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PERFORMANCE OF SOME SUGAR BEET TRAITS EVALUATED UNDER INTERCROPPING WITH FABA BEAN

EL-Refaey, R. A.[1]; U. A. Abd EL-Razik[1]; A. M. M. Sheha[2] and R. O. F. EL-Barky[2]

[1] Agronomy Department, Faculty of Agriculture, Tanta University.
[2] Crop Intensification Research Department, Field Crops Research Institute, Agriculture Research Center, Egypt.

Key Words: Intercropping system, sowing dates, ridge, sole crop.

I. ABSTRACT

Two field experiments were conducted at EL-Gemmeiza Agricultural Research Station farm, El-Gharbia Governorate during 2016/17 and 2017/18 winter seasons to study the effect of three sowing dates of faba bean and six intercropping systems of sugar beet (*Beta vulgares* L.) cv. Halawa Kws with faba bean (*Vicia faba* L.) cv. Giza 843. The field experiment was designed in a split plot design with three replicates, where the three sowing dates were allocated in the main plots and cropping systems i.e. **IS=** Inter cropping system In all intercropping systems **(IS)** sugar beet was35000 plants/fad (sugar beet sown in the two sides of bed 120cm width with 1 plant/hill and 20cm hill space)**,** **IS_1**=70000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 10cm hill space), **IS_2**=70000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 10cm hill space)**,** **IS_3**=35000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 20 cm hill space)**,** **IS_4**=35000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 20cm hill space), **IS_5**=17500 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 40 cm hill space) and **IS6** =17500 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 40cm hill space) were randomly distributed in the sub-plots. Sugar beet considered as main crop (35000 plants/fad) and faba bean was treated as secondary crop. The following traits of sugar beet were estimated i.ei, number of leaves/plant, root length, root diameter, root weight, top weight/plant, biological yield/plant, root yield/fad, top weight/fad. and biological yield/fad. results indicated that, the effect of sowing dates were highly for all studied traits, except for top weight/plant where it was not significant. The late sowing date (15th Nov.) had the highest values for all studied traits, followed by the mid-sowing date (1st Nov.). The

intercropping system IS_6 where faba bean sown two rows on the top of sugar beet ridges with one plant/hill and 40 cm hill space (17500 plants/fad.) had highest values for all studied traits. sugar beet traits were significantly affected by the interactions of sowing dates and intercropping systems, except for top weight/plant and the content of Alpha amino. However, the interactions between the late sowing date and the intercropping system IS_6 had the highest values for all studied traits.

II. INTRODUCTION

Sugar beet (*beta vulgaris* L.) is an important crop in Egypt, and over the whole world as a source of sugar industry. In Egypt, sugar beet considers the second sugar crop after sugar cane. Sugar beet successfully grows in the newly reclaimed soils by about 131308 fed and 423633 fad in old lands **(Kamel *et al.*, 2017)**. In 2017/18 season, the world total production of sugar beet was 266 million ton produced from total harvested area of 7.8 million hectare, while the total harvest area in Egypt reached 559744 faddan with total productive of 11.21 million ton **(FAO STAT, 2018)**. Egyptian government imported 1.2 million ton of sugar in 2017 to reduce the gab between production and consumption under the large increase of population. Sugar beet had a higher yield with a short growth period is about a half of sugar cane in season (6-7 months) and it has lower water consumed about 25% requirements of sugar cane **(Kamel et al., 2017)**.

There is a large gap between sugar crops production and sugar consumption around 32%, where the cultivated area of sugar cane and sugar beet is not enough to attain self-sufficiency of sugar. Additionally, there is a large gap in legume crops, especially faba been. This gap of faba bean resulted from two reasons, the first one is the wide infection of Delta land with broom rape which resulted in large losses in faba bean yield. The second reason is the current expansion in sugar beet cultivated area on be-half the cultivated area of faba bean resulted in 65% production–consumption gap in faba bean **(Zohry and Ouda, 2017)**.

Intercropping consider an excellent solution to reduce the gabs of sugar beet and faba bean together. In Egypt, several crops are good candidates to the main crop in an intercropping system. Sugar beet is one of them, where two intercropping systems were successfully implemented in Egypt: faba bean intercropped with sugar beet. Sugar beet is cultivated with 100% of its recommended population density and it get its required water and fertilizer. Whereas, faba bean considered as the secondary crop, which it use the applied water and fertilizer for the main crop (sugar beet). To reduce intraspecific competition between the main crop (sugar beet) and the secondary crop (faba bean), the optimum population density for either crops is 25%. As a result, the farmer could

obtain 100 and 25% of sugar beet and faba bean yield, respectively **(Abd El-Zaher and Gendy, 2014).**

The present work was aimed to determine the efficacy of some intercropping systems of sugar beet and faba bean under different sowing dates in increasing root yield and its component of both sugar beet and faba bean in addition to maximized the farmer income return from the unit area.

III. MATERILS AND METHODS

Two field experiments were conducted at EL-Gemiza Agricultural Research station, El- Gharbia Governorate, during 2016/17 and 2017/18 seasons to study the effect of three sowing dates (15^{th} October, 1^{st} November and 15^{th} November) and the six intercropping patterns of faba bean (*Vicia faba*) cv. Giza 843 with sugar beet (*Beta vulgaris* L.) cv. Halawa kws. The field experiment was designed in a split-plot design with three replicates, where, the three sowing dates were allocated in the main plots and the cropping systems were randomly distributed in the sub-plots.

In all intercropping systems **(IS)** sugar beet was sown in the rate of 35000 plants/fad. Sugar beet sown in the two sides of redges 120cm width with 1 plant/hill and 20cm hill space

IS= Inter cropping system In all intercropping systems **(IS)** sugar beet was35000 plants/fad (sugar beet sown in the two sides of bed 120cm width with 1 plant/hill and 20cm hill space)

IS_1=70000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 10cm hill space).

IS_2=70000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 10cm hill space).

IS_3=35000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 20 cm hill space)**.**

IS_4=35000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 20cm hill space).

IS_5=17500 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 40 cm hill space).

IS6 =17500 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 40cm hill space).

The number of rows in sub-plot was 4 ridges 120 cm apart and 3.5 m length. Where sugar beet sown in the two sidess of the bed and faba bean sown one or two rows on the top of sugar beet bed according to the system of intercropping. All the other culture practices were done according to the recommendation of faba bean and sugar beet in the area.

Sugar beet was sown on September 15th and 18th, in the first and second seasons, respectively.

The applications of intercropping faba bean with sugar beet were fertilized by 95 kg N/fad for IS_1 and IS_2, 90 kg N/fad for IS_3 and IS_4 and 85 N/fad for IS_5 and IS_6 applied in two equal doses, before the first and the second irrigations, respectively.

