Life Science Journal

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# Study Planting Methods to Improve Water Use Efficiency and Productivity of Sugar Beet in a Newly Reclaimed Area

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**Abstract:** The present research was implemented at Wadi El-Natrun Research Station in the western desert of Egypt to investigate the effect of different planting methods of sugar beet (traditional and transplanting) on water requirement, water saving, growth analysis, net return, quality and yield of mono and multi-germ sugar beet varieties grown under sandy soil conditions. Results revealed that planting sugar beet using transplanting method resulted in the highest water use efficiency, root and sugar yield, and net return, compared with that sown traditionally using dry seeds, in both growing seasons. Multigerm varieties recorded the highest significant leaf area index, crop growth rate, sucrose and extractable sugar percentages in both seasons. Irrigation water requirements decreased by (27.6, 26.5), (22.2, 21.6) and (10.4, 9.9) % by increasing transplanting period to 30 days from planting compared to 0 (direct sowing), 10 and 20 days transplanting period in the first and second season, respectively. The highest root water use efficiency values were obtained when sugar beet transplanting 30 days and with mono-germ variety (11.84 and 13.26) kg/m$^3$, respectively). However, the lowest values of them (7.29 and 8.47 kg/m$^3$, respectively) were obtained when using the traditional method with multi-germ variety in the first and second season, respectively. Transplanting 30 days saved water by about 26.8 and 26% compared with traditional method in the first and second season.
[Moursy, M.A.M. and M.S. El-Kad. **Study Planting Methods to Improve Water Use Efficiency and Productivity of Sugar Beet in a Newly Reclaimed Area.** *Life Sci J* 2019;16(12):11-19]. ISSN: 1097-8135 (Print) / ISSN: 2372-613X (Online). http://www.lifesciencesite.com. 2. doi:10.7537/marslsj161219.02.

**Keywords:** Economic analysis, sugar beet, transplanting, water saving, yield.

## 1. Introduction

Sugar (the common name for sucrose) is obtained from only two crops, cane, and beet. Sugar cane has been produced in large areas in tropical regions for many centuries and continues to dominate the world supply of sugar. In contrast, sugar beet is a relatively new crop, appearing in temperate regions in the nineteenth century and spreading widely only in the twentieth century. Sugar beet (*Beta vulgaris* L.) is the main crop of sugar production in Europe and grown under different environmental conditions; Successful management and crop production are often a challenge for farmers **(Jaggard *et al.*, 2007 and Hergert, 2010).** The sugar industry depends on sugar cane and sugar beet crops to produce sugar, where the latter contributes more than 33% of world production of sugar, and 57.7 % locally in Egypt with a total production of 1.32 million tons of sugar (**Sugar Crops Council Report-December, 2018**). In addition, sugar beet consumes less irrigation water. Whereas, to produce one kilogram of sugar from sugar beet about 1.4 m$^3$ water is required were producing the same amount of sugar from sugar cane requires about 4.0 m$^3$ of water (**Sohier and Ouda, 2001**).

For farmers, sugar beet is an important crop as it is a dependable cash crop. It improves the texture of salt soils while enhancing soil fertility and provides by-products as feed for the animal when green fodder is not readily available.

The maximum yield that can be achieved from the production of sugar beet in Egypt depends on many factors, including the period of the growing season. Sugar beet seeds are grown directly in the field in a normal condition which calls for the long growing season.

