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# EFFECT OF NITROGEN FERTILIZER RATES AND FOLIAR FERTILIZATION ON GROWTH, YIELD AND YIELD COMPONENTS OF SUNFLOWER

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## ABSTRACT

Two field experiments were carried out in 2006 and 2007 summer seasons at Sakha Agric. Res. Station (ARC) to study the effect of soil and foliar fertilization on growth, yield and its components of sunflower c.v. Sakha 53. Nitrogen fertilizer rates at 15, 30 and 45 kg N/fed were applied alone or along with foliar spray of urea (2%), single superphosphate (4%) and a mixture of micronutrients (100 ppm Fe + 140 ppm Zn + 120 ppm Mn).

Results indicated that vegetative growth traits at 65 days after planting were significantly affected by nitrogen fertilizer rates and foliar spray nutrient application. Plant height, leaf area and dry matter/plant, as well as chlorophyll *a* and total photosynthetic pigments in leaves were significantly increased with increasing nitrogen level. Foliar nutrient application of urea remarkably improved growth traits. Flowering date was delayed with increasing nitrogen rates and foliar spraying of micronutrient. Increasing nitrogen fertilizer up to 45 kg N/fed led to significant increases in plant height, stem diameter, head diameter, 100-seed weight, seed yield/plant and seed yield/fed However, seed oil% was decreased with increasing nitrogen fertilizer rates. Oil yield/fed was significantly increased with increasing fertilizer nitrogen rate. It could be concluded that nitrogen applied at of 45 or 30 kg/fed with spraying with urea (2%) gave the highest oil yield/fed.

## INTRODUCTION

Many attempts were carried out in Egypt to cover partially the big gap between local production and consumption of edible oils. Sunflower is a promising oil crop to cover the increasing demand for edible oils due to its wide adaptability to environmental conditions and its high seed oil content. Nitrogen fertilization is one of the most important factors to increase seed and oil yields of sunflower. Sunflower crop requires a suitable amount of nitrogen for each type of soil to produce maximum seed and oil yields. Sarmach *et al.* (1994) concluded that size and dry weight of head, 100-seed weight, seed yield/plant and seed yield/ha were highest with 80 kg N + 40 kg $P_2O_5$/ha Kumara *et al.* (2003) and Kall (2004) reported that application of N at 60 kg N/ha greatly improved plant height, head diameter, number of seeds/head, seed and oil yields. Gandahi and Oad (2005) found that plant height, head diameter, 100-seed weight and seed yield were increased with increasing nitrogen fertilizer rate up to 100 kg N/ha. Sayed *et al.* (2006) concluded that increasing nitrogen fertilizer rates up to 80 kg N/ha increased seed and oil yields of sunflower.

Increasing nitrogen fertilization significantly increased plant height, leaf area/plant, dry weight/plant, days to flowering head diameter, 100-seed weight,

seed and oil yields, but decreased seed oil % (Azouz and Selim, 2007, Awad and Gharib, 2009 and Ibrahim and El-Genbehy, 2009).

Foliar application of urea, superphosphate and micronutrients gave beneficial effects over soil application especially under unfavorable soil conditions (high pH, salinity and poverty in organic matter. Foliar application of urea, super phosphate and micro-elements increased growth and yield of sunflower (El-Kady, 1987 and 1997, Vasudevan *et al.*, 1997 and Gaina and Barbu, 2005). Azouz and Selim (2007) reported that foliar spraying with a mixture of Fe, Zn and Mn on sunflower significantly increased plant height and leaf area/plant.

The present investigation was designed to study the effect of both soil and foliar fertilization on growth, yield, yield components and seed quality of sunflower.

## MATERIALS AND METHODS

Two field experiments were conducted at Sakha Agricultural Research Station during the two successive summer seasons of 2006 and 2007. The aim of this study was investigate the response of sunflower (*Helianthus annuus* L.) c.v. Sakha 53, to foliar spraying with urea (2%), superphosphate (4%) and micronutrients, under different rates of nitrogen fertilizer as soil application. The soil of the experimental sites was clay loam in texture. The physical and chemical analyses of the experimental soil is presented in Table (1).