Sugar beet as a monoculture crop was fertilized by 100 kg N/fad applied in two equal doses before the first and the second irrigation, respectively. While, faba bean pure stand was fertilized by 50 kg N/fad as single dose before the first irrigation. Nitrogen was added as the form of urea (46.5%), whereas calcium super phosphate (15.5% P_2O_5), 200kg/fad was added at soil preparation, both monoculture crops and the intercropping systems were fertilized by 50 kg potassium sulphate (48% K_2O) as single dose before the second irrigation of sugar beet and at pod filling of sole faba bean and intercropping systems.

- **Data recorded:**

1- Growth, root yield traits:

At harvest ten plants were randomly chosen from each sub-plot to estimate the following measurements:

1-1- Number of leaves/plant.
1-2- Root length (cm).
1-3- Root diameters (cm).
1-4- Root weight (g).
1-5- Green foliage yield/plant (g).
1-6- Biological yield/plant (g).
1-7- Root yield/fad (ton).
1-8- Green foliage yield/fad (ton).
1-9- Biological yield/fad (ton).

2- Quality attributes:

Fresh sugar beet samples were taken representing each treatment to determent the following, traits.

2-1-1- Sucrose (%) according to **(Winner, 1982)**
2-1-2- Sugar yield (ton Fad^{-1}) = root yield (ton fad^{-1}) x sucrose %
2-1-3- Alpha amino and potassium contents (mg/100g fw) according to **(Jackson 1965)**)

Statistical analysis:

Mean data collected were statistically analyzed according to **Gomez and Gomez (1984).** Treatment means were compared using Duncan's multiplr range test at 5% and 1%, respectively. All statistical analysis performed using analysis of variance technique by "MSTAT – C" computer software 1990.

IV. RESULTES AND DISCUSSION

1- Sugar beet growth and root yield traits:

1.1. Number of leaves / plant:

Results in **Table 1** showed that, number of leaves / plant of sugar beet significantly affected by sowing dates in both studied seasons. Sugar beet plants under the late sowing date (Nov.15th) had the highest number of leaves/plant (27.09 and 26.21), followed by sugar beet sown in Nov. 1st with averages of 26.25 and 23.56 in both seasons, respectively. On the other side, the results indicated that, sowing sugar beet in Oct. 15th gave the lowest number of leaves /plant in both seasons. **Sarmast (2011)** found that, in sugar beet plants that were sown later in 25th June the warm month have spent most of their nutrients energy for storage of sugar in the root as a result of the large decline in green foliage production, low leaves number and area per plant.

Data in **Table 1** revealed that, number of leaves/plant of sugar beet significantly affected by faba bean densities in both seasons. Sugar beet plants under IS_6 had the highest leaves number /plant (28.63 and 25.88) followed by sugar beet plants sown under IS_4 with averages of 26.66 and 24.88 in both seasons, respectively. In the contrast of this, sugar beet plants under IS_1 gave the lowest leaves number /plant with averages of 23.33 and 23.02 in both seasons, respectively.

The presented data in **Table 1** showed that, number of leaves /plant of sugar beet significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet in Nov. 15th under IS_6 had the highest leaves number/plant (30.39 and 28.90) while, the lowest number of leaves/plant were obtained by sugar beet plants sown in Oct. 15th under IS_1 with averages of 23.55 and 22.10 in both seasons, respectively.

The highly decreased in sugar beet leaves number by the increasing faba bean density due to the increased intra- and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crop of faba bean. **(Aboukhadra *et al.*, 2013)**. Also, **Salama *et al.*, (2016)** revealed that, the number of leaves/plant, leaf area m^2 of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons.

1.2. Root length (cm):

Results in **Table 1** showed that, root length significantly affected by sowing dates in both studied seasons. Sugar beet plants under the late sowing date (Nov. 15th) had the longest roots (32.04 and 32.22), followed by sugar beet sown on Nov. 1st with averages of 29.75 and 29.19 in both seasons, respectively. On the other hand, the results indicated that, sowing sugar beet in 15th Oct. gave the shortest sugar beet roots (27.48 and 27.48) in both seasons, respectively.

Table (1): Effect of sowing date, intercropping system (IS) of sugar beet with faba bean and their interactions on leaves numbers/plant, root length (cm) and root diameter (cm) of sugar beet during 2016/17 and 2017/18 growing seasons.

Factors		Number of leaves/plant		Root length (cm)		Root diameter (cm)	
Sowing date		S1	S2	S1	S2	S1	S2
15th Oct.		24.74 b	22.82 c	27.48 c	27.48 c	16.95 c	16.96 c
1st Nov.		26.25 a	23.56 b	29.75 b	29.19 b	18.36 b	18.01 b
15th Nov.		27.09 a	26.21 a	32.04 a	32.22 a	19.77 a	19.88 a
F test		**	**	**	**	**	**
Intercropping system							
IS_1		23.33 d	23.02 d	26.14 e	25.71 f	16.13 e	15.86 f
IS_2		26.48 b	24.12 c	27.12 e	27.28 e	16.73 e	16.83 e
IS_3		24.81 cd	23.24 d	28.99 d	28.52 d	17.88 d	17.60 d
IS_4		26.26 bc	24.03 c	30.57 c	30.56 c	18.86 c	18.85 c
IS_5		26.66 b	24.88 b	32.05 b	31.81 b	19.78 b	19.63 b
IS_6		28.63 a	25.88 a	33.68 a	33.90 a	20.78 a	20.92 a
F test		**	**	**	**	**	**
Sowing date	Intercropping system						
15th Oct.	IS_1	23.55 fg	22.10 j	23.34 h	23.34 j	14.40 i	14.40 i
	IS_2	25.22 et	23.00 gh	25.41 g	25.41 i	15.68 h	15.68 h
	IS_3	23.49 fg	22.30 j	26.44 g	26.44 hi	16.31 gh	16.32 h
	IS_4	24.79 e-g	22.93 g-i	28.51 f	28.51 tg	17.59 f	17.59 tg
	IS_5	24.99 et	23.00 gh	29.54 et	29.55 e-g	18.23 et	18.23 e-g
	IS_6	26.41 c-e	23.60 f	31.61 cd	31.62 cd	19.51 cd	19.51 cd
1st Nov.	IS_1	23.66 fg	22.53 h-j	26.73 g	25.41 i	16.49 gh	15.68 h
	IS_2	25.77 e	23.37 tg	26.57 g	26.77 h	16.39 gh	16.51 h
	IS_3	25.86 de	22.47 ij	29.83 e	28.51 tg	18.41 et	17.59 tg
	IS_4	26.12 de	24.17 e	29.67 et	29.87 et	18.31 et	18.43 et
	IS_5	27.00 c-e	23.70 et	32.94 bc	31.62 cd	20.32 bc	19.51 cd
	IS_6	29.11 ab	25.13 d	32.77 bc	32.97 bc	20.22 bc	20.34 bc
15th Nov.	IS_1	22.77 g	24.43 e	28.34 f	28.37 g	17.49 tg	17.51 g
	IS_2	28.44 a-c	26.00 c	29.38 f	29.66 e-g	18.13 et	18.30 e-g
	IS_3	25.07 et	24.97 d	30.68 de	30.60 de	18.93 de	18.88 de
	IS_4	27.88 b-d	27.53 b	33.52 b	33.28 b	20.68 bc	20.54 b
	IS_5	28.00 b-d	25.40 d	33.67 b	34.28 b	20.78 b	21.15 b
	IS_6	30.39 a	28.90 a	36.65 a	37.10 a	22.61 a	22.89 a
F test		**	**	**	**	**	**
Sole 15th Oct.		27.22	25.10	31.72	31.73	19.65	19.65
Sole 1st Nov.		28.88	25.92	33.73	33.11	21.19	20.81
Sole 15th Nov.		31.80	30.83	37.24	37.44	22.75	23.87

