



## Survey and Screening of Tomato Varieties against Early Blight (*Alternaria solani*) Under Field Condition

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### ABSTRACT

Tomato production in India and elsewhere is under constant threat of the *A. solani* that causes early blight disease. Disease surveys were conducted in seven villages (Kanke, Boriya, Pithoria, Chutia, Nagari, Mandar and Thakurgaon) of different blocks of Ranchi district (Jharkhand) during the Rabi season, 2013-14 to record the incidence of early blight of tomato caused by *Alternaria solani*. Early blight of tomato was prevalent in all the areas surveyed the disease severity in leaf and stem varied from 12.0 to 34.6% and 14.2 to 26.6 per cent respectively depending on localities, however, highest disease intensity in leaf was recorded at Nagari being 34.6% and disease intensity of 26.6% in stem. Which was followed by Pithoria which recorded PDI of 32.6% in leaf and 21.2% in stem. All the entries disease observations were recorded under natural epiphytotic condition. However, reactions varied with the cultivars. The mean disease intensity ranged from 16.0 to 40.7%. whereas eight varieties namely Pusa rohini, BT 12, Arka meghali, Pusa uphar, Swarn samridhi, Swarn lalima, Arka abha and Pusa rubi showed moderately susceptible (MS) reactions. The cultivars, Swarn baibhav, BT10 and S-22 showed susceptible reaction (S) against early blight disease. Two varieties i.e., Arka vikas and Swarn sampada were found moderately resistant reaction (MR) against early blight. The cultivars, Swarn sampada recorded highest yield 233.6 q/ha. Which is at par with cultivar Arka meghali (213.5 q/ha). The next higher yielder in order to superiority were Arka vikas (210.6 q/ha), Swarn lalima (206.4 q/ha), Swarn samridhi (202.6 q/ha) etc.

**Key words:** *Lycopersicon esculentum*, Survey, Varietal screening, early blight, Yield, *Alternaria solani*.

### INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is second most important vegetable crops after potato and is cultivated almost year round in tropical and subtropical regions of the world. It belongs to the family Solanaceae and is

believed to be a native of Western South America. Tomato is regular kitchen component of Indian diet and grown for its edible fruit or cooked in the form of various processed products like juice, ketchup, sauce, pickle, pastes and powder.

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It also has high medicinal value; the pulp and juice is digestible, promoter of gastric secretion and blood purifier. It is an excellent source of many nutrients and metabolites that are important for human health: folate, potassium, vitamins A and C. In terms of area, it occupies second place after potato at the national level and cultivated in area of 865.0 thousand hectares produces about 16.82 thousand million tonnes of fruits with an average productivity of 19.5 metric tonnes ha<sup>-1</sup> Anonymous<sup>5</sup>.

However, fungal diseases, especially early blight caused by *Alternaria solani* (Ellis and Martin), is the most threatening one<sup>8,9,2,1</sup>, which causes great reduction in the quantity and quality of fruit yield. It affects severely at all stages of the crop growth during both Kharif and Rabi season. This disease, which in severe cases can lead to complete defoliation, is most damaging on tomato in regions with heavy rainfall, high humidity and fairly high temperatures 24-29°C.

Apart from the leaf symptoms that are known as early blight, *A. solani* causes other symptoms on tomato which are less economically important; including collar rot (basal stem lesions at the seedling stage); stem lesions in the adult plant stage and fruit rot<sup>23,6</sup>. The fungus causes disease on tomato, potato and eggplant. It is now found in all continents of the world. Yield losses up to 79% due to early blight damage were reported from Canada, India, USA, and Nigeria<sup>7,14,10</sup>. It is very destructive in temperate humid climates. Although the disease is called early blight but it can occur on the plant at all stages of development.

