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# ADAPTATION AND IMPROVING OF SUNFLOWER PLANT UNDER STRESS CONDITIONS AT TOSHKA REGION

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**ABSTRACT:** *Two field experiments were carried out in 2013 and 2014 growing seasons to investigate the role of some foliar application (Elga 600) at 1⁄2 g⁄L , (boron) at 1cm ⁄L, water , mixed from Elga 600 with boron and dry seed as a control and three date of planting ie 1st august , 20th august and 10th September in adapting and improving sunflower (Helianthus annuus L.) plants cv. Vidoc under saline conditions at the experimental station of desert research center Toshka Egypt. Two samples were taken at 60 days after sowing and at harvesting time (90 days after sowing) .*

*Application of 10th September as a sowing date of sunflower plant showed significant increase in all growth parameters compared with the other sowing dates during both seasons. Yield and its components surpassed with sowing date at 10th September.*

*Applied foliar application with Elga (600) at 1⁄2 gm⁄L and (boron) at 1cm ⁄L improve growth parameters, yield, yield components and nutritious value of sunflower plant as compared with control at growth and heading stages in 2012 and 2013 growing seasons. In the same direction Elga (600) at 1⁄2 gm⁄L and (boron) at 1cm ⁄Las a foliar treatments may correct the metabolic disturbance under saline condition at experimental station 1nToshka Egypt which reflect on yield and its components. However, Elga (600) at 1⁄2 gm⁄L as a foliar treatment was better than(boron) at 1cm ⁄L for improving the developmental traits and chemical composition .10th September as a sowing date significantly decreased Na concentrations and increased K, K/Na, and P concentrations. Foliar applications of (Elga 600) at 1⁄2 gm⁄L or (boron) at 1cm ⁄L, decreased Na concentration and increased K, Ca and P concentrations as well as K/Na ratio. All foliar applications significantly increased oil percentage and yield compared with the control. Regarding 10th September as a sowing date and foliar application interactions all treatments enhanced the level of IAA and GA3.*

***Key Words:*** *Sunflower, Helianthus annuus L, Elga 600, boron, sowing date growth, yield, oil quality and mineral elements,*

## INTRODUCTION

Sunflower (Helianthus annuus L.) represents one of the main oil crops of the world . Being a thermos insensitive, grown in all seasons and producing oil resistant to rancidity and characterized by higher percent of unsaturated fatty acids ( El-Baz, 1995). In Egypt, there is a gap between production and consumption of plant oils. Increasing the cultivated areas of sunflower should be done in the reclaimed lands due to the limited areas of the Nile valley and the competition of the main crops. Thus the Experimental farm at Toshka Research station devoted to Desert Research Center was undertaken for the present investigation. This farm is characterized as highly calcareous soil (31.7 % $CaCO_3$), slightly saline (EC 2986 ppm), mildly alkaline (pH 7.9) and loamy in texture. Irrigation water is slightly saline (EC 2950.4 ppm salts). The presence of $CaCO_3$ directly or indirectly affecting the chemistry and availability of Nitrogen (N), Phosphorous (P), potassium (K), magnesium (Mg), Iron (Fe), Manganese (Mn) and Zinc (Zn), (Obreza *et al.*, 1993).

On the other hand, salinity had deleterious effects on plant growth, development and even seed germination,

particularly seed characteristic of sunflower, mainly oil content. Also, salinity influences nutrient uptake. Where salt concentration is low to moderate, the first visual symptom is often a thin stem and stunted growth Weiss . (2000).

Under these circumstances, potassium, phosphorus and zinc play an important role in improving the plant growth and subsequently, the yield of oil crops. Sakr *et al.* (1990) reported that, application of P as mono calcium phosphate gave the highest dry matter yield in barley and sunflower plants under calcareous soil. Moreover, Harmati (1993) stated that $P_2O_5$ and K applications increased achene and oil yield of sunflower plants. Badawy (1990) investigated the effect of P on the growth and yield of soybean plants. He found that P (48 kg $P_2O_5$/ fed) treatment increased shoot dry weight and seed yield of soybean plants under calcareous soil (34% $CaCO_3$). Salama (1987) showed that, K fertilizer (200 kg/ h) increased achene and oil yields of sunflower plants on calcareous sandy soil. Application of microelements either as soil application or foliar spray provided the best treatments which improved growth and yield of sunflower plants (Hegazy, 2004).

In this respect, dry matter amount of maize plant increased with increasing Zn doses applied to each pot as $ZnSO_4.7H_2O$ in sandy calcareous and clay calcareous soils (Adiloglu, 2006).

The present study tended to improve growth and oil production of sunflower plants grown under saline conditions at Toshka Aswan governorate by using the combination of five foliar application (Elga 600) at 1⁄2 gm, (boron) at 1 cm ⁄L water , mixed from Elga 600 with boron, tap water, and dry seeds as a control ) under three sowing dates at 1st, 20th of august and 10th of September in both seasons.

## MATERIALS AND METHODS

Two Field experiment were conducted in Toshka Station, Desert Research Center in 2012 and 2013 growingseason. Such studies was conducts to investigate the effect of five different foliar application treatments with three dates of sowing on plant growth characters, yield and yield components of sunflower plant under saline conditions at Toshka region. Each experiment included 15 treatments, i.e. the combination of five foliar application (Elga 600) at 1⁄2 g, (boron) at 1cm ⁄L water, mixed from Elga 600 with boron, tap water, and dry seeds as a control) and three date of sowing at 1st and 20th of August and 10th of September in both seasons.

## Elga 600:-
## Soluble Seaweed Extract Powder

Elga 600 is a complete natural extract finely derived from brown seaweed, which contains 70 minerals, 17 amino acids,4 plant hormones, chelating agents and complex sugars. These naturally occurring nutrients and bioactive substances can provide multiple benefits to enhance yields, quality and vigor significantly for various plants. It is available in a 100% soluble powder, which reduces transport costs and can be used through different application methods, and suitable for both growers and formulation manufactures.

More importantly, Elga 600 is both nontoxic and environmental friendly which will increase marketable value for agricultural product.

## GUARANTEED ANALYSIS

| Analysis of Elga 600 | 1(w⁄w) |
|---|---|
| Organic Matter | 45.0 ~55.0% |
| Alginic Acid | 8 ~10% |
| Total Nitrogen | 6.0% |
| Phosphoru(p2o5) | 5% |
| Potassium(K2o) | 20% |
| Mg | 0.06% |
| Ca | 0.4 ~1.6% |
| Fe | 0.15 ~0.3% |
| Cu | 25 ~45ppm |
| S | 1.0~1.5 % |
| I | 300 ~600ppm |
| Soluble in Water | 100% |
| pH | 9 ~10 |
| Specific gravity | 0.5 ~0.55 g⁄Cm3 |
| Odder | Seaweed-like |
| Appearance | brownish powder |

Four naturally occurring plant growth regulators, auxins, gibberellins, cytokinins and betaines found in Elga 600, play very important roles in cell division and the synthesis of protein, carbohydrate and chlorophyll. In addition, these plant growth regulators have a huge positive impact on resistance to stress, pest and disease through activating immune system.

Alginic acid, the major content of Elga 600, stimulates activities of soil microorganisms, improves the water-holding capability of soil, protects chemical fertilizers from leaching or locking up and helps the formation of crumb .

Structure. Mannitol existing in Elga 600 is a powerful chelating agent which helps cations entry into plants and be absorbed by plants more easily. It is beneficial for plants to utilize chemical fertilizers more efficiently.

Treatments were arranged in split plot design with three replicates. The main plots were occupied by the three date of sowing treatments and five foliar application in the sub plots. Organic manure and calcium superphosphate fertilizers were added during soil preparation at the rate of $20m^3$ and 31 Kg $P_2O_5$/fed respectively. Two equal doses of ammonium nitrate (33.5% N) were added at a rate of 66 kg N/fed twice after 20 and 45 days from sowing. Each experimental plot included 5 ridges, 60 cm apart with 3.5 m length, comprising an area of 10.5 $m^2$ (1/400 fed). The soil type of the experimental site was loamy sand in texture with pH 7.7, $CaCO_3$ 30.4%, organic matter 0.5% and E.C 10 mmhos/cm. Sunflower seeds were obtained from Oil Crop Research Institute, Agriculture Research Center in Giza and were planted in hills at 25 cm apart at three dates of sowing at 1st and 20th of august and 10th of September in both seasons, respectively, The drip irrigation system of GR16 was used and plants were irrigated daily using saline well water of about 4500 ± 100 ppm salinity. Foliar application treatments were sprayed twice at 30 and 60 days after sowing using tween 20 as welting agent . The plants were thinned to two plants per hill at 20 days after sowing date.

Two samples were taken. First sample was taken at 60 days after sowing and the following growth parameters were recorded; plant height, stem diameter, stem fresh and dry weights, leaves number, fresh and dry weights for leaves. Chemical analysis was conducted in leaves on the 7-8th nodes from the top for determination of some elements (Na, K, Ca and P).

The second sample was taken at harvesting time (90 days after sowing) to determine yield components including, plant height (cm) head diameter, seeds number/head, seeds weight/ head, 100 seeds weight (gm.), straw yield(kg\fed.) and the seeds yield (ton/ fed). Samples were dried in an oven at 70°C to calculate the dry matter. The dried and fresh materials for the first sample were grounded into a fine powder and used for chemical analysis (combined analysis of 2012 and 2013 for chemical constituents were used).

Soluble protein was measured photo metrically at 750 mm. with folin-phenol reagent (Lowry *et al* 1951). The acid digests of dried powdered materials were analyzed for mineral determination. $Na^+$, $K^+$ and $Ca^{++}$ were measured by using the flame photometer “149” as described by Johanson and Ulrich (1959). Also, oil content of seeds was determined according to A.O.A.C. (1984) by using soxhlet apparatus and petroleum ether as an organic solvent. Phosphorus was determined according to Murphy and Riley (1962).

## Extraction of seed oils :-

Three individual 10 g samples of crushed dry seeds of each sunflower treatment were refluxed with 300 mL of petroleum benzene in weighed flasks using a Soxhlet apparatus according to the AACC (1987) method. The oils were recovered by distilling the solvent in a rotary evaporator at

45°C, then dried to constant weight in a vacuum oven at 90°C, for 1 h and weighed.

## Determination of plant hormones

The purified samples were methylated with diazomethane (Schlenk and Gelerman, 1960) dissolved in ethyl ether and methanol (9:1 v/v). The derivatives were dried under vacuum and re-dissolved in 100 µl of EtOAc for GC analysis.

## Statistical Analysis:-

Data were subjected to statistical analysis according to Gomez and Gomez (1984), LSD was used to detect significant differences at 0.05 level.

## RESULTS AND DISCUSSION

## 1- Growth characters:

### 1-1-Effect of sowing date

Sowing dates on growth parameters of sunflower plants was presented in Table (1). 10th September sowing dates showed significant increase in plant height, stem diameter, and stem fresh and dry weights during the two successive seasons. Also, leaves number, leaves fresh and dry weights tack the same trend. These results may be due to the essential role of late of planting sunflower plant which reflect on development of meristem tic tissues (Russell, 1973). Such response was noticed by El- Baisary *et al.* (1981) in cowpea plants grown under calcareous soil.

The maximum mean values of stem diameter (5.79 cm), shoot fresh weight (427.14 g/ plant) and shoot dry weight (99.44 g/plant) was achieved by sowing sun flower on 10th September as Compared with sowing sunflower on 1st August or 20 August in both seasons. . This finding is in harmony with that obtained by Aboul- Magd (1999) on tomato plants. The interpretation for this promotive effect may be related to for the late of planting sunflower on 10th September at this time increases the photosynthetic rates, $CO_2$ assimilation (Sangakkara *et al.*, 2000) and has an important role in the translocation of photosynthates from source to sink (Cakmak *et al.*, 1994). Furthermore, climatic etchings plays an important role in the osmotic adjustment for plant under saline conditions to maintain the selectivity and integrity of cell membrane (Satti and Lopez, 1994).

