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# Effect of some Irrigation Systems and Fertilizer Levels used under Water Stress on Growth, Yield and Quality for Sugar Beet Crop. (*Beta vulgaris* L)

**El darder, A. M. A.[1]; M. A. Gamaa[2]; M. A. Sayed[3] and M. Z. Kamel[4]**
**[1]Nobaria Sugar Company.**
**[2]Soils and water Dept., Fac. Agric., Asyut Univ., Egypt.**
**[3]Soils, Water and Environment Res. Institute, Agric. Res. Center**
**[4]Agricultural consultant of Nobaria Sugar Copmany**

## ABSTRACT

Two field experiments were conducted at Wadi El-Natrun EL- Beheira governorate, Egypt during the two growing seasons of 2014/2015 and 2015/2016 to study the effect of water stress (60%, 80% and 100% from irrigation water requirements), two organic fertilization levels (zero and 6 ton compost/fed) and three nitrogen fertilization rates (60, 90 and 120 kg N/fed) on growth, yield and quality of sugar beet plants grown under conditions of drip and sprinkler irrigation systems. Results revealed that drip irrigated sugar beet plants with 80% of irrigation water requirements (IWR) recorded the highest significant leaf area index, sucrose%, purity% and extractable sugar% in both seasons and white sugar yield in the second season only, while application of sprinkler irrigation at 100% of IWR gave the heaviest root weight, root number/fed, purity%, root yield in both seasons. Applying of 6 ton/fed compost with sprinkler irrigation significantly increased root weight, root number and root yield in both seasons. Also, application of compost at 6 ton/fed with drip irrigation system increased root yield. Increasing N level up to 120 kg N/fed significantly increased LAI, root weight, root number/fed and impurities % as well as root yield in both seasons and white sugar yield only in the first one. Excessive N application lowered beet quality in terms of sucrose, purity and extractable sugar percentages in both seasons. The minimum value of net profit was yield and quality resulted from drip irrigation system with 80% water regime, 6ton/fed compost and 90 kg N/fed during 2014/15 season, while the maximum value of net profit was L.E. 7688 .10 fed resulted from drip irrigation system with 80% water regime 6 t/fed compost 90 kg N/fed during 2014-2015 season ,while the minimum value of net profit was L.E. 2231.88 /fed resulted from sprinkler irrigation with 60% water regime, 6ton/fed compost and 120 kg N/fed during season 2015/2016. Data indicated that using of drip irrigation system with 1322 $m^3$ water/fed (60% of the calculated water requirements) + 6 ton/fed compost + 120 kg N/fed of ammonium nitrate (33.5%) for the best results of yield and quality with sugar beet crop .So recommended that using of drip irrigation system with 1322 $m^3$ water/fed (60% of the calculated water requirements) + 6 ton/fed compost + 120 kg N/fed of ammonium nitrate (33.5%) for the best yield and quality with sugar beet crop at the same Wadi El-Natrun condition, Egypt.

**Keywords:** Sugar beet, drip, sprinkler, water stress, compost, nitrogen fertilization.

## INTRODUCTION

In Egypt, sugar industry depends on sugar cane and sugar beet crops, where the latter contributes to more than 30% of world sugar production and more than 50% locally in Egypt with a total production of 1.3 million tons of sugar (Sugar Crops Council Report, 2015). This indicates the strategic importance of this crop, especially in the new soils because of its ability to withstand drought and salinity, which gives it the advantage to compete with the other winter crops as alfalfa. In addition, the natural residues of this crop can be used in the production of feed.

The global climate change next to the limited water component are the most important factors at all in the field of crop production. Therefore under the current circumstances and future, it has become mandatory application of the appropriate methods to conserve water and reduce chemical inputs in the field of crop production in line with the sustainable agriculture. Despite the introduce of modern irrigation systems in the production of many crops, the management of sugar beet production under these systems in Egypt and especially for the farmers still has a lot of weaknesses, which need to be studied and improved (Morad *et al*., 2012).

Organic fertilization plays an important role in reducing the use of chemical fertilizers and thus reducing the harmful impact of chemical use on soil and the environment and sustainable agriculture, where the organic material has an important role as an alternative in the supply of plant nutrients necessary, especially nitrogen.

The rate of N in plant nutrition has been recognized to be connected to the production of vigorous vegetation growth. Crop response to N fertilization can be expressed in terms of higher yield and improved crop quality. Some of the most significant advances in nitrogen fertilization of crops have been occurred during its beneficial capacity to provide both cash income from the harvested root as well as livestock feed in the form of above-ground biomass (tops) and root processing byproducts such as pulp and molasses (Stevens *et al.,* 2008). Nitrogen fertilization of sugar beet should be managed to produce high root tonnage with high sucrose concentration and purity levels and with minimal top growth. The economic yield of sugar beet, thus closely relates to the sugar accumulation process. The filling process also depends on the photosynthetic efficacy of leaves, which is not only controlled by light intensity and temperature but also by mineral nutrition (Seadh *et al.,* 2007).

Therefore, the present investigation aimed to study study the effect of water stress (60%, 80% and 100% from irrigation water requirements), two organic fertilization levels (zero and 6 ton compost/fed) and three nitrogen fertilization rates (60, 90 and 120 kg N/fed) on growth, yield and quality of sugar beet plants grown under conditions of drip and sprinkler irrigation systems.

## MATERIALS AND METHODS

Two field experiments were carried out in 2014/2015 and 2015/2016 seasons at Nubaria Sugar Factory, El-Beheira Governorate, Egypt to study the requirements of water for sugar beet crop grown under drip and sprinkler irrigation methods.

Nubaria Sugar Factory is situated at 30°38'00.4"N latitude, 30°13'35.9"E longitude and the altitude is 28 m above the sea level.

The experimental soil is classified as sandy soil (Table 1). Soil samples were collected from three successive depths (0-20, 20-40 and 40-60 cm) before cultivation and analysed for certain physical and chemical characteristics, according to (Jackson, 1967) and data presented in Table (1).

