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## Abstract

The research was conducted in the field of Khabat Technical Institute / Erbil Polytechnic University during winter season of 2019-2020 and summer season of 2020. It shows the effect of plantingdate, varieties on growth and yield component of sugar beet under two different seasonal conditions. A factorial experimental design was applied in randomized complete block design with three replication; the first factor represents three planting dates (1stOctober, 16thOctober and 31thOctober, 2019) in winter and (1stMarch, 16thMarch and 31thMarch, 2020) in summer season, the second factor was three varieties of sugar beet (Germany, Turkish and Iranian), had been applied in both seasons. The combined effect of planting in 1stOctober and the Turkish variety produced the highest value of all study traits; No. of leaf.plant-1, leaf area (cm2), leaf area index (LAI), root length cm, root diameter cm, root weight kg.plant-1, root yield t.ha-1, sugar % and sugar yield t.ha-1in winter season, but the Germany variety surpassed in length of root (cm) in summer season. The interaction between planting date from 1stOctober with Turkish variety recorded the highest value of all study traits, in winter season achieved the lowest value in number of leaf.plant-1, root length cm, root diameter cm, root weight kg.plant-1, root yield t.ha-1, sugar% and sugar yield, were recorded from the interaction between planting in 31thMarch and Iranian variety in summer season. On the other hand, the interaction treatment 31thMarch with Turkish variety recorded the lowest value in leaf area and leaf area index.



## Keywords

Sugarbeet varieties, plantingdate, Growth and Yield Component

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RESEARCH ARTICLE

# Response of Some Sugar Beet Varieties to Different Sowing Dates Under Two Seasonal Conditions in Khabat

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## ABSTRACT

The research was conducted in the field of Khabat Technical Institute / Erbil Polytechnic University during winter season of 2019-2020 and summer season of 2020. It shows the effect of planting date, varieties on growth and yield component of sugar beet under two different seasonal conditions. A factorial experimental design was applied in randomized complete block design with three replication; the first factor represents three planting dates (1st October, 16th October and 31th October, 2019) in winter and (1st March, 16th March and 31th March, 2020) in summer season, the second factor was three varieties of sugar beet (Germany, Turkish and Iranian), had been applied in both seasons. The combined effect of planting in 1st October and the Turkish variety produced the highest value of all study traits; No. of leaf.plant$^{-1}$, leaf area (cm$^2$), leaf area index (LAI), root length cm, root diameter cm, root weight kg.plant$^{-1}$, root yield t.ha$^{-1}$, sugar % and sugar yield t.ha$^{-1}$in winter season, but the Germany variety surpassed in length of root (cm) in summer season. The interaction between planting date from 1st October with Turkish variety recorded the highest value of all study traits, in winter season achieved the lowest value in number of leaf.plant$^{-1}$, root length cm, root diameter cm, root weight kg.plant$^{-1}$, root yield t.ha$^{-1}$, sugar% and sugar yield, were recorded from the interaction between planting in 31th March and Iranian variety in summer season. On the other hand, the interaction treatment 31th March with Turkish variety recorded the lowest value in leaf area and leaf area index.

**Key words: Sugar beet varieties, planting date, Growth and Yield Component**

## INTRODUCTION

The sugar beet crop (*Beta vulgaris* L.) is considered as one of the most important source for sugar from the family of Amaranthaceae, after sugar cane world wise. Sugar beet is cultivated in 40 countries and accounts for up to 40 to 45 % production of sugar in the total world (Shahl *et al*., 2000). Sugar beet is recognized for sweetening plant with valuable properties in the early 1700s. Sucrose is used as a pure high energy food widely or food additive and from sugar beet pulp, high fiber dietary food additives are manufactured. Sugar beets contain from 13 to 22% sucrose and used primarily for the production of sucrose and feed supplements for livestock. Molasses are used in the presses of alcohol, the pharmaceuticals and food additives industries. Lime wasted from processing sugar beet is a major soil factor for increasing soil pH levels (Cattanach *et al*., 2017). Yield is reduced by many biotic and abiotic factors that can damage the leaves of the sugar beet plant, among these factors are cold, frost, drought, hail, wind, pests and diseases that can effectively reduce leaf area (Jadidi *et al*., 2010).

