

Original Research Article

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Integrated Management of Major Fungal Diseases of Tomato in Kashmir Valley, India

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ABSTRACT

A field trial was conducted to evaluate effective management practices and to develop integrated management strategy for fungal diseases of tomato crop. The treatments comprised of sheep manure @ 3 kg/m², mulching by mustard straw @ 4 kg/m²; seedling dip in *Trichoderma harzianum*, *Pseudomonas fluorescence* each @ 4 g/L water and carbendazim 50 WP @ 1 g/L water) and 2 foliar sprays of mancozeb 75 WP @ 0.2% followed by carbendazim 50 WP @ 0.05% 20 days after the onset of disease. The removal of basal infected leaves and foliar sprays with mancozeb 75 WP or carbendazim 50 WP proved best exhibiting a disease severity of 6.5% in case of Septoria leaf spot and a minimum disease severity of 1.6% in case of Alternaria loaf spot, while seedlings root dip in carbendazim 50 WP was least effective against both the diseases. Minimum rotted fruits (0.03 kg/plot) was observed in spray treatments of mancozeb 75 WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water, whereas, *T. harzianum* (root dip @ 4 g/L water) resulted highest rotted fruits (0.28 kg/plot). Different management practices like stacking in combination with fungicides could therefore be integrated for effective management of the diseases.

Keywords

Tomato, IDM, *Trichoderma*, *Pseudomonas*, Mulches, Fungicides.

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Introduction

Tomato (*Lycopersicon esculentum* L.) originated South America belongs to Solanaceae family is a widely grown vegetable in the world. The leading producer of tomato in the world is USA followed by China, Italy, Turkey, Egypt, Spain, Romania, Brazil and Greece. It is the popular vegetable of Kashmir because of its taste, colour and high nutritive value and also for its diversified use. In Kashmir Valley, the crop is grown over an area of 1500 hectares with an average yield of 400-500 q/ha (Wani, 2011). Tomato is attacked by variety of pathogens;

predominant being the fungal fruit rots (Taskeen-un-Nisa *et al.*, 2011). These fungal rots are responsible for causing serious production problems and become menace for successful cultivation of tomatoes in valley. Fungal rots are world-wide in occurrence and have been reported almost in all parts of the world. According to Sokhi and Sohi (1982), the destructive pathogen causing fruit rots on tomato is present in parts of the country where moisture is plentiful and temperatures are moderate to favour their development. Besides, Septoria leaf spot is very common

foliar disease of field-grown tomatoes in the Kashmir valley. Managing diseases is critical to successful tomato production because diseases, unfortunately, are a common occurrence wherever tomatoes are grown. An important aspect of effective management is accurate and early identification to ensure control practices used are appropriate. Protective sprays of non-systemic fungicides like dithio-carbamates (Choulwar and Datar 1992), Copper oxychloride (Maheshwari *et al.*, 1991) and Captan (Vakalounakis and Malathrakis 1988) were found effective up to some extent but eco-friendly and complete control measure is still lacking.

The IDM practices not only save the crop from the diseases but also reduce the possibility of attack by the other pathogens (viruses, bacteria and nematodes) to tomato crop in a cropping season (Afroz *et al.*, 2008). There is a great need to carry out farmer level research aiming to develop a holistic disease management model to manage the major diseases of tomato. The present study was therefore undertaken to develop an effective and eco-friendly management practices against major fungal diseases of tomato.

Materials and Methods

A field trial was laid at research farm of SKUAST in a randomized block design. The 35 day old tomato seedlings cv. 'SH-1' were transplanted in a plot size of 2.0 x 1.5 m² at a plant spacing of 40 x 30 cm. The treatments comprised of different management practices [organic amendment (sheep manure)] @ 3 kg/m², cultural practices (stacking, mulching by mustard pod straw @ 4 kg/m², removal of basal infected leaves); seedling root-dip in bioagents (*Trichoderma harzianum*, *Pseudomonas fluorescense*; each @ 4 g/L water) and fungicide carbendazim 50 WP @ 1 g/L water) and 2 foliar sprays (mancozeb 75 WP @ 0.2% followed by carbendazim 50 WP

