

## Surveillance of tomato foot rot caused by *Rhizoctonia solani* in Pothohar Region of Pakistan

\*Amjad Shahzad Gondal<sup>1</sup>, Chaudhary Abdul Rauf<sup>1</sup>, Farah Naz<sup>1</sup>, Nadeem Akhtar Abbasi<sup>2</sup>

<sup>1</sup>Department of Plant Pathology, PMAS Arid Agriculture University Rawalpindi, Pakistan

<sup>2</sup>Department of Horticulture, PMAS Arid Agriculture University Rawalpindi, Pakistan  
\*Corresponding author's email: amjadshahzad@live.com

### Abstract

Tomato (*Solanum lycopersicum* L.) is the world's 2<sup>nd</sup> largest vegetable crop after potato. Diseases of tomato are considered as the limiting factor to its economic production. *Rhizoctonia solani* Kühn (teleomorph = *Thanatephorus cucumeris* (Frank) Donk) is the most important soil-borne fungal pathogen that has a significant establishment with soil and causes seedling death, and foot rot in tomato. It is a ubiquitous soil-borne fungus with broad host range and diverse genetic makeup. A survey of different locations of districts Rawalpindi, Jhelum, Attock, Chakwal and federal capital Islamabad was conducted during 2014 and 2015 cropping season to figure out the scenario of tomato foot rot. The disease was 100% prevalent to all the visited locations. Maximum mean disease incidence (38.7%) was observed in Islamabad followed by district Attock (36.3%), district Rawalpindi (34.9%) and district Chakwal (29.6%) while minimum mean disease incidence was recorded in district Jhelum (27.5%). This varying incidence of foot rot of tomato may be attributed to the varying climatic conditions including temperature variations, relative humidity and cultivation of susceptible varieties. The findings of the present studies can serve as basics to evaluate integrated disease management strategies against tomato foot rot.

### Introduction

Tomato is an edible fruit and one of the most consumed vegetables in the world. It is an adaptable crop used for fresh market and processing in prepared foods as canned, ketchup, sauce, juice, paste, powder, puree, salad dressings, soups, vegetable and juice cocktails, frozen tomatoes, preserved or dried foods. It is now considered to be a part of the daily diet (Onyambus *et al.*, 2011). Tomato is a short-lived perennial crop by nature however, it is universally grown as an annual crop of 5 to 6 months (Kaul, 1991). It is grown in temperate climates across the world. The optimum temperature for growth and development is between 21-24 °C (Naika *et al.*, 2005). Temperature tolerance for extreme heat and cold is important for blossoms development and subsequent fruit set (Barten *et al.*, 1992; Gould, 2013). Pakistan has varying climatic conditions. Three crops of tomato; early, mid-season and mains season, are being grown in Pakistan (Khan, 2012). Locally, tomato is grown over an area of 62 thousand hectares with a production of 599 thousand tons. Pothohar region contributes 7.58% of the total tomato production of the country. For the last few years, there has been a progressive increase in the area and production of tomato in Pakistan (FAO, 2014).

Diseases are a major limiting factor in tomato production throughout the world. Tomato plant is prone to numerous fungal, bacterial, viral and nematode diseases (Scofield *et al.*, 1996; Agrios,

2005; Jones *et al.*, 2014). At present, tomato is susceptible to more than 200 diseases (Rashid *et al.*, 2016). Fungi are considered as an important group of microorganisms responsible for various diseases of tomato and cause significant yield losses. Among soil-borne fungal pathogens, *Fusarium* spp., *Phytophthora* spp., and *Rhizoctonia solani* cause significant yield losses (Moataza, 2006; Abdel-Monaim, 2012). *R. solani* cause seedling damping off and foot rot of mature tomato (Montealegre *et al.*, 2003; Traquair *et al.*, 2013) and eventual death of diseased plants leading to the significant yield losses (Anderson, 1982; Arora *et al.*, 2008). Although, some contribution to Rhizoctoniasis on potato is reported from Pakistan (Rauf *et al.*, 2007) however no detailed data on *R. solani* infection on tomato is available. The present study was conducted to know the prevalence and incidence of foot rot of tomato in the Pothohar region.

### Materials and Methods

The studies on disease documentation of *R. solani* on tomato were made in Pothohar region which includes districts; Jhelum, Chakwal, Attock, Rawalpindi, and Islamabad Capital Territory. Pothohar region is situated between latitude 32.5° 00'N to 34° 00'N and altitude 72° 00'E to 74° 00'E in the Asian subcontinent with an elevation of 517 m from sea level and experiences semi-arid to humid climate (Chaudhry and Rasul, 2004). This region

features a humid subtropical climate with hot summer, monsoon and short, mild and wet winters. The climate of the region has considerable temperature variations. The average annual rainfall is 1,249 mm, most of

which falls in the monsoon season. Details on different locations surveyed from each district for is given in Table 1.

