

SCREENING OF CITRUS CULTIVARS FOR SOURCE OF RESISTANCE AGAINST CITRUS CANKER UNDER FIELD CONDITIONS

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Abstract

Twenty six citrus cultivars were screened for resistance against citrus canker under artificial disease conditions in the field of Orange Research Institute, Sargodha during 2006. A considerable variation was observed among the cultivars with respect to their disease reaction. Disease rating scale ranged from 0-4 to know the level of resistant and susceptibility of citrus cultivars. Two cultivars Meiwa and Naghmi had no lesions on leaves and categorized as immune while Kozan and Tahiti lime had minute infection were highly resistant. Four cultivars viz; Valencia late, Olinda Valencia, Musambi and Honey were rated as moderately susceptible whereas Pummelo white, Shamber grapefruit and Rough lemon were found susceptible. Other fifteen varieties behaved as resistant.

Introduction

Citrus occupies a prominent position in fruit industry of the world. Pakistan is among the leading citrus growing countries of the world and earns substantial amount of foreign exchange annually. In Pakistan, citrus is the largest group of fruits produced over an area of 183.8 thousand hectares with a total production of 1943.7 thousand tons annually (Anon., 2004-05). The national average yield is 10.6 tons / hectare which is very low as compared to other citrus growing countries.

Diseases are one of the major factors which impede the fruit yield and quality. Among diseases, citrus canker caused by the bacterium *Xanthomonas campestris*. *pv. citri*, one of the most devastating and occurs throughout citrus growing countries of the world (Kaizomi, 1985) including Pakistan. The bacteria form lesions on all parts of plant (Hussain *et al.*, 1988). The disease causes extensive damage to citrus and severity of this infection varies with different species and varieties (Fallico-De-Alcaraz, 1986). Burhan *et al.*, (2007) also investigated great variation in disease severity among 15 orange cultivars and observed that Jaffa, Navelate and Salustiana were less infected while Marrs early, Olinda Valencia, Pine apple were more prone to disease under field conditions. Gott Wald *et al.*, (1988) suggested that disease increases more rapidly in Marsh grape fruit than in Valencia late orange. Rough lemon and Kaghzi lime are considered to be the most affected varieties (Arif *et al.*, 1964). Graham (2001) described Mandarins "Kinnow. Murcott and Feuterell's Early" as resistant to citrus canker. Similarly Viloria *et al.*, (2004) examined that limquats were resistant to citrus canker. Gott Wald *et al.*, (1993) classified Kumquats as highly resistant to canker. Many workers have studied resistance under field conditions and mentioned different cultivars of sweet orange, grapefruit and other citrus species infected with canker (Jain, 1959; Prasad *et al.*, 1997; Wang & Chung, 1991).

The most satisfactory and economical method to control disease is the use of resistant varieties. Keeping this in view, present study was specially designed for screening resistant and susceptible citrus material against citrus canker under field conditions through artificial inoculation as very little work had been done previously in Pakistan. The findings of these studies may be helpful for breeders and citrus growers to select promising cultivars resistant against the disease for boosting of citrus yield.

Materials and Methods

Twenty six citrus cultivars were screened in field area of Orange research Institute, Sargodha for determining the level of resistance/susceptibility against citrus canker (*X. campestris* pv. *citri*) during 2006. Each cultivar grafted on Rough lemon was replicated thrice. Young citrus plants showing infection on leaves were collected from the experimental area of Orange Research Institute, Sargodha and processed for isolation of causal bacterium in the laboratory of Department of Plant Pathology, University of Agriculture Faisalabad. A special medium known as Nutrient Agar (Khan & Chohan 2000) was used for isolation of bacterium. The isolated organism was purified and multiplied which was later on identified as *Xanthomonas campestris* pv. *citri* on the basis of morphology and biochemical characteristics (Breed et al., 1957). Citrus plants were inoculated by spraying aqueous spore suspension having approximate concentration of 5×10^4 spores/ml. Inoculation was made by Pink Prick method. Disease severity percent data were recorded 21 days after inoculation. Diseased leave %age and lesions/leaf was calculated for each cultivar by using following formula:

$$\text{Diseased leaves (\%)} = \frac{\text{Diseased leaves}}{\text{Total leaves}} \times 100$$

$$\text{No. of lesions per leaf} = \frac{\text{Total lesions on leaves}}{\text{Infected leaves}}$$

The level of resistance and susceptibility was determined by using the rating scale given by Horsfall & Heuberger (1942).

