*Assiut J. of Agric. Sci., 41 (Special Issue )(The 4th Conference of Young Scientists Fac. of Agric. Assiut Univ. April, 27, 2010)* ***(153-170)***

# Effect of Different Nitrogen Fertilizer Sources on Vegetative Growth, Nutrient Status and Fruiting of Balady Mandarin Trees.

Abdel Fatah M.El-Salhy,[1], Hassan A. Abd El-Galil[1] and Ahmed H. Abd El-Aal[2] and Montaser M. Ali[3]

[1]Horti. Dept., Fac. Agric., Assiut Univ., Assiut, Egypt. [2]Horti. Dept., Fac. Agric., El-Azhar Univ., Assiut, Egypt. [3]Horti. Dept., Fac. Agric., South Valley Univ., Qena, Egypt.

**Key words:** Slow release, organic, bio-fertilization, Balady mandarin yield, nutrient status, fruiting.

**Abstract:**

This investigation was carried out in the experimental orchard, Faculty of Agriculture, Assiut University, Egypt, to study the influence of slow release N, organic and bio-form fertilizers on growth vigour and fruiting of Balady mandarin trees during 2006, 2007 and 2008 seasons.

The experiment was arranged in a randomized complete block design with three replications, using a tree as an experimental unit and it consisted of 7 treatments. Fast release nitrogen fertilize was added at three equal doses in March, May and August, while the slow-release N, and bio-fertilizers were applied once at the start of spring growth.

The obtained results could be summarized as follow:

- The application of slow release N and other three fertilizers once a year surpassed the application of fast release (mineral) N in improving shoot and leaf traits.
- The slow release-N fertilizer and organic, bio and inorganic forms (three forms) significantly increased N, P and K contents of leaves as well as the total carbohydrates and C/N ratio of shoots compared to using the fast release-N fertilizer.
- The fertilization using either 80% of the recommended N dose as slow release-N or other three forms would achieve a beneficial improvement to vigour and nutrient status of the trees.
- The use of slow release-N fertilizer and either bio-fertilization or organic and bio-forms plus mineral-N form increased the yield and improved the fruit quality of Balady mandarin trees.
- No significant influence was detected on such traits due to rising the slow release-N from 80 to 100% of the recommended N dose (RND).

It is evident from the foregoing results that using either 80% of the RND as a slow release-N fertilizer or other three fertilization forms improved the

***A portion of thesis presented in partial fulfilment of the Ph.D degree**

**Received on**: 19/1/2010 **Accepted for publication on**: 23/1/2010

**Referees**: Prof.Dr.: Kamelia I. Ahmed Prof.Dr.: Mohamed A. EL-Desoky

tree nutrient status, yield and fruit quality. In addition, it minimized the production costs and environmental pollution which could be occurred by excess of chemical fertilizers.

**Introduction**

Citrus is one of the most important cash crops all over the world, especially in U.S.A. and warm temperature regions. It is the backbone of fruit grown crop in Egypt; it is considered among the principal and strategic fruit crops. Thus, it is ranked in the first position. In 2006, the cultivated areas by citrus orchards in Egypt reached 341.718 feddans and produced 3.211.709 ton fruits/year; Mandarin trees occupied 92.060 feddans, representing 26.9% of the total citrus acreage, producing more than 730.901 ton fruits/year, according to 2006. During the last few years, the citrus area increased due to increasing the demands of the local consumption and exportation, which it is expected to boom in the future. Such extension in the citrus cultivated area encourages to carry out more studies to find out an appropriate integrated NPK management for improving the production and fruit quality.

Fertilization is one of the important management tools in increasing crop yield, especially with nitrogen. Nitrogen (N) is known to be one of the most major elements for plant nutrition and development. It plays an important role as a constituent of all proteins, nucleic acids and enzymes (Nijjar, 1985).

Nitrogen fertilization effects depend upon the nutrient status of the cultivated soil, as well as applied amount, sources and methods of N applications (Yagodin, 1990). Therefore, adjusting N nutrition for citrus trees still needs more studies about the best N management for producing the highest and economical yield and for improving the physical and chemical properties of the fruits.

