



**Effect of some fertilizers and antioxidants on
growth and fruiting of Balady mandarin trees
(*Citrus reticulata* L.)**

By

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6- SUMMARY AND CONCLUSION

This study was carried out during three successive seasons of 2014, 2015 and 2016 on ninety six uniform in vigour Balady mandarin trees (*Citrus reticulata*, Blanco), 45 years old and grown at the experimental orchard of Faculty of Agriculture, Assuit University. Trees were budded on sour orange (*Citrus aurantium* var. amara) rootstock and planted at spacing 5x5 meters. Flood irrigation system was followed in the orchard. The texture of the tested soil is clay with a water depth not less than two meters. This study were involved two experimental, as follows:

First experiment:

Thirty two healthy trees with no visual nutrient deficiency symptoms and as uniforms as possible were chosen and devoted for carrying out this experiment. The chosen trees were divided into eight groups. Each group had four trees and received one fertilization regime management of the following treatments.

1. Application of the recommended dose of N (RND 1000g N/tree) completely via inorganic N sources (2985 g ammonium nitrate/tree).
2. Application of 75% RND via (2239 g ammonium nitrate/tree) and humic acid (25 g/tree).
3. Application of 75% RND via (2239 g ammonium nitrate) and spraying seaweed extract at 25 g/5 L water/tree.
4. Application RND of N (1000 g N/tree) completely via organic N sources (liquid organic fertilizer 3 L/tree).
5. Application of 75% RND via liquid organic fertilizer (2.25 L/tree) and humic acid (25 g/tree).
6. Application of 75% RND via liquid organic fertilizer (2.25 L/tree) and spraying seaweed extract at 25 g/5 L/tree.

7. Application of 33% RND via 985 g ammonium nitrate/tree plus humic acid (33 g/tree) and spraying seaweed extract (33 g/5 L/tree).
8. Application of 33% RND via liquid organic fertilizer (1 L/tree) plus humic acid (33 g/tree) and spraying seaweed extract (33 g/5 L/tree).

Ammonium nitrate (33.5% N) as a fast release N fertilizer splitted into three equal batches and added at growth starts, after full bloom and two month later, whereas, liquid N fertilizers was added three times at growth start, just fruit set and two months later, whereas

Seaweed extract spraying was applied three times at growth start, just fruit set and two month later. Humic acid was adding as soil dressing at the same times previous.

Other horticulture practices were carried out as usual. The following parameters were measured during the three growth seasons.

Second experiment:

The experiment involved two factors (A and B). The first factor (A) included the effect of organic and inorganic fertilization. Four treatment were included in this factor as follows:

- 1- 100% R.ND, via mineral-N (check treatment).
- 2- 100% RND via organic-form.
- 3- 75% organic and 25% mineral-N.
- 4- 50% organic and 50% mineral-N.

The second factor (B) involved four treatment from antioxidants treatments. Foliar spray:

- 1- Spraying tree with water (check treatment).
- 2- Spraying tree with ascorbic acid (1000 ppm).
- 3- Spraying tree with citric acid (1000 ppm).
- 4- Spraying tree with ascorbic acid (500 ppm) + citric acid (500 ppm).

Sixty four healthy tree with no visual nutrient efficiency symptoms were chosen and devoted for achieving the experiment. The chosen tree were divided into 16 different treatment. The experiment was set up in a split-plot complete randomized block design with three replication per-treatment, one tree each.

Antioxidants spraying was applied three times at growth start, just fruit set and two months later.

All the experimental trees received the regular horticultural practices that carried out in vineyard except those dealing with the present treatment.

The following parameters were determined to evaluate the effects of different fertilization treatments on growth and fruiting.

- 1- Vegetative growth characteristics
- 2- Leaf nutritional status and total carbohydrates and nitrogen and C/N ratio of shoots.
- 3- Yield and its components:
- 4- Fruit physical and chemical properties:

The obtained data during three studied seasons could be summarized under the following main items.