**Table 1. Certain physical and chemical characteristics of the experimental site soil.**

**Physical characters**

| Soil depth (cm) | Particle size distribution % | | | Texture | Bulk density ($g/cm^3$) | Moisture content by volume (%) | | |
|---|---|---|---|---|---|---|---|---|
| | Sand | Silt | Clay | | | Field Capacity | Wilting point | Available Water |
| 0 - 20 | 94.5 | 3.5 | 2 | | 1.65 | 13.25 | 5.50 | 7.75 |
| 20 - 40 | 95 | 3.3 | 1.7 | Sandy soil | 1.56 | 14.25 | 4.90 | 9.35 |
| 40 - 60 | 95.7 | 3 | 1.3 | | 1.44 | 14.50 | 4.30 | 10.20 |

Chemical characters

| Soil depth (cm) | EC ($dSm^{-1}$) | pH | Organic matter (%) | N (ppm) | Soluble anions (meq/l) | | | | Soluble cations (meq/l) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $CO_3^{--}$ | $HCO_3^-$ | $Cl^-$ | $SO_4^{--}$ | $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ |
| 0 - 20 | 1.46 | 8.23 | | 10.0 | - | 0.93 | 1.88 | 9.61 | 6.23 | 2.24 | 3.44 | 0.51 |
| 20 - 40 | 1.56 | 8.11 | 1.025 | 9.7 | - | 1.15 | 2.05 | 9.85 | 6.45 | 2.26 | 3.76 | 0.58 |
| 40 - 60 | 1.63 | 7.97 | | 9.6 | - | 1.33 | 2.01 | 10.16 | 6.65 | 2.29 | 3.91 | 0.65 |

A split-split plot design with three replications was used for each irrigation system. Each experiment included 18 treatments, represented the combination among three water deficit treatments, two organic fertilization levels and three nitrogen fertilization levels. The water stress treatments occupied the main plots, while the sub plots were assigned for the two organic fertilization levels. Meantime, the three nitrogen levels were randomly distributed in the sub-sub plots.

Multi-germ variety *viz.* Gazelle imported from Germany was sown on the first week of October of each season. Seeds was sown on ridges 60 cm apart and 20 cm between hills. Each sub-sub plot included 5 ridges each is 5 m in length. Therefore each sub-sub plot size was 15 $m^2$.

Nitrogen was added in the form of ammonium nitrates (33.5% N) in six equal portions. The first was applied after thinning at 4-leaf stage. Phosphorous in the form of super phosphate (15.5%) at the rate of 30 Kg $P_2O_5$/fed and compost were added before sowing and during land preparation. Potassium in the form of potassium sulfate (48%) was added at the rate of 48 Kg $K_2O$/fed with the first dose of N. Thinning took place to one plant/hill at 4-leaf stage (4 weeks from planting). Other cultural practices were done as recommended. The chemical analyses of the applied compost are presented in Table (2).

Irrigation water used in the experiment was pumped from a well, which its chemical analysis is given in Table (3) according to A.O.A.C. (1970).

**Table 2. Chemical analysis of compost.**

| Weight of m3 (Kg) | Moisture content % | pH | EC ($dSm^{-1}$) | Total nitrogen % | O.M % | Organic carbon % | Ashes % | C/N ratio | Total P % | Total K% | Weed seeds | Nematode |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 680 | 16.6 | 7.86 | 4.46 | 1.03 | 31 | 17.5 | 69 | 1:17 | 1.25 | 1.34 | Not found | Not found |

**Table 3. Chemical characteristics of irrigation water.**

| SAR (meq/l) | RSC | ESP (%) | C/N ratio | pH | TDS (ms/l) | EC ($dSm^{-1}$) | Soluble anions (meq/l) | | | | Soluble cations (meq/l) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | $CO_3^{--}$ | $HCO_3^-$ | $Cl^-$ | $SO_4^{--}$ | $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ |
| 12.1 | 0.2 | 78.1 | 9.8 | 7.14 | 345.6 | 1.18 | 0.0 | 1.3 | 1.25 | 2.98 | 2.0 | 2.98 | 2.0 | 1.0 |

The average of evapotranspiration in Wadi El-Natrun region is shown in Table 4. The crop factor of sugar beet and the amount of applied water are represented in Table 5 and 6, respectively.

**Table 4. Average $ET_o$ at Wadi El-Natrun.**

| Month | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|
| $ET_0$ (mm/day) | 5.4 | 3.45 | 2.64 | 2.87 | 3.76 | 4.59 |

**Table 5. The crop factor ($K_c$) of sugar beet in the semi-arid region (Doorenbos and Kassam, 1979).**

| Crop stages | Initial | | Crop development | | Mid-season | | Late-season | | Total (days) |
|---|---|---|---|---|---|---|---|---|---|
| | Time (days) | $K_c$ | Time (days) | $K_c$ | Time (days) | $K_c$ | Time (days) | $K_c$ | |
| | 30 | 0.35 | 60 | -- | 60 | 1.2 | 30 | -- | 180 |

Normal cultural practices as recommended by Agricultural Research Center (ARC) Egypt were done as well as disease control whenever it was necessary. It was intended to study the addition total yield (root and sugar) and quality of sugar.

The sugar beet plants were harvested 190 – 200 days after sowing in both seasons. Ten guarded plants were selected at random from each treatment of four replications:

**Determinations related to sugar beet crop as follow:**

**A-Growth traits:**

At harvesting, a sample of ten plants was taken at random from each sub-sub plot and topped to determine the following traits in both seasons:

**1- Root weight (kg)**

**2- Leaf area index (LAI):**Leaf area index [(LAI) = unit leaf area per plant ($cm^2$)/ plant ground area ($cm^2$)] was determined after 90 days from planting according to Watson (1958) and leaf area was determined using area meter, ATA60, Model 3100

**Table 6. The amounts of the applied water for the three water regimes (average of the two growing seasons).**

| Days from planting | Growing stage | Amount of water ($m^3$/fed) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Sprinkler | | | Drip | | |
| | | 60% | 80% | 100% | 60% | 80% | 100% |
| 1<br>30 | Initial | 297.7 | 297.7 | 297.7 | 258.9 | 258.9 | 258.9 |
| 31<br>90 | Development | 326.2 | 483.3 | 652.4 | 283.7 | 425.5 | 567.3 |
| 91<br>150 | Mid-season | 624.95 | 931.43 | 1249.9 | 543.5 | 815.2 | 1086.9 |
| 151<br>180 | Late-season | 340.4 | 510.6 | 680.8 | 235.9 | 443.9 | 591.9 |
| Total in the season | | 1589.3 | 2223.0 | 2880.8 | 1322.0 | 1943.5 | 2505.0 |

**B-Yield quality traits:**

At harvesting, a sample of ten roots was taken at random from each sub-sub plot and cleaned to determine the following traits in both seasons:

**2Sucrose percentage:** was determined by using sacharometer lead acetate extract of fresh macerated roots according to **Carruthers and Oldfield (1960).**

**3- Extractable sugar percentage (ES%):** According to Renfield *et al.* (1974), it was determined using the following formula:

**ES% = pol-[0.343(K + Na) + 0.094 α-amino N + 0.29] where Pol = sucrose percentage.**

4- **Juice purity percentage (QZ)** = (ES% / pol) × 100 and

5- **Impurities percentage** = [0.343(K + Na) + 0.094 α-amino N + 0.29]

Were determined according to Renfield *et al.* (1974).

