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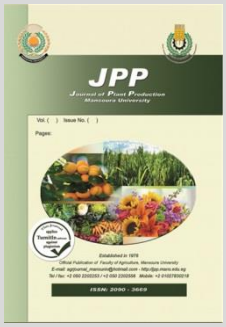
Possibility of Enhancing Growth, Yield and Fruit Quality by Application with Yeast, Amino Acids and Salicylic Acid of Balady Mandarin Trees

Silem, A. A. E. M.*

Hort. Dept. Fac. of Agric. Al-Azahar Univ. Assiut Branch, Egypt



ABSTRACT

This study was conducted during two successive seasons (2018 and 2019) in a private farm located at Tokh district, Qaluobiya Governorate; to investigate the application yeast, amino acids and salicylic acid (SA) on leaf area, tree nutritional status, productivity and fruit quality attributes of Balady Mandarin Trees. Yeast application was added either soil addition at 2.5, 5 and 10g/tree or foliar spraying at 0.25, 0.50 and 1% were carried out either in the solely or in combined with spraying of amino acids (tryptophan, methionine and cysteine) at 5% and salicylic acid at 50 ppm. All treatments were done four times at growth start (1st week of March), just after fruit setting (mid of April) and at two months intervals. The results showed that the application of yeast, amino acids and salicylic acid either alone or in combination among them had the best results compared to untreated plants in the tested seasons. Triple application of yeast at concentration of 10 g/tree plus foliar spraying of amino acids at 0.5% and salicylic acid at 50 ppm resulted in significantly the heviest yield, improved fruit quality attributes in terms of increasing fruit weight, total soluble solids%(ssc), total sugars %, and decreasing total acidity %, as well as stimulated leaf area(cm^2) and leaf content of total chlorophylls, nitrogen, phosphorus, potassium and zinc of Balady mandarin trees.

Keywords: Balady mandarin, yeast, amino acids, salicylic acid, vegetative growth characteristics, tree nutritional status, yield.

INTRODUCTION

There are many attempts to improve yield and fruit quality of Mandarin trees by using untraditional methods like the use of yeast, amino acids and salicylic acid.

Yeast is very essential and beneficial for the synthesis of amino-linolenic acid (AA) and is necessary for the building of protoprphyrin, the precursor of chlorophyll. It aids in activating photosynthesis process through enhancing the release of carbon dioxide (N.R.P 1977 and Barnett *et al*., 1990). Bakry (2007) showed that spraying of Jafa orange trees with active dry yeast led to obtained maximum yield of Jafa orange.

Amino acids are the building blocks in the synthesis of proteins, which are formed by as process in which ribosomes catalyze the polymerization of amino acids (Davies, 1982 and Raskin, 1992). Several hypotheses have been proposed the explanation for the amino acid roles in plant. Several alternative routes of IAA and ethylene synthesis in plants, starting from amino acids (Hashimoto and Yamada, 1994). Where, (Waller and Nowaki, 1978) suggested that the regulatory effect of certain amino acids like phenylalanine and ornithine in plant development appeared through their influence on the biosynthesis of gibberellins.

Several studies support major roles of salicylates in modulation of the plant response to several abiotic stresses, such as Uv light, drought, salinity, chilling stress and heat shock (Ding *et al*., 2001 and Ding and Wang, 2003). On the other hand, SA has received a particular attention because it is a key signal molecule for expression of multiple modes of plant stress resistance. Although the focus has been mainly on the roles of SA on biotic stresses.

Salicylic acid and oxygen reactive species which accumulate in stresses cells are essential signals to trigger local defense response or to activate transpiration of stress defense genes. Salicylic acid seems to have a strong influence on cellularredox homeostasis (Lobez- Deglado *et al*., 2007).

There are numerous studies showed that application of yeasts (Mohamed *et al*., 2008; Abd El- Motty- Elham *et al*., 2010; Abdelaal *et al*., 2012 and Mahmoud, 2012), amino acids (Abd El- aal, 2013; Hassan, 2014; Hassan-Huda, 2014; Rabeh *et al*., 2014 and Ahmed, 2016) and salicylic acid (Ahmed, 2011; Karmi *et al*., 2012; Osman, 2014 and Abd El- Megeed, 2015) were effective in enhancing growth, yield and fruit quality of fruit crops.

The aims of this study were to evaluate the effectiveness of either single or combined applications of yeast, amino acids and salicylic acid on leaf area, leaf chemical composition, yield and fruit quality of Balady mandarin trees growing under Qaluobiya region conditions.

MATERIALS AND METHODS

This investigation was carried out during seasons 2018 and 2019 on 84 nearly uniform and similar in vigour 15- years old Balady mandarin trees (Citrus reticulata L. Blanco) budded on sour orange rootstock in a private orchard located at El- Amar village at Tookh city, Qaluobiya Governorate where the soil is silty clay and well

* **Corresponding author.**
E-mail address: dr.ahmadsilem@gmail.com
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drained and with a water table not less than two meters deep. The selected trees planted at 4x4 meters apart. Surface irrigation system was followed.

