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ORIGINAL ARTICLE

THE EFFECT OF MANDARIN CULTIVARS AND THEIR HYBRIDS ON THE PHYSICAL CHARACTERISTICS AND FRUIT PRODUCTION

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ABSTRACT: Studies have shown that fruit weight, size and shape are important for fresh consumption group. It seems that cultivar has a profound influence on these factors. The goal of the present study is to investigate on yield and physical characteristics of mandarin cultivars and their hybrids. In the last week of January 2012, fruits were collected from different cultivars and were measured using a digital balance. Data were analyzed using one-way analysis of variance (ANOVA) and Duncan's multiple range tests. The fruit production ranged from 32 to 109 kg/tree. Among cultivars examined, Unshiu, Younesi, Minneola tangelo and Orlando tangelo showed the highest content of fruit production. As a result of our study, we can conclude that the mandarin cultivars can influence the physical characteristics and fruit production.
KEYWORDS: Fruit Production, Mandarin Cultivars, Mandarin Hybrids, Physical Characteristics.

INTRODUCTION

Citrus is one of the most economically important crops in Iran. In the period 2009- 2010, the total Citrus production of Iran was estimated at around 87000 tonnes (FAO, 2012). Mandarin hybrids are so variable as the result of hybridization between many fine-quality mandarins and Citrus species. Many of these varieties or cultivars are now being used successfully for juice production and as fresh fruit (Fotouhi and Fattahi, 2007). Cultivars and hybrids that studied in this research were twenty of the most important mandarin cultivars used in word. Although they are as important cultivars, the yield and traits of these cultivars have been investigated very little previously (Babazadeh, 2013a). The fruit of Citrus are used for flavoring foods, beverages and medicines in the word (Babazadeh, 2013b). Citrus fruits are mainly used as fresh in Iran and a small portion is used for juice production. Fruit weight is considered as an important trait in the fresh consumption group. Fruit shape or size is very important for packaging and transportation. Fruit weight, shape, size and yield are variable and depend upon a number of factors including: rootstock (Rafat, 2009), scion or cultivars (Nematollahi, 2005), fertilizer (Eshkevari, 2005), irrigation (Ebadi, 2011) and etc. In this paper, we compared the mandarin cultivars with the aim of determining whether the Physical characteristics and yield influenced by the cultivars.

MATERIALS AND METHODS

2.1. Scions

In 1989, mandarin scions that grafted on sour orange rootstock, were planted at 8×4 m with three replication at Ramsar research station [Latitude 36° 54' N, longitude 50° 40' E; Caspian Sea climate, average rainfall and temperature were 970 mm and 16.25°C per year respectively; soil was classified as loam-clay, pH ranged from 6.9 to 7]. Twenty mandarin and their hybrids were used as scions in this experiment (Table 1).

2.2. Fruit Production (Yield)

The fruit yield was measured separately for each tree. Fruits for each tree were measured using a digital balance.

2.3. Physical Characteristics of Fruit

Fifty fruits for each tree were randomly sampled and measured. Physical characteristics were fresh fruit weight (g), dried fruit weight (g) fruit length (mm), fruit diameter (mm), and fruit shape index. Fruit weight was measured using a digital balance with a sensitivity of 0.01 g. Dried fruit weight measured with oven drying. Fruit length and diameter were measured using a digital vernier caliper with a sensitivity of 0.01 mm. Fruit shape index was explained as the ratio of fruit diameter to fruit length. Physical characteristics of the samples were determined according to citrus descriptors (IPGRI, 1999) (Table 2).