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IS_3=35000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 20 cm hill space).

IS_4=35000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 20cm hill space).

IS_5=17500 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 40 cm hill space).

IS6 =17500 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 40cm hill space).

The results indicated that, root length significant differ under all sowing dates in both seasons. These findings are in agree with those reported by **Ilkaee *et al.*, (2016)** which evaluated the effect of sowing dates on the quantitative and qualitative traits of sugar beet in Iran and they revealed that, different sowing dates have significant effect on the root length.

Data presented in **Table 1** indicated that, the length of sugar beet roots significant affected by faba bean densities in both seasons. Sugar beet plants under IS_6 gave the longest roots (33.68 and 33.90 cm) followed by sugar beet plants under IS_5 with averages of 32.05 and 31.81 cm in both seasons, respectively. On the other hand, sugar beet plants under IS_1 gave the shortest roots with averages of 26.14 and 25.71 cm in both seasons, respectively.

Data presented in **Table 1** showed that, the length of sugar beet roots significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15^{th} under IS_6 had the longest roots (36.65 and 37.10 cm), while the shortest sugar beet roots were obtained by sugar beet plants sown on Oct. 15^{th} under IS_1 with averages of 23.34 and 23.34 cm in both seasons, respectively.

The results indicated that, the longest sugar beet roots were obtained under the low faba bean densities in the same line. **Mohammed *et al.*, (2005)** reported that, the maximum significant root length of sugar beet was abtained for pure stands, followed by the lowest intercropping density of the companion crop, when sugar beet was intercropped with faba bean. Also, **Abo Mostafa *et al.*, (2012)** found that, the intercropping pattern faba bean on the other side of bed, at 60 cm hill spacing with two plants/hill, alternating with two solid sugar beet ridges produced the highest sugar beet roots length as well as these values suppressed the same obtained from faba bean on the other side of bed at 40 cm hill-spacing with two plants/hill, alternating with one solid sugar beet bed under the second intercropping date. **Salama *et al.*, (2016** revealed that, root length of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons.

1.3. Root diameter (cm):

The obtained data listed in **Table 1** revealed that, root diameters significantly affected by sowing dates in both studied seasons. Sugar beet plants under the late sowing date (Nov. 15^{th}) gave the highest root diameters (19.77 and 19.88 cm), followed by sugar beet sown on Nov. 1^{st} with averages of 18.36 and 18.01 cm in both seasons, respectively. On the other side, the results indicated that, sowing sugar beet on Oct. 15^{th} gave the lowest sugar beet root diameters (16.95 and 16.96 cm) in both

seasons, respectively. The results indicated that, root diameters significant differ under all sowing dates in both seasons. These findings are in agree with those reported by **Ilkaee *et al.*, (2016)** which evaluated the effect of sowing dates on the quantitative and qualitative traits of sugar beet in Iran and they revealed that, different sowing dates had significant effect on root diameters.

Data shown in **Table 1** indicated that, the diameters of sugar beet roots significantly affected by faba bean densities in both seasons. Sugar beet plants under IS_6 had the highest root diameters (20.78 and 20.92 cm), followed by sugar beet plants under IS_5 with averages of 19.78 and 19.36 cm in both seasons, respectively. In the contrast, sugar beet sown under IS_1 gave the lowest root diameters with averages of 16.13 and 15.86 cm in both seasons, respectively.

The presented data in **Table 1** showed that, the diameters of sugar beet roots significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15th under IS_6 had the highest root diameters (22.61 and 22.89 cm), while the lowest sugar beet root diameters were obtained by sugar beet plants sown on Oct. 15th under IS_1 with averages of 14.40 and 14.40 cm in both seasons, respectively.

The results indicated that, the highest sugar beet root diameters were obtained under the low faba bean densities in the same line. **Mohammed *et al.*, (2005)** reported that, the maximum significant root diameters of sugar beet was obtained in pure stands, followed by the lowest intercropping density of the companion crop, when sugar beet was intercropped with faba bean. Also, **Abo Mostafa *et al.*, (2012)** found that, the intercropping pattern of faba bean on the other side of bed, at 60 cm hill spacing with two plants/hill, alternating with two solid sugar beet ridges produced the highest sugar beet roots diameters and these values suppressed the same obtained from faba bean on the other side of bed at 40 cm hill-spacing with two plants/hill, alternating with one solid sugar beet bed under the second intercropping date. **Salama *et al.*, (2016** revealed that, root diameter of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons.

1.4. Root weight (g):

Results listed in **Table 2** indicated that, the root weight of sugar beet plants significantly affected by sowing dates in both studied seasons. Sugar beet plants under the late sowing date (Nov. 15th) showed the heaviest roots (929.15 and 934.25 g) followed by sugar beet sown on Nov. 1st with averages of 862.80 and 846.55 g in both seasons, respectively. On the other side, the results indicated that, sowing sugar beet on Oct. 15th gave the lowest root weight (796.80 and 796.90 g) in

both seasons, respectively. The results indicated that, root yield/plant significant differ under all sowing dates in both seasons. These findings are in agree with those reported by **Ilkaee *et al.*, (2016)** which evaluated the effect of sowing dates on the quantitative and qualitative traits of sugar beet in Iran and they revealed that, different sowing dates have significant effect on root yield/plant. These findings are in agree with those obtained by **Ntwana and Tuwana (2013)** who investigated the effect of sowing date on yield and sugar content of sugar beet cultivars and they found that, low temperature during sowing date in May gave the highest root yield /plant which was significantly higher than yields obtained from other high temperature sowing date in June.