Transplanting of seedling has been widely used to reduce the seedling emergence period, increasing emergence and improve emergence rate (**Basra *et al.*, 2005**). Transplanting is a practice commonly used with many seeded plants, particularly those which are slow or difficult to germinate or require special germination conditions. Many advantages of transplanting could be extracted. Such as increasing plant stand per unit area and an increasing number of the harvestable plants. Also, transplanting is an easy, low-cost and low-risk technique used to overcome agricultural problems (**Iqbal and Ashraf, 2005**). Transplanting sugar beet is a method to increase the effective growing season of the crop and increased sucrose percentage and sucrose yield by 320 kg/ha compared with direct-seeded sugar beet **(Dean Yonts *et al.*, 2013)**. **Kazemin Khah (2006)** compared between different period of transplanting (30, 45, 60 days after sowing sugar beet seed into the paper pots in the greenhouse) and an direct sowing of sugar beet and found that the highest root yield, sugar yield and sugar yield (32.8, 5.4 and 4.2 ton/ha, respectively) were gained with transplanting of sugar-beet after 45 days. **Yousef (2009)** studied the effect of transplanting dates; namely 15, 25 and 35 days from sowing nursery compared with direct seeding (control) on productivity of five sugar beet varieties, namely Top, Kawemira, Gloria, Pleno and Farida and showed that both direct seeding and transplant 25 days age produced the highest root yield without significant difference between them. Farida cv. variety recorded the highest roots and sugar yields/fed. **Ibrahim *et al.*, (2016)** indicated transplanting by paper pots recorded the highest T.S.S %, sucrose % and purity% in both seasons and the highest potassium in the first season. Also, transplanting by paper pots maximized root and sugar yields per feddan. **Ibrahim *et al.*, (2017)** compared between transplanting (45 days) or direct seeding under saline soil conditions and found that transplanting sugar beet plant revealed an increment in root length, diameter top length, fresh and dry weights of top and root as compared to seed sowing plants.

**Nassar and Abou EL Azem, (2008)** recommended that using the drip irrigation system increased the water use efficiencies, potato tuber yield, and enhancing the tuber qualities.

**Problem statement**

Losses of irrigation water in the germination stage, decrease in germination ratio, need for many labors to thinning plant and growth and competition of weeds for plants, which led to solving these problems. One of these approaches is seedlings transplanting. Where it works to save the amount of irrigation water added at the germination stage, reduce competition between plants and grassroots, reducing the labor that used to thinning and weed control plants and increase germination ratio. Avoid the impact of water salinity in germination ratio.

**The objective** of the present study is to investigate the effect of transplanting vs direct seed sowing under different varieties on some growth, physiological responses and ultimately yield production of sugar beet in sandy soil.

## 2. Materials and Methods

**Experimental location:**

This study was carried out in sandy soil at Wadi El-Natrun Research Station, Water Management Research Institute, NWRC, in the western desert, Egypt (latitude of 30°23' 19.89″ N and longitude of 30°21'41.06″ E) in 2017/2018 and 2018/2019. Mono and Multi-germ varieties were obtained from Sugar Crops Research Institute, Agricultural Research Center (ARC). Water and soil samples were collected for laboratory analyses at Central Laboratory for Environmental Quality Monitoring (CLEQM). Samples from soil and irrigation water were taken and analyzed (Table 1and2).

**Table 1. Soil physical and chemical properties of soil samples.**

| Soil layer (cm) | Particle size distribution % Sand | Silt | Clay | Texture class | Moisture content (%) F. C | W.P | A. W |
|---|---|---|---|---|---|---|---|
| **0 –20** | 94.5 | 3.5 | 2.0 | | 13.2 | 5.5 | 7.7 |
| **20-40** | 95.0 | 3.3 | 1.7 | Sandy | 14.2 | 5.2 | 9.0 |
| **40-60** | 95.7 | 3.0 | 1.3 | | 14.5 | 4.9 | 9.6 |

| Soil layer Cm | SAR | $P^H$ | EC (dS/m) | Soluble anions (meq/l) $CO_3^{--}$ | $HCO_3^-$ | $Cl^-$ | $SO_4^{--}$ | Soluble cations (meq/l) $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **0 –20** | 1.66 | 8.23 | 1.46 | 0.1 | 0.93 | 1.98 | 9.61 | 6.23 | 2.24 | 3.44 | 0.51 |
| **20-40** | 1.74 | 8.11 | 1.56 | 0.1 | 1.15 | 2.05 | 9.85 | 6.45 | 2.26 | 3.76 | 0.58 |
| **40-60** | 1.84 | 7.97 | 1.63 | 0.1 | 1.33 | 2.11 | 10.16 | 6.65 | 2.29 | 3.91 | 0.65 |

**Source:** Central Laboratory for Environmental Quality Monitoring.

**Table 2. Chemical analysis of irrigation water.**

| $P^H$ | EC (ds/m) | Soluble anions (meq/l) $CO_3^{--}$ | $HCO_3^-$ | $Cl^-$ | $SO_4^{--}$ | Soluble cations (meq/l) $Ca^{++}$ | $Mg^{++}$ | $Na^+$ | $K^+$ | SAR |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.14 | 1.81 | 0.1 | 4.7 | 10.6 | 8.15 | 1.8 | 2.8 | 18.4 | 0.55 | 12.1 |

**Source:** Central Laboratory for Environmental Quality Monitoring.

**Experimental design and treatments**

Drip irrigation system was used in the experimental, consist of pump, control unit, main line, sub main line and laterals. The dripper types were GR with 4 lit/h discharge and 25 cm between dipper to another (Fig. 1).

