

Proceedings:
International Symposium on
Prospects of Horticultural Industry in Pakistan
28th to 30th March, 2007
Institute of Horticultural Sciences, University of Agriculture, Faisalabad

INFESTATION OF CITRUS ORCHARDS BY CITRUS NEMATODE (*Tylenchulus semipenetrans*) AND SCREENING OF SOME ROOTSTOCKS FOR RESISTANCE OR SUSCEPTIBILITY

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Abstract

A survey of different localities of district Sargodha was conducted and it was found that maximum numbers of nematodes were recovered from soil during the month of March. The population declined in June and again increased during the month of October. Similar was the case with females per gram of root. The nematodes ranged from 5325-12400, 2523-7234 and 3230-13209 juveniles per 500 g of soil in March, June and October respectively. Similarly, females per gram of root ranged from 613-1421 in March, 93-625 in June and 122-1593 in October. Nematode and female populations also varied on different citrus rootstocks. Sweet orange, Feutrell's Early and lime harboured less number of nematodes and females as compared to rough lemon and sour orange, the former showing relatively resistant to *T. semipenetrans* as compared to the latter.

INTRODUCTION

Citrus is the world's recognized agricultural and commercial fruit crop which maintains a prominent position in the fruit industry. World trade in citrus is second only to bananas and more than double the volume of apples. Citrus industry, because of their quality and acceptance by consumer, representing 50-60% of new citrus plantations in the last 10 years. Citrus fruit is highly nutritive and refreshing, being a source of vitamins A and C, organic acids, sugars and carotenoids, is grown in more than 125 countries in a belt within 35 latitude north or south of the equator (Duncan and Cohn, 1990). Citrus species are naturally deep-rooted plants (Ford, 1954a and 1954b) and optimum growth requires deep alluvial and well-drained soils because root will not grow into or remain in saturated zones. Citrus grow well under any rainfall regime where adequate soil moisture can be maintained.

Pakistan is one of the ten citrus producing countries of the world and sixth largest producer of Kinnow mandarins and oranges in the world. Citrus is mostly grown in plain areas of Sargodha, Bhalwal, Sahiwal, Faisalabad, Kasur, Rawalpindi and Islamabad (Anonymous, 2004). In Pakistan, citrus is the largest group of fruits produced over an area of 195 thousand hectares with an annual production of 1670 thousand tonnes out of which 206 thousand tonnes were exported earning 4202 million rupees of foreign exchange (Anonymous, 2005).

The Province of Punjab is leading in fruit production as it contributes 65% of the total fruit production in the country, and 85% of the citrus with a major part of Kinnow (mandarin), 10% of musambi, 4% of Feutrell's Early and 1% of Red Blood. The rootstock of rough lemon (*Citrus jambhiri*) is extensively used in Punjab. A total of 4800 hectares of citrus acreage in Mardan, Swat, Peshawar, Swabi, Nowshera and Hazara, NWFP gives production of 40200 tonnes of citrus annually. In Sindh, 3900 hectare of land is under citrus cultivation, mainly in Sukkar, Naushero Feroz, Nawab Shah and Khair Pur districts where 30.9 thousand tonnes of citrus is produced while very little citrus is produced in Baluchistan. A total of 13.6 thousand tonnes of citrus are produced from 2400 ha in Makran, Sibi and Kech. Pakistan produces 1.9 million tonnes of citrus from 198700 ha of land and its production lasts from December to March with highest in mid January. The total production of citrus in Pakistan is 1612 thousand tonnes (Anonymous, 2004) which is less as compared to last four years 2000-2004 i.e. 1943, 1865, 1830, 1702 thousand tonnes respectively. Area under citrus is increasing substantially every year but production per unit area is increasing at a every low pace. The production of citrus was consistent from 1994 to 1998. The fruit yield during 1994-95 was 10,135.0 kg ha⁻¹ and after five years (1999-2000) it fell down to 9,829.0 kg/ha. In Pakistan, average productivity is 9.5 tonnes ha⁻¹. However, the average yield of citrus fruit in Pakistan is very low (9.425 tonnes/ha) as compared to 30-40 tonnes/ha in USA and Brazil and Australia (Anonymous, 1988).

Citrus is attacked by a number of insect pests and diseases causing heavy losses both in quality and quantity. Among the nematodes citrus nematode, *Tylenchus semipenetrans* Cobb., has been recognized as one of the greatest threats throughout the world. It occurs in all citrus producing regions of the world and limits production of citrus fruits under a wide range of environmental and adaphic conditions.

As citrus orchard are declining in citrus growing areas of the Punjab, therefore, present survey of different citrus orchards was conducted to determine the nematode population associated with citrus plantation from various localities of Sargodha district. Screening of different citrus rootstocks for relative resistance and susceptibility against *T. semipenetrans* was also conducted at Orange Research Institute, Sargodha.