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Table 1: Common and botanical names for citrus taxa used as scions and rootstock (Fotouhi and Fattahi, 2007)

Common name	botanical name	Parents	category
Clementine (scion)	*Citrus clementina cv. Cadox*	*Unknown*	Mandarin
Satsuma mandarin (scion)	*Citrus unshiu cv. Miyagawa*	*Unknown*	Mandarin
Willow leaf (scion)	*Citrus deliciosa*	*Unknown*	Mandarin
Fortune (scion)	*Citrus reticulata cv. Fortune*	*Clementine mandarin× Dancy tangerine*	Mandarin hybrid
Lee (scion)	*Citrus sp.cv. Lee*	*Clementine mandarin×Orlando tangelo*	Mandarin hybrid
Robinson (scion)	*Citrus reticulata cv. Robinson*	*Clementine mandarin×Orlando tangelo*	Mandarin hybrid
Osceola (scion)	*Citrus reticulata cv. Osceola*	*Clementine mandarin×Orlando tangelo*	Mandarin hybrid
Dancy(scion)	*Citrus reticulata cv. Dancy*	*Unknown*	Tangerine
Cleopatra (scion)	*Citrus reticulata (C.reshni Hort.ex.Tan) cv. Cleopatra*	*Unknown*	Tangerine
Bam (scion)	*Citrus reticulata cv. Bam*	*Unknown*	Tangerine
Younesi (scion)	*Citrus reticulata cv. Younesi*	*Unknown*	Tangerine
Atabaki(scion)	*Citrus reticulata cv. Atabaki*	*Unknown.*	Tangerine
Moallem-kooh (scion)	*Citrus reticulata cv. Moallem-kooh*	*Unknown*	Tangerine
Adib (scion)	*Citrus reticulata cv. Adib*	*Unknown*	Tangerine
Mahalli (scion)	*Citrus reticulata cv. Mahalli*	*Unknown*	Tangerine
Honeybell tangelo (scion)	*Citrus sp. cv. Honeybell*	*(Citrus reticulata cv. Dancy × Citrus paradisi cv. Duncan)*	Tangelo
Orlando tangelo (scion)	*Citrus sp. cv. Orlando*	*(Citrus reticulata cv. Dancy × Citrus paradisi cv. Duncan)*	Tangelo
Murcott(scion)	*Citrus sp. cv. Murcott*	*(C.reticulata× C.sinensis)*	Tangor
Temple(scion)	*Citrus sp. cv. Temple*	*(C.reticulata× C.sinensis)*	Tangor
King (scion)	*Citrus nobilis*	*Unknown*	Mandarin
Sour orange (Rootstock)	*C. aurantium (L.)*	*Mandarin ×Pomelo*	Sour orange

Table 2: Statistical analysis of variation in yield and physical characteristics of mandarin cultivars.

scion	Fruit Production (kg/tree) (2011-2012)	Fruit Production (ton/ha) (2011-2012)	Fresh fruit weight (g)	Dried fruit weight (g)	Fruit Length (mm)	Fruit Diameter (mm)	Fruit shape index (Fd/Fl)
Clementine(scion)	71	22	69.15	11.07	46.3	54.0	1.17
Unshiu(scion)	109	34	50.5	6.48	40.0	50.9	1.27
Willow- leaf (scion)	32	10	63.23	8.86	42.9	51.7	1.21
Fortune(scion)	71	22	80.55	11.29	45.8	55.6	1.21
Lee(scion)	71	22	95.5	14.69	48	60.6	1.26
Robinson(scion)	71	22	98.8	13.34	49.5	62.4	1.26
Osceola(scion)	71	22	53.75	8.17	38.7	49.8	1.29
Dancy(scion)	71	22	88.86	13.14	45.8	59.9	1.31
Cleopatra (scion)	32	10	28.64	5.03	30.6	41.0	1.34
Bam(scion)	71	22	66	8.34	44.6	52.7	1.18
Younesi (scion)	109	34	115.7	17.13	50.7	65.1	1.28
Atabaki(scion)	71	22	95.5	12.62	59.0	57.5	0.97
Moallem-kooh(scion)	71	22	143.44	23.06	51.6	73.6	1.43
Adib(scion)	71	22	109.1	19.42	53.9	62.4	1.16
Mahalli(scion)	96	30	82.5	11.97	49.6	58.6	1.18
Minneola tangelo(scion)	109	34	149.8	23.27	65.9	65.7	1.00
Orlando tangelo(scion)	109	34	96.3	13.95	47.6	61.5	1.29
Murcott (scion)	90	28	67.45	12.31	40.7	53.2	1.31
Temple(scion)	90	28	184.48	28.48	71	75.4	1.06
King(scion)	90	28	104.86	17.40	51.6	61.4	1.19
F-value	F**	F**	F**	F**	F**	F**	F**

Mean is average of physical characteristics in different cultivars used with three replicates. F value is accompanied by its significance, indicated by: NS = not significant, * = significant at P = 0.05, ** = significant at P = 0.01.