The randomized complete block design was used, in a split-plot arrangement, with three replications, where the transplanting period treatments were distributed in the main plots, while varieties were allocated in the sub-plots.

- Two cultivation methods were used:

1. Direct sowing using seeds (traditional): Seeds were sown on the 1st of October in both seasons.
2. Transplanting period (10, 20 and 30 days from planting): seeds were sown in the nursery using foam trays in the same date of direct sowing using seeds (1st of October) and the transplants are transported to the field after 10, 20 and 30 days from planting date (Fig. 2).

- Two varieties were planted, namely: the mono-germ *4 K 521* and multi-germ *Faten*.

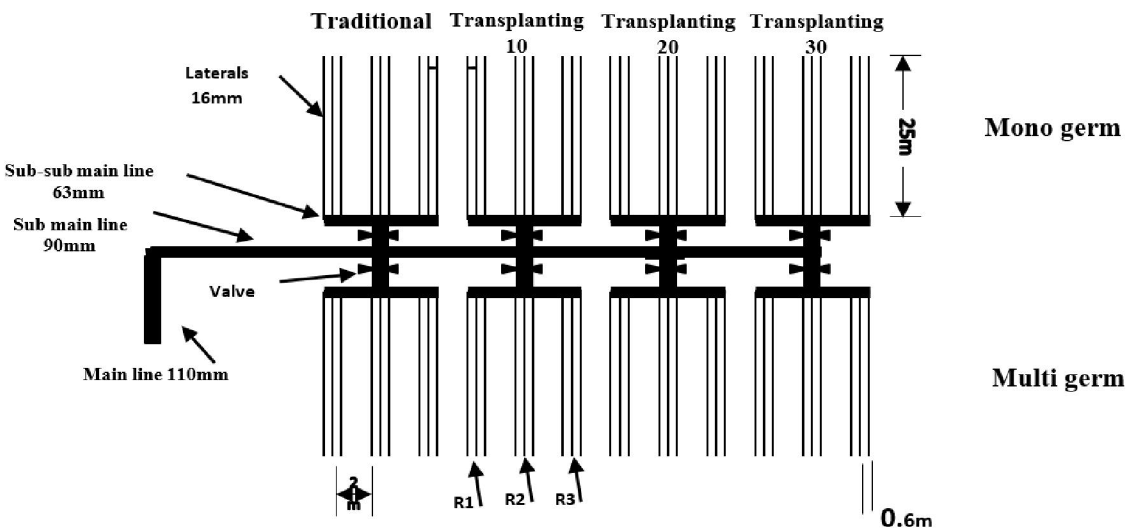



**Fig. (1): lay out of the experimental.**

All agronomic practices for growing sugar beet crop including soil preparation, chemical fertilization, irrigation, pest management, and manual cultivation were carried out as recommended. Harvest was done at the age of 200 days in the middle of April in the first and second seasons.

**Fig. 2. Sugar beet (Planting the nursery of on foam trays (left images) and transplanting of in the field (right image)).**


**Fig. 3. Methods of measured (growth analysis and weight ).**

**Measurements:**

**Crop irrigation water requirement**

The amount of irrigation water requirements under each treatment was calculated using the equation as sited from **Moursy (2013)**:

$$IR = \frac{[(\Theta_{FC} - \Theta_{V}) \times d] + Lf}{E_s}, mm$$

Where, IR= irrigation water requirements, mm/intervals; $E_s$ = system efficiency (%); $\theta_{FC}$= soil moisture content at field capacity (%); $\theta_v$ = soil moisture content (%) before irrigation and d= depth of soil layer (mm).

