The Libyan Journal of Agriculture: volume 9, 1980

The Fruit Quality and Potassium Leaf Content of 'Clementine' Mandarin as Affected by Rootstock and Potassium Fertilizer

HUSAIN S. AHMED, MOHAMED Y. EL-SHURAFA
AND MOHAMED S. SHALADAN[1]

ABSTRACT

Seven years old 'Clementine' Mandarin grown on five rootstocks, were put under potassium fertilizer programme since establishment in 1972. Rootstocks used were: Sour Orange, Cleopatra Mandarin, Rough Lemon, Rangpur Lime and Troyer Citrange. Measurement of the physical and chemical quality characters of the 'Clementine Mandarin' showed that fruits grown on Sour Orange rootstock were small in size, but rich in TSS, acidity and ascorbic acid; while fruits grown on Rough Lemon rootstock were large in size but low in TSS, acidity, and ascorbic acid. Other stocks were inconsistent in their effect. Potassium content of leaves was found normal. However, trees grown on Cleopatra Mandarin were significantly lower than those on other rootstocks. Fertilization with potassium was found to be of no significant effect on most fruit quality characteristics. The interaction of rootstocks and potassium was non-significant.

INTRODUCTION

It has been known for many years that rootstocks can influence the size and growth of trees. They can also improve or adversely affect quality of fruits. Potassium has a definite effect on the quality of citrus fruits (6,9,10,11,12). High levels of potassium in orange trees had increased peel thickness of fruits, decreased the juice content and total soluble solids, but was associated with a greater concentration of vitamin C, and acidity (4,10).

The purpose of this work was to study the effect of rootstock and potassium on potassium leaf content and on the quality of 'Clementine Mandarin' fruits. This work was a part of long-term experiment established at the Faculty of Agriculture Experimental Farm to evaluate the performance of different rootstocks. Some work had already been published (5).

MATERIALS AND METHODS

'Clementine Mandarin' *Citrus reticulata* Blanco, budded on five different rootstocks: Sour Orange *Citrus aurantium* L.; Rough Lemon *C. jambhiri* Lush.; Rangpur Lime *C. limonia* Osbeck; Cleopatra Mandarin *C. reshni* Hort. ex. Tan.; and Troyer Citrange *Poncirus trifoliate* (L.) Ref. X C. Sinensis (L.) Osbeck, were used in this study.

[1]*Department of Horticulture, Faculty of Agriculture, University of Al-Fateh, Tripoli, S.P.L.A.J.*

Trees were planted in February 1972, in a deep sandy loam soil, calcareous, with a pH value around 7.8. The orchard was divided into two plots, each consisting of 45 trees laid out in three rows of 15 trees representing the five rootstocks, with three replicate trees per stock in each row. These rows were separated by guard rows and the whole orchard was surrounded with guard belt of trees and windbreaks. Since establishment of the orchard, all trees received equal amounts of ammonium sulphate and superphosphate but variable amounts of potassium sulphate. The total amounts of nitrogen (N) applied annually since planting of the trees were 150, 210, 400, 420, 500 and 500 grams per tree. Half of these amounts of P_2O_5 were added annually. K_2O was applied annually in three levels based on the amount of N; they were 0, $\frac{1}{2}$, and 1 (of the amount of N).

Fruits were harvested when they attained at least a ratio of 8 to 1, TSS to acidity (4). Twenty fruits from each tree were picked at random and used for analysis. Fruit analysis for total soluble solids (TSS), acidity, and ascorbic acid was according to standard methods (1). Other characteristics studied, were fruits weight, volume, length, diameter, length/diameter, rind thickness and juice volume. Leaf samples were collected in October, 1978, from non-fruiting shoots of the spring cycle. Samples collected from the two plots, were pooled together resulting in three replicates per treatment. Potassium was determined by a flame photometry method, as described by Chapman and Pratt (2). The study was carried out over two growing seasons (1977 and 1978). Data from the two plots and the two growing seasons were pooled and statistically analysed.

RESULTS AND DISCUSSION

The effects of rootstocks and potassium fertilizer on the physical and chemical quality characters of 'Clementine Mandarin' are presented in Tables 1 and 2 respectively.

