



Short Communication

Status of bacterial wilt (*Ralstonia solanacearum*) of solanaceous vegetables in Himachal Pradesh

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Abstract

Ralstonia solanacearum, the causal agent of bacterial disease, is a severe obstacle to the production of solanaceous vegetables in both tropical and temperate regions. A total of nine major vegetables growing districts viz., Kangra, Hamirpur, Solan, Sirmour, Kullu, Shimla, Mandi and Bilaspur were surveyed in the month of June-July, 2019 to know the status of bacterial wilt of solanaceous vegetables in term of its incidence. A significant variation was observed in term of bacterial wilt incidence among the major vegetables growing areas surveyed. The highest wilt incidence (90-100%) was recorded in tomato varieties Lal Sona, Roma and Manisha at Shimla, Kangra and Solan districts at Nayaser, Palampur and Gaura areas respectively. The Arka Kusumkar variety of brinjal also showed high wilt incidence of about 90-100 per cent in Palampur. Whereas, in capsicum variety California wonder was found to be susceptible to bacterial wilt and recorded about 60-90 per cent wilt incidence. In Hamirpur and Kangra 'Heemsohna' showed susceptible reaction (65-80%) but in Sirmour and Solan their reaction was moderately susceptible whereas, in Kullu district moderately resistant reaction was noticed in the same cultivar. Although 'Roma' in Kangra and 'Lal Sona' in Shimla were found highly susceptible against bacterial wilt of tomato. Similarly, 'California Wonder' of bell pepper and 'Arka' of brinjal showed highly susceptible reaction to bacterial wilt in Kangra district. Only one tomato cultivar 'Heemsohna' from Tyali village of Shimla was found completely resistant to bacterial wilt

Key words: Bacterial wilt incidence, solanaceous vegetables, *Ralstonia solanacearum*, Himachal Pradesh.

Himachal Pradesh, a north Indian state where agriculture and horticulture are the main constituents of the economy. It is situated at 30°22'-33°12' N and 75°45'-39°04' E. It is also well known for the vegetable cultivation and seed production. The state shows a range of variation in elevation which is main reason for favorable climatic condition for fruits and vegetables. The climate varies from hot and sub-humid tropical at low elevations to cold, glacial and alpine climate at higher elevations. The agro climatic conditions of Himachal Pradesh are ideally suited for the production of off-season vegetable crops and make fruits available in the market during June to October when it does not grow in the plains due to the unfavorable high temperature.

On the basis of elevation and climate, Himachal Pradesh is divided into four agroclimatic zones. Zone

IV is comprised of high hill temperate dry zone with altitudes more than 2,000 m amsl and high hill temperate wet zone (Zone III) at 1,800-2,000 m amsl are suitable for the production of vegetable crops such as potato, peas, cauliflower, cabbage and beans. The mid hill sub-humid zone (Zone II) at 650-1,800 m amsl and sub mountain low hills subtropical zone (Zone I) at 350-650 m amsl are very suitable for the production of solanaceous vegetables such as tomato, brinjal, potato, capsicum (bell pepper and hot pepper) and cucurbits during the summer months (mid-March to mid-September).

The cultivation of vegetable faces a great threat due to the diseases caused by fungi, bacteria and viruses. Among these diseases, bacterial wilt caused by *Ralstonia solanacearum* is one of the most devastating diseases of solanaceous vegetables and cause high economic losses. The disease is more common in

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occurrence in regions where solanaceous crops viz. tomato, brinjal, potato and chili etc. are grown and is more severe under weather conditions of high temperature and high humidity which is congenial for disease development (Sunder *et al.*, 2011). In India, the losses due to bacterial wilt varied from 31.47 to 81.7 % and 36.88 to 91.06 % in fruit number and weight respectively. The plant mortality and losses in fruit yield due to bacterial wilt ranged from 10 to 100% and 10.83 to 92.62% (Kishun, 1987).

A great setback was suffered by tomato cultivation in the areas of Kangra and surrounding areas of Mandi district of Himachal Pradesh due to the rise in the incidence of this disease and has become endemic in these areas (Sood and Singh, 1993). The disease has been reported from Solan area also (Gupta *et al.*, 1998). Therefore, the present study was conducted to know the prevalence of bacterial wilt incidence in various districts of Himachal Pradesh.

