55 (3.17)	6-30 (2.64)
Control	22.44 (4.79)	28.34 (5.37)	33.72 (5.85)	27.67 (5.33)
Mean	13.92 (3.70)	16.26 (4.01)	21.16 (4.57)	17.11 (4.09)
Main plot	-	-	-	0.50
	-	-	-	1.88
Sub plot	-	-	-	0.06
	-	-	-	0.19

Main plot treatments: M1 =Bleaching powder application 7 days prior to planting; M2=Bleaching powder application at the time of planting; M3 = No Bleaching powder application at the time of planting. Sub plot treatmentsT1= large sized tuber, T2=tuber treatment with *B. Subtilis*, T3=tuber treatment with boric acid, T4=tuber treatment with *B. Subtilis* + Boric Acid, T5=Tuber treatment and basal drenching with Streptocycline, T6 =Control.

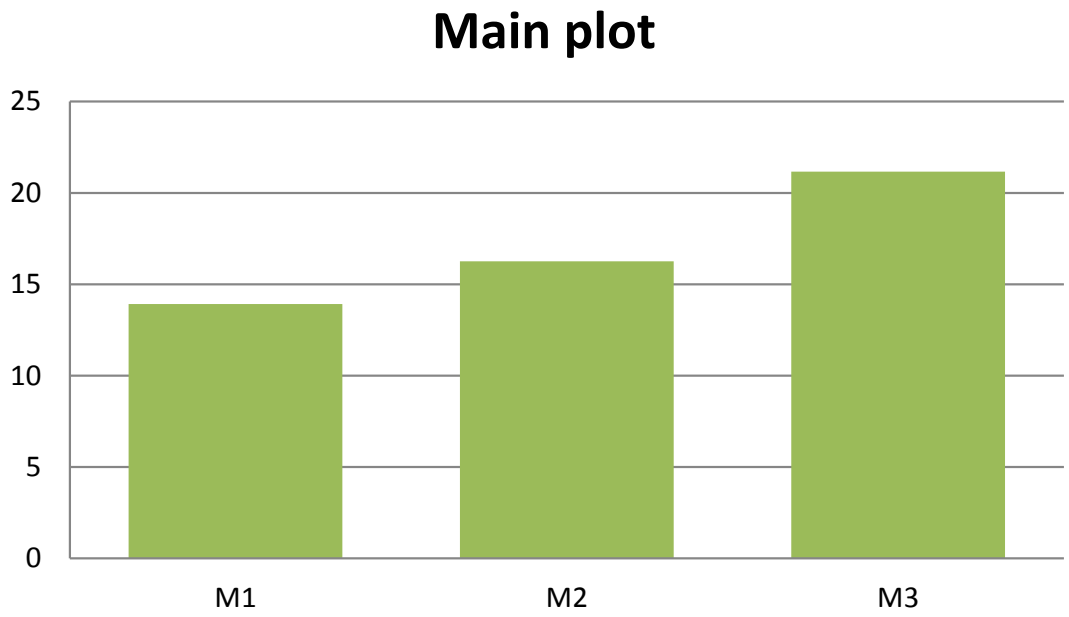

Figure 1. Mean of incidence of bacterial wilt in response to different treatments in main plot under field condition at 75 days after planting.

times basal application of streptocycline at 10days interval resulted in highest production of healthy tubers (18.21 t/h) and lowest quantity of rotten tubers (0.07 t/h) as against 3.96 and 4.21 t/h respectively in case of control followed by tuber treatment with *B. subtilis* along with 3% boric acid recoded to be the second best treatment in production of healthy tubers (17.31 t/h) and reducing the wilting (9.55%). While considering mean of healthy tuber yield, the same trend was noticed in bleaching powder application irrespective of tuber treatments, that is,14.48t/h,11.08t/h and 6.7t/h respectively (Table 4a, Figure 3). Similarly, the mean