Planting was done on the 26 and 29 June in 2006 and 2007 seasons, respectively. The plants were later thinned to one plant per hill before the first irrigation (17 days after sowing). The preceding crop was wheat in both seasons. The experimental unit was consisted of six ridges, 4 m long, 60 cm apart and 20 cm.between hills. The plot area was 14.4 $m^2$. The experiment included 12 treatment combinations arranged in a randomized complete block design with four replicates. The treatment combinations of nitrogen fertilization and foliar spray with urea, superphosphate and micronutrients were as follows:

1. 15 kg N/fed
2. 15 kg N/fed + foliar spray with 2% urea.
3. 15 kg N/fed + foliar spray with 4% superphosphate.
4. 15 kg N/fed + foliar spray with micronutrients (Zn + Fe + Mn).
5. 30 kg N/fed
6. 30 kg N/fed + foliar spray with 2% urea.
7. 30 kg N/fed + foliar spray with 4% superphosphate.
8. 30 kg N/fed + foliar spray with micronutrients (Zn + Fe + Mn).
9. 45 kg N/fed
10. 45 kg N/fed + foliar spray with 2% urea.
11. 45 kg N/fed + foliar spray with 4% superphosphate.
12. 45 kg N/fed + foliar spray with micronutrients (Zn + Fe + Mn).

**Table 1: Mechanical and chemical analysis of experimental field in the two growing seasons 2006 and 2007.**

| Variables | Season | |
|---|---|---|
| | 2006 | 2007 |
| **Mechanical analysis:** | | |
| Sand % | 17.88 | 16.43 |
| Silt % | 31.98 | 32.64 |
| Clay % | 50.14 | 50.93 |
| Textural class | Clay loam | Clay loam |
| **Chemical analysis:** | | |
| pH | 8.30 | 8.10 |
| EC (m.mhos/cm) | 3.45 | 3.30 |
| Organic matter | 1.85 | 1.95 |
| Available N ppm | 17.25 | 18.30 |
| Available P ppm | 6.83 | 6.18 |
| Available K ppm | 295.36 | 269.35 |

The foliar spray treatments were 2% urea (46% N), 4% calcium superphosphate (15.5% $P_2O_5$) and micronutrients (mixture of 140 ppm Zn + 100 ppm Fe + 120 ppm Mn). The concentration of micronutrients get from 1 g EDTA-Zn, 14% Zn + 1 g DTPA-Fe, 10% Fe + 1 g EDTA-Mn, 12% Mn/L. These treatments were applied twice at 30 and 45 days after planting and the volume of the spray solution was 200 and 300 L/fed, respectively.

The phosphorus fertilizer was applied during soil preparation at the rate of 15.5 kg $P_2O_5$/fed as basic dose. Nitrogen fertilizer was applied in the form of ammonium nitrate (33% N) at the above mentioned levels in two equal doses, the first was applied before the first irrigation and the second before the second irrigation. Other culture practices were carried out as recommended.

At 65 days after planting, one sample (five plants) from each plot was taken at random to measure the vegetative growth traits (plant height, leaf area/plant, photosynthetic pigments content in leaves and dry matter/plant). The photosynthetic pigments content (chlorophyll a, chlorophyll b, carotenoids and total) in the forth upper most leaf were determined according to Wettstein (1957). Two ridges from each plot were checked daily to calculate days to 50% flowering.

At harvest, ten graded plants were randomly taken from each plot to determine plant height, stem diameter at 30 cm from soil surface, head diameter, 100-seed weight and seed yield per plant. Seed yield in ton per feddan was determined from two inner ridges, whereas the oil yield (kg/fed) was calculated from seed yield/fed and seed oil %. Oil percentage in seed was determined as described by A.O.A.C. (1995). All data collected were subjected to statistical analysis as described by Snedecor and Cochran (1980). The treatment means were compared according to analysis which performed using analysis of variance technique by means of "IRRISTAT" computer software package.

## RESULTS AND DISCUSSION

**I.Growth and flowering:**

The results recorded in table 2 shows the effects of nitrogen fertilization with or without foliar spray with urea (2%), superphosphate (4%) and foliar spraying of micronutrients on different vegetative growth traits of sunflower plants at 65 days from planting. The results indicated that vegetative characteristics were significantly affected by increasing nitrogen fertilizer levels and foliar spraying with urea and mixture of micronutrients. Increasing nitrogen fertilizer levels led to increases in plant height and leaf area/plant. Increasing nitrogen fertilizer levels up to 45 kg N/fed produce taller plants and larger leaf area per plant. In addition, foliar spraying with 2% urea increased plant height and leaf area in both seasons. Dry weight per plant at 65 days after planting was significantly increased with increasing nitrogen fertilizer levels and foliar spraying of urea or micronutrients. Nitrogen fertilization at a rate of 45 or 30 kg/fed along with foliar spray with urea at 2% surpassed the other treatments in dry weight/plant.