Previous studies have demonstrated the widespread occurrence of early blight in all vegetable growing areas of India. Prasad<sup>19</sup> conducted a field survey in northern districts of Karnataka viz., Raichur, Gulbarga and Dharwad during Kharif 2001 and recorded percent disease index of 28.60 to 65.36%. Abhinandan *et al.*<sup>3</sup> reported maximum disease intensity of 49.5% in Tapa district and minimum disease intensity of 8.2% in Babakala District of Punjab. Kamble *et al.*<sup>12</sup>

conducted roving survey in Rabi season in Konkan region of Maharashtra; early blight incited by *A. solani* was found to be major disease of tomato under agro climatic conditions of Konkan. Early blight disease intensity in Raigad district ranged between 20.78 to 42.30% and 35.12 to 55.75% in Thane district. However, more recent studies by Patel *et al.*<sup>18</sup> demonstrated that early blight are major problem of tomato in Chhattisgarh. Kumar and Srivastava<sup>13</sup> also reported early blight as serious problem of tomato in Varanasi (U.P.) and causes severe losses in yield by this disease.

Field evaluation has been the most utilized method of screening tomatoes for Early Blight resistance. The advantages of field screening include the ability to grow large populations, evaluating plants under natural conditions and recording disease progress throughout the entire life cycle of the plant. Field evaluation is usually conducted throughout the plant's growing season, starting with observation of the first disease symptoms, usually 2 to 3 weeks after initial infection and ending with a recording of final percent defoliation at the end of the season. Disease severity is typically expressed as percent defoliation<sup>11</sup>. In general, however, field evaluation is highly useful as the data can be used to compare across plant genotypes at various time intervals during the season. This kind of information can be particularly useful when breeding early blight resistant tomatoes for targeted environments.

In view of the dynamic nature of the tomato diseases and their negative impact on tomato production, the current study aimed at establishing the seasonal occurrence of the tomato diseases in the tomato producing areas of Ranchi district. The second objective, namely; find sources of resistance against early blight in cultivated tomato lines.

## MATERIALS AND METHODS

Seven villages (Kanke, Boriya, Pithoria, Chutia, Nagari, Mandar and Thakurgaon) of different blocks of Ranchi district were surveyed during the Rabi season, 2013-14 to

record the incidence of early blight of tomato caused by *Alternaria solani*. A large number of diseased samples of tomato plants carrying the characteristic symptoms of early blight were collected from farmer's field in above villages of Ranchi and also from research farm of BAU, Ranchi. The diseased specimens were collected in paper examination. Diseased

samples were then preserved under dried conditions for further studies. In each field 40 leaves were selected randomly and disease severity was assessed by using 0-5 scale<sup>15</sup>.

Per cent disease index (PDI) was calculated by using following formula proposed by Wheeler<sup>24</sup>.

$$\text{PDI} = \frac{\text{Sum of the individual disease ratings}}{\text{Number of fruits/leaves observed X Maximum disease grade}} \times 100$$

### Varietal screening

In order to find out resistant source against the early blight disease, an experiment was laid out in RBD. Thirteen cultivars (Arka vikas, Pusa rohini, BT 12, Arka meghali, Pusa uphar, Swarn baibhav, BT10, Swarn sampada, Swarn samridhi, Swarn lalima, Arka abha, Pusa rubi and S-22) of tomato were screened against early blight disease intensity under natural conditions during *Rabi* season at Department of Horticulture, BAU, Ranchi during 2013-14. They were graded according to the techniques

mentioned below. Thirteen Varieties were transplanted in area of 2.0 m X 2.0 m with spacing of 60 cm X 45 cm. Fertilizers were applied at the rate of 100:60:60 kg NPK /ha and FYM @ 200 q/ha. Per cent disease intensity was recorded from time to time till maturity by using 0-5 rating scale<sup>15</sup>. The disease intensity was assessed by grading forty leaves of ten tagged plants randomly selected from all the varieties and graded as stated below.