Data presented in **Table 2** revealed that, the weight of sugar beet roots significant affected by faba bean densities in both seasons. Sugar beet plants sown under IS_6 had the heaviest roots (976.70 and 983.03 g), followed by sugar beet plants sown under IS_5 with averages of 929.50 and 922.60 in both seasons, respectively. In the contrast, sugar beet plants sown under IS_1 gave the lowest root weight with averages of 757.93 and 745.53 in both seasons, respectively.

Data presented in **Table 2** showed that, the weight of sugar beet root significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15^{th} under IS_6 had the highest root weight (1062.90 and 1076.00 g), while the lowest root weights were obtained by sugar beet plants sown on Oct. 15^{th} under IS_1 with averages of 676.80 and 676.90 g in both seasons, respectively.

The highest root weight of sugar beet under the low faba densities may due to the low competitions between the two crops under these densities compared with the densities in this way. **Mohammed *et al.*, (2005)** reported that, the effect of intercropping on the root yield of sugar beet, mainly depends on the nature and growth habit of the companion crop. However, the maximum significant root yield per plant of sugar beet was achieved for pure stands, followed by the lowest intercropping density of the companion crop, when sugar beet was intercropped with faba bean. **Aboukhadra *et al.*, (2013)** indicated that, the highest sugar beet root yield per plant were recorded with decreased densities of different companion crops. This reduction in sugar beet traits was mainly due to the increased of intra- and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crops. **Abo Mostafa *et al.*, (2012)** reported that, the intercropping pattern of faba bean on the other side of bed, at 60 cm hill spacing with two plants/hill, alternating with two solid sugar beet ridges produced the highest sugar beet root yield per plant as well as these values suppressed the same obtained from faba bean on the

other side of bed at 40 cm hill-spacing with two plants/hill, alternating with one solid sugar beet bed under the second intercropping date. **Salama *et al.*, (2016)** revealed that, root yield per plant of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons.

1.5. Top weight (g):

Results shown in **Table 2** showed that, sugar beet top weight did not affected significantly by sowing dates in both studied seasons.

The presented data in **Table 2** revealed that, the weight of sugar beet tops significant affected by faba bean densities in both seasons. Sugar beet plants sown under IS_6 gave the highest top weights (274.44 and 279.93 g), followed by sugar beet plants under IS_4 with averages of 264.44 and 269.73 cm in both seasons, respectively. On the other hand, sugar beet plants sown under IS_1gave the lowest top weight with averages of 216.67 and 221.00 g in both seasons, respectively.

The presented data in **Table 2** showed that, the weight of sugar beet tops did not affected significantly by the interaction of intercropping systems and sowing dates in both seasons.

1.6. Biological yield/plant (g):

Data in **Table 2** revealed that, biological yield/plant significantly affected by sowing dates in both studied seasons. Sugar beet plants in the late sowing date (Nov. 15th) had the highest biological yield/plant (1174.15 and 1184.15 g), followed by sugar beet sown on Nov. 1st with averages of 1106.69 and 1095.32 g in both seasons, respectively. On the other side, sowing sugar beet on Oct. 15th gave the lowest sugar beet biological yield/plant (1017.08 and 1021.58 g) in both seasons, respectively.

The effect of sowing date on biological yield of sugar beet may due to their effect on root weight or the canopy alone or together. For root weight **Ilkaee *et al.*, (2016)** revealed that, different sowing dates have significant effect on root yield/plant of sugar beet. These findings are in agree with those obtained by **Ntwana and Tuwana (2013)** who investigate the effect of sowing date on yield and sugar content of sugar beet cultivars and they found that, low temperature during sowing date in May gave the highest root yield /plant which was significantly higher than yields obtained from other high temperature sowing date in June. **Sarmast (2011)** found that, in sugar beet plants that, were sown later in 25 June sugar beet under this warm month have spent most of their nutrients energy for storage of sugar in the root as a result of the large decline in green foliage production, low leaves number and area per plant and this may resulted in decline sugar beet canopy and the final top weight.

Table (2): Effect of sowing date, intercropping system (IS) of sugar beet with faba bean and their interactions on root weight (g), top weight/plant (g) and biological yield/plant (g) of sugar beet during 2016/17 and 2017/18 growing seasons.

Factors		Root weight (g)		Top weight /plant (g)		Biological yield/ plant (g)	
Sowing date		S1	S2	S1	S2	S1	S2
15th Oct.		796.80 c	796.90 c	220.28	224.68	1017.08 c	1021.58 c
1st Nov.		862.80 b	846.55 b	243.89	248.77	1106.69 b	1095.32 b
15th Nov.		929.15 a	934.25 a	245.00	249.90	1174.15 a	1184.15 a
F test		**	**	Ns	Ns	**	**
Intercropping system							
IS_1		757.93 e	745.53 f	216.67 bc	221.00 bc	974.60 d	966.53 d
IS_2		786.40 e	791.10 e	258.89 ab	264.07 ab	1045.29 c	1055.17 c
IS_3		840.57 d	827.03 d	191.67 c	195.50 c	1032.23 c	1022.53 c
IS_4		886.40 c	886.10 c	264.44 a	269.73 a	1150.84 b	1155.83 b
IS_5		929.50 b	922.60 b	212.22 c	216.47 c	1141.72 b	1139.07 b
IS_6		976.70 a	983.03 a	274.44 a	279.93 a	1251.14 a	1262.97 a
F test		**	**	*	*	**	**
Sowing date	Intercropping system						
15th Oct.	IS_1	676.80 h	676.90 g	206.67	210.80	883.47 k	887.70 i
	IS_2	736.80 g	736.90 f	243.33	248.20	980.13 ij	985.10 gh
	IS_3	766.80 g	766.90 f	185.00	188.70	951.80 jk	955.60 hi
	IS_4	826.80 f	826.90 e	213.33	217.60	1040.13 hi	1044.50 fg
	IS_5	856.80 ef	856.90 de	223.33	227.80	1080.13 f-h	1084.70 ef
	IS_6	916.80 cd	916.90 bc	250.00	255.00	1166.80 c-e	1171.90 cd
1st Nov.	IS_1	775.20 g	736.90 f	253.33	258.40	1028.53 h-j	995.30 gh
	IS_2	770.40 g	776.20 f	263.33	268.60	1033.73 hi	1044.80 fg
	IS_3	865.20 ef	826.90 e	190.00	193.80	1055.20 g-i	1020.70 f-h
	IS_4	860.40 ef	866.20 de	276.67	282.20	1137.07 d-f	1148.40 c-e
	IS_5	955.20 bc	916.90 bc	213.33	217.60	1168.53 c-e	1134.50 de
	IS_6	950.40 bc	956.20 b	266.67	272.00	1217.07 bc	1228.20 bc
15th Nov.	IS_1	821.80 f	822.80 e	190.00	193.80	1011.80 h-j	1016.60 f-h
	IS_2	852.00 ef	860.20 de	270.00	275.40	1122.00 d-g	1135.60 de
	IS_3	889.70 de	887.30 cd	200.00	204.00	1089.70 e-h	1091.30 ef
	IS_4	972.00 b	965.20 b	303.33	309.40	1275.33 b	1274.60 b
	IS_5	976.50 b	994.00 b	200.00	204.00	1176.50 cd	1198.00 b-d
	IS_6	1062.90 a	1076.00 a	306.67	312.80	1369.57 a	1388.80 a
F test		**	**	Ns	Ns	**	**
Sole 15th Oct.		918.48	918.59	252.31	247.15	1170.79	1165.74
Sole 1st Nov.		959.08	961.21	278.28	285.64	1237.36	1246.85
Sole 15th Nov.		1065.07	1079.68	349.5	364.89	1414.57	1444.57