As for the effect of different treatments on the photosynthetic pigments (chl. a, chl. b, carotenoid and total), the results showed that its significantly differed in chl. a and total photosynthetic pigments during the two growing seasons. Generally increasing nitrogen fertilizer levels and foliar spraying with urea at 2% or foliar spraying of micronutrients at (140 ppm Zn + 100 ppm Fe + 120 ppm Mn) increased chl. a and total photosynthetic pigments in leaves. Greater values of chl. a and total pigments were achieved at 45 kg or 30 kg N/fed along with foliar fertilization.

The favorable effect of nitrogen on these traits agreed with those obtained by (Kumara *et al.*, 2003 and Kall, 2004; Gandahi and Oad, 2005 and Azouz and Selim, 2007). Also, El-Kady (1987), El-Kady (1997), Vasudevan *et al.* (1997), Gaina and Barbu (2005) and Azouz and Selim (2007) concluded that foliar spraying of urea, superphosphate and micronutrients increased growth and yield of sunflower plants. Foliar fertilization with micronutrients enhance sunflower vegetative growth and dry matter accumulation of sunflower plants might be attributed to enhancing the production of photosynthetic surface, because, it favours cell division and expansion as well as to their favourable effect on photosynthetic pigment contents (Saad *et al.*, 1982).

The results in Table 2 also indicated that increasing nitrogen fertilizer levels and foliar spraying with urea at 2%, or superphosphate 4% and/or microelement mixture of (Fe, Zn, Mn) significantly delayed flowering date in both seasons. These results are in agreement with those obtained by Azouz and Selim (2007), who stated that increasing nitrogen fertilization rate and foliar spraying of mixture of (Fe, Zn and Mn) delayed flowering date.

**II.Seed yield and its components:**

The results in Table 3 clearly indicated that sunflower yield and its components significantly affected by nitrogen fertilizer levels and foliar spraying of urea at 2%, superphosphate at 4% and mixture of 140 ppm Zn + 100 ppm Fe + 120 ppm Mn.

**Table (2): Effect of soil and foliar fertilization on growth (at 65 days after planting) and flowering of sunflower in 2006 and 2007 seasons.**

