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# Effect of Using Conventional Versus Nano NPK on Fruiting of Valencia Orange Trees

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**Abstract:** During 2021 and 2022 seasons, Valencia orange trees received NPK as 100% via normal system (2976.0 g ammonium nitrate / tree / year + 1488.0 g potassium sulphate / tree/ year + 1190.0 g calcium superphosphate/ tree/ year) or as 60 to 90 % via normal system and 10 to 40 % via nano-technology system as same NPK (at 0.1 to 0.4% spraying three times during seasons Hyper feed amino compound). The target was selecting the best ratio between different NPK sources. Using the 60 to 90% via normal mineral NPK source plus 10 to 40 % spraying the same nutrients via nanotechnology (Hyper feed Amino at 0.1 to 0.4 %) gave good results on some vegetative growth characteristics, leaf pigments and nutrients, yield and quality in fruit of Valencia orange trees grown in Bany Suef region conditions comparing with using NPK as 100% via normal mineral. The increasing content of investigated the parameters was significantly related to the reduction of normal form NPK percentages from 90 to 60% and at the same time to increasing percentages of NPK via nanotechnology form from 10 to 40% (spraying Hyper feed Amino compound from 0.1 to 0.4 %). The result obtained in the present study indicates that fertilizers Valencia orange trees with NPK as 60 % via normal system (1785.6 g ammonium nitrate + 892.8 g potassium sulphate + 714.0 g calcium superphosphate / tree / year in addition to spraying Hyper Feed Amino compound at 0.4% three times during season gave the best results regarding yield and fruit quality.

**Key words:** Valencia orange trees · Nanotechnology yield · Fruit quality · NPK

## INTRODUCTION

Nitrogen, phosphorus and potassium fertilizers are major sources of plant nutrient that can be added either to the soil or foliar to supplement its natural fertility. These fertilizers can be credited for improving fruit quality as well as quantity. Literature concerning the effect of these fertilizers on some vegetative growth traits, leaf composition, yield and fruit quality. Kotur and Mustaffa, [1] found in their studies on the influence of N application on Robusta banana that raising the nitrogen rates increased significantly leaf nitrogen and decreased both P and K content. The same finding was noticed by Singh and Rajput, [2] who indicated that that N level in leaves increased with raising urea fertilization. Chapman, [3] on Imperial mandarins, Carcia *et al*., [4] on banana and Takatsuji and Ishihara, [5] on Satsuma mandarins indicated that increasing K level, increased K contents of leaves and decreased N and P contents. On the other hand, Bakr *et al*., [6] on Valencia orange trees and Bazeleth *et al*., [7] on Shamouti orange trees stated that K application had no appreciable effect on leaf N and P contents. Baruch and Mohan, [8] reported that potassium has announced roles in stimulating the biosynthesis and translocation of cell division, plant pigments and carbohydrates, the resistance to insect, disorders and colds, osmotic pressure of cells, water uptake of roots and cell enlargement [9].

Nanofertilizers are one of the nutrient carries developed using substrates of 1 to 100 nm nano dimensions used solely or in combination to improve the plants growth, the yield and plant performance. It was made from conventional fertilizers extracted from different plants or the plant parts by coating them with nanomaterials. Nanofertilizers have many other names like the nano-carriers, nanoenabled fertilizers,

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Bionanofertilizers, controlled released nano-fertilizers, NPs- based nutrient and nano- based delivers systems of micronutrients, which delivers nutrients at the right time and in the right place [10].

Nano-fertilizers play a significant role in physiological and biochemical processes by improving some nutrients availability, which can help in the enhancement of metabolic processes and stimulate meristematic activities, resulting in increased apical growth and photosynthetic. Nano-fertilizers are crucial for increasing vegetative growth aspects, flowering and so increasing productivity, product quality and shelf life of fruits. Nano fertilizers balance the release of N, P, K and other macronutrients fertilizers absorbed by the plant. It also avoids nutrient losses and unwanted interactions of some nutrients with water, air and especially microorganisms [11].

The formulation of nanofertilizer allows for the controlled release of nutrients in accordance with crop needs and prevents nutrients interactions with soil, water and microorganisms that results in the immobilization of nutrients [12]. Anticipated that dual benefits of an easily absorbed plant micronutrient and a bio-stimulant [13].

Obviously, there is an opportunity for via nano to have a significant influence on energy, the economy and the environment, by improving fertilizers, hence nanotechnology has a high potential for achieving sustainable agriculture especially in developing countries [14-17]. Practice the 4Rs of fertilizing plants to maximize plant uptake and minimize losses to the environment: apply the right fertilizer, in the right place, in the right amount and at the right time.