**Table (1): Effect of sowing dates treatment on growth traits of sunflower at 60 days from sowing under Toshka conditions in 2012 and 2013 seasons.**

| treatments | Plant height (avg.) | Stem / plant | | | Leaves / plant | | |
|---|---|---|---|---|---|---|---|
| Sowing dates | | Diameter (cm) | Fresh weight (g) | Dry weight (g) | Number | Fresh weight (g) | Dry weight (g) |
| 2012 | | | | | | | |
| 1st August | 135.68 | 3.862 | 299.56 | 72.656 | 33.15 | 187.26 | 33.6 |
| 20th August | 142.86 | 4.068 | 362.46 | 93.382 | 29.796 | 231.16 | 56.95 |
| 10th September | 147.22 | 4.672 | 427.14 | 105.94 | 32.852 | 243.84 | 61.366 |
| L.S.D. 5% | 0.40 | 0.02 | 19.43 | 0.811 | 1.55 | 13.81 | 0.52 |
| 2013 | | | | | | | |
| 1st August | 132.02 | 4.81 | 309.36 | 75.92 | 26.132 | 192.06 | 49.192 |
| 20th August | 142 | 5.012 | 314.48 | 79.02 | 34.666 | 218.2 | 55.664 |
| 10th September | 161.16 | 5.79 | 345.4 | 99.44 | 38.626 | 236.9 | 59.992 |
| L.S.D. 5% | 1.03 | 0.43 | 21.02 | 10.21 | 1.21 | 10.26 | 0.44 |

### 1-2 Effect of foliar application:-

Table (2) showed that the effect of foliar application of caborn and Elga 600 nutrients on growth parameters of sunflower plants. Application of Elga and boron showed significant increase in plant height and stem diameter during the two successive seasons. These results may be due to the essential role of Elga in cell division and development of meristematic tissues (Russell, 1973). Also, Elga 600 treatment did not significantly affect for shoot fresh and dry weights in both seasons. Such response was noticed by El- Baisary *et al.* (1981) in cowpea plants grown under calcareous soil.

The maximum mean values of stem diameter (4.95 cm), shoot fresh weight (405.40 g/ plant) and shoot dry weight (102.95 g/plant) was achieved by (Elga 600) compared to untreated plants which recorded 3.45 cm, 316.40 g and 82.27 g respectively in 2012. The same trend was noticed in the second season. This finding is in harmony with that obtained by Aboul-Magd (1999) on tomato plants. The interpretation for this promotive effect of K on sunflower growth is that, K increases the photosynthetic rates, $CO_2$ assimilation (Sangakkara *et al.*, 2000) and has an important role in the translocation of photosynthates from source to sink (Cakmak *et al.*, 1994). Furthermore, K plays an important role in the osmotic adjustment for plant under saline conditions to maintain the selectivity and integrity of cell membrane (Satti and Lopez, 1994). Also, leaves number, leaves fresh and dry weights for leaves.

**Table (2): Effect of foliar application treatments on growth traits of sunflower at 60 days from sowing under Toshka conditions in 2012and 2013 seasons.**

| Treatments | Plant height (avg.) | Stem | | | Leaves | | |
|---|---|---|---|---|---|---|---|
| Foliar application | | Diameter (cm) | Fresh weight (g) | Dry weight (g) | Number | Fresh weight (g) | Dry weight (g) |
| 2012 | | | | | | | |
| Control (Dry) | 133.7 | 3.45 | 316.4 | 82.27 | 24.49 | 195.8 | 42.45 |
| Tap Water | 137.7 | 3.97 | 348.7 | 85.5 | 26.57 | 203.9 | 46.45 |
| Caborn (1$Cm^3$/L | 145.2 | 4.51 | 383.6 | 93.85 | 31.48 | 233.1 | 54.68 |
| Elga 600(1/2cm/L) | 150.2 | 4.95 | 405.4 | 102.95 | 34.34 | 257.6 | 60.17 |
| Caborn +Elga 600 | 142.7 | 4.12 | 362 | 88.73 | 27.78 | 213.4 | 49.44 |
| L.S.D. 5% | 0.45 | 0.2 | 14.02 | 0.62 | 0.96 | 13.32 | 0.22 |
| 2013 | | | | | | | |
| Control (Dry) | 134.43 | 4.62 | 271.93 | 69.21 | 27.07 | 195.4 | 49.19 |
| Tap Water | 144.16 | 5.00 | 321.4 | 81.43 | 31.30 | 208.73 | 53.31 |
| Caborn(1$Cm^3$/L) | 141.83 | 5.41 | 333.9 | 82.94 | 35.50 | 223.5 | 57.52 |
| Elga 600(1/2cm/L) | 156.06 | 5.79 | 361.6 | 91.18 | 38.56 | 234.17 | 59.51 |
| Caborn+Elega 600 | 148.8 | 5.19 | 326.53 | 78.38 | 33.28 | 216.77 | 55.20 |
| L.S.D. 5% | 0.52 | 0.02 | 9.31 | 0.33 | 1.20 | 9.32 | 0.18 |

### 1-3- Effect of interaction :-

Regarding the effect of the interactions between date of planting and folair application (Table 3) on plant height, stem diameter, stem fresh and dry weights, leaves number, leaves fresh and dry weights in 2012 and 2013, growing season a significant increase were obtained by all treatments. Moreover, 10th September as a planting date with spray Elega600treatment interaction showed the maximum significant values which reached, 158.3 cm, 5.71 cm, 486.3 g. 120.60 g, 40.70, 295.7g,74.13g comparing with control plants (1st August as a planting date x without spray treatment interaction) which recorded 122.5cm, 3.35 cm,247.5 g.60.10 g,18.16178.5g ,28.15 g respectively for all growth parameters ( plant height, stem diameter ,stem fresh and dry weights, leaves number, leaves fresh and dry weight) during the 1st season. The same trend was achieved in the 2nd season.

These results were in agreement with Wu *et al.* (1999) who revealed that K and trace elements application increased P concentration in soybean. Insignificant increments in Mg concentration were noticed by all treatments. Also, an increase in Mg concentration of Sudan grass plants was mentioned by Kishk *et al.* (1985) as a result of Zn application under calcareous soil (30%$CaCO_3$) with salinity.

Also, Ozoris *et al.* (1985) who reported that the concentration of $K^+$ and $Mg^{+2}$ in sorghum plants were increased by application of Zn under calcareous soil and saline conditions. The role of K in the osmotic adjustment of plants under saline conditions and consequently its importance of being required to the selectivity and integrity of cell membrane was explained by (Satti and Lopez, 1994).

## 2- Yield and yield components:-

### 2-1-Effect of sowing dates:-

Data in Table (4) showed that, 10th September as a date of planting significant increased head diameter, number of seeds/ head, seeds weight/ head, 1000 seeds weight and seeds yield/ fed. Compared with the both date of planting 1n 2012 and 2013 growing seasons. However 20th august as a sowing date recorded the second order except seed yield /fed. during 1st season and 1000 seed weight 1n 2013growing season. The positive effect for all characters for sunflower plants during 2nd season compared with the 1st one .

These results may be due to the essential role of late of planting sunflower plant which reflect on development of meristem in tissues (Russell, 1973). Such response was noticed by El- Baisary *et al.* (1981) in cowpea plants grown under calcareous soil. Also, these results were in agreement with Hegazy (2004) on sunflower and Sawan *et al.* (2006) on seeds yield of Egyptian cotton. Also, planting sunflower plant during 10th September led to the moisture in the soil more, than the other sowing date which reflect on yield and its components in this regard Vitkov (1976) reported that the highest sunflower seed and straw yields were In addition, increasing soil moisture content increased seed yield and 100 seed weight of sunflower plants. (Muriel *et al.,* 1977)

Sarkar and Bhattacharya (1980) observed that good yield was obtained when sunflower was irrigated at 60 % of available soil moisture.

Moreover, El-Sawaby and Zekril (1982) added that the highest yield of sunflower was gained by raising soil moisture at field capacity every 14 days.

### 2-2-Effect of foliar application:-

Data presented in Table (5) indicated that all sunflower yield and its attributes markedly responded to boron and Elga spraying treatments, compared with control.

**Table (3): Effect of the interaction between Sowing dates and different foliar application on growth traits of sunflower at 60 days from sowing under Toshka conditions in 2012and 2013 seasons.**

| Treatments | | Plant height (avg.) | Stem | | | Leaves | | |
|---|---|---|---|---|---|---|---|---|
| Sowing dates | Foliar application | | Diameter (cm) | Fresh weight (g) | Dry weight (g) | Number | Fresh weight (g) | Dry weight (g) |
| 2012 | | | | | | | | |
| 1st August | Control (Dry) | 122.5 | 3.35 | 247.5 | 60.10 | 18.16 | 178.5 | 28.15 |
| | Tap Water | 130.6 | 3.78 | 305.5 | 70.10 | 22.12 | 181.6 | 31.25 |
| | Caborn (1Cm$^3$/L | 140.5 | 4.03 | 315.8 | 75.35 | 27.16 | 190.5 | 35.85 |
| | Elga600(1\2cm\L) | 144.0 | 4.43 | 318.5 | 85.13 | 30.16 | 200.5 | 39.25 |
| | Caborn +Elga 600 | 140.8 | 3.72 | 310.5 | 72.6 | 23.15 | 185.2 | 33.5 |
| 20th August | Control (Dry) | 138.7 | 3.40 | 339.6 | 96.2 | 27.20 | 200.5 | 48.1 |
| | Tap Water | 140.0 | 3.93 | 340.2 | 85.9 | 28.45 | 210.9 | 52.5 |
| | Caborn (1Cm$^3$/L | 144.6 | 4.50 | 375.7 | 94.2 | 31.16 | 242.5 | 60.6 |
| | Elga600(1\2cm\L) | 148.4 | 4.71 | 411.3 | 103.11 | 32.17 | 276.7 | 67.13 |
| | Caborn +Elga 600 | 142.6 | 3.80 | 345.5 | 87.50 | 30.00 | 225.5 | 56.42 |
| 10th September | Control (Dry) | 140.0 | 3.60 | 362.2 | 90.50 | 28.10 | 208.5 | 51.1 |
| | Tap Water | 142.4 | 4.20 | 400.5 | 100.50 | 29.14 | 219.3 | 55.60 |
| | Caborn (1Cm$^3$/L | 150.6 | 5.00 | 456.7 | 112.00 | 36.12 | 266.2 | 67.60 |
| | Elga600(1\2cm\L) | 158.3 | 5.71 | 486.3 | 120.60 | 40.70 | 295.7 | 74.13 |
| | Caborn +Elga 600 | 144.8 | 4.85 | 430.0 | 106.10 | 30.20 | 229.5 | 58.40 |
| L.S.D. 5 % | | 0.11 | 0.50 | 0.53 | 0.12 | 0.13 | 4.20 | 1.2 |
| 2013 | | | | | | | | |
| 1st August | Control (Dry) | 122.5 | 4.35 | 254.5 | 65.12 | 20.11 | 183.5 | 46.13 |
| | Tap Water | 131.8 | 4.62 | 315.5 | 80.10 | 24.12 | 186.6 | 47.93 |
| | Caborn (1Cm$^3$/L | 114.4 | 4.93 | 322.8 | 78.35 | 29.16 | 195.5 | 51.15 |
| | Elga600(1⁄2cm⁄L) | 148.1 | 5.33 | 338.5 | 84.43 | 32.14 | 205.5 | 51.24 |
| | Caborn +Elga 600 | 143.3 | 4.82 | 315.5 | 71.60 | 25.13 | 189.2 | 49.51 |
| 20th August | Control (Dry) | 136.2 | 4.50 | 261.2 | 66.30 | 27.10 | 191.6 | 48.25 |
| | Tap Water | 141.2 | 4.90 | 317.5 | 82.50 | 33.25 | 219.2 | 55.40 |
| | Caborn (1Cm$^3$/L | 144.6 | 5.30 | 326.6 | 80.46 | 37.02 | 224.2 | 57.60 |
| | Elga600(1⁄2cm⁄L) | 147.5 | 5.41 | 346.3 | 88.61 | 40.76 | 235.5 | 61.14 |
| | Caborn +Elga 600 | 140.5 | 4.95 | 320.8 | 77.23 | 35.20 | 220.5 | 55.93 |
| 10th September | Control (Dry) | 144.6 | 5.01 | 300.2 | 76.22 | 34.00 | 211.1 | 53.18 |
| | Tap Water | 159.5 | 5.50 | 331.2 | 81.70 | 36.54 | 220.4 | 56.62 |
| | Caborn (1Cm$^3$/L | 166.5 | 6.00 | 352.3 | 90.00 | 40.31 | 250.9 | 63.83 |
| | Elga600(1⁄2cm⁄L) | 172.6 | 6.63 | 400.0 | 100.5 | 42.78 | 261.5 | 66.16 |
| | Caborn +Elga 600 | 162.6 | 5.81 | 343.3 | 86.30 | 39.50 | 240.6 | 60.17 |
| L.S.D. 5 % | | 0.10 | 0.02 | 0.38 | 0.07 | 0.08 | 3.16 | 0.05 |

**Table (4): Effect of sowing dates treatment on yield and yield components of sunflower at harvesting date under Toshka conditions in 2012and 2013 seasons.**

| Treatments | Plant height (avg.) | Head | | | | Yield (kg/fed) | |
|---|---|---|---|---|---|---|---|
| | | Diameter (cm) | Seed number | Seed weight (g) | Weight of 1000 seed (g) | Straw | Seed |
| 2012 | | | | | | | |
| 1st August | 150.9 | 19.44 | 991.1 | 83.072 | 71.98 | 1752.8 | 753.93 |
| 20th August | 161.5 | 22.04 | 1208.8 | 104.80 | 85.66 | 2018.2 | 745.87 |
| 10th September | 166.1 | 23.7 | 1325.4 | 140.14 | 96.932 | 2439.4 | 1247.93 |
| L.S.D. 5 % | 1.04 | 0.20 | 33.0 | 0.42 | 3.02 | 33.43 | 4.22 |
| 2013 | | | | | | | |
| 1st August | 154.2 | 20.76 | 1009.4 | 87.05 | 364.85 | 1764.3 | 823.112 |
| 20th August | 162.2 | 22.24 | 1397.1 | 112.47 | 96.62 | 2068.6 | 971.18 |
| 10th September | 172.3 | 23.52 | 1271.2 | 111.8 | 101.96 | 2465.0 | 1258.09 |
| L.S.D. 5 % | 1.10 | o.30 | 10.22 | 0.40 | 4.00 | 23.31 | 6.02 |

**Table (5): Effect of foliar application on yield and yield components of sunflower at harvesting date under Toshka conditions in 2012and 2013 seasons.**

| Treatments | Plant height | Head | | | | Yield (kg/fed) | |
|---|---|---|---|---|---|---|---|
| | | Diameter (cm) | Seed number | Seed weight (g) | Weight of 1000 seed (g) | Straw | Seed |
| 2012 | | | | | | | |
| Control (Dry) | 156.2 | 20.13 | 1077.6 | 92.74 | 79.52 | 1956.44 | 858.45 |
| Tap Water | 159.03 | 21.26 | 1136.8 | 99.95 | 82.7 | 1985.43 | 930.38 |
| Cab.(1$Cm^3$/L | 161.63 | 22.3 | 1229.2 | 117.06 | 89.15 | 2125.13 | 1041.11 |
| Elga600(1⁄2cm⁄L) | 164.3 | 24.26 | 1284.1 | 126.16 | 93.18 | 2217.55 | 1103.5 |
| Cab.+Elga600 | 159.4 | 21.33 | 1147.7 | 110.8 | 86.40 | 2066.06 | 979.43 |
| L.S.D. 5 % | 0.72 | 0.22 | 8.32 | 0.51 | 2.10 | 13.07 | 11.03 |
| 2013 | | | | | | | |
| Control (Dry) | 158.9 | 21.4 | 1134.8 | 86.6 | 83.9 | 1956.4 | 897.6 |
| Tap Water | 164.06 | 21.6 | 1193.9 | 100.63 | 87.3 | 2085.4 | 991.75 |
| Cab.(1$Cm^3$/L | 161.73 | 22.63 | 1268.9 | 112.2 | 93.6 | 2143.82 | 1039.56 |
| Elga600(1⁄2cm⁄L) | 167.4 | 11.6 | 1321.1 | 118.9 | 99.7 | 2229.4 | 1110.24 |
| Cab.+Elga600 | 162.4 | 22.03 | 1210.9 | 100.56 | 88.13 | 2049.05 | 948.14 |
| L.S.D. 5 % | 0.55 | 0.30 | 3.05 | 0.46 | 1.00 | 11.05 | 10.33 |

Application of Elga 6001⁄2cm as foliar spraying recorded the maximal significant values of yield and its components. Such efficient treatment increased head diameter, seeds number/head, seed weight/head, 1000-seed weight and yields of biological, straw and seed/fed. By 20.5, 19.2, 36.0, 17.2, 5.6, 4.2 and 28.5%, respectively, compared to control during 1st season. Moreover, spraying of boron recorded the second order in this respect, and enhanced the mentioned traits by 2.5, 10.8, 14.1, 26.2, 12.1, 8.6 and 21.3 %, respectively, than the control (without boron) in 2012 growing season. However all characters for yield and its components tack the same trend in 2013 growing season. It is clear that the increase in boron level improved sunflower yield and its attributes. Boron fertilization stimulated vegetative growth traits of sunflower plants (Table, 5 ), and this in turn increased photosynthetic areas and activity as well as dry matter accumulation in seeds and heads. Similar results were obtained by Tamak *et. al.* (1997), Vyakaranahal *et. al.* (2001) and El-Sadek *et. al.* (2004). The spraying of boron at the rate of 339 ppm secured the highest values of harvest index, crop index and water use efficiency, exceeding the other treatments in this respect.

Concerning the effect of Elga600 application, it is obvious from data in Table (5) that significantly enhanced all yield parameters in both seasons except head diameter which showed insignificant increase in the first season. These results confirmed the findings of Salama (1987) and Mekki *et al.* (1999) on sunflower plants. However, Elga600 is required as cofactor for many enzymes involved in respiration and photosynthesis. Thus, an enhancement in carbon fixation and energy production would gain by Elga600 application which positively affect oil seed yield.

### 2-3- Effect of interaction:-

The interaction between sowing date and spraying boron and Elga 600 interaction divulged remarkable effect on sunflower yield and its components (Table 6). In this respect, the combination of 10th September as a sowing date x Elga 600 recorded the maximum values of plant height, head diameter, seeds number/head, seed weight/head, 1000-seed weight, biological yield and seed yields/fed. Compared with the other treatments during both seasons. Additionally, under the same sowing date with boron spraying interaction recorded the 2nd one for improving yield and its components in 2012 and 2013 growing season. Otherwise, 1st August as a sowing date with dry seeds interaction (without any spraying) gave the minimal values of all yield and yield components .

## 3- Chemical constituents:-

### 3-1-Effect of Sowing date:-

Data in Table (7) clearly demonstrated that, planting sunflower plant during 10th September, protein yield and protein percentages, oil yield and oil percentages as well as mineral recorded the highest significant mean values as compared with the both sowing date (1st and 20thAugust) . Meanwhile Na content tack the adverse effect. However, planting sunflower plant during 1st and 20th August detected the 2nd and 3rd order for chemical constituents.

### 3-2-Effect of Foliar application:-

As shown in Table (7), spray Elga 600 marked the highest significant mean values for protein yield and protein percentage as compared with different foliar application treatments. Also, oil yield and oil percentages gave the trend. However, mineral content K, Ca and P surpassed with Elga 600 and boron as a foliar application with seed sunflower plant compared with the control. Whereas, Na content tack the adverts effect under different foliar application.

