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Seasonal occurrence of prevalent diseases of tomato under field conditions

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Abstract

Tomato is one of the most popular and extensively grown vegetables in India as well as in Chhattisgarh. The tomato plant is infected with number of diseases in its life span but they do not occur simultaneously and their development varies with location and season. Therefore a study was undertaken in *Kharif* season of three consecutive years (2015, 2016 and 2017) at Horticulture Instruction cum Research Farm, College of Agriculture, Raipur (Chhattisgarh) to know the prevalent diseases of tomato, their occurrence pattern and extent of infection. Five diseases viz. leaf curl, mosaic, tomato spotted wilt, early blight and collar rot were observed to infect the crop during the investigation. Under Raipur situations the first occurrence of leaf curl, mosaic, tomato spotted wilt, early blight and collar rot were observed in August, September – October, October, September – October and August - September respectively. Leaf curl and early blight were most serious diseases of the crop out of five commonly occurring diseases.

Keywords: disease, collar rot, leaf curl, mosaic, tomato

1. Introduction

Tomato, *Solanum lycopersicum* L. a member of the family Solanaceae (Singh, 2014) [41] is one of the most popular and extensively grown vegetables (Chaudhary *et al.* 2010 and Singh *et al.* 2015) [15, 42] of both tropics and subtropics of the world (Govindappa *et al.* 2013) [18]. In the world, tomato is cultivated over an area of 5.7 million ha with an annual production of 211.80 million metric tonnes and productivity of 37.16 metric tonnes ha⁻¹ (Anonymous, 2016) [7]. In India, it occupies an area of about 0.80 million ha producing over 19.54 million metric tonnes with the productivity of 21.2 metric tonnes ha⁻¹ (Anonymous, 2017) [8]. There are many constraints that come in the way of tomato cultivation but diseases are one of the important factors for low productivity of the crop (Kakati and Nath, 2014) [20]. Tomato is known to susceptible for more than 200 diseases (Shelat *et al.* 2014) [40]. Among them buckeye rot (fruit rot); *Phytophthora nicotianae* var. *parasitica* (Sharma and Dohroó, 2004) [39], collar rot or Sclerotium wilt; *Sclerotium rolfsii* (Mahato *et al.* 2017) [22], damping off; *Fusarium* spp., *Pythium* spp., *Rhizoctonia solani*, *Sclerotium rolfsii* (Prasad *et al.* 2017) [32], early blight; *Alternaria solani* (Roopa, 2012) [35], *Fusarium* wilt; *Fusarium oxysporum* f.sp. *lycopersici* (Manikandan and Raguchander, 2014) [23], late blight (Olanya *et al.* 2015) [28], powdery mildew (Park *et al.* 2010 and Cerkauskas and Brown, 2015) [29, 14], *Rhizoctonia* root rot; *Rhizoctonia solani* (Sumalatha *et al.* 2017) [44], *Septoria* leaf spot (Parker *et al.* 1997 and Blum, 2000) [30, 11], bacterial fruit canker; *Clavibacter michiganensis* subsp. *michiganensis* (Ftayeh *et al.* 2010 and Sharabani *et al.* 2013) [17, 38], bacterial spot; *Xanthomonas campestris* pv. *vesicatoria* (Kavitha and Umesha, 2007) [21], bacterial wilt; *Ralstonia solanacearum* (Ayana and Fininsa, 2016) [9], bud blight; *Groundnut bud necrosis virus* (Manjunatha *et al.* 2010) [24], leaf curl disease; *Tomato leaf curl virus* (Shelat *et al.* 2014 and Yadav *et al.* 2014) [40, 46], tomato mosaic; *Tomato mosaic virus* (Alishiri *et al.* 2013) [4], tomato spotted wilt; *Tomato spotted wilt virus* (Sevik and Arli-Sokmen, 2012) [37], Root knot; *Meloidogyne* spp (Naz *et al.* 2012) [26], little leaf; *Candidatus Phytoplasma trifolii* (Santos-Cervantes *et al.* 2008 and Rathnamma, 2014) [36, 34] are major diseases of tomato (Mahato *et al.* 2017) [22]. But it is not necessary that all these diseases come together with great extent in one crop season, climatic conditions and location because the climatic conditions of a particular area favours some specific pathogens and this is the important consideration for the management of disease. Therefore a study was undertaken to know the prevalent diseases of tomato, their occurrence pattern and extent of infection in *Kharif* season under Raipur conditions.