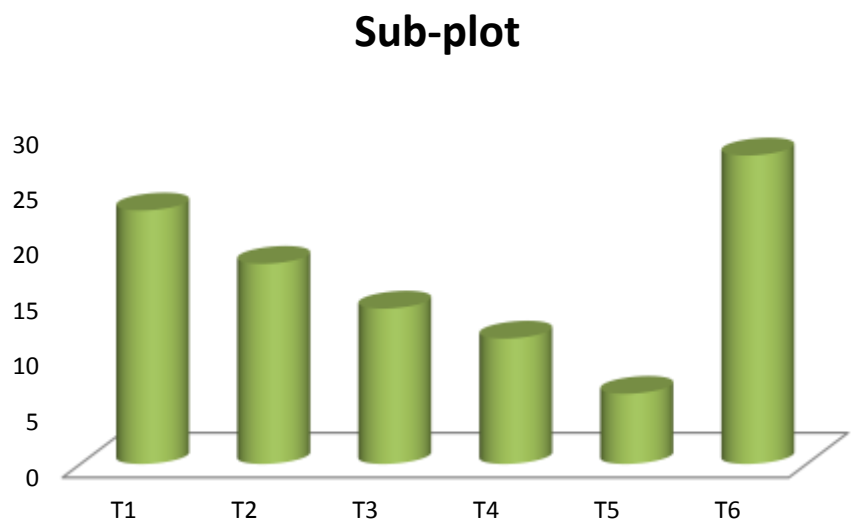

Figure 2. Mean of incidence of bacterial wilt in response to different sub-plot treatments under field condition at 75 days after planning in sub-plot treatments.

Table 2. Effect of management practices on the yield of potato tuber (Pooled Data of the Year 2008-9 and 2009-2010).

Treatments	M1 (Bleaching powder application 7 days prior to planting)			M2(Bleaching powder application at the time of planting)			M3 (No bleach Ing powder application)			Mean		
	Healthy	Rotted	Total	Healthy	Rotted	Total	Healthy	Rotted	Total	Healthy	Rotted	Total
Large sized tuber	12.04	0.80	12.84	8.46	1.45	9,91	4.76	2.07	6.83	8.42	1.44	9.86
Tuber treatment with *Bacillus subtilis*(10^6)	13.65	0.68	14.33	9.92	1.08	11.00	5.69	1.37	7.06	9.79	1.04	10.83
Tuber treatment with Boric acid (3%)	15.49	0.40	15.89	12.65	0.75	13.40	7.31	1.12	8.43	12.82	0.76	13.58
Tuber treatment with *Bacillus subtilis*(10^6)+ Boric Acid (3%)	17.31	0.23	17.54	13.62	0.43	14.05	8.45	0.80	9.25	16.46	0.49	16.95
Tuber treatment and basal drenching with streptocycline(0.015%)	18.21	0.07	18.28	15.35	0.12	15.47	10.05	0.27	10.32	17.87	0.17	18.04
Control	10.18	1.23	11.41	6.59	1.85	8.44	3.96	4.21	8.17	7.24	2.43	9.77
Mean	14.48	0.57	15.05	11.08	0.94	12.02	6.70	1.64	8.34	11.55	1.05	12.60
-	-	Healthy	Rotted	Pooled	Healthy	Rotted	Pooled	-	-	-	-	-
-	B	0.15	0.02	0.17	0.40	0.06	0.23	-	-	-	-	-
-	T	0.10	0.03	0.16	0.30	0.09	0.19	-	-	-	-	-
-	BXT	0.31	0.07	0.19	0.90	0.23	0.56	-	-	-	-	-
-	TXB	0.16	0.05	0.10	0.50	0.16	0.33	-	-	-	-	-

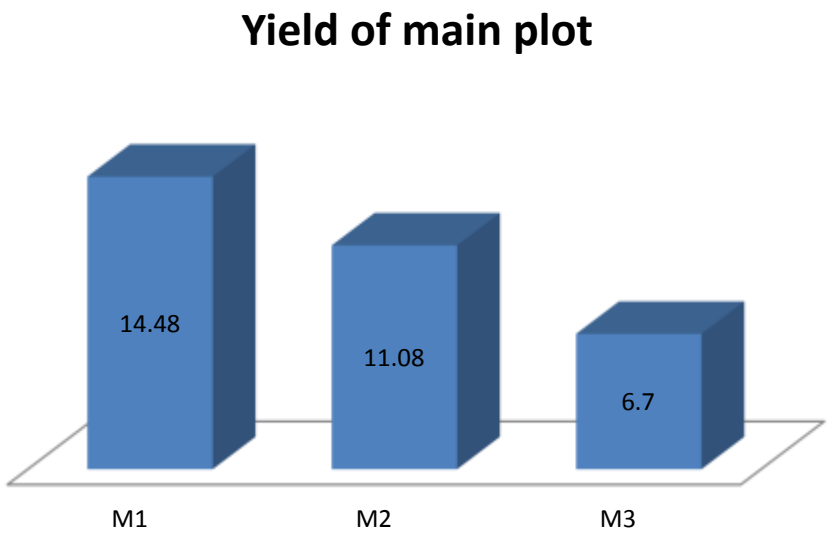

Figure 3. Yield response to different treatments in main plot under field condition at harvest.