**Table (6): Effect of foliar application and different sowing dates treatments on yield and yield components of sunflower at harvesting dates under Toshka conditions in 2012 and 2013 seasons.**

| Treatments | | Plant height | Head | | | | Yield (kg/fed) | |
|---|---|---|---|---|---|---|---|---|
| Sowing dates | Foliar application | | Diameter (cm) | Seed number | Seed weight (g) | Weight of 1000 seed (g) | Straw | Seed |
| 2012 | | | | | | | | |
| 1st August | Control (Dry) | 144.6 | 18.2 | 855.4 | 61.66 | 62.50 | 1598.22 | 589.50 |
| | Tap Water | 150.6 | 18.8 | 936.5 | 71.20 | 66.75 | 1650.45 | 645.8 0 |
| | Caborn (1Cm$^3$/L | 152.6 | 20.6 | 1075.2 | 96.50 | 77.50 | 1833.12 | 855.35 |
| | Elga600(1⁄2cm\L) | 155.2 | 22.0 | 1145.6 | 102.60 | 81.60 | 1855.60 | 905.30 |
| | Caborn +Elga600 | 151.5 | 19.6 | 942.6 | 83.40 | 71.60. | 1826.40 | 773.7 0 |
| 20th August | Control (Dry) | 158.2 | 20.2 | 1166.5 | 91.36 | 82.50 | 1882.40 | 780.50 |
| | Tap Water | 160.0 | 21.5 | 1188.3 | 95.75 | 83.60 | 1896.25 | 905.75 |
| | Caborn (1Cm$^3$/L | 162.5 | 22.2 | 1212.3 | 110.5 | 86.75 | 2085.16 | 1005.40 |
| | Elga600(1⁄2cmL) | 166.6 | 24.5 | 1276.5 | 117.6 | 89.55 | 2296.75 | 1115.2 |
| | Caborn +Elga600 | 160.4 | 21.8 | 1200.5 | 108.8 | 85.90 | 1930.50 | 922.5 |
| 10th September | Control (Dry) | 165.8 | 22.0 | 1210.8 | 125.2 | 93.56 | 2388.7 | 1205.35 |
| | Tap Water | 166.5 | 23.5 | 1285.5 | 132.9 | 97.80 | 2409.60 | 1239.60 |
| | Caborn.(1Cm$^3$/L | 169.8 | 24.1 | 1400.1 | 144.2 | 103.2 | 2457.10 | 1262.6 |
| | Elga600(1⁄2cmL) | 171.0 | 26.3 | 1430.3 | 158.3 | 108.4 | 2500.3 | 1290.0 |
| | Caborn +Elga600 | 166.2 | 22.6 | 1300.1 | 140.1 | 101.7 | 2441.3 | 1242.1 |
| L.S.D. 5 % | | 0.32 | 0.24 | 4.09 | 0.51 | 1.07 | 13.00 | 9.04 |
| 2013 | | | | | | | | |
| 1st August | Control (Dry) | 147.5 | 19.9 | 862.5 | 65.85 | 62.70 | 1620.50 | 592.80 |
| | Tap Water | 155.6 | 20.0 | 955.6 | 88.60 | 72.20 | 1835.20 | 798.60 |
| | Cab.(1Cm$^3$/L | 156.2 | 21.2 | 1096.0 | 98.50 | 78.80 | 1839.30 | 862.20 |
| | Elga600(1⁄2cmL) | 159.5 | 22.0 | 1157.6 | 106.7 | 82.35 | 1866.70 | 911.12 |
| | Caborn+Elga 600 | 152.3 | 20.7 | 975.5 | 75.60 | 68.80 | 1659.65 | 650.84 |
| 20th August | Control (Dry) | 159.8 | 21.5 | 1301.2 | 93.75 | 90.20 | 1891.46 | 888.20 |
| | Tap Water | 165.2 | 21.8 | 1335.6 | 103.2 | 89.50 | 1998.30 | 933.30 |
| | Caborn (1Cm$^3$/L | 155.6 | 22.9 | 1440.8 | 122.5 | 98.50 | 2092.18 | 981.50 |
| | Elga600(1⁄2cmL) | 167.5 | 23.00 | 1505.6 | 129.5 | 109.50 | 2306.5 | 1119.6 |
| | Cab.+Elga 600 | 162.8 | 22.00 | 1402.2 | 113.40 | 95.40 | 2000.5 | 933.3. |
| 10th September | Control (Dry) | 169.5 | 22.80 | 1240.6 | 100.2 | 98.80 | 2400.2 | 1211.80 |
| | Tap Water | 171.4 | 23.00 | 1290.5 | 110.1 | 100.2 | 2422.7 | 1243.35 |
| | Cab.(1Cm$^3$/L | 173.4 | 23.80 | 1270.0 | 115.6 | 103.4 | 2500.0 | 1275.0 |
| | Elga600(1⁄2cmL) | 175.2 | 24.6 | 1300.0 | 120.4 | 107.2 | 2515.0 | 1300.0 |
| | Cab.+Elga 600 | 172.1 | 23.4 | 1255.0 | 112.7 | 100.2 | 2487.0 | 1260.3 |
| L.S.D. 5 % | | 0.11 | 0.18 | 2.65 | 0.43 | 1.02 | 11.21 | 6.28 |

**Table (7): Effect of sowing dates , foliar application treatments and their interactions on chemical constituents of sunflower seeds under saline soil at Toshka conditions.**

| Treatments | | Protein | | Oil | | Mineral nutrients | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | yield kg/fed | % | yield kg/fed | % | Na. Mg/g weight | K.. Mg/g weight | Ca. Mg/g weight | p Mg/100g weight |
| Effect of sowing dates :- | | | | | | | | | |
| 1st August | | 176.8 | 14.16 | 246.7 | 23.56 | 16.54 | 41.18 | 53.72 | 25.58 |
| 20th August | | 179.3 | 15.06 | 254.9 | 23.58 | 16.36 | 42.10 | 55.04 | 25.76 |
| 10th September | | 185.5 | 20.78 | 349.3 | 31.46 | 16.46 | 46.58 | 56.96 | 29.32 |
| L.S.D. 5 % | | 2.02 | 3.14 | 6.08 | 0.30 | 0.02 | 0.11 | 0.42 | 0.05 |
| Effect of foliar application :- | | | | | | | | | |
| Control (Dry) | | 169.2 | 14.0 | 256.5 | 23.8 | 19.0 | 35.8 | 48.4 | 21.3 |
| Tap Water | | 171.2 | 15.5 | 272.5 | 24.7 | 18.4 | 38.9 | 53.1 | 23.0 |
| Caborn (1Cm3/L | | 176.5 | 16.3 | 282.0 | 26.0 | 16.1 | 44.1 | 57.1 | 27.5 |
| Elga 600(1/2cm/L) | | 190.5 | 18.2 | 296.2 | 27.7 | 14.9 | 47.1 | 58.3 | 30.5 |
| Caborn +Elga600 | | 195.4 | 19.2 | 310.8 | 28.7 | 13.9 | 50.5 | 59.2 | 32.0 |
| L.S.D. 5% | | 0.50 | 0.82 | 10.02 | 0.21 | 0.03 | 0.12 | 0.25 | 0.10 |
| Effect of interaction:- | | | | | | | | | |
| 1st August | Control (Dry) | 166.5 | 13.0 | 235.5 | 22.5 | 18.5 | 32.6 | 46.5 | 20.6 |
| | Tap Water | 168.6 | 13.8 | 240.6 | 22.8 | 18.2 | 34.2 | 52.5 | 22.5 |
| | Caborn (1Cm3/L | 171.5 | 14.2 | 244.5 | 23.5 | 16.2 | 42.4 | 55.2 | 25.8 |
| | Elga 600 | 185.6 | 14.6 | 251.2 | 24.2 | 15.8 | 46.5 | 56.8 | 28.4 |
| | Caborn +Elga 600 | 191.8 | 15.2 | 261.5 | 24.8 | 14.0 | 50.2 | 57.6 | 30.6 |
| 20th August | Control (Dry) | 169.2 | 13.5 | 238.5 | 22.5 | 18.8 | 34.2 | 48.6 | 20.8 |
| | Tap Water | 169.5 | 14.2 | 246.5 | 23.2 | 18.0 | 38.2 | 52.9 | 22.4 |
| | Cab.(1Cm3/L | 175.6 | 14.6 | 255.5 | 23.2 | 16.2 | 42.8 | 57.2 | 24.6 |
| | Elga 600 | 190.2 | 16.2 | 261.6 | 24.2 | 14.6 | 46.5 | 58.0 | 30.2 |
| | Caborn +Elga 600 | 192.2 | 16.8 | 272.3 | 24.8 | 14.2 | 48.8 | 58.5 | 30.8 |
| 10th September | Control (Dry) | 171.8 | 15.5 | 295.5 | 26.5 | 19.6 | 40.5 | 50.2 | 22.6 |
| | Tap Water | 175.5 | 18.6 | 330.5 | 28.2 | 19.0 | 44.2 | 54.0 | 24.2 |
| | Caborn (1Cm3/L | 182.5 | 20.2 | 346.2 | 31.5 | 16.0 | 47.2 | 58.8 | 32.2 |
| | Elga 600 | 195.6 | 23.8 | 375.8 | 34.6 | 14.2 | 48.5 | 60.2 | 32.8 |
| | Caborn +Elga 600 | 202.2 | 25.8 | 398.5 | 36.5 | 13.5 | 52.5 | 61.6 | 34.8 |
| L.S.D. 5% | | 2.04 | 0.90 | 12.12 | 0.43 | 0.07 | 1.05 | 1.12 | 0.33 |

## 3-3-Effect of interactions:-

Data in Table (7) showed that protein and oil percentage of sunflower seeds cv. Vidoc under the experimental conditions is.23.8% and 34.6 % respectively with planting seed of sunflower during 10th September as a sowing date with spray Caboron+Elga 600.Also, Caborn +Elga 600 with planting seed of sunflower in the 10thSeptemberinteraction (202.2 and 398.5 kg\fed.) respectively recorded the highest significant values followed by(10thSeptember + Elga 600 ) and (caboron with the same sowing date ) then (tap water during the late of sowing date) comparing width untreated plants dry seeds. The lowest values of oil % comparing with control plants were recorded by dry seeds with planting sunflower plant in the 1st August interaction. In the same direction mineral content K ,Ca and P tack the braves' same trend. Whereas, Na content tack the adverts effect under different interaction treatments.

These results are in agreement with Wu *et al.* (1999) who revealed that K and trace elements application increased P concentration in soybean. This finding was in harmony with Ozoris *et al.* (1985) who reported that the concentration of $K^+$ and $Mg^{+2}$ in sorghum plants were increased by application of Zn under calcareous soil and saline conditions. The role of K in the osmotic adjustment of plants under saline conditions and consequently its importance of being required to the selectivity and integrity of cell membrane was explained by Satti and Lopez, (1994).

The primitive effects of spraying plants with Elga and boron treatments increasing oil % were achieved also by Sawan *et al.* (2006) on cotton plants. This may be attributed to the requirement of P for production of high quality seeds, since it involved in energy transfer reactions; energy is trapped in photosynthesis in form of ATP and NADP. Also, these results were found to be agree with those obtained by Rajendran and Veeraputhiran (2001) on sunflower plant.

## 4- Endogenous hormones:-

Data presented in Table (8) revealed that, all treatments enhanced the level of IAA in the leaves. Stimulatory marked effects were obtained by caboron + Elga 600 under the differences sowing date interaction or caborn with planting sunflower plant in the 10th September as a sowing date. Application of dry seed (control) combination with planting during 1stAugust as a sowing date showed less concentrations of IAA comparing with other treatments. These results are in confirmation with Marschner (1995) and Hitoshi *et al.* (1997) Who reported that Zn deficiency leads to the destruction of auxin and impairs its biosynthesis because Zn is required directly for the synthesis of tryptophan (precursor for the biosynthesis of IAA) and indirectly for the synthesis of auxins. Moreover, Zaghlool (2002) and Sakabutdinova *et al.* (2003) affirmed that foliar application increased IAA concentration. The same trend was obtained by Shakirova (2007).

It is obvious from Table (8) that, $GA_3$ concentrations increased by all treatments compared with control plants. The highest $GA_3$ concentrations were achieved by the application of caboron + Elga 600 (458.3 mg/100g fresh weight) under 10th September as a sowing date followed by treatments of caboron + Elga 600 under 20th August as a sowing date (432.2 mg/100g fresh weight) then caboron + Elga 600 (426.2 mg/100g fresh weight) under 1st August as a sowing date. These simulative effects of treatments on growth promoters may due to the adjustment of the nutrients concentration which induces the synthesis of CK and $GA_3$ required for growth (Amzallag *et al.,* 1992).