Sugar beet is able to adapt to various environmental factors, such as climate, however, the properties of sugar beet can be affected by climatic conditions (Sogut and Arioglu 2004). Yield and quality is affected by critical influence that limits how soon the crop can be sown its susceptibility to vernalisation due to the presence of lignified bolters in the harvested crop (Scott and Jaggard, 2000). Many of cultural practices such as planting date, cultivars are very important factors, which limiting sugar production from sugar beet. Planting date at suitable time is very important to obtained higher yield and quality (Hanna *et al*., 1988). Earliest planting dates produce the best yield and quality (Leilah 2005). Sugar beet production decreased under semi-arid conditions of growth has been mainly due to the limited access to water (Morillo-Velarde and Ober, 2006) Root yield decreases by 80% reduction in leaf weight between 23% to 27% due to complete defoliation, especially when sugar beet faces semi-arid conditions, high temperature, mild stress and salinity, (Munns, 2002; Chaves *et al*., 2002).

NemeataAlla (2016) concluded that planting sugar beet on October surprising than planting on other dates in most sugar beet characters root weight, root yield and sugar yield. El-Kassaby and Leilah (1992) found that sowing sugar beet increased the diameter, length and weight of roots, sugar content, as well as, root and sugar yields during October compared with the late planting of November. Martin (1983) Studies show that the cultivars response in some locations is influenced by the planting date. Lauer (1997) stated that he obtained significant different between cultivars on yield, sugar content and its yield. Since the climatic conditions in Kurdistan region-Iraq, especially in Khabat district changing from winter and summer seasons in terms of temperature, rain and humidity as they are present in the Table (2), Metrological data for Khabat field station, therefore, it is difficult to determine a suitable date for planting beets for non-local varieties, and to find a suitable date that it is preferable to plant them at different dates in two seasons. The objective of this research is to determine the effect of various sowing dates of varieties under study on some agronomic parameters and yield of sugar beet varieties under different season conditions.

## MATERIALS AND METHODS

This research was carried out at the field of Khabat Technical Institute during winter season of 2019-2020 and summer season 2020. The Factorial experiment was applied in a randomized complete block design, with three replications, the first factor represents three dates of planting (1st October, 16th October and 31th October, 2019) as winter season and (1st March, 16th March and 31th March, 2020) as summer season, the second factor represents three varieties of sugar beet (Germany, Turkish and Iranian), these varieties were taken by commercial and the research was conducted on them with the Research Station Center in Erbil.

The plot size is 12 m2 (4 m × 3 m), planting was done manually at a row spacing 40 cm and plant spacing 25 cm, two seeds were planted in each hole at a depth of 3 cm, then the plants were thinned after emergence stage to (16 plant.$m^{-2}$) Furthermore, Diammonium phosphate (NH4)2 HPO4 (18%N 46% P2O5) fertilizer was applied by rate of 100kg $ha^{-1}$ at planting date drilling near the rows and covering. In addition, nitrogen fertilizer in the urea form (46% N) was applied by 80 kg $ha^{-1}$ at vegetative growth. After plowing the field, soil samples were taken at depth of (0-30 cm) from various locations of the field and drying the samples with air, they were sifted with a 2 mm sieve and then packed for analysis (Table 1). The successful sugar beet production is found only on fertilizer soils and a good % of organic matter, loam or sandy loam. The irrigation every (10) days by the furrow methods before yield results when the field is irrigated before the plant show signs of water need, especially in summer season. Ten plants from each experimental unit randomly where taken at flowering stage to determine some growth parameters; number of days from planting to flowering, number of leaf.$plant^{-1}$,

From viticanopy program application, leaf area ($cm^2$) and leaf area index (LAI): was calculated:

$$LAI = \frac{\text{Plant total leaf area per plant}}{\text{Average land area occupied by plant}}$$

but root dry matter: was calculated after drying at 80°C for (48) hours, then weight was converted to %; which represent the dry mass of root part of plant. Yield and yield component include root length cm, root diameter cm, root weight kg.$plant^{-1}$and sugar yield (t.$ha^{-1}$) root yield t.$ha^{-1}$; all middle-line plants of each experimental unit were harvested, leaving the plants next to middle-line then the weight was converted to t $ha^{-1}$. Harvest date for the winter season is up to August, but the summer harvest falls in the month of December 2020.