The present experiment included the following twenty-eight treatments from two factors (A & B). The first factor (A) contained from seven concentrations of yeast. The following seven yeast treatments, A_1 (control), A_2 (yeast at 0.25 %), A_3 (yeast at 0.50 %), A_4 (yeast at 1%), A_5 (yeast at 2.5 g /tree), A_6 (yeast at 5g /tree and A_7 (yeast at 10g/tree). The second factor (B) comprised four treatments from amino and salicylic acids as follows: B_1 (control), B_2 (amino acids at 0.5%), B_3 (salicylic acid at 50 ppm) and B_4 (amino acids at 0.5% + salicylic acid at 50 ppm). Therefore, this experiment included twenty-eight treatments. Each treatment was replicated three times, one tree per each. Salicylic acid (SA) solutions were adjusted to pH 6 by using ion H_2SO_4 for facilitating of solubility.

Yeast (*Saccharomyces ccrvicisae*) was active dry with gassing power 150 cm^3/91 hours and its concentration was 95% of fungus cells (Table 1). Yeast application was added either soil addition or foliar spraying, amino acids (tryptophan, methionine and cysteine) and salicylic acid were done four times at growth start (1st week of March), just after fruit setting (mid of April) and at two months intervals. Triton B was added to all spraying solutions at 0.05% as a wetting agent including the control.

Table 1. Chemical analysis of yeast (*S. ccrvicisae*) extract (according to Abou- Zaid, 1984).

Amino acids (mg/ 100 d d.w)	**Arginine**	**Histidine**	**Isoleucine**	**Leucine**	**Lycine**	**Methionine**	**Phenyl alanine**	**Threonine**	**Tryptophan**	**Valine**	**Glutamic acid**	**Serine**	**Aspartic acid**	**Cystine**	**Proline**	**Tyrosine**
	1.99	2.63	2.31	3.09	2.95	0.72	2.01	2.09	0.45	2.19	2.00	1.59	1.33	0.23	1.53	1.49

Vitamins (mg/ 100 g d.w)	B1	B2	B6	B12	Thiamin	Riboflavin	Ensitol	Biotin	Nicotinic acid	Panthothenic acid	Pamino benzoic acid	Folic acid	Pyridoxine
	2.23	1.33	1.25	0.15	2.71	4.96	0.26	0.09	39.88	19.56	9.23	4.36	2.90

Carbohydrates (mg/ 100 g d.w)	Carbohydrates	Glucose
	23.2	13.33

N %	7.3
Fats %	3.5
Ash %	6.7

During two seasons the following measurements were recorded:

- Leaf area (cm^2) (Ahmed and Morsy, 1999) in the spring growth cycle.
- Leaf pigments namely chlorophyll a & b and total chlorophylls (mg/ 1 g F.W.) (Hiscox and Isralstam, 1979).
- leaf content of N, P, and K % and zinc as (ppm) (Chapman and Pratt, 1965; Peach and Tracey, 1968; Summer, 1985 and Wilde *et al.*, 1985).
- Yield expressed in weight (kg.).
- Percentage of preharvest fruit dropping.
- Fruit quality attributes such as fruit weight (g.), T.S.S. %, total sugars (Lane and Eynon, 1965 and A.O.A.C., 2000) and total acidity % (as g. citric acid / 100 ml juice) (A.O.A.C., 2000).
- Experimental design and statistical Analysis

Completely randomized block design in split plot arrangement was followed. The yeast occupied the main plots and amino acids, salicylic acid ranked the sub-plots. The statistical analysis of the present data was carried out according to Snedecor and Cochran (1980). Averages were compared using the new L.S.D. values at 5% level (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Results

Leaf area

Data in Table (2) clear that treating of Balady mandarin trees with yeast at 2.5 to 10.0 g/tree as a soil treatment or a foliar treatment at 0.25 to 1.0% significantly stimulated the leaf area relative to the untreated plants. The enhancing was associated with increasing levels of yeast from 2.5 to 10.0 g/ tree and concentrations from 0.25 to 1%. Increasing levels of yeast from 5 to 10 g/tree and concentrations of yeast from 0.50 to 1.0% had no significant stimulation on the leaf area. Using yeast via soil at 2.5 to 10 g/tree was significantly favorable than using yeast via spraying at 0.25 to 1.0% in enhancing the leaf area. The maximum values of leaf area were recorded on the trees that received yeast via soil at 10 g/tree. Untreated trees produced the minimum values. A similar trend was noticed during both seasons.

It is revealed from the obtained data that treating Balady mandarin trees with amino acids at 0.5% and/or salicylic acid at 50 ppm significantly was responsible for stimulating leaf area relative to the control. Using amino acids at 0.5% was significantly superior to using salicylic acid at 50ppm in enhancing the leaf area. Combined application of amino acids at 0.5% and salicylic acid at 50 ppm significantly was preferable than using each material alone in enhancing the leaf area. The maximum values were recorded on the trees that received amino acids plus salicylic acid together. The lowest values were recorded on untreated trees.

