World Journal of Agricultural Sciences 6 (6): 635-638, 2010
ISSN 1817-3047

The Beneficial Effects of Yeast and Zinc Sulphate on Yield and Fruit Quality of Navel Orange Trees

S.A.A. Khafagy, N.S. Zaied, M.M. Nageib, M.A. Saleh and A.A. Fouad

Department of Pomology, National Research Center, Dokki, Giza, Egypt

Abstract: Yield and fruit quality of Navel orange trees in response to spraying yeast extract at (0.2 and 4.0%) or zinc sulphate at (0.5 and 1.0%) either singly or in combinations were evaluated during two successive seasons, 2008 and 2009 at EL Qalubia Governorate, Egypt. Tested trees were sprayed two times yearly at the beginning of March and after fruit set. Results showed that single or combined application of either yield or zinc were very effective in stimulating yield as well as physical and chemical characters of fruits rather than control. Spraying trees with 4.0% yeast extract combined with 1.0% zinc sulphate was more effective in improving total yield and fruit numbers beside increasing fruit weight, length and volume. Also, recorded the highest values of fruit quality resembled by increasing total soluble solids, ascorbic acid and decreasing fruit acidity. The best results with regard to yield and fruit quality were significantly obtained due to spraying Navel orange trees with combination of (0.4% yeast + 1.0 % zinc) followed in descending order by (0.4% yeast + 0.5% zinc) and (0.2% yeast + 1.0% zinc).

Key words: Navel orange · Yeast extract · Zinc sulphate · Fruit quality

INTRODUCTION

Citrus is one of the most important world fruit crops. However, citrus in Egypt is ranked the first in this respect. Most extended Navel orange trees occupied in newly reclaimed sandy soil where trees suffering from adverse growth factors such as scarcity of water and poor soil fertility. The various positive effects and benefits of applying active dry yeast as biofertilizer were attributed to its own different nutrients, greater amounts of vitamins B_1, B_2 and B_6 and cytokinin as natural plant hormone. In addition, application of active dry yeast was very effective in releasing carbon dioxide and stimulating photosynthesis [1]. Hegab [2] reported that spraying micronutrients slightly reduced juice acidity of Navel orange trees. In addition, Sayed [3] and Badawy [4] found that micronutrient treatments gave a little effect on fruit quality of Balady mandarin trees.

The present study aimed mainly to evaluate the effect of sprays active dry yeast and zinc sulphate as foliar either alone or in combinations on yield and fruit quality (physical and chemical properties) of Navel orange trees.

MATERIALS AND METHODS

This study was carried out at EL Qalubia Governorate during 2008 and 2009 seasons. Healthy and nearly uniform Navel orange trees (*Citrus sinensis* L. Osbeck) of 10 years old budded on sour orange rootstock growing in clay loam soil at 3.5 x 5.0 meters a part were devoted for this study. The selected trees were sprayed as follows:

- Control (sprayed with water).
- $ZnSO_4$ at 0.5%.
- $ZnSO_4$ at 1.0%.
- Yeast at 0.2%.
- Yeast at 0.4%.
- Combinations of $ZnSO_4$ at 0.5% + yeast at 0.2%.
- Combinations of $ZnSO_4$ at 1.0% + yeast at 0.2%.
- Combinations of $ZnSO_4$ at 0.5% + yeast at 0.4%.
- Combinations of $ZnSO_4$ at 1.0% + yeast at 0.4%.

All treatments were sprayed two times yearly at the beginning of March and after fruit set. Trees were separated from each side with plastic sheets to avoid any contamination between them, all treatments received the regular fertilization and cultivation practices as

Corresponding Author: S.A.A. Khafagy, Department of Pomology, National Research Center, Dokki, Giza, Egypt.

recommended by the Ministry of Agriculture. The dry pure yeast powder was activated by using sources of carbon and nitrogen with the ratio 6:1 according to Barnett *et al*. [5].

Measurements and Determination

Yield: In both seasons, the fruits were harvested as reached maturity according to Schirra *et al*. [6] then number of fruits per tree was calculated and weighed in kg.

