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MANAGEMENT OF LATE BLIGHT OF TOMATO

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ABSTRACT

Disease management model for late blight (*Phytophthora infestans)* of tomato (Roma VF.) was developed to increase productivity. The experiment was conducted during the winter season of 2001-2002, in the field laboratory of the Department of Plant Pathology, BAU, Mymensingh, following Randomized Complete Block Design (RCBD) comprising six replications with combination of treatments viz; T_1 (control: no management); T_2 (sanitation: removal of disease parts from plants), T_3 (using fungicide, Ridomil MZ-68 @ 0.2%) and T_4 (combined use of sanitation with fungicide spray). Significant differences were observed among the treatments regarding disease incidence, severity and fruit yield. The highest disease incidence (88.34%) and severity (84.33%) were recorded at 90 days after treatment in control (T_1). The combined effect of sanitation with spraying fungicide (T_4) reduced late blight disease incidence and severity by 96.22% and 90.65%, respectively over control. The highest fruit yield 80.66 t/ha was obtained by T_4 compared with the lowest (41.80 t/ha) in control (T_1). The combined application of sanitation with fungicide spray increased 93.01% fruit yield over control. The benefit cost ratio (BCR) resulted the lowest (8.15) in T_2 treatment and the highest (23.87) in T_3 treatment. Cost benefit analysis showed that the T_4 gave a marginal return of 46.66% higher yield over control.

Key wards: Management, tomato, late blight, *Phytophthora infestans.*

INTRODUCTION

Tomato (*Lycopersicon esculantum* Mill.) is the most popular vegetable fruit of the world. It is believed that this vegetable was introduced in Bangladesh during British period. It is known as a poor man's apple in our country because of its taste, attractive shape, size, color, high nutritional value, medicinal value and diversified uses (Bose and Sam, 1986). It is used as green vegetables like salads and in many other forms. In Bangladesh, tomato is generally grown during the winter season, which is increasing attention of both growers and consumers. The demand of tomato is increasing in the agro-food industries of Bangladesh and it may also consider as a leading cash crop in the country. However, the yield of the crop in this country is very low due to disease infection compared to those of some advanced countries.

There are many factors behind the low yield of tomato in our country, among them disease infection caused by fungi, bacteria, viruses, nematodes and parasitic weeds play important role (Villaral, 1980). Late blight of tomato caused by *Phytophthora infestans* is a major disease of tomato in Bangladesh (Meah *et.al.*,1987). The pathogens attack leaves, stems and immature fruits and 80-90% production may be reduced by them, if control measures are not taken in proper time (Zahid *et. al.*, 1993). In suitable weather, the patches caused by this disease increase rapidly to produce a general blighting of the foliage and stem (Ashrafuzzaman, 1991). On the ventral surface of the leaves, the fungus from a white mildew on the advancing margin of the lesions and the crown may fall over in a rotten pulp in a day or two (Agrios, 1988). The subsequent rot is formed and remains superficial unless the fruit is put in a humid condition to allow the fungus to grow internally. Frequently, in humid weather a white fungal growth develops on the affected area (Ayub *et. al.*, 1997). When blight is followed by soft rot, the fruit is disintegrated. In Bangladesh, the crop loss due to late blight of tomato may rise 10 to above

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80%, if the cropping season is humid along with low temperature. To ensure yield and quality, prime importance need to be given to control the disease to drive maximum yield. For the strategy of developing control measures against late blight of tomato, a disease management model is essential. Therefore, the present study was undertaken to investigate the effectiveness of sanitation, fungicidal spray and combination of sanitation with fungicide spray for the management of *Phytophthora infestans* causing late blight of tomato for profitable production.

MATERIALS AND METHODS

The experiment was conducted at the field laboratory of the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. The experimental area was under a sub-tropical climate, which was characterized by heavy rainfall during the months of April to September and scanty average rainfall 42.72 mm during the period from October to March (2001-2002). During the study period average air temperature varied from 19.18 to 27.97^{0}C, relative humidity (R.H) varied from 72.61 to 86.16%, dew point from 13.87 to 24.71^{0}C (BBS, 2000). Soils are prepared with good ploughing with proper weeding having average soil pH 6.5 (UNDP and FAO, 1988). Manures and fertilizers were applied as per standard recommendation for the tomato research in our country (Hossain *et. al.*, 2006). The experiment was laid out in the Randomized Complete Block Design (RCBD) with 6 replications. Proper intercultural operations were made and plants were tag marked for data collection.

Variety selection: Roma-VF, a known susceptible foreign variety of tomato (Kabir and Nahar, 1997), was used in this experiment.