Leaf area was significantly enhanced in response to all investigated interactions among the yeast, amino acids and salicylic acid. The maximum values of leaf area (10.5 & 10.7 cm^2) were recorded on the trees that received yeast

via soil at 10 g/tree, amino acids at 0.5% and salicylic acid at 50 ppm during the both seasons (2018 and 2019), respectively. The untreated trees produced the lowest values. These results were true during the both seasons (2018 and 2019).

Table 2. Effect of yeast, amino and salicylic acids applications on leaf area (cm^2) of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid Treatments (B)									
	2018					2019				
	b 1	b 2	b 3	b 4	Mean (A)	b 1	b 2	b 3	b 4	Mean (A)
	Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids		Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids	
a1 Control	7.0	8.0	7.5	8.4	7.7	6.9	8.0	7.6	8.5	7.8
a2 Yeast at 0.25 %	7.5	8.4	8.0	9.0	8.2	7.6	8.5	8.1	9.1	8.3
a3 Yeast at 0.50 %	8.0	8.5	8.6	9.6	8.8	8.0	9.0	8.7	9.7	8.8
a4 Yeast at 1%	8.1	9.0	8.7	9.7	8.9	8.2	9.0	8.7	9.8	8.9
a5 Yeast at 2.5 g /tree	8.6	9.6	9.1	10.0	9.3	8.7	9.7	9.1	10.1	9.4
a6 Yeast at 5 g /tree	9.1	10.0	9.6	10.5	9.8	9.2	10.1	9.7	10.6	9.9
a7 Yeast at 10 g /tree	9.2	10.0	9.7	10.5	9.9	9.2	10.1	9.8	10.7	10.0
Mean (B)	8.1	9.1	8.7	9.7		8.3	9.2	8.8	9.8	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		0.4	0.3	0.8			0.4	0.4	1.1	

Leaf chemical composition

Data in Tables (3, 4, 5, 6 &7) cleared that treating Balady mandarin trees with yeast either via soil at 2.5 to 10.0 g/tree or via foliage at 0.25 to 1.0% significantly was enhanced total chlorophylls, N, P, K and Zn in the leaves compared to the control. There was a gradual promotion of these traits of leaves with increasing levels and concentrations of yeast. Increasing levels from 5 to 10 g/tree and concentrations from 0.50 to 1.0% of yeast had a negligible promotion on these total chlorophylls and nutrients.

Using yeast via soil at 2.5 to 10 g/tree was significantly superior than using yeast via leaves at 0.25 to 1.0% in enhancing these total chlorophylls and nutrients. Treating the trees with yeast via soil at 10 g/tree maximized the total chlorophylls and nutrients. The lowest values were found on untreated trees. Similar trend was noticed during both seasons.

Varying amino acid and salicylic acid treatments had a significant effect on total chlorophylls, N, P, K and Zn. Single and combined applications of amino acids at 0.5% and salicylic acid at 50 ppm significantly increased on total chlorophylls and nutrients in the leaves compared to the control. The promotion was significantly associated with using amino acids than using salicylic acid. Using both materials together significantly surpassed than application of each material alone in this traits. The maximum values were recorded on the trees that received both materials together. The untreated trees

The interactions between yeast, amino acids and salicylic acid had a significant effect on total chlorophylls and nutrients in the leaves of Balady mandarin trees. Treating the trees with yeast via soil at 10 g/tree, amino acids at 0.5% and salicylic acid at 50 ppm gave the maximum values of total chlorophylls (12.0 & 12.4 mg/ 1g F.W), N (2.10 & 2.11%), P (0.178 & 0.190%), K (1.61 & 1.59%) and Zn (72.5 & 73.4 ppm) during both seasons, respectively. The untreated trees produced the lowest values.

Table 3. Effect of yeast, amino and salicylic acids applications on total chlorophylls (mg/1.0 F.W) in the leaves of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid Treatments (B)									
	2018					2019				
	b 1	b 2	b 3	b 4	Mean (A)	b 1	b 2	b 3	b 4	Mean (A)
	Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids		Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids	
a1 Control	5.2	7.1	6.1	8.6	6.8	5.0	7.2	6.1	8.6	6.7
a2 Yeast at 0.25 %	6.1	8.1	7.1	9.4	7.7	6.2	8.2	7.1	9.5	7.8
a3 Yeast at 0.50 %	7.0	8.9	7.9	10.1	8.5	7.1	9.0	7.9	10.3	8.6
a4 Yeast at 1%	7.2	9.1	8.0	10.2	8.6	7.1	9.1	7.9	10.4	8.6
a5 Yeast at 2.5 g /tree	8.1	10.0	8.8	11.1	9.5	8.3	10.3	9.0	11.6	9.8
a6 Yeast at 5 g /tree	9.0	10.9	9.8	12.0	10.4	9.3	11.3	10.1	12.4	10.8
a7 Yeast at 10 g /tree	9.1	10.9	9.8	12.0	10.5	9.3	11.3	10.1	12.4	10.8
Mean (B)	7.4	9.3	8.2	10.5		7.5	9.5	8.3	10.7	
NEW L.S.D at 5 %		A	B	AB		A	B	AB		
		0.6	0.5	1.3		0.7	0.6	1.6		