Fruit Quality: At maturity stage, a representative sample of 20 fruits was taken from each tree (replicate) and the following characteristics were determined: Fruit weight, fruit size, total soluble solids by using hand refractometer, total acidity, total sugar and ascorbic acid content (mg /100 ml juice) according to the standard procedure of A.O.A.C. [7].

Generally, all the previous treatments were arranged in a complete randomized block design with three replicates for each treatment and each replicate was represented by two trees. The obtained data was statistically analyzed according to Snedecor and Cochran [8]. The means were differentiated using Duncan method at 5% level [9].

RESULTS AND DISCUSSION

Yield and Fruit Quality: Data presented in Table 1 indicated that in both seasons s praying combination of either 0.5% $ZnSO_4$ + 0.4% yeast or 1.0% $ZnSO_4$ + 0.4% yeast gave significantly the highest number of fruits per tree and yield (kg) than those sprayed of other combinations, compared with other treatments as well as control. However, no significant differences between spraying with yeast at (0.2%) and $ZnSO_4$ at (1.0%) for both seasons. Generally, all treatments significantly increased total yield either as fruit number or weight per tree for both seasons as compared with control treatment. Moreover, all combined treatments caused the highest effect in increasing the yield followed in descending order by 0.4% yeast extract treatment, while the lowest values was obtained with $ZnSO_4$ at (0.5%) treatments as compared with control. These results are in agreement with the finding of Bakry [10] on Jafa orange. Who found that the maximum yield/tree (kg) was noticed when these trees were sprayed with active dry yeast. In addition, Mohamed [11] found that spraying Balady mandarin trees with active dry yeast and $ZnSO_4$ reflected high yield values.

Table 1: Effect of spraying Navel orange trees with yeast extract and $ZnSO_4$ on number of fruits and total yield / tree

	No. of fruits/trees		Yield (kg)/tree	
Treatments	2008	2009	2008	2009
Control	90.33^F	90.63^F	25.63^F	26.60^E
$ZnSO_4$ (0.5%)	92.33^E	92.63^E	26.63^E	27.32^D
$ZnSO_4$ (1.0%)	98.00^D	99.33^D	27.30^D	27.67^D
Yeast (0.2%)	99.63^D	100.36^D	27.33^D	28.00^D
Yeast (0.4%)	110.63^C	113.63^b	28.33^C	30.33^b
$ZnSO_4$ (0.5%) + yeast (0.2%)	113.33^b	114.00^b	30.00^b	30.33^b
$ZnSO_4$ (1.0%) + yeast (0.2%)	113.63^b	114.73^b	31.00^b	30.63^b
$ZnSO_4$ (0.5%) + yeast (0.4%)	134.00^a	135.67^a	34.63^a	35.30^a
$ZnSO_4$ (1.0%) + yeast (0.4%)	135.00^a	134.32^a	33.63^a	35.35^a

Means followed by the same letters within each column of each category are not significantly differed from each other at 5% level

Fruit Quality

Physical Properties: Data in Table 2 indicated that spraying Navel orange trees with yeast extract either alone or combined with $ZnSO_4$ significantly increased fruit weight than those of $ZnSO_4$ treatments as well as the control. Furthermore, combined treatment $ZnSO_4$ (1.0%) + yeast (0.4%) proved to be the most effective treatment for increasing fruit weight. Concerning fruit length $ZnSO_4$ at (1.0%) as combined with yeast at either 0.2 or 0.4% proved to be the most efficient combination in improving fruit length. This holds true for both seasons. Moreover, all treatments under study recorded higher values of fruit length as compared with the control in both seasons except those sprayed with $ZnSO_4$ at either (0.5%) or (1.0%). However, all treatments increased fruit volume of than that of $ZnSO_4$ (0.5%) treatment and the control. In both seasons, different combined treatments increased fruit volume over other treatments. The highly values were significantly obtained in descending order with 0.4% yeast + 1.0% $ZnSO_4$ followed by either o.4% yeast + 0.5 $ZnSO_4$ or 0.2% yeast + 1.0 $ZnSO_4$ treatments. Generally, the above results disclosed that the combination treatments highly improved all physical properties under study. These results partially agreed with the findings of Sayed [3] and Badawy [4] who found that micronutrient treatments affected fruit quality of Balady mandarin trees. Meanwhile, Bakry [10] indicated that spray Jafa orange trees with yeast extract improved fruit physical properties.

