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REACTION OF VARIOUS CITRUS ROOT STOCKS (GERMPLASM) AGAINST CITRUS ROOT NEMATODE (*TYLENCHULUS SEMIPENETRANS* COBB.)

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Abstract

Thirteen root stocks of citrus were evaluated to identify genetic sources of resistance against citrus nematode (*Tylenchulus semipenetrans* Cobb.). Out of 13 root stocks 3 root stocks were resistant, 2 moderately resistant, 3 moderately susceptible and 5 were susceptible. Carrizo citrang, Citromela and Grape fruit were resistant. Sachton citrumelo and Savageage citrange were moderately resistant and Gadi Dahi, Yuma citrange and Kharana khata were moderately susceptible, whereas, root stocks of Bitter sweet orange, Brazilian sour orange, Sour orange, Chakotra, Rough lemon were found to be susceptible. The resistant genotypes could be used in future breeding programs for the development of nematode resistant rootstocks.

Introduction

Citrus is the world recognized agricultural commercial fruit crop and occupies a prominent position in the fruit industry. It is grown in more than 125 countries falling in a belt within 35^{o} latitude north or south of the equator (Duncan & Cohn, 1990). Pakistan is among the leading citrus growing countries of the world and this fruit is a source of foreign exchange earning. Citrus is grown all over Pakistan. However, Punjab alone contributes 95% of the national citrus production. In Pakistan, citrus is the largest group of fruits produced over an area of 192.3 thousand hectares with an annual production of 2458.4 thousand tones during 2005-06 (Anon., 2006) Area under citrus is increasing substantially every year in the country but production per unit area is increasing at a very low pace. However, the average yield of citrus fruits in Pakistan is very low (9.425 tones/ha) as compared to USA (30.40 tones/ha). Any effort to increase citrus production involves steps to protect the plants against pests and diseases. Among different microorganisms (fungi, bacteria and viruses etc.), nematodes are the important agents affecting the quality and quantity of citrus. The citrus root nematode (*Tylenchulus semipenetrans* Cobb.) the cause of slow decline of citrus orchards, has become one of the serious constraints for citrus production. Citrus nematode is an obligate parasite of citrus roots and mainly disseminated from the nursery stocks to the citrus groves. This nematode causes immense damage to citrus trees. According to various surveys carried out in USA, this nematode infests 50-60 % plants in California and Florida and as many as 90 % plants in the orchards of Texas and Arizona. Similar statistics are reported world wide (Ahmed & Khan, 1973; Van Gundy & Meager, 1977; Heald & O'Bannon, 1987). This paper reports the reaction of various citrus root stocks against citrus root nematode (*T. semipenetrans*).

Materials and Methods

Seeds of 13 root stocks were obtained from Institute of Horticulture, University of Agriculture, Faisalabad. The seeds were sown in 500 ml pots; containing formalin sterilized sandy loam soil. There were three replications for each rootstock. After germination they were thinned to one plant/ pot. At the age of 4 months these plants were inoculated with freshly hatched 2nd stage juveniles of *T. semipenetrans* @ 2000 juveniles per pot. The plants were irrigated daily with tap water and the greenhouse temperature ranged from 23-35^{o}C. The pots containing highly susceptible rootstock of rough lemon (*C. jambhiri*) served as control. After two months of inoculation the plants were uprooted and soil and root samples were processed by Whitehead & Heamimg tray method for nematode isolation. The population of the isolated nematodes was counted under stereoscope. The roots of each rootstock were washed in tap water and stained in acid fuchsion lactophenol (Byrd *et al*., 1983). For destaining, roots were washed in glycerol and distilled water (50:50) to remove excess stain and then the data was recorded on number of females/gm of roots. The level of resistance or susceptibility of each root stock was determined by using the following self designed rating scale (Table 1).

Table 1. Rating scale for resistance or susceptible response.