An extensive survey was carried out to monitor the prevalence of bacterial wilt of solanaceous vegetables in Himachal Pradesh in term of its incidence in some selected districts viz., Kangra, Hamirpur, Solan, Sirmour, Kullu, Shimla, Mandi and Bilaspur during April to August, 2019 where tomato, eggplant, chili and bell pepper are abundantly grown. At least three locations in each district and five farmer's fields from each location were surveyed to record the bacterial wilt incidence. For a quick field diagnosis, the streaming of milky white masses of bacterial cells (ooze) confirmed the disease is bacterial wilt caused by *Ralstonia solanacearum* (Plate 1) and to distinguish bacterial wilt from vascular wilts caused by fungal pathogen and nematode. At least 5 samples of the diseased plants were collected from each of the surveyed district, proper labeling of the collected samples was done and then put into the polythene bags and brought to the laboratory for the isolation of different isolates of *R. solanacearum*. The plant samples were tested on tetrazolium chloride (TZC) medium (Kumar and Sood, 2001) for the appearance of virulent colonies of *R. solanacearum* (Plate 1). Total number of healthy and wilted plants was counted in 2 x 2 m² area in 5 counts per location and per cent wilt incidence was recorded. During the survey other aspects like the variety used, cropping pattern and crop history were also recorded. The per cent wilt incidence was calculated by the following formula:

$$\text{Wilt incidence (\%)} = \frac{\text{Number of wilted plants} \times 100}{\text{Total number of plants observed}}$$

Further on the basis PDI the varieties are designated

as highly resistant (HR), resistant (R), moderately resistant (MR), moderately susceptible (MS), susceptible (S) and highly susceptible (HS) according to disease scale given by Winstead and Kelman (1952). During survey it was observed that the wilt incidence varied from 10-100 per cent in various hybrids/varieties grown in different districts but 'Heemsohna' was found to be the most cultivated variety by the farmers under natural conditions and gave variable reactions in different districts of Himachal Pradesh (Table 1, Fig.1).

In Hamirpur and Kangra districts the variety 'Heemsohna' showed susceptible reaction (65-80%) but at Sirmour and Solan their reaction was moderately susceptible whereas, in Kullu district moderately resistant reaction was noticed on the same cultivar. Although 'Roma' in Kangra and 'Lal Sona' in Shimla were found highly susceptible against bacterial wilt of tomato. Similarly, 'California Wonder' of bell pepper and 'Arka' of brinjal showed highly susceptible reaction to bacterial wilt in Kangra district. Only one tomato cultivar 'Heemsohna' from Tyali village of Shimla was found completely resistant to bacterial wilt.

Highest wilt incidence (90-100 per cent) was found in Solan, Shimla and Kangra districts. In Solan district of Himachal Pradesh village Gaura had maximum wilt incidence of about 90-100 per cent in Manisha variety of tomato (Plate 2) and the whole farmer fields were wilted by the disease whereas, in Shimla highest wilt was in village Nayaser about 90-100 per cent in 'Lal sona' variety of tomato. In Kangra district highest wilt incidence was found at Palampur about 90-100 per cent in the tomato field in 'Roma' and variety 'Arka Kusumkar' of brinjal. Differences of wilt incidence were also reported in eggplant due to the great diversity of host plants affected by this pathogen, phenotype and genotype of *Ralstonia solanacearum*, its wide geographical distribution, and the range of environmental conditions conducive to bacterial wilt (Rahman *et al.*, 2010).

The wilt incidence in the fields of bell pepper was found maximum in Palampur i.e. 70-90 per cent. Variety of tomato 'Lal Sona', 'Manisha' and 'Roma' were found to have maximum wilt incidence of about 90-100 per cent. Whereas, variety 'California Wonder' of bell pepper showed 70-90 per cent wilt incidence and in case of brinjal maximum wilt incidence was found on the variety 'Arka Kusumkar'.

Variety 'Heemsohna' was found to be susceptible in Hamirpur and Kangra whereas, it showed resistant reaction in Shimla and Bilaspur however, it was

moderately susceptible in Una and Sirmour. The variety 'Lal Sona'of tomato was found highly susceptible in Nayaser village whereas, same variety was found susceptible in village Halot of Shimla district. Palampur showed highly susceptible reaction in all three crops surveyed. The disease is well established in the mid-hill sub-humid areas of Himachal Pradesh and appears endemically every year (Sood and Singh, 1993; Gupta *et al.*, 1998). Gradually, the disease is further spreading to other districts like Kullu, Bilaspur and Hamirpur (Sood *et al.*, 2002). Some workers reported high wilt incidence due to

Table 1. Status and distribution of bacterial wilt of solanaceous crops in Himachal Pradesh

District	Location	Variety	Host	Wilt Incidence (%)	Reaction*
Hamirpur	Lahar	Heemsohna	Tomato	65-80	S
	Bhumpal	Local variety	Brinjal	50-60	MS
	Bhumpal	Surajmukhi	Chilli	40-50	MS
Kullu	Bajaura	Heemsohna	Tomato	20-40	MR
	Bajaura	California wonder	Bell pepper	20-40	MR
	Tharman	Manik	Tomato	30-40	MR
Sirmour	Maryog	Heemsohna	Tomato	45-60	MS
	Maryog	Indira	Bell pepper	45-50	MS
Mandi	Dadaur	East west	Tomato	70-80	S
	Balh	PusaPurple Round	Brinjal	25-30	MR
	Sarkaghat	Naveen 2000	Tomato	30-40	MR
Solan	Mundikala	Heemsohna	Tomato	45-50	MS
	Mundikala	Indira	Bell pepper	30-40	MR
	Gaura	Manisha	Tomato	90-100	HS
	Gaura	Dollar	Bell pepper	30-40	MR
	Kothi	Heemsohna	Tomato	30-40	MR
Kangra	Palampur	Roma	Tomato	90-100	HS
	Palampur	California wonder	Bell pepper	80-90	HS
	Palampur	Arka Kusumkar	Brinjal	90-100	HS
	Panaper	Heemsohna	Tomato	65-70	S
	Kural	Heemsohna	Tomato	70-80	S
Shimla	Halot	Lal sona	Tomato	65-70	S
	Halot	Shamli	Brinjal	30-40	MR
	Halot	Dollar	Bell pepper	20-40	MR
	Nayaser	Lal sona	Tomato	90-100	HS
	Dhamandari	Heemsohna	Tomato	25-30	MR
	Tiyali	Heemsohna	Tomato	15-20	R
	Kanda	Heemsohna	Tomato	30-40	MR
Una	Amb	Naveen	Tomato	45-50	MS
	Santokhgarh	Heemsohna	Tomato	50-60	MS
	Harouili	Aruna	Brinjal	30-40	MR
Bilaspur	Namhol	Rupali	Tomato	25-30	MR
	Berthin	Indira	Bell pepper	45-50	MS
	Jukhala	Heemsohna	Tomato	30-40	MR

***Winstead and Kelman (1952)**

Highly resistant (HR) = 0%, Resistant (R) = 1-20 %

Moderately Resistant (MR) = 21-40%, Moderately susceptible (MS) = 41-60% Susceptible (S) = 61-80%, Highly Susceptible (HS) =>80%