Using some nutrients via normal system was found by El- Sayed- Esraa, [18] and Ahmed, [19] to improve the yield of Ewaise and Keitte mango trees. Abd- El-Latief, [20] on Balady mandarin trees, AbouEl-Komsan *et al*. [21] on Balady orange trees.

Previous studies showed that using fertilizers via nantechnology system was superior to using normal forms in improving the growth, the yield and fruit quality of different fruit crops. Sabir *et al*., [22] on grapevines, Refaai, [23] on Zaghloul date palms, Roshdy *et al*. [24] on Zaghloul date palms, Ahmed, [25] on flame seedless grapevines. Abdalla, [26] on Zaghloul date palms, El-Wany, [27] on superior grapevines and Ismaiel and aboel-Anin, [28] on citrus fruits.

The target was elucidating the comparative effect of nanotechnology NPK fertilizers versus conventional ones with respect to performance of Valencia orange trees.

Table 1: Analysis of the tested soil

| Content | Values | Content | Values |
|---|---|---|---|
| Sand % | 9.1 | Total N% | 0.15 |
| Silt % | 11.7 | Available P (ppm) | 6.22 |
| Clay % | 79.2 | Available K (ppm) | 411.0 |
| Texture | Clay | Fe (ppm) | 23.9 |
| pH (1: 2.5 extract) | 7.86 | Zn (ppm) | 5.1 |
| EC (1: 2.5 extract) mmhos | 0.77 | Mn (ppm) | 20.2 |
| Organic matter % | 2.21 | | |
| $CacO_3$% | 1.55 | | |

## MATERIALS AND METHODS

The study was conducted during 2021 and 2022 growing seasons at a private orchard in Ahnasia district, Bany- Suef Governorate, Egypt, on 12 uniform in vigor 22- years old orange trees (*Citrus sinensis* L., cv. Valencia) budded on sour orange rootstock. The orchard soil was clay in texture with a water table of not less than 2 m deep. Trees were planted at 5.0 *5.0 meters apart (168.0 trees/ fed). Soil analysis was conducted according to the procedures outlined by Wilde *et al*., [29] Table 1 and surface irrigation system was carried out and using Nile water.

Selected trees (twelve trees) received the usual horticultural practices which are by the ministry of agriculture.

This experiment comprised the following four treatments:

$T_1$ - Control (regular NPK fertilizers at 100% normal) (2976.0 g ammonium nitrate / tree / year + 1488.0 g potassium sulphate / tree / year + 1190.0 calcium superphosphate / tree/ year).

$T_2$ - Regular NPK fertilizers at 90% normal (2678.4 g ammonium nitrate / tree + 1339.2 g potassium sulphate / tree+ 1071.0 g calcium superphosphate / tree) the remaining 10% via spraying Hyper Feed amino compound at 0.1%.

$T_3$ - Regular NPK fertilizers at 80% normal (2380.8 g ammonium nitrate / tree + 1190.4 g potassium sulphate / tree+ 952.0 g calcium superphosphate / tree) the remaining 20% via spraying Hyper Feed amino compound at 0.2%.

$T_4$ - Regular NPK fertilizers at 60% normal (1785.6 g ammonium nitrate / tree + 892.8 g potassium sulphate / tree + 714.0 g calcium superphosphate / tree) the remaining 40% via spraying Hyper Feed amino compound at 0.4%.

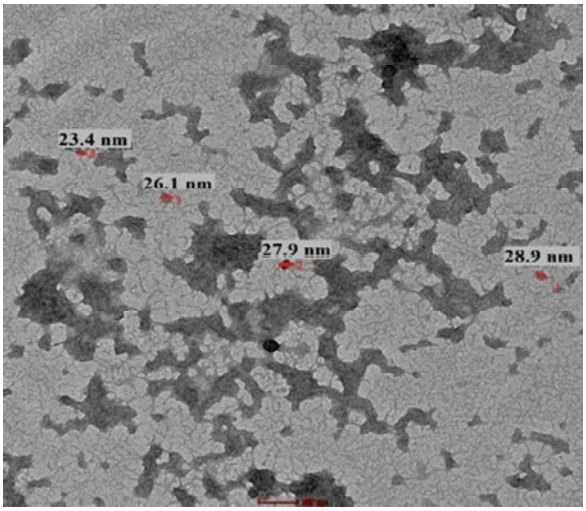


Fig. 1: TEM image of CS-NPK NF.

