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(Original Article)

Relation of Balady Mandarin Trees Fruiting to use Different Nitrogen Sources

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Abstract

The experimental orchard in the Shandaweel region of the Sohag Governorate, Egypt, served as the study site for this investigation into the feasibility of using organic and bio fertilizers of Balady mandarin trees during the 2020, 2021and 2022 seasons.

The experiment set up as a randomized complete block design with three replications, one tree each. Microbine as a bio form and humic acid as an organic form ware added in March, mineral nitrogen fertilizer is divided to equal three doses and applied at March, May and August.

Using the recommended nitrogen dose (RND) via organic-N, bio-form, or combination of inorganic and organic plus microbine significantly increased growth traits, N, P, K, Mg, and total chlorophyll of leaves, as well as yield per tree compared to using RND as mineral –N.

The trees that were fertilized with the triple form (25% mineral, 25%organic, and 25% microbine) had the highest values of these features.

Using double or triple forms increased fruit quality in terms of increasing fruit weight, pulp percentage, total soluble solids, sugar, and vitamin C contents and lowering total acidity compared to using RND via a mineral-N source alone.

Hence, it could conclude that the tree's nutrient status, yield, and fruit quality were all increased when 75% of the nitrogen fertilization was replaced with organic or bio-form. Furthermore, it reducedproduction expenses and potential environmental pollution caused by excessive use of chemical fertilizers. Moreover, the producers can generate products from organic farming.

Keywords: *Fertilizers, Humic acid, Microbein, Balady mandarin, Nutrient status*

Introduction

Citrus is the maximum significant crop in the world after grapes. It is one of the greatest valuable crops in over 140 nations, holding a particular place in global commerce. Furthermore, over the past ten years, there has been a significant increase in the cultivation of citrus, which is Egypt's most important fruit crop.

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5,000,000 tonnes of fruits were produced from 486000 feddans of cultivated land that were home to citrus orchards. Mandarin trees produced 1168682 tons in 2022, using 122630 feddans, according to the Ministry of Agriculture's Annual Statistics.

Mandarin, also known as *Citrus reticulate* Blanco, is a citrus fruit that is highly valued in many nations, including Egypt. Only the native Balady cultivar, which is a member of the common Mediterranean mandarin family, is used extensively in Egypt's mandarin industry.

One of the most crucial methods for raising crop yields is fertilization, particularly when using nitrogen. The effects of nitrogen fertilization are contingent upon the cultivated soil's nutrient status, as well as the quantity, sources, and techniques of N application (Ge *et al*., 2018).

Citrus is known to require a lot of fertilizer, particularly nitrogen. Hence, the primary issues that producers face are the exorbitant expense of highly manufactured fertilizer requirements for plants. Additionally, throughout their manufacture and use, these chemical fertilizers are regarded as polluting agents of the air, soil, and water.

Therefore, having corrective ways to avoid the many risks caused by chemical application, as well as enhancing production and fruit quality, are major benefits of biological fertilization (Suhag, 2016). Beneficial microorganisms that can liberate nutrients from rock and plant wastes in the soil and make them available for cost-effective crop production make up the majority of bio fertilizers (Ortas, 2012; El-Salhy *et al.*, 2017 and Hazarika and Aheibam, 2019).

When organic fertilizers are used in citrus orchards, less mineral fertilizer is applied overall and clean fruit and juice are produced without the use of chemicals. Utilizing recycled animal and farmer wastes to create composite that enhances biological cycles, increases fertility of soils, and prevents pollution from conventional agricultural practices is the basis of using organic fertilizers, which encompass all types of organic soil amendments (Obreza and Ozores, 2000; El-Salhy *et al*., 2017; Hameed *et al*., 2018 and Tadayon and Hosseini, 2020).

Humic acid is a bio stimulant that enhances the qualities of soil and plants, hence promoting growth. It is a complex mixture of aromatic organic acids with various functional groups, metal ions, and varying amounts of carbon, hydrogen, oxygen, nitrogen, phosphorus, Sulphur, and carbon (Zhang and Ervin, 2004). Because humic chemicals promote enzyme activity, membrane permeability, photosynthesis, and respiration, they are regarded as a Kay component of soil and plants (Muscolo *et al*., 2007 and Hameed *et al*., 2018), sustaining the pace of transpiration, raising the amount of protein and vitamins, and producing dry matter (Al-Hayani, 2016 and Ihsan *et al*., 2019).

