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FACTORS FAVOURING THE DEVELOPMENT OF FOOT ROT PATHOGEN (*PHYTOPHTHORA NICOTIANAE* VAR. *PARASITICA*) IN PUNJAB

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KEYWORDS

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ABSTRACT

Foot rot/gummosis caused by *Phytophthora nicotianae* var. *parasitica* (Dastur.) Waterhouse has become an important pathogen in the decline of Kinnow orchards, Sweet orange and nurseries in the Punjab state. The disease is characterized by rotting of the rootlets, girdling of the trunk, dropping of brightened leaves, canker lesions and gummosis at the base of the trunk, as well as root rot, extending from main roots into feeder roots. An experiment was conducted to study the effect of age and cultivar from two major citrus growing areas of Punjab (Hoshiarpur and Fazilka). *Phytophthora* population was estimated by plating the soil on selected media. Population of pathogen was significantly higher ($p = .05$ is 11.60) in 10 year old plants orchards than 5 year old plants. Sweet orange cultivar showed relatively higher populations at both locations in constitutive six months till harvesting. Cfu was highest (> 300 propagules / cc of soil) in the month of July 2013. So, in conclusion we observed higher cfu of pathogen in 10 year old plants and sweet orange cultivar for both observed locations. The population of the pathogen was found beyond economic injury level in Punjab conditions (> 15 propagules / cc of soil).

INTRODUCTION

Citrus is the third most important fruit crop in the world after apple and banana and accounts for the production of about 100 million tonnes with massive area of cultivation spread over 7.2 million hectares. India ranks sixth amongst the various citrus producing countries in the world (Savita *et al.*, 2012). Citrus species are almost universally propagated by budding on to seedling rootstocks so susceptible rootstocks leads to heavy *Phytophthora* infection (Gade., 2012). In Punjab, rough lemon (*Citrus jambhiri* Lush.) is being used as major root stock (Dhakad *et al.*, 2014) in a number of *Citrus* spp. like mosumbies, kinnows, oranges, grape fruits etc. for its high vigour and well adaptation to climate of Punjab as well as resistance to *Citrus tristeza virus* (cause of an epidemic). However, the main drawback is its sensitivity to *Phytophthora*, which leads to major losses in an orchard if proper phytosanitary conditions are not followed (Whiteside, 1974). In field nurseries, the eradication of soil borne pathogens like *Phytophthora* once introduced becomes very difficult (Ilyas *et al.*, 2015). Keeping in view the wide proliferation and destructive nature of the disease, an attempt has been made to study the effect of cultivar and age on pathogen population in soil was done in Punjab.

MATERIALS AND METHODS

The investigation was undertaken at Kinnow mandarin and sweet orange growing areas of Punjab *viz.* Hoshiarpur and Fazilka during June 2013 to December 2013. The soil sampling was done to record the population dynamics. Plants showing typical yellowing and gummosis symptoms were selected for studying different factors favouring pathogen development. Soil sampling was done from different age group of Kinnow mandarin plants *viz.* 5 and 10 year old at both locations. Sweet orange and Kinnow mandarin plants were selected for soil population densities. Soil sampling was done from rhizosphere soil in plant canopy along with feeder roots for all factors. Pathogen population in soil was evaluated by soil plating method on selective PARPH-CMA media (Naqvi., 1994). In this method 20 cc composite sample was mixed with 80 ml of water to make 100 ml of soil suspension. Out of this, 5 mL of soil suspension was taken and put on 5 Petri plates (1 mL/Petri plate) of selective PARPH-CMA media. After incubation, pathogen colonies were counted to calculate the propagules/cc of soil. The media was poured in Petri plates and after solidification, 5 mL of soil suspension was spread over media in 5 Petri plates (1 mL/Petri plate) to count per cc population of pathogen. Petri plates were incubated at $25 \pm 1^\circ\text{C}$ for two days. Propagules of *Phytophthora* appeared on Petri plates were counted (Fig. 1), this procedure was followed every month to record fluctuations of population at monthly interval.

