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Some disease management practices for bacterial wilt of potato

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A B S T R A C T

Bacterial wilt [c.o. - *Ralstonia solanacearum* (Smith) Yabuuchi *et al.*] is one of the threatening potato diseases. To study the effect of some disease management practices in potato, an investigation was conducted in slightly acidic (*p*H 5.62) loamy sand soil with medium fertility status in a Randomised Block Design with three replicates and seven treatment modules, as described in Materials & Methods. Investigation revealed that T_1 (TPS whole tuber planting) and T_4 (supervised management - cowdung @ 40 ha^{-1} at land preparation + seed piece tuber treatment with carbendazim 2.5 gL^{-1} and Streptocycline @ 1 gL^{-1} + stable bleaching powder drenching with out removal of affected plant at 40 Days After Planting (DAP) @ 10 gL^{-1}, along with protective banding with well decomposed cowdung + oilcake + Single Super Phosphate + Muriate of Potash mixture at 20:5:3:1 in each bacterial wilt affected plant + mancozeb spray @ 2.5 gL^{-1} at 50, 57 and 60 DAP) were the best treatment in terms of their responses to yield, disease management and higher return per rupee investment. The highest tuber yield and low disease intensity was obtained from T_1 (TPS whole tuber planting) followed by T_4 (supervised management) but under congenial condition for a particular disease like bacterial wilt, it may not possess same result as obtained in the experiment. One of the major advantages of TPS whole tuber planting includes the lack of incipient infection of bacterial wilt pathogen in seed tuber. Therefore, it is always desirable to obtain planting tuber from reliable source. So, integration between whole tuber planting or seed piece treatment units supervised management may offer better protection from the dreaded disease. Dynamic nature of disease management offers the scope for future modification.

Keywords: Disease Intensity, protective banding, *Ralstonia solanacearum*, yield loss, potato

Introduction

Bacterial wilt [c.o. *Ralstonia solanacearum* (Smith 1896) Yabuchhi *et al.* 1996] is one of threatening potato diseases. Serious presence of the disease in the tropics and warmer climate throughout the world leads to heavy crop loss in potato in terms of premature wilting even before tuber initiation. In India, this disease causes 50% crop loss in potato in a regular manner (Mukherjee & Dasgupta 1989) and up to 75 % losses as reported in some areas of Karnataka (Gadewar *et al.* 1991). Sekhawat *et al.* (1999) reported that quantitative yield loss has not been determined in India, and further from other experiments it was also pointed out that relationship between yield loss and disease intensity is linear (Ghosh 2005).

Bacterial wilt of solanaceous vegetables appears as a sudden wilt. Infected young plants die rapidly within 3-4 days. Older plants first show wilting of the young leaves, or partial one sided wilting of the plant and stunting, and finally the plants wilt permanently and die (Agrios 2005). The disease can be easily detected by ooze test of small pieces of wilted plant stem within clear water.

The bacterial wilt is primarily tuber-borne and infected soil also serves as a source of infection (De 2004). Tuber may carry the pathogen in vascular tissues, on the tuber surface and within lenticels. Seed-borne wilt or latent infection has often been resulted in severe out-breaks and even may develop as epidemic of bacterial wilt (French 1986). Infectivity titration showed that inoculum threshold of 10cfu/g soil is required for the infection (Devi *et al.* 1982). The incidence of bacterial wilt is far less in the whole tubers than in cut tuber planting (Khurana & Thind 2003). Traditional farmers' practice like adding chicken or other livestock manure may reduce bacterial wilt under certain conditions (Hayward & Hartman 1994).

Amending infested soils with stable bleaching powder (SBP) at 25 kg ha^{-1} was effective and suitable for control of bacterial wilt under glass house and field condition. A combination of the use of pathogen-free seed tubers and application of SBP at 12 kg ha^{-1} along with 30 kg ha^{-1} additional nitrogen during the time of planting is effective against bacterial wilt (Shekhawat *et al.* 1990).