| Treatment | | Plant height (cm) | Leaf area/plant ($dm^2$) | Dry weight/plant (g) | Photosynthetic pigment content (mg/$dm^2$ LA) | | | | No. of days to 50% flowering |
|---|---|---|---|---|---|---|---|---|---|
| N (kg/fed) | Foliar spray | | | | Chl. a | Chl. b | Carot. | Total | |
| **2006** | | | | | | | | | |
| 15 | - | 175.0 c | 61.31 c | 140.2c | 2.40 c | 2.03 | 1.24 | 5.66 c | 50.50 c |
| 15 | 2% Urea | 177.0 b | 63.50 c | 149.2 bc | 2.61 b | 2.11 | 1.18 | 5.90 b | 54.11 b |
| 15 | 4% Super phosphate | 176.0 c | 61.73 c | 141.7 c | 2.51 b | 2.01 | 1.20 | 5.72 bc | 52.01 b |
| 15 | Micronutrient | 175.0 c | 62.81 c | 143.1 c | 2.56 b | 2.10 | 1.16 | 5.81 b | 52.66 b |
| 30 | - | 180.0 a | 70.79 ab | 156.1 b | 2.72 ab | 2.15 | 1.06 | 5.91 b | 55.65 b |
| 30 | 2% Urea | 184.0 a | 73.15 a | 159.0 ab | 2.95 a | 2.25 | 1.10 | 6.31 a | 56.36 b |
| 30 | 4% Superphosphate | 183.0 a | 71.66 a | 157.2 b | 2.73 ab | 2.18 | 1.20 | 6.11 b | 55.78 ab |
| 30 | Micronutrient | 183.0 a | 71.82 a | 156.6 b | 2.80 a | 2.20 | 1.23 | 6.22 a | 55.80 ab |
| 45 | - | 184.0 a | 72.61 a | 163.1 a | 2.86 a | 2.02 | 1.05 | 5.94 a | 56.90 a |
| 45 | 2% Urea | 186.0 a | 74.28 a | 170.2 a | 2.98 a | 2.24 | 1.20 | 6.41 a | 57.64 a |
| 45 | 4% Superphosphate | 185.0 a | 72.59 a | 166.3 a | 2.77 a | 2.33 | 1.11 | 6.21 a | 56.93 a |
| 45 | Micronutrient | 185.0 a | 73.60 a | 167.1 a | 2.97 a | 2.25 | 1.10 | 6.33 a | 57.32 a |
| **2007** | | | | | | | | | |
| 15 | - | 165.1 c | 55.21 c | 130.1 c | 2.30 d | 1.90 | 1.00 | 5.21 d | 50.71 c |
| 15 | 2% Urea | 169.1 bc | 57.61 c | 137.1 bc | 2.43 c | 1.86 | 1.06 | 5.36 c | 53.11 c |
| 15 | 4% Super phosphate | 168.0 bc | 56.66 c | 135.3 c | 2.36 cd | 1.80 | 1.13 | 5.29 c | 50.86 c |
| 15 | Micronutrient | 169.2 b | 56.26 c | 136.0 c | 2.40 c | 1.90 | 1.02 | 5.31 c | 51.66 c |
| 30 | - | 170.3 b | 61.72 bc | 140.1 b | 2.48 cb | 1.94 | 1.18 | 5.60 c | 53.81 b |
| 30 | 2% Urea | 1732.2 b | 66.72 b | 144.5 ab | 2.82 ab | 1.99 | 1.18 | 5.99 a | 54.66 ab |
| 30 | 4% Superphosphate | 171.8 b | 63.54 b | 143.7 b | 2.69 b | 1.92 | 1.26 | 5.87 ab | 53.80 b |
| 30 | Micronutrient | 172.1 b | 64.91 b | 144.0 ab | 2.80 ab | 1.92 | 1.21 | 5.93 a | 53.92 b |
| 45 | - | 176.0 ab | 74.81 a | 146.1 a | 2.66 b | 1.97 | 1.18 | 5.81 b | 57.61 a |
| 45 | 2% Urea | 180.3 a | 76.21 a | 151.0 a | 2.96 a | 2.06 | 1.19 | 6.21 a | 58.43 a |
| 45 | 4% Superphosphate | 178.0 a | 75.66 a | 147.2 a | 2.83 ab | 1.96 | 1.21 | 6.00 a | 57.21 a |
| 45 | Micronutrient | 178.6 a | 75.90 a | 147.8 a | 2.90 a | 2.01 | 1.22 | 6.13 a | 57.36 a |

*** Means followed by the same letter(s) are not statistically different**

**Table (3): Effect of soil and foliar fertilization on yield and its components of sunflower in 2006 and 2007 seasons.**