2.4. Data Analysis

SPSS 18 was used for analysis of the data obtained from the experiments. Analysis of variations was based on the measurements of 7 characters. Comparisons were made using one-way analysis of variance (ANOVA) and Duncan's multiple range tests. Differences were considered to be significant at $P < 0.01$. Correlation between pairs of physical characters was evaluated using Pearson's correlation coefficient. Also experimental data were analyzed using linear regression.

RESULTS

3.1. Fruit Production (Yield)

Yield ranged from 32 to 109 kg/tree. Among cultivars examined, Unshiu, Younesi, Minneola tangelo and Orlando tangelo showed the highest content of fruit production (Figure 1).

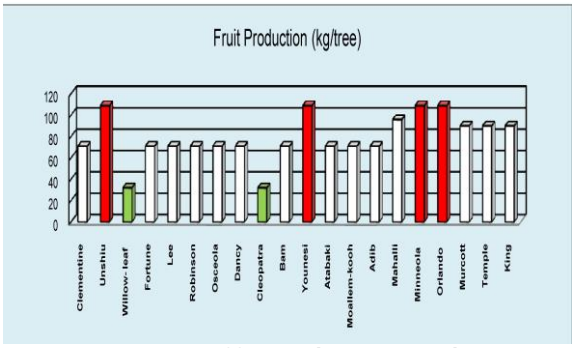

Figure 1: Comparison of fruit production in mandarin cultivars and their hybrids.

3.2. physical Characteristics of Fruit

The physical characteristics of the fruit are given in table 2. Fresh fruit weight ranged from 28.64 g (Cleopatra) to 184.48 g (Temple). Dried fruit weight ranged from 5.03 g (Cleopatra) to 28.48 g (Temple).

Fruit length ranged from 30.6 mm (Cleopatra) to 71 mm (Temple). Fruit diameter ranged from 41 mm (Cleopatra) to 75.4 mm (Temple). Fruit shape index ranged from 0.97 (Atabaki) to 1.43 (Moallem-kooh).
Among the cultivars examined, Temple showed the highest content of fresh weight. The lowest of fresh weight was produced by Cleopatra (Table 2).

3.3. Results of Statistical Analyses
Differences were considered to be significant at $P < 0.01$. These differences on the 1% level occurred in fruit production, fresh weight, dried weight, fruit length, fruit diameter and fruit shape index (Table 2).

3.4. Result of Correlation
Simple intercorrellations between 7 characters are presented in a correlation matrix (Table 3). Not only fresh fruit weight showed a high positive correlation with dried fruit weight but also it showed a high positive correlation with fruit length and diameter. Dried fruit weight also showed a high positive correlation with fruit diameter (Table 3).

Table 3: Correlation matrix (numbers in this table correspond with physical characteristics mentioned in Table 2)

	Fruit Production (kg/tree)	Fruit Producti (ton/ha)	Fresh fruit weight	Dried fruit weight	Fruit length	Fruit diameter
Fruit Producti (ton/ha)	0.99**					
Fresh fruit weight	0.42**	0.42**				
Dried fruit weight	0.39**	0.39**	0.97**			
Fruit length	0.42**	0.43**	0.91**	0.86**		
Fruit diameter	0.44**	0.46**	0.94**	0.92**	0.83**	
Fruit shape index	-0.17	-0.17	-0.36**	-0.30*	-0.68**	-0.17

*=significant at 0.05
**=significant at 0.01

3.5. Result of Regression Analysis
The result of regression showed that fresh fruit weight (Y) was positively related to the dried fruit weight (X4) and fruit length (X5). The fit of the model was checked by the coefficient of determination R^2 and was calculated at around 0.95. It indicated that about 95% of the variability in the response could be explained by this model. It was considered as very high correlation when the R^2-value was higher than 0.90.