Table 4. Effect of yeast, amino and salicylic acids applications on the percentage of N in the leaves of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid Treatments (B)									
	2018					2019				
	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)
a1 Control	1.59	1.72	1.66	1.80	1.69	1.60	1.73	1.67	1.81	1.70
a2 Yeast at 0.25 %	1.66	1.79	1.73	1.87	1.76	1.66	1.80	1.93	1.88	1.77
a3 Yeast at 0.50 %	1.74	1.87	1.81	1.95	1.84	1.75	1.88	1.81	1.95	1.85
a4 Yeast at 1%	1.75	1.88	1.81	1.95	1.85	1.75	1.88	1.81	1.95	1.84
a5 Yeast at 2.5 g /tree	1.82	1.95	1.88	2.02	1.92	1.84	1.97	1.90	2.04	1.95
a6 Yeast at 5 g /tree	1.90	2.03	1.96	2.10	2.00	1.92	2.05	1.98	2.11	2.01
a7 Yeast at 10 g /tree	1.91	2.03	1.97	2.10	2.00	1.92	2.05	1.98	2.11	2.01
Mean (B)	1.77	1.89	1.83	1.97		1.78	1.91	1.84	1.98	
NEW L.S.D at 5 %		A	B	AB		A	B	AB		
		0.06	0.05	0.13		0.05	0.04	0.11		

Table 5. Effect of yeast, amino and salicylic acids applications on the percentage of P in the leaves of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)
a1 Control	0.111	0.129	0.120	0.139	0.125	0.109	0.130	0.119	0.141	0.125
a2 Yeast at 0.25 %	0.120	0.138	0.129	0.148	0.134	0.120	0.141	0.130	0.152	0.136
a3 Yeast at 0.50 %	0.129	0.147	0.138	0.156	0.142	0.130	0.151	0.140	0.165	0.147
a4 Yeast at 1%	0.130	0.148	0.139	0.157	0.143	0.131	0.151	0.141	0.166	0.147
a5 Yeast at 2.5 g /tree	0.140	0.158	0.149	0.167	0.153	0.141	0.161	0.151	0.179	0.158
a6 Yeast at 5 g /tree	0.150	0.168	0.159	0.177	0.163	0.151	0.171	0.161	0.189	0.168
a7 Yeast at 10 g /tree	0.151	0.169	0.160	0.178	0.165	0.151	0.171	0.161	0.190	0.168
Mean (B)	0.133	0.151	0.142	0.160		0.133	0.154	0.163	0.169	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		0.005	0.004	0.011			0.006	0.005	0.013	

Table 6. Effect of yeast, amino and salicylic acids applications on the percentage of K in the leaves of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)
a1 Control	1.11	1.23	1.17	1.30	1.20	1.04	1.18	1.11	1.25	1.15
a2 Yeast at 0.25 %	1.17	1.29	1.23	1.37	1.27	1.12	1.26	1.19	1.33	1.18
a3 Yeast at 0.50 %	1.24	1.36	1.29	1.44	1.33	1.20	1.34	1.27	1.41	1.31
a4 Yeast at 1%	1.25	1.36	1.30	1.45	1.34	1.20	1.34	1.28	1.41	1.31
a5 Yeast at 2.5 g /tree	1.33	1.44	1.38	1.53	1.42	1.28	1.42	1.36	1.50	1.39
a6 Yeast at 5 g /tree	1.41	1.52	1.46	1.61	1.50	1.36	1.50	1.44	1.58	1.47
a7 Yeast at 10 g /tree	1.41	1.52	1.46	1.61	1.50	1.37	1.51	1.45	1.59	1.48
Mean (B)	1.27	1.19	1.33	1.47		1.22	1.36	1.30	1.44	
NEW L.S.D at 5 %		A	B	AB		A	B	AB		
		0.04	0.03	0.08		0.05	0.04	0.11		

Table 7. Effect of yeast, amino and salicylic acids applications on the leaf content of zinc (as ppm) of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)
a1 Control	51.9	57.0	54.0	60.0	55.7	52.1	58.2	55.1	61.3	56.7
a2 Yeast at 0.25 %	55.0	60.0	57.3	62.9	58.8	55.1	61.3	58.1	64.3	59.7
a3 Yeast at 0.50 %	57.9	62.9	60.0	66.1	61.7	58.1	64.3	61.1	67.6	62.8
a4 Yeast at 1%	58.0	63.0	60.3	66.1	61.9	58.2	64.4	61.1	67.7	62.9
a5 Yeast at 2.5 g /tree	61.3	66.0	63.7	69.3	65.1	61.4	67.7	64.1	70.2	65.9
a6 Yeast at 5 g /tree	64.3	69.0	67.0	72.4	68.2	64.4	71.7	68.1	73.3	69.4
a7 Yeast at 10 g /tree	64.4	69.0	67.0	72.5	68.2	64.5	71.8	68.2	73.4	69.5
Mean (B)	59.0	63.8	61.3	67.0		59.1	65.6	62.3	68.3	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		2.1	1.9	5.0			1.9	1.6	4.2	