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2. Material and Methods

A study was undertaken in *Kharif* season of three consecutive years (2015, 2016 and 2017) at Horticulture Instruction cum Research Farm, College of Agriculture, Raipur (Chhattisgarh) to know the prevalent diseases of tomato, their occurrence pattern and extent of infection. The observations on percent disease incidence and percent disease index (PDI) of each disease were recorded at fortnight interval from ten untreated plots of tomato (cv. Pusa Ruby). Percent disease incidence was calculated by following formula suggested by Nene (1972) [27]:

$$\text{Percent incidence} = \frac{\text{Number of infected plants}}{\text{Total number of plants observed}} \times 100$$

However the disease rating was recorded for each plant of every plot by following rating scales as described in below thereafter percent disease index (PDI) was calculated for each plot by implying formulae suggested by Wheeler (1969) [45].

$$\text{PDI} = \frac{\text{Sum of numerical disease ratings}}{\text{Number of plants observed} \times \text{maximum disease rating}} \times 100$$

2.1 Leaf curl

Disease rating of individual plants was recorded by using a slightly modified visual scale of 0-7, where: 0 = No visible disease symptom; 1 = Top leaves curled only; 3 = Top leaves curled and slight stunting of plant or All leaves curled without stunting; 5 = All leaves curled and slight stunting of plant and 7 = Severe curling of leaves, stunting of plant and proliferation of auxiliary branches (Alegbejo, 1995 and Alegbejo and Banwo, 2006) [3, 2].

2.2 Mosaic

Disease symptoms of mosaic were rated on a scale of 0-5, where: 0 = No symptoms; 1 = Light or dark green mottling or mosaic; 2 = Light or dark green mottling or mosaic with distortion or reduction of younger leaves; 3 = Dark green areas of the mottle often appear thicker and somewhat elevated giving the leaves a blister like appearance with no stunting; 4 = Dark green areas of the mottle often appear thicker and somewhat elevated giving the leaves a blister like appearance with stunting and sometimes yellow mottling of leaves and 5 = Severe stunting of plant with leaves look fern like and sharply pointed and sometimes dark necrotic streaks in stems, petioles, leaves or fruit (Cerkauskas, 2004 and Anonymous, 2012) [13, 5].

2.3 Tomato spotted wilt

A visual disease rating of 1-5 was used, where: 1 = No visible symptoms; 2 = Mild purpling, chlorosis, and limited leaf distortion; 3 = Moderate purpling, chlorosis, and leaf distortion with some plant stunting; 4 = Severe purpling, chlorosis, leaf distortion and plant stunting; 5 = Severe purpling, chlorosis, leaf distortion and extreme stunting (Canady *et al.* 2001 and Sivparsad and Gubba, 2011) [12, 43].

2.4 Early blight

The percent disease index (PDI) of the early blight was recorded according to following scale of 0-9 given by Mayee and Datar, 1986 [25]. Where: 0 = No symptoms; 1 = Small circular, scattered, brown spots, covering 1 per cent or less of the leaf area; 3 = Spots enlarging, dark brown in colour covering 1 to 10 per cent of leaf area and infection on the lower most leaves of the plant; 5 = Spots enlarging, dark brown in colour covering 11 to 25 per cent of leaf area and

infection on the lower most leaves of the plant; 7 = Spots dark brown in colour covering 26 to 50 per cent of leaf area and covering one third of the plant and 9 = Spots uniformly dark brown, coalescing, covering 50 per cent or more leaf area and severe infection on all leaves (Abdussamee *et al.* 2014) [1].

3. Results and Discussions

In field condition the occurrence of prevalent diseases were recorded for *Kharif* seasons of three consecutive years (2015, 2016 and 2017). It was recorded from last week of July to first fortnight of November (Table 1, 2 and 3). Five diseases *viz.* leaf curl, mosaic, tomato spotted wilt, early blight and collar rot were appeared during the course of investigation.

