*J. Agric. Sci. Mansoura Univ., 25 (3): 1563 - 1572, 2000.*

# RESPONSE OF NAVEL ORANGE YIELD TO OPTIMIZED NUTRITION IN GHARBIA GOVERNORATE

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## ABSTRACT

Field trials were carried out to study the response of navel orange to optimized nutrition. The field trials were conducted during 94/95, 95/96 and 96/97 seasons in Tanta, Kafr El-Zayat, Bassioun and Kotour districts at Gharbia governorate.

The first season of all farms was considered as control and the amounts of fertilizers were applied according to the farmer practices. During 95/96 and 96/97 seasons, supplementary amounts of NPK were applied in soil together with spraying chelated micronutrients on leaves for correcting nutrient deficiency. Application of NPK, Fe, Mn and Zn led to both improvement of leaf nutritional status and considerable increase of yield in second and third seasons ranged between 25-60 and 52-70 % over check season, also, the average yield of farms improved from 42 % less than governorate average in 94/95 to excecd governorate average by 9 % in 96/97.

In addition, leaf analysis indicated that correction of micronutrients deficiency by foliar application led to increase macro and micronutrients concentration in leaves.

## INTRODUCTION

Citrus is the most important fruit crop in Egypt. The problem of yield production in navel orange was investigated by numerous researchers. Wallace, 1980, and El-Bendary *et al*., 1992, cleared that decrease of yield production may be related to nutrient imbalance; among other reasons. Need to micronutrients, especially, Zn, Mn and Fe supply has become necessary to aquire nutrient balance within plants as a tool to achieve high yield (Wallace, 1983). This is because of low availability of such elements in soil to plants grown under arid and semi arid climates characterized with high pH and low organic matter content (Sillanpää, 1982 and El-Fouly, 1983). Furthermore, most farmers tend to use large amounts of N and P fertilizers, while K and micronutrient fertilizers are mostly neglected. No consideration is given to specific fertilizer recommendation according to soil lasting and leaf analysis (El-Fouly, 1985). Positive yield responses to micronutrients foliar application were reported by Abd El-Hadi *et al*., (1986). In addition, El-Fouly *et al*., 1995 indicated that micronutrients foliar application can increase the yield of agronomic and horticultural crops by an average of 22 %.

It is worthly to mention here that, average yield of navel orange in the four private farms under investigation in Gharbia governorate was (6.5 ton/fed.) being 42 % less than governorate average (9.2 ton/fed.) in 94/95 (Anonymus, 1995). This investigation aimed to study the effect of optimized nutrition on yield production of navel orange in four private farmers located in four districts in Gharbia governorate.

## MATERIALS AND METHODS

The present study was carried out in 94/95, 95/96 and 96/97 seasons on "Washington Navel" Orange trees budded on sous orange rootstocks. Selected sites were private orchards located at Tanta, Kafr El-Zayat, Bassioun and Kotour districts, Gharbia governorate. Trees were 15-20-year old and the distances were 5 x 5 m apart. A representative soil samples from the surface layer of each orchard (0-40 cm) were collected during the first season (94/95) before fertilizers application for analysis (Table 1,2). During the first season, all the orchards received available amount of fertilizers depending on farmer practices for each farm. During the second and third seasons, the amounts of fertilizer were adjusted according to the results of soil testing and leaf analysis (specific recommendation for each orchard). The organic manure added as one dose on Dec., nitrogen was split into four doses, added on March, May, July and August as ammonium sulphate and ammonium nitrate (Table 3). Phosphorus was added as single application on Dec., as supper phosphate mixed with organic manure. Potassium was added at two doses, i.e., March and July as potassium sulphate. Chelated compound with Zn, Mn and Fe, i.e., Wuxal sus Zn (4 % Zn + 2.7 % Mn + 1.35 % Fe and 14 % N) was splited during into three doses and was added prior to bloom, end of fruit set and during fruit development. Leaves were sampled in Sept. from 4-7 month old spring cycle leaves on fruit bearing terminals taken at random from each orchard (all seasons) to determine nutrient concentration (Figs. 1&2). Yield of each orchard was recorded as tons/feddan (Fig.3).

**Soil tests :**

Soil samples were air-dried and sieved through 2mm pores. Determination of texture (Bauyoucos, 1954), pH, E.C. in 1:2.5 soil : water (Jackson, 1973), organic matter (Walkley and Black, 1934), calcium carbonate (Black, 1965), $NaHCO_3$ extractable-P (Olsen *et al*., 1954), $NH_4$-OAC extractable-K, Mg (Jackson, 1973) and DTPA-extractable-Fe, Mn, Zn and Cu (Lindsay and Norvell, 1978).

**Leaf analysis :**

Leaf samples were washed with a sequence of tap-water, (0.01 N) HCl-acidified bidistilled water and bidistilled water, respectively, and were oven-dried at 70 $^{o}$C. Dried samples were ground in stainless steel mill. Total nitrogen using micro-kjeldahl method (Allen, 1953; Ma and Zauzaga, 1942). P, K, Mg, Fe, Mn, Zn and Cu concentrations in leaves were determined using wet digestion method with a mixture of nitric, perchloric and sulphuric acids (8:1:1 v/v) according to Chapman and Pratt (1978). The values are evaluated according to Ankerman and Large (1974). The data were statistically analyzed according to the methods discribed by Snedecor and Cochran (1967).