The nitrogen fertilizer efficiency under field and surface irrigation conditions rarely exceeds 50% and it ranges between 30 and 40% (Saharawat, 1979). The loss of nitrogen by leaching, volatilization, denitrification is considered the most important problem in same soils. Thus, the management of N applied sources is required to solve this problem.

The loss of nitrogen via leaching through drainage water may be reduced to some extent by using the slow release-N fertilizers that could regulate the release of their own N as the plant needs. During the last decades, several controlled-release fertilizers were developed mainly to improve the efficiency of nitrogen used by the fruit trees (Miller *et al*., 1990). Application of controlled- release fertilizers seem to be very effective in improving the growth and productivity of most fruit trees. This is attributed to the continuous amendment of N during all growth and fruit development stages (Koo, 1988). Slow release fertilizers are synthesized by condensing urea with aldehydes such as formaldehyde, acetaldehyde, crontonaldehyde, isobutyraldehyde and others. Other slow release fertilizers were processed by coating their granules with thin film of organic (polymeric) or inorganic (elemental sulphur) materials (Travis, 1971; Yagodin, 1990).

Bio-fertilizers are mainly consisted of beneficial microorganisms that can release nutrients from rock and plant residues in the soil and make them available for economical crops. They are of the most importance for plant production and soil fertility as they improve the biological, physical and chemical properties of the soil. Moreover, biological fertilization plays an important role in increasing the yield and fruit quality of citrus (Subba Rao *et al*., 1993; Subba Rao, 1984).

The application of organic fertilizers to citrus orchard is a production system that avoids or largely excludes the use of synthetic chemical fertilizers. Most organic fertilizers depends on using recycled animal manure and farm residues to produce a compost for enhancing biological cycles, improving soil fertility and avoiding all forms of pollution that may result from conventional agriculture techniques (Cook, 1986; Miller *et al*., 1990; Yagodin, 1990).

So, this study aims to investigate the response of Balady mandarin trees to the applications of fast and slow release N fertilizers as well as organic and biofertilization, as well as, finding out the best ratio of mineral, organic and bio fertilizers used for these trees.

**Materials and Methods**

This study was conducted during three successive seasons of 2006, 2007 and 2008 on Balady mandarin trees grown on the Experimental Orchard of Faculty of Agriculture, Assiut University, Egypt, where the soil has a clay texture (Table 1), is irrigated via surface irrigation and well drained. The selected trees were in uniform vigour, 13 years old, budded on sour orange root stock and planted at 5x5 m apart.

Twenty one healthy trees with no visual nutrient deficiency symptoms were chosen and devoted for carrying out this experiment. The chosen trees were divided into seven groups. Each group had three trees and received one fertilization regime management of the following treatments:

$T_1$- Applying the recommended nitrogen dose (RND) of N (1000 g N/tree) using a fast mineral release source of 3.0 kg of ammonium nitrate 33.5% N/tree).

$T_2$- Applying 100% of the RND using a slow release N fertilizer (2.5 kg of Enciaben 40% N/tree).

$T_3$- Applying 80% of the RND using a slow release N fertilizer (2.0 kg of Enciaben 40% N/tree).

$T_4$- Applying 60% of the RND using a slow release N fertilizer (1.5 kg of Enciaben 40% N/tree).

$T_5$- Applying 80% of the RND using a mineral fertilizer (2.39 kg of ammonium nitrate + 10% of a bio-fertilizer, 100 g of Biogen/tree).

$T_6$- Applying 60% of the RND using a mineral fertilizer (1.79 kg of ammonium nitrate + 20% of a bio-fertilizer, 200 g of Biogen/tree).

$T_7$- Applying 50% of the RND using an organic fertilizer (167 kg of farmyard manure + 20% of a mineral fertilizer, 0.6 kg of ammonium nitrate + 10% of a bio-fertilizer, 100 g of Biogen/tree).

These treatments were carried during the first and second seasons, while in the third one, the treatments were reduced to 50% of the RND in respect to slow release and organic fertilizers.

The experiment was set in a randomized complete block design with three replications per treatment, one tree each.

