Scientia Horticulturae 169 (2014) 1–5

Contents lists available at ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Effect of proline and tryptophan amino acids on yield and fruit quality of Manfalouty pomegranate variety

Omima M. El Sayed*, O.H.M. El Gammal, A.S.M. Salama

Desert Research Center, Plant Production Department, Cairo, Egypt

ARTICLE INFO

Article history:
Received 11 October 2013
Received in revised form 14 January 2014
Accepted 17 January 2014
Available online 3 March 2014

Keywords:
Pomegranate
Proline
Tryptophan
Fruit quality
Cracked fruits

ABSTRACT

A two-year trial was conducted during 2011 and 2012 seasons in Manfalouty pomegranate orchard about 12 years old grown in sandy soil under drip irrigation system from well at El Maghara Station (Desert Research Center), North Sinai Governorate, Egypt. Three concentrations (50, 75 and 100 ppm) of proline and tryptophan and tap water control were foliar sprayed twice a year i.e. at full bloom and four weeks later. Briefly, proline and tryptophan treatments enhanced all studied growth, yield and fruit quality traits and minimized cracked fruit percentage. Tryptophan treatment at 100 ppm proved to be most efficient treatment in this respect.

1. Introduction

Pomegranate (*Punica granatum* L.) has high adaptability to versatile conditions especially stress conditions (Haggag and El-Shamy, 1987). These differentiations make it as a favorable fruit for marginal land. It is recommended for resource limited farmers. Pomegranate fruit has medicinal properties especially in traditional systems from time immemorial (Roy and Waskar, 1997).

Fruit disorder is considered the most important factors believed to be responsible for the reduction of pomegranate production. Cracking or splitting is a serious problem in pomegranate orchard as it causes about 50% of fruit marketing value. Fruit cracking has no standard definition. Moreover, there is no single factor that could be pointed out as fruit cracking. Furthermore, changes of peel properties and fruit volume are thought to be involved in fruit cracking (El-Masry, 1995).

Several horticultural practices could be used to enhance tree productivity and diminish fruit disorders (El-Masry, 1995). Chemicals could be used as one of these horticultural practices. Amino acids i.e. proline and tryptophan have been shown to accumulate in plant tissues under various conditions (Yang et al., 1999; Mansour, 2000). The proposed functions of these amino acids accumulation are osmoregulation, maintenance of membrane and protein stability, growth and provisions of a store of carbon, nitrogen and energy (Mansour, 2000).

In this respect, Mostafa (1998) pointed out that foliar sprays with amino acid (Glutathion) at 25, 50 or 75 ppm on Manfalouty pomegranate at three weeks after anthesis and four weeks later significantly induced positive effects on tree yield and fruit quality parameters. On the other hand, Ezz (1999) has worked on Washington navel orange, Takeuchi et al. (2008) on Japanese pear, Caronia et al. (2010) on citrus, Khuong et al. (2010) navel orange, Clementine mandarin and Hanafy Ahmed et al. (2012) on Valencia orange. They mentioned that foliar sprays of tryptophan and or proline improved tree growth, yield and fruit quality parameters of the aforementioned fruit species.

The purpose of this work is to evaluate the effect of proline and tryptophan amino acids on yield, fruit quality, and fruit cracking of Manfalouty pomegranate variety.

2. Materials and methods

This investigation was carried out during two successive seasons 2011 and 2012 at Experimental orchard of El Maghara Station of Desert Research Center, North Sinai Governorate (latitude 30.35 N, longitude 33.20 E) in Egypt. Manfalouty pomegranate trees aged 12 years old grown in sandy soil, and spaced 3.6 × 3.6 m apart (324 tree/fed) under drip irrigation system from well. Physical and chemical analysis of the experimental soil shown in Table 1, meanwhile the chemical analysis of used water from irrigation is recorded in Table 2. Forty two trees healthy, nearly uniform in shape and size and productivity and received the same horticulture practices, were subjected to seven treatments as: control tap water, Proline as foliar sprays at 50 ppm, Proline as foliar sprays at 75 ppm, Proline as foliar sprays at 100 ppm, Tryptophan as foliar sprays at

* Corresponding author. Tel.: +20 1002816313.
E-mail address: drmagdimicro@yahoo.com (O.M. El Sayed).

0304-4238/$ – see front matter © 2014 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.scienta.2014.01.023

Table 1
Analysis of experimental soil of El-Maghara Station, North Sinia Governorate in 2011 and 2012 seasons. (I) Physical analysis of El-Maghara soil. (II) Chemical analysis of El-Maghara soil.

