

ASSESSMENT AND MANAGEMENT OF TOMATO DISEASES UNDER PLASTIC HOUSE CONDITIONS IN LAMJUNG

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ABSTRACT

An experiment was conducted under plastic houses at three farmers' field, each farmer as a replication, in Tarku and Banhjakheth VDCs in Lamjung district during July to December 2010, to identify and manage major fungal diseases of tomato (variety Srijana) using chemicals and bio-pesticides. The treatments Bio-cure-F (*Trichoderma viride*, bio-fungicide), carbendazim (Bavistin, systemic fungicide) and Dithane M-45 (Mancozeb, contact fungicide) were applied as foliar spray. Control plot was maintained without application of any treatment. Mainly four fungal diseases, early blight (*Alternaria solani*), late blight (*Phytophthora infestans*), powdery mildew (*Leveillula taurica*) and septoria leaf spot (*Septoria lycopersici*) were recorded. Dithane M-45 appeared the best to control early blight, late blight and septoria leaf spot, followed by Bavistin and Bio-cure-F over control. Bavistin performed the best to control powdery mildew, followed by Dithane M-45 and Bio-cure F over control. Severity of fungal diseases appeared high on tomato in plastic house. Based on type of disease, Dithane M-45 or Bavistin is suggested to spray for the management.

Key words: tomato, plastic house, fungal diseases, control measures.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) belongs to family Solanaceae and is one of the most remunerable and widely grown vegetables in the world. The world annual production of tomato during 2003 was 113.3 million tons covering an area of 4.3 million hectare with the productivity of 26.34 tons per hectare. Tomato is one of the important vegetable crops in Nepal and is grown commercially in plains and hills for fresh consumption and processing to some extent. In Nepal, tomato stands in third position after cauliflower and cabbage in terms of area (21,389 ha) and production (400,674 tons) (MOALD, 2018). It is also known as poor man's apple in Nepal. Although the Terai region produces and sells more vegetables, vegetables grown in the hilly region have greater value; these vegetables are produced during the rainy season when prices are higher (NEAT, 2011). Tomatoes, which are actually a fruit vegetable, are loaded with all kinds of health benefits for the body.

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Tomato contains a very powerful antioxidant called lycopene which purportedly fights the free radicals that can interfere with normal cell growth and activity. These free radicals can potentially lead to cancer, heart disease and premature aging. Introduction of tomato cultivation under plastic house conditions favored the off season production making possible availability of tomato in all the seasons in the market.

There are several diseases on tomato caused by fungi, bacteria, viruses, nematodes and abiotic factors (Balanchard, 1992) that are limiting its production and productivity. Early blight caused by *Alternaria solani*, late blight caused by *Phytophthora infestans* and septoria leaf spot caused by *Septoria lycopersici* are the major fungal foliar diseases. Powdery mildew caused by *Leveillula taurica* and *Oidium* spp. is another foliar disease generally appearing in late season. To combat with diseases growers/farmers are using chemical fungicides haphazardly, but still satisfactory level of diseases control are not achieved by them. At the same time, the ultimate results of haphazard use of chemicals create health related problems, increase environmental pollution and yield loss also due to non-target fungicides application resulting in fungicide induced disease resurgence, the whole natural ecosystem is adversely affected and also financial burden increased to the poor farmers (Palikhe, 2006). Therefore, the objective of the study was to find out the effectiveness of most commonly used chemical fungicides and bio-fungicide for the management of major, foliar fungal diseases of tomato grown under plastic houses.

METHODOLOGY

An experiment was conducted in three plastic houses on three farmers' fields at two VDCs in Lamjung (Tarku and Banjhakhet) during July to December, 2010. Mean area of each plastic house was 50 sq m (10 m x 5 m). Two plastic houses were selected, from Banjhakhet, one from the village an altitude of 900 masl, situated north-east from Beshisahar and Marshyangdi river, and the other at Kupling village, a pocket region of vegetable production in Lamjung, at an altitude of 1,150 masl, on the southern face of a hill, and the third plastic house was taken from Thakle village of Tarku VDC, situated at 800 masl in southern side of Lamjung district on the bed of Paudi Khola. A nursery bed of 5 m² size was prepared, applying 18 kg well decomposed FYM, at one corner inside the plastic house at Tarku. After seed bed preparation, 5 gram seeds of "Srijana F1 hybrid" tomato were sown continuously in row in 1 cm depth with row to row spacing of 10 cm on 18th June, 2010. Twelve days old seedlings were uprooted and transplanted on the same bed for hardening. Each plastic house was taken as a replication where there were 4 plots/plastic house with a size of 5m x 2m and inter plot spacing 40 cm. The plots were slightly raised to avoid the water logging and flooding. Twenty five

