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Status of Late Blight of Tomato in Different Locations of Himachal Pradesh, India

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A B S T R A C T

Late blight disease caused by *Phytophthora infestans* (Mont.) de Bary is one of the most destructive pathogen among pest and diseases for tomato production in India. It not only adversely affects fruit yield and economy of tomato growers, but also reduces produce quality. Therefore, keeping in view the importance of disease, present investigation was aimed to carry out disease survey and record crop losses in order to work out ultimate integrated management strategies against this disease. Maximum disease severity and fruit rot incidence was recorded in Shimla district of Himachal Pradesh.

Introduction

Late blight (LB) caused by the oomycete *Phytophthora infestans* (Montagne, Bary) is one of the most potentially devastating disease of tomato in areas with high humidity and cool temperatures and can cause 100% crop loss in an unprotected tomato fields or greenhouses. Because of its devastating economic impact, this disease has been the subject of intensified pathological and genetic research since the occurrence of the Irish potato famine in the 1840s.

Tomato is one of the world's largest grown vegetable crop after potato and sweet potato. Tomato ranks 7th in worldwide production after maize, rice, wheat, potatoes, soybeans and cassava, reaching a worldwide production of around 160 million tons on a cultivated area of almost 4.8 million hectares in 2011 (FAOSTAT, 2011). Tomato belongs to family Solanaceae along with potatoes, peppers and eggplants. In tropics *Lycopersicon esculentum* is grown as perennial crop whereas in northern climates it is grown as an annual. Botanically this vegetable is a fruit (a berry). Flowers are generally borne in clusters of 4 to 8 but small fruited types may have 30 to 50 flowers per cluster. The flowers are mainly self pollinated by the wind. It is noteworthy that tomatoes are not only sold fresh, but also processed as soups, sauces, juices or powder

concentrates. Ripened fruits of tomato are good source of ascorbic acid, vitamin A, organic acid and minerals like potassium and sodium. Raiola *et al.,* (2014) described that lycopene pigment in tomato is responsible for some anti oxidative activities and also functions as anti cancerous substance. Thus, tomato production and consumption are constantly increasing.

Poor agricultural practices lead to increased disease incidences. Insect, pests and diseases, not only cause reduction of produce and quality, but also increase cost of production. Among these diseases late blight of tomato caused by *Phytophthora infestans* (Mont.) de Bary is one of the most important disease affecting stems, petioles, leaves and fruits of tomato. Guenthner *et al.,* (2001) reported that upon favorable environmental conditions late blight can cause considerable yield losses even it can lead upto 100% yield losses. Late blight is one of the most destructive disease of solanaceous crops in hills and plains of India which leads to 95 percent of yield losses in epidemic conditions (Lal *et al.,* 2015). Lal *et al.,* (2016) estimated that there was 10-15 percent reduction in yield of potato due to occurrence of late blight in India on over all basis. Late blight caused by *Phytophthora infestans* (Mont.) de Bary has historically been an important disease of potatoes and tomatoes worldwide. In the mid 1800, late blight caused widespread crop failures throughout Northern Europe including Ireland where it was responsible for the Irish famine (Elansky *et al.,* 2001). Since then, it has spread far and wide and now occurs wherever potatoes and tomatoes are grown.

At present, no tomato cultivars in the world are grown on a commercial scale without chemical protection from late blight disease. Application of chemical is maximum in tomato and potato crops than any other food crops grown (Niederhauser, 1991). Such heavy use of pesticides could result in increased human health hazards and environmental pollution.

Materials and Methods

Disease survey

To record the disease severity of late blight of tomato caused by *Phytophthora infestans*, major tomato growing locations of four districts viz., Solan, Sirmour, Shimla and Kullu, Himachal Pradesh were periodically surveyed during the months of July and August for two consecutive years 2016 and 2017.The data on disease severity was recorded by following the disease rating scale of 0 to 5 as described by Irzhansky and Cohen (2006).