Table3a. Mean of incidence of bacterial wilt in main plot in response to different treatments under field condition at 75 days after planting.

Main plot	Bacterial wilt (%) (mean)
M1	13.92
M2	16.26
M3	21.16

Table 3b. Mean of incidence of bacterial wilt in response to different treatments in sub plot under field condition at 75 days after planting.

Sub plot	Bacterial wilt (%) (Mean)
T1	22.74
T2	17.96
T3	13.94
T4	11.25
T5	6.30
T6	27.67

Table 4a. Mean of yield response to different treatments under field condition at harvest in main plot.

Main plot	Yield (t/h)(Mean)
M1	14.48
M2	11.08
M3	6.70

Table 4b. Yield response to different treatments in sub plot under field condition at harvest.

Sub plot	Yield (t/ha) (Mean)
T1	8.42
T2	9.79
T3	12.82
T4	16.46
T5	17.87
T6	7.24

yield of healthy tuber in different types of tuber treatments irrespective of soil application of bleaching powder revealed maximum yield in streptocycline tuber treatment with basal drenching (17.87t/h) as against 7.24t/h in control (Table 4b and Figure 4).

There was report of use of bio-agents and anti biotics against bacterial wilt of brinjal caused by *R. solanacearum* (Gupta and Razdan, 2013; Sawant et al, 2014). The bio-agent *B. subtilis* was also potential in the reduction of wilting from 27.67 to 13.94% in AICPIP, Bhubaneswar. Application bleaching powder in field was regularly used against wilting in all four potato growing zones of India and also in Bangladesh (Chakraborty and Roy, 2016).

The present study revealed in coastal plains of Odisha soil applications of bleaching powder 7 days before planting along with the seed tuber treatment with

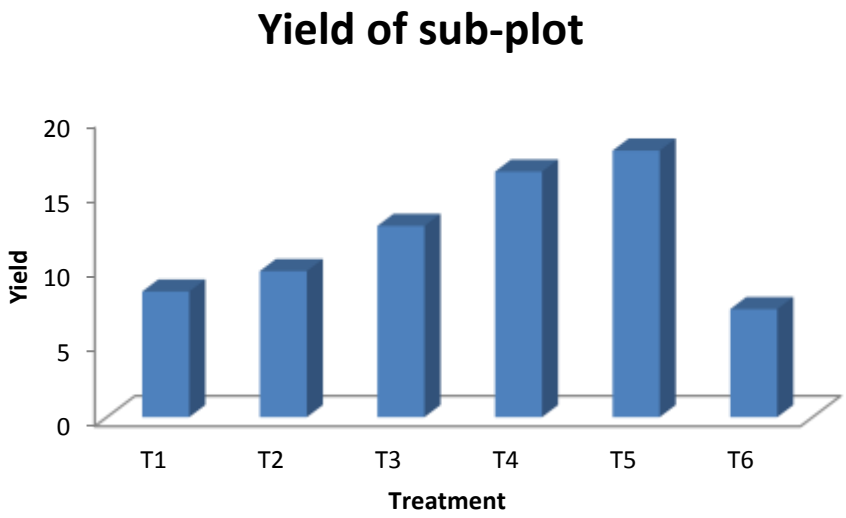

Figure 4. Mean yield response to different treatments in sub plot under field condition at harvest.

streptocycline followed by four times basal application of streptocycline at 10 days interval which was very effective against bacterial wilt caused by *R. solanacearum*. This resulted in highest production of healthy tubers (18.21 t/h) (Table 4,Figure 4) and lowest quantity of rotten tubers (0.07 t/h) followed by tuber treatment with *B. subtilis* along with 3% boric acid in which the production of healthy tubers and rotten tubers was 17.31 t/h and (0.21t/h) respectively

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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