Chemical Properties: Data in Table 3 indicated that spraying 0.4% yeast combined with $ZnSO_4$ at either 0.5 or 1.0% gave fruits with significant higher values of

Table 2: Effect of spraying Navel orange trees with yeast extract and on physical fruit properties

	Fruit weight (gm)		Fruit length (cm)		Fruit volume (cm^3)	
Treatments	2008	2009	2008	2009	2008	2009
Control	120.00^{F}	125.63^{F}	5.63^{D}	5.33^{D}	126.30^{B}	126.70^{E}
$ZnSO_4$ (0.5%)	135.30^{E}	134.63^{E}	5.76^{D}	5.70^{D}	128.30^{B}	129.60^{E}
$ZnSO_4$ (1.0%)	136.70^{E}	138.63^{E}	5.63^{D}	5.76^{d}	136.63^{D}	137.62^{D}
Yeast (0.2%)	153.63^{D}	150.30^{D}	6.73^{C}	6.70^{C}	133.76^{D}	134.80^{D}
Yeast (0.4%)	165.30^{C}	167.63^{C}	6.80^{C}	6.76^{C}	146.63^{C}	149.63^{C}
$ZnSO_4$ (0.5%) + yeast (0.2%)	178.33^{b}	179.00^{B}	7.00^{b}	7.33^{b}	158.30^{b}	159.00^{D}
$ZnSO_4$ (1.0%) + yeast (0.2%)	179.33^{b}	180.30^{b}	7.63^{a}	7.59^{a}	159.36^{b}	159.63^{b}
$ZnSO_4$ (0.5%) + yeast (0.4%)	180.67^{b}	182.63^{b}	7.00^{b}	7.30^{b}	160.63^{b}	159.33^{b}
$ZnSO_4$ (1.0%) + yeast (0.4%)	186.70^{a}	185.60^{a}	7.63^{a}	7.57^{a}	170.30^{a}	169.13^{a}

Means followed by the same letters within each column of each category are not significantly differed from each other at 5% level

Table 3: Effect of spraying Navel orange trees with yeast extract and $ZnSO_4$ on chemical fruit properties

	TSS (%)		Total Acidity (%)		Ascorbic acid (mg/100 ml)	
Treatments	2008	2009	2008	2009	2008	2009
Control	9.60^{D}	9.50^{D}	0.81^{a}	0.81^{a}	36.67^{E}	37.33^{C}
$ZnSO_4$ (0.5%)	9.60^{D}	9.50^{D}	0.82^{a}	0.82^{a}	38.70^{D}	38.00^{BC}
$ZnSO_4$ (1.0%)	9.70^{D}	9.50^{D}	0.79^{b}	0.76^{b}	39.50^{D}	38.50^{C}
Yeast (0.2%)	9.70^{D}	9.60^{D}	0.78^{b}	0.78^{b}	36.06^{E}	39.00^{B}
Yeast (0.4%)	10.50^{C}	10.30^{C}	0.72^{C}	0.73^{C}	39.23^{B}	39.00^{B}
$ZnSO_4$ (0.5%) + yeast (0.2%)	10.60^{C}	10.80^{C}	0.72^{C}	0.74^{C}	39.36^{BC}	38.76^{BC}
$ZnSO_4$ (0.1%) + yeast (0.2%)	11.50^{b}	12.70^{a}	0.72^{C}	0.73^{C}	40.00^{B}	38.67^{BC}
$ZnSO_4$ (0.5%) + yeast (0.4%)	12.20^{a}	12.40^{a}	0.65^{D}	0.69^{D}	39.00^{BD}	39.16^{AB}
$ZnSO_4$ (1.0%) + yeast (0.4%)	12.00^{a}	12.23^{a}	0.66^{D}	0.63^{D}	42.37^{A}	40.43^{A}

Means followed by the same letters within each column of each category are not significantly differed from each other at 5% level

TSS than those of the other used treatments and the control. This holds true for both seasons except those of 0.2% yeast + 1.0% $ZnSO_4$ treatment which revealed higher values in the second season only. Regarding sole treatment of $ZnSO_4$ or yeast treatments, it is clear that trees sprayed with yeast (0.4%) in both seasons significantly increased TSS in fruit juice as compared with those sprayed with yeast extract and $ZnSO_4$ treatments. On the other hand, no significant differences were noticed in T.S.S. in fruit juice among spraying trees with $ZnSO_4$ at either (0.5%) or (1.0%) and dry yeast at (0.2%) as well as the control of both seasons.