**Table 1:** Districts and their locations surveyed for *Rhizoctonia solani* infection on tomato during the crop season 2014 and 2015.

Sr. No.	District	Location (s) Surveyed	Longitude/ Latitude
1	Rawalpindi	Taxila	33.7463° N, 72.8397° E
		Rawalpindi	33.3593° N, 72.9461° E
		Gujar Khan	33.2622° N, 73.3060° E
		Kallar Syedan	33.4137° N, 73.3768° E
		Kahuta	33.5896° N, 73.3886° E
		Kotli Sattian	33.8082° N, 73.5255° E
Jhelum	Jhelum	Jhelum	32.9696° N, 73.6889° E
		Pind Dadan Khan	32.5884° N, 73.0435° E
		Sohawa	33.1129° N, 73.4121° E
		Dina	33.0305° N, 73.6124° E
Attock	Attock	Attock	33.7645° N, 72.3666° E
		Fateh Jang	33.5673° N, 72.6506° E
		Hazro	33.9053° N, 72.4791° E
		Hassan Abdal	33.8263° N, 72.6802° E
		Jand	33.4365° N, 72.0172° E
		Pindi Gheb	33.2452° N, 72.2660° E
Chakwal	Chakwal	Chakwal	32.9221° N, 72.8634° E
		Kallar Kahar	32.7769° N, 72.7068° E
		Choa Saidan Shah	32.7220° N, 72.9785° E
		Talagang	32.9172° N, 72.4081° E
		Lawa	32.6972° N, 71.9312° E
Islamabad	NARC	33.6701° N, 73.1261° E	

Tomato is grown on scattered locations in the selected districts so purposive sampling was done. To determine disease prevalence, each field was diagonally visited in Z transect to observe presence or absence of *R. solani* infection at soil line level of the stem. Depending on the field size, quadrat of 1 m<sup>2</sup> was thrown 5-8 times in each field. Healthy and infected plants within the specific area were counted to determine disease incidence percentage. Disease prevalence and incidence percentage were calculated using formula;

$$\text{Disease prevalence (\%)} = \frac{\text{Locations showing } R. \text{ solani infection}}{\text{Total locations examined}} \times 100$$

$$\text{Disease incidence (\%)} = \frac{\text{No of infected plants}}{\text{Total no. of plants}} \times 100$$

By employing above formula, prevalence and incidence of tomato foot rot disease in each field location was calculated and consequently, districts mean incidence was calculated.

## Results and Discussion

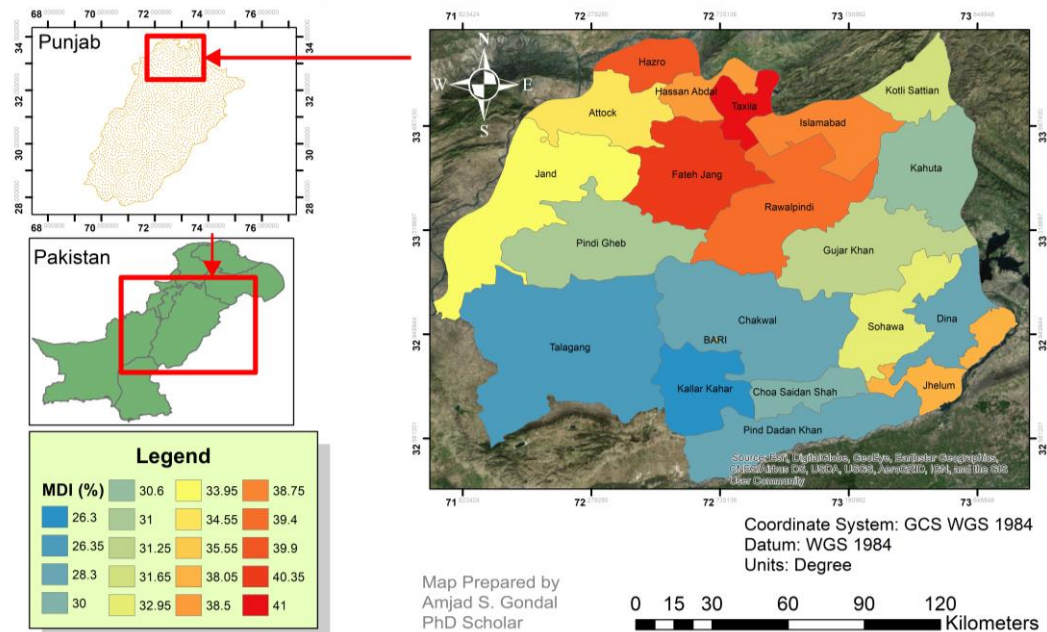
Tomato production in Pothohar region is mostly at scattered locations. *R. solani* infection was 100% prevalent to all the visited locations. In district Rawalpindi, the maximum mean disease incidence was recorded in Taxila (41.0%) followed by tehsil Rawalpindi (39.4%), Gujar Khan (32.2%)