The first experiment:

Vegetative growth shoot growth:

Using the recommended nitrogen dose (RND) via liquid organic-N as well as a combination of mineral plus humic acid or seaweed significantly increased the shoot growth aspects compared to the use of RND via mineral-N (check treatment). No significant differences were found due to fertilize via either mineral or organic-N combined either humic acid or seaweed. Furthermore, fertilization via triple from (mineral, organic plus humic acid or seaweed) resulted in more announced and highly significant increment of shoot growth aspects.

The maximum value of shoot length and shoot thickness as well as laterals number/shoot were obtained due to the fertilization with triple form, 33 g humic acid 33 g seaweed + 33% of RND via mineral-N or 33 g humic acid + 33 g seaweed + 33% of RND via organic-N, respectively.

On the other hand, the minimum values of shoot length, shoot thickness and laterals shoot number were obtained with check treatment.

Leaf characteristics:

Fertilization by recommended nitrogen dose (RND) via organic-N only or double form (75% of RND at 75% organic-form) plus humic acid or seaweed as well as triple form (mineral N plus humic acid and seaweed or organic-N plus humic acid and seaweed significantly increased the leaf traits compared to the use of RND via mineral-N only (check treatment). No significant differences were found due to fertilize via 75% of recommended nitrogen dose (RND) either mineral-N or organic-N plus whatever, humic acid or seaweed. The maximum values of leaf numbers/shoot, leaf area and its chlorophyll recorded due to fertilize via triple form (humic acid and seaweed) plus either mineral-N or organic-N.

Nutritional status:

Fertilization via either organic only or double form, mineral-N either plus humic acid or seaweed, organic either humic acid or seaweed, as well as triple form, humic acid and seaweed plus either mineral-N or organic-form significantly increased the N, P and K contents of leaves compared to fertilize via mineral-N only. Furthermore, using organic, humic acid or seaweed resulted in more announced and highly significant increment in leaf phosphorus compared to use organic or mineral-N only.

Fertilizing the trees with organic only or double form as well as triple form significantly increased total carbohydrates, nitrogen percentage and

C/N ratio of shoot compared to check treatment. No significant differences were seen between fertilization via triple form used either mineral-N or organic, as well as due to the use of double form whatever, humic acid or seaweed extract.

Yield:

Number of fruit/tree and yield/tree significantly increased by using fertilization, RND, via mineral-N combined with humic acid, mineral-N combined with seaweed, organic-N, organic plus humic acid and organic plus seaweed, triple form whether using humic acid and seaweed plus mineral-N or organic compared to use the RND via mineral-N source alone (check treatment). No significant differences between fertilization via any form of double forms, as well as using triple form either using mineral-N or organic form.

Fruit quality:

Fruit weight, pulp percentage and fruit dimension significantly increase in response of all used fertilization treatments compared to fertilize with RDN via mineral-N source only. The more improvement in these physical traits of fruits were associated with using triple form. No significant differences were seen between fertilization via double form, whatever, combined with humic acid or seaweed extract, as well as via triple form due to either the use of mineral-N or organic form.

Some chemical properties i.e. percentage of total soluble solids, total acidity and total soluble solids/acid ratio, as well as sugar contents and vitamin C (V.C) content (mg/100 ml juice) were significantly improved by organic fertilizer as well as seaweed extract and humic acid treatments compared with using the recommended dose of nitrogen (RDN) via mineral-N source alone.

It is clear from the obtained data that fertilization with organic, double or triple forms was improving these chemical constituents in terms of increasing TSS, TSS/acid ratio, sugar content and V.C. and decreasing total acidity.