Each treatment was replicated three times, one Valencia orange trees per replicate and it was noticed that the Nano needs for the selected trees are met with three sprays according to what is written on the package. Regular sources of NPK via normal system, N source was applied in the source of ammonium nitrate (33.5 % N) was the nitrogen source. It was splatted into three equal batches and applied on the first week of March, May and August for the two consecutive seasons. Potassium sulphate (48% $K_2O$) was the source of potassium, it was splatted two equal batches and applied at the first week of March and August. Calcium superphosphate (15.5 % $P_2O_5$) was the source of phosphorous. It was added once at the first week of January during both seasons. Hyper Feed amino compound (19% N, 19% $P_2O_5$, 19 % $K_2O$, 0.5 % Fe, 1% Mg, 0.25 % Mn, 0.35 % Zn, 0.1 % B, 0.1% Cu, 5% amino acids and 0.5 % Alga extracts) was sprayed three times at the first week of March, May and August. Triton B as a wetting agent was added to all Hyper feed amino compound solutions at 0.5 ml/ L. spraying was done till run off (25 L. / tree). The amount of spray solution and concentration of spray solution were sufficient for the trees needs.

Complete randomized block design (CRBD) was followed for statistical analysis of the present Investigation.

**Measurements:** During both seasons the following measurements were recorded:

Shoot length (cm), shoot thickness (cm) and leaf area ($cm^2$) of the spring growth flush according to Ahmed and Morsy [30].

Chlorophylls a, b, total chlorophylls and total carotenoids (as mg/1.0g F.W) according to Hiscox and Isralstam, [31]. Total carbohydrates % in the leaves according to A.O.A.C., [32].

Leaf content of N, P and K (as%) and Fe, Zn and Mn (as ppm) were determined according to Summer, [33] and Wilde *et al*., [29].

Yield was expressed in weight (kg.) and number of fruits per tree.

Physical and chemical characteristics of fruits namely; weight (g.), percentages of fruit peel weight, fruit peel thickness (cm), TSS%, titratable acidity % (as a critic acid /100 ml juice) [32]. Total and reducing sugars (%) according to Lane and Eynon, [34] and vitamin C content according to A.O.A.C., [32].

**Transmission Electron Microscope (TEM) Analysis Result:** Transmission electron microscope (TEM) gave us information on the particle shape and the determination of particle size. Typical TEM micrograph of the CS-NPK NF was shown in Figure 1. CS-NPK NF has nearly spherical shape, smooth surface and average size about 26.6 nm [35].

**Statistical Analysis:** The experiment was arranged as a complete randomized blocks design and the collected data were statistically analyzed according to Mead *et al*., [36]. Means of treatments were compared using New L.S.D at 5% level of probability by Steel and Torrie [37].

## RESULTS AND DISCUSSION

**Vegetative Growth Characteristics:** It is clear from the data in Table 2 that fertilizing Valencia orange trees with NPK via regular fertilizers at 90 to 60% and the remaining 10 to 40% of the requirements by spraying Hyper Feed Amino significantly enhanced shoot length, leaf area and shoot thickness of the spring growth cycle compared control. Reducing Percentage of regular fertilizers from 100 to 60% and increasing percentages of Spraying Hyper Feed from 0.0 to 0.4% were accompanied with a gradual increase of those characteristic on such three growth characters.

The maximum values were recorded for trees that were fertilized by regular NPK at 60% (1785.6g ammonium nitrate + 892.8/g potassium sulphate + 714.0g. calcium super phosphate/tree) plus Spraying Hyper feed Amino at 0.4% three times during seasons. Whereas, the least values were attained by control trees. These results were true during 2021 and 2022 seasons as New L.S.D at 5% level of probability.

Table 2: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on some vegetative growth characteristics of Valencia orange trees during 2021 and 2022 seasons

| | Shoot length (cm) | | Leaf area $(cm)^2$ | | Shoot thickness (cm) | |
|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 6.10 | 6.25 | 25.50 | 26.00 | 0.14 | 0.15 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 7.15 | 7.50 | 26.40 | 26.80 | 0.17 | 0.18 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 8.20 | 8.45 | 27.30 | 28.00 | 0.19 | 0.21 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 9.15 | 9.50 | 28.10 | 29.00 | 0.22 | 0.23 |
| New LS.D. at 5% | 0.19 | 0.21 | 0.14 | 0.15 | 0.03 | 0.04 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)
-NPK via nanotechnology system (Hyper Feed amino compound).