**Table (1) : Soil physico-chemical character of orange orchards in 1994/1995 season.**

| Character | 4 Orchards | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | Mean | SD |
| Sand % | 13 | 19 | 20 | 20 | 18 | ± 3.37 |
| Sill % | 27 | 33 | 28 | 37 | 31 | ± 2.33 |
| Clay % | 60 | 48 | 52 | 43 | 51 | ± 3.59 |
| Texture | clay | clay | clay | clay | clay | |
| pH (1:2.5) | 7.8 | 7.9 | 7.5 | 7.4 | 7.65 H | ± 0.12 |
| E.C (mmhos/cm) | 0.71 | 0.86 | 0.55 | 0.83 | 0.74 L | ± 0.19 |
| $CaCO_3$ % | 2.88 | 3.92 | 3.30 | 3.60 | 3.53 M | ± 0.22 |
| O.M % | 1.70 | 1.52 | 1.8 | 1.98 | 1.75 L | ± 0.09 |

**L : Low M : Medium H : High**

**Table (2): Nutrients concentration in soils of orange orchards in 1994/1995 season.**

| Character | 4 Orchards | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | Mean | SD |
| **Mg/100 Soil** | | | | | | |
| N | 59.5 | 53.2 | 63.0 | 69.3 | 61.25 H | ±2.67 |
| P | 4.1 | 2.6 | 4.72 | 1.98 | 3.35 H | ±0.64 |
| K | 32 | 28 | 35 | 32.5 | 31.88 H | ±1.54 |
| Mg | 85.9 | 58.5 | 152 | 130 | 106.00 M | ±20.6 |
| **Mg/Kg Soil** | | | | | | |
| Fe | 8.3 | 4.2 | 8.3 | 15.9 | 9.18 L | ±2.44 |
| Mn | 9.6 | 7.1 | 9.1 | 9.8 | 8.9 L | ±0.56 |
| Zn | 0.6 | 1.1 | 0.7 | 1.01 | 0.85 L | ±0.12 |
| Cu | 3.6 | 2.7 | 5.4 | 7.5 | 4.80 H | ±1.06 |

**L : Low M : Medium H : High**

## RESULTS AND DISCUSSION

Data presented in Table (1) showed that clay soils of the 4 orchards were characterized, in average by low organic matter and high pH values. The negative effects of such conditions known to reduce the availability of Fe, Mn and Zn (Table 2) to plants (Sillanpää, 1982 and Wallace, 1983). Moreover, compactness of heavy soil limits the ability of plants to take up adequate amounts of available nutrients leading to shortage of plant nutrient needed for high yield (Talha *et al*., 1978; El-Sayed *et al*., 1992). Low organic matter and high amount of clay content (above 40 %) in soils probably contribute to more potassium fixation by clay minerals, and thus the high demand for K due to such unfavorable soil condition might occurred.

Changes in macronutrients status of orange leaves are showed in Fig. (1). N and P concentrations in orange leaves were positively affected by micronutrients foliar application. N and P concentrations were positively higher in 95/96 and 96/97 seasons compared to those observed in 94/95 season. The highest N and P concentrations were observed in 96/97 season.

Potassium concentration in leaves was almost the same in both 95/96 and 96/97 seasons and was higher than that observed in check season (94/95).

Data in Fig. (1) showed that Mg-concentration was negatively affected by increasing K-concentration in leaves in 95/96 and 96/97 season compared to control season.

K/Mg ratio was increased in 95/96 and 96/97 seasons over the control season. Results presented in Fig. (1) showed that the highest improvement in K/Mg ratio was obtained in 95/96.

Concerning micronutrients concentration on orange leaves, it was found that the highest increase in Fe, Mn, Zn and Cu concentrations occurred in 95/96, while in 96/97 season, the leaves contained less Cu-concentration compared to other two seasons.

Results in Table (3) classify that in the first season (94/95) all orchards added high amounts of N and P, no micronutrients were applied and two of these orchards neglected K.

Values in Figs. (1), (2) and (3) showed that in check season, yield decrease was accompanied by relatively more nitrogen, low potassium and micronutrient concentrations in leaves compared with 95/96 and 96/97 seasons. Using optimized nutrition (Table 3) based on soil tasts and plant analysis which include increase of organic matter and K application, reduction of N and P and foliar application of chelated micronutrients compounds, led to positive response on nutrient status of tress in general. The use of optimized nutrition in the four experimental farms resulted in improving the yield (ton/fed) in both 95/96 and 96/97 seasons by 25-60 % and 42-70 % respectively compared to the check season (94/95) as shown from data illustrated in Fig. (3) and the yield moved from 42 % less than the governorate average in 94/95 to 3 % less than the governorate average in 95/96 season and exceed the governorate avergae in 96/97 season by 9 % (Fig. 3).