Yield / tree

It is clear from the obtained data in Table (8) that using yeast via soil at 2.5 to 10.0 g/tree or via spraying at 0.25 to 1.0% had a significant promotion on yield expressed in weight over the control. There was a progressive promotion on the yield with increasing levels and concentrations of yeast. Using yeast via soil at 2.5 to 10 g/tree was significantly favorable than using yeast via

leaves at 0.25 to 1.0% in improving yield expressed in weight (kg). No significant promotion was observed among the higher two levels and concentrations of yeast. The maximum values were recorded on the trees that treated with yeast via soil at 10 g/tree, but from an economical point of view, it is advised to use yeast via soil at 5.0 g/tree. Untreated Balady mandarin trees produced the lowest values.

Treating the trees with amino acids at 0.5% and/or salicylic acid at 50ppm significantly was very effective in improving yield expressed in weight relative to the control. Using amino acids at 0.5% was significantly superior to using salicylic acid in improving the yield expressed in weight. Combined applications were significantly favorable than using each material alone in this connection. The maximum values were recorded on the trees that received both materials together. The untreated trees produced the lowest values. These results were true during both seasons. The interactions between yeast, amino acids and salicylic acid applications had a significant effect on the yield expressed in weight. From an economical point of view, the maximum yield/tree (61.6 & 65.9 kg) was recorded on the trees that received yeast via soil at 5.0 g/tree, amino acids at 0.5% and salicylic acid at 50 ppm during both seasons, respectively. The untreated trees produced the lowest values (39.9 & 38.8 kg) during both seasons, respectively. The percentage of increment on the yield due to using the previous promised treatment (yeast via soil at 5.0 g/tree+ amino acids at 0.5% + salicylic acid at 50 ppm) over the control treatment reached 54.4 and 69.8% during both seasons, respectively. These results were true during both seasons.

Table 8. Effect of yeast, amino and salicylic acids applications on the yield/ tree (kg) of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1	b 2	b 3	b 4	Mean (A)	b 1	b 2	b 3	b 4	Mean (A)
	Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids		Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids	
a1 Control	39.9	44.3	41.9	47.3	43.4	38.8	44.4	41.6	47.9	43.2
a2 Yeast at 0.25 %	42.3	46.9	44.6	50.0	45.9	42.4	38.3	45.5	51.9	47.0
a3 Yeast at 0.50 %	44.8	49.5	47.3	52.8	48.6	45.4	51.3	48.3	55.1	50.0
a4 Yeast at 1%	45.2	49.9	47.3	52.9	48.8	45.5	51.4	48.4	55.2	50.1
a5 Yeast at 2.5 g /tree	48.1	53.0	50.3	56.9	52.1	49.0	55.2	52.3	60.1	54.2
a6 Yeast at 5 g /tree	51.3	56.9	54.2	61.6	56.0	53.1	60.4	57.7	65.9	59.3
a7 Yeast at 10 g /tree	51.6	57.4	54.5	62.0	56.4	53.2	60.6	57.8	66.5	59.5
Mean (B)	46.2	51.1	48.6	54.8		46.8	53.1	50.2	57.5	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		2.0	1.8	4.8			2.1	2.0	5.3	

Percentage of preharvest fruit dropping

It is clear from the data in Table (9) that the percentage of preharvest fruit dropping was significantly controlled by using yeast via soil at 2.5 to 10.0 g/tree or via foliage at 0.25 to 1.0% over the control. There was a gradual reduction in the percentage of preharvest fruit dropping with increasing levels and concentrations of yeast. Using yeast via soil at 2.5 to 10.0 g/tree significantly was superior to using yeast via leaves in controlling preharvest fruit dropping. Increasing levels from 5.0 to 10.0 g/tree and concentrations of yeast from 0.5 to 1.0% had no significant reduction on the percentage of preharvest fruit dropping. The great reduction was recorded on the trees that received yeast via soil at 10 g/tree. The untreated trees produced the highest values. A similar trend was noticed during both seasons.

A significant reduction in the percentage of preharvest fruit dropping was observed due to treating the trees with amino acids at 0.5% and/or salicylic acid at 50ppm relative to the control. Using amino acids at 0.5% was significantly preferable than using salicylic acid in reducing the percentage of preharvest fruit dropping. Using amino acids is combined with salicylic acid significantly surpassed the application of each material alone in controlling the percentage of preharvest fruit dropping. The lowest values were recorded on the trees sprayed with both materials together. The highest values were recorded on the untreated trees. These results were true during both seasons.

The lowest values of preharvest fruit dropping (22.0 & 21.0%) were recorded on the trees that treated with yeast via soil at 5.0 g/tree+ amino acids at 0.5%+ salicylic acid at 50 ppm during both seasons, respectively. The highest values (41.9 & 40.7%) of preharvest fruit dropping were recorded on untreated trees during both seasons, respectively. These results were true during both seasons.