Rootstock: Most physical and chemical characteristics of 'Clementine Mandarin' were significantly influenced by rootstock (Tables 1 and 2). Fruits from trees grown on Sour Orange and Cleopatra Mandarin rootstock were small in fruit length, and low in juice volume (Table 1), but were very rich in TSS, acidity and ascorbic acid (Table 2). The least rind thickness was obtained from trees grown on 'Cleopatra Mandarin'. On the other hand, fruits from trees grown on Rough Lemon rootstock were large in fruit length, rind thickness and high in juice volume, but were significantly low in TSS, acidity and ascorbic acid. Fruit volume, fruit diameter and length/diameter were not significantly affected by rootstocks. The influence of rootstocks on the quality of citrus fruits was also reported on Washington Navel (3,8), Hamlin (3), Valencia, and Ruby-red grapefruit (5). Fruit quality of 'Clementine Mandarin' on Sour Orange was superior, while Rough Lemon was inferior. The other rootstocks did not show any consistent trend, but generally, 'Cleopatra Mandarin' would be the next choice after Sour Orange in respect to fruit quality. This was in agreement with a previous recommendation made by Hodgson (7).

Potassium: Leaves from 'Clementine Mandarin' trees grown on 'Cleopatra Mandarin' rootstock were significantly lower in potassium content than those on the other rootstocks. Potassium content of trees on all rootstocks was within optimum range required for normal growth (4). Potassium fertilizer was of no significant effect on the potassium leaf content of 'Clementine Mandarin' grown on the five rootstocks used in this study. Therefore, these trees were in no need of any potassium fertilizer, since their potassium content was within optimum range without potassium fertilizer (Table 3).

Table 1 Effect of different rootstocks and amounts of potassium sulphate fertilizer on the physical characters of 'Clementine Mandarin' fruits.*

Rootstock	K_2O/N	Fruit weight (gm)	Fruit volume (ml)	Fruit length(L) (cm)	Fruit diameter(D) (cm)	L/D	Rind thickness (mm)	Juice volume (ml)
Cleopatra Mandarin	0	109.7	119.67	5.62	6.13	0.91	3.07	43.45
	½	106.4	115.33	5.33	5.90	0.90	2.74	43.58
	1	96.4	100.67	5.22	5.73	0.90	2.75	42.00
	Avg.	104.2	111.89	5.30	5.90	0.90	2.85	41.01
Sour Orange	0	109.8	118.67	5.58	6.03	0.92	3.28	41.37
	½	91.9	105.00	5.25	5.83	0.90	2.90	43.82
	1	82.4	87.00	5.05	5.73	0.89	2.78	38.92
	Avg.	94.7	103.56	5.29	5.87	0.90	2.98	41.37
Rough Lemon	0	100.1	123.33	5.62	6.03	0.92	3.12	44.17
	½	96.2	114.00	5.43	5.97	0.91	3.03	45.47
	1	101.5	122.33	5.6	6.17	0.92	3.31	46.50
	Avg.	99.3	119.89	5.55	6.06	0.91	3.15	45.38
Troyer Citrange	0	101.1	117.33	5.67	6.13	0.92	2.97	42.47
	½	95.4	111.33	5.27	6.03	0.89	2.95	43.80
	1	104.1	112.33	5.68	6.00	0.91	2.89	44.92
	Avg.	100.2	114.33	5.54	6.06	0.91	2.94	43.73
Rangpur Lime	0	101.4	110.33	5.42	6.03	0.89	2.95	41.93
	½	106.9	116.67	5.43	6.20	0.88	3.03	45.70
	1	93.6	114.00	5.42	6.03	0.91	3.09	45.48
	Avg.	100.6	113.67	5.42	6.09	0.89	3.02	44.37
Overall average for fertilizer	0	104.4	117.87	5.59	6.07	0.91	3.08	42.68
	½	99.4	112.87	5.34	5.99	0.90	2.93	44.47
	1	95.6	107.27	5.39	5.93	0.91	2.96	43.56
LSD 0.05 Rootstock(s)		NS	NS	0.18	NS	NS	0.19	2.41
LSD 0.05 Fertilizer(F)		6.76	8.35	0.14	NS	NS	NS	NS
LSD 0.05 S × F		NS	NS	NS	NS	NS	NS	NS

*Values represent average of the two growing seasons (1977, 1978).