Disorders in the balance between elements in the nutrient medium result in manifested deficiencies and a decrease in plant growth and development.

Correction of plant nutrition disorders may be accomplished by foliar application of necessary nutrient (Miller *et al*., 1995a).

Foliar application of micronutrients was successful in correction their deficits and improving nutritive status in leaves which led to high yields in 95/96 and 96/97 seasons.

Correction of micronutrients deficiency through foliar supply promoted further nutrient uptake through the roots. In this connection, Mobarak and Abdalla; Hahr, 1987; El-Fouly and Fawzi 1982; Amberger, 1980 and Balba, 1980 reported that micronutrients foliar spray improve root growth and lead to greater absorbing surface of the root and consequently increase nutrients uptake by roots.

Many studies were conducted to show the effect of micronutrient foliar application on different crops (El-Fouly *et al*., 1990; Miller *et al*., 1995b and Abd El-Hadi *et al.,* 1995).

The results presented give evidence that the decrease of yield production of navel orange is related to nutrient imbalance and this problem could be improved by using optimizing nutrition with considerable macro and micronutries based on the results of soil tests and plant analysis.

Table 3

**Fig. (1) Effect optimized nutrition on macronutrients concentrations in leaves of navel orange in Gharbia governorate during 94/95, 95/96 and 96/97 seasons (mean ± SD of four private farms).**

**Fig. (2) Effect optimized nutrition on micronutrients concentrations in leaves of navel orange in Gharbia governorate during 94/95, 95/96 and 96/97 seasons (mean ± SD of four private farms).**

**Fig. (3) Effect of the optimized nutrition on navel orange yield in Gharbia Governorate during 94/95, 95/96 and 96/97 seasons (mean ± SD of four private farms).**

## ACKNOWLEDGMENT

This work was conducted as a part of the Egypto-German project "Micronutrients and Other Nutrition in Egypt" executed National Research Centre NRC (coordinator, Prof. Dr. M.M. El-Fouly) and the Institute for Plant Nutrition. Technical University, Munich. The project was supported by the Egyptian Academy of Scientific Research and Technology (ASRT) and German Federal Ministry of Technical Cooperation (BMZ) through the German Agency for Technical Cooperation (GTZ).

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## استجابة محصول البرتقال أبو سرة للتغذية المرشدة فى محافظة الغربية

**محمد فتحى المصرى و أسامة أنور نوفل**

**قسم النبات ، المركز القومى للبحوث ، دقى - مصر**

أجريت تجارب حقلية لدراسة استجابة البرتقال ابو سرة للتغذية المرشدة. ولقد أجريت التجارب أثناء مواسم 95/94 ، 96/95 ، 97/96 فى مراكز طنطا وكفر الزيات وبسيون وقطور بمحافظة الغربية. ولقد أعتبر أول موسم فى كل المزارع كمقارنة، حيث كانت كميات الاسمدة المضافة طبقاً لمعاملات المزارع، بينما اضيفت الكميات التكميلية من ن، فو، بو معاً فى التربة مع رش المغذيات الصغرى المخلبية على الأوراق لتصحيح النقص الغذائى وذلك أثناء موسمى 95/96 / 97/96.

ولقد أدت إضافة ن ، فو ، بو / ح ، من ، خ الى تحسين كلاً من الحالة الغذائية للأوراق وزيادة معقولة فى المحصول فى الموسم الثانى والثالث بزيادة تراوحت ما بين 25-60 %، 52-70 % عن موسم المقارنة، كذلك تحسن متوسط محصول المزارع من 42 % أقل من متوسط المحافظة فى 95/94 الى زيادة عن متوسط المحافظة بـ 9% فى 97/96 بالإضافة الى تحليل الأوراق أكد أن تصحيح نقص العناصر بالإضافة رشاً أدى الى زيادة تركيز العناصر الكبرى والصغرى فى الأوراق.

**Table (3) : Doses of different fertilizers which used in the four orchards in 94/95, 95/96 and 96/97 seasons.**

| Fertilizer | 94/95 | | | | 95/96 | | | | 96/97 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | orch. 1 | orch. 2 | orch. 3 | orch. 4 | orch. 1 | orch. 2 | orch. 3 | orch. 4 | orch. 1 | orch. 2 | orch. 3 | orch. 4 |
| Organic Manure (m3/fed) | 15 | 20 | 20 | 25 | 25 | 20 | 25 | 25 | 25 | 20 | 25 | 25 |
| Nitrogen (kg/fed) $(NH_4)SO_4$ | 900 | 850 | 1100 | 1000 | 700 | 650 | 800 | 750 | 650 | 600 | 700 | 650 |
| $NH_4 NO_3$ | - | - | - | - | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Phosphorus (kg/fed.) $Ca_2 HPO_4$ | 600 | 400 | 600 | 400 | 450 | 300 | 450 | 350 | 300 | 300 | 300 | 300 |
| Potassium (kg/fed.) $K_2SO_4$ | 100 | - | 100 | - | 175 | 150 | 200 | 150 | 200 | 175 | 200 | 200 |
| Micro-nutrients (kg/fed.) Wuxal Sus-Zn | - | - | - | - | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |