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Survey of sweet orange cultivars for stubborn disease resistance in Iran

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Abstract

Stubborn, caused by *Spiroplasma citri*, is one of the most economically important diseases of citrus particularly of sweet orange in Iran. The main vector of *S. citri* in Iran is the leafhopper *Circulifer* (*Neoaliturus*) *haematoceps*. For survey of sweet orange cultivars for citrus stubborn disease resistance, an experiment was conducted as factorial using randomized complete block design with three replications. The experiment was carried out with combination of seven sweet orange cultivars including: local varieties of Fars, Ramsar Number 4, Hamlin, Washington Navel, Tompson Navel, Frost Navel and Frost Valencia and eight different rootstocks of Key lime, sour orange, Bakraee, Rough lemon, Troyer citrange, Cleopatra mandarin, citrumelo and Rangpur lime. On the basis of statistical analysis, the most tolerant cultivars were Washington Navel and Frost Valencia orange. The most sensitive cultivar was Ramsar Number 4. On the basis of mean comparison scion and rootstock combination, the most tolerant among combinations were Washington Navel orange on Cleopatra and Frost Valencia orange on Cleopatra. The most sensitive of combinations were Ramsar Number 4 on Troyer citrange, Ramsar Number 4 on Bakraee, Hamlin on Bakraee, Ramsar Number 4 on sour orange and local orange on Troyer citrange.

Key words: stubborn, citrus, sweet orange cultivars, ELISA, spiroplasma.

Introduction

Stubborn is an important disease of citrus in certain warm and arid citrus-growing areas. It occurs in a number of countries around the Mediterranean basin and the Middle East, as well as in parts of the US and northern Africa. Citrus is the main economic host of *Spiroplasma citri*. Stubborn is of major concern to citrus growers because the disease is transmitted by insect vectors. Even though accurate data are missing, citrus trees with severe stubborn symptoms appear most frequently in countries of the Mediterranean area and the Near East where summer temperatures are high. This is certainly so in the Islamic Republic of Iran, Iraq, Morocco and Syria, where the diagnosis of this disease has been based not only on symptomatology, but also on the detection of *S. citri* by culture and ELISA (Bové et *al.*, 1984). The main vector of *S. citri* in Iran is the leafhopper *Neoaliturus haematoceps* (Mulsant and Rey) (Salehi *et al*., 1993). The spread of the disease is most rapid and noticeable in young trees. No information is available concerning sweet orange cultivars resistant to stubborn disease.

Materials and methods

To survey sweet orange cultivars for citrus stubborn disease resistance, the experiment was done as factorial using randomized complete block design with three replications. The experiment was done with combination of seven sweet orange cultivars and eight different rootstocks . Each treatment had 4 trees , totally on 672 trees. Rootstocks included: Key lime, sour orange (*C. aurantium* L.), Bakraee (*C. reticulata* hybrid), Rough lemon (*C. jambhiri* Lush.), Troyer citrange (*Citrus sinensis* L.) Osbeck cv. Washington Navel [X *Poncirus trifoliata* (L.) Raf.] or (X *Citroncirus webberi* cv. Troyer), Cleopatra mandarin (*C. reshni* Hort. Ex Tan.), citrumelo [*Citrus paradisi* Macf. X *Poncirus trifoliata* (L.) Rafin] or (X *Citroncirus* Swingle) and Rangpur lime (*C. limonia* Osb.). For rootstock production, seeds of these rootstock were planted in a separate location. Sweet orange [*Citrus sinensis* (L.) Osb.] cultivars included: local cultivar of Fars, Ramsar Number 4, Hamlin, Washington Navel, Tompson Navel, Frost Navel and Frost Valencia witch were used as scion. The seedlings were prepared in insect proof nursery, then they were transferred to the area where natural spread occurred. They were planted in an orchard with high percentage of uniformly affected trees. After five years all of trees were surveyed for symptoms. Sampling was done from all trees and from symptomatic areas. Sampling was done in the early fall and presence of *S. citri* was verified by indirect ELISA (Saillard and Bové, 1983). Statistical analysis was done by SAS program.