@ 0.05%) 20 days after the onset of disease including an untreated checks. Each treatment was replicated 3 times. All the agronomical practices except fungicidal sprays were adopted as per recommended packages practices. The treatments comprised of different management practices viz. T₁- Staking, T₂-Mulching (mustard pod straw @ 4 kg/m²), T₃- Removal of basal leaves, T₄- Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water, T₅- Staking + Mulching (mustard pod straw @ 4 kg/m²), T₆- Staking + Removal of basal leaves, T₇-Staking + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water, T₈- Mulching (mustard pod straw @ 4 kg/m² + Removal of basal leaves, T₉- Mulching (mustard pod straw @ 4 kg/m² + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water, T₁₀- Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water, T₁₁- Staking + Mulching (mustard pod straw @ 4 kg/m²) + Removal of basal leaves, T₁₂- Staking + Mulching (mustard pod straw @ 4 kg/m²) + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water, T₁₃- Mulching (mustard pod straw @ 4 kg/m² + Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water, T₁₄- Staking+ Removal of basal leaves + Sprays of Mancozeb 75WP @ 2g/L water followed by Carbendazim 50WP @ 0.5 g/L water and T₁₅- Staking + Removal of basal leaves + Mulching (mustard pod straw @ 4 kg/m +Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water 20 days after the onset of disease including an untreated checks. Each treatment was replicated 3 times. Data on disease severity of foliage was recorded by using 0-5 rating scale and that of fruits on 0-4 rating scale (Sokhi and Sohi, 1974). Statistical

analysis of the data was done as per the methods given by Gomez and Gomez, 1984.

Results and Discussion

Among the various fungal diseases, Septoria leaf spot, Alternaria leaf spot, buckeye fruit rot and Alternaria fruit rot were found to be the major diseases occurring on tomato crop. Septoria leaf spot disease and buckeye fruit rot were more severe than other disease in all three years. All the treatments significantly reduced severity of both the diseases (Septoria leaf spot and buckeye rot). T₁₅, Staking + Removal of basal leaves + Mulching (mustard pod straw @ 4 kg/m² + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water proved best in controlling both the diseases and exhibited a minimum disease severity of 4.4% with highest disease of

control 80.85% in case of Septoria leaf spot and a minimum disease severity of 1.40% with highest disease control of 87.04% in case of Alternaria leaf spot (Table 1). The control plot showed Septoria and Alternaria leaf spot severities of 22.98 and 10.81%, respectively. T₁₄ was next best treatment, while T₂, Mulching (mustard pod straw @ 4 kg/m²) was least effective exhibiting disease severity of 18.25 and 7.19% against both the diseases, respectively.

Minimum rotted fruits (0.65 kg/plot) were observed in treatment T₁₅ followed by T₁₁, whereas, T₃ resulted highest rotted fruits (1.35 kg/plot) (Table 2). Further, T₁₅ also showed superiority on other treatments in respect of producing highest healthy fruits yield of 4.65 kg/pot followed by T₈ which produced healthy fruit yield of 4.11 kg/plot.

Table.1 Effect of various management practices on the major foliar diseases of Tomato variety (SH-1)

Treatment	Severity of foliage diseases (%)	
	Septoria leaf spot	Alternaria leaf spot
T ₁ Staking	14.43	6.39
T ₂ Mulching (mustard pod straw @ 4 kg/m ²)	18.25	7.19
T ₃ Removal of basal leaves	8.08	5.50
T ₄ Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	6.53	3.12
T ₅ Staking + Mulching (mustard pod straw @ 4 kg/m ²)	12.45	5.33
T ₆ Staking + Removal of basal leaves	7.20	4.50
T ₇ Staking + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	10.30	2.73
T ₈ Mulching (mustard pod straw @ 4 kg/m ² + Removal of basal leaves	6.10	4.63
T ₉ Mulching (mustard pod straw @ 4 kg/m ² + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	11.16	2.50
T ₁₀ Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	7.05	2.34
T ₁₁ Staking + Mulching (mustard pod straw @ 4 kg/m ²) + Removal of basal leaves	6.95	3.88
T ₁₂ Staking + Mulching (mustard pod straw @ 4 kg/m ²) + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	9.55	2.25
T ₁₃ Mulching (mustard pod straw @ 4 kg/m ² + Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	5.35	1.97
T ₁₄ Staking + Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	4.75	1.75
T ₁₅ Staking + Removal of basal leaves + Mulching (mustard pod straw @ 4 kg/m ² + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	4.40	1.40
T ₁₆ Check/Control	22.98	10.81
CD (P=0.05)	6.91	2.91