The second experiment vegetative growth:

Shoot growth:

Growth parameter i.e. shoot length were significantly increased by organic fertilization, whatever used alone or combined with mineral-N compared with using the recommended dose of nitrogen (RDN) via mineral-N only. No significant differences for fertilization via, 75% organic-form plus 25% mineral or 50% organic-form plus 50% mineral. The maximum shoot growth traits were detected on trees that fertilized with 50% organic-form plus 50% mineral. Whereas, the minimum values were recorded on trees that fertilized with recommended dose of nitrogen (RDN) via mineral form only.

Shoot growth aspects significantly increased due to spray ascorbic acid, citric acid compared to unsprayed ones. The highest shoot growth aspects were recorded due to combined of ascorbic and citric acids spraying.

All combinations of fertilization with RDN via organic totally or partial as well as all combination of ascorbic acid, citric acid or ascorbic and citric acid spraying significantly increased shoot growth traits compared to combination of fertilization via mineral-N with unsprayed ones (check treatment).

Total carbohydrates, total nitrogen and C/N ratio of shoots significantly increased due to fertilize via organic-form only or along with 25 or 50% of mineral-N compared to fertilize via mineral-N alone. The highest values of total carbohydrates total nitrogen and C/N ratio of shoots

were recorded in the trees that fertilized with RDN via 100% organic form. No significant differences were detected due to use organic form only or combine with 25 or 50% of RDN.

Spraying ascorbic acid or citric acid singly or combination significantly increased the total carbohydrates, total nitrogen and C/N ratio of shoots compared to unsprayed ones. Combination of ascorbic acid citric acids spraying gave the highest these shoot traits compared to other treatments. No significant difference were noticed for either ascorbic acid or citric acid spraying.

All combination either organic alone or along 25 or 50% of RDN with either ascorbic acid or citric acid whatever alone or together significantly increased total carbohydrates, total nitrogen and C/N ratio of shoot compared to check treatment. All combination of ascorbic and citric acids spraying gave the highest values compared to other combination.

Leaf characteristics:

All organic fertilization significantly increased the leaves number per shoot, leaf area and total chlorophyll percentage compared to fertilize by mineral-N only (check treatment). The highest leaves number and biggest leaf area as well as highest chlorophyll contents were obtained due to fertilize with combined organic-form plus 25% mineral. No significant differences of leaf traits due to fertilize via, 75% organic plus 25% mineral or 50% of each one.

Spraying ascorbic acid, citric acid or ascorbic and citric acids increased the leaves number and their area as well as chlorophyll contents compared to unsprayed ones (check treatment). The highest values of these leaf traits were obtained due to spray ascorbic acid along citric acid.

Leaves number and leaf area as well as chlorophyll contents significantly increased to the interaction between nitrogen fertilization and

antioxidants application. Combined 75% organic-form plus 25% mineral with ascorbic plus citric acids spraying gave the highest these leaf traits.

Leaf nutrient

Using RDN via 100% organic-form or 75% organic-form plus 25% mineral as well as 50% organic-form plus 50% mineral significantly increased the contents of N, P and K in leaves compared to use the mineral fertilizer alone. 75% organic-form plus 25% mineral 50% organic-form plus 50%. The highest values of N, P and K contents were recorded in leaves of trees that fertilized RDN via 75% organic-form plus 25% mineral-N compared to other fertilization treatment. No significant differences were detected in these nutrient content due to use organic form only or combined with 25 or 50% of mineral-N.

Spraying ascorbic acid or citric acid as well as ascorbic and citric acid significantly increased the contents of N, P and K in leaves compared to unsprayed ones (check treatments). Spraying ascorbic and citric acids gave the highest leaf contents of N, P and K compared to other treatments.

All combination either of 100% organic-form or 75% organic-form plus 25% mineral as well as 50% organic-form plus 50% plus 25% mineral, organic with ascorbic acid or citric acid as well as ascorbic and citric acids significantly increased percentage of N, P and K in leaves compared to check treatment. All combinations with ascorbic acid or citric acid as well as ascorbic and citric acids gave the highest values and were most effective in increasing the leaf contents of N, P and K.