**C-Yield:**

At harvesting, the guarded ridges of sugar beet in each sub-sub plot were up-rooted, topped, cleaned and weighed to determine:

**6- Root number/fed.**

**7- Root yield (ton/fed).**

**8- White sugar yield (ton/fed) =** root yield (ton/fed) x (Extractable sugar%/100).

**D-Statistical analysis**

Collected data under each irrigation system were subjected to normal statistical analysis according to Snedecor and Cochran (1989). Treatment mean comparisons were done using least significant difference (LSD) at 5% level of probability. After homogeneity test, combined analysis was done to compare between the two irrigation systems.

## RESULTS AND DISCUSSION

**A-Effect of water stress**

Results in Table (7) cleared that mean root weight, sucrose, purity and impurities percentages as well as root and white sugar yields were significantly affected by increasing water deficit from 100% up to 60% of the irrigation water requirements (IWR). These results were true under both irrigation systems in the two growing seasons, except for sucrose percentage under sprinkler irrigation in the first season. Leaf area index values fluctuated among irrigation levels under drip irrigation system during the first growing season only. The highest LAI values under drip irrigation resulted from 80% of IWR. These results are in accordance with those obtained by Hosseinpour *et al.,* (2006 a). Goodman (1968) reported that the size and longevity of sugar beet leaf canopies strongly influenced by soil moisture and soil fertility. Decreasing the amount of irrigation water from 100% to 80% and 60% of IWR under drip irrigation significantly decreased mean root weight by 8.04 and 26.79% in the 1st season and by 6.78 and 20.34% in the 2nd season. However, under sprinkler irrigation the decrease in mean root weight amounted to 4.0 and 22.0% in the 1st season and 7.41 and 27.78% in the 2nd season, respectively. Drip-irrigated sugar beet plants with 80% of irrigation water requirements (IWR) recorded the highest percentages of sucrose (20.17 and 20.08%), purity (85.72 and 80.57%) and extractable sugar (17.30 and 16.23%) in the first and second seasons, respectively (Table 7) with a significant difference between 60% and 80% of IWR. Moreover, under sprinkler irrigation, juice quality trait values fluctuated among the three irrigation levels during the two growing seasons. Data averaged across seasons revealed that application of 80% of IWR gave the highest values of extractable sucrose percentage under both irrigation systems (Table 7). These results are in agreement with those reported by Roberts *et al.,* (1980) who mentioned that deficit irrigation usually increases percent of sucrose in the root. Hang and Miller (1986) found that sugar concentration in well watered crops rises steadily through the growing season, often leveling off before the harvest between 15 and 18% (g sugar per 100 g fresh roots). In water stressed crops it rises more quickly, and under severe stress conditions it can be 5% higher than in unstressed crops.

Roots number was significantly affected by the irrigation water levels only under sprinkler irrigation system during the two growing season (Table7).

**Table 7. Effect of water stress on sugar beet yields and some of its attributes under drip and sprinkler irrigation systems during 2014/2015 and 2015/2016 seasons.**

| Water stress | Leaf area index (LAI) | | Root weight (kg) | | Sucrose% | | Purity | | Impurities % | | Extractable sugar% | | Root number/fed x $10^3$ | | Root yield (ton/fed) | | White sugar yield (ton/fed) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler |
| 2014/2015 | | | | | | | | | | | | | | | | | | |
| 60% | 1.54 | 1.93 | 0.82 | 0.78 | 19.70 | 20.68 | 82.53 | 84.86 | 3.43 | 3.12 | 16.27 | 17.56 | 21.23 | 21.21 | 17.38 | 16.52 | 2.82 | 2.89 |
| 80% | 2.30 | 1.91 | 1.03 | 0.96 | 20.17 | 20.05 | 85.72 | 88.56 | 2.86 | 2.25 | 17.30 | 17.73 | 21.43 | 21.16 | 21.96 | 20.39 | 3.79 | 3.60 |
| 100% | 2.00 | 2.70 | 1.12 | 1.00 | 19.87 | 20.20 | 85.51 | 88.80 | 2.87 | 2.22 | 17.00 | 17.98 | 21.22 | 22.20 | 23.70 | 22.18 | 4.01 | 3.97 |
| LSDat 5% | 0.42 | N.S | 0.02 | 0.04 | 0.18 | N.S | 1.49 | 0.76 | 0.29 | 0.29 | 0.25 | N.S | N.S | 0.62 | 0.30 | 0.30 | 0.08 | 0.15 |
| 2015/2016 | | | | | | | | | | | | | | | | | | |
| 60% | 2.19 | 2.59 | 0.94 | 0.78 | 18.62 | 19.80 | 75.98 | 78.77 | 4.45 | 4.14 | 14.17 | 15.67 | 21.46 | 20.63 | 20.08 | 16.06 | 3.08 | 3.15 |
| 80% | 2.96 | 2.57 | 1.10 | 0.96 | 20.08 | 19.11 | 80.57 | 82.55 | 3.88 | 3.27 | 16.23 | 15.84 | 21.22 | 20.93 | 24.09 | 20.89 | 3.91 | 2.52 |
| 100% | 2.66 | 3.36 | 1.18 | 1.08 | 19.21 | 18.88 | 79.67 | 82.68 | 3.89 | 3.24 | 15.32 | 15.64 | 21.28 | 21.31 | 25.19 | 23.09 | 3.57 | 3.61 |
| LSDat 5% | N.S | N.S | 0.04 | 0.04 | 0.31 | 0.35 | 1.60 | 1.05 | 0.05 | 0.05 | 0.40 | N.S | N.S | 0.20 | 0.47 | 0.62 | 0.09 | 0.12 |
| Combined analysis of the two growing seasons | | | | | | | | | | | | | | | | | | |
| 60% | | | | | 19.16 | 20.24 | | | | | 15.22 | 16.62 | | | 18.73 | 16.29 | 2.95 | 3.02 |
| 80% | | | | | 20.13 | 19.58 | | | | | 16.77 | 16.79 | | | 23.03 | 20.64 | 3.85 | 3.06 |
| 100% | | | | | 19.54 | 19.54 | | | | | 16.16 | 16.81 | | | 24.45 | 22.64 | 3.79 | 3.79 |

**N.S = Not significant**

Irrigated sugar beet plants with 2880 $m^3$/fed (100% of IWR) recorded the highest and significant harvested roots number in the first season (22.20 thousand root/fed) and in the second season (21.31thousand root/fed).