| Treatment | | Plant height at harvest (cm) | Stem diameter (cm) | Head diameter (cm) | 100 seed weight (g) | Seed yield/plant (g) | Seed yield/fed | Seed oil (%) | Oil yield /fed (kg) |
|---|---|---|---|---|---|---|---|---|---|
| N (kg/fed) | Foliar spray | 2006 | | | | | | | |
| 15 | - | 177.8 c | 2.1 c | 16.6 d | 5.05 c | 44.2 e | 1.326 d | 39.60 a | 525.10 d |
| 15 | 2% Urea | 181.5 b | 2.4 b | 18.1 c | 5.25 bc | 50.6 cd | 1.518 c | 38.98 b | 591.72 c |
| 15 | 4% Super phosphate | 179.8 b | 2.6 b | 17.8 c | 5.23 bc | 48.1 d | 1.443 c | 39.20 a | 565.66 cd |
| 15 | Micronutrient | 180.3 b | 2.7 ab | 18.6 c | 5.55 b | 48.5 cd | 1.455 c | 39.00 a | 567.45 c |
| 30 | - | 185.5 ab | 2.6 b | 18.9 c | 5.75 b | 51.1 cd | 1.533 c | 39.10 a | 599.41 c |
| 30 | 2% Urea | 190.8 a | 2.9 a | 21.6 ab | 5.98 a | 57.5 ab | 1.725 ab | 38.00 b | 655.03 a |
| 30 | 4% Superphosphate | 186.8 a | 2.8 a | 21.5 b | 5.73 b | 55.2 c | 1.656 b | 38.20 b | 632.60 b |
| 30 | Micronutrient | 185.3 ab | 2.9 a | 21.0 b | 5.53 b | 56.7 c | 1.701 b | 38.18 b | 649.43 b |
| 45 | - | 186.0 a | 2.8 a | 21.2 a | 5.35 b | 58.6 a | 1.7557 a | 37.30 cd | 655.35 a |
| 45 | 2% Urea | 190.0 a | 2.9 a | 22.9 a | 6.18 a | 58.9 a | 1.766 a | 37.10 d | 665.17 a |
| 45 | 4% Superphosphate | 188.5 a | 2.9 a | 22.5 a | 6.13 a | 58.0 a | 1.741 a | 37.60 c | 654.63 a |
| 45 | Micronutrient | 187.5 a | 5.0 a | 22.8 a | 6.00 a | 58.5 a | 1.755 a | 37.70 bc | 661.61 a |
| | | 2007 | | | | | | | |
| 15 | - | 168.0 d | 1.9c | 14.0 c | 4.60 c | 35.28 d | 1.058 d | 39.50 | 418.07 d |
| 15 | 2% Urea | 173.0 c | 2.2 b | 16.2 b | 5.01 ab | 37.70 c | 1.131 c | 39.10 | 442.22 bc |
| 15 | 4% Super phosphate | 172.0 c | 2.2 b | 14.7 bc | 4.72 b | 36.92 c | 1.108 b | 39.50 | 437.38 c |
| 15 | Micronutrient | 175.0 c | 2.2 b | 14.9 bc | 4.77 b | 37.57 c | 1.127 c | 38.87 | 438.10 c |
| 30 | - | 175.0 c | 2.2 b | 15.2 b | 5.21 ab | 38.09 bc | 1.143 bc | 39.20 | 447.94 bc |
| 30 | 2% Urea | 178.0 ab | 2.4 a | 17.4 ab | 5.40 ab | 44.2 a | 1.326 a | 38.77 | 514.10 a |
| 30 | 4% Superphosphate | 175.0 c | 2.3 b | 15.6 b | 5.30 a | 40.95 b | 1.229 b | 39.27 | 482.43 a |
| 30 | Micronutrient | 177.0 b | 2.3 b | 15.8 b | 5.31 a | 41.34 b | 1.2470 b | 39.10 | 484.92 ab |
| 45 | - | 180.0 ab | 2.4 a | 17.6 ab | 5.36 a | 41.34 b | 1.240 b | 38.40 | 476.24 b |
| 45 | 2% Urea | 186.0 a | 2.6 a | 18.4 a | 5.52 a | 45.5 a | 1.365 a | 38.10 | 520.07 a |
| 45 | 4% Superphosphate | 181.0 a | 2.4 a | 17.9 a | 5.39 a | 41.73 b | 1.252 b | 38.80 | 485.74 b |
| 45 | Micronutrient | 180.0 a | 2.5 a | 18.0 a | 5.43 a | 43.94 a | 1.318 a | 38.95 | 513.44 a |

*** Means followed by the same letter(s) are not statistically different**

The results showed that plant height, stem diameter and head diameter at harvest were significantly affected by the applied treatments. Taller plants and thicker stems were obtained when nitrogen fertilizer levels at 45 or 30 kg N/fed along with foliar spraying with urea at 2%. Such effect may be attributed to the fact that N is essential for building up the protoplasma and protein which increase cell number and size leading to an overall increase in plant height and stem diameter. Similar results were obtained by Kall (2004) and Azouz and Selim (2007).

Head diameter, 100-seed weight, seed yield per plant and seed yield per feddan significantly increased by increasing nitrogen fertilizer levels up to 45 kg N/fed and foliar fertilization with urea or micronutrients. Nitrogen applied at 45 kg/fed gave the highest values of these traits without significant differences from 30 kg N/fed and foliar spray with urea. The increase in 100 seed weight might be due to the increase in plant photosynthetic area, subsequently metabolic compounds which stored in seeds. Also, the increases in both seed yield per plant and per feddan might be due to the improvement in plant growth, such as the increase in dry matter, leaf area and plant height which were reflected on the different yield components. Similar results were obtained by El-Kady (1987), Sarmah *et al.* (1994), Kumara *et al.* (2003), Gandahi and Oal (2005), Sayed *et al.* (2006), Azoz and Selim (2007) and Ibrahim and El-Genbehy (2009).