IS= Inter cropping system In all intercropping systems (IS) sugar beet was35000 plants/fad (sugar beet sown in the two sides of bed 120cm width with 1 plant/hill and 20cm hill space)

IS= Inter cropping system In all intercropping systems (IS) sugar beet was35000 plants/fad (sugar beet sown in the two sides of bed 120cm width with 1 plant/hill and 20cm hill space)

IS_1=70000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 10cm hill space).

IS_2=70000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 10cm hill space).

IS_3=35000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 20 cm hill space).

IS_4=35000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 20cm hill space).

IS_5=17500 faba bean plant/fad (sown one row on the top of sugar beet ridges with two plants/hill and 40 cm hill space).

IS6 =17500 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one plant/hill and 40cm hill space).

Data listed in **Table 2** indicated that, biological yield/plant of sugar beet significant affected by faba bean densities in both seasons. Sugar beet plants sown under IS_6 had the highest biological yield/plant (1251.14 and 1262.97 g), followed by sugar beet plants sown under IS_4 with averages of 1150.84 and 1155.83 g in both seasons, respectively. In the contrast, sugar beet plants sown under IS_1gave the lowest biological yield/plant with averages of 974.60 and 966.53 g in both seasons, respectively.

The presented data in Table 2 showed that, biological yield/plant of sugar beet significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15th under IS_6 had the highest biological yield/plant (1369.57 and 1388.97 g), followed by the same sowing date (Nov. 15th) under IS_4 with averages of 1275.33 and 1274.60 g in both seasons, respectively. The lowest biological yield/plant obtained by sugar beet plants sown on Oct. 15th under IS_1 with averages of 883.47 and 887.70 g in both seasons, respectively.

Increasing biological yield of sugar beet under the low faba bean densities may due to the increase in root weight or the canopy alone or together. The highest root weight of sugar beet under the low faba densities may due to the low competitions between the two crops under these densities compared with the densities in this way. **Mohammed *et al.*, (2005)** reported that, the effect of intercropping on the root yield of sugar beet, mainly depends on the nature and growth habit of the companion crop. However, the maximum significant root yield per plant of sugar beet was achieved for pure stands, followed by the lowest intercropping density of sugar beet with faba bean. **Aboukhadra *et al.*, (2013)** indicated that, the highest sugar beet root yield per plant were recorded with decreased densities of different companion crops. This reduction in sugar beet traits was due to the increased of intra- and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crops. **Abo Mostafa *et al.*, (2012)** reported that, the intercropping pattern of faba bean on the other side of bed, at 60 cm hill spacing with two plants/hill, alternating with two solid sugar beet ridges produced the highest sugar beet roots yield per plant as well as these values suppressed the same obtained from faba bean on the other side of bed at 40 cm hill-spacing with two plants/hill, alternating with one solid sugar beet bed under the second intercropping date. **Salama *et al.*, (2016)** revealed that, root yield per plant of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons. As for top weight, the highest competition increased the intra- and intercrop competition between the sugar beet, as a main crop, and the high

densities of the companion crops (faba bean) resulted in reduce leaves number of sugar beet **(Aboukhadra *et al.*, 2013)**. Also, **Salama *et al.*, (2016)** revealed that, the number of leaves/plant, leaf area (cm^2) of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons.

1.7. Root yield/fad (ton):

Results shown in **Table 3** indicated that, root yield/fad of sugar beet significantly affected by sowing dates in both studied seasons. Sugar beet under the late sowing date (15^{th} Nov.) had the highest root yield/fad (30.97 and 31.14 ton) followed by sugar beet sown in 1^{st} Nov. with averages of 28.76 and 28.22 ton in both seasons, respectively. On the other side, sowing sugar beet on Oct. 15^{th} gave the lowest root yield/fad (26.56 and 26.56 ton) in both seasons, respectively. These findings are in agree with those reported by **Ilkaee *et al.*, (2016)** where they revealed that, different sowing dates have significant effect on sugar beet root yield/ha.

Data listed in **Table 3** revealed that, the root yield/fad of sugar beet significantly affected by faba bean densities in both seasons. Sugar beet sown under IS_6 had the highest root yield/fad (32.56 and 32.77 ton), followed by sugar beet plants sown under IS_5 with averages of 30.98 and 30.75 ton in both seasons, respectively. In the contrast, sugar beet plants sown under IS_1 gave the lowest root yield/fad with averages of 25.26 and 24.85 in both seasons, respectively.

The presented data in **Table 3** showed that, root yield/fad of sugar beet significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15^{th} under IS_6 had the highest root yield/fad (35.43 and 35.87 ton), followed by the interaction of 15^{th} Nov. under IS_5, where the averages of both seasons were32.55 and 33.13 ton, respectively. The lowest root yield/fad obtained by sugar beet sown on Oct. 15^{th} under IS_1 with averages of 22.56 and 22.56 ton in both seasons, respectively.

