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EFFECT OF SOIL NITROGEN FERTILIZER ON FRUIT SET, THE YIELD AND FRUIT QUALITY OF VALENCIA ORANGE TREES

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ABSTRACT

This experiment was carried out during 2018/2019 and 2019/2020 seasons on Valencia orange trees cultivated on clay soil located at Mallawy district to investigate the effect of different nitrogen doses on the yield and its fruits quality. Different Nitrogen applications at 600, 900 and 1200 g N/ tree in the form of ammonium nitrate (33.5%) were added annually per tree in two or three equal batches at Mid- November and first week of December and Mid- November, first week of December and Last week of December. In addition to the control 1000 g N / tree at three equal batches, at the start of spring growth cycle, just after fruit setting and at two months later. Increasing the nitrogen doses was very effective in increasing fruit set, the yield per tree and fruit quality. The best results concerning yield and fruit quality were presented by adding 1200 g N /tree annually at three equal batches.

INTRODUCTION

Large amounts of nitrogen are depleted annually from the soil as a result of heavy crop productivity and pruning of shoots and leaves. Such huge reduction in soil nitrogen content must be compensated annually by adding nitrogen fertilizers to maintain the high yield and good quality of citrus crops. It is very important to use proper nitrogen level that resulted in balancing growth and fruiting status. Choosing the proper and suitable source of nitrogen is very essential for enhancing the availability of most nutrients especially under higher soil PH and it is surely reflected on enhancing nutritional status of the trees on favour of maximizing the yield .Thereby, adjusting nitrogen nutrition of citrus considered an important and limited factor for improving production and fruit quality.

Marschner (1995) demonstrated that nitrogen, as a plant nutrient is required by trees in comparatively larger amounts than

other elements. Nitrogen is essential for many compounds of plants, nucleotides, proteins, chlorophylls, vitamins, enzymes, alkaloids and hormones.

Many authors had discussed the influence of nitrogen on fruit setting.

Awan et al (1985) proved that fruit set of sweet lime was increased by the application of 5kg N /tree. **Ali and Lovatt[1](1994)** mentioned that the total number of flowers in the following spring was three times with ammonum nitrate added in December, January and February. **Zaghloul and Kanany (2012)** demonstrated that the balanced fertilizer had the highest fruit set (7.8% and 8.1%) during the two years of the experiment. **Randa (2017)** indicated that initial fruit setting of navel orange trees increased positively with increasing nitrogen levels from 100 to 140 kg N / feddan either used ammonium nitrate (33.5%) or ammonium sulfate (20.6%) as a source of nitrogen. The best results were obtained by using 120 kg N/feddan/year. The addition of fertilizers was carried out at two equal patches.

The influence of nitrogen on the yield of citrus trees had been demonstrated by several authors. **Chapman (1982)** found that the application of ammonum nitrate at a rate of 0.4 and 0.7 kg N/tree/annually was of meaningless effect on the yield of Imperial mandarin trees when used at the lowest dose. **Bevington (1984)** indicated that Valencia orange trees gave satisfactory promotion yield when 900 g N was added to the soil/tree. **Intrigliolo (1984)** showed that urea, ammonum sulfate or calcium nitrate at (400-600 g N/tree) resulted in increasing the yield /tree of Sanguinello moscato .**Awan et al (1985)** demonstrated that the yield of Sweet lime trees was increased positively by adding 5 k g N/tree /annually **.Hume et al (1985b)** revealed that the yield of Valencia orange trees was gradually stimulated with increasing nitrogen levels till 1000g N/tree. **Abo-Elkomsan and Ebrahem (2002b)** found that Valencia orange trees budded on Troyer citrange gave the highest yield by adding 1250 g N /tree annually.

The response of some physical and chemical properties of citrus fruits to nitrogen fertilization had been discussed by several investigators on fruit weight. **Darwish et al (1992)** on Ballad orange CV, **El- Hossiny (1994)** on navel orange and **Koseloglu et al (1995)** on satsuma trees. They demonstrated that raising nitrogen rates almostely increased fruit weight. Besides **Merweld et al (2014)** on Valencia orange declared that using slow release nitrogen fertilization added to the soil in Valencia orange orchard resulted in enhancing positively fruit weight. Similar results had been noticed by **Ramana et al (2014)** on sweet orange.