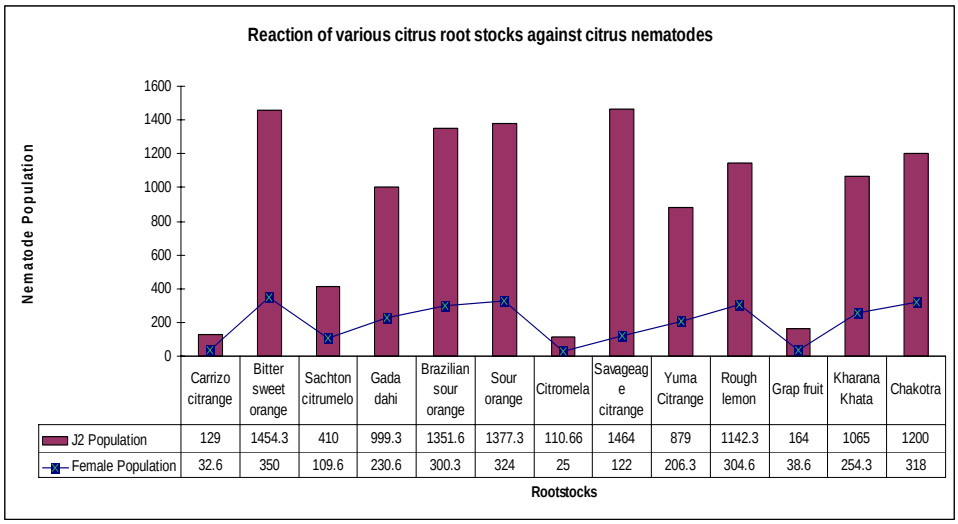
Grade in rating scale	Response	$J_2/100cm^3$ soil	Females/gm roots
1	R	Below 250	Below 100
3	MR	250-500	100-200
5	MS	500-1000	200-300
7	S	1000-1600	300-500
9	HS	Above 1600	Above 500

Results and Discussion

The screening of 13 citrus rootstocks against citrus root nematode revealed that 3 root stocks i.e., Carrizo citrange (*P. trifoliate X C. Sinensis*), Citromela (*P. trifoliat*e x *C. parasidi*) and Grape fruit(*C. paradisi*) having mean nematode population of 129, 110.66 and 164 $J_2/100cm^3$ soil and 32.6, 25 and 38.6 females/gm roots respectively, were resistant. The root stocks of Sachton citrumelo (*P. trifoliate* X *C. paradisi*) and Savageage citrange (*P. trifoliate* X *C. sinensis*) having mean nematode population of 410 and 464 $J_2/100cm^3$ soil and 109.6 and 122 females/gm roots respectively, were moderately resistant as they were harbouring less than 200 females /gm of roots and less than 500 juveniles / 100 cm^3 of soil. Gada dahi (*C. aurantium*), Yuma Citrange (*P. trifoliate* x *C.sinensis*) and Kharana Khata (*C. karma*) having a mean population of 999.3,879 and 965 $J_2/100cm^3$ soil and 230.6, 206.3 and 254.3 females respectively were moderately susceptible The root stocks of Bitter sweet orange (*C. sinensis*), Brazilian sour orange (*C. aurantium*), Sour orange (*C. aurantium*), Chakotra (*C. grandis*) and Rough lemon (*C. jambhiri*) having mean population of 1454.3, 1351.6, 1377.3, 1200 and 1142.3 $J_2/100cm^3$ soil and 350,300.3, 324,318 and 304.6 females/gm roots respectively were found to be susceptible to citrus root nematodes (Table 2 and Fig. 1). Sour orange and Troyer citrange of the genus citrus were found to be susceptible to *T. semipenetrans* (Magunacelaya *et al*., 2004). The commercial rootstocks of Rough lemon, Rangpur lime, Cleopatra mandarin and Orlando tangelo and Poncirus trifoliate have potential to overcome the citrus nematode problem (Prasad *et al*., 1998).

Table 2. Reaction of various citrus root stocks against citrus root nematode (*T. semipenetrans*).