Table 3: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on chlorophylls A, B and total chlorophylls in the leaves of Valencia orange trees during 2021 and 2022 seasons

| | Chlorophyll a (mg/ g F.W.) | | Chlorophyll b (mg/ g F.W.) | | Total chlorophylls (mg/ g F.W) | |
|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2020 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 1.13 | 1.17 | 0.71 | 0.70 | 1.84 | 1.87 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 1.25 | 1.33 | 0.81 | 0.84 | 2.06 | 2.17 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 1.41 | 1.45 | 0.88 | 0.91 | 2.29 | 2.36 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 1.55 | 1.60 | 0.95 | 0.98 | 2.50 | 2.58 |
| New LS.D. at 5% | 0.11 | 0.13 | 0.07 | 0.08 | 0.14 | 0.15 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)
-NPK via nanotechnology system (Hyper Feed amino compound).

Table 4: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on total carotenoids, total carbohydrates % and percentages of N, P and K in the leaves of Valencia orange trees during 2021 and 2022 seasons

| | Total carotenoids (mg/g.f.w.) | | Total carbohydrates % | | Leaf N % | | Leaf P % | | Leaf K % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 0.66 | 0.68 | 24.5 | 25.0 | 1.60 | 1.60 | 0.16 | 0.17 | 1.05 | 1.07 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 0.72 | 0.75 | 27.3 | 28.0 | 1.68 | 1.71 | 0.19 | 0.21 | 1.11 | 1.14 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 0.81 | 0.84 | 29.5 | 29.8 | 1.77 | 1.81 | 0.24 | 0.25 | 1.19 | 1.22 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 0.92 | 0.95 | 31.0 | 32.0 | 1.84 | 1.88 | 0.27 | 0.28 | 1.23 | 1.26 |
| New LS.D. at 5% | 0.06 | 0.07 | 0.5 | 0.6 | 0.03 | 0.04 | 0.02 | 0.03 | 0.06 | 0.07 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)
-NPK via nanotechnology system (Hyper Feed amino compound).

Table 5: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on content of Fe, Zn and Mn (as ppm) in the leaves of Valencia orange trees during 2021 and 2022 seasons

| | Fe (ppm) | | Zn (ppm) | | Mn (ppm) | |
|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 61.5 | 62.0 | 48.5 | 49.0 | 44.5 | 45.0 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 64.2 | 65.0 | 51.5 | 52.0 | 46.0 | 46.5 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 68.3 | 68.8 | 53.6 | 54.0 | 47.7 | 48.0 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 70.2 | 71.0 | 57.2 | 58.0 | 48.5 | 49.0 |
| New LS.D. at 5% | 1.2 | 1.4 | 1.1 | 1.2 | 0.9 | 1.1 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)
-NPK via nanotechnology system (Hyper Feed amino compound).

**Leaf Chemical Composition:** It is clear from the data in Tables 3 to 5 that some plant pigments namely chlorophyll a, chlorophyll b, total chlorophylls, total carotenoids and total carbohydrates % and some mineral elements like N, P, K, Fe, Zn and Mn in the leaves were significantly improved in response to fertilizing the trees with regular NPK 90 to 60% plus spraying the trees three times with NPK via nanotechnology system at 10 to 40% relative to using NPK via normal system at 100%.

The increasing in concentrations of these parameters were significantly associated with reducing regular NPK fertilizers percentages from 100 to 60% and at the same

time increasing percentages of NPK via nanotechnology from 40% to 0.0 spraying Hyper feed Amino at 0.0 to 0.4%. The maximum values were recorded for the trees that were fertilized by regular NPK at 60% (1785.6g ammonium nitrate /tree + 892.8g potassium sulphate /tree +714.0g calcium superphosphate/tree) plus fertilizers NPK via nanotechnology system at 40% spraying Hyper feed Amino three times during seasons at 0.4%.

Control trees attained the lowest values. These results were true during 2021 and 2022 seasons were compared using New L.S.D at 5% level of probability.

**The Yield per Tree:** It is clear from the data in Table 6 that using NPK at 90 to 60% as regular fertilizers plus spraying NPK as 10 to 40% of the full requirements significantly improved the yield expressed as number of fruits / tree and weight (kg) relative to control. A significant decline in the yield was observed when regular NPK percentage was lowered to 60 to 90% and fertilizers of NPK via nanotechnology at 10 to 40%.