Table 9. Effect of yeast, amino and salicylic acids applications on the percentage of preharvest fruit dropping of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1	b 2	b 3	b 4	Mean (A)	b 1	b 2	b 3	b 4	Mean (A)
	Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids		Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids	
a1 Control	41.9	38.0	40.0	35.0	38.7	40.7	37.0	39.0	34.0	37.7
a2 Yeast at 0.25 %	39.9	36.0	38.0	33.0	35.2	38.9	34.9	37.0	32.0	35.7
a3 Yeast at 0.50 %	38.0	34.0	35.9	31.0	34.7	37.0	33.9	34.9	30.0	34.0
a4 Yeast at 1%	37.9	33.9	35.6	30.9	34.6	36.7	33.8	34.6	30.0	34.0
a5 Yeast at 2.5 g /tree	33.0	28.9	30.0	25.0	29.2	32.0	28.4	30.0	24.0	28.6
a6 Yeast at 5 g /tree	30.0	25.9	27.0	22.0	26.2	29.0	25.0	27.0	21.0	25.5
a7 Yeast at 10 g /tree	29.9	25.9	26.9	21.9	26.2	28.8	24.9	26.9	21.0	25.4
Mean (B)	35.8	31.8	33.3	28.4		34.7	31.1	32.9	27.4	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		1.1	1.0	2.7			1.2	1.0	2.7	

Fruit quality

It is clear from the obtained data in Tables (10, 11, 12 & 13) that subjecting Balady mandarin trees to yeast via soil at 2.5 to 10.0 g/tree or via leaves at 0.25 to 1.0% significantly was very effective in improving fruit quality in terms of increasing fruit weight, T.S.S %, total sugars % and decreasing total acidity % over the check treatment. The promotion of fruit quality was significantly related to the increase in the levels and concentrations of yeast.

Using yeast via soil significantly favorable than using yeast via leaves in improving the quality of the fruits. No significant promotion on fruit quality was observed with increasing levels from 5.0 to 10.0 g/tree and concentrations from 0.5 to 1.0% of yeast. The best treatment was the application of yeast via soil at 5.0 g/tree (since no significant effect on quality was detected among the use of 5.0 and 10.0 g yeast/tree). Un-favorable effects on fruit quality were observed on untreated trees. Similar trend was noticed during both seasons.

Spraying the trees with amino acids at 0.5% and/or salicylic acid at 50ppm significantly succeeded in improving the quality of the fruits in terms of increasing fruit weight, T.S.S %, total sugars % and decreasing total acidity % relative to the check treatment. Spraying amino acids was significantly superior to using salicylic acid in enhancing fruit quality. Combined applications were significantly favorable than using each material alone in enhancing fruit quality. The best results with regard to fruit quality were recorded on the trees sprayed with both materials together. The untreated trees produced un-favorable effects on fruit quality. These results were true during both seasons.

The best results in fruit quality were recorded in treated trees with yeast as a soil treatment at 5.0 g/tree+ amino acids at 0.5%+ salicylic acid at 50 ppm, from an economical point of view.

Spraying trees with both materials together gave the high yield with good fruit quality.

Table 10. Effect of yeast, amino and salicylic acids applications on the percentage of the average fruit weight (g) of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1	b 2	b 3	b 4	Mean (A)	b 1	b 2	b 3	b 4	Mean (A)
	Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids		Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids	
a1 Control	105.0	111.0	108.0	114.0	109.5	104.9	111.0	108.0	114.0	109.5
a2 Yeast at 0.25 %	108.0	114.0	111.5	117.0	112.6	108.8	114.9	112.4	117.9	113.5
a3 Yeast at 0.50 %	111.0	117.0	114.3	120.0	115.6	112.0	118.0	115.0	121.0	116.5
a4 Yeast at 1%	111.5	117.3	114.5	120.0	115.8	112.0	118.0	115.0	121.0	116.5
a5 Yeast at 2.5 g /tree	114.5	120.4	118.0	125.0	119.5	115.0	121.0	118.5	126.0	126.1
a6 Yeast at 5 g /tree	118.0	125.0	123.0	131.3	124.3	118.0	125.9	124.0	132.0	125.0
a7 Yeast at 10 g /tree	118.3	125.3	123.3	131.3	124.6	118.0	126.0	124.0	133.0	125.3
Mean (B)	112.3	118.6	116.1	122.6		112.7	119.3	116.7	123.6	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		2.9	2.8	7.4			3.0	2.9	7.7	

Table 11. Effect of yeast, amino and salicylic acids applications on the percentage of total soluble solids in the fruit of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1	b 2	b 3	b 4	Mean (A)	b 1	b 2	b 3	b 4	Mean (A)
	Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids		Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids	
a1 Control	11.3	11.9	11.6	12.2	11.8	11.3	11.9	11.6	12.2	11.8
a2 Yeast at 0.25 %	11.6	12.2	11.9	12.5	12.1	11.6	12.2	11.9	12.5	12.1
a3 Yeast at 0.50 %	11.9	12.5	12.2	12.8	12.4	11..9	12.5	12.2	12.9	12.4
a4 Yeast at 1%	12.0	12.6	12.3	12.9	12.5	12.1	12.7	12.4	13.0	12.6
a5 Yeast at 2.5 g /tree	12.4	13.0	12.7	13.3	12.9	12.5	13.1	12.8	13.4	13.0
a6 Yeast at 5 g /tree	12.6	13.2	12.9	13.6	13.1	12.7	13.2	13.0	13.6	13.1
a7 Yeast at 10 g /tree	12.7	13.3	13.0	13.7	13.2	12.7	13.3	13.1	13.6	13.2
Mean (B)	12.1	12.7	12.4	13.0		12.1	12.7	12.4	13.0	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		0.2	0.2	0.5						