Table.2 Effect of various management practices on the severity of major Fungal fruit rots and fruit yield

Treatment	Severity of fruit rots (%)		Yield (kg/plot)	
	Buckeye rot	Alternaria rot	Rotted fruits	Healthy fruits
T ₁ Staking	2.50	2.45	0.71	3.70
T ₂ Mulching (mustard pod straw @ 4 kg/m ²)	2.01	2.27	0.88	4.01
T ₃ Removal of basal leaves	2.72	1.32	1.35	3.10
T ₄ Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.65	1.75	1.25	3.35
T ₅ Staking + Mulching (mustard pod straw @ 4 kg/m ²)	1.87	2.05	0.70	3.72
T ₆ Staking + Removal of basal leaves	2.30	1.70	0.69	3.75
T ₇ Staking + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.47	1.55	1.21	3.50
T ₈ Mulching (mustard pod straw @ 4 kg/m ² + Removal of basal leaves	1.93	1.75	0.84	4.11
T ₉ Mulching (mustard pod straw @ 4 kg/m ² + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.45	1.67	1.20	3.58
T ₁₀ Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.45	1.69	1.19	3.69
T ₁₁ Staking + Mulching (mustard pod straw @ 4 kg/m ²) + Removal of basal leaves	1.95	2.19	0.68	3.77
T ₁₂ Staking + Mulching (mustard pod straw @ 4 kg/m ²) + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.45	1.49	1.14	3.88
T ₁₃ Mulching (mustard pod straw @ 4 kg/m ² + Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.49	1.55	1.15	3.85
T ₁₄ Staking + Removal of basal leaves + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.35	1.48	1.09	3.98
T ₁₅ Staking + Removal of basal leaves + Mulching (mustard pod straw @ 4 kg/m ²) + Sprays of mancozeb 75WP @ 2 g/L water followed by carbendazim 50 WP @ 0.5 g/L water	1.27	1.34	0.65	4.65
T ₁₆ Check/Control	3.48	3.75	1.38	3.02
CD (P=0.5)	0.72	0.91	0.12	1.14

Successful integrated management of fungal foliar and fruit diseases of tomato has been important in temperate climate of mountainous Kashmir where cultivation of tomato crop attained the generally ideal environmental conditions for occurrence of dreaded diseases. The diseases affect all the plant parts reducing the vigorosity and quality produce of tomato hence various approaches have been integrated for combating and mitigating the production and productivity of tomato (Wani, 2011). Out of the inevitable approaches, cultural practices and spray of the crop with fungicides proved to be most effective where scarce occurrence of disease spreading was recorded. In spite of foliar diseases, the minimum incidence of fruit diseases like buckeye rot and Alternaria rot

were also found which might be due to removal of basal and old leaves of the crop which provided good aeration and favourable micro-climate of the crop canopy, that is the reason pathogens of different diseases could not develop adequately and might be lacking of favourable habitat for the pathogen as the attack over the old and basal leaves (Banyal *et al.*, 2008 and Begum, 2001). It is evident that when fungicide was to be sprayed over the crop, the secondary and aerial infection has also impeded and significant yield was harvested with the quality produce of fruits. Meanwhile the other approaches viz. staking and seedling dip with bioagents were also effective the diseases. Several studies have been made with respect to occurrence of the disease severity, yield losses and the

integrated management in tomato crop (Aulakh and Grover, 1969; Iqbal *et al.*, 2003;; Hossain and Fakir, 2001). Stacking, removal of infected basal leaves coupled with sprays of mancozeb 75WP @0.2% followed by carbendazim 50WP @0.05% were therefore recommended for integrated management of the diseases.

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