Yield

Application of RDN fertilization via 100% organic-form, 75% organic-form plus 25% mineral or 50% organic-form plus 50% mineral significantly increased the number of fruit and yield/tree compared to use RDN via mineral-N only. The highest number of fruits and heaviest

yield/tree were detected on trees fertilized with 75% organic-form plus 25% mineral followed with trees that fertilized with the recommended dose of RDN via 100% of organic-N. Contrary, the least one recorded on trees fertilized with RDN via mineral. No significant difference in yield components were found due to fertilize with RDN via either 75% organic plus 25% mineral or 100% organic-N. Number of fruits and yield/tree significantly increased due to spray ascorbic and citric acid compared to unsprayed ones. No significant difference of fruits number and yield/tree due to spray either ascorbic or citric acids. The highest number of fruit and heaviest yield/tree were recorded on trees that sprayed with ascorbic and citric acids compared to other treatment.

All combination of 100% organic-form or 75% organic-form plus 25% mineral as well as 50% organic-form plus 50% mineral with ascorbic acid or citric acid as well as ascorbic and citric acids significantly increased number of fruits and yield/tree compared to use mineral with unsprayed ones (check treatment). The maximum values of number of fruits and yield/tree were recorded on 75% organic-form 25% mineral combined with ascorbic and citric acids spray to other compared combinations.

Fruits characteristics:**1. Physical properties of fruits:**

Fertilized with organic fertilization significantly increased the weight pulp % dimension of fruits compared with using mineral-N source only. Use organic or 50% organic-form plus 50% mineral-fertilizer gave the highest improvement of compared to other treatment.

Combination of 100% organic-form or 75% organic-form plus 25% mineral as well as 50% organic-form plus 50% mineral, organic with ascorbic acid or citric acid as well as ascorbic and citric acid significantly

increased the weight pulp % and dimension of fruits compared to check treatment.

2. Chemical constituents of juice:

Chemical properties i.e. T.S.S., acidity T.S.S./acid ratio, V.C and sugars contents were significantly increased due to fertilize with organic only or along 25 or 50% mineral-N compared to fertilize with 100% mineral-N alone.

Using ascorbic acid and citric acid as antioxidants source significantly increased sugar and V.C contents, total soluble solids and reduced the titratable acidity, hence increased total soluble solid/acid ratio compared to unsprayed ones (check treatments). No significant differences due to spray with ascorbic acid or citric acid. The highest values of these chemical quality parameters recorded in trees that sprayed by ascorbic plus citric acid, whereas the least one was recorded on trees unsprayed ones (check treatment).

Application of RDN organic, 75% organic-form plus 25% mineral or two form (50 organic-form plus 50 mineral plus organic) significantly increased soluble solid, V.C and sugar contents and reduced the acidity, hence increased total soluble solid/acid ratio compared to application of RDN via 100% mineral fertilizer. The highest values of these chemical quality parameters recorded in trees received N as 100% organic.

All combination of 75% organic-form plus 25% mineral or organic N as well as ascorbic and citric acid significantly increased sugar and C.V contents and total soluble solids and reduced titratable acidity, hence increased total soluble solid/acid ratio compared to use mineral with unsprayed ones (check treatment). The highest values of these chemical quality parameters recorded on trees that received 100% organic plus combined sprayed ascorbic and citric acid.

Conclusion

On the light of previous results, it could be concluded that replacing 25 to 66% of nitrogen fertilization by organic (humic acid) or/and bio-form (seaweed extract). As well as fertilizing by double forms (75% organic-form plus 25% mineral) accompanied with ascorbic and citric acid as a source of antioxidants (500 ppm of each) sprayed, three times at growth start, just fruit set and two months later. These application enhanced the growth and nutritional status of Balady mandarin trees. In addition, it increased the yield and improved the fruit quality. Moreover, improved the soil fertility and minimized the production cost and the environments pollution which could be occurred by excess of chemical fertilizers used.