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Evaluation of two potential *Cucumis* spp. resources for grafting melons

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Abstract

Cultivation of *Cucumis melo* is hampered by soil stresses. Grafting is used to overcome these limitations. Different cucurbits belonging to several genera have been used as rootstocks for melons: *Cucurbita, Lagenaria, Luffa*, etc. However, negative effects on fruit quality appear in some rootstock-scion combinations. The selection of new resistant rootstocks that do not cause this negative impact in quality is necessary to improve melon cultivation. In this work, we evaluated two rootstocks, closer genetically to melon scions than those usually employed: a) an F1 hybrid between a commercial melon (*C. melo* subspecies *melo* var *inodorus* market class Piel de Sapo) and one exotic accession (*C. melo* subspecies *agrestis* var. *chinensis*) with resistance to *Monosporacus cannonballus*, the causal agent of melon vine decline, and with a certain level of tolerance to *Fusarium oxysporum* f sp. *melonis* race 1.2, that causes *Fusarium* wilt, and b) an accession of *Cucumis metuliferus*, highly resistant to *M. cannonballus*, *F. oxysporum* 1.2 and evaluated and classified as highly resistant to *Meloidogyne* spp. in this work. Grafting compatibility of these two selected genotypes with commercial melons was good. All grafted plants displayed higher vigour and earlier flowering than ungrafted plants. Fruits from plants grafted onto *C. metuliferus* showed similar quality than those from ungrafted/selfgrafted plants. However, fruits from plants grafted onto the F1 (*inodorus* x *chinensis*) had in this experiment lower brix degree than the ungrafted controls. The resistance to soil borne pathogens found in *C. metuliferus* and the good performance regarding plant development and fruit quality of the scions indicate that this species is a promising rootstock for melons.

INTRODUCTION

The use of grafting in melon (*Cucumis melo* L.) is more recent than in other crops such as watermelon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai) or tomato (*Lycopersicon esculentum* Mill.). However, this technique is spreading rapidly due to the withdrawal of methyl bromide and to the global aim of increasing sustainable crop production practices. Cucurbits belonging to different genera like *Cucurbita*, *Luffa* or *Benincasa*. have been successfully used as melon rootstocks to avoid problems caused by different soil stresses that hamper melon production (Louws et al., 2010). Among these, the interspecific hybrids *Cucurbita maxima* Duchesne × *Cucurbita moschata* Duchesne, are the most widely used melon rootstocks. However, melon quality may be negatively affected as a consequence of grafting onto *Cucurbita* spp. From the beginnings of melon grafting, effects such as changes in rind netting and flesh sugar content were reported (Kamiya and Tamura, 1964) in muskmelons grafted on to *Cucurbita* subsp. The use of the interspecific hybrid rootstocks, such as 'Shintosa' reduces sugar content, increase alcoholic fermentation, and leads to a more fibrous flesh (Muramatsu, 1981; Davis et al. 2008). Other variations in fruit quality are related with changes in fruit shape, internal cavity and flesh firmness, aroma and flavor (Lee et al., 1998; Traka- Mavrona et al. 2000; Colla et al. 2006; Davis et al. 2008; Verzera et al. 2014). Apart from the effect on fruit quality, *Cucurbita* hybrids, have only a moderate level of tolerance to root-knot nematodes (RKN), that in some cases is not perceptible as has been reported for cucumber onto RS841 (Giné et al., 2013) and their continuous cultivation may increase nematode population densities at similar levels than do ungrafted plants.

Although melon grafting follows the same principles as grafting other types of vegetables, it has some singularities: scion plants develop hollow hypocotyls soon after seed germination, reducing the tissue contact area in the grafting union. Therefore, it is better to use very young seedlings in which the central cavities are still small (Guan and Zhao, 2014). Other inconvenient is the incompatibility problems that appear frequently in some rootstock-scion combinations (de Miguel et al. 2007).