Increasing water deficit from 100% to 60% of IWR significantly decreased root and white sugar yields under both irrigation systems during the two growing seasons (Table 7). Root yield reduction amounted to 26.67 and 25.52% in the first season and 20.29 and 30.45% in the second one under drip and sprinkler irrigation systems, respectively. On other hand, white sugar yield decrease amounted to 29.68% in the first season and 26.30% in the second one under drip irrigation system, corresponding to 27.20 and 30.47% under sprinkler irrigation system. However, the decrease in sugar yield accompanying high water deficit might have been due to the decrease in root yield as well as extractable sugar percentage as mentioned before. Results on root and white sugar beet yields indicated that yield of drip-irrigated sugar beet with 80% of IWR nearly matched yield of sprinkler- irrigated sugar beet with 100% of IWR during the two growing seasons and this might be due to the high efficiency of drip irrigation system as compared to sprinkler irrigation system (Tognetti *et al.,* 2003). Data in the same table showed that averaged across seasons revealed that application of 100% of IWR gave the highest value of root and white sugar yields/fed under drip and sprinkler irrigation systems (Table 7). Such results are in accordance with those reported by Tognetti *et al.* (2002), Tognetti *et al.* (2003) and Hosseinpour *et al.* (2006 a).

**B-Effect of compost**

Adding compost had no clear trend with respect to its effect on sugar beet yield and its attributes (Table 8).

**Table 8. Effect of compost levels on sugar beet yields and some of its attributes under drip and sprinkler irrigation systems during 2014/2015 and 2015/2016 seasons.**

| Compost levels (ton/fed) | Leaf area index (LAI) | | Root weight (kg) | | Sucrose% | | Purity% | | Impurities% | | Extractable sugar% | | Root number/ fed x $10^3$ | | Root yield (ton/fed) | | White sugar yield (ton/fed) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler |
| 2014/ 2015 | | | | | | | | | | | | | | | | | | |
| 0 | 2.29 | 2.48 | 0.99 | 0.90 | 20.06 | 20.32 | 84.77 | 87.60 | 3.04 | 2.51 | 17.02 | 17.80 | 20.89 | 21.36 | 20.59 | 19.25 | 3.58 | 3.41 |
| 6 | 1.59 | 1.88 | 0.99 | 0.93 | 19.76 | 20.30 | 84.40 | 87.20 | 3.07 | 2.55 | 16.69 | 17.70 | 21.69 | 21.68 | 21.44 | 20.14 | 3.50 | 3.56 |
| LSD at 5%. | * | N.S | N.S | ** | N.S | N.S | N.S | N.S | N.S | * | N.S | N.S | ** | * | ** | ** | N.S | ** |
| 2015/2016 | | | | | | | | | | | | | | | | | | |
| 0 | 2.71 | 2.89 | 1.06 | 0.93 | 19.68 | 19.54 | 81.04 | 83.42 | 3.71 | 3.19 | 15.99 | 16.35 | 21.24 | 21.08 | 22.39 | 19.66 | 3.58 | 3.21 |
| 6 | 2.49 | 2.78 | 1.09 | 0.98 | 18.92 | 18.99 | 76.44 | 79.24 | 4.43 | 3.90 | 14.48 | 15.08 | 21.40 | 21.83 | 23.84 | 20.37 | 3.45 | 3.07 |
| LSD at 5%. | N.S | N.S | N.S | ** | ** | * | ** | ** | N.S | ** | ** | ** | N.S | * | ** | ** | ** | ** |
| Combined analysis of the two growing seasons | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | 16.51 | 17.08 | | | 21.49 | 19.46 | 3.58 | 3.31 |
| 6 | | | | | | | | | | | 15.59 | 16.39 | | | 22.64 | 20.26 | 3.48 | 3.32 |

*** Significance and ** highly significance at 0.05 and N.S = Not-significant levels, respectively.**

In the first season, some traits showed significant response either under both irrigation systems (roots number and root yield) or under sprinkler irrigation (root weight, impurities and white sugar yield). In the second season, most evaluated traits significantly responded to compost under both irrigation system except for root weight, roots number and impurities under drip irrigation system. Applying compost with sprinkler irrigation significantly increased root weight (3.33 and 5.38%), roots number (1.50 and 3.56%), impurities (1.59 and 22.26%) and root yield (4.62 and 3.61%) in the 1st and 2nd seasons, respectively. Also, adding compost with drip irrigation increased root yield by about 4.13 and 6.48% in the first and second season, respectively. The same table showed that data averaged across seasons (Table 8) indicated that, zero ton/fed compost recorded the highest sucrose%, extractable sugar% and white sugar yield (ton/fed). On the contrary, application of 6 ton/fed of compost gave the highest value of root yield/fed under both irrigation systems in both seasons. Similar results were reported by Wallace and Carter (2007) and Mahmoud *et al.* (2012).

**C-Effect of nitrogen** fertilization levels. The effect of N levels on growth, yield, yield components and juice quality traits of sugar beet plants in 2014/2015 and 2015/2016 seasons are presented in Table (9). Leaf area index (LAI) increased significantly due to increasing nitrogen fertilizer levels from 60 to 90 and 120 kg N/fed under drip irrigation system during the two growing seasons (Table 9). Application of 120 kg N/fed to drip irrigated plants significantly increased LAI by about 112.20 and 73.02% in the 1st and the 2nd seasons, respectively as compared to application of 60 kg N/fed. Such increase in this trait may be returned to the role of nitrogen fertilizers certainly in stimulating growth and increasing leaf area per plant. The aforementioned results are generally in good agreement with those stated by Mahmoud *et al.* (2012).