Per cent leaf area covered	Disease scale	Disease reaction
<1	0	Immune (I)
1-5	1	Resistant (R)
6-20	2	Moderate resistant (MR)
21-40	3	Moderately susceptible (MS)
41-70	4	Susceptible (S)
71-100	5	Highly susceptible (HS)

## RESULTS AND DISCUSSION

### Survey

Early blight of tomato was prevalent in all the areas surveyed the disease severity in leaf and stem varied from 12.0 to 34.6% and 14.2 to 26.6 per cent respectively depending on localities, however, highest disease intensity in leaf was recorded at Nagari being 34.6% and disease intensity of 26.6% in stem. Which was followed by Pithoria which recorded PDI of 32.6% in leaf and 21.2% in stem. The relative lower disease intensities were recorded other locations *viz.*, Kanke, Boriya, Chutia, Mandar and Thakur goan.

### Evaluation of tomato cultivars against early blight under natural epiphytotic

In this trial, all the entries disease observations were recorded under natural epiphytotic condition. However, reactions varied with the cultivars. The mean disease intensity ranged from 16.0 to 40.7%. whereas eight varieties namely Pusa rohini, BT 12, Arka meghali, Pusa uphar, Swarn samridhi, Swarn lalima, Arka abha and Pusa rubi showed moderately susceptible (MS) reactions. The cultivars, Swarn baibhav, BT10 and S-22 showed susceptible reaction (S) against early blight disease. Two varieties *i.e.*, Arka vikas and

Swarn sampada were found moderately resistant reaction (MR) against early blight. The cultivars, Swarn sampada recorded highest yield 233.6 q/ha. Which is at par with cultivar Arka meghali (213.5 q/ha). The next higher yielder in order to superiority were Arka vikas (210.6 q/ha), Swarn lalima (206.4 q/ha), Swarn samridhi (202.6 q/ha) etc (Table 2.).

Abhinandan *et al.*<sup>3</sup> conducted a survey in Punjab, India during 2001 and reported that maximum disease intensity of 49.5 per cent at the Tapa District and minimum disease intensity of 8.2 per cent at the Babakala districts. Kamble *et al.*<sup>12</sup> conducted survey programme in Konkan region of Maharashtra State, it is mostly grown in the Thane and Raigad districts. Early blight incited by *Alternaria solani* was found to be major disease of tomato under agroclimatic conditions of Konkan. Early blight disease intensity in Raigad district ranged between 20.78 to 42.30 per cent and 35.12 to 55.75 per cent in Thane district.

A disease survey was conducted during *Rabi*, 2012-13, to know the seasonal occurrence of tomato diseases and current status of early blight diseases in Abhanpur, Aarang and Dharsiwa block of Raipur district (Chhattisgarh). In entire growing season (from September 2012 to March 2013) many diseases occurred in Raipur district. Early blight disease severity was more in Abhanpur block (51.31%) followed by Aarang block (49.35%) and least in Dharsiwa block (44.24%)<sup>22</sup>. A survey was conducted in Peshawar, Pakistan to determine the incidence of early blight of tomato caused by *A. solani*. High disease incidence (100%) was recorded in Pathwarbala, Sufaid sang, kanderysadin and Shahibala. Regiaftezai and Malakandhir had the lowest (50%) incidence of the disease. Ahmad *et al.*<sup>4</sup>. Rani *et al.*<sup>20</sup> conducted field survey of tomato diseases in all the vegetable growing areas of Jammu division of Jammu and Kashmir during 2011 and 2012. The early blight disease (*A. solani*) disease intensity and incidence ranged from 21.66 to 34.13 per cent and 10.48 to 18.56 per cent, respectively.

Kumar and Srivastava<sup>13</sup> conducted tomato screening against early blight of tomato during 2010-11 and 2011-12. They observed that only two genotypes viz., EC-520061 and H-88-74-1 were found highly resistant to early blight of tomato. The lower early blight disease incidence was found in H-88-74-1(12.04%), EC- 520061(12.29%) and EC-521071 (25.0%) Floraded (27.0%) and Swarna naveen (28.61%). Other fifteen genotypes showed moderately resistant reaction.