Reports on the effect of potassium fertilizer are in a way confusing. Increasing potassium leaf levels enhanced the development of larger fruits, increased acidity and ascorbic acid, and decreased the TSS (4,6,9). This relationship was evident especially at low levels of K (10). On the other hand, Wilson (12) found that the leaf potassium and fruit quality relationships were not consistent over seven years of study.

In this study potassium was found of no significant effects on most fruit quality characteristics (Tables 1 and 2). This could be explained by the potassium leaf analysis results (Table 3), where no significant differences were found between treatments. The reduction in fruit weight, fruit volume, and fruit length in trees receiving high levels of potassium in Sour Orange and Cleopatra Mandarin (Table 1) could be explained in the light of Smith's review on potassium (10). He pointed out that excessive amounts of potassium in the soil might interfere with the uptake of other elements such as Mg and Zn.

The statistical interaction of rootstocks and potassium was found non-significant. In other words, rootstocks and potassium fertilizer were independent in their effect on the fruit quality of 'Clementine Mandarin' (Tables 1 and 2).

Table 2 Effect of different rootstocks and amounts of potassium sulphate fertilizer on the chemical characteristics of 'Clementine Mandarin' fruits.*

Rootstocks	K_2O/N	TSS %	Acidity %	TSS/Acidity	Ascorbic acid mg/100 ml juice
Cleopatra Mandarin	0	9.78	0.94	10.38	41.82
	½	9.96	0.90	11.06	43.90
	1	10.08	0.94	10.59	43.23
	Avg.	9.94	0.93	10.67	42.98
Sour Orange	0	10.10	0.99	10.25	41.87
	½	9.98	0.99	10.16	43.87
	1	10.17	0.99	10.43	44.00
	Avg.	10.08	0.99	10.28	43.20
Rough Lemon	0	8.78	0.91	9.48	36.08
	½	8.94	0.90	9.93	37.77
	1	8.89	0.91	9.80	37.48
	Avg.	8.87	0.91	9.74	37.11
Troyer Citrange	0	9.20	1.05	9.01	41.78
	½	9.30	0.96	0.96	41.73
	1	9.29	0.95	9.78	39.90
	Avg.	9.26	0.99	9.49	41.10
Rangpur Lime	0	9.16	0.93	10.14	40.38
	½	8.82	0.93	9.54	39.98
	1	9.45	0.90	10.13	38.15
	Avg.	9.14	0.92	9.94	39.51
Overall average for fertilizer		9.40	0.97	9.85	40.39
		9.40	0.94	10.07	41.42
		9.58	0.94	10.15	40.55
LSD 0.05 Rootstock(S)		0.26	0.04	0.44	1.77
LSD 0.05 Fertilizer(F)		NS	NS	NS	NS
LSD 0.05 S × F	NS	NS	NS	NS	NS

*Values represent average of the two growing seasons (1977, 1978).

It was concluded that potassium had no impact on the fruit quality characteristics, and on the potassium leaf content of 'Clementine Mandarin'. Therefore, these trees were in no need of any potassium. This could be generalized for trees grown under similar conditions.

Table 3 Percent potassium leaf content of 'Clementine Mandarin' as affected by potassium sulphate fertilizer and rootstocks.*

	% K (Dry weight bases)					
K_2O/N	Cleopatra Mandarin	Sour Orange	Rough Lemon	Troyer Citrange	Rangpur Lime	Average
0	0.843[b]	1.013[a]	1.030[a]	1.163[a]	1.127[a]	1.031[a]
½	0.797[b]	1.003[a]	1.003[a]	1.067[a]	1.033[a]	0.981[a]
1	0.780[b]	1.057[a]	1.007[a]	1.007[a]	1.133[a]	0.995[a]
Average	0.807[b]	1.024[a]	1.004[a]	1.079[a]	1.098[a]	

*Values followed by same letter are not significantly different at P = 0.5. Rootstocks are compared horizontally; potassium levels are compared vertically.