Results in the same table revealed that N rates exhibited significant effect on root fresh weight in both seasons under both irrigation systems. A gradual increase in root weight as N level increased up to 120 kg N/fed was recorded. The increase amounted to (9.89% and 16.48%) and (11.22% and 17.35%) in the first and second seasons under drip irrigation system and (9.64% and 20.48%) and (9.09% and 15.90%) in the first and second seasons under sprinkler irrigation system as N level increased from 60 and 90 to 120 kg N/fed, respectively. This increase in root weight is mainly due to the role of N in stimulating the meristematic growth activity which contributes to the increase in number of cells in addition to cell enlargement. Similar findings were reported by Mahmoud *et al.* (2014).

**Table 9.Effect of nitrogen levels on sugar beet yield and some of its attributes under drip and sprinkler irrigation systems during 2014/2015and 2015/2016 seasons.**

| Nitrogen levels (kg N/fed) | Leaf area index (LAI) | | Root weight (kg) | | Sucrose% | | Purity% | | Impurities % | | Extractable sugar% | | Root number/fed x $10^3$ | | Root yield (ton/fed) | | White sugar yield (ton/fed) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler | Drip | Sprinkler |
| 2014/2015 | | | | | | | | | | | | | | | | | | |
| 60 | 1.23 | 1.89 | 0.91 | 0.83 | 20.57 | 20.95 | 86.51 | 88.46 | 2.77 | 2.37 | 17.79 | 18.58 | 20.67 | 20.84 | 18.63 | 17.29 | 3.34 | 3.22 |
| 90 | 1.99 | 2.26 | 1.00 | 0.91 | 19.99 | 20.48 | 85.07 | 87.53 | 2.98 | 2.54 | 17.01 | 17.86 | 21.08 | 21.50 | 21.07 | 19.57 | 3.59 | 3.50 |
| 120 | 2.61 | 2.39 | 1.06 | 1.00 | 19.18 | 19.50 | 82.17 | 86.22 | 3.41 | 2.68 | 15.77 | 16.83 | 22.14 | 22.23 | 23.34 | 22.23 | 3.69 | 3.74 |
| LSD at 5% | 0.58 | N.S | 0.02 | 0.03 | 0.36 | 0.32 | 0.71 | 0.61 | 0.12 | 0.05 | 0.39 | 0.37 | 0.26 | 0.20 | 0.30 | 0.48 | 0.10 | 0.12 |
| 2015/2016 | | | | | | | | | | | | | | | | | | |
| 60 | 1.89 | 2.55 | 0.98 | 0.88 | 20.02 | 19.94 | 81.00 | 82.72 | 3.79 | 3.39 | 16.23 | 16.54 | 21.15 | 20.79 | 20.58 | 18.31 | 3.34 | 3.03 |
| 90 | 2.65 | 2.92 | 1.09 | 0.96 | 19.36 | 19.29 | 79.27 | 81.29 | 4.00 | 3.55 | 15.40 | 15.73 | 21.09 | 20.83 | 23.77 | 19.93 | 3.66 | 3.13 |
| 120 | 3.27 | 3.05 | 1.15 | 1.02 | 18.52 | 18.57 | 75.95 | 79.99 | 4.43 | 3.70 | 14.09 | 14.88 | 21.72 | 21.24 | 25.00 | 21.80 | 3.52 | 3.24 |
| LSD at 5% | 0.58 | N.S | 0.19 | 0.03 | 0.23 | 0.44 | 0.75 | 0.81 | 0.12 | 0.08 | 0.29 | 0.08 | 0.28 | 0.22 | 0.25 | 0.47 | 0.07 | N.S |
| Combined analysis of the two growing seasons | | | | | | | | | | | | | | | | | | |
| 60 | | | | | 20.30 | 20.45 | | | | | 17.01 | 17.56 | | | 19.61 | 17.80 | 3.34 | 3.13 |
| 90 | | | | | 19.68 | 19.89 | | | | | 16.21 | 16.80 | | | 22.42 | 19.75 | 3.63 | 3.32 |
| 120 | | | | | 18.85 | 19.04 | | | | | 14.93 | 15.86 | | | 24.17 | 22.02 | 3.61 | 3.49 |

**NS = Non significant**

Number of roots at harvest was significantly affected by N rates in both seasons. Increasing N level up to 120 kg N/fed increased number of roots at harvest by (1.47 and 0.57 thousand root/fed under drip) and (1.39 and 0.45 thousand root/fed under sprinkler) as compared to application of 60 kg N/fed in the first and second seasons, respectively. This result is in agreement with that obtained by Mahmoud and Masri (2009).

Significant differences among N levels in root yield were recorded under the two irrigation systems in both seasons (Table 9) Increasing N rates from 60 to 90 kg/fed and from 90 to 120 kg/fed increased root yield under drip irrigation system by about 10.77 and 13.10% in the 1st season, corresponding to 5.17 and 15.50% in the 2nd season.

Root quality traits, in terms of sucrose%, purity% and extractable sucrose% as well as impurities% were significantly affected by varying N levels in both seasons under two irrigation systems (Table 9). Decreasing N levels from 120 to 60 kg N/fed with the drip irrigated plants significantly increased sucrose% by 6.75 and 7.49%, purity by 5.02 and 6.24% and extractable sugar% by 11.35 and 13.18% in the first and second seasons, respectively; while for sprinkler irrigated plants these increases amounted to 6.92 and 6.87% for sucrose%, 2.53 and 3.30% for purity% and 9.42 and 10.04% for extractable sugar% in the first and second seasons, respectively. On the contrary, impurities% decreased by about 18.78 and 14.45% under drip and by 11.57 and 8.38% under sprinkler in the first and second seasons, respectively. Also, data averaged across seasons revealed that application of 60 kg N/fed gave the highest values of sucrose percentage and extractable sucrose percentage under both irrigation systems (Table 9). The depressive effect of N on beet quality coincides with those reported by Mahmoud and Masri (2009) and Mahmoud *et al.* (2012).

Number of roots at harvest was significantly affected by N rates in both season. Increasing N level up to 120kg N /fed increased no of roots at harvest by (1.47 and 0.57 thousand root / fed under drip) and (1.39 and 0.45 thousand root / fed under sprinkler) as compared to application of 60 kg N/ fed in the first and second season, respectively, also, under sprinkler irrigation system by about 13.59 and 13.19% in the first season, corresponding to 9.38 and 8.84% in the second season, respectively. The increase in root yield accompanying high N level might have been due to the increase in number of harvested roots as well as individual root weight as mentioned before. Also, data averaged across seasons revealed that application of 120 kg N/fed gave the highest values of root yield/fed under both irrigation systems (Table 9). Such results are in accordance with these reported by Mahmoud and Masri (2009), Mahmoud *et al.* (2012), El-Sarag (2009) and Mahmoud *et al.* (2014).