The best results with regard to yield were obtained with using fertilizers NPK via normal system at 60% (1785.6g ammonium nitrate / tree + 892.8g potassium sulphate /tree + 714.0g calcium superphosphate / tree) plus fertilizers NPK via nanotechnology system at 40% (spraying Hyper feed Amino compound three times at 0.4%) under such promised treatment the yield / tree reached 65.70 and 67.70 kg compared with yield of the trees fertilizers NPK as 100% normal system that reached 52.70 and 56.0kg. during both seasons, respectively the percentage of increase in the yield to using the pervious treatment over the fertilizers NPK as100% normal system reached 24.7 and 20.9 % during 2021 and 2022 seasons during both seasons by using New L.S.D at 5% level of probability.

Table 6: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on yield and fruit weight of Valencia orange trees during 2021 and 2022 seasons

| | No. of fruits/tree | | Yield /tree (kg) | | Fruit weight (g) | |
|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 340.0 | 350.0 | 52.70 | 56.00 | 155.0 | 160.0 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 348.0 | 360.0 | 56.38 | 61.20 | 162.0 | 170.0 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 360.0 | 370.0 | 63.00 | 65.86 | 175.0 | 178.0 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 365.0 | 372.0 | 65.70 | 67.70 | 180.0 | 182.0 |
| New LS.D. at 5% | 6.8 | 7.1 | 3.6 | 3.8 | 5.3 | 5.5 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)
-NPK via nanotechnology system (Hyper Feed amino compound).

Table 7: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on some physical characteristics of Valencia orange fruits during 2021 and 2022 seasons

| | Fruit peel weight % | | Fruit peel thickness (cm) | | Juice % | |
|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 22.5 | 22.2 | 0.33 | 0.31 | 41.2 | 41.5 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 21.2 | 21.0 | 0.30 | 0.29 | 41.9 | 42.2 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 19.6 | 19.2 | 0.29 | 0.27 | 42.8 | 43.0 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 18.3 | 18.0 | 0.28 | 0.26 | 44.0 | 44.5 |
| New LS.D. at 5% | 0.9 | 1.1 | 0.02 | 0.02 | 0.6 | 0.7 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)
-NPK via nanotechnology system (Hyper Feed amino compound).

Table 8: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on some chemical characteristics of Valencia orange fruits during 2021 and 2022 seasons

| | TSS % | | Titratable acidity % | | TSS / acid ratio | |
|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 11.3 | 11.5 | 1.405 | 1.388 | 8.0 | 8.3 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 12.1 | 12.3 | 1.305 | 1.285 | 9.3 | 9.6 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 12.7 | 12.8 | 1.210 | 1.190 | 10.5 | 10.8 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 13.2 | 13.3 | 1.050 | 1.005 | 12.6 | 13.2 |
| New LS.D. at 5% | 0.5 | 0.6 | 0.028 | 0.033 | 0.9 | 1.1 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)
-NPK via nanotechnology system (Hyper Feed amino compound).

Table 9: Effect of foliar application with nano NPK as a partial substitute for normal NPK fertilizer on some chemical characteristics of fruits of Valencia orange trees during 2021 and 2022 seasons

| | Total sugars % | | Reducing sugars % | | Vitamin C (mg/100ml Juice) | |
|---|---|---|---|---|---|---|
| Treatments | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| $T_1$- NPK as 100% Normal | 6.8 | 6.9 | 3.2 | 3.3 | 42.6 | 43.0 |
| $T_2$- NPK as 90% Normal + NPK as 10% nano | 7.3 | 7.5 | 3.8 | 4.0 | 44.0 | 44.4 |
| $T_3$- NPK as 80% Normal + NPK as 20% nano | 7.9 | 8.2 | 4.4 | 4.5 | 46.2 | 46.8 |
| $T_4$- NPK as 60% Normal + NPK as 40% nano | 8.6 | 8.9 | 4.8 | 5.0 | 47.5 | 48.2 |
| New LS.D. at 5% | 0.3 | 0.4 | 0.2 | 0.3 | 0.6 | 0.7 |

-NPK via normal system (Ammonium nitrate 33.5 % N – calcium superphosphate 15.5 % $P_2O_5$- potassium sulphate 48% $K_2O$)

-NPK via nanotechnology system (Hyper Feed amino compound).