The organic N fertilizer (farmyard manure, 0.3 N) was added once in the last week of January. The bio-fertilizer (Biogen) and the slow release N fertilizer (Enciaben) were added once during the spring growth in the first week of March. Ammonium nitrate as a fast release N fertilizer was splitted into three equal doses added in the first week of March, May and August. Biogen as a bio-fertilizer that contains nitrogen fixation bacteria Azotobacter was brought fresh, immediately used by mixing it with moist sand before the application, added in soil holes around the trunk of the tree and then, directly irrigated after covering the holes with soil. Other horticulture practices were carried out as usual.

The following parameters were measured during the three growth seasons.

**A- Vegetative Growth:**

Four main branches which were nearly uniform in growth, diameter and foliage density and distribution around the periphery of each tree were chosen and labeled in February. In the autumn growth cycle, the following vegetative characters were measured:

1- Shoot length (cm).
2- Leaf number/shoot.
3- Leaf area ($cm^2$), where thirty full mature leaves/tree (from the $4^{th}$ to $5^{th}$ leaf of the labeled shoot base) were randomly taken and weighing 60 sections of 1 $cm^2$ (2 sections of 1 $cm^2$/leaf) and then the average leaf area was determined as

$$\text{The average leaf area } (cm^2) = \frac{\text{Leaves weight (g)}}{\text{Sections weight (g)}} \; x \; 2$$

follows:

**B- N, P and K in leaves and Total Carbohydrates and Nitrogen in Shoots:**

Samples of fifty mature leaves were randomly selected from the non fruiting shoots of the spring in mid September to determined N, P and K in leaves as well as nitrogen in shoots using the digestion with a mixture of sulfuric acid and hydrogen peroxide (**Wilde *et al.*, 1985)**. Then, nitrogen was measured by the micro-kjeldahl methods, phosphorus was determined colorimetricaly, and potassium was determined using flame photometer in the digests.

Another part of each ground shoot sample was used to determine the total carbohydrates according to **Smith *et al*. (1956).**

**C- Yield and Its Components:**

Ten distributed fruiting shoots around trees were chosen and labeled before the beginning of treatments. The number of flowers per each shoot was counted. Before harvest, the fruit retention for each branch was calculated as:

$$\text{Fruit retention } (\%) = \frac{\text{Total number of fruits}}{\text{Total number of flowers}}$$

At harvesting time, in the last week of December, the number of fruit per tree was counted and then, the yield per tree was calculated.

**D- Fruit Quality:**

Samples of 10 fruits were randomly taken from each tree to estimate the fruit quality. The fruit weight and the chemical fruit quality such as total soluble solids, total acidity (expressed as g citric acid/100 ml juice), ascorbic acid (mg/100 ml juice) and sugar contents were determined according to **A.O.A.C.** methods **(1985)**.

The obtained data were statistically analyzed according to **Gomez and Gomez (1984) and Mead *et al*. (1993)** using the L.S.D. test to define the significance of the differences among various treatment means.

**Results**

**1- Vegetative Growth**

It is clear from data presented in Table (2) that the fertilization using the recommended dose of nitrogen (RND) via the slow release fertilizer significantly increased the shoot growth and leaf parameters compared to using the mineral fertilizer only. The promotion on such growth traits were associated with increasing the level of slow release-N applied from 60 to 100%. No significantly effected due to fertilization via either bio plus inorganic or organic, bio and inorganic forms compared to using the mineral source. The maximum shoot growth and leaf traits were detected on trees fertilized with the recommended dose using 100% of the slow release fertilizer. Meaningless influence was detected on such growth aspects due to rising the slow N release

source from 80 to 100%. The recorded shoot length was 48.42, 47.16, 43.99, and 42.00 cm av. (averaged over the three growth seasons due to $T_2$, $T_3$, $T_1$, respectively. The corresponding leaf area values were 8.48, 8.20, 8.28 and 7.57 $cm^2$, respectively.

The increment percentages due to $T_2$, $T_3$ and $T_7$ over $T_1$ were 15.28, 12.28 and 4.74%, respectively, for shoot length and 12.02, 8.32 and 9.38% for leaf area, respectively.