In addition, ABA concentration was decreased by planting sunflower plant during 1st August as a sowing date

compared with the other different sowing date. Spray application treatments were detected the positive effect on ABA. Planting sunflower plant during 10thSeptember as a sowing date with all foliar application treatments which increased ABA level compared with the untreated plants (Table 8). Moreover, 10thSeptember as a sowing date gave a stimulatory effect on ABA concentration when applied with foliar application treatments. The maximum values were given by planting sunflower plant during 10th September as a sowing date with elega 600 followed by the same sowing date with caboron + Elga 600 as a foliar application .

The high level of ABA under the experimental stress condition was in agreement with Masia *et al* (1994) who reported that ABA accumulate in water stressed cotton and sunflower plants. The effect of Kon the accumulation of ABA is well documented by Sakhabutdinova *et al.* (2003) and Shakirova (2007).

It could be seen that, the highest concentrations of IAA, $GA_3$ and ABA were achieved by K, N, P and Mg as a foliar treatments. Moreover, organic matter gave the maximum concentrations of IAA and a marked increase in $GA_3$ and ABA concentrations. These results were accompanied by marked improvement in growth and yield indicating that, the interaction of planting sunflower during 1st September as a sowing date with Elga (600) and boron as a foliar application created endogenous hormonal .

**Table (8): Effect of the interaction between sowing dates and foliar application treatments interaction on IAA,GA3 and ABA (mg /100gfw.) in leaves of sunflower plants at 50 days after planting under saline soil at Toshka conditions.**

| Treatments | | IAA concentration (mg /100gfw.) | GA3 concentration (mg /100gfw.) | ABA concentration (mg /100gfw.) |
|---|---|---|---|---|
| *Effect of interaction:- after* | | | | |
| Sowing dates | Foliar | | | |
| 1st August | Control (Dry) | 2.01 | 92.5 | 0.44 |
| . | Tap Water | 2.15 | 295.4 | 0.54 |
| | Cab.(1Cm$^3$/L | 4.58 | 419.6 | 0.62 |
| | Elga600(1\2cm\L) | 2.55 | 300.6 | 0.85 |
| | Cab.+Elga 600 | 8.66 | 426.2 | 0.75 |
| 20th August | Control (Dry) | 2.26 | 95.6 | 0.86 |
| . | Tap Water | 2.42 | 300.0 | 1.04 |
| | Cab.(1Cm$^3$/L | 5.64 | 428.5 | 1.07 |
| | Elga600 (1/2cm/L) | 2.88 | 306.4 | 1.14 |
| | Cab.+Elga 600 | 9.25 | 432.2 | 1.09 |
| 10thSeptember | Control (Dry) | 2.87 | 107.2 | 0.95 |
| | Tap Water | 3.00 | 309.6 | 1.13 |
| | Cab.(1Cm$^3$/L | 6.52 | 449.4 | 1.25 |
| | Elga6001/2cm/L) | 3.42 | 324.5 | 1.53 |
| | Cab.+Elga 600 | 11.63 | 458.3 | 1.44 |

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## أقلمة وتحسين نبات عباد الشمس تحت ظروف الإجهاد البيئى بمنطقة توشكا

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وحدة الأقلمة- قسم الأصول الوراثية النباتية - مركز بحوث الصحراء-المطرية-القاهرة

**الملخص العربى**

أجريت التجارب الحقلية فى محطة بحوث توشكا التابعة لمركز بحوث الصحراء خلال موسمى 2012،2013. بهدف دراسة تاثير مواعيد الزراعة ودور عمليات الرش ببعض العناصر على أقلمة وتحسين نباتات زهرة عباد الشمس صنف فيدوك تحت ظروف الإجهادات الملحية بمنطقة توشكى .

**تم زراعة بذور زهرة عباد الشمس فى ثلاث مواعيد للزراعة وكمايلى:-**

1- الميعاد الاول وهو الاول من اغسطس
2- الميعاد الثانى 20 من اغسطس
3- الميعاد الثالث 10 من سبتمبر

**تم رش النباتات بعد7,5 أسابيع من الزراعة بمحاليل العناصر التالية:**

1-الالجا 600 بمعدل 2/1 سم /اللتر. 2- بورون 1سم /اللتر. 3- الالجا 600 + بورون 4-الماء العادى . 5- بذور جافة (كونترول) .

**قياسات النمو والمحصول ومكوناته:-**

1- حققت الزراعة فى 10 من سبتمبر زيادة معنوية فى كل من الوزن الغض و الجاف لكل من الساق والاوراق .وكذلك زيادة فى عدد البذور/قرص- ووزن البذور/ قرص- ووزن المحصول مقارنة بالزراعة خلال شهر اغسطس.
2- أدى رش النباتات بالالجا 600 وكذلك البورون 1سم/التر الى تحسين واضح فى كل من صفات النمو وكذلك المحصول ومكوناتة .

تفوق الرش بالالجا 600 عن البورون فى كل من عدد البذور/قرص- ووزن البذور/ قرص - ووزن المحصول .

3- أعطت معاملة التفاعل بين (ميعاد الزراعة فى 10 منسبتمبر +الرش بالالجا 600 ) أعلى قيم معنوية فى الوزن الغض و الجاف للمجموع الخضرى وكذلك المحصول و مكوناتة تليها معاملة التفاعل بين (ميعاد الزراعة فى 10 من سبتمبر+ الرش بالبورون 1سم/للتر ) فى كلاالموسمين.
4- أوضحت النتائج أن جميع معاملات الرش بالعناصر أدت الى زيادة معنوية فى النسبة المئوية لزيت بذرة نبات عبادالشمس وكذلك نسبة البروتين والذى انعكس على زيادة محصول الزيت والبروتين للنبات .
5- حققت الزراعة المتأخرة (10 من سبتمبر) مع الرش بالالجا 600 تحسن واضح فى البوتاسيوم – الكالسيوم- الفسفور مقارنة بالمواعيد ومعاملات الرش الاخرى.وسلك الصوديوم التأثير المعاكس.
6- أظهرت النتائج زيادة الهرمونات النباتية IAAG-A3- ABA- بزراعة بذور زهرة عباد الشمس فى 20 من سبتمبر (الميعاد الثالث) مع الرش بالالجا 600 مقارنة بالمواعيد ومعاملات الرش الاخرى.