Lf =leaching factor under drip irrigation systems was calculated according to using the following equation:

$$LR = \frac{ECw}{2 \max \ Ece}$$

Where:

*ECw*= salinity of the applied irrigation water, dS/m.

*ECe*= average soil salinity tolerated by the crop as measured on a soil saturation extract, dS/m.

**Crop characteristics:**

**Growth analyses** were determined after 90, 105 and 120 days from planting (Fig. 3) according to **Watson (1947) and Chen and Black (1992)** as follow:

- **Leaf area index (LAI)** was calculated according to the following equation:

$$_{1\text{-}2}\overline{LAI} = \frac{_2LA - _1LA}{P}$$

Where, $_2LA$ = total leaf area in the second age ($cm^2$), $_1LA$ = total leaf area in the first age ($cm^2$) and P = land area ($cm^2$).

**Crop Growth Rate (CGR) (mg/cm$^2$/day)** was calculated according to the following equation:

$$_{1\text{-}2}\overline{CGR} = \frac{1}{P} \times \frac{_2W - _1W}{_2T - _1T}$$

Where, $_2W$= total dry weight of plant in the second age (mg), $_1W$= total dry weight of plant in the first age (mg), $_2T$ = the second age at which the dry weight (day) was determined and $_1T$ = the first age at which the dry weight (day) was determined.

At harvest, ten plants were taken at random from each plot to assess technological characteristics and notice the technological differences between roots under the transplanting method compared to direct sowing by seeds. Sucrose percentage was determined in the fresh minced roots using "saccharometer" according to the method of **Carruthers and Oldfield (1960)**.

Extractable Sugar percentage (ES%) was determined according to the following equation:

ES% = pol-[0.343(K + Na) + 0.094 α-amino N + 0.29] according to **Renfield *et al.* (1974)**, where Pol = sucrose percentage.

**Root yield (ton/ha):**

Sugar beet plants in two ridges of each experimental unit (subplot) were harvested, separated into roots and tops and weighted in kg/plot, which was converted into (ton/ha) to estimate root and top yields. Also, the abnormal roots counted which not exceed 10% of the total yield under the transplanting method.

**Sugar yield/ha (ton)** = root yield/ha (ton) × extractable white sugar %.

**Water use efficiency (WUE)**:

Water use efficiency values as kg $m^{-3}$ of irrigation water applied were calculated for each treatment after harvest using the following equation according to **(Jensen, 1983)**.

$$WUE_{\text{root yield}} = \frac{\text{root yield (kg/ha)}}{\text{Applied irrigation water } (m^3/ha)}, kg/m^3$$

$$WUE_{\text{sugar yield}} = \frac{\text{sugar yield (kg/ha)}}{\text{Applied irrigation water } (m^3/ha)}, kg/m^3$$

**Statistical analysis**

Statistical analysis was carried out using a split-plot procedure of the M Stat-c statistical package. LSD comparison was used to identify means that were different at probabilities of 5 % or less **(Snedecor and Cochran, 1980)**.

**Economic analysis**

Sugar beet crop prices of inputs and output were calculated for the studied treatments. The inputs including costs of the irrigation network, irrigation, labors, foam trays, seeds, fertilizers, and pesticides. The output is the price (LE) paid for the harvested root yield/ha.