**Some Physical and Chemical Characteristics of the Fruits:** Data in Tables 4, 5 and 6 clearly show that supplying the trees with regular NPK at 60 to 90% plus the remaining NPK requirement i.e. 10 to 40% via spraying significantly improved fruit quality in terms of increasing fruit weight, juice %, TSS%, TSS/acid ratio, total and reducing sugars % and vitamin C content and decreasing fruit peel weight %, fruit peel thickness and titratable acidity % relative to using NPK completely via normal system alone. The promotion on the fruit quality was significantly associated with reducing percentages of regular NPK from 90 to 60% at the same time increasing concentrations of sprayed NPK from 10 to 40% of the total requirements via spraying. The best results with regard to some physical and chemical characteristics of the fruits were attributed to applying regular NPK fertilizers with NPK at 60% i.e. (1785.6g ammonium nitrate /tree + 892.8g potassium sulphate /tree + 714.0g calcium superphosphate /tree) plus fertilizers applying the remaining NPK requirement a=i.e. 40% via spraying Hyper feed Amino compound three times at 0.4%. Significantly lower fruit quality were the observed on the trees that were fertilized with regular NPK at 100% of the requirements. These results were true during 2021 and 2022 seasons at 5% probability.

## DISCUSSION

Nanotechnology has provided the feasibility of exploiting nanostructured or nanoscale materials as the fertilizers carries or controlled release vectors for building of So-called smart fertilizer as new facilities to enhance some nutrients use efficiency [38].

Encapsulation of fertilization within a nano-practical is one of these new facilities which are done in the following three ways (1) Nutrients can be encapsulated inside nanoporous materials. (2) Coated with thin polymer film. (3) Delivered as particle or emulsions of nanoscale dimensions [39].

In addition nanofertilizer will combine nanodevices in order to synchronize the release fertilizer nitrogen and phosphorus with their uptake by fruit trees, so preventing undesirable some nutrients losses to the soil, water and Air via direct internalization by crops and avoiding the interaction of nutrients with soil, water, air and microorganisms [12].

Coating and binding of nano and subnano-composites are able to regulate the release nutrients from the fertilizer capsule [40]. In this regard Jinghu, [41] showed that application of nano-compsite consists of N, P, K, some micronutrients, amino acids and mannose enhanced the uptake and used of some nutrients by grain the crops. Practice the 4Rs of fertilizing plants to maximize plant uptake and minimize losses to the environment: apply the right fertilizer, in the right place, in the right amount and at the right time.

Moreover the nanotechnology could supply tools and mechanisms to synchronize N release from fertilizers with crop requirements [28].

The previous beneficial effects of nanotechnology use of some nutrients of the growth and fruiting of Valencia orange trees could be explained to its effect in enhancing nutrients use efficiency and preventing the release of the fertilization and their uptake by crops so preventing some nutrients losses [37, 12].

Nanotechnology use of some nutrients used for reducing the vegetative growth. The results of current study observed that this treatment had a positive effect on some vegetative growth characteristic, increase flower and fruit size, yield and improved fruit quality and this was in harmony with those obtained by several authors, Sabir *et al*., [22] and Wassel *et al*., [42] on grapevines; Refaai, [23]; Roshdy, [24] and Mohamed *et al*. [43] on Zaghloul date palms; Abou- Bakr- Basma, [44]; Ahmed, [25]; Chapman, [45] Rashwan *et al*., [46] and Ismaiel and aboel-Anin, [28] on *Citrus sinensis* L. and Abdalla, [26] on Zaghloul date palms.

## CONCLUSION

The best results regarding yield and fruit quality at This present the study gave by fertilizers Valencia orange trees with NPK as 60% via normal from 1785.6g ammonium nitrate + 892.8g potassium sulphate + 714.0g calcium superphosphate / tree / year on addition to spraying Hyper feed Amino compound at 0.4% three times during both seasons and was recommended.