**2– N, P and K in Leaves as well as Total Carbohydrates, Nitrogen and C/N Ratio of Shoots:**

Tables (3 and 4) showed that the slow release-N and organic, bio and inorganic fertilizers significantly increased N, P and K contents of leaves as well as the total carbohydrates and C/N ratio of shoots compared to using the fast release-N fertilizer. Using the 100% of the RND of the slow release-N fertilizer resulted in a significant increase in the leaf nitrogen content. No significant differences in leaf N between using either the 100 or 80% of the RND of the slow release-N and bio-plus inorganic or fast release-N applications. The leaf N values were 2.38, 2.35, 2.25 and 2.16% (averaged over the three studied seasons) due to $T_2$, $T_3$, $T_7$ and $T_1$, respectively. The increment percentages of N were 10.19, 8.80 and 4.17% due to $T_2$, $T_3$ and $T_7$, respectively, compared to $T_1$.

Moreover, using either the 60% of the RND using mineral-N fertilizer plus 20% bio-fertilizer ($T_6$) or the 50% of the RND using organic plus bio and mineral-N sources significantly increased the leaf P and K as well as the total carbohydrates and C/N ratio of shoot compared to other treatments

Decreasing the amount of the fast release-N (mineral) fertilizer to induced a gradual increase in the carbohydrate content and a decrease in N amount of shoots leading to an increase in the shoot C/N ratio. The shoot C/N ratio was 7.59, 7.55, 7.66 and 7.15 % (averaged over the three studied seasons) due to $T_2$, $T_3$, $T_7$ and $T_1$, respectively. The increase in the C/N ratio was 6.15, 5.59 and 7.13 %) due to $T_2$, $T_3$ and $T_7$, respectively, compared to $T_1$

Hence, the maximum C/N ratio of shoots was recorded in shoots of the trees that were fertilized by the three different fertilization sources. Therefore, it could be concluded that the fertilization using either the 80% of the RND of the slow release-N fertilizer or a mixture of the other three sources would achieve a beneficial improvement in the tree vigour and nutritional status.

**3 – Yield and Its Components:**

The slow release-N and either bio- fertilization or organic and bio plus the mineral-N ones showed increases in the productivity of Balady mandarin trees (Table 5). These fertilization treatments significantly increased the fruit retention, number of fruits/tree and yield (kg)/tree compared to the fertilization with the fast release (mineral) N source. The fruit yield was 37.73, 45.63, 41.33 and 38.07 kg/tree (averaged over the three studied seasons) due to $T_{2,}$ $T_{3,}$ $T_7$ and $T_1$, respectively. The increment percentages of yield were 25.37, 19.86 and 8.56% due to $T_{2,}T_3$ and $T_7$, respectively, compared to $T_1$.

It is clear that the use of the slow release-N fertilizer as well as the fertilization using the other three sources (organic + bio + mineral fertilizers) have beneficial effects on the citrus yield. They also improve the structure and fertility of the soil. In addition, such fertilization treatments reduce the cost of production and environmental pollution problems.

**4 – Fruit Quality:**

The fertilization with either the slow release-N source or the three other sources (organic and bio-plus mineral-N) improved the fruit quality in terms of increasing the fruit weight, total soluble solids (TSS), and sugar and vitamin C contents and decreasing the total acidity compared to using the recommended nitrogen dose (RND) using the release (mineral) N source Table(6 and 7) The fruit weight was 140.71, 139.72, 142.97 and 136.14 g (averaged over the three studied seasons) due to $T_{2,}$ $T_{3,}$ $T_7$ and $T_1$, respectively. The increment percentages in the fruit weight were 3.36, 2.63 and 5.02 % due to $T_{2,}$ $T_3$ and $T_7$, respectively, compared to $T_1$. The corresponding T.S.S values were 11.63, 11.56, 11.62 and 10.93%

(averaged over the three studied seasons) and its increment percentages were 6.40, 5.76 and 6.31%, respectively. In addition the corresponding vitamin C content was 35.62, 35.23, 35.12 and 33.26 mg/100g (averaged over the three studied seasons), respectively, and its increment percentages were 7.10, 5.92 and 5.59%, respectively.