## 3. Results And Discussion

**Crop irrigation water requirement**

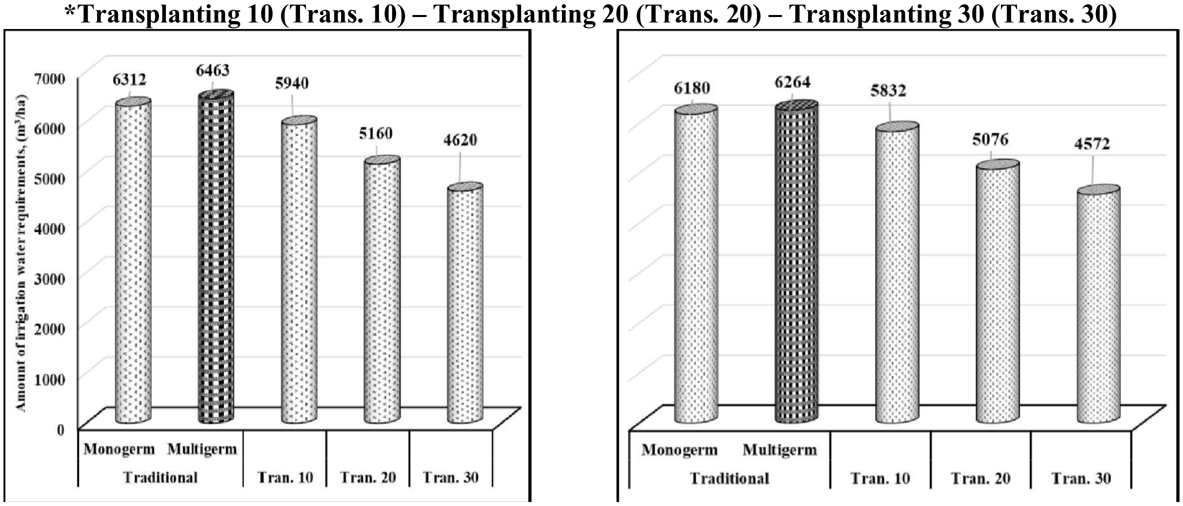
To evaluate the effectiveness of different treatments on crop water requirement for sugar beet grown in sandy soil during the first and second season, the amount of irrigation water requirements under each treatment was shown in Fig. 4.

Data in Fig.2. showed that irrigation water requirements decreased by (27.6, 26.5), (22.2, 21.6) and (10.4, 9.9)% by increasing transplanting period to 30 days from planting compared to 0 (direct sowing), 10 and 20 days transplanting period in the first and second season, respectively.

Moreover, results showed that the highest value of irrigation water requirements was (6463 and 6264 $m^3$/ha) gained under traditional method and Multi-germ variety, while the lowest values were (4620 and 4572 $m^3$/ha) gained under 30 days transplanting period at first and second seasons, respectively.

Transplanting methods saved water compared with traditional planting method. Transplanting 30 days saved water by about 26.8 and 26% compared with traditional method in the first and second season.

***Transplanting 10 (Trans. 10) – Transplanting 20 (Trans. 20) – Transplanting 30 (Trans. 30)**




**First Season** **Second Season**

**Fig. 4. Amount of irrigation ($m^3$/ha) water requirements under different treatments.**

**Crop characteristics**

**Leaf area index and Crop growth rate ($mg/cm^2$/day)**

Results in Fig. 5 cleared that Leaf Area Index (LAI) and Crop Growth Rate (CGR) of both varieties during the periods between 90 and 105 days from planting and between 105 and 120 days from planting affected by increasing transplanting periods from 0,10, 20 to 30 days from planting under the average of the two successive seasons.

The highest line of LAI values was measured after 30 days of transplanting for the two varieties, while the timeline of CGR values under 30 days transplanting slightly differed compared to the timeline of CGR values under 20 days transplanting, this results occurred under the two (multi and monogram) varieties. The increments of LAI and CGR due to that transplanting of seedling have been widely used to reduce the seedling emergence period, increasing emergence and improve emergence rate which made healthy plants (Basra *et al.*, 2005). These results are in accordance with those obtained **Waston (1952) and Goodman (1968)**, who's reported that the size and longevity of sugar beet leaf canopies strongly influenced by soil moisture and soil fertility especially in the first stage of growing plants which are better in the foam trays.