Sucrose percentage determined by refractometry: calibrated in sucrose units was used. Juice from the grated beet was squeezed directly on to the prism. In accordance with the manufacturer's instruction for beet measurements, 2.50 Jo was subtracted from the measurements obtained (Bert *et al*., 1980). This methods for determine sucrose percentage is wildly used (Bahrami *et al*., 2020). The data was statistically analyzed by using the Statistical Analysis System (SAS Institute, 2005), the data was statistically analyzed for all of the studied traits. Duncan's multiple range test (DMR) at 5% level was used to determine the difference among means (Steel and Torrie, 1997). Simple correlation coefficient was calculated between the seed yield and other traits (Al-Rawi, 1984).

**Table (1): Some physical and chemical parameters of the soil at the depth of (0 - 30 cm).**

**Table (2): Metrological data for Khabat field station during the rainfall season of (2019-2020).**

| Parameter Years 2019-2020 | Air Temperature in (°C) | | | Monthly total rainfalls mm | Relative Humidity R.H% |
|---|---|---|---|---|---|
| | Maximum | Minimum | Average | | |
| October 2019 | 34.1 | 17.0 | 25.6 | 7.1 | 59.0 |
| November 2019 | 25.4 | 7.2 | 16.3 | 23.7 | 66.4 |
| December 2019 | 16.3 | 6.0 | 11.1 | 100.1 | 68.9 |
| January 2020 | 12.5 | 3.1 | 7.8 | 99.9 | 84.9 |
| February 2020 | 14.0 | 4.2 | 9.1 | 57.6 | 78.3 |
| March 2020 | 19.9 | 8.9 | 14.4 | 136.4 | 72.3 |
| April 2020 | 26.3 | 9.8 | 18.6 | 23.6 | 65.1 |
| May 2020 | 36.6 | 13.8 | 25.2 | 13.6 | 55.3 |
| Jun 2020 | 41.9 | 20.5 | 31.2 | --- | 50.8 |
| July 2020 | 46.4 | 25.0 | 35.7 | --- | 47.0 |
| August 2020 | 46.1 | 25.5 | 35.8 | --- | 50.4 |
| September 2020 | 42.2 | 20.8 | 31.5 | --- | 46.8 |
| October2020 | 35.6 | 15.1 | 25.3 | --- | 48.8 |
| November2020 | 24.2 | 11.5 | 17.8 | 42.8 | 71.5 |
| December2020 | 20.2 | 5.1 | 12.6 | 33.7 | 78.0 |

## RESULT AND DISCUSSION

### 1-Effect of planting date on some growth parameters of sugar beet varieties:

### Number of days from planting to flowering:

The data presented confirms the significant difference between the planting dates and the number of days from planting to flowering (242.77) days was recorded in 1st October in winter season (Table 3), compared with planting in 31th March from summer season which recorded the lowest (222.77) days (table 3) too, varieties cultivated where not significant different for both seasons. However the interaction among planting date and varieties was also shows significant differences, the more number of days (245.66) was obtained for the Germany variety at 1st October, while the lowest days (221.66) was recorded for the Iranian variety at 31th March.

### No. of Leaf.plant$^{-1}$:

The maximum number of leaves was noted from winter season in 1st October (37.66) and (34.66) for the Turkish variety (Table 3), whereas the minimum was for 31th March and Germany variety in summer season which was (22.77 and 26.11) respectively. The superior interaction was for 1st October with Turkish variety (39.00); the Iranian variety recorded the lowest value in 31th March. Table (5) shows a positive correlation and highly significant between this trait and the root yield t.ha$^{-1}$ (r= 0.790**) respectively.

### Leaf area (cm$^2$)

The data in (Table 3) shows influenced by planting dates varieties and their interactions between different planting dates, 1st October showed significantly higher leaf area (5073.66 cm$^2$) in winter season as compared to 31th March in summer season, due to the presence of suitable temperatures for vegetative growth in early planting October, the leaf area increases. Turkish variety recorded significantly higher Leaf area (4766.66 cm$^2$) in winter season compared with same variety was recorded lowest (2736.00 cm$^2$) in summer season. The highest leaf area (6080.33 cm$^2$) for Turkish variety when planted at 1st October compared with Turkish variety when planted in 31th March recorded lowest (2100.00 cm$^2$).