days old, 20 seedlings per plot and 80 seedlings per plastic house were transplanted on 12th July, 2010 in all the plastic houses. There were two rows/plot and planting distance was 80 cm row to row and 50 cm plant to plant.

TREATMENTS

There were 4 treatments as below in the study, which were replicated 3 times. Treatments details are presented below.

T1 = Bio-cure-F (*Trichoderma viride*)

T2 = Bavistin (carbendazim)

T3 = Dithane M-45 (mancozeb)

T4 = Control

Application of treatments

The bio-pesticide, Bio-cure-F @ 5 g/l, Bavistin at the concentration of 2 g/l and Dithane M 45 @ 2 g/l water were sprayed five times at seven days intervals after the appearance of any of the fungal diseases.

OBSERVATION

Observations on plant height, leaf numbers, yield, disease incidence and severity were taken. Plant height and leaf number were recorded two times, first 10 days after transplanting and the second 15 days after the first observation. Disease scoring was done from the central four plants of each plot after the appearance of the disease. Each 3rd plant from both the ends among the 10 plants in a row is selected for the observation. Disease scoring of infected plants was done using the following standard scales.

Scale used for assessment of late blight (Mayee and Datar, 1986)

0= No symptoms, 1 = 1 - 10% leaf area infected, 2 = 11 - 25% leaf area infected, 3 = 26 - 50% leaf area infected, 4 = 51 - 75% leaf area infected and 5 = >75% area infected.

Scale used for assessment of early blight (Mayee and Datar, 1986)

0 = no symptoms, 1 = 1-9% plant parts infected, 2 = 10-24% plant parts infected, 3 = 25-49% plant parts infected, 4 = 50-74% plant parts infected and 5 = 75-100% plant parts infected.

Scale used for assessment of powdery mildew (Thayer and Stall, 1962)

0 = no appearance, 1 = <25% leaf area infected, 2 = 50% leaf area infected, 3 = >75% leaf area infected and 4 = 100% leaf area infected.

Scale used for assessment of septoria leaf spot (Emua, 1980)

1 = Disease free leaf, 2 = Few lesions on leaf 3 = large number of lesions but with little coalescence. 4 = Large number of lesions with yellowing, 5 = leaf completely destroyed.

Disease incidence and severity were calculated by using the following formulae

$$\text{Disease Incidence (\%)} = \frac{\text{Number of infected plant units}}{\text{Total number of plant units}} \times 100$$

$$\text{Disease severity (\%)} = \frac{\text{Sum of all numerical value in each category}}{\text{Total no. of samples x maximum scale value}} \times 100$$

$$\text{Disease Index (\%)} = \frac{\text{Sum of all disease ratings}}{\text{Total no. of samples x maximum scale value}} \times 100$$

These formulae were applied to all the numerical scales.

AUDPC was calculated by using the following formula (Das *et al.*, 1992).

$$\text{AUDPC} = \sum_{i=1}^{n-1} \left[\left(\frac{X_{(i+1)} + X_i}{2} \right) \right] (T_{(i+1)} - T_i)$$

Where,

X_i = Disease intensity on the i^{th} date. T_i = Days from transplanting to the date of disease scoring

n = number of dates on which disease was scored

LABORATORY WORK

Preparation of Potato Dextrose Agar and *Trichoderma* Selective Media

Potato Dextrose Agar (PDA) and *Trichoderma* selective media (Table 1 and 2) were prepared in the laboratory of IAAS, Rampur, Chitwan, for the confirmation of potato diseases from the research plots and to check the viability of the commercial product of *Trichoderma viride*.