The assessment of alternative rootstocks is necessary to solve some of these limitations. The aim of this work is the evaluation of two new potential rootstocks for melon, both belonging to the genus *Cucumis*: an F1 hybrid between a commercial melon (*C. melo* subspecies *melo* var *inodorus* market class Piel de Sapo) and one exotic accession (*C. melo* subspecies *agrestis* var. *chinensis* cv. Pat 81) with resistance to *Monosporacus cannonballus*, the causal agent of melon vine decline, and with a certain level of tolerance to *Fusarium oxysporum* f sp. *melonis* race 1.2, that causes *Fusarium* wilt, and b) an accession of *Cucumis metuliferus*, an African species reported to be highly resistant to *M. cannonballus*, *F. oxysporum* 1.2 and root knot nematodes. The use of these putative rootstocks, genetically closer to the melon scions, could increase grafting compatibility and minimize negative impact on fruit quality.

MATERIALS AND METHODS

One *C. metuliferus* accession (BGV11135) selected from the COMAV´s Genebank and one F1 hybrid between a commercial melon (*C. melo* subspecies *melo* var *inodorus* market class Piel de Sapo) and the accession Pat 81 (*C. melo* subspecies *agrestis* var. *chinensis*), with resistance to *Monosporascus cannonballus* (Iglesias et al., 2000) and with a certain level of tolerance to *Fusarium oxysporum* f sp. *melonis* race 1.2 (Gisbert et al., 2014) were used as rootstocks of a melon cantaloupe (*C. melo* subspecies *melo* var *cantalupensis*, market class Charentais). The cleft procedure was used for grafting. Ten grafted plants were obtained per combination. The grafting compatibility of the two putative rootstocks was also checked with a Piel de Sapo scion.

The response to root-knot nematodes (RKN) of the selected *C. metuliferus* accession (BGV11135) was performed in by inoculating 200 juveniles (J2) of *M. incognita* or *M. javanica* in plants growing in pots (200 cm^3) with sterilized sand. Plants were incubated in a growth chamber at 25ºC and 16h light: 8h dark photoperiod until RKN completed one generation (10 replications cultivar/accession-RKN population). After this period, the number of egg masses and eggs per plant was assessed and the infectivity (II) and the reproduction (IR) indexes were calculated as described in Cortada et al. (2008). The response against RKN species was classified according to Hadisoeganda and Sasser (1982). The experiment was repeated once.

The effect of the rootstock on Charentais melon fruit quality was assessed. Plants of the Charentais scion grafted onto both rootstocks as well as control plants (ungrafted and selfgrafted plants) were phenotyped. Ten randomized plants per condition were grown in Valencia (Spain) (39°28′11″ N- 0°22′38″ W) at COMAV-UPV greenhouse facilities. One fruit per plant was characterized for the following fruit quality traits: Fruit weight (g), length and width (cm), fruit shape (calculated as the length/width ratio), rind, flesh and cavity width (mm), rind and flesh firmness (measured using a fruit pressure tester FT327 with a plunger diameter of 8 mm), total soluble solids, ºBrix (measured from drops of juice using a Milwaukee MR32ATC refractometer), and flesh color (L, lightness, and a, b, color-opponent dimensions, green/red and blue/yellow respectively were measured with a Minolta colorimeter). Flesh color, firmness, and total soluble solids were measured at four points in the equatorial region of the mesocarp. All fruits were harvested when the abscission layer was starting to develop (an indicator of full maturity).

RESULTS AND DISCUSSION

Grafting melons onto different resistant cucurbits have been successfully used to avoid problems caused by different soil stresses. However, the selection and breeding of new rootstocks for melon is needed due to negative quality effects found in some rootstock-scion combinations and to the limited nematode resistance of the commonly used rootstocks.

In this work we tested two *Cucumis* genotypes as new putative rootstocks for melon: an accession of *C. metuliferus* and one experimental *C. melo* F1 hybrid. Both genotypes are genetically closer to the melon scions than the commonly used rootstocks and therefore lower incompatibility and quality problems may be expected.

Good grafting afinity was observed (>70-80%) with both *Cucumis* rootstocks, using Charentais and Piel de sapo scions, even despite the thinner stems of *C. metuliferus* that somehow hinders the grafting process.