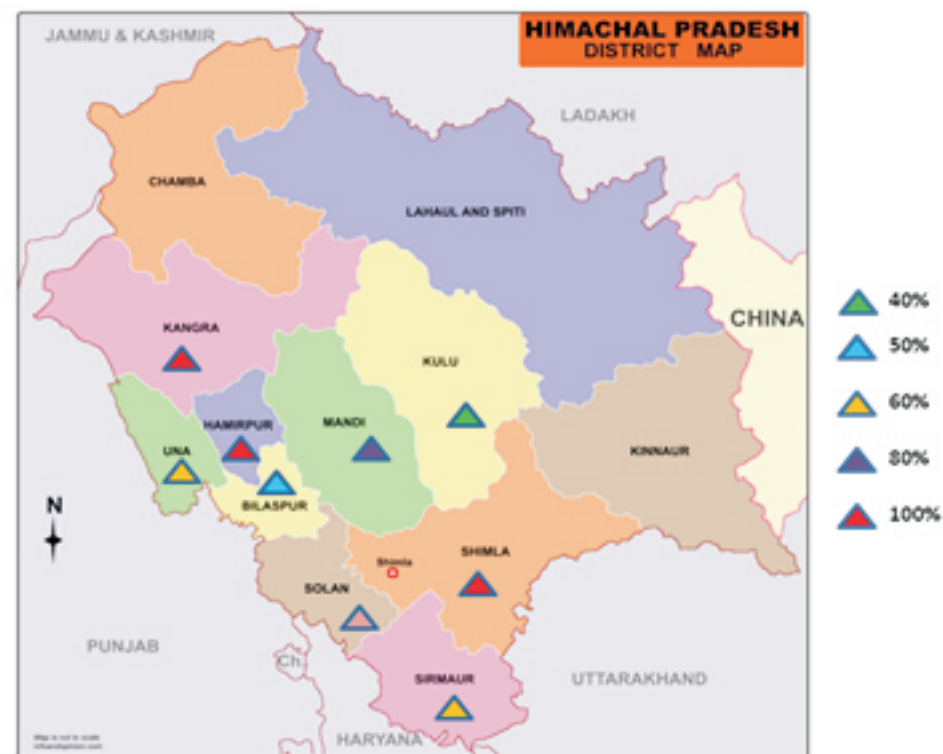


Fig.1. Distribution of bacterial wilt pathogen in major solanaceous vegetable growing areas of Himachal Pradesh during July-June, 2019

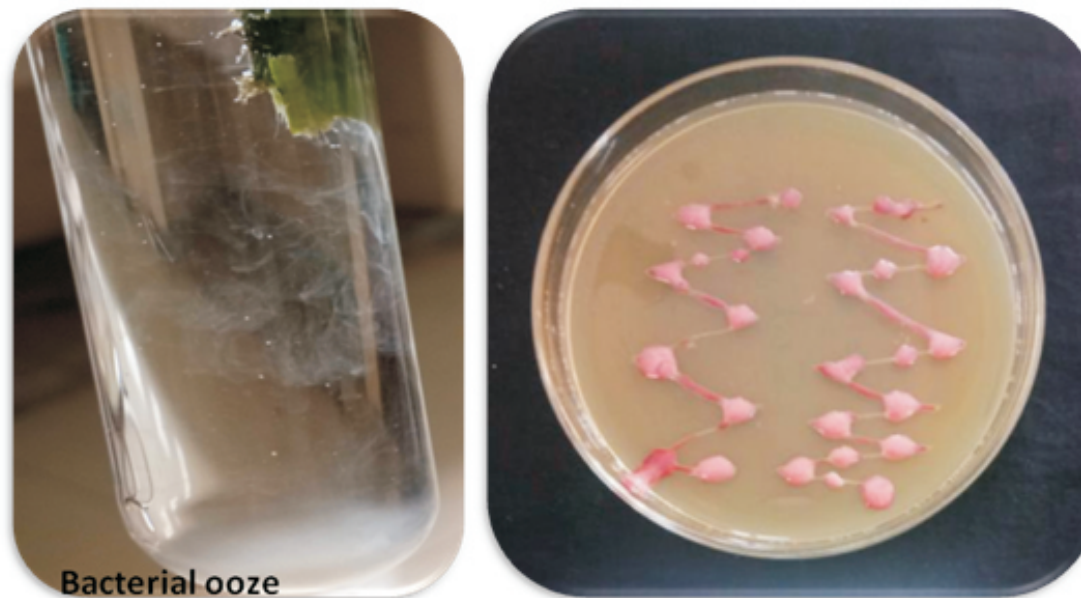


Plate 1. Bacterial ooze and virulent colonies of *R. solanacearum* in TZC medium



Plate 2. Incidence of bacterial wilt in tomato (Manisha) and bell pepper (Dollar) at Gaura (Solan)

Ralstonia solanacearum at higher temperature (Devi and Menon 1980; Kishun 1987). Aggarwal *et al.* (2006) reported occurrence of bacterial wilt in tomato, brinjal and capsicum in Himachal Pradesh and the wilt incidence reported was about 2-100%.

Moreover, these variations of wilt incidence and

severity may be attributed due to the diversity of *R. solanacearum* isolates and also due to the variations in soil factors prevailing in different locations surveyed.

Conflict of interest: The authors declare that they have no conflict of interest in this paper.

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