Obreza and Rouze[2] (1993) on Hamlin orange trees, **Abo-Elkomsan and Ebrahiem (2002)** on Valencia orange trees in addition to **Mansour and Shaaban (2007)** on Washington navel orange. Other authers demonstrated that addition of the suitable amount of nitrogen to the trees resulted in increasing the T S S and reducing sugars, meanwhile reduced acidity of fruit juice. Similar trend had been notised by **Merwald et al (2014)** on Valencia orange, **Habash (2017)** on navel orange and **Goud et al (2017)** on Nagpur mandarin .The ascorobic acid content in the juice of Valencia orange fruits (33.9 m g/L) had been enhanced by the addition of slow release nitrogen fertilizer.

The present work was carried out to study the effect of different nitrogen doses added to the soil on fruit set, yield and fruit quality of Valencia orange trees.

MATERIALS AND METHODS

This investigation was conducted during two consecutive seasons (2018/ 2019) and (2019/ 2020) on 21 Valencia orange trees uniform in vigor, budded on sour orange rootstock, 27-year old and spaced at 6.0x6.0 meters apart. The trees are grown in a private orchard situated at Agricultural Research Station, Malawi, Minia Governorate, Egypt. Surface irrigation was carried out using Nile water.

The objective of this experiment was studying the effect of different levels and number of application nitrogen to the soil on fruit set, yield and fruit quality of Valencia orange trees.

During the two experimental seasons, seven treatments were carried out as follows:

- Control, application of inorganic N source (1000 g N / tree) at three equal batches, at the start of spring growth cycle, just after fruit setting and at two months later.
- Application of inorganic N source twice annually at a rate of 600 g N / tree, divided at two equal patches, at mid –November and first week of December.
- Application of inorganic N source twice annually at a rate of 900 g N / tree, divided at two equal patches, at mid –November and first week of December.
- Application of inorganic N source twice annually at a rate of 1200 g N / tree, divided at two equal patches, at mid –November and first week of December.
- Application of inorganic N source thrice annually at a rate of 600 g N / tree, divided at three equal patches, mid –November, first week of December and last week of December.
- Application of inorganic N source thrice annually at a rate of 900 g N / tree, divided at three equal patches, mid –November, first week of December and last week of December.
- Application of inorganic N source thrice annually at a rate of 1200 g N / tree, divided at three equal patches, mid –November, first week of December and last week of December.

Each treatment was of three replicates, one tree per each. Inorganic Nitrogen source was applied in the form of ammonium nitrate (33.5 %) as a soil dressing. The experiment was set in Complete Randomized block design (CRBD) in the two experimental seasons.

The following parameters were carried out as follows:

- Percentages of initial fruit setting, number of fruits per tree and yield per tree (kg).
- Some physical and chemical characteristics of fruits were determined as follows:
- Average fruit weight by using analytical balance.
- Total soluble solids (T.S.S) by using handy refractometer.
- Total acidity in the juice by titration with sodium hydroxide of a known normality (0.1 N) then estimated as a citric acid.
- -Reducing sugars was determined by using volumetric method as outlined by **Lane and Eynon (1965).**
- Ascorbic acid in the juice (Vitamin C) was determined by titration with Tillman's reagent as outlined in A.O.A.C (2000).

The yield data were tabulated and statistically analyzed to obtain new L.S.D at 5% to make the comparison among the treatment means, **Mead et al (1993).**

RESULTS AND DISCUSSION

1-Effect of Nitrogen fertilization on the initial fruit setting as well as number of fruits and the yield per tree of Valencia orange trees during (2018/2019) and (2019/2020) seasons.

It is cleared from the data obtained on table (1) that the highest initial fruit setting was obtained in Valencia orange trees fertilized by 1200 g N/ tree, three times annually during the first season .Similar results were shown in the second one. The percentage of initial fruit setting in this treatments was higher than any other treatments including the control. This was proved statistically significant.

Concerning the effect of using N at 600, 900 and 1200 g N/tree annually either splitted in twice or thrice applications was of pronounced effect on the number of fruits per tree. The maximum number of fruits per tree was presented in the two years of the experiment due to the addition of 1200g N/tree annually added in three equal batches. The different between its effect and the other treatments on number of fruits per tree was statistically significant in the first and second experimental seasons.