In this study, the highest sugar beet yield/fad were obtained under the low faba bean densities in the same line **Mohammed *et al.*, (2005)** reported that, the effect of intercropping on the root yield of sugar beet, mainly depends on the nature and growth habit of the companion crop. However, the maximum significant root yield per fad of sugar beet was achieved for pure stands, followed by the lowest intercropping density of the companion crop, when sugar beet was intercropped with faba bean. **Aboukhadra *et al.*, (2013)** indicated that, the highest sugar

beet root yield per plant and per fad as well as sugar yields were recorded with decreased densities of different companion crops. This reduction in sugar beet traits was due to the increased of intra- and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crops. **Abo Mostafa *et al.*, (2012)** indicated that, the intercropping pattern of faba bean on the other side of bed, at 60 cm hill spacing with two plants/hill, alternating with two solid sugar beet ridges produced the highest sugar beet roots yield per plant and per fad as well as these values suppressed the same obtained from faba bean on the other side of bed at 40cm hill-spacing with two plants/hill, alternating with one solid sugar beet bed under the second intercropping date

1.8. Top yield/fad (ton):

Results presented in **Table 3** showed that, sugar beet top yield/fad significantly affected by sowing dates in both studied seasons. Sugar beet plants sown under the late sowing date (15th Nov.) had the highest top yield/fad (7.93 and 7.91 ton) in both seasons, respectively, but these values did not differ significant with those of sugar beet sown on Nov. 1st (7.37 and 7.35 ton) in both seasons, respectively. The effect of sowing date on top yield /plant may effect on the total amount of top yield /fad in the same way, **Sarmast (2011)** found that, in sugar beet plants that, were sown later on June 25th have spent most of their nutrients energy for storage of sugar in the root as a result of the large decline in green foliage production, low leaves number and area per plant and this may resulted in decline sugar beet canopy and the final top weight.

The presented data in **Table 3** revealed that, sugar beet top yield/fad significant affected by faba bean densities in both seasons. Sugar beet plants sown under IS_6 gave the highest top yield/fad (8.74 and 8.71 ton), followed by sugar beet plants sown under IS_2 with averages of 8.14 and 8.12 ton and IS_4 with averages of 8.06 and 8.04 ton in both seasons, respectively, without significant differences between the three intercropping systems in this concern. On the other hand, sugar beet plants sown under IS_3 gave the lowest top yield/fad with averages of 5.74 and 5.72 ton in both seasons, respectively.

The presented data in **Table 3** showed that, top yield/fad significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15th under IS_6 had the highest top yield/fad (10.30 and 10.27 ton). While the lowest top yield/fad obtained by sugar beet plants sown on Oct. 15th under IS_3 with averages of 5.26 and 5.24 ton in both seasons, respectively.

Table (3): Effect of sowing date, intercropping system (IS) of sugar beet with faba bean and their interactions on root yield/fad (ton), top yield/fad (ton) and biological yield/fad (ton) of sugar beet during 2016/17 and 2017/18 growing seasons.

Factors		Root yield /fad (ton)		Top yield / fad(ton1)		Biological yield /fad (ton)	
Sowing date		S1	S2	S1	S2	S1	S2
15th Oct.		26.56 c	26.56 c	6.41 b	6.39 b	32.97 c	32.95 c
1st Nov.		28.76 b	28.22 b	7.37 ab	7.35 ab	36.13 b	35.57 b
15th Nov.		30.97 a	31.14 a	7.93 a	7.91 a	38.90 a	39.05 a
F test		**	**	**	**	**	**
Intercropping system							
IS_1		25.26 e	24.85 f	6.55 b	6.53 b	31.82 d	31.38 d
IS_2		26.21 e	26.37 e	8.14 a	8.12 a	34.36 c	34.49 c
IS_3		28.02 d	27.57 d	5.74 b	5.72 b	33.76 c	33.29 c
IS_4		29.55 c	29.54 c	8.06 a	8.04 a	37.61 b	37.57 b
IS_5		30.98 b	30.75 b	6.19 b	6.17 b	37.18 b	36.93 b
IS_6		32.56 a	32.77 a	8.74 a	8.71 a	41.29 a	41.48 a
F test		**	**	*	*	**	**
Sowing date	Intercropping system						
15th Oct.	IS_1	22.56 h	22.56 j	6.12 f-h	6.10 f-h	28.68 k	28.66 k
	IS_2	24.56 g	24.56 i	7.01 c-h	6.99 d-h	31.57 ij	31.55 ij
	IS_3	25.56 g	25.56 i	5.26 h	5.24 h	30.82 jk	30.80 jk
	IS_4	27.56 f	27.56 f-h	5.95 gh	5.93 gh	33.51 hi	33.50 hi
	IS_5	28.56 ef	28.56 e-g	6.46 d-h	6.44 d-h	35.02 f-h	35.01 f-h
	IS_6	30.56 cd	30.56 cd	7.64 c-g	7.61 c-g	38.20 c-e	38.18 c-e
1st Nov.	IS_1	25.84 g	24.56 i	7.72 b-g	7.70 b-g	33.56 hi	32.26 ij
	IS_2	25.68 g	25.87 hi	8.16 b-f	8.13 b-f	33.84 hi	34.01 g-i
	IS_3	28.84 ef	27.56 f-h	5.87 gh	5.86 gh	34.71 gh	33.42 hi
	IS_4	28.68 ef	28.87 ef	8.46 a-d	8.43 a-d	37.14 d-g	37.30 d-f
	IS_5	31.84 bc	30.56 cd	5.76 gh	5.74 gh	37.60 c-f	36.30 e-g
	IS_6	31.68 bc	31.87 bc	8.27 a-e	8.25 a-e	39.95 bc	40.12 bc
15th Nov.	IS_1	27.39 f	27.43 gh	5.81 gh	5.79 gh	33.20 h-j	33.22 h-j
	IS_2	28.40 ef	28.67 e-g	9.26 a-c	9.24 a-c	37.66 c-e	37.91 c-e
	IS_3	29.66 de	29.58 de	6.08 f-h	6.06 f-h	35.74 e-h	35.64 e-h
	IS_4	32.40 b	32.17 b	9.78 ab	9.75 ab	42.18 b	41.92 b
	IS_5	32.55 b	33.13 b	6.36 e-h	6.34 e-h	38.91 cd	39.47 b-d
	IS_6	35.43 a	35.87 a	10.30 a	10.27 a	45.73 a	46.14 a
F test		**	**	*	**	**	**
Sole 15th Oct.		31.22	31.72	7.80	7.78	39.02	38.50
Sole 1st Nov.		32.64	33.17	8.86	8.59	41.50	40.63
Sole 15th Nov.		36.37	36.86	10.43	10.40	46.50	46.66

IS= Inter cropping system In all intercropping systems (IS) sugar beet was35000 plants/fad (sugar beet sown in the two sides of bed 120cm width with 1 plant/hill and 20cm hill space)

IS= Inter cropping system In all intercropping systems (IS) sugar beet was35000 plants/fad (sugar beet sown in the two sides of bed 120cm width with 1 plant/hill and 20cm hill space)

IS_1=70000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two seeds/hill and 10cm hill space).

IS_2=70000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one seed/hill and 10cm hill space).

IS_3=35000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two seeds/hill and 20 cm hill space).

IS_4=35000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one seed/hill and 20cm hill space).

IS_5=17500 faba bean plant/fad (sown one row on the top of sugar beet ridges with two seeds/hill and 40 cm hill space).