Reducing the amount of mineral fertilization may be accomplished by applying humic materials and bio fertilizer (Abdel-Monem *et al*., 2008; Pathak *et al*., 2017; El-Salhy *et al*., 2017 and Yadav and Sarka, 2019).

Bio-fertilizers could improve crop productivity through increasing biological N-fixation, availability and uptake of nutrients as well as stimulating of natural hormones (Hegab *et al*., 2005; El-Salhy *et al*., 2017; Bhandari *et al*., 2018 and Liu *et al*., 2020). Biofertilizers containing the microbine, nitrobine and azotobacter produces many growth regulators such as IAA and GA_3 which positively influence plant growth (Sharma and Kumar, 2008 and Shamseldin *et al*., 2010).

It was impossible to grow organic or healthful citrus fruits without the use of bio fertilizers. By boosting biological N fixation, nutrient availability and uptake, and natural hormone stimulation, they may contribute to increased crop output. As a result, using organic and bio fertilizers has frequently been discounted as the best way to increase citrus tree yield (Abdo, 2008; Khehra and Bal, 2016; El-Salhy *et al*., 2017; El-Badawy, 2017; Hameed *et al*., 2018; Ihsan *et al*., 2019; Rana *et al*., 2020 and Abobatta and El-Azazy, 2020).

In order to enhance the growth and fruiting of Balady mandarin trees, the purpose of this study was to investigate the feasibility of partially substituting organic and bio fertilizers for mineral-N fertilizers.

Materials and Methods

The investigation was conducted on 40-year-old Balady mandarin trees (*Citrus reticulata* Blanco) that were planted 5 m apart and budded on sour orange root stock during the course of three consecutive seasons in 2020, 2021, and 2022. They were grown on the farm of the Agricultural Research Station, Shandaweel, Sohag Governorate, Egypt. The soil of orchard was well-drained, has a clay loam texture, and is irrigated by surface irrigation (Table 1).

Table 1. Analysis of the soil of the experimental site before starting the study.

Characters	Value	Character	Value
Sand (%)	24.11	Total N (%)	25.51 mg/kg
Silt (%)	47.46	Available P (ppm)	10.76 mg/kg
Clay (%)	28.43	Available K (ppm)	218.0 mg/kg
Texture	Clay loam	DTPA-extractable	
pH (1:2.5)	8.10	Fe (ppm)	22.70
E.C (1:2.5) (dS/m)	1.85	Mn (ppm)	18.31
Organic matter (%)	1.38	Zn (ppm)	4.6
$CaCO_3$ (%)	3.66	Cu (ppm)	3.18

Twelve uniform, healthy trees that did not exhibit any visible signs of a nutritional deficit were selected to participate in this experiment. Four groups were created out of the selected trees. One fertilization regime management was given to each group in the manner described below:

1-Applying inorganic N sources only (2985 g ammonium nitrate; 33.5% N/tree) to achieve the recommended nitrogen dose RND (1000 g N/tree).

2-Application of 25% RND via mineral-N (250 g ammonium nitrate) and 75% via humic acid.

3-Application of 25% RND via mineral-N (250 g ammonium nitrate and 75% microbine (750 g/tree).

4-Application of 25% mineral-N plus 25% humic acid and 25% microbine.

As a fast-release nitrogen fertilizer, ammonium nitrate (33.5% N) is divided to equal three doses and applied during the first week of March, May, and August.

Once in March, microbine and humic acid were introduced, combined with the soil's top layer, and then the area was directly irrigated.

Three replications, one for each treatment, of a randomized complete block design were used in the experiment.

Over the course of the three growing seasons, the following parameters were measured.