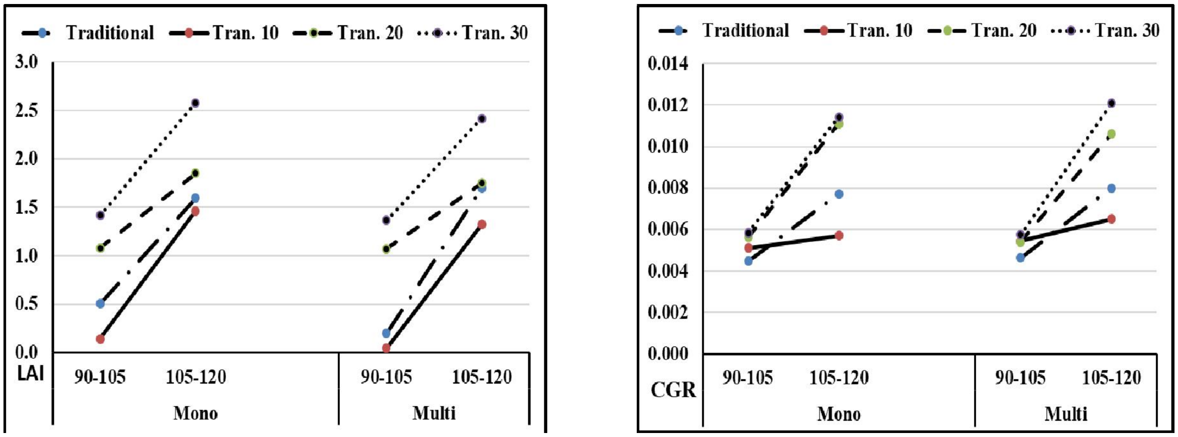



**Fig. 5. Average of LAI and CGR during the period of 90-105 to 105-120 days from planting under different treatments.**

**Sucrose and extractable white sugar percentage**

Despite the appearance of the non-regular shape of the sugar beet roots under transplanting technique, but the characters were slightly decreased as transplanting period raised from 0 to 30 days from planting, whereas this decrease was non-significant for both characters under the two seasons, showed table 3.

A significant difference between the tested varieties in sucrose and extractable white sugar % was observed, the highest values noticed under multigerm variety (20.265 and 22.265 for sucrose %) and (17.948 and 19.658 for ES %) in first and second seasons, respectively. These results are in agreement with that reported by **Yousef (2009) and Ibrahim *et al.*, (2016)**.

**Table 3. Sucrose and Extractable white sugar percentage under different treatments.**

| | First season | | Second season | |
|---|---|---|---|---|
| **Treatments** | **Sucrose (%)** | **Extractable white sugar (%)** | **Sucrose (%)** | **Extractable white sugar (%)** |
| **Traditional (A)** | 20.74 | 18.39 | 22.74 | 20.10 |
| **Tran. 10 (B)** | 20.19 | 18.22 | 22.19 | 19.93 |
| **Tran. 20 (C)** | 19.86 | 17.57 | 21.86 | 19.28 |
| **Tran. 30 (D)** | 18.93 | 16.33 | 20.93 | 18.21 |
| **LSD** | N.S | N.S | N.S | N.S |
| **Monogerm (1)** | 19.60 | 17.31 | 21.60 | 19.10 |
| **Multigerm (2)** | 20.26 | 17.95 | 22.26 | 19.66 |
| **LSD** | 0.25 | 0.36 | 0.26 | 0.31 |
| **A1** | 20.23 | 17.91 | 22.23 | 19.62 |
| **A2** | 21.25 | 18.87 | 23.25 | 20.58 |
| **B1** | 19.91 | 17.98 | 21.91 | 19.69 |
| **B2** | 20.47 | 18.45 | 22.47 | 20.16 |
| **C1** | 19.69 | 17.47 | 21.69 | 19.18 |
| **C2** | 20.03 | 17.68 | 22.03 | 19.39 |
| **D1** | 18.56 | 15.86 | 20.56 | 17.91 |
| **D2** | 19.31 | 16.80 | 21.31 | 18.51 |
| **LSD** | N.S* | N.S | N.S | N.S |

***N.S = non-significant at 5%**

**Root and sugar yield (ton/ha)**

A significant increase in the root yield (ton/ha) amounted to 6.1 ton/ha accompanying the increase of transplanting period from 0 to 30 days from planting was gained, in both seasons. On the other hand, the highest sugar yield was obtained by transplanting after 20 days from planting but this increase was non-significant showed table 4.