Treatment Groups: To carry out the experiment, four treatments are grouped as T_1 (control: no management); T_2 (sanitation: removal of disease parts in plants), T_3 (using fungicide Ridomil MZ-68 @ 0.2%) and T_4 (combined use of sanitation with fungicide Ridomil MZ-68 spray). Ridomil MZ-68 was applied four times @ 2g/1 (0.2%) at 15 days interval after the first symptom appeared. The spray solution was prepared in fresh water. The chemical was applied to the plots using a compressed air sprayer.

Data collection: Data were collected according to standard procedure. Data on disease incidence and severity at 45, 60, 75 and 90 days after transplanting were recorded by visual diagnosis method. Six plants per plot were considered for disease incidence and three plants for disease severity. Five leaves were selected successively from the top by avoiding most old and young leaves of each of the three plants to score the disease severity. Crops were harvested at optimum time and data for yield was recorded from the tagged plants. The disease incidence and severity was calculated by the following formula:

$$\% \text{ Disease incidence} = \frac{\text{Number of infected plant}}{\text{Number of total plant inspected}} \times 100$$

$$\% \text{ Disease severity} = \frac{\% \text{ infected leaf area}}{\text{Total leaf area inspected}} \times 100$$

Economic analysis of the treatments were done to compare the profitability among them and the BCR was calculated by using the following formula according to Hossain *et. al.* (2001) as shown below:

$$\text{BCR} = \frac{\text{Yield of individual treated plot} - \text{yield of control plot}}{\text{Cost of total treated plots}}$$

Collected data were statistically analyzed by using analysis of variance to find out the variation resulting from experimental treatments. Treatments were compared by LSD (Least Significant Difference) test.

RESULTS AND DISCUSSION

Effect of different treatments on percent plant infection of late blight of tomato

The effect of different treatments on disease incidence recorded at different days after transplanting (DAT) differed significantly except 45 DAT. The spraying of Ridomil MZ 68 @ 0.2% in combination with sanitation showed remarkable performance in reducing disease incidence irrespective of DAT followed by spraying of Ridomil alone. The plant infection recorded at 60 DAT, 75 DAT and 90 DAT, respectively were 2.50%, 5.16% and 3.33%, while the infections were 30.67%, 64.93 % and 88.34 %, respectively at 60 DAT, 75 DAT and 90 DAT respectively. The result showed that the incidence of late blight of tomato could be reduced 96.22 % by foliar spraying of Ridomil MZ- 68 @ 0.2% in combination with sanitation over control followed by foliar spraying of Ridomil (85.65%). The sanitation alone also showed promizing result that reduced 13.97% of plant infection over control (Table 1).

Table 1. Effect of different treatments on per cent plant infection of late blight of tomato

Treatment	Plant infection (%) per plot				Percent reduction over control at 90 DAT
	45 DAT	60 DAT	75 DAT	90 DAT	
T_1 (Control)	12.33	30.67a	64.93a	88.34a	
T_2 (Sanitation)	9.66	10.50b	39.32b	76.00a	13.97
T_3 (Ridomil MZ 68 @ 0.2%)	5.66	6.00b	8.33c	12.67b	85.65
T_4 (Sanitation + Ridomil)	5.50	2.50b	5.16c	3.33b	96.22
LSD (p=0.01)	NS	14.28	21.59	17.59	-

Values in column with different letters are significantly different at 1% level of significance

Effect of different treatments n disease severity (% Leaf Area Disease-LAD)

The trends of the effect of different treatments on late blight severity were more or less similar to that of late blight incidence observed at different days after transplanting (DAT). The treatments effect on %LAD was found non-significant at 45 DAT but in the following day at 60 DAT, 75 DAT and 90 DAT, the effect on %LAD was differed significantly among the treatments. At 60 DAT, the lowest % LAD (2.83%) was recorded in case of application of Ridomil in combination with sanitation, which was significantly identical with the application of Ridomil alone (Uddin *et.al.*1996). The highest %LAD (53.17%) was recorded in control preceded by sanitation (24.33%). The effects of the treatments on percent LAD at 75 DAT and 90 DAT were found to be similar to that of observed at 60 DAT. The lowest LAD (1.16% and 3.66%) were recorded respectively at 75 DAT and 90 DAT in case of T_4 (Ridomil + Sanitation), which were statistically similar with T_3 (Ridomil). The performance of T_2 (sanitation) also showed potential performances in controlling disease severity of late blight of tomato at 75 DAT and 90 DAT compared to control (T_1).

Calculation of reduction of late blight severity (% LAD) at 90 DAT showed that 90.65% reduction of %LAD was observed in case of T_4, where foliar spray of Ridomil was done in combination with sanitation followed by application of Ridomil alone (79.94%). Application of sanitation reduced 51.67% LAD over control (Table-2).