Vegetative growth, leaf chlorophyll and nutrient status

In February, four primary branches were selected and tagged; these branches were almost identical in terms of growth, diameter, density of foliage, and distribution around the periphery of each tree. The following vegetative characteristics were assessed during the autumn growth cycle:

By picking and weighing 30 fully mature leaves/tree and recording the weight of 60 sections (2 sections of 1 cm2/leaf), it was possible to estimate the shoot length (cm), leaf number/shoot, and leaf area (cm2). The average leaf area (cm2) was then calculated by multiplying the leaf weight (g) by the 2/sections weight (g), and the leaf chlorophyll content was measured using a chlorophyll meter (Minolta, SPAD 502 plus). Replicate from the fourth terminal spent leaf of the shoot, using ten leaves.

N, P, K and Mg in leaves

To determination N, P, and K in the leaves, fifty mature leaf samples were chosen at random from the non-fruiting shoots of the spring flush in mid-September. Using a combination of sulfuric acid and hydrogen peroxides for digestion, nitrogen was measured in shoots in accordance with established procedures described by (Chapman and Pratt, 1975 and Wilde *et al*., 1985).

Yield and its components

The quantity of fruits on each tree was tallied during the final week of December, when harvesting took place, and the yield per tree was then calculated.

Fruit Quality

To determine the fruit quality, ten randomly selected samples were taken from each tree. Fruit weight and chemical quality metrics, including sugar contents%, total soluble solids%, total acidity%, and ascorbic acid%, were calculated using A.O.A.C. methods (1995). The obtained data were statistically analyzed according to Gomez and Gomez (1984) and Mead *et al*. (1993) the L.S.D. test at 5% was used to define the significance of the differences among of the various treatment means.

Results

1. Vegetative growth

The effects of applying microbine as a bio and humic acid as an organic nitrogen on the shoot length, number of leaves per shoot, leaf area, and total chlorophyll content of Balady mandarin trees in 2020, 2021, and 2022 seasons were displayed in Tables 2 and 3. The illustrated data declared that across the three seasons under study, the results displayed a similar tendency.

The use of the recommended nitrogen dose (RND) via organic-N (T2) or microbine (T3) as well as a combination of inorganic and organic plus bio-form (T4) significantly increased the shoot growth and leaf attributes in comparison to the use of RND via mineral-N (check treatment T1).

A triple method of fertilization 25% mineral, 25% organic, and 25% bio was used to achieve the highest values of shoot length and leaf characteristics (T4).

Due to fertilization using triple form (T4), the highest values of shoot length were 55.23 cm, leaf area was 12.53 cm2, and chlorophyll content was 49.67% (as an average of the three analyzed seasons). On the other hand, trees that were fertilized with the recommended dose of nitrogen (RND) via mineral (T1) showed the corresponding lowest values of 44.83 cm, 10.27 cm2, and 46.17% (as an average of the three investigated seasons).

Table 2. Impact of various sources of nitrogen fertilization on shoot length (cm) and no leaves/shoot of Balady mandarin trees during 2020, 2021, and 2022 seasons

Treatments	Shoot length(cm)				No leaves/Shoot			
	2020	2021	2022	Mean	2020	2021	2022	Mean
T_1	43.0D	45.17D	46.33C	**44.83D**	28.0C	27.33C	27.60C	**27.64D**
T_2	48.03C	49.33C	50.67B	**49.34C**	34.0B	36.0B	36.50B	**35.50C**
T_3	50.20B	51.47B	52.33B	**51.33B**	34.0B	37.0B	37.90AB	**36.30B**
T_4	53.17A	55.87A	56.67A	**55.23A**	39.0A	39.0A	39.80A	**39.26A**
LSD 5%	**0.99**	**1.39**	**1.85**	**0.77**	**2.07**	**1.99**	**2.40**	**0.99**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

Table 3. Impact of various sources of nitrogen fertilization on Leaf area (cm2) and Chlorophyll content (SPAD value) of Balady mandarin trees during 2020, 2021, and 2022 seasons