Results in Table 9 cleared that white sugar yield was significantly increased by increasing N levels from 60 to 120 kg/fed. These results were true in the two growing seasons under both irrigation systems except for the second season under sprinkler irrigation system. Such increase amounted to 10.48% in the first season and 5.39% in the second one under drip irrigation system and 16.15% in the first season under sprinkler irrigation system. However, fertilized beet plants with 120 kg N/fed had less effect on sugar yield than 90 kg N/fed in the 2nd season under drip irrigation system because of the depressive effect of high N rates on extractable sugar%. It is worth to mention that the reduction in quality traits (sucrose, purity and extractable sucrose percentages) accompanying higher N levels was compensated by higher root yield. Also, data averaged across seasons revealed that application of 120 kg N/fed gave the highest values of white sugar yield/fed under both irrigation systems (Table 9). Similar results were reported by Mahmoud and Masri (2009) and Mahmoud *et al*., (2012).

**D- Interaction effects**

**1-Effect of interaction between water stress and compost levels**

Data of traits that affected significantly by the interaction between water regimes and compost levels are listed in Table (10) for irrigation systems during the two growing seasons. Root fresh weight was significantly affected by the interaction between water regimes and compost application under drip irrigation system in first season. The heaviest root (1.14 kg) resulted from 100% water regime and 0 ton/fed compost.

Interaction between water stresses and compost under sprinkler irrigation system was significant for sucrose and extractable sugar percentages in the first season, while it was significant for purity% in the second season and impurities in both seasons. The highest sucrose content (21.04%) resulted from 60% water regimes without compost (Table 10). The highest percentage of purity% (85.92%) resulted from 80% water regime without compost. On the other hand, the highest impurities (3.10 and 4.36 %) was obtained from 100% water regime without compost in the first and second seasons, respectively. while, the highest extractable sugar percentage (18.11%) resulted from 100% water regime +6 ton/fed compost

Water regimes x compost interaction exhibited significant effect on number of roots/fed at harvest during the two seasons under drip irrigation system and in the second season for sprinkler irrigation system.

**Table 10. Effect of the interaction between water stress and compost levels on significant sugar beet yield and some of its attributes under drip and sprinkler irrigation systems during 2014/2015 and 2015/2016 seasons.**

| Water stress | compost levels | Root weight (kg) | Sucrose% | Purity% | Impurities% | | Extractable sugar% | Root number/fed x $10^3$ | | | Root yield (ton/fed) | | White sugar yield (ton/fed) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Drip | Sprinkler | Sprinkler | Sprinkler | | Sprinkler | Drip | | Sprinkler | Drip | | Sprinkler |
| | | 2014/15 | 2014/15 | 2015/16 | 2014/15 | 2015/16 | 2014/15 | 2014/15 | 2015/16 | 2015/16 | 2014/15 | 2015/16 | 2014/16 |
| 60% | 0 | 0.81 | 21.04 | 80.18 | 2.18 | 3.04 | 17.94 | 21.25 | 21.64 | 20.42 | 17.23 | 19.99 | 2.84 |
| | 6 | 0.82 | 20.31 | 77.37 | 3.13 | 3.44 | 17.18 | 21.21 | 21.29 | 20.83 | 17.54 | 20.16 | 2.93 |
| 80% | 0 | 1.02 | 19.87 | 85.92 | 2.25 | 2.62 | 17.62 | 21.17 | 21.18 | 21.43 | 21.54 | 22.93 | 3.55 |
| | 6 | 1.03 | 20.24 | 79.17 | 2.24 | 3.91 | 17.83 | 21.69 | 21.25 | 20.43 | 22.37 | 25.24 | 3.65 |
| 100% | 0 | 1.14 | 20.03 | 84.18 | 3.10 | 4.36 | 17.86 | 20.26 | 20.90 | 21.38 | 22.99 | 24.26 | 3.84 |
| | 6 | 1.10 | 20.36 | 81.18 | 2.55 | 3.91 | 18.11 | 22.18 | 21.65 | 21.23 | 24.41 | 26.12 | 4.10 |
| LSD at 5% | | 0.02 | 0.43 | 0.91 | 0.30 | 0.12 | 0.41 | 0.39 | 0.30 | 0.25 | 0.25 | 0.35 | 0.06 |

Applying 100% of IWR with 6 ton/fed compost produced the highest number of roots at harvest being 22.18 and 21.65 thousand roots under drip irrigation system in the first and second seasons, respectively. While, under sprinkler irrigation system it was 21.43 thousand roots/fed with 80% of IWR without compost in the second season. The highest and significant root yield (24.41 and 26.12 ton/fed) resulted from applying 100% of IWR and 6 ton/fed compost under drip irrigation in the 1st and in the 2nd seasons, respectively. The same trend was for white sugar yield (4.10 ton/fed) under sprinkler irrigation system in the first season.

**2-Effect of interaction between water stress and nitrogen levels**

Data of traits that affected significantly by the interaction between water regimes and nitrogen rates are listed in Table (11) for irrigation systems during the two growing seasons.

Applying 100% of IWR and 120 kg N/fed to sprinkler irrigated plants gave the highest and significant value of root weight (1.05 kg) in the first season. Results also revealed that application of 60% of IWR and 90 kg N/fed produced the highest purity % being 90.33 and 84.59% under sprinkler irrigation system in the first and second seasons, respectively. On the other hand, impurities % was significantly high with application of 100% of IWR with 120 kg N/fed under drip (4.72%) or 90 kg N/fed under sprinkler (4.23%) in the second season only as compared to other interactions.

Applying 100% of IWR and 120 kg N/fed to sprinkler irrigated plants gave the highest significant value of roots number in the two growing seasons as well as under drip in the second season.