3.1 Leaf curl

In *kharif* season the first appearance of leaf curl was observed in first fortnight of August in 2015 and 2017 while in 2016 first symptom of the disease was observed in second fortnight of August and appeared up to first fortnight of November. Initially the occurrence of the disease started with very low disease incidence (1.00, 3.70, and 2.66,) and percent disease index (0.24, 1.49 and 1.14) which increased with increase in age of the plant and reached maximum in first fortnight of November (68.48, 49.58; 62.36, 45.56 and 69.64, 51.30) (Table 1, 2 and 3).

The average incidence of leaf curl was recorded from October 2013 to March 2014 in *kharif* with increasing trend and average maximum disease incidence of 12.24 percent (March 2014) was recorded under open field condition (Anonymous, 2013-14) [6]. Ehsanullah (2014) [16] recorded 10.8 to 91.3 percent disease incidence in major tomato growing districts of Karnataka with highest disease incidence of 70.81 percent in Kolar and least incidence of 21.00 percent in Ramanagara district.

3.2 Mosaic

The first occurrence of mosaic was observed in second fortnight of September in 2015 whereas in 2016 and 2017 first symptoms of the disease was noticed in first fortnight of October and appeared up to first fortnight of November. The disease incidence (0.59, 0.96 and 0.67) and percent disease index of the disease were very low (0.24, 0.48 and 0.15) during the early growth stage which gradually increased as plant developed and reached maximum in first fortnight of November (2.75, 1.63; 4.38, 4.10 and 2.69, 1.78) (Table 1, 2 and 3).

Ten fields of Raipur (Chhattisgarh) were selected for the pest surveillance of tomato in *Kharif* 2013. The average incidence of mosaic was recorded from October 2013 to March 2014 with increasing trend and average maximum disease incidence of 17.03 percent was recorded in February 2014 in open field condition (Anonymous, 2013-14) [6]. Jalender *et al.* (2017) [19] conducted survey in tomato growing areas of Ranga Reddy district during *kharif* 2013 and in Guntur district during *rabi* 2013-14 and recorded natural occurrence of disease incidence with a percent ranged from 6.9 to 15.7 among different Mandals.

3.3 Tomato spotted wilt

The disease was not occurred in *Kharif* 2015 but the first occurrence of tomato spotted wilt disease was appeared in first and second fortnight of October in 2016 and 2017 respectively. The infection was started with 0.96 and 0.38 percent incidence and 0.53 and 0.35 percent disease index in 2016 and 2017 respectively. The disease was appeared up to first fortnight of November with maximum disease incidence

(2.36 and 1.34) and percent disease index (1.42 and 0.70) (Table 1, 2 and 3).

Pattaiya, (2006) [31] carried out survey and surveillance of tomato spotted wilt virus disease at open fields of three locations viz. Panagar, Jabalpur and Indrana to determine the incidence of virus. A total of five thousand and sixty tomato plant samples from five varieties viz. Pusa early dwarf, JT 99, Pusa ruby, Sourabh and Abhisek were observed for tomato spotted wilt virus. Overall 18 to 34, 15 to 30 and 16 to 24 percent infection was observed in Panagar, Jabalpur and Indrana respectively in different varieties.

3.4 Early blight

In three consecutive *Kharif* seasons (2015, 2016 and 2017) the first appearance of early blight was observed in first fortnight of October in 2015 whereas in 2016 and 2017 first symptom of the disease was recorded in second fortnight of September and appeared up to first fortnight of November. Initially the disease incidence (4.03, 2.91 and 0.95 percent) and percent disease index of the disease were very low (0.32, 0.11 and 0.03) which rapidly increased and reached maximum in the first fortnight of November (52.79, 19.91; 54.57, 26.45 and 56.89 and 29.11) (Table 1, 2 and 3).

Prasad, (2002) [33] recorded 28.60 to 65.36 percent disease severity of early blight in northern districts of Karnataka during 2001. Roopa (2012) [35] undertook a roving survey

during 2011 to assess the disease severity of early blight of tomato in major tomato growing areas of Dharwad, Belgaum, Haveri, Gadag and Bagalkot districts. The severity was ranged from 17.30 to 37.25 percent, highest disease severity was recorded in Haveri (31.03%) and least in Dharwad (20.16%) districts. Ten fields of Raipur (Chhattisgarh) were selected for the pest surveillance of tomato in *Kharif* 2013-14. The average severity of early blight was recorded from October 2013 to March 2014 with increasing trend and average maximum disease severity of 23.33 percent was recorded in March under open field condition (Anonymous, 2013-14) [6].