## REFERENCES


1. Koture, S.C. and M.M. Moustafa, 1986. Effect of spacing and nitrogen on the leaf nutrient status of Robusta banana. South India. Hort., 32(6): 324-326.
2. Singh, N.P. and C.B.S. Rajput, 1986. Leaf analysis as a guide to nitrogen nutrition of guava (*Psidium guiava*, L.) Horticultural Abstracts, 53(1): 703, pp: 76.
3. Chapman, J.C., 1983. The effect of potassium and nitrogen fertilizers on the yield. Fruit quality and leaf analysis of Imerial mandarins. Horticultural Abstracts, 53(6): 4562, pp: 443.
4. Carcia, R., R. Gudarro and B. Diaz, 1981. Changes in the nutritional status of banana due to the effect of potassium, on red soil in Cuba. Their relations with yield and with the control of fertilizing. Horticultural Abstracts, (8): 6579, pp: 577.
5. Takatsuji T. and M. Ishihara, 1981. Studies on the potassium nutrition of Satsuma. III influence on cold hardiness and leaf composition. Bull. of the Fruit Tree Research Station, 7: 45-62.
6. Bakr, E.I., M.R. Barakat, M.A. Shaban and S.I. Salem, 1980. Effect of potassium fertilization and leaf nutrient content of Valencia orange trees grown in sandy soils. Annals of Agricultural Science, Moshtohor, 13: 153-168.
7. Bazeleth, M., S. El-Genbaum and A. Barakiva, 1980. Potassium fertilization experiment in Shamouti Orange grove. Horticultural Abstracts, 51(4): 3034, pp: 252.
8. Baruch, P.J. and N.K. Mohan, 1986. Effect of potassium on vegetative growth of banana (Musa Cavendish) Horticultural Abstracts, 56(12): 1072-1081.
9. Mengle, K., E.A. Kirkby, H. Kosegarten and T. Appel, 2001. World aufen Bern Switzerland, Internatinal Potash Institute, pp: 70-85.
10. Gomez, D.G., J.C. Pieretti, W.R. Rolim, A.B. Seabra and H.C. Oliverira, 2021. Advances in nano- based delivery system of micronutrients for a greener agriculture. In Advances in nano- fertilizers and nano- pesticides in agriculture, Woodhead Publishing, 111: 143.
11. Blois, L. and A. Lay-Ekuakille, 2018. Reliability and metrology features for manufacturing process of nanoelements for geo-environmental protection. Nanotechnology for Instrumentation and Measurement (Nanofim) pp: 1-4.
12. De-Rosa, M.R., C. Monreal, M. Schnitzar, R. Walsh and Y. Sultan, 2010. Nanotechnology in fertilizers. Nat. Nanotechnol. J., 5(2): 91.
13. El-Saied, R.M. and Maha S. Elsayed, 2022. Effect of Different Concentrations from Zinc Oxide Nanoparticles Prepared in Date Pits Extract on Pea (*Pisum sativum* L.) Plant. Egyptian journal of chemistry. Volume 65, Issue 8-N. 8 August 2022, pp: 575-582.
14. Sultan, Y., M. Walsh, C.M. Monreal and M.C. Derosa, 2009. Preparation of functional Apatmer films using layer- byself assembly Biomacromolecules K. J. App. Bviol. Biotech, 10: 1149-1154.
15. Prasad, R., V. Kumar and K.S. Prasad, 2014. Nanotechnology in sustainable agriculture: present concerns and future aspects. African J. Biotechnology, 13(6): 705-713.
16. Mukhopadhyay, S.S., 2014. Nanotechnology in agriculture: prospects and constraints. Nanotechnology, Science and Applications, 7: 63-71.
17. Manjunatha, S.B, D.P. Biradar and Y.R. Aladakatti, 2016. Nanotechnology and its applications in agriculture: A review. J. Farm Sci., 29(1): 1-13.
18. El-Sayed- Esraa, M.H., 2010. Beheviour of Ewaise mango trees to foliar application of some nutrients and seaweed extract. Ph. D. Thesis Fac. of Agric. Minia Univ. Egypt.
19. Ahmed, A.Y.M., 2014. Effect of spraying fenugreek seed and some nutrients on fruiting of Keitte mango trees grown under Aswan region conditions. World Rural Observations, 6(4): 103-108.
20. Abd- El-Latief, M.A., 2002. studies on potassium fertilization of Balady mandarin trees. M.Sc. Thesis of Fac. of Agric. Minia Univ. Egypt.
21. AbouEl-Komsan, E.A., M.Y. Hegab and A. Fouad-amera, 2003. Response of Balady orange trees to application of some nutrients and citric acid. Egypt. J. Appl. Sci., 18(1): 228-246.