Table 1. Composition of potato dextrose agar medium

Constituents	Quantity
Potato (Peeled)	200.0 g
Dextrose	20.0 g
Agar	20.0 g
Dicrysticin	0.1 g
Distilled water	1000.0 ml

Table 2. Compositions of *Trichoderma* selective medium

Contents	Quantity
Potato	200.0 g
Dextrose	20.0 g
Agar	20.0 g
Dicrysticin	0.1 g
Vitavex	0.1 g
Distilled water	1000.0 ml

Statistical analysis

Data entry was done in MS-excel and analyzed using SPSS, MSTATC (MSTAT, Michigan State University, USA). Mean values were compared by using analysis of variance, Duncan's Multiple Range Test and descriptive analysis.

RESULTS AND DISCUSSION

Mainly four major diseases were observed in tomato plants under plastic house during experimental period. They were early blight, late blight, septoria leaf spot and powdery mildew. Powdery mildew appeared in late season of cropping period. All the treatments were significantly different from untreated control as shown in the tables 3, 4 and 5 below.

EARLY BLIGHT

Initial symptoms of early blight were appeared on 26th September, 2010. The disease was identified by the appearance of brown to dark, leathery, necrotic spots first on leaflets in a target board pattern. The pathogen was identified as *Alternaria solani* by its typical conidiophores and conidia under microscope. Older leaves of tomato were affected first and the disease progressed upwards. Finally the leaves dried up and dropped down. Walker (1952) reported that the spots were oval or angular in shape up to 0.3 or 0.4 cm diameter and there was usually a narrow chlorotic zone around the spot which later faded into the normal green color.

Effect of treatments

The results of the experiment revealed that the least disease incidence and severity of early blight were recorded in Dithane M-45 treated plots (27.0% and 6.6%), followed by Bavistin (30.0% and 11.67%) and Bio-cure-F (35.33% and 16.67%) as compared to Control (45.33% and 30.0%) respectively (Table 3 and 4). Choulwar and Datar (1992) reported also similar results. Among the tested fungicides, copper oxychloride, mancozeb, carbendazim and captafol against early blight of tomato, mancozeb was the most effective in reducing disease intensity and increasing the yield in cultivar Pusa Ruby.

LATE BLIGHT

Symptoms of late blight caused by *Phytophthora infestans* were noticed on October 5, 2010, which were at the base of the petiole as water soaked lesions with ash or green colour in later days. The symptoms were also seen in green fruits which were rotted in late stage. The pathogen was identified with papillate lemon shaped sporangia developed in the lesions under moist conditions.

Effect of treatments

The least incidence and severity of late blight was shown by Mancozeb (18.0% and 11.25%), followed by Bavistin (22.33% and 13.67%), respectively (Table 3 and 4). As reported by Gisi *et al.* (1983) mancozeb was more effective in controlling *Phytophthora infestans* on potato and *Plasmopara viticola* on grapes than the other systemic fungicides used alone.

POWDERY MILDEW

The symptoms of powdery mildew caused by *Leveillula taurica* were appeared on November 3, 2010. The fungus produced a white talcum like covering on the lower leaves first and progressed toward upper leaves. The infected leaves became yellow and prematurely dried up. Correll (2014), stated that three fungal species (*Leveillula taurica*, *Oidium lycopersici* and *Oidium neolycopersici*) cause powdery mildew in tomato.

Effect of treatments

The least disease incidence of powdery mildew was observed in Bavistin treated plots (10.67%) followed by Dithane M-5 (12.0%) and Bio-cure-F (15.0%). Similarly, the least disease severity of powdery mildew was recorded in Bavistin (5.83%), and followed by Dithane M-45 (10.43%) and Bio-cure F (12.50%) as compared to control (20.56%) (Table 3 and 4). Germination of powdery mildew fungi may distinguish from other fungi is the manner in which water is bound with in the conidia (Somers. and Horsfall, 1966).

SEPTORIA LEAF SPOT

The initial symptoms of septoria leaf spot caused by *Septoria lycopersici* appeared on September 26, 2010. The symptoms were minute to small brownish spots on the lower leaves. As the spots grew larger, they became more or less circular in outline and showed definite brown colored margin with grey centre in which minute fruiting bodies, pycnidia, were appeared and black circular spots were appeared on the fruits.