Treatments	Leaf area (cm^2)				Chlorophyll content (SPAD value)			
	2020	2021	2022	Mean	2020	2021	2022	Mean
T_1	9.63C	10.50C	10.70C	**10.27C**	44.20C	45.10C	49.22C	**46.17D**
T_2	11.53B	12.40B	12.37B	**12.10B**	45.60B	47.50B	50.57B	**47.89C**
T_3	11.97A	12.63AB	12.76AB	**12.45A**	46.30AB	47.82B	52.23A	**48.78B**
T_4	12.10A	12.67A	12.82A	**12.53A**	47.81A	49.43A	51.78AB	**49.67A**
LSD 5%	**0.36**	**0.25**	**0.40**	**0.23**	**1.84**	**1.68**	**1.79**	**0.75**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

As a result, the increment percentage for shoot length, leaf area, and chlorophyll content (as an average of the three studied seasons) were associated with the triple form fertilization (25 percent mineral plus 25 percent organic and 25 percent nitrobine, T4) as opposed to check treatment (100% inorganic, T1), respectively.

2. Percentage of N, P, K and Mg in leaves

The data displayed in Tables 4 and 5 demonstrated how various nitrogen fertilization treatments affected the leave- N, P, K, and Mg content of Balady mandarin trees in 2020, 2021, and 2022 seasons. The data in the aforementioned tables showed that the various applications under study had a substantial impact on the proportion of N, P, K, and Mg in leaves. The data showed that across the three seasons under study, the results displayed a similar tendency.

Table 4. Impact of various sources of nitrogen fertilization on N% and P% of Balady mandarin trees during 2020, 2021, and 2022 seasons

Treatments	N%				P%			
	2020	**2021**	**2022**	**Mean**	**2020**	**2021**	**2022**	**Mean**
T_1	1.66B	1.68B	1.72C	**1.68B**	0.16D	0.18C	0.19C	**0.17C**
T_2	1.95A	1.96A	1.97B	**1.96A**	0.18C	0.19B	0.20B	**0.19B**
T_3	1.90A	1.94A	2.14A	**1.99A**	0.19B	0.21A	0.19C	**0.19B**
T_4	1.96A	2.01A	2.18A	**2.05A**	0.21A	0.20A	0.22A	**0.21A**
LSD 5%	**0.12**	**0.15**	**0.17**	**0.11**	**0.012**	**0.011**	**0.014**	**0.008**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

Table 5. Impact of various sources of nitrogen fertilization on K% and Mg% of Balady mandarin trees during 2020, 2021, and 2022 seasons

Treatments	K%				Mg%			
	2020	**2021**	**2022**	**Mean**	**2020**	**2021**	**2022**	**Mean**
T_1	1.54B	1.56C	1.56C	**1.55C**	0.16C	0.15C	0.14C	**0.15C**
T_2	1.66A	1.68B	1.69B	**1.67B**	0.17B	0.16B	0.15B	**0.16B**
T_3	1.68A	1.79A	1.80A	**1.75A**	0.16C	0.15C	0.14C	**0.15C**
T_4	1.67A	1.78A	1.82A	**1.75A**	0.19A	0.18A	0.17A	**0.18A**
LSD 5%	**0.08**	**0.09**	**0.06**	**0.05**	**0.009**	**0.008**	**0.006**	**0.005**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

In comparison to using mineral-N alone (T1), fertilization with either double form (mineral-N plus organic acid), triple form (mineral-N plus organic and microbine), or bio-form (mineral-N plus bio-form) greatly improved the N, P, and K contents of leaves.

The maximum values of N, P, K, Mg% were 2.05, 0.210, 1.75 and 0.18% (as an av. of the three studied seasons) due to triple form (mineral-N plus organic and bio-form (T_4), respectively.

Fertilization using organic acid, bio-form, or double form did not differ significantly from each other.

On the other hand, mineral-N fertilization alone resulted in the most recent matching values of 1.68, 1.70, 1.55, and 0.15 (T1). Therefore, the triple form as opposed to the usage of mineral-N alone (T1) resulted in the corresponding increment % reaching 22.02, 23.53, 12.90, and 20.00 (as an average of the three examined seasons), respectively.

The aforementioned findings indicate that, in comparison to applying solely mineral nitrogen, utilizing humic acid as an organic and microbine as a bio-form together greatly improved the vitality and nutrient status of trees.

Thus, it is possible to draw the conclusion that fertilizing trees with nitrogen from two or three different sources at once would boost their vitality and nutritional health.