| | | | |
|---|---|---|---|
| Depth cm | | | 0-30 |
| PSD % | Sand | g/kg soil | 6 |
| | Silt | | 50 |
| | Clay | | 44 |
| Soil Texture | | | Silty clay |
| pH | | | 7.5 |
| Ec ds/m | | dS/m | 1.3 |
| O.M % | | % | 1.1 |
| (N) % | | | 0.27 |
| Available (P) | | mg.g$^{-1}$ | 3.76 |
| $K^+$ | | Mmolic.L$^{-1}$ | 0.22 |
| $Ca^{+2}$ | | | 6.57 |
| $Mg^{+2}$ | | | 3.98 |

**Leaf area index (LAI)**

The results shown in Table (3), the heights of leaf area index was recorded at planting date of 1st October (8.06) in summer season but the lowest has shown in planting on 31th March (4.00) in summer season. Turkish variety has significantly recorded higher leaf area index in winter season compared with same variety was recorded lowest in summer season. Early planting at 1st October recorded highest leaf area index with Turkish variety (9.89) compared with Turkish variety planted on 31th March that recorded the lowest (3.31). Martin (1983) found that delay in planting of sugar beet crop from November to March gradually decreased leaf area index.

**Root dry matter percentage%**

The results in Table (3) showed significant differences among all the studied factors. Root dry matter (23.56 %), was produced higher at 1st October from winter season, while in 31th March the root dry matter (18.07%) rise in temperature degree at late planting dates and harvesting in December from summer season which resulted in decrease in leaf area and root dry matter, planting at 1st October recorded highest root dry matter with Turkish variety (24.76%) as compared with planting on 31th March with Iranian variety (16.60 %). From table (5) there was a positive correlation and highly significant between this trait and yield and sugar yieldt.ha-1 (r= 0.802** and r= 0.828**) respectively.

**Table 3: The Effect of sowing dates on growth parameters of thre**

| Characteristic | | Number of days from planting to flowering | No. of (Leaf.plant$^{-1}$) | Leaf area (cm$^2$) | Leaf area index (LAI) | Root Dry matter (%) |
|---|---|---|---|---|---|---|
| | | Winter season 2019-2020 | | | | |
| 1st October | | 242.77 a | 37.66 a | 5073.66 a | 8.06 a | 23.56 a |
| 16th October | | 232.22 b | 28.77b | 4073.88 b | 6.51 b | 22.55 b |
| 31th October | | 226.88 c | 26.00c | 3609.33 c | 5.77 c | 18.98 c |
| Varieties | | | | | | |
| Germany | | 232.55 a | 27.77 c | 3390.88 b | 5.42 b | 21.57 b |
| Turkish | | 237.11 a | 34.44a | 4766.66 a | 7.57 a | 22.82 a |
| Iranian | | 232.22 a | 30.22b | 4533.33 a | 7.37 a | 29.71 c |
| Planting dates xVarieties | | | | | | |
| 1st October | Germany | 245.66 a | 38.00 ab | 5967.33 a | 9.5 a | 23.26 b |
| | Turkish | 243.66 ab | 39.00 a | 6080.33 a | 9.89 a | 24.76 a |
| | Iranian | 239.00 ab | 36.00 bc | 4826.66 b | 7.23 b | 22.66 c |
| 16th October | Germany | 231.11 bcd | 21.33 f | 2386.66 g | 4.21 g | 22.46 c |
| | Turkish | 232.00 bcd | 35.00 c | 4655.00 bc | 7.44 bc | 23.43 b |
| | Iranian | 233.00 bcd | 30.00 d | 4320.00 cd | 6.91 cd | 21.76 d |
| 31th October | Germany | 221.00 d | 24.00 ef | 3960.00 de | 6.33 de | 19.00 f |
| | Turkish | 235.00 bc | 29.33 d | 3168.00 f | 5.07 f | 20.26 e |
| | Iranian | 224.66 cd | 24.66 e | 3700.00 e | 5.9 e | 17.70 g |
| **Characteristic** | | Number of days from planting to flowering | No. of (Leaf.plant-1) | Leaf area (cm2) | Leaf area index (LAI) | Root Dry matter (%) |
| | | Summer season 2020 | | | | |
| 1st March | | 240.55a | 31.55a | 3982.00 a | 6.37a | 23.30a |
| 16th March | | 230.22 b | 27.55b | 3637.77b | 5.82b | 20.24b |
| 31th March | | 222.77 c | 22.66c | 2503.33c | 4.00c | 18.07c |
| Varieties | | | | | | |
| Germany | | 232.55a | 26.11 b | 3710.00 a | 5.96a | 20.29 b |
| Turkish | | 230.11 a | 27.77 a | 2736.00b | 4.37b | 21.30 a |
| Iranian | | 232.55a | 28.33a | 3676.66 a | 5.88a | 19.03c |
| Planting dates xVarieties | | | | | | |
| 1st March | Germany | 242.66 a | 33.33a | 5000.33a | 8.0a | 22.26b |
| | Turkish | 236.66 b | 31.33ab | 4655.00a | 7.60a | 23.36a |
| | Iranian | 242.33 a | 30.00b | 3750.33 b | 6.0b | 21.30c |
| 16th March | Germany | 231.00cd | 24.66cd | 3250.00c | 5.22c | 19.96 d |
| | Turkish | 227.00de | 26.00c | 3196.00cd | 4.66de | 21.56c |
| | Iranian | 233.00bc | 32.00ab | 2912.00de | 5.11cd | 19.20e |
| 31th March | Germany | 224.00ef | 24.00cd | 2880.00e | 4.61e | 18.66e |
| | Turkish | 222.00f | 23.00 de | 2100.00 g | 3.31 g | 18.96e |
| | Iranian | 221.66f | 21.00e | 2530.00f | 4.04f | 16.60f |