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Dasgupta & Bandyopadhyay (1999) suggested that farm compost, oilcake, preferably neem single super phosphate, and potash at 20:5:3:1 placed liberally to fill up root zone-deep double bands first of which around wilted plants without uprooting them as well as a similar second band outside the neighbouring apparently healthy plants on all sides, the process being repeated every time a plant wilted singly or in patches, to reduce the spread of wilting at field levels (Figure 1).

The aim of the present investigation was to study the incidence, loss as well as economic and ecofriendly management practices of bacterial wilt of potato in red and lateritic zone of West Bengal, which is emerging as a new potato growing belt .

Materials and Methods

The experiment was conducted on TPS Potato (cv. C-3) during *Rabi* season of 2003-04 at the Palli-Siksha Bhavana Agricultural Farm, Visva-Bharati, Sriniketan, Birbhum, under Agroclimatic Region of Eastern Plateau and Hill Region, Zone VII and agroclimatic zone of undulating red and lateritic area of West Bengal. This is characterized by tropical dry sub-humid area having annual rainfall ranging from 1100-1400 mm, annual normal atmospheric temperatures 37°C (max.) and 14.8°C (min.), loamy sand textured soil with medium fertility status and acidic in nature (pH 5.62).

The experiment was conducted in RBD with 3 replicates and 7 treatment combinations viz. T_1 – TPS Whole tuber planting; T_2 – (Minimum routine practice I) seed piece tuber treatment with carbendazim at 2.5 gL^{-1} + mancozeb spray at 0.25% at 30 and 45 DAP; T_3 – (Minimum routine practice II) seed piece tuber treatment with carbendazim 2.5 gL^{-1} and Streptocycline at 100ppm + tuber dipping in 1% Biovita [sea weed (*Ascophyllum nodosum*) extract] liquid + copper oxychloride spray at 0.25% at 30 and 45 DAP; T_4 – (Supervised management) well decomposed cowdung manure at 40 tha^{-1} at land preparation + seed piece tuber treatment with carbendazim 2.5 gL^{-1} and Streptocycline at 100 ppm + post-appearance SBP drenching at 41 DAP at 10 gL^{-1}, along with protective root-zone deep double banding (Figure 1) with well decomposed cowdung manure + oilcake + SSP + MOP mixture in a ratio of 20:5:3:1 in each bacterial wilt affected plants + mancozeb spray at 2.5 gL^{-1} at 50, 57 and 60 DAP; T_5 – (Maximum routine practice) well decomposed cowdung at 40 tha^{-1} at land preparation + seed piece tuber treatment with carbendazim 2.5 gL^{-1} and Streptocycline at 100 ppm tuber dipping in 1% Biovita liquid + Ridomil MZ (metalaxyl 8% + mancozeb 64%) spray at 1 gL^{-1} at 25DAP + dimethoate (Rogor 30EC) at 0.04% at 30 DAP + mancozeb spray at 0.25% at 50 and 57 DAP; T_6 – (recomended package of practice) seed piece tuber treatment with 2-methoxy ethyl mercury chloride (MEMC) at 1 gL^{-1} + two mancozeb spray at 40 DAP and 55 DAP at 2.5 gL^{-1}; T_7 – (Farmers' practice) well decomposed cowdung manure at 40 tha^{-1} at land preparation + seed piece tuber treatment with MEMC at 1 gL^{-1} + two mancozeb spray at 40 DAP and 55 DAP at 2.5 gL^{-1}.

The disease incidence was recorded at 15 days interval and the disease intensity has been determined using following formula:

$$DI\% = \frac{n}{N+n} \times 100$$

Where, n = total number of infected plant in a plot and N = total number of survived plant in a plot.

Yield loss was estimated using the following formula:

$$\text{Yield loss}\% = \frac{Y_d}{Y_a + Y_d} \times 100$$

where, yield difference (Y_d) was calculated by subtracting actual plot yield (Y_a) from expected yield (Y_e), while Y_e of a plot has been determined on the basis of yield of 30 randomly selected "apparently healthy" plants.