The promotion in these traits was associated with fertilization using organic, bio and mineral sources or the slow release-N source either at 100 or 80% of the RND. No significant differences in these traits were attributed to rising the slow release-N fertilizer from 80 to 100% of the RND.

Hence, the money-wise evaluation of the application of these N sources is in favour of either the slow release-N source at 80% of the RND or using the other sources. Such fertilization programs are very important for the production of mandarin fruits, because the increase in the fruit weight and size induce an increase in the packable yield.

## Discussion and Conclusion

The application of the slow release and organic sources of nitrogen reduces the loss of nitrogen by leaching, volatilization, denitrification as well as mobility. It also regulates the release of own –N over a long period of time for the plants need. Moreover, it remains the highest values of residual N in the soil due to their low activity index, and substantially improves the soil properties and vegetative growth traits compared to the fast release (mineral) N application which gives the lowest values of available N left in the soil (Mikkelsen *et al*., 1994). Nitrogen is a necessary element for chlorophyll, protoplasm, protein and nucleic acid synthesis (Nijjar, 1985) so that its application can result in an increase in the cell number and cell size with an increase in the growth. Such effects increase the number and area of leaves. Moreover, the organic fertilization has a positive action in increasing the activity of micro flora, water holding capacity, soil structure aggregation, soil organic matter, soil humus content and the availability of most nutrients. Such stimulation on the uptake of nutrients leads to enhancing the biosynthesis of organic foods and cell division (Miller *et al.,* 1990). Biofertilization has an important role on biological, physical and chemical soil properties, as well as, on facilitating the fixation of atmospheric N, activating the availability and uptake of the nutrients and reducing the incidence of soil born diseases, and then improving the soil fertility. (Subba Rao, 1984)

Hence, it could be concluded that the fertilization using either the slow release or organic and bio sources effective in improving the tree vigour expressed as an increase in shoot growth and, leaf surface expansion and its nutrient status. These findings emphasize the vital importance of these fertilization sources in order to overcome the losses of nutrients by leaching, volatilization and mobility of movement elements. These sources also, improve the soil fertility (Table 1) due to the highest values of the residual nutrients, the enhanced solubility of nutrients and the increased activity of microorganisms. In addition, the importance of such fertilization treatments is considered for the organic farming production.

The results were in agreement with those achieved by Travis (1971), Ferguson and Davies (1996) Hegab *et al*. (1999), Wassel *et al*. (2000), Youness-Randa (2002) and El-Khawaga and El-Wasfy (2008). They concluded that using slow release of N fertilizers was very effective in improving growth characters compared to using the fast release ones i.e. ammonium nitrate. In addition, when using slow release-N fertilizers, the applications frequency could be reduced to 50% without reducing the optimum leaf N content. Soluble (fast release) N fertilizers were generally more readily available but they had shorter residual effects on leaves and soil than the slow release-N ones.

The promotive effect of bio-fertilizers on the growth of citrus trees and the nutrient status were emphasized by Subba-Rao (1984), Helail and El-Deeb (1993), Ahmed *et al*. (2007), Wassel *et al*. (2007a) and Abdo (2008). They stated that the bio-fertilization of citrus trees had a promoting effect on growth traits that was attributed to the reduction in the soil pH and to the increase in the uptake of elements.

Moreover, the beneficial effects of the organic fertilization on the growth of citrus trees were reported by Ebrahiem and Mohamed (2000), Garamnagar *et al.* (2000), Wang *et al*. (2000), Srivastava *et al*. (2002), El-Salhy *et al*. (2002), Ahmed *et al*. (2007) and Abdo (2008). They found that the application of either organic-N alone or along with mineral source was effective in improving most growth characters of citrus trees compared to using N completely as a mineral source.

Similarly, using slow release, organic and bio-fertilization had a positive action in improving growth vigour and nutrient status in favour of improving the flower formation as well as its important action in maintaining a good balance between total carbohydrates and nitrogen (C/N ratio, Table, 4) in favour of improving the floral bud formation and initiation aids of the flowers to retention. Thus, the aforementioned points resulted in an increase in the number of fruits per trees.