$Y = 6.00\ X4 - 8.20; \quad R^2 = 0.95$
$Y = 4.60\ X4 - 1.04\ X5 - 22.96; \quad R^2 = 0.97$

DISCUSSION

Our observation that mandarin cultivars and their hybrids had an effect on the yield and physical characteristics was in accordance with previous findings (Nematollahi, 2005).
Comparison of our data with those in the literatures revealed some inconsistencies with previous studies (Rafat, 2009). It may be related to rootstock, alternate bearing and environmental factors that can influence the content of the fruit production. Fertilizer (Eshkevari, 2005) and irrigation (Ebadi, 2011) affects the content of fruit production and physical characteristics. Fertilization, irrigation and other operations were carried out uniform in this study so we did not believe that this variability was a result of these factors.
High positive correlations between pairs of characters suggest a genetic control (Scora *et al.*, 1976) and such dependence between pairs of characters was due to genetic linkage that was not known. Non-significant negative and positive correlations can imply genetic independence (Scora *et al.*, 1976).
Considering that yield is a polygene trait so it is difficult to directly improve. Traits which have a high correlation with the yield may be helpful in this regard and can indirectly improve the yield. (Ojaghi and Akhundova, 2010).

CONCLUSION

In the present study we found that the yield and physical characteristics were significantly affected by cultivars and there was a great variation in most of the measured characters among cultivars. The present study demonstrated that yield and physical characteristics can vary when different cultivars utilized. Among cultivars examined, Unshiu, Younesi, Minneola tangelo and Orlando tangelo showed the highest content of fruit production. The lowest of yield were produced by Willow-leaf and Cleopatra. Studies like this are very important to determine excellent traits in different cultivars. Further research on the relationship between yield and cultivar is necessary.

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REFERENCES

Babazadeh Darjazi B. Comparison of Vitamin C in Mandarin (*Citrus* Blanco.) cultivars. Eco-phytochem J Medical Plants 2013a; 3: 82-93.

Babazadeh Darjazi B. Comparison of the peel oil composition and juice quality in tangerine)*C.reticulata* Blanco.(cultivars in Mazandaran province. Eco-phytochem J Medical Plants 2013b; 2: 50-63.

Ebadi H. Effect of water different levels of micro irrigation on quality and yeild fruit of Thomson navel orange in the west of Mazandaran. Final Report of Project. Iran Citrus Research Institute, Ramsar 2011; pp: 28.

Eshkevari A. Investigation on the effects of different amounts of macronutrients on quantitative and qualitative characteristic tics of Thomson navel sweet orange. Final Report of Project.Iran Citrus Research Institute, Ramsar 2005; pp:28.

FAO. Statistical Database Available from: http://faostat.fao.org/site/567/default.aspx #ancor. 2012

Fotouhi R, Fattahi J. Citrus growing in Iran. 2nd Edition, Gilan University, Rasht 2007.

IPGRI . Descriptors for Citrus. International Plant Genetic Resources Institute (IPGRI), Rome, Italy 1999; pp:1-66.

Nematollahi C. Evaluation the effect of Citrumelo Swingle rootstock on quantitative and qualitative characteristics mandarins and orange varieties. Final Report of Project. Iran Citrus Research Institute, Ramsar, 2005; pp: 21.

Ojaghi J, Akhundova E. Genetic diversity in doubled haploids wheat based on morphological traits, gliadin protein patterns and RAPD markers. Afr J Agric Res 2010; 5(13): 1701-1712.

Rafat F. Evaluation of the effect of Orlando tangelo, murcott and sure orange rootstocks on quantity and quality of selected tangerine cultivars in north Iran. Final Report of Project.Iran Citrus Research Institute, Ramsar, 2009; pp:35.

Scora RW, Esen A, Kumamoto J. Distribution of essential oils in leaf tissue of an F2 population of Citrus. Euphytica 1976; 25: 201-209.