**Table 11. Effect of the interaction between water stress and nitrogen levels on significant sugar beet yield and some of its attributes under drip and sprinkler irrigation systems during 2014/2015 and 2015/2016seasons.**

| Water stress | Nitrogen levels | Root weight (kg) | Purity% | | Impurities% | | Root number/fed x $10^3$ | | | Root yield (ton/fed) | | White sugar yield (ton/fed) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sprinkler | Sprinkler | | Drip | Sprinkler | Drip | Sprinkler | | Drip | Sprinkler | Drip | Sprinkler |
| | | 2014/15 | 2014/15 | 2015/16 | 2015/16 | 2015/16 | 2015/16 | 2014/15 | 2015/16 | 2014/15 | 2014/15 | 2015/16 | 2014/15 |
| | 60 | 0.65 | 85.25 | 79.57 | 3.46 | 3.07 | 21.69 | 21.05 | 20.66 | 15.68 | 13.70 | 3.02 | 2.48 |
| 60% | 90 | 0.76 | 90.33 | 84.59 | 3.82 | 3.12 | 21.31 | 21.05 | 20.51 | 19.53 | 18.25 | 3.02 | 3.43 |
| | 120 | 0.93 | 89.81 | 84.01 | 4.38 | 3.43 | 21.39 | 21.54 | 20.71 | 20.68 | 19.92 | 3.15 | 3.76 |
| | 60 | 0.89 | 84.40 | 77.88 | 3.62 | 2.97 | 21.19 | 20.51 | 20.98 | 17.55 | 15.87 | 3.68 | 2.77 |
| 80% | 90 | 0.98 | 89.01 | 83.01 | 3.83 | 3.21 | 20.92 | 21.32 | 20.60 | 21.93 | 20.71 | 4.27 | 3.70 |
| | 120 | 1.03 | 89.19 | 82.98 | 4.19 | 3.61 | 21.54 | 21.66 | 21.21 | 23.73 | 22.13 | 3.75 | 4.03 |
| | 60 | 0.95 | 84.92 | 78.88 | 4.29 | 4.13 | 20.57 | 20.96 | 20.72 | 18.92 | 19.98 | 3.32 | 3.41 |
| 100% | 90 | 1.00 | 86.34 | 80.04 | 4.35 | 4.23 | 21.04 | 22.15 | 21.39 | 24.41 | 22.22 | 3.69 | 3.68 |
| | 120 | 1.05 | 87.40 | 81.05 | 4.72 | 4.05 | 22.23 | 23.49 | 21.81 | 26.70 | 24.48 | 3.63 | 4.14 |
| LSD at 5% | | 0.04 | 1.05 | 1.40 | 0.14 | 0.14 | 0.49 | 0.35 | 0.38 | 0.51 | 0.82 | 0.12 | 0.20 |

Data during 2014/15 season revealed that application of 100% water regimes and 120 kg N/fed gave the highest values of root yield being 26.70 and 24.48 ton/fed under drip and sprinkler irrigation systems, respectively (Table 11). Also, application of the same rate of IWR and N rate gave the highest value of white sugar yield (4.14 ton/fed) with sprinkler irrigation system in 1st season, but application of 80% of IWR and 90 kg N/fed resulted in the highest value of white sugar yield (4.27 ton/fed) with drip irrigation system in 2nd season.

**3-Effect of interaction between compost and nitrogen levels**

Among the studied traits, only roots number/fed affected significantly by the interaction between compost and nitrogen levels under both irrigation systems in 2015/16 growing season (Table 12). The highest value of roots number (22.12 thousand/fed) was produced from application of 6 ton/fed compost and 120 kg N/fed under drip irrigation system and being (21.47 thousand/fed) from zero ton compost/fed and 120 kg N/fed under sprinkler irrigation system.

**Table 12. Effect of the interaction between compost and nitrogen levels on root number/fed under drip and sprinkler irrigation systems during 2015/2016 season.**

| Compost levels | Nitrogen levels | Root number/fed | |
|---|---|---|---|
| | | Drip | Sprinkler |
| | | 2015/2016 | 2015/2016 |
| | 60 | 21.52 | 21.64 |
| 0 | 90 | 20.89 | 21.13 |
| | 120 | 21.32 | 20.47 |
| | 60 | 20.78 | 20.93 |
| 6 | 90 | 21.29 | 20.54 |
| | 120 | 22.12 | 21.02 |
| LSD at 5% | | 0.40 | 0.31 |

**4-Effect of interaction among water regimes, compost and nitrogen levels**

Among the studied traits only roots number/fed was affected significantly by the interaction among water stress, compost and nitrogen levels under drip irrigation systems in the two growing seasons (Table 13). The highest values of roots number were produced from application of 6 ton/fed compost and 120 kg N/fed with 80% water stress in the first season (22.98 thousand/fed) and 100% water stress in the second season (22.63 thousand/fed).

**Table 13. Effect of the interaction among water stress, compost and nitrogen levels on root number/fed under drip irrigation systems during 2014/2015and 2015/2016 seasons.**

| Water stress | Compost levels | Nitrogen levels | Root number/fed Drip 2014/2015 | Root number/fed Drip 2015/2016 |
|---|---|---|---|---|
| 60% | 0 | 60 | 20.89 | 23.07 |
| | | 90 | 21.05 | 21.24 |
| | | 120 | 21.82 | 20.60 |
| | 6 | 60 | 20.56 | 20.31 |
| | | 90 | 21.18 | 21.38 |
| | | 120 | 21.89 | 22.18 |
| 80% | 0 | 60 | 20.53 | 21.20 |
| | | 90 | 20.89 | 20.82 |
| | | 120 | 22.09 | 21.53 |
| | 6 | 60 | 20.54 | 21.18 |
| | | 90 | 21.56 | 21.02 |
| | | 120 | 22.98 | 21.55 |
| 100% | 0 | 60 | 19.11 | 20.29 |
| | | 90 | 19.78 | 20.60 |
| | | 120 | 21.89 | 21.82 |
| | 6 | 60 | 22.36 | 20.85 |
| | | 90 | 22.00 | 21.47 |
| | | 120 | 22.18 | 22.63 |
| LSD at 5% | | | **0.63** | **0.70** |

**E-Effect of irrigation systems**

Data in Table(14 revealed that drip irrigation system in the first season was significantly more efficient than sprinkler irrigation system due to root weight (kg), root yield (ton/fed) and white sugar yield (ton/fed), while in the second season it was significantly more efficient than sprinkler system due to root weight (kg), sucrose%, root number/fed, root yield (ton/fed) and white sugar yield (ton/fed). These results are in agreement with those of Arroyo *et al.* (1999).