Moreover, the slow release-N, organic and bio-fertilizers improve the nutrient status and the total leaf surface area of the trees which increase the synthesis of carbohydrates and proteins and consequently enhance cell division and enlargement leading to an increase in the fruit weight as well as overcome the rind puncture and puffing and creasing of pulp. Also, more available carbohydrates produced and translocated to the fruit can advance the fruit maturity and improve the fruit chemical attributes.

Such findings are of a good evidence for the importance of using the slow release as well as organic and bio fertilizers to increase the efficiency use of fertilizers, control the release of nutrients to trees and consequently improve the soil fertility and tree nutrient status as well as produce the high yield with good fruit quality. The above mentioned results were in accordance with those obtained by Allen (1986), Hegab *et al*. (1999), Rouse *et al*. (1999), Wassel *et al*. (2000), Youness Randa (2002) and El-Khawaga and El-Wasfy (2008) .They conculded that using the slow release-N fertilizers was very favorable in increasing the yield and improving the fruit quality.

The promotive effect of organic fertilization on citrus yield and fruit quality were emphasized by Ferguson (1994), Joo *et al*. (1999), Ebrahiem and Mohamed (2000), Wang *et al*. (2000), El-Salhy *et al*. (2002), Ahmed *et al*. (2007) and Abdo (2008). They showed that replacing 50 to 75% of N requirements of Balady mandarin trees by an organic-N form was very effective in improving the yield, with saving N fertilization cost and reducing nitrate pollution.

The improving effects of biofertilization were emphasized by Chokha (2000), Yu *et al*. (2001), Ahmed *et al*. (2007) and Wassel *et al*. (2007b). They point out that the yield and fruit quality of different citrus trees were positively affected by using biofertilizers along with mineral-N fertilization. The fruit quality was greatly improved due to the application of N using mineral source at 50% of the recommended N dose plus organic and biological sources each at 25%.

Therefore, it could be concluded that using either the slow release-N or other three fertilization sources improves the tree nutrient status, yield and fruit quality leading to an increase in the packable yield. In addition, it minimizes the production costs and environmental pollution which could be occurred by excess of chemical fertilizers.

These advantages will eventually enable growers to obtain high yield with good fruit quality. Furthermore, using the slow release, organic and bio-fertilization sources improves the soil fertility and reduces the added fertilizer requirements. Thus, the growers are able to produce organic farming products.

**References :**

**Abdo, Z.A.A. 2008:** Effect of some biofertilization treatments on growth and fruiting of Balady mandarin trees. Ph.D. Thesis Fac. of Agric. Minia Univ.

**Ahmed, F.F., A.E.M. Mansour and E.A. Shaaban 2007:** Effect of different sources of mineral N applied with organic and bio fertilizers on fruiting of Washington navel orange trees. Minia J. Agric. Res. and Develop. 27 (9): 30-51.

**Allen, S.E. 1986:** Slow release nitrogen fertilizers. "Nitrogen in crop production". ASA, CSSA and ASA, Madison. Pp 195-206.

**Association of Official Agricultural Chemists 1995:** Official Methods of Analysis 14th ed. (A.O.A.C.) Benjamin Franklin Station, Washington D.C., U.S.A., p 490-510.

**Cook, J.A. 1986:** Fertilizing for Maximum Yield. 3rd Ed. By EIBS, Book society, pp. 94-142.

**Ebrahiem, T.A and G.A. Mohamed 2000:** Response of Balady mandarin trees growing on sandy soil to application of filter mud and farmyard manure. Assiut J. of Agric. Sci. 31 (5): 55-69.

**El-Khawaga, A.S. and M.M. El-Wasfy 2008:** The effect of some slow release nitrogen fertilizers on growth, nutrient status and fruiting of Balady mandarin trees under sandy soil. Assiut J. of Agric. Sci. 39 (1): 107-119.

**El-Salhy, A.M., M. El-Dsouky and K.K. Attia 2002:** Effect of organic and inorganic nitrogen fertilization on nutrient status, yield and fruit quality of Balady mandarin trees. The 3rd Conf. of Agric. Sci., Fac. of Agric., Assiut Univ., Assiut, Oct. 2003, 303-315

**Ferguson, J.J. 1994:** Growth and yield of bearing and non-bearing citrus trees fertilized with fresh and processed chicken manure. Proc. of Florida State. Hort. Soc. 107: 29-32.