Soil depth (cm)	Particle size distribution				Texture class	Bulk density (g/cm)	Organic matter %	Moisture content (%)	
	Coarse sand	Fine sandy	Silt	Clay				Field capacity	Wilting point
0–30	0.00	98.00	1.00	1.00	Sand	1.55	0.24	10.23	4.45
30–60	0.00	98.50	0.80	0.70	Sand	1.58	0.23	9.98	4.51
60–90	0.00	99.00	0.50	0.50	Sand	1.60	0.19	10.35	4.64
90–120	0.00	98.50	0.70	0.80	Sand	1.57	0.28	9.87	4.41
120–150	0.00	99.50	0.30	0.20	Sand	1.56	0.22	10.18	4.39

Soil depth (cm)	$CaCO_3$	pH soil past	E.Ce (dS m^{-1})	Soluble cations (mequiv./l)				Soluble anions (mequiv./l)			
				Ca^{2+}	K^+	Na^+	Mg^{2+}	Cl^-	SO_4^{2-}	HCO_3^-	CO_3^{2-}
0–30	5.89	7.70	0.60	2.50	0.05	1.26	1.50	1.40	2.11	1.80	–
30–60	3.80	7.70	0.70	3.00	0.08	1.57	2.00	2.00	2.85	1.80	–
60–90	4.35	7.40	1.10	3.50	0.05	3.04	2.00	6.10	2.09	2.40	–
90–120	5.98	7.60	1.20	3.50	0.03	4.04	2.50	5.10	1.97	3.00	–
120–150	4.44	7.60	0.60	2.50	0.03	1.56	1.50	2.10	1.09	2.40	–

50 ppm, Tryptophan as foliar sprays at 75 ppm, and Tryptophan as foliar sprays at 100 ppm.

The experiment was designed as randomized complete block design with three replicates for each treatment and each replicate was represented by two trees. Foliar sprays of proline and tryptophan treatments were carried out at two times, the first foliar sprays was done at full bloom and the second one was performed four weeks later, meanwhile, the control trees were sprayed with tap water at the previously mentioned times. Response of Manfalouty pomegranate trees to the tested proline and tryptophan treatments was evaluated through the following determinations.

2.1. Leaf characteristics

The area of leaves was determined by using portable area planimeter Mod Li3100 Ali (Li-Cor) while Leaf total chlorophyll content was determined by Minolta chlorophyll meter SPAD-502. At harvest time the number of fruits per each treated tree was counted and reported then yield (kg) per tree was weighed and recorded.

2.2. Fruit physical and chemical properties

Number of cracked fruits per tree was counted and recorded and the percentage of cracked fruits was calculated. Ten fruits were taken at harvest from each treated tree for determination of the following physical and chemical properties. Fruit weight (g), fruit length (cm), fruit diameter (cm), weight of fruit grains (g), flesh (%), weight of 100 grains (g), juice volume (cm^3) per fruit, peel thickness. Furthermore, total sugar (%), total soluble solids (T.S.S.) was determined by Hand refractometer, total acidity in fruit juice (expressed as citric acid per 100 ml juice), TSS/acid ratio and ascorbic acid (mg ascorbic acid/100 ml juice) according to AOAC (1995).

2.3. Statistical analysis

The obtained data in 2011 and 2012 seasons were subjected to analysis of variance according to Clarke and Kempson (1997). Means were differentiated using Rang test at the 0.05 level (Duncan, 1955).

3. Results and discussion

3.1. Leaf characteristics

3.1.1. Leaf area (cm^3)

Table 3 demonstrates that all tested proline and tryptophan treatments enhanced leaf surface area of Manfalouty pomegranate in both seasons as compared with control treatment. Generally, 100 ppm tryptophan treatment was the alone treatment that induced positive significant effect in this respect. Other treatments produced a slight enhancing effect in this concern from the statistical standpoint.

3.1.2. Leaf total chlorophyll content

All tested treatments succeeded in increasing leaf total chlorophyll content as compared with the control in both seasons of study (Table 3). However, tryptophan treatments surpassed the corresponding ones of proline in enhancing leaf total chlorophyll content of Manfalouty pomegranate trees in both seasons. Moreover, 100 ppm tryptophan proved to be the superior treatment in this respect but without significant differences.

3.2. Yield and fruit quality

3.2.1. No. of fruits/tree

It is clear from Table 3 that proline and tryptophan sprayed trees produced higher number of fruits than those sprayed with tap water control in both seasons of study. Anyhow, 100 ppm tryptophan treatment shows superiority in this respect.

3.2.2. Yield (kg)/tree

Table 3 illustrates that proline and tryptophan treatments succeeded in improving tree yield as compared with the control in both seasons. Generally, 100 ppm tryptophan sprayed trees showed to be the highest production trees (40.67 and 40.33 kg/tree) against (22.33 and 21.33 kg/tree) for tap water control sprayed trees in 2011 and 2012 seasons, respectively.

The obtained results of tryptophan and proline regarding their positive effect on tree growth and yield are in harmony with the

Table 2
Chemical analysis of water used for irrigation at El-Maghara Station, North Sinai Governorate in 2011 and 2012 seasons.

pH	E.C. (dS m^{-1})	O.M (%)	Soluble cations (mequiv./l)				Soluble anions (mequiv./l)			
			Ca^{2+}	Mg^{2+}	Na^+	K^+	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}
8.36	4.38	1.40	11.40	3.48	24.60	0.69	0	4.40	3.57	32.20