Citrtus root stocks	Mean nematode population		Status of cultivars
	J_2/100cm^3 soil	females/gm roots	
Carrizo citrange (*P. trifoliate X C. sinensis*)	129	32.6	Resistant
Bitter sweet orange (*C. sinensis*)	1454.3	350	Susceptible
Sachton citrumelo (*P. trifoliate* X *C. paradisi*)	410	109.6	Moderate Resistant
Gada dahi (*C. aurantium*)	999.3	230.6	Moderate Susceptible
Brazilian sour orange (*C. aurantium*)	1351.6	300.3	Susceptible
Sour orange (*C. aurantium*)	1377.3	324	Susceptible
Citromela (*P. trifoliata* x *C. parasidi*)	110.66	25	Resistant
Savage citrange (*P. trifoliata* X *C. sinensis*))	464	122	Moderate Resistant
Yuma Citrange (*P. trifoliata* x *C.sinensis*	879	206.3	Moderate Susceptible
Rough lemon (*C. jimbhiri*)	1142.3	304.6	Susceptible
Grap fruit (*C. paradisi*)	164	38.6	Resistant
Kharana Khata (*C. karma*)	965	254.3	Moderate Susceptible
Chakotra (*C. grandis*)	1200	318	Susceptible



Mostly rough lemon is used as root stock in Pakistan, which is most susceptible to this nematode. From pathological point of view the susceptible root stocks should be discouraged and it should be replaced with resistant root stocks but it needs consideration from agronomist, horticulturists and farmers for their adaptability to environment and scions. Ideally root stocks (germplasm) would combine several traits that limit nematodes reproduction. Planting citrus tree with multiple defense systems to help combat citrus nematodes should reduce the development of nematodes (Kaplan & O'Bannon, 1981).

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References

Ahmad, R. and I.U. Khan. 1973. A survey of the occurrence of citrus nematode (*Tylenchulus semipenetrans*) in the Punjab, *Pak. J. Agric. Sci*., 10: 161-166.

Anonymous. 2006. *Agricultural Statistics of Pakistan*. *Ministry of Food, Agriculture and Livestock* (Economic Wing), Islamabad.

Byrd, Jr D.W., T. Kirkpatrick and K.R. Barker. 1983. An improved technique for clearing and staining plant tissues for detection of nematodes. *J. Nematol*., 15: 142-143.

Duncan, L.W. and E. Cohn. 1990. Nematode parasites of citrus, In: *Plant Parasitic Nematodes in Sub-tropical and Tropical Agriculture*, (Eds.): R. Luc, R.A. Sikora, and J. Bridge CAB International, 321-346.

Heald, C.M. and J.H. O'Bannon. 1987. Citrus decline caused by nematodes. Slow decline. Florida Depart., *Agric. Consumer Service. Div. Plant Industry, Nematol. Circular*, 143: 4.

Kaplan, D.T. and J.H. O'Bannon. 1981. Evaluation and nature of citrus nematode resistance in Swingle citrumelo. *Proceeding of the Florida State Horticultural Society*, 94: 158-162.

Magunacelaya, J.C., C. Villegas F. Lamberti and M.T. Ahumada. 2004. Studies on a population of *Tylenchulus semipenetrans* Cobb., from Chile. *Nematologia Mediterranea*, 32: 233-234.

Prasad, M.B.N.V, P.P. Reddy, M.S. Rao Rekha, A. Reddy, P.P. Kumar, N.K.K, Verghese. 1997. Evaluation of some inter-generic citrus rootstock hybrids for their resistance to the citrus nematode, *Tylenchulus semipenetrans* Cobb. Advances in IPM for horticultural crops. *Proceedings of the First National Symposium on Pest Management in Horticultural Crops:* environmental implications and thrusts, Bangalore, India, 15-17

Van Gundy, S.D. and J.W. Meagher. 1977. Citrus nematode *(Tylenchulus semipenetrans* Cobb.) problems worldwide. *International Citrus Congress*, Orlando, Florida: 7.

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