22. Sabir, A., K. Yazar F. Sabir, Z. Kara, M.A. Yazici, N. Goksu, 2014. Vine growth, yield, berry quality attributes and leaf nutrient content of grapevines as influenced by seaweed extract (*Ascophyllum nodosum*) and nanosize fertilizer pulverizations. Scientia Horticulturae, 175: 1-8.
23. Refaai, M.M., 2014. Response of Zaghloul date palms grown under Minia region conditions to spraying wheat seed sprout extract and Nano- boron. Stem Cell, 5(4): 22-28.
24. Roshdy, Kh. A. and M.M. Refaai, 2016. Effect of nanotechnology fertilization on growth and fruiting of Zaghloul date palms. J. Plant Production, Mansoura Univ., 7(1): 93-98.
25. Ahmed, M.M.M., 2018. Physiological studies on fertilization of Flame seedless grapevines by nano-technology system. M.Sc. Thesis Fac. of Agric. Minia Univ. Egypt.
26. Abdalla, O.G., 2018. Response of Zaghloul date palms to the use of some microelements through nanotechnology. M.Sc. Thesis of Fac. of Agric. Minia Univ. Egypt.
27. El-Wany, A.R.M., 2019. A comparative study on fertilization of Superior grapevines with N, P and K via traditional and Nano- Biotechnology system. Ph. D. Thesis Fac.of Agric. Minia Univ. Egypt.
28. Ismaiel, M.H. Huda and aboel-Anin A. Moustafa, 2021. Role of Boron-Nanoparticles to Improve Fruiting Properties, Chemical Constituents and Accumulation of Bioactive Compounds of *Citrus sinensis* L. Trees. International Research Journal of Innovations in Engineering and Technology (IRJIET), 5(1): 12-19.
29. Wilde, S.A., R.B. Corey, J.G. Layer and G.K. Voigt, 1985. Soils and Plant Analysis for Tree Culture. Oxford and IBH, New Delhi, India, pp: 1-142.
30. Ahmed, F.F. and M.H. Morsy, 1999. A new method for measuring leaf area in different fruit species. Minia J. Agric. Res. & Develop., (19): 97-105.
31. Hiscox, A. and B. Isralstam, 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. Can. J. Bot., 57: 1332-1334.
32. Association of Official Agricultural Chemists (A.O.A.C.), 2000. Official Methods of Analysis (A.O.A.C), 12th Ed., Benjamin Franklin Station, Washington D.C., U.S.A, pp: 490-510.
33. Summer, M.E., 1985. Diagnosis and recommendation Integrated system (DRIS) as a guide to orchard fertilization. Hort. Abst., 55(8): 7502.
34. Lane, J.H. and L. Eynon, 1965. Determination of reducing sugars by means of Fehlings solutions with methylene blue as indicator. A. O. A. C. Washington D. C., U.S.A.
35. Magda, N. Mohamed, Abdelgawad S. Ahmed and Khaled Y. Farroh, 2022. Usage of Nano-Particle NPK to Reduce the Amount of Mineral Fertilizers in 'Crimson Seedless' Grapevines. New Valley Journal of Agricultural Science NVJAS, 2(6): 473-482.
36. Lane, R., R.N. Currow and A.M. Harted, 1993. Statistical Methods in Agricultural and Experimental Biology. Second Ed. Chapman & Hall. London, pp: 10- 44.
37. Steel, R.G.D. and J.H. Torrie, 1984. Principles and procedures of statistics. " MC- Grow Hill Book Co. Singapore, 2: 633.
38. Al- Amin- Sadek M.D. and H.P. Jayasuriya, 2007. Nanotechnology prospects in agricultural context, An overview. In processing of the international agricultural engineering conference, 3-6 December, Banghok, pp: 548.
39. Rai, V., S. Acharya and N. Dey, 2012. Implications of nanobiosensors in agriculture. J. Biomater. Nanobiotechnol. 3: 315-324. 10.4236/jbnb.2012.322039
40. Liu, X., Z. Feng, J. Zhang, Q. Xiao and Y. Wang, 2006. Preparation and testing of cementing nano subnano composites of slower controlled release of fertilizers. Sci. Agr. Sin. Sin. J., 39: 1598-1604.
41. Jinghu, G., 2004. synchrotron radiation, soft x- ray, spectroscopy and nano materials J. Nano. Techno., 1: 193-225.
42. Wassel, A.M.M., M.M.M. El-Wasfy and M.M.A. Mohamed, 2017. Response of Flame seedless grapevines to foliar application on nano-fertilizers. J. Product & Dev., 22(3): 469-485.
43. Mohamed, A. El- Sayed, M.M. El- Wasfy and O.G.A. Abdalla, 2017. Effect of spraying some micro nutrients via normal versus nano technology on fruiting of Zaghloul date palms. New York Sci. J., 10(12): 1-10.
44. Abou- Bakr- Basma, A.D., 2018. Physiological studies on fertilization of Superior grapevines by using nano technology system. M. sc. Thesis Fac. of Agric. Minia Univ. of Egypt.
45. Chapman, H.D., 1968. The Mineral Nutrition of Citrus. Citrus Industry. Vol.11, Chap., pp: 3.
46. Basma R.A. Rashwan, Reham S. Abd Elhamed and Alaa F. Al Bakry, 2023. Effect of Zinc oxide nanoparticles on growth, chemical composition and yield of potato (*Solanum tuberosum* L.). J. Soil Sciences and Agricultural Engineering, Mansoura Univ., 14(3): 65-71.