Sahu *et al.*<sup>21</sup> found that Cherry tomato-2 (indeterminate), Cherry tomato-4 and VL Tamatar-4 (determinate) were found as highly resistant to early blight tomato and can be used in resistant breeding programme. Abdussamee *et al.* evaluated the response of fifty one tomato germplasm against early blight under field and walk-in tunnel conditions. None of the test germplasm was immune or highly resistant in both conditions. In the tunnel experiment, among the twenty seven indeterminate varieties and hybrids only one variety (Beefsteak) showed resistant response with PDI 15.55%, eleven varieties and five hybrids were moderately resistant, three varieties and five hybrids were moderately susceptible. In the field experiment, among the twenty four determinate varieties and hybrids, four varieties (Black Prince, Oregon spring, Zhezha and Bloody butcher) showed resistant response with PDI (11-16%) ten varieties and four hybrids were moderately resistant.

Yadav *et al.*<sup>25</sup> conducted an experiment to screen different advanced lines and genotypes against early blight of tomato caused by *Alternaria solani*. Two hundred and two advanced lines and nine genotypes were screened under natural epiphytic condition. Nineteen advanced line were found resistant reaction against early blight disease. The thirty one advanced lines and three genotypes were found moderate resistant reaction. Rani *et al.*<sup>20</sup> evaluated fifteen genotypes against early blight of tomato under artificial conditions of inoculation in field condition. They found only three varieties viz., Co3, Tomato cherry and Heem sohna were found moderately resistant while rest entries were susceptible to highly susceptible reaction to early blight of tomato.

**Table 1: Occurrence of early blight of tomato in different localities of Ranchi district**

Localities	Block	Cultivars	Age of the Plant (DAS)	*Leaf PDI (%)	*Stem PDI (%)
Kanke	Kanke	S-22	100	31.3 (34.0)	NS
		Arka Vikash	92	22.0 (27.8)	14.3 (22.1)
		Pusa Uphar	89	24.0 (29.2)	NS
Boriya	Kanke	US-404	70	23.3 (28.8)	NS
Pithoria	Kanke	Sungro 7007	85	32.6 (34.8)	21.2 (27.4)
Chutia	Khijri	US440(Bhavani)	68	21.3 (27.4)	NS
Nagari	Nagari	Mahyco 701	80	34.6 (36.0)	26.6 (31.0)
Mandar	Mandar	Unknown	95	18.0 (25.0)	16.8 (24.1)
Thakurgoaon	Budumu	Mahyco 401	90	12.0 (20.1)	14.2 (22.1)
<b>S Em (±)</b>				1.8	
<b>CD at 5%</b>				5.4	
<b>CV %</b>				10.8	

\*Mean of three replications Figures in parentheses are transformed arc sine values NS – Not seen

**Table 2: Evaluation of tomato cultivars against early blight under natural epiphytotics**

Cultivars	*PDI (%)	*Yield (q/ha)	Disease score	Reaction
Arka vikas	19.0 (25.8)	210.6	2	MR
Pusa rohini	26.0 (30.6)	181.8	3	MS
BT 12	32.0 (34.4)	170.5	3	MS
Arka meghali	34.7 (36.0)	213.5	3	MS
Pusa uphar	33.7 (35.4)	188.6	3	MS
Swarn baibhav	40.3 (39.4)	185.4	4	S
BT10	40.7 (39.6)	185.4	4	S
Swarn sampada	16.0 (23.5)	233.6	2	MR
Swarn samridhi	20.7 (27.0)	202.6	3	MS
Swarn lalima	36.7 (37.2)	206.4	3	MS
Arka abha	34.0 (35.7)	178.9	3	MS
Pusa rubi	20.0 (26.5)	172.5	3	MS
S-22	40.0 (39.2)	175.3	4	S
<b>S Em (±)</b>		1.5	7.0	
<b>CD at 5%</b>		4.6	20.7	
<b>CV%</b>		8.3	6.3	

\*Mean of three replications Figures in parentheses are transformed arc sine values

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