3. Yield and its components

A broad summary of the findings in Table 6 shows that, in comparison to the use of RND via mineral-N source alone (check treatment, T1), the number of fruit/trees and yield were significantly increased by using a combination of mineral-N plus either organic (T2) or bio (T3) as well as triple form (T4).

Table 6. Impact of various sources of nitrogen fertilization on Fruit number/tree and Yield/ tree (kg) of Balady mandarin trees during 2020, 2021, and 2022 seasons

Treatments	Fruit number/tree				Yield/ tree (kg)			
	2020	**2021**	**2022**	**Mean**	**2020**	**2021**	**2022**	**Mean**
T_1	234.5D	313.9D	318.3D	**288.9D**	39.85D	56.20D	57.33D	**51.1D**
T_2	243.0C	340.0C	368.0C	**317.1C**	47.66C	72.93C	73.83C	**64.8C**
T_3	254.7B	372.0B	374.0B	**333.5B**	51.69B	79.57B	80.70B	**70.6B**
T_4	278.0A	377.0A	378.7A	**344.5A**	62.10A	84.79A	85.50A	**78.3A**
LSD 5%	**4.58**	**2.76**	**3.15**	**2.06**	**0.86**	**1.24**	**1.19**	**0.68**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

Using of RND via triple form (T4), the maximum value of fruit per tree was 344.5, and the yield (as an average of the three examined seasons) was 78.3 kg/tree. On the other hand, using RND via mineral-N alone, the lowest values of fruit/tree and yield/tree were 288.9 fruits and 51.1 kg/tree, respectively (T1). Therefore, when compared to check treatments (T1), the increase in yield or tree resulting from T4 reached 53.23% (on average over the three seasons under study).

Additionally, the average of the three seasons under study showed that the yield/tree from fertilization with mineral-N mixed with organic form (T2) was 64.8 kg and bio (T3) was 70.6 kg. As a result, T2 and T3 compared to T1 caused the increment percentage of yield/tree to reach 26.81 and 38.16% (on average throughout the three examined seasons), respectively.

It is clear that, applying double or triple form mineral, organic, and biological benefits in yield. These fertilization techniques also lower production costs and pollution issues in the environment.

4. Fruit properties

The over mentioned data in Tables (7, 8, and 9) demonstrated how various organic and bio fertilization sources affected the fruit weight, pulp weight percentage, total soluble solids, sugar, and volatile carbon content, in addition to the total acidity of Balady mandarin fruits in the 2020, 2021, and 2022 seasons. Over the course of the three studied seasons, the acquired results generally displayed a similar tendency.

Table 7. Impact of various sources of nitrogen fertilization on Fruit weight (g) and Pulp weight % of Balady mandarin fruits during 2020, 2021, and 2022 seasons.

Treatments	Fruit weight (g)				Pulp weight %			
	2020	2021	2022	Mean	2020	2021	2022	Mean
T_1	155.7D	163.8D	164.3C	**161.2D**	57.50D	60.11D	61.26D	**59.62D**
T_2	196.2C	198.0C	200. 3B	**198.1C**	70.63C	71.28C	72.10C	**71.3C**
T_3	203.0B	214.0B	216.0A	**211.0B**	73.08B	77.04B	77.76B	**75.9B**
T_4	223.4A	225.0A	227.3A	**225.2A**	80.42A	81.00A	81.82A	**81.0A**
LSD 5%	**4.03**	**8.81**	**11.38**	**4.02**	**1.84**	**1.92**	**1.77**	**1.19**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

Table 8. Impact of various sources of nitrogen fertilization on TSS%, Total sugars% and reducing sugars% of Balady mandarin fruits during 2020, 2021, and 2022 seasons.