Grade	Description of symptoms
0	No visible symptoms
1	A few minute lesions to about 10% of the total area is blighted
2	Leaves on about 25% of the total plant area are infected
3	Leaves on about 50% of the total plant area are infected
4	Leaves on about 75% of the total plant area are infected
5	Leaves on whole plant are blighted and plant is dead

The per cent disease severity was calculated according to McKinney (1923) as given below

$$\text{Disease index}(\%) = \frac{\text{Sum of all disease ratings}}{\text{Total number of ratings} \times \text{Maximum disease grade}} \times 100$$

Results and Discussion

In the present investigation, the field survey was carried out to record the disease severity and fruit rot incidence in different locations of four districts of Himachal Pradesh. Diseased samples for isolating the late blight pathogen

were also collected from surveyed locations. The data of disease severity and fruit rot incidence of late blight of tomato was recorded and given below in the Table 1.

Perusal of data revealed that the mean disease severity recorded at Solan district was 29.5 percent in Pajjoon which was found to be maximum in Solan district. At Sirmour district, 58.9 percent severity was recorded as highest in Hanolipul region and 60.4 percent disease severity was found in Jathiya devi at Shimla district. However, at Kullu district 44.6 percent of disease severity was recorded as maximum in Badagram. 60.4 percent of disease severity recorded in Jathiya Devi of Shimla district was observed as maximum severity among all the four districts of Himachal Pradesh which was followed by 58.9 percent of disease severity in Hanolipul of Sirmour and 58.6 percent in Rampuri of Shimla districts. The lowest disease severity was observed as 17.2 percent in Banjani region of Solan district.

The locations in temperate regions of Shimla, Sirmour and Kullu district had higher disease severity ranging from 60.4 to 23.0, 58.9 to 21.4 and 44.6 to 26.3 percent respectively, in contrast to Solan district (29.5 to 17.2 percent). Overall the disease severity ranged in between 60.4 to 17.2 per cent under late blight infection.

Maximum incidence of fruit rot was recorded as 39.0 percent, which was also found to be highest in Jathiya Devi of Shimla district followed by Hanolipul (), Doon (38.5), Rajgarh (37.8) of Sirmour district, Rampuri (37.4) and Panesh (36.4) of Shimla district. The lowest fruit rot incidence was observed as 9.3 percent in Banjani of Solan district. The overall fruit rot incidence ranged from 39.0 to 9.3 percent.

Table.1 Status of late blight in different tomato growing locations of Himachal Pradesh during the year 2016 and 2017

District	Locality	Disease Severity (%)		Mean	Fruit rot incidence (%)		Mean
		2016	2017		2016	2017	
Solan	**Gadogh**	21.2	18.6	**19.9**	15.4	10.7	**13.1**
	Barog	25.0	20.5	**22.8**	17.3	13.3	**15.3**
	Nagali	28.5	25.4	**27.0**	21.5	18.5	**20.0**
	Pajjon	30.5	28.4	**29.5**	22.6	19.5	**21.1**
	Kandaghat	20.3	19.0	**19.7**	14.9	12.8	**13.9**
	Chail	29.4	27.4	**28.4**	20.8	19.3	**20.1**
	Kanori	28.2	26.5	**27.4**	19.6	15.5	**17.6**
	Mai	19.6	17.2	**18.4**	14.9	12.8	**13.9**
	Srinagar	22.3	18.4	**20.4**	14.4	10.8	**12.6**
	Banjani	18.6	15.8	**17.2**	9.8	8.7	**9.3**
	Samlech	18.7	17.6	**18.2**	10.7	9.0	**9.9**
	Hathopalech	22.3	21.4	**21.9**	13.4	12.8	**13.1**
	Gambarpul	21.5	19.5	**20.5**	14.5	12.8	**13.7**
	Dharon ki dhar	27.2	25.7	**26.5**	18.3	17.7	**18.0**