**Table 14. Effect of irrigation systems on sugar beet yield and some of its attributes during 2014/2015 and 2015/2016 seasons.**

| Measurements | 2014/2015 Drip | 2014/2015 Sprinkler | 2014/2015 Sig. | 2015/2016 Drip | 2015/2016 Sprinkler | 2015/2016 Sig. |
|---|---|---|---|---|---|---|
| Leaf area index | 1.94 | 2.18 | * | 2.60 | 2.84 | * |
| Root weight | 0.99 | 0.91 | * | 1.07 | 0.95 | * |
| Sucrose % | 19.91 | 20.28 | * | 19.31 | 19.26 | * |
| Juice purity % | 84.58 | 87.41 | * | 78.74 | 81.33 | * |
| Impurities % | 3.05 | 2.53 | * | 4.07 | 3.55 | * |
| Extractable sugar % | 16.86 | 17.75 | * | 15.24 | 15.72 | * |
| Root number/fed x $10^3$ | 21.29 | 21.52 | * | 21.32 | 20.95 | * |
| Root yield | 21.03 | 19.70 | * | 22.84 | 20.01 | * |
| White sugar yield | 3.54 | 3.49 | * | 3.52 | 3.15 | * |

*** indicate significance at 0.05 probability level.**

It could be concluded that that using of drip irrigation system with 1322 $m^3$ water/fed (60% of the calculated water requirements) + 6 ton/fed compost + 120 kg N/fed of ammonium nitrate (33.5%) for the best yield and quality with sugar beet crop at the same Wadi El-Natrun condition, Egypt.

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# أثر استخدام بعض نظم الري ومستويات التسميد المختلفة على النمو والمحصول والجودة تحت ظروف الإجهاد المائي لمحصول بنجر السكر *Beta vulgaris* L.


**عمرو محمد عبد السميع الدردير[1]، محسن عبد المنعم جامع[2]، محمود عاطف سيد[3] ومحمد زكريا كامل[4]**

**[1]شركة النوبارية للسكر- مصر.**

**[2]قسم الاراضى والمياه – كلية الزراعة –جامعة أسيوط- مصر.**

**[3] معهد الاراضى والمياه والبيئة – مركز البحوث الزراعية – مصر.**

**[4] المستشار الزراعي لشركة النوبارية للسكر.**



أجريت تجربتان حقليتان في منطقة وادي النطرون بمحافظة البحيرة، مصر خلال موسمي 2015/2014 و2016/2015 لدراسة تأثير ثلاث مستويات من الإجهاد المائي (60%، 80% و100% من الاحتياجات المائية المحسوبة)، واثنين من مستويات التسميد العضوي (صفر، 6 طن/الفدان من الكمبوست) وثلاث مستويات من التسميد الأزوتى (60، 90 و120 كجم ن/الفدان) على نمو وجودة ومحصول بنجر السكر تحت نظامين للري الحديث (التنقيط وبالرش). أظهرت النتائج أن نباتات بنجر السكر المروية بالتنقيط عند 80% من الاحتياجات المائية المحسوبة للمحصول أعطت اعلى دليل مساحة أوراق، نسبة سكروز، نسبة النقاوة ونسبة سكر مستخلص في الموسم الأول والثاني، واعلى محصول سكر ابيض في الموسم الثاني، بينما نباتات بنجر السكر المروية بالرش عند 100% من الاحتياجات المائية المحسوبة للمحصول أعطت اعلى وزن جذور، عدد جذور/الفدان، نسبة نقاوة، محصول جذور ومحصول سكر ابيض خلال الموسم الأول والثاني. أدت إضافة الكمبوست (6 طن/الفدان) مع الري بالرش إلى زيادة معنوية في وزن الجذور، عدد الجذور/الفدان، الشوائب ومحصول الجذور في الموسم الأول والثاني. كما أدت إضافة الكمبوست (6 طن/الفدان) مع الري بالتنقيط إلى زيادة معنوية في محصول الجذور في الموسم الأول والثاني، كما نتجت اعلى نسبة سكروز ونسبة سكر مستخلص ومحصول سكر ابيض مقارنه بعدم إضافة الكمبوست. كما أدت زيادة مستويات التسميد الأزوتى حتى 120 كجم ن/الفدان إلى زيادة في دليل مساحة الأوراق، وزن جذر النبات، عدد الجذور/الفدان، نسبة الشوائب بالإضافة إلى محصول الجذور خلال الموسمين ومحصول السكر الأبيض خلال الموسم الأول فقط، بينما أعطت إضافة 90 كجم ن/الفدان اعلى محصول سكر ابيض في الموسم الثاني. أدت الزيادة في استخدام التسميد الأزوتى إلى انخفاض جودة بنجر السكر من حيث نسبة السكروز والنقاوة ونسبة السكر المستخلص خلال الموسمين. بينما تحققت اقل كميه في الإنتاج والجودة تحت نظام الري بالرش مع استخدام 60% إجهاد مائي مع إضافة 6 طن كمبوست/الفدان و90 كجم ن/الفدان خلال موسم 2016/2015. كما أعطى نظام الري بالتنقيط مع إضافة 1322 م$^3$/الفدان (60% من الاحتياجات المائية المحسوبة) + 6 طن كمبوست/الفدان + 120 كجم ن/الفدان من نترات النشادر (33,5%) اعلي كميه في الإنتاج والجودة. خلال موسم 2016/2015. ولهذا تؤكد النتائج على انه لتحقيق اعلى كفاءة استخدام ماء لمحصولي الجذور والسكر الأبيض (كجم/م$^3$)، يفضل باستخدام نظام الري بالتنقيط مع إضافة 1322 م$^3$/الفدان (60% من الاحتياجات المائية المحسوبة) + 6 طن كمبوست/الفدان + 120 كجم ن/الفدان من نترات النشادر (33,5%). توصي هذه الدراسة بانه لتحقيق اعلى إنتاجه لمحصول بنجر السكر(كجم/م$^3$)، وكذلك الجودة يفضل باستخدام نظام الري بالتنقيط مع إضافة 1322 م$^3$/الفدان (60% من الاحتياجات المائية المحسوبة) + 6 طن كمبوست/الفدان + 120 كجم ن/الفدان من نترات النشادر (33,5%) تحت ظروف منطقه وادي النطرون بمحافظه البحيرة مصر.


**الكلمات الدالة:** بنجر السكر، الري بالتنقيط، الري بالرش، الإجهاد المائي، الكمبوست، التسميد الأزوتى