**Table 4. Root and Sugar yield (ton/ha) under different treatments.**

| | First season | | Second season | |
|---|---|---|---|---|
| **Treatments** | **Root Yield (ton/ha)** | **Sugar yield (ton/ha)** | **Root Yield (ton/ha)** | **Sugar yield (ton/ha)** |
| **Traditional (A)** | 48.25 | 8.87 | 53.73 | 10.80 |
| **Tran. 10 (B)** | 47.82 | 8.71 | 53.29 | 10.62 |
| **Tran. 20 (C)** | 53.21 | 9.35 | 58.69 | 11.31 |
| **Tran. 30 (D)** | 54.36 | 8.97 | 59.84 | 10.89 |
| **LSD** | **1.27** | **N.S** | **1.27** | **N.S** |
| **Monogerm (1)** | 51.21 | 8.88 | 56.69 | 10.81 |
| **Multigerm (2)** | 50.61 | 9.06 | 56.09 | 11.00 |
| **LSD** | **N.S** | **N.S** | **N.S** | **N.S** |
| **A1** | 49.36 | 8.84 | 54.84 | 10.76 |
| **A2** | 47.14 | 8.90 | 52.62 | 10.83 |
| **B1** | 48.02 | 8.63 | 53.49 | 10.53 |
| **B2** | 47.62 | 8.79 | 53.10 | 10.70 |
| **C1** | 52.78 | 9.21 | 58.26 | 11.17 |
| **C2** | 53.65 | 9.49 | 59.13 | 11.46 |
| **D1** | 54.68 | 8.85 | 60.16 | 10.77 |
| **D2** | 54.05 | 9.08 | 59.53 | 11.02 |
| **LSD** | **N.S** | **N.S** | **N.S** | **N.S** |

Also, the trait insignificantly differed between the two varieties. The increase in quantitative or root yield (ton/ha) can be attributed to their components or other traits contribute in/ have a direct role/affecting them. The increase in root yield accompanying high soil moisture and fertility level in foam trays might have been due to the increase in number of harvested roots as well as individual root weight, this increase in root yield is mainly due to the role of soil fertility in stimulating the meristematic growth activity which contributes to the increase in number of cells in addition to cell enlargement. Such results are in accordance with these reported by **El-Sarag (2009); Mahmoud *et al.* (2014) and Masri *et al*. (2015).**

**Water use efficiency (kg/m$^3$)**

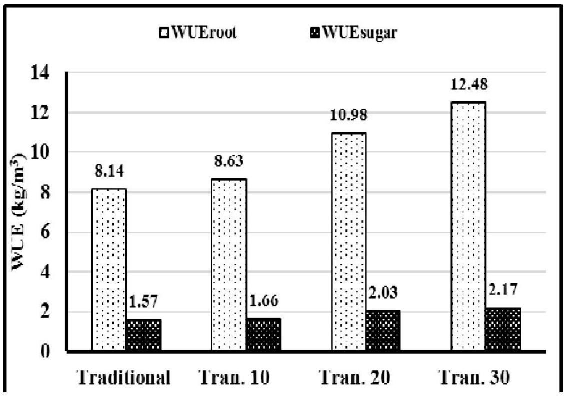
In this study, water use efficiency was expressed in kg of yield per m$^3$ irrigation water applied was calculated by dividing the yields (kg/ha) and the total irrigation water applied under each treatment (m$^3$/ha). This could be a fully beneficial parameter to be used because the high water efficiency emerges from higher yield and lower crop water requirement, showed table 5.

Concerning the interaction impact of planting method and verities on both root and sugar water use efficiencies, the results in Table 5 indicated that the highest root water use efficiency values were obtained when sugar beet transplanting 30 days and with mono-germ variety (11.84 and13.26) kg/m$^3$, respectively). However, the lowest values of them (7.29 and 8.47 kg/m$^3$, respectively) were obtained when using the traditional method with multi-germ variety in the first and second season, respectively.