**Ferguson, J.J. and Davis, F.S. 1996:** Fertilization of young citrus trees with controlled release fertilizers. Proc. of Florida State. Hort. Soc. 108: 156-160.

**Gomez, K.A. and Gomez, A.A. 1984:** Statistical Procedures for Agriculture Researches (2nd ed.) Published by John Wiley and Sons, New York, U.S.A. p. 10-20.

**Hegab, M. Y., Ali, A. H. and El- Dawwey, G. M. 1999:** Behavior of Balady mandarin trees (*Citrus reteculata* L.) grown in sandy soil to some slow release nitrogen fertilizers. Minia. J. Agric. Res & Dev. 19 (1): 81-96.

**Helail, B. M. and El- Deeb, M. D. 1993:** Response of Rangpur lime seedlings to soil inoculation with mycorrhizal fungi. Egypt. J. Appl. Sci. 8 (8) 485- 505.

**Koo, R. C. J. 1988:** Controlled release sources of nitrogen for bearing citrus. Proc. Florida State Hort. Soc. 99: 46 -48.

**Mead, R., R.N. Gurnow and A.M. Harted 1993:** Statistical Methods in Agriculture and Experimental Biology (2nd ed.). Chapman and Hall, London. p. 10- 44.

**Miller, E.W., D.L. Donahue and J.U. Miller 1990:** Soils "An Introduction to soils and plant Growth" (5th ed.). Prentice Hall, International Inc. Engleword Cliffs, New Jersy, pp 303- 339.

**Nijjar, G.S. 1985:** Nutrition of fruit tees. Mrs. Usha Raj Kumar for Kalyanin publishers, New Delhi, p. 10-52.

**Sahrawat, K.L. 1979:** Nitrogen losses in rice soils. Fert. News. 24: 38-48

**Smith, F., M.A. Gilles, J.K. Homilton and P.A. Godes 1956:** Colormimetric methods for determination of sugar and related substances Chem. 28: 350- 356.

**Srivastava, A.K., S. Shyam and R.A. Marathe 2002:** Organic citrus soil fertility and plant nutrition with K of sustainable Agric. Food Products Press., Binghamton, USA, 19 (3): 5-29.

**Subba- Rao, N.S. 1984:** Biofertilizers in Agriculture. Oxford, IBH, Company, New Delhi, p. 1- 186.

**Subba-Rao, N.S., G.S. Venkateraman and S. Kannaiyan 1993:** Biological nitrogen fixation. Indian Council. Agric. Res. New Delhi, p. 112.

**Travis, P.H. 1971:** Controlled release fertilizers. News 16: 42- 48.

**Wang, C.Q., S.L. Wang, J.Y. Zhoiu, Q.Y. Zhou, Z.Y. Deng and W.C. Han 2000:** On the citrus requirement on nutritions and the special organic compound fertilizers. South China fruits, 29: 5, 18-22.

**Wassel, A.M., F.F. Ahmed and T.A. Ebrahiem 2000:** Nitrogen better management for high and quality of Balady mandarin trees grown in sandy soil. The 2nd Conf. of Agric. Sci., Fac. of Agric., Assiut Univ., Assiut, Oct. 2000, 293-300.

**Wassel, A.M., M.A. Mohamed, M.A. Ragab, R.A. Sayed and Y.A. Hussein 2007a:** Influence of biofertilization and application of potassium. I- On growth and leaf chemical composition of Balady mandarin trees (Citrus reticulate, Blanco). 1st Inter. Conf. on Desert Cultivation Future (problems & Solution) 27- 29 March, Minia Univ. Egypt.

**Wassel, A.M., M.A. Mohamed, M.A. Ragab, R.A. Sayed and Y.A. Hussein 2007b:** Influence of biofertilization and application of potassium. II- on yield and fruit quality of Balady mandarin trees (*Citrus* *reticulata*, Blanco). 1st Inter. Conf. on Desert Cultivation Future (problems & Solution) 27- 29 March, Minia Univ. Egypt.

