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Fruit quality parameters of 'Pioneer' Japanese plums produced on eight different rootstocks

Antonio Daza *, Pedro A. García-Galavís, María J. Grande, Carmen Santamaría

IFAPA, Centro "Las Torres-Tomejil", Aptdo. Oficial, 41200-Alcalá del Río (Seville), Spain

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ABSTRACT

The influence of Marianna GF 8-1, GF 677, Julior-Ferdor, Nemared, Monegro (G × N 9), Felinem (G × N 22), Adesoto 101 and Cadaman rootstocks on fruit quality of 'Pioneer' Japanese plum was analysed. The study was performed during three consecutive years in the Guadalquivir Valley (Seville, Spain), on a silt loam and calcareous soil. Colour, fruit size, fruit and stone weights, hardness, soluble solid concentration and acidity were measured for fruit quality evaluation. In general, the effect of the different rootstocks on most of the analysed quality parameters was variable because a strong interaction rootstock × year was observed. However, several parameters as fruit shape, soluble solid concentration, acidity and maturity seem to be harder conditioned in some rootstocks, did not show significant differences year-by-year. Fruits produced on scions grafted on Marianna and Nemared showed the highest soluble solid concentration and Cadaman the lowest, the last also originated the hardest fruits and the lowest maturity.

1. Introduction

Most of the marketable varieties in fruit farming are produced grafted on different rootstocks. These rootstocks facilitate their culture on different soils and climatic conditions and provide trees against pests and diseases (Dichio et al., 2004; Cinelli and Loreti, 2004). These adaptive traits often produce increased fruit yields (Webster, 1995, 2001), but it had been assumed that rootstocks had little influence on fruit quality attributes, being considered foremost a scion cultivar-associated trait. However, in the last years different groups have reported the effect of rootstock on fruit quality for several species such as peach (Caruso et al., 1996; Albás et al., 2004; Iglesias et al., 2004), apple (Bielicki et al., 2004; Slowinska et al., 2004), and sweet cherry (Sitarek and Grzyb, 1998). Plum trees are cultivated on a high variety of rootstocks including different clones of plums, peaches and almond × peach hybrids (Casas et al., 1999) and the effect of rootstocks on plum quality has been poorly studied yet (Sitarek et al., 1999; Sosna, 2002). The aim of this work is to analyse the influence of eight different rootstocks on several fruit quality parameters of 'Pioneer' Japanese plum variety.

2. Materials and methods

2.1. Plant material

Rootstocks used in this work and trunk diameters of the variety in autumn 2005 are listed in Table 1. All rootstocks were grafted in 1998 with 'Pioneer' Japanese plum variety (ARC/Culdevco, 1995, South Africa).

2.2. Trial characteristics and agroclimatic conditions

The study was carried out in 2005, 2006 and 2007 at an orchard located in the province of Seville (Southwest of Spain), a traditional fruit tree culture region. The orchard contains three rows, 30 trees per row, of the specified variety grafted on each rootstock. The orchard has a silt loam soil with 6.06% active carbonate, 1.1% organic matter and pH 8.4, and the plantation was managed following the usual local procedures. All the fruit from the orchard was destinated to market and a manual fruit thinning was performed in April to leave 800–900 fruits/tree in all the 3 years. Agroclimatic conditions registered in the area are shown in Table 2.

* Corresponding author. Tel.: +34 955045505; fax: +34 955045625.
E-mail address: antonio.daza@juntadeandalucia.es (A. Daza).

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Table 1
Rootstocks used in this work and trunk diameters of the 'Pioneer' plum tree variety grafted on them

Rootstock	Species	Source	Variety trunk diameter (cm)
Marianna	*P. cerasifera* × *P. munsoniana*	INRA, France	16.74 b
GF 677	*P. persica* × *P. dulcis*	INRA, France	18.38 a
Julior-Ferdor	*P. domestica* × *P. insitia*	INRA, France	16.35 b
Nemared	*P. persica*	California, USA	16.65 b
G × N 9	*P. persica* × *P. amygdalus*	S.I.A., Zaragoza, Spain	18.63 a
G × N 22	*P. persica* × *P. amygdalus*	S.I.A., Zaragoza, Spain	19.06 a
Adesoto	*P. insitia*	Aula DEI (CSIC), Zaragoza, Spain	15.80 b
Cadaman	*P. persica* × *P. davidiana*	GYDFV (Hungary)/INRA	18.14 a

Trunk diameters of 'Pioneer' variety were measured at 20 cm above the graft union in Autumn 2005. Values followed by the same letter in a column were not statistically different ($P < 0.05$).