**III.Seed oil content and oil yield:**

The results in Table 3 indicate that increasing nitrogen fertilizer level significantly decreased seed oil content only in the first season. The reduction in seed oil content as a result of increasing nitrogen fertilizer levels may be due to the fact that when nitrogen fertilizer is increased, seed protein content will increase and sequently seed oil content is decreased (Guirguis *et al.*, 1996).

On the other hand, oil yield per feddan significantly increased with increasing in nitrogen fertilizer levels. Highest oil yield was obtained at the high level of nitrogen (45 kg N/fed) with no significant differences from 30 kg N/fed and foliar spraying with 2% urea. It was evident from Tables (2) and (3) that nitrogen fertilization along with foliar spray with urea at 2% or superphosphate at 4% or micronutrient at 140 ppm Zn, 100 ppm Fe and 120 ppm Mn increased growth, yield and yield components compared with nitrogen fertilization alone. Many investigators agreed with these findings (Kumara *et al.*, 2003; Kall, 2004; Gaina and Barbu, 2005; Azouz and Selim, 2007; Awad and Gharib, 2009 and Ibrahim and El-Genbehy, 2009).

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# تأثير معدلات التسميد النتروجينى والتسميد الورقى على النمو والمحصول ومكوناته لعباد الشمس

فهمى عبدالعزيز القاضى ، محمد مرسى عوض و عصام بكر أحمد عثمان
معهد بحوث المحاصيل الحقلية ـ مركز البحوث الزراعية

أجرى هذا البحث بالمزرعة البحثية بمحطة البحوث الزراعية بسخا خلال موسمى ٢٠٠٦ ، ٢٠٠٧م لدراسة تأثير معدلات التسميد النتروجينى (١٥ ، ٣٠ ، ٤٥كجم ن/ف) بمفرده أو مع الرش باليوريا (٢%) أو السوبر فوسفات (٤%) أو مخلوط العناصر الدقيقة (١٠٠ جزء فى المليون حديد و ١٤٠ جزء فى المليون زنك و ١٢٠ جزء فى المليون منجنيز) مرتين بعد ٣٠ ، ٤٥ يوم من الزراعة. وأخذت عينة خضرية بعد ٦٥ يوم من الزراعة قدرت فيها بعض قياسات النمو وبعض القياسات الخضرية ، وعند الحصاد أخذت القياسات المختلفة للمحصول ومكوناته.

**وتتلخص أهم النتائج فى النقاط الأتية:**

- أوضحت النتائج أن طول النبات والمساحة الورقية للنبات والوزن الجاف للنبات قد زاد بزيادة معدلات التسميد النتروجينى ، وكان للرش باليوريا تأثيرا واضحا فى زيادة هذه الصفات تحت كل معدل من التسميد الأرضى بالنتروجين.
- أشارت النتائج إلى أن زيادة معدل التسميد النتروجينى أدى الى زيادة محتوى الأوراق من كلوروفيل (أ) ومجموعة صبغات التمثيل الضوئى ، وكان التسميد بمعدل ٣٠كجم ن/ف مع الرش باليوريا أو معدل ٤٥كجم ن/ف أعلى قيم لهذه الصفة.
- أظهرت النتائج أن زيادة معدلات التسميد الأزوتى أدت إلى تأخير النباتات فى الوصول إلى طور التزهير بزيادة معدل التسميد الأزوتى الأرضى أو بمعاملات الرش تحت الدراسة.
- أوضحت النتائج إلى زيادة واضحة ومعنوية للصفات التى درست عند الحصاد وهى طول النبات ، وقطر الساق ، وقطر القرص ، ووزن الـ ١٠٠٠ بذرة ومحصول النبات من البذور، بينما نقصت النسبة المئوية للزيت فى البذرة وكان النقص معنوى فى السنة الأولى فقط وذلك بزيادة معدل التسميد الأزوتى ومعاملات الرش تحت الدراسة.
- أوضحت النتائج إلى زيادة معنوية لكل من محصول البذرة/فدان ومحصول الزيت للفدان بزيادة معدل التسميد الأزوتى الأرضى والرش بالمعاملات تحت الدراسة.
- توصى نتائج هذه الدراسة بتسميد محصول عباد الشمس صنف سخا ٥٣ بمعدل ٣٠كجم أزوت/ف ورش النباتات مرتين بـ ٢% يوريا عند عمرى ٣٠ ، ٤٥ يوم من الزراعة وذلك للحصول على أعلى محصول للبذرة والزيت بمنطقة شمال الدلتا.

**قام بتحكيم البحث**

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