Effect of treatments:

The least disease incidence of septoria leaf spot was observed in Dithane M-45 treated plots (24.0%), followed by Bavistin (29.45%) and Bio-cure-F (33.33%). Similarly, the least disease severity of septoria leaf spot was

observed in Dithane M-45 (24.0%), followed by Bavistin (29.39%) and Bio-cure-F (33.33%) as compared to control (40.0%). respectively.

Table 3. Effect of treatments on incidence of fungal diseases in tomato under plastic house during July to November, 2010 at Lamjung.

Treatments	Incidence (%)			
	EB	LB	PM	SLS
Bio-cure-F	35.33b	27.67b	15.00b	33.33b
Bavistin	30.00c	22.33c	10.67d	29.45c
Dithane M-45	27.00d	18.00d	12.00c	24.00d
Control	45.33a	38.00a	21.00a	40.00a
SEM (\pm)	1.014	1.280	0.645	1.054
LSD (= 0.05)	2.025	2.558	1.29	2.106
Probability	<.01**	<.01**	<.01**	<.01**
CV (%)	2.9	4.8	4.4	3.3

Treatment means followed by the same letter in a column are not significantly different by DMRT at 5% level of significance. LSD = Least Significant Difference, SEM = Standard error of mean. CV = Coefficient of variation, **significant at 1% level.

Table 4. Effect of treatments on severity of fungal diseases in tomato under plastic house during July to November, 2010 at Lamjung.

Treatments	Severity (%)			
	EB	LB	PM	SLS
Bio-cure-F	16.67b	16.25b	12.50b	33.33b
Bavistin	11.67c	13.67c	5.83d	29.33c
Dithane M-45	6.66d	11.25d	10.43c	24.00d
Control	30.00a	29.58a	20.56a	40.00a
SEM (\pm)	1.443	0.859	2.45	1.054
LSD (=0.05)	1.104	1.716	4.995	2.106
Probability	<.01**	<.01**	0.02**	<.01**
CV (%)	8.9	2.9	12.4	3.3

Figures in the column with the same letter are not significantly different ($p=0.05$) according to DMRT, LSD =Least Significance Difference, SEM =Standard Error of mean difference, CV= Coefficient of variation, EB =Early blight, LB = Late blight, PM = Powdery mildew, SLS= Septorial leaf spot. ** Significant at 1%.

EFFECT OF TREATMENTS ON AUDPC VALUES OF DIFFERENT FUNGAL DISEASES OF TOMATO

Table 5. Effect of treatments in AUDPC values of major fungal diseases of tomato under plastic house during July to November, 2010 at Lamjung

Treatments	AUDPC			
	EB	LB	PM	SLS
Bio-cure-F	870.00 b	1325.00 b	198.27 b	1597.00 b
Bavistin	604.00 c	1120.00 c	95.56 c	1381.45 c
Dithane M-45	339.00 d	890.80 d	172.34 d	1146.00 d
Control	1167.00 a	1685.80 a	328.76 a	1888.00 a
SEm (\pm)	44.6	31.43	38.8	40.50
LSD ($=0.05$)	89.1	62.80	77.40	80.90
Probability	<.01**	<.01**	0.002**	<.01**
CV (%)	6.0	2.5	19.5	2.7

Figures in the column with the same letter are not significantly different ($p=0.05$) according to DMRT, LSD =Least Significance Difference, SEM = Standard Error of Mean difference, CV= Coefficient of variation, EB =Early blight, LB = Late blight, PM = Powdery mildew, SLS= Septorial leaf spot. ** Significant at 1%.

EFFECT OF TREATMENTS ON YIELD OF TOMATO

Dithane M-45 treated plots showed the highest yield (52.35 ton/ha), which was significantly highest than other treatments, and it was followed by Bavistin (48.40 ton/ha), Bio-cure F (46.24 ton/ha) and control (41.47 ton/ha).

CONCLUSIONS

Dithane M-45 (mancozeb) can be used as foliar application To manage early blight, late blight and septoria leaf spot in tomato under plastic house at Lamjung and similar conditions. Similarly, foliar application of Bavistin (carbendazim) can be used to reduce powdery mildew disease in tomato. As powdery mildew appeared late in the season, early planting might be one of the best management tools to reduce this disease, which seemed to be an important area for future research work to find a potential measure for the proper management of the disease.

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