C. metuliferus is a good source of resistance to root knot nematodes (Fassuliotis, 1970; Walters et al. 2006). In our experiments, low levels of infection and reproduction of *M. incognita* or *M. javanica* were observed in the BGV11135 accession. Infectivity index of RKN species ranged from 2.1 to 3.1. Reproduction index of *M. incognita* ranged from 0.6 to 0.9, and those of *M. javanica* from 1.1 to 5.1. These results suggest that BGV11135 can be successfully used as rootstocks for RKN management in melon crops. The *Cucumis melo* F1 can be also useful to manage limiting soil born fungal diseases as it has been demonstrated to be resistant to *M. cannonballus* and less susceptible to *Fusarium* 1,2 than other melon germplasms (Iglesias et al., 2000; Gisbert et al., 2014)

Growth performance and fruit quality was recorded in Charentais grafted plants in comparison with non-grafted and selfgrafted plants. All grafted plants displayed a higher vigour and earlier flowering than nongrafted controls, but no significant differences were found in Charentais plants grafted onto the different rootstocks.

No alterations of fruit size or shape were observed and both, grafted and non-grafted plants develop round fruits of about 1 kg as it is expected for this Charentais cultivar (Figure 1). Regarding internal fruit quality, both rootstocks behaved similarly with no significant differences with the selfgrafted or ungrafted melons in internal fruit cavity with, flesh firmness, pH and color. Then fully mature fruits of the grafted plants were as firm as those of the non-grafted cantalups, with flesh pH around 6, and showed the medium to dark orange flesh characteristic of this type of melons.

The only quality component that was altered by grafting was flesh sugar content, that was in this assay lower in Charentais melons grafted onto the *C. melo* F1 rootstock, but remained unaltered in plants grafted onto *C. metuliferus*

There are only a few previous reports studying the effect of *C. metuliferus* rootstocks on melon scions. For example, Nisini et al. (2002) reported a ºBrix reduction in melon cv. 'Proteo' (cantaloupe). More recently Guan et al. (2014) reported that grafting onto *C.*

metuliferus decreased the flesh firmness of cv. 'Arava' (a Galia type melon). Differences in *C. metuliferus* accessions and in the scion cultivar might account for these discrepancies, and suggest the need of checking the effect in each rootstock–scion combination

CONCLUSIONS

Grafting RKN-susceptible melons onto *C. metuliferus* BGV11135 rootstock offers promise for growing melons in nematode infested soils. However, more studies are needed with other kind of melons to elucidate putative scion–rootstock interaction effect on fruit yield and quality as described in the literature, in order to confirm the value of this accession

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Literature cited

Colla, G., Rouphael, Y., Cardarelli, M., Massa, D., Salerno, A., and Rea, E. (2006). Yield, fruit quality and mineral composition of grafted melon plants grown under saline conditions. J. Hort. Sci & Biotech. 81:146-152.

Cortada, L., Sorribas, F.J., Ornat, C., Kaloshian, I., and Verdejo-Lucas, S. (2008). Variability in infection and reproduction of *Meloidogyne javanica* on tomato rootstocks with the *Mi* resistance gene. Plant Pathol. 57:1125–35.

Davis, A.R., Perkins-Veazie, P., Hassell, R., King, S.R., and Zhang, X. (2008). Grafting effects on vegetable quality. HortScience 43:1670-1672.

De Miguel, A., de la Torre, F., Baixauli, C., Maroto, J.V., Jordá, M.C., López, M.M., García-and Jiménez, J. (1997). El injerto de Hortalizas. Ministerio de Agricultura Pesca y Alimentación, Madrid, 168p.

Giné, A., González, C., Serrano, L., Ornat, C., and Sorribas, F.J. (2013). Effect of grafted cucumber Dasher II on RS841 rootstock (*Cucumis maxima* x *C. moschata*) on *Meloidogyne incognita* population growth and yield loss. Abstracts to the 1st Annual Conference COST ACTION FA 1204 - ROOTOPOWER Workshop, 12-14 November 2013, Murcia, Spain. p 59.

Guan, W., and Zhao, X. (2014). Techniques for melon grafting. Horticultural Sciences HS1257: Department, UF/IFAS Extension. http://edis.ifas.ufl.edu

Hadisoeganda, W.W., and Sasser, J.N. (1982). Resistance of tomato, bean, southern pea, and garden pea cultivars to root-knot nematodes based on host suitability. Plant Dis. 66:145-150.