	Shamrod	18.8	16.4	**17.6**	10.8	9.5	**10.2**
Mean		**23.5**	**21.2**		**15.9**	**13.6**	
Sirmour	**Rajgarh**	55.7	53.4	**54.6**	38.3	37.2	**37.8**
	Doon	57.3	54.2	**55.8**	39.5	37.5	**38.5**
	Hanolipul	59.7	58.1	**58.9**	39.7	38.6	**39.2**
	Sangrah	45.2	44.2	**44.7**	28.0	27.7	**27.9**
	Sanora	30.6	27.3	**29.0**	18.6	16.5	**17.6**
	Narag	24.5	20.1	**22.3**	14.7	10.3	**12.5**
	Sarsoo	33.8	30.4	**32.1**	15.3	12.2	**13.8**
	Banona	34.3	32.0	**33.2**	17.6	15.4	**16.5**
	Wasni	22.3	20.4	**21.4**	13.3	10.6	**12.0**
	Pajopad	35.2	30.0	**32.6**	19.8	17.3	**18.6**
	Kafota	49.6	47.5	**48.6**	26.5	24.8	**25.7**
	Shilai	43.5	40.2	**41.9**	25.8	21.3	**23.6**
	Chandani	28.1	25.6	**26.9**	14.7	11.3	**13.0**
	Mashuchiog	34.0	31.2	**32.6**	19.7	18.5	**19.1**
	Andheri	32.4	30.5	**31.5**	18.3	16.5	**17.4**
	Deedag	45.2	44.3	**44.8**	28.6	26.8	**27.7**
	Chambidhar	49.4	47.6	**48.5**	29.5	27.1	**28.3**
Mean		**40.0**	**37.5**		**24.0**	**21.7**	
Shimla	**Rampuri**	59.6	57.5	**58.6**	38.5	36.3	**37.4**
	Jathiya devi	65.3	55.5	**60.4**	42.5	35.5	**39.0**
	Panesh	55.4	50.0	**52.7**	38.4	34.3	**36.4**
	Ghanatti	45.6	42.6	**44.1**	28.6	24.2	**26.4**
	Piran	24.7	21.2	**23.0**	12.5	10.5	**11.5**
	Brahndi	28.9	24.8	**26.9**	15.6	11.2	**13.4**
	Chiog	43.5	40.8	**42.2**	22.3	20.6	**21.5**
	Anti	26.3	23.6	**25.0**	13.6	10.5	**12.1**
	Karalish	47.6	45.3	**46.5**	25.9	23.2	**24.6**
	Kansakoti	29.3	21.3	**25.3**	18.2	13.8	**16.0**
	Chirgaon	39.5	28.5	**34.0**	17.2	10.5	**13.9**
Mean		**42.3**	**37.4**		**24.8**	**21.0**	
Kullu	**Bhunter**	32.3	29.5	**30.9**	19.8	16.8	**18.3**
	Bajora	39.6	36.4	**38.0**	17.3	14.5	**15.9**
	Garsa	28.3	24.3	**26.3**	12.4	11.0	**11.7**
	Baragramn	45.5	43.7	**44.6**	25.6	24.2	**24.9**
	Hurla	41.3	38.2	**39.8**	23.5	20.6	**22.1**
	Thela	39.6	37.8	**38.7**	20.0	18.3	**19.2**
Mean		**37.8**	**35.0**		**19.8**	**17.6**	

Bhattacharyya *et al.*,(1990) noted that in the temperate hills of India (20% acreage), severe epiphytotic of late blight occurs every year resulting in 40-85% yield losses. In the subtropical Indo-Gangetic plains (80% acreage), late blight infection has observed mild to moderate. However, it has been observed that once in every 2 to 3 years it becomes epiphytotic resulting in 15-75% losses. It has become one of the major disease of *kharif* potato in Karnataka since 2007-2008. Therefore, survey was conducted during *kharif* crop 2012 and 2013 to know the late blight appearance, severity and losses caused by the disease. It has also been studied from perusal of literature that prior to 2006, late blight was an annual threat only in the states of northern India and it was not considered as major problem on potato or tomato production in South India (Chowdappa *et al.*, 2011). Lal *et al.*, (2015) had calculated 95 percent of yield losses in epidemic conditions caused by late blight of potato, one of the most destructive disease of potato in hills and plain regions of India The late blight disease severity ranged from 4 to40% and 0-100% during the year 2012 and 2013, respectively and the expected yield loss was about 20-30%. (Bairwa *et al.*,2016).

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