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The Beneficial Effect of Biofertilizers and Antioxidants on Olive Trees under Calcareous Soil Conditions

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Abstract: The effect of spraying the antioxidants (ascorbic acid or citric acid) each at 1000 and 2000 ppm alone or combined with the biofertilizer 'Phosphorine' on yield and fruit quality of olive trees, were studied, under calcareous soil conditions. Results cleared that sole application of either ascorbic acid or citric acid 2000ppm improved yield and fruit quality. Where, reducing their concentration to 1000 ppm had meaningless effect on all studied characters. Promotive effects were found in yield, fruit quality and flesh oils content as the biofertilizer 'Phosphorine' combined with either ascorbic acid or citric acid at low level (1000 ppm). Spraying low level of either ascorbic acid or citric (1000 ppm) at 1st of April, May and June in combination with sole application of 'Phosphorine' at 5 gm/ tree suggested to be most beneficial for increasing yield and fruits with fairly quality of olive trees.

Key words: Biofertilizers · Antioxidants · Olive fruits · Calcareous soil

INTRODUCTION

Bio-fertilization for fruit crops has become in the last few years a positive alternative to chemical fertilizers. Application of biofertilizers as supplementary amendments to fruit crops reduce pollution happened concerning both soil and underground water. Soil microorganisms which are known as phosphate soluble bacterial (PSB) plays a fundamental role in converting the fixed form to soluble one useful for plants. The microbial break-down of organic soil matter is associated with an increased CO_2 production which possibility increases as the solubility of soil phosphate [1]. The biofertilizer 'Phosphorine' is a commercial product by the General Authority of Agricultural Fund and Equalization, contains an active strain of (PSB). Antioxidants such as ascorbic acid and citric acid have auxinic action and also synergistic effect on flowering and fruiting of fruit trees. Recently antioxidants used instead of auxins and other chemicals for enhancing growth and fruiting of various fruit trees [2, 3].

The present investigation was outlined to study the beneficial effects of biofertilizers ' Phosphorine' and antioxidants on yield and fruit quality of olive trees (Chemlali Cv.) planted in calcareous soil.

MATERIALS AND METHODS

Plant Materials: Fifty four olive trees (Chemlali Cv.) planted in Burg El Arab region (54 Km west of Alexandria) were selected in August to carry out this experiment during the successive seasons: 2005, 2006, 2007 and 2008. Trees were in "on year", uniform in size and vigor.

Field experiment: In 2005 and 3 years later, trees received the following applications:

- Control (non- application).
- Ascorbic acid at 1000 ppm.
- Ascorbic acid at 2000 ppm.
- Citric acid at 1000 ppm.
- Citric acid at 2000 ppm.
- Ascorbic acid at 1000 ppm + Phosphorine.
- Ascorbic acid at 2000 ppm + Phosphorine.
- Citric acid at 1000 ppm + Phosphorine.
- Citric acid at 2000 ppm + Phosphorine.

Ascorbic acid or citric acid were sprayed 3 times (1st April, 1st May and 1st June). The biofertilizer Phosphorine amendment was applied to every tree at 1 of April as follows: a well mixed of 5 g. of Phosphorine and 200 g. of calcium super phosphate were added to every tree. Fruit yield was determined in October and fruit

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Table 1: Analytical data of the soil at the tested area

Characteristics	Value
pH	8.8
Total N (ppm)	220.00
Total P (ppm)	11.00
Total Fe (ppm)	300.00
Total Mn (ppm)	65.00
Total Zn (ppm)	45.00
Organic matter (%)	0.18
Calcium carbonate (%)	21.50
Soil texture	Loamy sand

samples were taken at the same time to estimate fruit weight and flesh oil content according to A.O.A.C.[4]. Soil characteristics of Burg El-Arab region are presented in Table 1.

Statistical Analysis: Experiment was designed as randomized complete block with 3 replicates, one tree per each. Data was subjected to analysis of variance to determine the significant differences and Duncan's multiple range tests [5] was used for means comparison when F test was significant at $p \geq 0.05$.

RESULTS AND DISCUSSION

Tables 2-4 shows that Single application of either ascorbic acid or citric acid at 1000 *ppm* was more effective in raising olive yield and fruit quality, as compared with control. Meanwhile during the four seasons, raising its concentration from 1000 *ppm* to 2000 *ppm* substantially improved yield, fruit weight and flesh oil content. Auxinic action of both ascorbic and citric acid on enhancing cell division and cell enlargement which reflected positively on leaf area was concluded by Ahmed *et al.* [6, 7] and Omar [8]. On other side, accumulation of dry matter production in canopy and fruits can be assumed proportional to solar radiation intercepted by foliage resulting in more efficiency of photosynthesis process [9]. Therefore, expected increments of carbohydrates supply to fruits can explain improvements of yield fruit weight and flesh oil content obtained in this experiment.