and Kotli Sattian (31.6%) while minimum mean disease incidence was recorded at Kahuta (30.6%). In district Jhelum, the maximum mean disease incidence was recorded in tehsil Jhelum (38.0%) followed by Sohawa (32.9%) while minimum mean disease incidence was observed in Pind Dadan Khan and Dina (28.3%). In district Attock, the maximum mean disease incidence was recorded in Fateh Jang (40.3%) followed by Hazro (39.9%), Hassan Abdal (38.5%), Attock (34.5%) and Jand (33.9%) while minimum mean disease incidence was recorded in Pindi Gheb (31.0%). In district Chakwal, the maximum mean disease incidence was recorded at Barani Agricultural Research Institute (35.5%) followed by Lawa (31.2%), Choa Saidan Shah (30.0%), Chakwal (28.3%) and Talagang (26.3%) while the minimum mean disease incidence was recorded at Kallar Kahar (26.3%). The mean disease incidence in Islamabad was recorded as 38.7% as shown in Fig. 1.

Variations in mean disease incidence of tomato foot rot in different districts were observed. District wise, maximum mean disease incidence was observed in Islamabad (38.7%) followed by district Attock (36.3%), district Rawalpindi (34.9%) and district Chakwal (29.6%) while minimum mean disease incidence was recorded in district Jhelum (27.5%). The varying disease incidence may be attributed to the conducive weather conditions

prevailing in these areas and ultimately leads to the remarkable yield reduction as reported by Hafiz (1986). Fontem (1993) and Al-Askar *et al.* (2014)

also reported *R. solani* as a causal agent for foot rot of tomato nurseries.



**Fig. 1:** Mean disease incidence percentage of tomato foot rot in various areas/ locations of districts of Pothohar region during 2014-2015.

Since the climate of the region has considerable temperature variations including semi-arid and sub-humid regions (Shamshad, 1988), the fungus can survive under both cool and warm soils. It can remain active at a range of temperatures (Olsen and Young, 2011), and is well adapted to survive unfavourable conditions as it remains dormant as sclerotia (Ceresini *et al.*, 2002). The optimum temperature ranges 24-31 °C for vegetative growth and the emergence of tomato seedlings also provide optimum temperatures for *R. solani* disease development; 24-32 °C (Harikrishnan and Yang, 2004). Pothohar region receives an average of 1,249 mm rainfall of which more than 65% is received in monsoon. In addition to temperature, soil moisture greatly influences the amount of *R. solani* inoculum in the soil (Frank, 1978) that ultimately favour the disease development (Kyritsis and Wale, 2002; Naz *et al.*, 2008; Shehata *et al.*, 1984).

Multicropping and the intercropping are the common practices adopted by the farmers of the region. Mostly the farmers are not progressive. They have small land holdings and do not follow the same cropping pattern. It is well accepted that the occurrence of soil-borne pathogens including *R. solani* is greatly influenced by intensive cropping (Gilligan *et al.*, 1996; Hooker, 1981; Kluth *et al.*, 2010). Solanaceous vegetable cultivation on the same fields also helps in the inoculum multiplication, however, this pathogen is also well adapted for life outside the host plants (Keijer *et al.*, 1997; Olsen and Young, 2011).

The use of noncertified seeds is also

commonly practiced as the same germplasm of the few local varieties is used for cultivation year after years. The most commonly used tomato varieties are Money Maker, Roma Rio Grande and Tropic (Sajjad *et al.*, 2011). It was found that tomato varieties Rio Grande was the most susceptible to *R. solani* infection in the presence of availability of favourable disease conditions. A substantial variation in disease incidence among different locations visited may be attributed to prevailing environmental conditions and different levels of susceptibility in the growing cultivars. In sum up, the disease was prevalent to all locations visited.

## Conclusion

The detailed survey shows an up-to-date status of tomato foot rot in Pothohar region of Pakistan that will help farmers and researchers formulating management strategies and highlighting the need for regular and targeted surveillance. *R. solani* is a species complex of several anastomosis groups (AGs). Based on the current findings; investigations should be made to further understand infection of different AGs on responsible for foot rot disease in tomato.

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