**Table 5. Water use efficiency (kg/m$^3$) under different treatments.**

| | First season | | Second season | |
|---|---|---|---|---|
| **Treatments** | **$WUE_{root}$** | **$WUE_{sugar}$** | **$WUE_{root}$** | **$WUE_{sugar}$** |
| **Traditional (A)** | 7.56 | 1.39 | 8.71 | 1.75 |
| **Tran. 10 (B)** | 8.05 | 1.47 | 9.21 | 1.84 |
| **Tran. 20 (C)** | 10.31 | 1.81 | 11.65 | 2.25 |
| **Tran. 30 (D)** | 11.77 | 1.94 | 13.19 | 2.40 |
| **LSD** | 0.27 | 0.07 | 0.25 | 0.10 |
| **Monogerm (1)** | 9.49 | 1.64 | 10.76 | 2.04 |
| **Multigerm (2)** | 9.35 | 1.66 | 10.63 | 2.07 |
| **LSD** | N.S | N.S | N.S | N.S |
| **A1** | 7.82 | 1.40 | 8.94 | 1.75 |
| **A2** | 7.29 | 1.38 | 8.47 | 1.74 |
| **B1** | 8.08 | 1.45 | 9.25 | 1.82 |
| **B2** | 8.02 | 1.48 | 9.18 | 1.85 |
| **C1** | 10.23 | 1.79 | 11.57 | 2.22 |
| **C2** | 10.40 | 1.84 | 11.74 | 2.28 |
| **D1** | 11.84 | 1.92 | 13.26 | 2.37 |
| **D2** | 11.70 | 1.96 | 13.12 | 2.43 |
| **LSD** | N.S | N.S | N.S | N.S |

With respect to the effect of sowing methods, it is obvious that the transplanting method significantly saved water and increase water use efficiency compared to the traditional method. Where increasing the transplanting period from 0 to 30 days from planting increased WUE of root yield by about 35.77% and 33.97% in the 1st and 2nd season, respectively, also, WUE of sugar yield increased by about 28.35% and 27.08% in the first and second season, respectively.



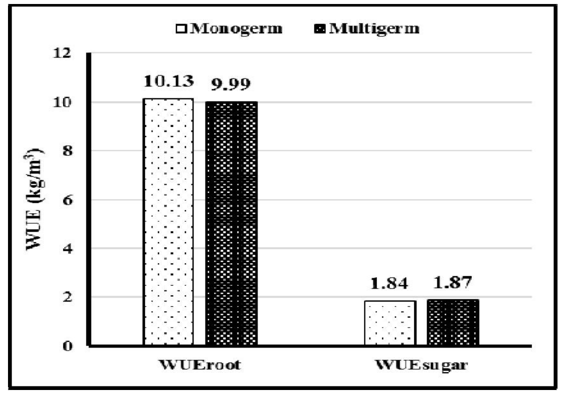




**Fig. 6. Average of WUE under different treatments.**

**Economic analysis**

The presented data in the table (6) shows the costs and net return under different applied treatments. It could be noticed that using transplanting increased net return and decreased costs.

Transplanting period 30 days increased the net return by 48 and 33.5% and reduced the costs by 23.6 and 23.6% compared to the traditional method under multigerm variety in the first and second seasons, successively.

It could be concluded that the highest costs were 19800 and 19752 LE/ha under transplanting period 20 days, while the lowest value was 15000 and 14952 LE/ha using transplanting period 20 days in the first and second season, respectively. Meanwhile, the maximum value of net return was 22002 and 28843 LE/ha with the use of transplanting period 20 days and multi-variety, while the minimum value was 14680 and 21363 LE/ha using the traditional method and multi-variety, respectively.

**Table 6. Costs, income and net return (LE/ha) under different treatments.**

| Treatments | | First season | | | Second season | | |
|---|---|---|---|---|---|---|---|
| | | Costs | Income | Net return | Costs | Income | Net return |
| **Traditional** | **Mono** | 18960 | 34842 | 15882 | 18912 | 41450 | 22538 |
| | **Multi** | 19800 | 34480 | 14680 | 19752 | 41115 | 21363 |
| **Tran. 10** | **Mono** | 15420 | 33500 | 18080 | 15372 | 39995 | 24623 |
| | **Multi** | 16020 | 33894 | 17874 | 15972 | 40447 | 24475 |
| **Tran. 20** | **Mono** | 15000 | 36531 | 21531 | 14952 | 43235 | 28283 |
| | **Multi** | 15600 | 37602 | 22002 | 15552 | 44395 | 28843 |
| **Tran. 30** | **Mono** | 14520 | 36305 | 21785 | 14472 | 42949 | 28477 |
| | **Multi** | 15120 | 36886 | 21766 | 15072 | 43601 | 28529 |

**Conclusion**

Under sandy soil using the monogerm beet sugar transplanting 20 period days with drip irrigation system is recommended to get high WUE, sugar beet yield and qualities.

In general, using the transplanting 20 period for tuber crops is recommended to maximums the soil use, saving water, high yield and enhancement the tubers quality.

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10/27/2019