Table 12. Effect of yeast, amino and salicylic acids applications on the percentage of total sugars in the fruit of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1	b 2	b 3	b 4	Mean (A)	b 1	b 2	b 3	b 4	Mean (A)
	Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids		Control	Amino acids 0.5%	SA 50 ppm	SA + Amino acids	
a1 Control	7.0	8.0	7.5	8.4	7.7	6.9	7.9	7.4	8.4	7.7
a2 Yeast at 0.25 %	7.5	8.4	8.0	8..7	8.2	7.4	8.3	7.9	8.6	8.1
a3 Yeast at 0.50 %	7.9	8.8	8.4	9.1	8.6	7.8	8.7	8.3	9.1	8.5
a4 Yeast at 1%	8.0	8.9	8.5	9.2	8.7	8.0	8.9	8.5	9.2	8.7
a5 Yeast at 2.5 g /tree	8.4	9.3	9.0	9.6	9.0	8.5	9.3	9.0	9.6	9.1
a6 Yeast at 5 g /tree	8.8	9.7	9.4	10.0	9.5	8.8	9.7	9.4	10.0	9.5
a7 Yeast at 10 g /tree	8.8	9.7	9.7	10.0	9.6	8.9	9.8	10.0	10.5	9.8
Mean (B)	8.1	9.0	8.6	9.3		8.0	8.9	8.6	9.3	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		0.5	0.4	1.1			0.5	0.4	1.1	

Table 13. Effect of yeast, amino and salicylic acids applications on the percentage of total acidity in the fruit of Balady mandarin trees during 2018 /2019 seasons.

Yeast Treatments (A)	Salicylic and amino acid treatments (B)									
	2018					2019				
	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)	b 1 Control	b 2 Amino acids 0.5%	b 3 SA 50 ppm	b 4 SA + Amino acids	Mean (A)
a1 Control	1.419	1.385	1.400	1.370	1.394	1.490	1.360	1.380	1.340	1.372
a2 Yeast at 0.25 %	1.400	1.370	1.380	1.350	1.375	1.390	1.340	1.360	1.320	1.353
a3 Yeast at 0.50 %	1.380	1.340	1.360	1.330	1.353	1.370	1.320	1.340	1.300	1.333
a4 Yeast at 1%	1.379	1.339	1.359	1.329	1.351	1.369	1.319	1.339	1.299	1.331
a5 Yeast at 2.5 g /tree	1.360	1.320	1.340	1.310	1.332	1.350	1.300	1.319	1.260	1.307
a6 Yeast at 5 g /tree	1.340	1.300	1.320	1.390	1.313	1.330	1.280	1.300	1.240	1.288
a7 Yeast at 10 g /tree	1.338	1.299	1.318	1.288	1.311	1.329	1.279	1.300	1.240	1.287
Mean (B)	1.373	1.336	1.354	1.324		1.364	1.314	1.334	1.286	
NEW L.S.D at 5 %		A	B	AB			A	B	AB	
		0.011	0.010	0.027			0.012	0.011	0.029	

Discussion:

Achieving clean cultivation yeast *Saccharomyces cerevisiae,* can be used for it contains IAA and cytokinin which effectively promote growth in plants and delays leaf aging. also, it contains 93 % dry matter, 44.4 % protein, 2.19 % arginine, 2.09 % glycine, 1.07 % histidine, 2.14 % isoleucine, 3.19 % leucine, 3.23 % lysine, 0.70 % methionine, 0.50 % cysteine, 1.18 % phenylalanine, 1.49 % tyrosine, 2.06 % threonine, 0.19 % tryptophan and 2.32 % vitamins B. as well as, it contains 7.5 - 8.5 % N, 2.6 % fat, 8 - 9.5 % ash, 6 - 12 % nucleic acid and 45 - 51 % crude protein. In addition yeast constituents glutathione, lecithin, enzymes and co-enzymes. (Abou-Zaid, 1984). Yeast is very beneficial and essential for the synthesis of amino-linolenic acid (AA) and is necessary for the formation of protoprphyrin, the precursor of chlorophyll. It abets in activating photosynthesis process through enhancing the release of carbon dioxide (N.R.P 1977 and Barnett *et al.,* 1990).

These results are in line with those obtained by Ahmed, (2001); El- Shammaa, (2001); Merwad; (2001); Mustapha and El- Hosseiny (2001); Sheta, (2002); Ahmed *et al*., (2003); Mouftah, (2007); Mohamed *et al*., (2008); Abd El- Motty- Elham *et al*., (2010); Abdelaal *et al*., (2012) and Mahmoud, (2012).