Data in Table 3 also demonstrated that all combinations between yeast and $ZnSO_4$ significantly decreased juice acidity percent ages in both seasons. Moreover, 0.4% yeast combined with 1.0 or 0.5% $ZnSO_4$ in both seasons recorded the lowest acid contents followed in a descending order by 0.2% yeast + 0.5 or 1.0% $ZnSO_4$ and 0.4% yeast as compared with high acid contents of $ZnSO_4$ (0.5%) treatment and the control.

Concerning ascorbic acid content; data in Table 3 indicated that in both seasons, combined treatments between yeast and $ZnSO_4$ treatments significantly increased juice content of ascorbic acid as compared with those of sole treatments of yeast and $ZnSO_4$ as well as control. In addition, the highest significant fruit juice of ascorbic acid values were obtained when Navel orange trees were sprayed with $ZnSO_4$ (1.0%) + yeast (0.4%) treatment as compared with other treatments and the control for both seasons. Generally, the above results disclosed that the combined treatments of yeast extract + $ZnSO_4$ revealed highest improvement of tested chemical properties. These results partially agreed with the findings of Hegab [2] on Navel orange who reported that spraying micronutrients slightly reduced juice acidity. The results of chemical fruit quality induced by yeast treatment are emphasized by the findings of Bakry [10] and Mohamed [11] who found that spraying yeast extract increased TSS/acid ratio and vitamin C of Jafa orange trees and Balady mandarin.

REFERENCES

1. Subba Rao, N.S., 1984. Biofertilizer in Agriculture. Oxford IBH Company, New Delhi.
2. Hegab, M.Y., 1994. Effect of urea, some micronutrients and growth regulators on the yield fruit quality und some vegetative characteristic of Navel orange trees. Ph. Dissertation, Fac. Agric. Minia Univ., Egypt.
3. Sayed, R.A., 1998. Studies of foliar application of some nutrients on Balady mandarin grow in new reclaimed lands. Ph.D. Thesis Fac. Agric. Univ. Cairo.
4. Badawy-Sabah, M., 2005. Histophysiological effects of yeast and kinetin application on fruit characteristics and fruit growth stages of Balady mandarin cultivar. Ph. D. Thesis Hort. Pomology Fac. of Agric, Assuit, University, Egypt.
5. Barnett, J.A., E. Payne and D. Yarrow, 1990. Yeast Caracteristics and Identification. 2nd Ed. Cambridge Univ. Press.
6. Schirra, M., M.A. Gabbio, D.G. Hallewin, M. Pala and R. Ruggir, 1997. Response of Tarocco Oranges to picking date, post harvest, hot water dips and chilling storage temperature. J. Agric. And Food Chemistry, 45(8): 3216-3220.
7. A.O.A.C., 1990. Officinal of Analysis. The Association of Official Analytical Chemists. 15th Ed., West Virginia, USA D.C.
8. Snedecor, G. W. and W.G. Corhran, 1980. Statistically Methods 6th Ed., Iowa State Univ. Press Ames. Iowa, USA, pp: 593.
9. Duncan, D.B., 1955. Multiple Range and Multiple F. tests Biometrics, pp: 1101-42.
10. Bakry, K.H.A., 2007. Response of Jafa orange trees to spray with yeast extract and promalin. Egypt. J. Appl. Sci., 22(10A): 195-210.
11. Mohamed, O.A.F., 2008. Response of Balady Mandarin trees to foliar application with active yeast and some microelements. M.Sc. Faculty of Agriculture, Moshtohor, Benha University, Egypt.