MATERIALS AND METHOD

Soil and root samples from symptomatic plants from different localities of district Sargodha were collected up to 30 cm depth. Samples were taken at a distance of 60 to 90 cm away from the tree trunk. Upper 15 cm soil was removed and then samples were collected by digging the soil. The soil along with feeder roots was collected in polyethylene bags and brought to Nematology Laboratory, University of Agriculture, Faisalabad for isolation and identification. Juveniles were extracted from the soil by modified Whitehead and Hemming tray method (Whitehead and Hemming 1965). The number of nematodes recovered from the soil of each sample was counted by using a counting dish. Feeder roots were washed under tap water carefully to remove soil particles and blotted dry. One gram of fresh feeder roots was placed in a blender and 20 ml of 10% sodium hypochlorite solution was added. Volume was increased up to 200 ml by adding water and blended for 45 seconds. The suspension was poured over 100 and 325 mesh sieves and females were collected in a beaker and their numbers were counted.

RESULTS AND DISCUSSION

It is obvious from Table 1, that maximum numbers of nematodes were recovered from soil during the month of March. The population declined in June and again increased during the month of October. Similar was the case with females per gram of root. Maximum infection of *T. semipenetrans* was recorded in areas of Chak No. 30/NB, Chak No. 9 Lokri and Chak No. 12/NB. On the other hand maximum numbers of females were recorded from Chak No. 12/NB followed by Chak No. 30/NB and Chak No. 9 Lokri. Minimum nematode population was recorded from

Chak No. 8/NB and Chak No. 11/NB. Minimum numbers of females were recorded from samples taken from Chak No. 11/NB, Chak No. 10/NB and Chak No. 8/NB.

The nematodes ranged from 5325-12400, 2523-7234 and 3230-13209 juveniles per 500 g of soil in March, June and October respectively. Similarly, females per gram of root ranged from 613-1421 in March, 93-625 in June and 122-1593 in October. Nematode and female populations also varied on different citrus rootstocks. Sweet orange, Feutrell's Early and lime harboured less number of nematodes and females as compared to rough lemon and sour orange showing relative resistant to *T. semipenetrans* as compared to the latter (Table 2).

The present survey confirms the occurrence of citrus nematode in district Sargodha. Since its first report in roots of citrus trees in California in 1912 and its description (Cobb, 1913), its occurrence has been reported from all over the major citrus growing regions of the world. By 1914, it had been reported parasitizing citrus roots in Florida, Malta, Spain, Australia and South America (Cobb, 1914).

According to Thorne (1961) 90-95% citrus orchards in South California were infested by this nematode. Survey of citrus nurseries in India revealed 75% infestation with citrus nematode (Mani et al., 1988). In China (Sichuan) 94.7% of orchards were found infested (Zu et al., 1992). Likewise the nematode was found infesting citrus orchards in NWFP (Khan et al., 1990). Similar statistics have been given by other researchers from different countries (Noling and Duncan 1988, Robinson et al., 1987). In the present survey, nematode population and number of females per gram root varied in different localities. This is because many factors affect citrus nematode population and infestation. These include host variety, age, soil texture, moisture, pH, nutrient status, temperature, soil depth etc. Reproductive rates of different races of nematode obviously vary with rootstock (O'Bannon and Hutchinson, 1974). Tree age has a marked effect on population size and distribution of the nematode (Bellow et al., 1986).

The nematode is sensitive to extreme moisture deficits but population development occurs across the normal range of agricultural soils (Van Gundy and Martin 1961, Van Gundy et al., 1964). Similarly population will increase between temperatures of 20-31°C with maximum development at 25°C and very slow development at extremes (O' Bannon et al., 1966). Davis (1984) reported that nematode population peaked in April and declined to lowest levels in August and September. Highest number of nematodes was obtained at 120 cm distance from tree trunk up to 30 cm depth (Chawala and Sharma, 1984). *T. semipenetrans* can be found in any soil texture, but greatest damage occurs in shallow, poorly drained soils with organic matter contents from 2-3% (O'Bannon and Essar, 1985). The present study confirms the presence of citrus nematode in district Sargodha and suggests further intensive survey and measures to control the nematode.

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Table 1: Citrus sites sampled, sampling time and citrus nematode, *Tylenchulus semipenetrans* J2s in soil and adult female population on roots

Sites sampled	Number of J2S 500g ⁻¹ of soil and females/g of root					
	March, 2006		June, 2006		October, 2006	
	J2S	Females	J2S	Females	J2S	Females
Chak No. 26 Bhalwal	6832	872	4322	613	7421	522
Chak No. 30 Ajnala	12400	1320	7234	519	9650	834
Chak No. 10 Bhalwal	8300	718	5220	392	9635	618
Chak No. 8 Lilani, Kot Momin	5325	735	2714	93	3230	122
Chak No. 9 Lokri, Kot Momin	11209	1215	7219	484	12629	993
Chak No. 11 Lilani, Kot Momin	5897	613	2523	124	4127	331
Chak No. 12 Muazamabad, Kot Momin	11375	1421	6984	625	13209	1593
Chak No. 15, Muzamabad	7832	809	2883	112	6723	789

Table 2: Nematode and female populations on five comparative resistant and susceptible citrus rootstocks at Orange Research Institute, Sargodha

Rootstock tested	Number of J2s per 500 g of soil	Number of females per g of root
Sweet Orange, Mosumbi (<i>Citrus sinensis</i>)	4392	236
Fuere Early (<i>C. reticulata</i>)	3990	205
Lime (<i>C. aurantifolia</i>)	4229	203
Rough lemon (<i>C. jambhiri</i>)	8721	635
Sour orange (<i>C. aurantium</i>)	6515	311