Results

On the basis of statistical analysis, the most tolerant cultivars were Washington Navel and Frost Valencia orange. The most sensitive cultivar was Ramsar Number 4. Mean comparison of sweet orange cultivars with Duncan test showed significant difference at 1% level among Washington Navel, Frost Valencia, Frost Navel, Tompson Navel orange and local cultivars of Fars, Hamlin and Ramsar Number 4 (figure 1). On the basis of mean comparison of scion and rootstock combination,

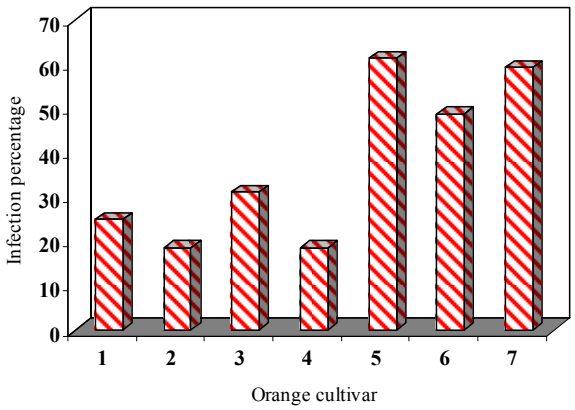

Figure 1. Mean comparison of sweet orange cultivars with Dunkan test at 1% level.
1-F.N, 2-W.N, 3-T.M, 4-F.V, 5-R4, 6-L, 7-H.

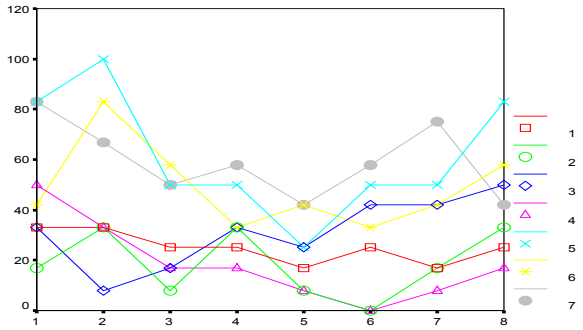

Figure 2. Mean infection percentage of scions - rootstocks.
1-B, 2-T.C, 3-Ro.L, 4-Ra.L, 5-Ci, 6-Cl, 7-K.L, 8-S.O;
1-F.N, 2-W.N, 3-T.M, 4-F.V, 5-R4, 6-L, 7-H.
(In colour at www.bulletinofinsectology.org).

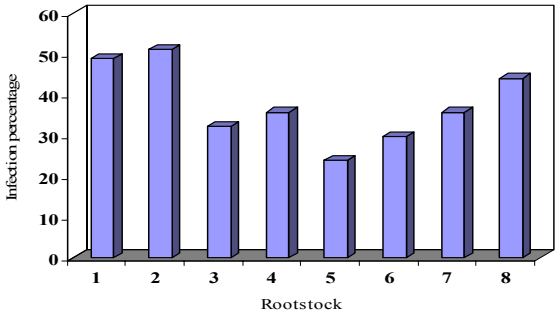

Figure 3. Mean comparison of infection percentage of rootstocks with Dunkan test in 5% level.
1-B, 2-T.C, 3-Ro.L, 4-Ra.L, 5-Ci, 6-Cl, 7-K.L, 8-S.O.

the most tolerant combinations were Washington Navel and Frost Valencia on Cleopatra. The most sensitive combinations were Ramsar Number 4 on Troyer citrange, Ramsar Number 4 on Bakraee, Hamlin on Bakraee, Ramsar Number 4 on sour orange and local orange on Troyer citrange (figure 2). Statistical analysis showed the most tolerant rootstock were citrumelo, after that Cleopatra, Rough lemon, Rangpur lime, Key lime, sour orange, Bakraee and Troyer citrange, in decreasing order (figure 3).

Discussion

The main citrus species and varieties in Iran are seedy local sweet orange trees on sour orange. The fact that local sweet orange varieties as well as a nucellar line are infected with *S. citri* shows that natural transmission of *S. citri* occurs in the country (Bové, 1995). Present research showed that foreign cultivars are more tolerant than local cultivars. May be there is co-evolution between pathogen and local cultivars. Sour orange is one of the suitable rootstocks of citrus. It has compatibility with all of citrus varieties. It is resistant to gummosis disease but susceptible to tristeza virus. Citrumelo is resistant to tristeza, gummosis and exocortis but it is not suitable for limy soil. Cleopatra mandarin is resistant to tristeza and is suitable for heavy and limy soil.

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