Treatments	TSS %				Total sugars%				Reducing sugars%			
	2020	2021	2022	Mean	2020	2021	2022	Mean	2020	2021	2022	Mean
T_1	9.87B	10.33C	10.50C	**10.23C**	9.12C	9.07C	9.14C	**9.11C**	4.17D	4.30D	4.40D	**4.29D**
T_2	10.73A	12.33A	12.43A	**11.83A**	9.67A	9.72A	9.87A	**9.75A**	6.65B	6.90B	7.06B	**6.87B**
T_3	10.87A	11.03B	11.17B	**11.02B**	9.30B	9.39B	9.42B	**9.37B**	6.24C	6.52C	6.75C	**6.43C**
T_4	10.67A	11.40B	11.50B	**11.19B**	9.98A	9.99A	10.12A	**10.03A**	7.21A	7.20A	7.40A	**7.27A**
LSD 5%	**0.46**	**0.39**	**0.53**	**0.31**	**0.57**	**0.42**	**0.31**	**0.28**	**0.19**	**0.23**	**0.16**	**0.09**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

Data indicated that double- or triple-form fertilization improved fruit quality in terms of increasing fruit weight, pulp percentage, total soluble solids (TSS), sugar, and vitamin C contents and decreasing total acidity when compared to using the recommended dose of nitrogen (RND) via a mineral-N source.

Table 9. Impact of various sources of nitrogen fertilization on Acidity % and V. C. (mg/100g/juice) of Balady mandarin fruits during 2020, 2021, and 2022 seasons

Treatments	Acidity %				V. C. (mg/100g/juice)			
	2020	2021	2022	Mean	2020	2021	2022	Mean
T_1	1.19A	1.10A	1.17A	**1.15A**	51.31B	52.20C	53.16C	**52.22D**
T_2	1.08B	1.11A	0.99B	**1.06B**	52.32B	57.33B	58.33B	**55.99C**
T_3	0.96D	1.02B	0.97B	**0.98B**	60.27A	61.0A	62.33A	**61.20B**
T_4	0.98C	1.0B	1.0B	**0.99B**	61.13A	62.33A	63.0A	**62.15A**
LSD 5%	**0.082**	**0.056**	**0.038**	**0.028**	**1.56**	**1.68**	**1.96**	**1.07**

T1:100%RND (Recommended nitrogen dose), T2: 25%RND+75% Humic acid, T3: 25%RND+75% Microbine, T4: 25%RND+25% Humic acid+25% Microbine. Same letters within column are not significantly different.

As an average of the three examined seasons, the high values of fruit weight were 225.2 g, pulp% 81.0, TSS 11.19, total sugar 10.03%, and V.C. were 62.15 mg/100 g due to T4. In contrast, the check treatment (T1) gave the lowest values of fruit weight (165.6 g), pulp (59.62), TSS (10.23%), total sugar (9.11%), and vitamin C (52.22 mg/100g) (as an average of the three examined seasons).

Hence, the increment percentages of the fruit weight were 35.99% and of TSS were 9.38%, total sugar 10.10% and vitamin C were 19.02% (as an av. of the three studied seasons) due to T4 compared to T1, respectively.

In contrast, the lowest values of total acidity were obtained when double or triple form were used.

Total acidity was lowest (averaging over the three seasons under study) at 0.98% due to T3, while it was highest (1.15%) due to mineral sources used (T1). As a result, T3 compared to T1 caused the declining percentage of total acidity to reach 14.78 % (as an average of the three examined seasons).

The improvement was greater when the triple form was used than when the double form was used. Therefore, the triple fertilization form is recommended for evaluating the application of N sources financially. A programme of this kind for fertilization is crucial to the production of mandarin oranges since it raises the marketable yield by enhancing the fruit's quality and increasing its weight and size.

Discussion

Fertilization with nitrogen is one of the most crucial methods for raising crop yield. Fruit trees depend heavily on nitrogen for nourishment. It is an essential component of nucleic acids, protoplasm, and chlorophyll (Nijjar, 1985).

All fruit trees require organic and bio fertilizers, such as microorganisms and humic materials, as vital parts of their nutrition management programme. They enhance soil biodiversity, which is crucial for maintaining soil fertility and enhancing tree development and nutritional status (Ortas, 2012 and Pathak *et al*., 2017).

One of the most important tools for sustainable crop production systems in horticulture is the use of organic and bio fertilizers. They reduced expenses and secured natural resources while also enhancing the health of the soil and rising fruit quality and output (El-Salhy *et al*., 2017; Hazarika and Aheibam, 2019 and Abobatta and El-Azazy, 2020).