IS6 =17500 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one seed/hill and 40cm hill space).

The decreased of sugar beet top yield/plant under the highest faba bean densities decreased in the total top yield/fad. This may be due to the decline of the canopy that, happened under the high competition between the two crops resulting in the large decrease in leaf area and leaves numbers. In the high competition, the increase of intra- and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crops (faba bean) resulted in reduce leaves number of sugar beet **(Aboukhadra *et al.*, 2013)**. Also, **Salama *et al.*, (2016)** revealed that, the number of leaves/plant, leaf area (cm^2) of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons.

1.9. Biological yield/fad (ton):

The obtained data in **Table 3** revealed that, biological yield/fad significantly affected by sowing dates in both studied seasons. Sugar beet plants sown under the late sowing date (15^{th} Nov.) had the highest biological yield/fad (38.90 and 39.05 ton), followed by sugar beet sown on Nov. 1^{st} with averages of 36.13 and 35.57 ton in both seasons, respectively. On the other side, sowing sugar beet on Oct. 15^{th} gave the lowest sugar beet biological yield/fad (32.97 and 32.95 to) in both seasons, respectively. The same line of these results were obtained by **Ilkaee *et al.*, (2016)** which found that, different sowing dates have significant effect on sugar beet biological yield/ha.

Data listed in **Table 3** indicated that, biological yield/fad of sugar beet significant affected by faba bean densities in both seasons. Sugar beet plants sown under IS_6 had the highest biological yield/fad (41.29 and 41.48 ton), followed by sugar beet plants sown under IS_4 with averages of 37.61 and 37.57 ton in both seasons, respectively. In the contrast, sugar beet plants sown under IS_1 gave the lowest biological yield/fad with averages of 31.82 and 31.38 ton in both seasons, respectively.

The presented data in **Table 3** showed that, biological yield/fad of sugar beet significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15^{th} under IS_6 had the highest biological yield/fad (45.73 and 46.14 ton). While the lowest biological yield/fad was obtained by sugar beet plants sown on Oct. 15^{th} under IS_1 with averages of 28.68 and 28.66 ton in both seasons, respectively.

The increase of biological yield/plant of sugar beet under the low faba bean densities may increase the total biological yield/fad. This may be due to the increase in root weight or the canopy alone or together. In this study, the highest sugar beet yield/fad were obtained under the low faba bean densities. **Mohammed *et al.*, (2005)** reported that, the effect of intercropping on the root yield of sugar beet, mainly depends on

the nature and growth habit of the companion crop. However, the maximum significant root yield per fad of sugar beet was achieved for pure stands, followed by the lowest intercropping density of the companion crop, when sugar beet was intercropped with faba bean. **Aboukhadra *et al.*, (2013)** indicated that, the highest sugar beet root yield per plant and fad as well as sugar yield were recorded with decreased densities of different companion crops. This reduction in sugar beet traits due to the increase of intra-and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crops. **Abo Mostafa *et al.*, (2012)** indicated that, the intercropping pattern faba bean on the other side of bed, at 60 cm hill spacing with two plants/hill, alternating with two solid sugar beet ridges produced the highest sugar beet root yield per plant and fad. These values suppressed the same obtained from faba bean on the other side of the bed at 40 cm hill-spacing with two plants/hill, alternating with one solid sugar beet bed under the second intercropping date. As for top weight, the high competition led to the increase of intra- and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crops (faba bean) resulted in reduce leaves number of sugar beet **(Aboukhadra *et al.*, 2013)**. Also, **Salama *et al.*, (2016)** revealed that, the number of leaves/plant, leaf area (cm^2) of sugar beet were significantly affected by the interaction between the companion crop species and percentage in both seasons.

2- Root quality characters:

2-1- Sugar percentage:

Results in **Table 4** indicated that, sugar percentage did not affected significantly by sowing dates in both studied seasons.

Data in **Table 4** revealed that, sugar percentage did not affected significantly by faba bean densities in the 1st season and significantly affected by the 2nd season. In the 2nd season sugar beet sown under IS_6 had the significantly highest sugar percentages 16.51 %), followed by sugar beet plants sown under IS_4 with an average of 16.23 %. In the contrast of this, sugar beet plants sown under IS_2 gave the lowest sugar percentage with an average of 15.26 in the 2nd season.

The presented data in **Table 4** showed that, sugar percentage did not affected significantly by the interaction of intercropping systems and sowing dates in both seasons.

2-2- Sugar yield/fad (ton):

Results in **Table 4** showed that, sugar top yield/fad significantly affected by sowing dates in both studied seasons. Sugar beet plants sown under the late sowing date (15th Nov.) had the highest sugar yield/fad (5.00 and 5.00 ton) in both seasons, respectively followed by sugar beet

sown in either 1st Nov. or 15th Oct., where there is no significant difference between both sowing date in this concern in both seasons.

The presented data in **Table 4** revealed that, sugar yield/fad significantly affected by faba bean densities in both seasons. Sugar beet plants sown under IS_6 gave the highest sugar yield/fad (5.32 and 5.41 ton) followed by sugar beet plants sown under IS_5 (5.00 and 4.90 ton) then IS_4 with averages of 4.77 and 4.79 ton in both seasons, respectively with no significant difference between both faba bean densities. On the other hand, sugar beet plants sown under IS_1gave the lowest sugar yield/fad with averages of 4.07 and 3.87 ton in both seasons, respectively.

The presented data in **Table 4** showed that, sugar yield/fad significantly affected by the interaction of intercropping systems and sowing dates in both seasons.

Sowing sugar beet on Nov. 15th under IS_6 had the highest sugar yield/fad (5.83 and 6.08 ton), followed by the interaction of Nov. 15th and **IS_6** in both seasons. While, the lowest sugar yield/fad was obtained by sugar beet plants sown on Oct. 15th under **IS_1** with averages of 3.59 and 3.54 ton in both seasons, respectively.

Aboukhadra *et al.*, (2013a) indicated that, the highest sugar yields were recorded with decreased densities of different companion crops. This reduction in sugar beet traits due to the increased intra- and intercrop competition between the sugar beet, as a main crop, and the high densities of the companion crops could be due to the high competition between plants in the unit area. In another study **Aboukhadra *et al.*, (2013b)** found an increase in sugar yield and sucrose % of sugar beet intercropped with low densities of wheat and faba bean, respectively. **Salama *et al.*, (2016)** revealed that, sugar yield (ton ha^{-1}) of sugar beet were significantly affected by the interaction between the companion crop species and percentage of sugar in both seasons.