Fassuliotis, G. (1970). Resistance of *Cucumis* spp. to the root-knot nematode, *Meloidogyne incognita*. J Nematol. 2:174–178.

Kamiya, F., and Tamura. S. (1964). Studies on grafting in muskmelon [in Japanese]. Bull. Shizuoka Pref. Agri. Exp. Stn. 9:79-83.

Gisbert, C., Sorribas, F.J., Martínez, E., Gammoudi, N., Bernat, G., and Picó, B.; (2014) Grafting melons onto potential cucumis spp. rootstocks. 2nd COST Action FA1204 Annual Conference-Innovation in vegetable grafting for sustainability. Carcavelos, Portugal. p57.

Guan W., Dickson D.W., Mendes M.K, and Thies J. (2014). Root-knot Nematode Resistance, Yield, and Fruit Quality of Specialty Melons Grafted onto *Cucumis metulifer* .HortSci. 49:1046-1051.

Koutsika-Sotiriou, M., and Traka-Mavrona, E. (2002). The cultivation of grafted melons in Greece, current status and prospects. Acta Hort. 579:325–330.

Lee, J.M., Bang, H.J., and Ham, H.S. (1998). Grafting of vegetables. J. Jpn. Soc. Hort. Sci. 67:1098–1114.

Louws, F.J., Kubota, C., and Rivard, C.L. (2010). Grafting fruiting vegetables to manage soilborne pathogens, foliar pathogens, arthropods and weeds. Sci. Hortic. 127:127-146.

Muramatsu, Y. 1981. Problems on vegetable grafting [in Japanese] Shisetu Engei. 10, 11:48–53, 46–52.

Nisini, P.T., Colla, G., Granati, E., Temperini, O., Crino, P., and Saccardo, F. (2002). Rootstock resistance and effect on fruit yield and quality of two muskmelon cultivars. Scientia Hort. 93:281-288.

Traka-Mavrona, M., Koutsika-Sotiriou E., and Pritsa, T. (2000). Response of squash (Cucurbita spp.) as rootstock for melon (*Cucumis melo* L.) Scientia Hort. 83:353–362

Verzera, A., Dima, G., Tripodi, G., Condurso, C., Crinò, P.,and Romano, D. (2014). Aroma and sensory quality of honeydew melon fruits (*Cucumis melo* L. subsp. Melo var. inodorus H. Jacq.) in relation to different rootstocks. Scientia Horticult. 169:118-124.

Walters, S.A., Wehner, T.C., Daykin, M.E., and Baker, K.R. (2006). Penetration rates of root-knot nematodes into *Cucumis sativus* and *C. metuliferus* roots and subsequent histological changes. Nematropica 36:231–242.

Figure 1. Charentais fruit from selfgrafted plants (A) plants grafted onto *C. metuliferus* (B) or F1 *Cucumis* experimental hybrid (C).

Table 1. Quality parameters of fruit of cantaloupe from ungrafted, selfgrafted and grafted plants; plants grafted onto *C. metuliferus* and onto the experimental F1 hybrid between (*C. melo* subspecies *melo* var *inodorus* market class Piel de Sapo x *C. melo* subspecies *agrestis* var. *chinensis* cv Pat 81).

Rootstock	Weight	Fruit width/ length	Seed Cavity width	Rind thickness	Flesh thickness	Rind firmness	Flesh firmness	Flesh Brix degree	Flesh pH	Flesh colour (hunter parameters)		
										F	a	b
None	749 a	0.89 a	56.4 a	5.1 a	26.9 a	8.2 a	2.1 a	10.1 a	5.7 a	55.5	12.1	23.6

(ungrafted)										a	a	a
Cantaloupe (selfgrafted)	822 a	0.93 a	50.7 a	5.5 a	29.2 a	9.7 a	2.1 a	10.5 a	6.0 a	53.6 a	11.91 a	21.6 a
C. metuliferus	1110 a	0.95 a	58.8 a	6.5 a	32.8 a	10.6 a	2.9 a	10.6 a	5.9 a	56.9 a	11.8 a	22.9 a
F1 hybrid	1192a	0.96 a	55.5a	6.6 a	29.2 a	7.1a	2.1 a	8.5 b	6.0 a	53.8 a	10.0a	22.3a