The important roles of salicylic acid in enhancing the trees tolerance to abiotic stress, the trees antioxidative capacities, the synthesis of protective compounds, building of natural hormones, photosynthesis, uptake and transport of nutrients, the tolerance of the trees to pathogens, the inhibition of reactive oxygen species (ROS) namely catalase and ascorbate peroxidade that capable of stimulating ROS accumulation during diverse biotic and abiotic stresses. Evidence indicates that salicylic acid together with oxygen reactive species which accumulate in the stresses cells are essential signals to trigger local defense response or to activate transpiration of stress defense genes (Janda *et al.*, 2007).

Amino acids as organic nitrogenous compounds are the forming units in the synthesis of proteins, which are formed by the polymerization of amino acids (Davies, 1982 and Raskin, 1992). There are several alternative routes of IAA and ethylene synthesis in plants, starting from amino acids (Hashimoto and Yamada, 1994). The effect of certain amino acids such as phenylalanine and ornithine in plant development materialize their influence on the biosynthesis of gibberellins, (Waller and Nowaki, 1978).

The effect of amino acids in enhancing of plant growth and fruiting of Balady mandarin trees are parallel those obtained by Yousef- Amal *et al.,* (2011); El- Badawy and Abd El- aal, (2013); Fathalla, (2013); Ibrahiem *et al.,* (2013); Ahmed *et al.,* (2014b); Hassan, 2014; Hassan-Huda, (2014); Rabeh *et al.,* (2014); Sayed – Ola, (2014) and Ahmed, (2016). Eshmawy (2010) Ahmed *et al.,* (2010); Kassem *et al.,* (2011) Ahmed (2011), Karmi *et al.,* (2012) Osman (2014). Abd El- Megeed (2015) supported the effect of salicylic acid on improving growth, nutritional status and fruiting of Balady mandarin trees.

CONCLUSION

It could be concluded that treating Balady mandarin trees grown under qaluobiya region condition four times with yeast as a soil treatment at 5 g/tree plus four sprays of amino acids at 0.5% and salicylic acid at 50 ppm to give the best results of yield and fruit quality.

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إمكانية تحسين النمو والمحصول وجودة الثمار من خلال إضافة كل من الخميرة والأحماض الأمينية وحمض السالسيليك لأشجار اليوسفى البلدى

أحمد عبد الفتاح السيد محمد سليم

مدرس بساتين الفاكهة ـ كلية الزراعة ـ جامعة الأزهر ـ فرع أسيوط

أجرى هذا البحث لمدة موسمين متتاليين (2018 – 2019) بأحد المزارع الخاصة بمنطقة العمار-مركز طوخ التابعة لمحافظة القليوبية بهدف تقييم إضافة كل من الخميرة والأحماض الأمينية وحمض الساليسيليك على مساحة الورقة والحالة الغذائية والإنتاجية وخصائص صفات جودة الثمار لأشجار اليوسفى البلدي. تمت إضافة الخميرة إما من خلال التربة عند ثلاثة تركيزات وهى 2,5 ، 5 ، 10 جم/ شجرة أو من خلال الرش الورقي عند ثلاثة تركيزات وهى 0,25 ، 0,50 ، 1 ٪ وذلك إما بصورة منفردة أو بالاشتراك مع الرش الورقي للأحماض الأمينية (التربتوفان والميثيونين والسيستين(عند 5 ٪ وحمض الساليسيليك عند 50 جزء في المليون، وتم إجراء جميع المعاملات على أربع مرات وهى: بداية النمو)الأسبوع الأول من مارس(، بعد العقد مباشرة)منتصف أبريل(، بعد العقد بشهرين ، بعد العقد بأربعة أشهر. أشارت نتائج الدراسة إلى أن إضافة كل من الخميرة والأحماض الأمينية وحمض الساليسيليك إما بصورة منفردة أو مشتركة فيما بينهم أعطوا أفضل النتائج مقارنة بالكنترول في كلا الموسمين. كما أدت الإضافة المشتركة لكل من الخميرة عند 5 و10 جم / شجرة بالإضافة إلى الرش الورقي للأحماض الأمينية بنسبة 5 ٪ وحمض الساليسيليك عند 50 جزء في المليون إلى تحقيق أعلى إنتاجية بالإضافة إلى تحسين صفات الجودة للثمار والتى تمثلت فى زيادة وزن الثمار ، نسبة المواد الصلبة الذائبة الكلية ، نسبة السكريات الكلية، وانخفاض نسبة الحموضة الكلية ، وكذلك تحسين مساحة الأوراق وزيادة محتوى الأوراق من الكلوروفيل الكلي والنيتروجين والفوسفور والبوتاسيوم والزنك في أشجار اليوسفى البلدي.

الكلمات الدالة: اليوسفى البلدي ، الخميرة، الأحماض الأمينية، حمض الساليسيليك ، خصائص النمو الخضري، الحالة الغذائية للشجرة، المحصول