**Wilde, S.A., B.B. Gorey, J.G. Layer and J.K. Voigt 1985:** Soils and Plant Analysis for tree culture. Published by Mohan primlani, Oxford and IBH publishing Co., New Delhi, p. 1- 142.

**Yagodin, B. A. 1990:** Agriculture Chemistry. Mir publishers Moscow p. 278-281.

**Youness- Randa, E. 2002:** Effect of different sources and methods of nitrogen application on vegetative growth and fruiting of Valencia orange trees (*Citrus sinensis* L.). Ph. D. thesis, Fac. of Agric., Minia Univ., Egypt.

# تأثير مصادر مختلفة من الأسمدة النيتروجينية على النمو الخضرى والحالة الغذائية وإثمار أشجار اليوسفى البلدى

**عبدالفتاح مصطفى الصالحى[1] ، حسن عبدالقوى عبدالجليل[1] ، أحمد حسن عبد العال[2] ، منتصر محمد على عبد الرحمن[3]**

[1] قسم البساتين – كلية الزراعة – جامعة أسيوط – أسيوط – مصر، [2]قسم البساتين – كلية الزراعة – جامعة الأزهر فرع أسيوط – مصر، [3]قسم البساتين – كلية الزراعة – جامعة جنوب الوادى – قنا – مصر

أجريت هذه الدراسة خلال ثلاثة مواسم متتالية 2006 ، 2007 و 2008 بمزرعة كلية الزراعة جامعة أسيوط – مصر لدراسة تأثير إضافة الأسمدة بطيئة التحلل أو خليط من الأسمدة العضوية والحيوية وسريعة الذوبان على النمو الخضرى والحالة الغذائية والمحصول وخصائص الثمار فى أشجار اليوسفى البلدى مقارنة بإضافة الأسمدة المعدنية سريعة الذوبان فقط . حيث تم إضافة الأسمدة سريعة الذوبان على ثلاثة دفعات فى مارس ومايو وأغسطس بينما أضيفت الأسمدة بطيئة التحلل أو الحيوية دفعة واحدة فى بداية الربيع .

وقد أظهرت النتائج ما يلى :

- أعطت الأسمدة البطيئة التحلل أو خليط الأسمدة ( العضوية + الحيوية + سريعة الذوبان) زيادة جوهرية فى صفات النمو الخضرى ومساحة الأوراق مقارنة بالأسمدة سريعة الذوبان فقط .
- أدى التسميد بالأسمدة بطيئة التحلل أو خليط الأسمدة إلى زيادة مؤكدة فى نسبة العناصر الغذائية (NPK) بالأوراق وكذلك نسبة النيتروجين والكربوهيدرات ونسبة الكربوهيدرات إلى النيتروجين بالأفرع مقارنة باستخدام الأسمدة المعدنية سريعة الذوبان فقط .
- سبب التسميد بالأسمدة بطيئة التحلل أو خليط الأسمدة زيادة جوهرية فى إنتاجية أشجار اليوسفى البلدى مقارنة باستخدام الأسمدة المعدنية سريعة الذوبان فقط .
- أعطى استخدام الأسمدة بطيئة التحلل أو خليط الأسمدة محصول عال ذو صفات ثمرية جيدة مقارنة بالأسمدة المعدنية سريعة الذوبان .
- عدم وجود فروق جوهرية فى الصفات المقدرة نتيجة التسميد بمعدل 100% أو 80% من الأسمدة بطيئة التحلل .

من نتائج هذه الدراسة يمكن التوصية باستخدام الأسمدة بطيئة التحلل بمعدل 80% أو خليط من الأسمدة (50% عضوى + 10% حيوى + 20% معدنى سريع الذوبان) . حيث يؤدى ذلك إلى تحسين النمو والحالة الغذائية للأشجار مع إنتاج محصول عال ذو خصائص ثمرية جيدة فضلاً عن تقليل تكاليف التسميد والتلوث الناشئ عن زيادة الأسمدة المعدنية وإمكانية إنتاج ثمار يوسفى عضوياً.