Organic fertilizers improve the physical properties of soil by augmenting its capacity to retain water and nutrients, as well as its total pore space, aggregate stability, erosion resistance, resilience to temperature fluctuations, and apparent soil density. By increasing the soil's nutrient content and cation exchange capacity, organic fertilizers improve the chemical properties of the soil (Shiralipour *et al*., 1992; El-Salhy *et al*., 2002 and Hameed *et al*., 2018).

The results of Abdel Hamied (2014), Trinchera *et al*. (2015), Al-Hayani *et al*. (2016), El-Salhy *et al*. (2017), El-Badawy (2017) and Tadayon and Hosseini

(2020) verified that using organic fertilizers improved the growth, yield, nutritional state, and fruit quality of various orange and mandarin trees.

Bio-fertilizers have been shown to have a significant favorable impact on growth and fruiting because they improve soil fertility, microbial activity, N fixation, and nutrient availability (Kannaiyan, 2002).

The findings of indicated that bio fertilizers have a positive impact on fruit quality, yield, growth, and nutritional status (Hegab *et al*., 2005; Gamal, 2006; Hassan, 2008; Ismail *et al*., 2011; Abdel-Aal *et al*., 2012; Khehra and Bal, 2016; El-Salhy *et al*., 2017; Bhandari *et al*., 2018 and Rana *et al*., 2020).

Conclusion

Therefore, it is reasonable to conclude that using nitrogen sources of organic and bio fertilizer improves fruit quality, production, tree development, and nutrient status—all of which increase packable yield. It also lessens the environmental damage that comes from using an excessive amount of chemical fertilizers and reduces production costs. The application of organic and bio fertilizers also improves soil fertility and reduces the requirement for more fertilizer. As a result, the growers can produce fruits using organic farming.

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علاقة إثمار أشجار اليوسفي البلدي باستخدام مصادر أسمدة نيتروجينية مختلفة

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الملخص

أجريت هذه الدراســة خلال ثلاثة مواســم متتالية 2020، 2021، 2022 بالمزرعة البحثية لمركز البحوث الزراعية بشندويل، سوهاج، مصر، لدراسة إمكانية استبدال التسميد النيتروجيني بكل من الأسـمدة العضـوية (حمض الهيوميك) أو الحيوية (ميكروبين) فردياً أو معاً. وقد صـممت التجربة بنظام القطاعات العشـوائية الكاملة وتحتوي على أربع معاملات وكررت كل معاملة ثلاث مرات لكل مكررة شجرة.

وقد أظهرت النتائج ما يلي

أدي اسـتخدام التسـميد بالصـورة الثلاثية (معدني + عضـوي + حيوي) أو الصـورة الثنائية (معدني + عضوي أو معدني + حيوي) زيادة مؤكدة في صفات النمو الخضري ومحتوي الأوراق من الكلوروفيل وكل من النيتروجين والفوســفور والبوتاســيوم والماغنســيوم مقارنة بالتســميد النيتروجيني المعدني فقط.

سبب التسميد بالصورة الثنائية أو الثلاثية زيادة مؤكدة في المحصول / شجرة وكذلك تحسين خصائص الثمار حيث أدي ذلك لزيادة وزن الثمرة ونسبة اللب ومحتوي العصير من المواد الصلبة الذائبة الكلية والســكريات وفيتامين (C) مع تقليل نســبة الحموضـــة مقارنة باســتخدام التســميد النيتروجيني في الصورة المعدنية.

سـجلت أفضـل النتائج باسـتبدال 75% من النيتروجين المعدني بالأسـمدة العضـوية (حمض الهيوميك) والحيوية (ميكروبين).

من نتائج هذه الدراســة يمكن التوصــية بأهمية اســتبدال 75% من النيتروجين المعدني بالأسـمدية العضـوية والحيوية – حيث يؤدي ذلك إلي تحسـين النمو والحالة الغذائية للأشـجار مع إنتاج محصــول عال ذو خصــائص ثمرية جيدة فضــلاً عن تقليل تكاليف التســميد والتلوث البيئي الناشئ عن زيادة الأسمدة المعدنية مع إمكانية إنتاج ثمار يوسفي عضوية.