RESULTS AND DISCUSSION

Effect of age and cultivar on pathogen development at Fazilka

The population of the pathogen was relatively higher in the 10 years age group of

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Table 1: Effect of different age groups of plants on pathogen population at Fazilka

Month	Cfu/cc of pathogen	
	5 year	10 year
June 2013	4.0	7.0
July 2013	325	371
August 2013	182	241
September 2013	74	157
October 2013	45	71
November 2013	30	50
December 2013	17	24

LSD (p = .05) Month = 21.74 ; LSD (p = .05) Age of plant = 11.60 ; LSD (p = .05) Month x Age of plant = 30.70

Table 2: Effect of different cultivar on root rot and pathogen population at Fazilka

Month	Cfu/cc of pathogen	
	Kinnow mandarin	Sweet orange
June 2013	2.0	5.0
July 2013	319	328
August 2013	154	178
September 2013	98	154
October 2013	56	64
November 2013	36	35
December 2013	27	23

LSD (p = .05) Month = 12.8; LSD (p = .05) Cultivar = NS LSD (p = .05) Month x Cultivar = 18.16

Table 3: Effect of different age groups of plants on pathogen population at Hoshiarpur

Month	Cfu/cc of pathogen	
	5 year	10 year
June 2013	4.0	6.0
July 2013	325	366
August 2013	184	279
September 2013	64	162
October 2013	34	60
November 2013	26	42
December 2013	19	26

LSD (p = .05) Month = 22.90; LSD (p = .05) Age of plant = 24; LSD (p = .05) Month x age of the plant = 32.39

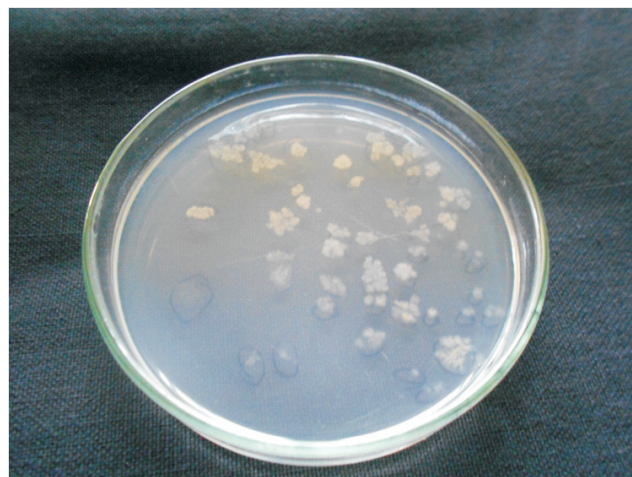
Table 4: Effect of different cultivar on root rot and pathogen population at Hoshiarpur

Month	Cfu/cc of pathogen	
	Kinnow mandarin	Sweet orange
June 2013	4.0	3.0
July 2013	320	360
August 2013	156	226
September 2013	112	109
October 2013	64	75
November 2013	37	44
December 2013	32	32

LSD (p = .05) Month = 33.75; LSD (p = .05) Cultivar = NS; LSD (p = .05) Month x Cultivar = NS

to age and month.

The population were lowest in June 2013 for both of the cultivars and reached highest in July 2013 (Table 2). Kinnow mandarin and Sweet orange cultivar did not differed significantly for pathogen population and feeder root rot. However, the pathogen population recorded higher on Sweet

**Figure 1: Phytophthora propagules appeared on selective PARPH – CMA media**

orange cultivar.

Effect of age and cultivar on pathogen development at Hoshiarpur

Population of the pathogen was observed for different age groups (5 and 10 year) of Kinnow mandarin plants at Hoshiarpur district from June 2013 to December 2013 (Table 3). The pathogen population in 10 year aged plants significantly differed from population observed for 5 years aged plants.

Kinnow mandarin and Sweet orange orchards at the Hoshiarpur had no significant difference in pathogen populations (Table 4). However, pathogen populations were high for Sweet orange cultivar. The population of pathogen differed significantly in different months and decreased till the December 2013.

The present findings are in agreement with Kaur *et al.* (2009) who observed that disease incidence was 20.42 per cent and 23.58 per cent for 1-6 and 7-12 year age plant respectively and stated that plant age has direct correlation with the disease incidence. Thind *et al.* (2008) also reported the increase in the incidence of citrus foot rot with an increase in age of the plant. The present findings are in agreement with Kapoor and Bakshi (1967), who reported that 14-18 per cent decline in Sweet orange was due to foot rot in Abohar (Punjab). Similarly, Menge (1986) reported that *Phytophthora* alone reduced 46 per cent yield in California citrus industry. Kaur *et al.* (2009) observed that foot rot infected Kinnow mandarin gave reduced yield. Savita *et al.* (2012) also stated that foot rot caused 18 per cent decline in sweet orange cultivars of Punjab.

From the above study, it can be concluded that pathogen population was very higher in the citrus orchards of Punjab. In monsoon season population touches its highest level and present throughout the year in considerable amount. Rootstock which is being used *i.e.* Rough lemon is highly susceptible for infection. Higher aged groups of plants are more prone to attack than younger plants.

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