Rating scale	Disease intensity (%)	Reaction
0.	Free from infection or / nearly so (4%)	Immune/highly resistant
1.	Trace 25% leaf area killed	Resistant
2.	Trace 26-50% leaf area killed	Moderately susceptible
3.	Trace 51-75 % leaf area killed	Susceptible
4.	Trace 76-100% leaf area killed	Highly susceptible

Results and Discussion

Inoculation with *X. campestris* pv. *citri* produced well developed canker lesions within 21 days. The results presented in Table 1 depicts that there were considerable differences among the citrus cultivars for the level of resistance and susceptibility against the disease. Two cultivars, Meiwa and Naghmi remained free from disease whereas Kozan and Tahiti lime were found highly resistant. Our results are in conformity with Gott Wald et al., 1993; Ready et al., (1997) and Viloria et al., (2004).

Table 1. Reaction of various citrus cultivars against citrus canker under artificial disease conditions during 2006 at Orange Research Institute, Sargodha.

Sr. No.	Name of cultivars	Severity rating of citrus canker	Level of Resistance and Susceptibility	Lesions/l leaf
Common sweet oranges				
1.	Jaffa	1	R	1.1
2.	Pineapple	1	R	1.32
3.	Kozan	O	HR	0.5
4.	Salustiana	1	R	1.14
Sugar or acidless oranges				
5.	Musambi	2	MS	1.17
6.	Succari	1	R	1.25
Pigmented oranges				
7.	Blood red	1	R	1.18
8.	Tarocco	1	R	1.0
9.	Moro blood	1	R	0.7
Valencia oranges				
10.	Valencia late	2	MS	1.51
11.	Olinda Valencia	2	MS	1.25
Navel oranges				
12.	Washington Navel	1	R	1.10
Mandarin				
13.	Kinnow	1	R	1.15
14.	Murcott	1	R	1.0
15.	Feutrell's Early	1	R	1.0
16.	Honey	2	MS	1.50
17.	Fall glo	1	R	1.0
18.	Nagpuri Santra	1	R	1.12
Kumquats				
19.	Meiwa	0	I	0.0
20.	Naghmi	0	I	0.0
Acid lime				
21.	Tahiti lime	O	HR	0.5
22.	Eustis	1	R	1.0
Pummelo				
23.	Pummelo white	3	S	1.56
Grapefruit				
24.	Shamber	3	S	1.52
Sweet lime				
25.	Local mitha	1	R	1.0
26.	Rough lemon	3	S	1.58

Fifteen out of 26 citrus cultivars i.e., Jaffa, Pineapple, Salustiana, Succari, Blood red, Tarocco, Moro Blood, Washington Navel, Kinnow, Murcott, Feutrell's Early, Fall glo, Nagpuri Sangtara, Eustis and Local Mitha were found as resistant (Table 1). The genetic bases of disease resistance against canker cultivars in citrus could be the best possible solution of this problem and can be used in successful citrus breeding program. Some cultivars resistant to the disease had already been reported by Leite *et al.*, (1994) and Graham (2001).

Four cultivars Valencia late, Olinda Valencia, Musambi and Honey appeared as moderately susceptible while Pummelo white, Shamber grapefruit and Rough lemon were susceptible. Our findings on the presence of moderately susceptible and susceptible varieties against pathogen are in accordance with earlier reports that some varieties of sweet oranges, grapefruit and lemon were susceptible (Arif *et al.*, 1964; Civerolo, 1984; Wang and Chung, 1991). It was also observed that Shamber grapefruit was more susceptible than Valencia oranges. Similar findings were reported by Gott Wald *et al.*, (1988).

Number of lesions per leaf were different among cultivars. Lesions number on susceptible cultivars Rough lemon, Pummelo white and Shamber grapefruit were consistently higher than on the resistant cultivars. Awan *et al.*, (1995) reported Shamber grapefruit had prominently maximum number of lesion/leaf.

In the present study, minimum ratio was observed as highly resistant which indicated that immunity in citrus is rather scarce to canker. On the basis of these findings, it can be proposed that the two varieties identified as highly resistant can be exploited in breeding programme for the achievement of highly resistant citrus cultivars.

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