2.3. Fruit analysis

In general, the analysed fruits were sampled when the first commercial harvest in all the 3 years (8th June in 2005, 3rd June in 2006 and 6th June in 2007); these first harvests represented about 60% of total yields. In 2005 and 2007 and additional fruit sampling was carried out, 7 days later, to determine solid soluble concentration. Fruit from each variety/rootstock combination (ca. 15 kg) was randomly harvested from 9 different trees, three per row, and 18 representative plums were processed for all the analysis. Plums were harvested from different parts of the trees to avoid fruit position effect (Taylor et al., 1993).

Size was determined using a digital slide gauge (Mitutoyo CD-15CR). Following the terminology proposed by Caillavet and Souty (1950), polar (ØP), suture (ØS) and equatorial (ØE) diameters were measured. Fruit sphericity, defined as ØP/ØE, was also determined. Fruit weight, stone weight and fruit weight/stone weight ratio were also evaluated. Fruit colour parameters L^*, a^* and b^* were measured with a Minolta colorimeter CR-300. Soluble solid concentration (°Brix) was determined using an ATAGO PR-101 digital refractometer. For each rootstock/'Pioneer' combination titratable acidity was determined on three juice samples (6 plums each), diluted in distilled water, and microtitrated with NaOH 0.1 N. The ripeness index was calculated as the ratio solid soluble concentration/acidity. Hardness (Shore) was tested by a Durometer.

Table 2
Agroclimatic conditions registered along the study

Parameter	Year		
	(2004)–2005	(2005)–2006	(2006)–2007
Chilling units (hours) (1 November to 15 February)	1026	768	645
Rainy (ml) (September to August)	269.6	534.6	617.2
Mean air temperature in May (°C)	27.6	22.4	18.7
Mean air humidity in May (%)	51.8	54.8	61.9

Table 3
Influence on fruit size and shape of 'Pioneer' Japanese plum variety of eight different rootstocks

Rootstock	Ø Equatorial (cm)				Ø Polar (cm)				Ø Suture (cm)				Sphericity			
	2005	2006	2007	Mean	2005	2006	2007	Mean	2005	2006	2007	Mean	2005	2006	2007	Mean
Marianna	47.78 b	51.28 ab	47.83 bc	48.95 cd	44.93 b	49.01 abc	45.00 ab	46.36 cd	46.47 de	49.97 a	47.20 b	47.86 a	0.94 a	0.95 de	0.94 a	0.95 bc
GF 677	52.59 a	47.23 e	48.47 b	49.43 bc	49.81 a	48.16 bcd	45.17 ab	47.69 ab	50.80 a	46.06 de	47.38 b	48.10 a	0.94 a	1.02 a	0.93 a	0.97 a
Julior-Ferdor	49.06 b	51.54 a	44.03 d	48.11 d	45.83 b	50.17 a	41.10 b	45.79 d	47.49 cd	47.98 bc	43.30 d	46.27 b	0.93 a	0.97 cd	0.93 a	0.95 abc
Nemared	51.48 a	48.29 de	47.92 bc	49.27 bc	48.19 a	46.33 d	44.21 bc	46.29 cd	49.04 abc	45.28 e	42.62 d	45.61 b	0.93 a	0.96 de	0.92 a	0.94 c
G × N 9	49.29 b	49.41 bcd	47.76 bc	48.87 cd	45.70 b	48.44 abc	44.26 bc	46.09 d	47.72 bcd	46.86 cde	42.34 d	45.59 b	0.92 a	0.98 cd	0.92 a	0.94 bc
G × N 22	52.38 a	48.73 cde	50.34 a	50.46 a	49.16 a	49.43 abc	46.60 a	48.41 a	48.80 bc	47.05 cde	49.50 a	48.40 a	0.93 a	1.01 ab	0.92 a	0.96 ab
Adesoto	49.07 b	50.60 abc	46.46 c	48.72 cd	45.41 b	50.02 ab	42.96 cd	46.19 cd	44.84 e	47.42 cd	45.22 c	45.79 b	0.92 a	0.99 ab	0.92 a	0.95 abc
Cadaman	51.64 a	51.36 ab	47.40 bc	50.18 ab	49.01 a	47.84 cd	44.82 abc	47.22 bc	49.56 ab	49.60 ab	46.95 bc	48.64 a	0.94 a	0.93 e	0.94 a	0.94 c

Values followed by the same letter in a column were not statistically different ($P < 0.05$).