LITERATURE CITED

1. Anonymous. 1975. Official Methods of Analysis of the Association of Official Analytical Chemists. (AOAC). 12th ed.
2. Chapman, H. D. and P. F. Pratt. 1961. Methods of Analysis for Soils, Plants, and Water. University of California.
3. El-Nokrashy, M. A., El-Nasharty, A. H. and El-Mahmodi, L. T. 1966. Effect of Rootstocks on Orange Fruit Quality. Agric. Res. Rew. Cairo. 1966. 44(3): 19–25 (Hort. Abst. Vol. 38, p. 817).
4. Embleton, T. W., W. W. Jones, C. K. Labanauskas, and W. Reuther. 1973. Leaf Analysis as Diagnostic Tool and Guide to Fertilization. In: W. Reuther (Editor). Citrus Industry. Vol. III. pp. 183–190. University of California.
5. Fahmy, I. and I. A. Hassaballa. 1977. The effect of Different Rootstocks and Potassium Sulfate Fertilizer on Leaf Potassium, Calcium and Sodium in Young 'Clementine' Mandarin Trees. The Libyan J. Agri. Vol. 6: 1–5.
6. Goldweber, S., M. Boss and S. J. Lynch. 1956. Some Effects of Nitrogen, Phosphorus, and Potassium Fertilization on the Growth, Yield and Fruit Quality of Persian Limes. Pro. Fla. State Hort. Soc. 69: 328–332.
7. Hodgson, R. W. 1964. An Analysis of the Libyan Citrus Industry and Recommendation for its Improvement. Ministry of Agriculture, Tripoli, Libya.
8. Nasr, M. M., Z. Ismail and A. T. El-Wakeel. 1966. Effect of three Rootstocks on Fruit Qualities and Juice Composition of Washington Navel Oranges. Agric. Res. Rev. Cairo. 44(3): 44–55. (Hort. Abst. Vol. 38, p. 817).
9. Reitz, H. J. and R. C. J. Koo. 1959. Effect of Nitrogen and Potassium Fertilization on Yield and Fruit Quality of Valencia Orange on Calcareous Soil. Pro. Fla. State Hort. Soc. 72: 12–16.
10. Smith, P. F. 1966. Citrus Nutrition. In: Temperate to Tropical Fruit Nutrition. pp. 208–228. Edited by N. F. Childers. Rutgers, The State University.
11. Smith, P. F. and G. K. Rasmussen. 1960. Relationship of Fruit Size and Quality of March Grapefruit to Potash Fertilization. Proc. Fla. State Hort. Soc. 73: 42–49.
12. Willson, A. E. and W. J. Arey. 1958. Potash Relationship in Commercial Grovers. Proc. Fla. State Hort. Soc. 71: 181–186.

تأثير الأصول والتسميد البوتاسى على نوعية الثمار ومحتوى الأوراق من البوتاسيوم فى صنف اليوسفى كليمانتين

د. حسين سالم أحمد
د. محمد يوسف الشرفا
م. محمد سليمان شلدان

المستخلص

أشجار من اليوسفى كليمانتين ذات عمر سبع سنوات ومطعومة على خمسة أصول حمضيات (النارنج ـ الشفشى ـ ، يوسفى كليوباترا ، ليمون مخرفش ، ليمون رانجبور ، وترويير سترانج) وضعت تحت برنامج تسميد بالبوتاسيوم منذ زراعتها فى عام ١٩٧٢ . وبتقدير الصفات الطبيعية والكيميائية للثمار لوحظ أن الأشجار المطعومة على الشفشى كانت ثمارها صغيرة ولكنها مرتفعة فى محتواها من المواد الذائبة الكلية ، والحموضة ، وحمض الاسكوربيك (فيتامين ج) بينما الأشجار المطعومة على ليمون مخرفش كانت ثمارها كبيرة فى الحجم ولكن منخفضة فى محتواها من المواد الذائبة الكلية ، والحموضة ، وحمض الاسكوربيك .

أما الأصول الأخرى فلم تكن ثابته فى تأثيرها . محتوى الأوراق من البوتاسيوم كان عاديا ولكن الأشجار المطعومة على يوسفى كليوباترا كانت منخفضة مقارنة ببقية الأصول .

وكذلك وجد أن معاملات التسميد البوتاسى لم تؤثر على معظم صفات الجودة فى الثمار ، لذا ينصح بعدم اضافة السماد البوتاسى للأشجار النامية تحت ظروف التجربة والظروف المشابهة .