The analysis of variance has been done for statistical analysis (Panse & Sukhatme, 1978). The significance of difference of different sources of variation was tested by error mean square method of Fisher and Snedecor's F- test at P = 0.05 level for required error degrees of freedom. The cost of cultivation was also estimated as per the treatment. The gross return, net return and return per rupee invested were calculated for each treatment. Loca market price of 2003-04 of various input and outputs were considered for economic analysis.

Results

The primary data were analysed and presented in Table 1. The highest yield loss (32.39%) was experienced in T_5 followed by T_3 and lowest in T_1 followed by T_4. The incidence of bacterial wilt has a greater impact on yield loss and indicates a strong positive correlation (r = 0.97). Maximum bacterial wilt incidence encountered 26.38% (up to 40 DAP) and 32.9% (up to 55 DAP) in T_5 and minimum for the same as 0% and 0.3% respectively in T_1. The highest return per rupee investment was experienced in T_1 (TPS whole tuber planting) followed by T_4 (supervised management).

Discussion

The physical examination of the seed tuber lot showed no incipient infection of *R. solanacearum* in potato tuber is difficult to detect externally. Therefore, seed treatment with antibiotics is a prerequisite in the locality where wilt is an endemic problem. The data presented on the incidence of wilt

Table 1:
Effect of different management modules for bacterial wilt of potato and their impact on disease incidence, yield loss and return per rupee investment

Treatments	Disease Incidence (%) 40 DAP	Disease Incidence (%) 55 DAP	Yield Loss (%)	Return per Rupee Investment
T1	0.0 (2.92)*	0.34 (3.89)	0.40	3.06
T2	2.77 (8.56)	2.77 (8.56)	2.80	1.94
T3	19.78 (26.03)	23.59 (29.06)	24.69	0.97
T4	6.59 (14.73)	6.59 (14.73)	6.59	2.23
T5	26.38 (30.80)	32.9 (35.00)	32.39	0.91
T6	3.12 (9.17)	3.81 (11.25)	5.53	1.52
T7	1.04 (5.34)	2.10 (8.33)	2.09	1.96
CD at 5%	6.92	6.84		

*Data in the parentheses represent the angular transformed values.

in Table 1 indicate that seed treatment with organomercurials and carbendazim failed to protect the crop up to 40 DAP. Streptocycline used as seed piece tuber treatment at 100 ppm also failed to fully protect the plants, which suggests infection may have originated from soil through partially suberized tubers. In T_3 and T_5, when closely examined, incidence of bacterial wilt was higher. This has originated perhaps due to application of Biovita during seed piece tuber treatments, which might predispose the host, scavenge the effect of Streptocycline or enhanced bacterial multiplication. The quality of Streptocyline may be poor cannot be ruled out. Interestingly, the effect of cowdung manure for reduction of the wilt disease at the early phase is also negated and the answer of which may be sought to the application of Biovita. It is interesting to note that in supervised management (T_4), banding after 40 DAP and 1% SBP drenching without roguing of affected plant are found to be effective to contain the disease. Therefore, seed treatment with antibiotics, TPS whole tuber planting, stable bleaching powder drenching (1%) along with protective root zone-deep double banding (Figure 1) (cowdung manure: neem cake: SSP: MOP = 20:5:3:1) may be recommended in the areas of high bacterial wilt incidence. The disease has been checked in T_2 by pre-appearance management. In the entire trial no new infection developed after 55 DAP irrespective of treatments suggesting early oficious management.

This investigation revealed that among all disease management modules, T_1 (TPS whole tuber planting) and T_4 (supervised management), with well decomposed cowdung at land preparation, seed piece tuber treatment with carbendazim + Streptocycline, SBP (1%) drenching along with protective banding with well decomposed cowdung, oilcake, SSP and MOP (20:5:3:1) were the best treatments in terms of their response to yield, disease management and higher return per rupee investment.

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Figure 1: Lay-out of protective double banding: after Dasgupta & Bandyopadhyay, (1999), where, W1, W2....W5 are the wilted plants appearing in succession; smaller hollow squares represent the stage 1 banding at root zone-deep around wilted plants, and the larger solid squares represent the second stage protective banding. See text.