Regarding the influence of different nitrogen doses, 600, 900 and 1200 g N/tree annually and the number of applications(twice or thrice) on the yield per tree, results in the same table (1) indicated that the highest yield / tree was due to adding 1200g N / tree, at three equal batches . All other treatments including the control were significantly of lowest yield than the prementioned treatment.

Our results are in agreement with those obtained by: **Awan et al (1985)** on sweet lime, **Ali and Lovatt[1] (1994)** on Washington navel orange**, Chapman (1982)** on imperial mandarin, **Bevington (1984)** on Valencia orange trees, as well as **Zaghloul and Kanany (2012)** on navel orange.

2-Effect of nitrogen fertilization on fruit weight of Valencia orange trees during 2018/2019-2019/2020 seasons.

It is cleared from data in table (1) that raising the inorganic nitrogen fertilizer is corresponding in increasing fruit weight of Valencia orange fruits. This saying was also noticed when the application was done twice or thrice annually. The best increasing in fruit weight was resulted when 1200g N/tree was added to Valencia orange trees three times annually.

These results are in line with those obtained by **Koseloglu et al (1995)** on satsuma trees and **Merweld et al (2014)** on Valencia orange.

3- Effect of nitrogen fertilization on total soluble solid, total acidity, reducing sugars and Vitamin C content in Valencia orange fruits during 2018/2019-2019/2020 seasons.

Results in table (2) showed that the highest T.S.S and the lowest acidity were shown in the juice of Valencia orange fruits presented from trees fertilized by 1200g N / tree annually, either added at two or thrice applications annually. The difference between this treatment and the others are statistically significant in the two experimental seasons.

The effect of nitrogen fertilization on reducing sugars and ascorbic acid (Vitamin c) are almostly similar to its effect on total soluble solids and total acidity. In other words, the nitrogen dose of 1200 g N /tree applied three times annually had improved fruit quality.

Our results are in accordance with those obtained by **Ramana et al (2014)** on sweet orange , **Obreza and Rouze[2] (1993)** on Hamlin orange, **Abo-Elkomsan and Ebrahiem (2002)** on Valencia orange **and Goud et al (2017)** on Nagpur

Table (1): Effect of nitrogen fertilizer on percentages of Initial fruit setting, number of fruits and the Yield per tree as well as fruit weight of Valencia orange trees during 2018/ 2019 and 2019/2020 seasons.

Treatments	Initial fruit setting %		Number of fruits tree		Yield per tree (kg.)		Av. Fruit weight (g.)	
	2018/2019	2019/2020	2018/2019	2019/2020	2018/2019	2019/2020	2018/2019	2019/2020
(Control) Add 1000 g N/ tree thrice	12.27	12.47	300.00	308.00	52.90	55.95	176.33	181.67
Add 600 g N/ tree twice	11.83	11.97	283.33	287.00	47.50	48.60	167.67	169.33
Add 900 g N/ tree twice	12.03	12.20	298.00	302.67	51.75	53.88	173.67	178.00
Add 1200 g N/ tree twice	12.87	12.37	328.67	319.33	55.10	53.99	167.64	169.10
Add 600 g N/ tree thrice	11.97	12.17	292.67	292.67	50.14	51.12	171.33	174.67
Add 900 g N/ tree thrice	12.13	12.43	306.67	310.00	54.49	57.45	177.67	185.33
Add 1200 g N/ tree thrice	13.07	13.27	332.33	330.00	63.14	65.01	190.00	197.00
L.S.D. at 5%	0.19	0.30	14.60	7.47	7.99	9.88	4.32	3.11

Table (2): Effect of nitrogen fertilizer on T S S, acidity, reducing sugars and vitamin C in the fruits of Valencia orange trees during 2018/ 2019 and 2019/2020 seasons.