3.5 Collar rot

In *kharif* season (2015, 2016 and 2017) the first appearance of collar rot was recorded in first fortnight of September in 2015 and 2017 whereas in 2016 the first symptoms of the disease were observed in second fortnight of August. Initially percent incidence of the disease was low (2.05, 3.36 and 1.67) which steadily increased and reached maximum in first fortnight of October (2.72, 5.40 and 4.72) (Table 1, 2 and 3).

In field condition the incidence of collar rot was recorded 5 to 10 percent in Raipur, Chhattisgarh (Anonymous, 2013-14) [6], 10-45 percent in Himachal Pradesh (Banyal, *et al.* 2008) [10] and 7.61 to 21.79 percent in undulating red and lateritic zone of West Bengal (Mahato *et al.* 2017) [22].

Table 1: Seasonal occurrence of prevalent diseases of tomato under field conditions (*Kharif* 2015)

Disease	Incidence and PDI	At 15 days interval (Days after transplanting)						
		Aug		Sep		Oct		Nov
		I	II	I	II	I	II	I
Leaf curl	Incidence	1.00	3.71	9.66	16.05	34.77	58.29	68.48
	PDI	0.24	1.50	4.66	7.87	20.32	42.25	49.58
Mosaic	Incidence	-	-	-	0.59	0.69	0.28	2.75
	PDI	-	-	-	0.24	0.28	1.11	1.63
Spotted Wilt	Incidence	-	-	-	-	-	-	-
	PDI	-	-	-	-	-	-	-
Early blight	Incidence	-	-	-	-	4.03	21.13	52.79
	PDI	-	-	-	-	0.32	4.98	19.91
Collar rot	Incidence	-	-	2.05	2.39	2.72	2.72	2.72

Table 2: Seasonal occurrence of prevalent diseases of tomato under field conditions (*Kharif* 2016)

Disease	Incidence and PDI	At 15 days interval (Days after transplanting)						
		Aug	Sep		Oct		Nov	
		II	I	II	I	II	I	
Leaf curl	Incidence	3.70	5.74	8.14	20.26	47.92	62.36	
	PDI	1.49	2.76	4.11	11.75	26.48	45.56	
Mosaic	Incidence	-	-	-	0.96	3.57	4.38	
	PDI	-	-	-	0.48	2.37	4.10	
Spotted Wilt	Incidence	-	-	-	0.96	1.83	2.36	
	PDI	-	-	-	0.53	0.93	1.42	
Early blight	Incidence	-	-	2.91	6.26	23.00	54.57	
	PDI	-	-	0.11	0.39	5.78	26.45	
Collar rot	Incidence	3.36	4.05	4.05	5.40	5.40	5.40	

Table 3: Seasonal occurrence of prevalent diseases of tomato under field conditions (*Kharif* 2017)

Disease	Incidence and PDI	At 15 days interval (Days after transplanting)						
		Aug		Sep		Oct		Nov
		I	II	I	II	I	II	I
Leaf curl	Incidence	2.66	7.33	13.28	17.70	29.67	54.91	69.64
	PDI	1.14	4.00	7.70	10.70	18.74	40.56	51.30
Mosaic	Incidence	-	-	-	-	0.67	1.64	2.69
	PDI	-	-	-	-	0.15	0.71	1.78
Spotted Wilt	Incidence	-	-	-	-	-	0.38	1.34
	PDI	-	-	-	-	-	0.35	0.70
Early blight	Incidence	-	-	-	0.95	8.62	33.51	56.89
	PDI	-	-	-	0.03	0.75	9.17	29.11
Collar rot	Incidence	-	-	1.67	4.14	4.72	4.72	4.72

4. Conclusion

From the present investigation it can be concluded that in Raipur, five diseases *viz.* leaf curl, mosaic, tomato spotted wilt, early blight and collar rot were prevalent in tomato crop under field conditions. The severity pattern of the diseases was leaf curl > early blight > collar rot > mosaic > tomato spotted wilt.

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