Means the same letters are not significant

**Table 4: The Effect of sowing dates on yield and sugar yield of sugar beet varieties less than two seasons.**

| Characteristic | | Root length (cm) | Root diameter (cm) | Root weight (kg.plant$^{-1}$) | Root yield (t.ha$^{-1}$) | Sugar (%) | Sugar yield (t.ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| | | **Winter season 2019-2020** | | | | | |
| 1st October | | 34.44 a | 10.55 a | 1.06 a | 42.40 a | 20.40 a | 8.65 a |
| 16th October | | 31.44 b | 8.86 b | 0.8 b | 32.17 b | 19.85 b | 6.39 b |
| 31th October | | 30.00 c | 7.22 c | 0.6 c | 24.00 c | 17.45 c | 4.19 c |
| Varieties | | | | | | | |
| Germany | | 36.22 a | 9.05 b | 0.82 b | 32.88 b | 19.85 b | 6.53 b |
| Turkish | | 30.33 b | 9.92 a | 0.96 a | 38.48 a | 20.76 a | 7.99 a |
| Iranian | | 29.33 b | 7.66 c | 0.68 c | 27.2 c | 17.17 c | 4.67 c |
| Planting dates xVarieties | | | | | | | |
| 1st October | Germany | 39.11 a | 11.16 a | 1.12 a | 44.80 a | 20.57 c | 9.22 b |
| | Turkish | 28.00 d | 11.5 a | 1.22 a | 49.06 a | 22.60 a | 11.09 a |
| | Iranian | 36.33 b | 9.00 b | 0.83 b | 33.33 b | 18.33 de | 7.40 c |
| 16th October | Germany | 34.00 bc | 8.00 bc | 0.68 bc | 27.20 bc | 20.44bc | 5.56 cd |
| | Turkish | 32.33 c | 11.26 a | 1.05 a | 42.13 a | 21.12 b | 8.90 b |
| | Iranian | 28.00 d | 7.33 c | 0.68 bc | 27.20 bc | 20.66 a | 5.60 cd |
| 31th October | Germany | 35.66 b | 8.00 bc | 0.66 bc | 26.66 bc | 17.38 f | 4.63cde |
| | Turkish | 27.66 d | 7.00 c | 0.60 c | 24.26 c | 18.87ef | 4.58 de |
| | Iranian | 26.66 d | 6.66 c | 0.52 c | 21.06 c | 16.45 g | 3.46 e |
| **Characteristic** | | **Root length (cm)** | **Root diameter (cm)** | **Root weight (kg.plant$^{-1}$)** | **Root yield (t.ha$^{-1}$)** | **Sugar (%)** | **Sugar yield (t.ha$^{-1}$)** |
| | | **Summer season 2020** | | | | | |
| 1st March | | 30.44 a | 9.88 a | 0.83 a | 33.06 a | 19.38 a | 6.41 a |
| 16th March | | 29.00 b | 9.22 a | 0.69 b | 27.64 b | 18.30 b | 5.06 b |
| 31th March | | 24.33 c | 7.11 c | 0.55 c | 22.04 c | 16.05 c | 3.54 c |
| Varieties | | | | | | | |
| Germany | | 27.55 b | 8.11 b | 0.65 b | 26.04 b | 18.68 b | 4.86 b |
| Turkish | | 29.33 a | 9.62 a | 0.77 a | 31.11 a | 19.78 a | 6.15 a |
| Iranian | | 26.88 b | 7.33 c | 0.62 b | 25.6 b | 16.92 b | 4.33 c |
| Planting dates xVarieties | | | | | | | |
| 1st March | Germany | 36.00 a | 10.00 b | 0.81 b | 32.00 c | 19.86 c | 6.36 b |
| | Turkish | 29.33 c | 11.5 a | 0.88 a | 35.73 a | 20.56 a | 7.35 a |
| | Iranian | 26.00 b | 8.33 c | 0.79 b | 31.46 c | 19.33 b | 6.08 b |
| 16th March | Germany | 25.00 b | 8.00 c | 0.62 c | 24.80 d | 18.87 b | 4.68 c |
| | Turkish | 32.33 b | 11.26 a | 0.84 ab | 33.88 b | 20.33 a | 6.89 b |
| | Iranian | 29.33 c | 7.66 c | 0.60 c | 20.73 d | 20.46 a | 4.24 d |
| 31th March | Germany | 25.66 d | 6.33 c | 0.53 d | 19.86 e | 17.46 f | 3.47 e |
| | Turkish | 26.00 d | 7.00 c | 0.59 cd | 21.43 c | 17.84ef | 3.82 d |
| | Iranian | 21.33 e | 8.00 c | 0.52 d | 18.73 f | 16.66 g | 3.12 e |