Treatments	T.S.S. %		Acidity %		Reducing sugars %		Vitamin C (mg/ 100 ml/ juice)	
	2018/2019	2019/2020	2018/2019	2019/2020	2018/2019	2019/2020	2018/2019	2019/2020
(Control) Add 1000 g N/ tree thrice	10.97	11.21	1.33	1.31	4.03	4.40	45.47	46.07
Add 600 g N/ tree twice	10.40	10.27	1.36	1.37	3.53	3.97	44.30	44.67
Add 900 g N/ tree twice	10.87	11.00	1.34	1.30	3.97	4.10	44.80	45.67
Add 1200 g N/ tree twice	11.90	11.53	1.27	1.28	4.57	4.53	46.20	47.00
Add 600 g N/ tree thrice	10.67	10.87	1.35	1.34	3.70	4.07	44.67	44.97
Add 900 g N/ tree thrice	10.97	11.23	1.33	1.31	4.10	4.20	45.00	46.17
Add 1200 g N/ tree thrice	12.07	11.87	1.25	1.26	4.80	4.63	46.93	47.33
L.S.D. at 5%	0.20	0.31	0.01	0.01	0.15	0.23	0.75	0.33

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الملخص العربي

تأثير التسميد الارضى بالنيتروجين على العقد وكمية المحصول وخصائص الجودة فى ثمار البرتقال الفالنشيا

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تم التسميد ألارضى لأشجار البرتقال الفالنشيا خلال فصل الشتاء موسمى 2019\2018 و 2020\2019بمعدل 600,900,1200جرام من النيتروجين للشجرة سنوياً وأضيفت هذه الكميات علي دفعتين في منتصف نوفمبر وألاسبوع ألاول من ديسمبر أو علي ثلاث دفعات في منتصف نوفمبر وألاسبوع الاول من ديسمبر وألاسبوع ألاخير من ديسمبربالاضافة الي 1000 جرام نيتروجين للشجرة سنويا تضاف علي ثلاث دفعات متساوية في بداية دورة النمو في الربيع وبعد العقد مباشراً وبعد شهرين من تمام العقد وكان عمر ألأشجار عند بداية التجربة 27 عام مطعومة علي أصل نارنج وذلك لدراسة تأثير التسميد النيتروجينى علي نسبة العقد وكمية المحصول وكذلك الصفات الطبيعية والكيميائية للثمار خلال موسمى الدراسة ويمكن إيجاز أهم النتائج ألمتحصل عليها على الوجه التالى:

- أدت جميع المعاملات إلى زيادة نسبة ألعقد في ألازهار وكان أعلى معدل في نسبة ألعقد ناتج من إضافة 1200 جرام من النيتروجين للشجرة سنوياً على ثلاث دفعات متساوية في منتصف نوفمبر وألاسبوع ألاول من ديسمبر وألاسبوع الاخير من ديسمبر.
- أوضحت النتائج مدى تأثير التسميد النيتروجينى ألارضي علي عدد الثمار علي ألاشجار وأعطت المعاملة بـ 1200 جرام نيتروجين \شجرة \سنويا علي ثلاث دفعات متساوية أعلى عدد من الثمار على ألشجرة وكانت الفروق معنوية بينها وبين أى معاملة أخري في هذا الصدد وذلك خلال موسمي الدراسة.
- أعطت ألمعاملة ألسابق ذكرها 1200) جرام نيتروجين للشجرة سنويا (أعلى كمية محصول للشجرة وكانت أيضا ألفروق معنوية بينها وبين ألمعاملات المختلفة خلال موسمي الدراسة.
- وهناك تأثير واضح للمعاملات على الصفات الطبيعية والكيميائية للثمار حيث ادت الى زيادة وزن الثمرة ونسبة المواد الصلبة الذائبة الكلية ونسبة السكريات المحتزلة وكذلك فيتامين ج) سي (وفي نفس الوقت أدت ألي تقليل نسبة ألحموضة فى العصير مما أدي الى تحسين جودة المحصول.

من النتائج السابق ذكرها نوصى بإضافة 1200 جرام نيتروجين لشجرة البرتقال الفالينشيا سنوياً على ان يتم إضافتها علي ثلاث دفعات متساوية في منتصف نوفمبر وألاسبوع الأول من ديسمبر وألاسبوع الاخير من ديسمبر وذلك لزيادة كمية محصول ألاشجار وتحسين جودة الثمار تحت ظروف التجربة والظروف المماثلة لها .