Ascorbic acid and citric acid as antioxidants appears to be a powerful tool for improving yield, fruit weight and flesh oil content of olive trees (Chemlali Cv.) planted in calcareous soil.

Table 2: Effect of some antioxidants and the biofertilizer Phosphorine on yield of olive trees (Chemlali *Cv.*)

	Yield (kg / tree)			
Treatments	2005	2006	2007	2008
Control	11.00d	23.90d	10.98d	24.20d
Ascorbic acid (1000 ppm)	12.10c	25.95bc	12.60bc	26.80bc
Ascorbic acid (2000 ppm)	13.00b	26.20b	12.80b	27.01b
Citric acid (1000 ppm)	11.90c	25.80bc	12.55bc	26.70bc
Citric acid (2000 ppm)	13.05b	26.00b	12.85b	27.04b
Ascorbic acid (1000 ppm) + Phosphorine	13.70a	27.10a	14.60a	29.20a
Ascorbic acid (2000 ppm) + Phosphorine	14.05a	27.35a	15.08a	29.45a
Citric acid (1000 ppm) + Phosphorine	13.60ab	27.25a	14.70a	29.18a
Citric acid (2000 ppm) + Phosphorine	13.90a	27.42a	15.00a	29.40 a

According to Mean Separation by Duncan's multiple range test at 5% level

Table 3: Effect of some antioxidants and the biofertilizer Phosphorine on fruit weight of olive trees (Chemlali Cv.)

	Fruit weight (gm)			
Treatments	2005	2006	2007	2008
Control	1.22d	1.10e	1.26e	1.01e
Ascorbic acid (1000 ppm)	1.26c	1.23d	1.34c	1.24cd
Ascorbic acid (2000 ppm)	1.30b	1.25c	1.37b	1.28b
Citric acid (1000 ppm)	1.25c	1.24cd	1.33cd	1.26c
Citric acid (2000 ppm)	1.29bc	1.27bc	1.36bc	1.29b
Ascorbic acid (1000 ppm) + Phosphorine	1.34ab	1.32a	1.39a	1.35a
Ascorbic acid (2000 ppm) + Phosphorine	1.36a	1.34a	1.40a	1.37a
Citric acid (1000 ppm) + Phosphorine	1.38a	1.30ab	1.38ab	1.35a
Citric cid (2000 ppm) + Phosphorine	1.39a	1.32a	1.41a	1.36a

According to Mean Separation by Duncan's multiple range test at 5% level

Table 4: Effect of some antioxidants and the biofertilizer Phosphorine on flesh oil content of olive trees (Chemlali Cv.)

	Flesh oil content (% F.W)			
Treatments	2005	2006	2007	2008
Control	65.36d	64.22de	65.48d	64.56d
Ascorbic acid (1000 ppm)	66.60c	65.82c	66.71c	66.30bc
Ascorbic acid (2000 ppm)	66.75bc	66. 15b	66.86bc	66.45b
Citric acid (1000 ppm)	66.70c	65.95c	66.75c	66.40bc
Citric acid (2000 ppm)	66.88b	66.20b	66.96b	66.59b
Ascorbic acid (1000 ppm) + Phosphorine	67.00ab	67.00a	67.12ab	66.95a
Ascorbic acid (2000 ppm) + Phosphorine	67.15a	67.20a	67.30a	67.16a
Citric acid (1000 ppm) + Phosphorine	67.10a	67.18a	67.35a	67.00a
Citric cid (2000 ppm) + Phosphorine	67.30a	67.30a	67.41a	67.20a

According to Mean Separation by Duncan's multiple range test at 5% level

Regarding to the combined effect of "Phosphorine" application in addition to antioxidants, Tables 2-4 presents the significant increases of yield, fruit weight and flesh oil content compared to sole treatment of either ascorbic acid or citric acid as well as control. Moreover, Promotive effects were significantly found in yield and fruit quality as the biofertilizer "Phosphorine" combined with either ascorbic acid or citric acid at low level (1000 ppm). The important role of 'PSB' on solving the fixed phosphate in calcareous soils was studied by Osman *et al*. [10], who found that inoculation with 'PSB' increased P-uptake of plants under study. Results obtained concerning phosphorine can interpreted on the basis of role of phosphate in biological process through its information of pyrophosphate bonds which allow energy transfer. Many investigators i.e. Tombersi *et al*. [11] and Watanabe and Yoshida [12] reported that low phosphate levels were associated with reduction in the rate of photophosphoration and the rate of electron transfer in the photosynthetic chain.

Beneficial effects of phosphorine application as 'PSB' on yield and fruit quality in olive trees can be expected partially as a result of improvements in P level of trees grown in calcareous soils.

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