**2-Effect of sowing dates on yield and sugar yield of sugar beet varieties:**

**Root length (cm):**

Results in table (4) shows significant differences among all studied factors. The highest root length reached (34.44 cm) at 1st October in winter season, but the lowest length for this trait (24.33 cm) was obtained on 31th March in summer season. Plant cultivated at 1st October with Germany variety gave highest root length (839.11 cm), while Iranian variety produced the lowest length for this trait (21.33 cm) when planted on 31th March.

**Root diameter (cm):**

The result of Table (4) shows planting at 1st October in winter season recorded maximum Root diameter whereas the minimum was for 31th March which was (10.55 and 7.11 cm) in summer season, respectively. However, the Turkish variety obtained significantly root diameter in winter season followed by Iranian variety in summer season. The highest root diameter was found in 1st October (11.5 cm) with Turkish variety, but Germany variety recorded the least value on 31th March (6.33 cm). Also Nemeata Alla (2016) showed root diameter increase at early planting date and is significantly higher over other planting dates.

**Root weight kg.plant$^{-1}$:**

The highest value for root weight was recorded for the sample collected from planting in 1st October (1.06 kg.plant$^{-1}$) and Turkish variety (0.96 kg.plant$^{-1}$) in winter season, but the lowest was from planting in March 31 (0.55 kg.plant$^{-1}$) and Iranian variety (0.62 kg.plant$^{-1}$) in summer season. Among different planting dates and varieties, the highest was recorded Turkish variety with planting at 1st October (1.22 kg.plant$^{-1}$), but the lowest (0.52 kg.plant$^{-1}$) was recorded for the Iranian variety at 31th March. This result is in agreement with the finding of Martin (1983) who showed that sugar beet cultivars sown on September exhibited significantly greater root weight as compared to these growing in November. From table (5) there was a positive correlation and highly significant correlation among this trait with yield and sugar yield t.ha$^{-1}$ (r= 0.845** and r= 0.868**) respectively.

**Root yield (t ha$^{-1}$):**

The Table (4) displayed yields performed the highest was at planting in 1st October (42.40 t ha$^{-1}$) in winter season, but the lowest was in 31th March (20.01 t.ha$^{-1}$) in summer season this variation is due to when planting sugar beet early in October leads to increase root weight, length and width root and consequently resulted to increase yield components. The highest value was also for Turkish variety (38.48 t ha$^{-1}$) in winter season but the lowest value was recorded for Iranian variety (25.60 t.ha$^{-1}$) at summer season. The best value was at 1st October for Turkish variety (49.06 t.ha$^{-1}$), whereas the lowest was at 31th March for Iranian variety (18.73 t ha$^{-1}$). This result is in agreement with Ntwana and Tuwana (2013) who showed that early sown sugar beet cultivars exhibited significantly greater compared to delay planting.