Table 2. Effect of different treatments on percent leaf area disease (%LAD) of late blight of tomato

Treatments	% Leaf Area Disease				% LAD reduction (over control)
	45 DAT	60 DAT	75 DAT	90 DAT	at 90 DAT
T_1 (Control)	4.88	53.17a	44.17a	84.33a	
T_2 (Sanitation	4.08	24.33b	27.50b	40.67b	51.67
T_3 (Ridimil MZ 68 @ 0.2%)	3.73	3.50c	3.33c	17.67c	79.94
T_4 (Sanitation+ Ridomil)	2.76	2.83c	1.167c	3.66d	90.65
LSD (p=0.01)	NS	10.52	12.16	9.72	

Values in column with different letters are significantly different at 1% level of significance

Effect of different treatments on yield of tomato as affected by the late blight disease

It is evident that the T_4 (Sanitation plus Ridomil) had profound effect on increase of yield of tomato followed by T_3 (Ridomil) and T_2 (Sanitation). The result showed that T_4 produced the highest yield (80.66 t ha^{-1}), which was 93.01 % increase over control. T_3 (Ridomil) produced the second highest yield (62.66 t ha^{-1}), which was 49.30% increase over control (Table 3).

Table 3. Effect of different treatments on yield of tomato as affected by the late blight disease

Treatment	Yield (kg $plant^{-1}$)	Yield (kg $plot^{-1}$)	Yield (t ha^{-1})	%Yield increased over control
T_1 (Control)	1.35c	7.53c	41.80c	
T_2 (Sanitation)	1.60bc	9.60bc	53.28bc	27.49
T_3 (Ridomil MZ 68 @ 0.2%)	1.88b	11.29b	62.66b	49.30
T_4 (Sanitation Ridomil).	2.67a	14.53a	80.66a	93.01
LSD (p=0.01)	0.43	2.40	13.31	

Values in column with different letters are significantly different at 1% level of significance

The present findings of the experiment on the late blight incidence, severity and yield of tomato corroborate with the findings of previous researchers (Begum, 2001; Tumwine, 1999; Fontem, 1993 and Ahmed, 1999). Begum (2001) reported that the treatment combination of Sanitation + Ridomil significantly reduced the incidence and severity of late blight of tomato and increased fruit yield by 78.6%. Tumwine (1999) observed that crop sanitation in combination with other treatment helped in controlling late blight disease of tomato. Fontem (1993) reported that crop sanitation combined with spraying Ridomil remarkably reduced the incidence and severity of late blight of tomato and increased yield 94%. Ahmed (1999) also observed promising combined effect of crop sanitation and spraying of fungicide reducing disease severity of late blight of tomato and increasing yield.

Economic analysis of the management treatments

economic analysis of the treatment has been done on the basis of yield, market price of tomato, cost inputs and cost of labor, against the gross margin of control (T_1). The lowest gross margin of 418000 Tk ha^{-1} was obtained against the yield of 41.80 t ha^{-1} in the T_1 (control) plots. Average yield of 80.66 t ha^{-1} was obtained in T_4 giving a gross margin of 783758.75 Tk ha^{-1}. This was 46.66% increase in gross margin over control. In T_3 (only Ridomil application), the average yield of 62.66 t ha^{-1} gave a gross margin of 617858.75 Tk ha^{-1}, which was about 32.35% increase over control. Under T_2 (only sanitation), the average yield was 53.28 t ha^{-1} which gave a respective gross margin of 518700 Tk ha^{-1}, which gave an increase gross margin of 19.42% over the control (Table 4).

Table 4. Economic analysis for the production of tomato under four different treatments

Treatments	Average yield (t ha^{-1}) a	Gross return (Tk ha^{-1}) b	Total cost of Treatment (Tk ha^{-1}) C	Gross margin (Tk ha^{-1}) d=(b-c)	Gross margin over control (Tk ha^{-1}) e=(T_2-T_1)	Increase of gross margin overontrol (%) $= \frac{e}{d} \times 100$	Benefi t cost ratio (BCR)
T_1 (Control)	41.80	418000.00		418000.00			
T_2 (Sanitation)	53.28	532800.00	14100.00	518700.00	100700.00	19.42	8.15
T_3 (Ridomil MZ 68 @ 0.2%)	62.66	626600.00	8741.25	617858.75	199858.75	32.35	23.87
T_4 (Sanitation + Ridomil)	80.66	806600.00	22841.25	783758.75	365758.75	46.66	17.01

Market price of tomato = 10 tk kg^{-1}

Result from economic analysis of different treatments revealed that the highest BCR (23.87) was found in T3 (Ridomil MZ-68 @ 0.2% spray) produced a moderate average yield (62.66 t ha^{-1}) followed by 17.01 BCR in T4 comprised with sanitation plus Ridomil MZ-68 @ 0.02% spray, which produced maximum yield (80.66 t ha^{-1}). And the lowest BCR (8.15)was found in T2 comprised with sanitation.

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