**Sugar percentage%:**

The highest level of sugar percentage (20.40%) was obtained in winter season 1st October and the minimum (16.05%) was in summer season 31th March, while the highest rate was in Turkish variety which was (20.76%) in winter season (Table 4). The optimum rate of interaction between planting dates and varieties was at 1st October with was Turkish variety that was (22.60%) and the minimum was at 31th March for Iranian variety and was (16.66%). This result is in an agreement with the finding of Nemeata Alla (2016). He observed that sugar beet sown on early planting date significantly increasing sugar percentage. From (Table 5) there was a positive and highly significant correlation between this trait and the root dry matter, root diameter and root weight (r= 0.818**, 0.771** and0.785**), respectively.

**Sugar yield (t.ha$^{-1}$):**

The sugar yield results are displayed from (Table 4) shows that the highest level (8.65 t.ha$^{-1}$) was observed in 1st October and (7.99t.ha$^{-1}$) for the Turkish variety in winter season. While the minimum rate (3.54 t ha$^{-1}$) was obtained for 31th March and the minimum was for the Iranian which was (4.33 t.ha$^{-1}$) from summer season, (Table 6). The planting dates with varieties recorded the highest yield of sugar was in 1st October with Turkish variety (11.09 t.ha$^{-1}$), but the lowest was in 31th March with Iranian variety (3.12 t.ha$^{-1}$). This result is in an agreement with the finding of El-Kassaby and Leilah (1992) that showed sugar yield increased during October compared with the late planting of November.

## CONCLUSION

Early planting date on 1st October in winter season showed high value of all the other planting dates for all the studied characters, also Turkish varieties surpassed Germany and Iranian varieties for all characteristics except for the leaf area and leaf area index in summer season. The highest root yield and sugar yield (42.40 and 8.65 t.ha$^{-1}$) were recorded at the planting date 1st October respectively, but the lowest were obtained from 31th March (22.04 and 3.54 t.ha$^{-1}$) respectively. The highest root yield (49.06 t.ha$^{-1}$) found from Turkish variety with planting date at 1st October but the lowest was recorded for Iranian variety in 31th March (18.73t.ha$^{-1}$).

**Table 5: Correlation coefficient analysis among the traits of**

**sugar beet varieties**

| | No. of days from planting to flowering | No. of leave/plant | Leaf area ($cm^2$) | Leaf area index (LAI) | Root Dry matter % | Root length (cm) | Root diameter cm | Root weight (kg/plant) | Root yield ($t.ha^{-1}$) | Sugar (%) | Sugar yield ($t.ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of days from planting to flowering | 1.000 | | | | | | | | | | |
| No. of leave/plant | 0.629 ** | 1.000 | | | | | | | | | |
| Leaf area ($cm^2$) | 0.598 ** | 0.702 ** | 1.000 | | | | | | | | |
| Leaf area index (LAI) | 0.598 ** | 0.702 ** | 1.000 ** | 1.000 | | | | | | | |
| Root Dry matter (%) | 0.670 ** | 0.702 ** | 0.347 * | 0.347 * | 1.000 | | | | | | |
| Root length (cm) | 0.577 ** | 0.530 ** | 0.401 * | 0.401 * | 0.252 | 1.000 | | | | | |
| Root diameter (cm) | 0.517 ** | 0.417 * | 0.404 * | 0.403 * | 0.760 ** | 0.327 | 1.000 | | | | |
| Root weight (kg/plant) | 0.601 ** | 0.729 ** | 0.493 ** | 0.493 ** | 0.809 ** | 0.298 | 0.854** | 1.000 | | | |
| Root yield ($t.ha^{-1}$) | 0.601 ** | 0.790 ** | 0.493 ** | 0.493 ** | 0.809 ** | 0.298 | 0.845** | 1.000** | 1.000 | | |
| Sugar (%) | 0.418 ** | 0.440 ** | 0.592 ** | 0.447 ** | 0.818 ** | 0.313 | 0.771 ** | 0.785 ** | 0.785 ** | 1.000 | |
| Sugar yield ($t.ha^{-1}$) | 0.581 ** | 0.749 ** | 0.447 ** | 0.597 ** | 0.828 ** | 0.295 | 0.868 ** | 0.990 ** | 0.990 ** | 0.854** | 1.000 |

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