2-3- Root contents of alpha amino (mg/g fw.):

The obtained data in **Table 4** revealed that, root content of alpha amino significantly affected by sowing dates in both studied seasons. Sugar beet plants sown under the late sowing date (Nov. 1th) had the highest alpha amino (3.14 mg/g fw.) followed by sugar beet sown in either on Oct. 15th or on Nov. 15th in the first season, where there is no significant difference between the two sowing dates in this concern. While, Sugar beet plants sown under the late sowing date (15th Nov.) had the highest alpha amino (3.38 mg/g fw.) followed by sugar beet sown either in 15th Oct. (2.95 mg/g fw) or in 1st Nov. (2.91 mg/g fw) with no significant difference between both sowing dates.

Table (4): Effect of sowing date, intercropping system (IS) of sugar beet with faba bean and their interactions on sugar percentage, sugar yield/fad (ton), sugar purification (%) and root content of alpha amino (mg/g) of sugar beet during 2016/17 and 2017/18 growing seasons.

Factors		Sugar %		Sugar yield /fad (ton)		Alpha amino		K (mg/g fw.)	
sowing date		S1	S2	S1	S2	S1	S2	S1	S2
15th Oct.		16.27	16.13	4.33 b	4.29 b	2.80 b	2.95 b	6.40	6.51 b
1st Nov.		15.82	15.57	4.55 b	4.39 b	3.14 a	2.91 b	6.39	6.72 ab
15th Nov.		16.13	16.02	5.00 a	5.00 a	2.73 b	3.38 a	6.37	6.93 a
F test		-	-	**	**	*	**	Ns	**
Intercropping system									
IS_1		16.11	15.59 cd	4.07 c	3.87 e	2.87	2.66 b	6.37 a	6.46 b
IS_2		16.11	15.26 d	4.23 c	4.02 d	3.03	2.98 ab	6.50 a	6.77 ab
IS_3		15.62	15.91 bc	4.37 c	4.38 c	2.70	3.15 a	5.97 b	6.88 a
IS_4		16.14	16.23 ab	4.77 b	4.79 b	2.94	3.24 a	6.59 a	6.76 ab
IS_5		16.13	15.93 bc	5.00 ab	4.90 b	2.78	3.19 a	6.39 ab	6.66 ab
IS_6		16.33	16.51 a	5.32 a	5.41 a	3.02	3.26 a	6.51 ab	6.80 a
F test		Ns	*	**	**	Ns	*	*	*
Sowing date	Intercropping system								
15th Oct.	IS_1	15.92	15.70	3.59 i	3.54 h	2.31	2.44	6.18	6.30 f
	IS_2	15.93	15.33	3.91 hi	3.77 gh	3.15	2.81	6.35	6.62 d-f
	IS_3	16.15	16.59	4.13 gh	4.24 ef	2.65	3.01	6.02	6.35 ef
	IS_4	16.65	16.97	4.59 e-g	4.68 c-e	2.91	3.32	6.82	6.72 c-e
	IS_5	16.25	15.51	4.64 c-f	4.43 de	2.94	3.09	6.50	6.45 d-f
	IS_6	16.70	16.69	5.10 bc	5.10 bc	2.82	3.03	6.53	6.62 d-f
1st Nov.	IS_1	15.92	15.83	4.12 gh	3.88 f-h	3.14	2.34	6.30	6.40 ef
	IS_2	16.19	15.06	4.17 f-h	3.89 f-h	3.08	2.89	6.48	6.85 a-d
	IS_3	15.30	14.99	4.42 fg	4.13 e-g	2.96	2.79	6.50	7.06 a-c
	IS_4	15.70	15.50	4.50 fg	4.46 de	3.02	2.81	6.36	6.72 c-e
	IS_5	15.98	16.15	5.09 b-d	4.93 bc	3.35	3.28	6.28	6.69 c-f
	IS_6	15.83	15.87	5.02 b-e	5.06 bc	3.28	3.36	6.44	6.62 d-f
15th Nov.	IS_1	16.50	15.25	4.52 fg	4.18 e-g	3.16	3.20	6.63	6.69 c-f
	IS_2	16.20	15.39	4.60 d-g	4.41 de	2.87	3.25	6.67	6.84 a-d
	IS_3	15.40	16.16	4.57 e-g	4.78 cd	2.48	3.64	5.40	7.25 a
	IS_4	16.07	16.21	5.21 b	5.22 bc	2.88	3.59	6.58	6.84 a-d
	IS_5	16.17	16.13	5.26 b	5.35 b	2.05	3.20	6.38	6.83 b-d
	IS_6	16.45	16.96	5.83 a	6.08 a	2.97	3.38	6.57	7.17 ab
F test		Ns	Ns	**	**	Ns	Ns	Ns	*
Sole 15th Oct.		17.89	17.74	5.23	5.18	3.25	3.25	7.04	7.16
Sole 1st Nov.		17.40	17.12	5.51	5.31	3.20	3.20	7.03	7.39
Sole 15th Nov.		17.74	17.62	6.04	6.03	3.71	3.71	7.01	7.63

IS= Inter cropping system In all intercropping systems (IS) sugar beet was35000 plants/fad (sugar beet sown in the two sides of bed 120cm width with 1 plant/hill and 20cm hill space)

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IS_1=70000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two seeds/hill and 10cm hill space).

IS_2=70000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one seed/hill and 10cm hill space).

IS_3=35000 faba bean plant/fad (sown one row on the top of sugar beet ridges with two seeds/hill and 20 cm hill space).

IS_4=35000 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one seed/hill and 20cm hill space).

IS_5=17500 faba bean plant/fad (sown one row on the top of sugar beet ridges with two seeds/hill and 40 cm hill space).

IS6 =17500 faba bean plant/fad (sown two rows on the top of sugar beet ridges with one seed/hill and 40cm hill space).

Data in **Table 4** indicated that, root content of alpha amino significant affected by faba bean densities in the 2nd season only. In the 2nd season, sugar beet plants sown under IS_6 had the highest root content of alpha amino (3.26 mg/g fw.). The exceeded of IS_6 in this trait did not differ significantly with all intercropping systems, except **IS_1**. In the contrast, sugar beet plants sown under IS_1 gave the lowest root content of alpha amino with an average of 2.66 mg/g fw. in the 2nd season.

The presented data in **Table 4** showed that, root content of alpha amino did not affected significantly by the interaction of intercropping systems and sowing dates in both seasons.

2-7- Root content of K (mg/g fw.):

Results in **Table 4** indicated that, sugar beet root content of K did not affected significantly by sowing dates in the 1st season and significant affected in the 2nd season. Sugar beet plants sown under the late sowing date (Nov. 15th) had the highest root content of K (6.93 mg/g fw.), but these values did not differ significantly with those obtained by sugar beet sowing on Nov. 1st (6.72 mg/g fw.). In the contrast of this **Sarmast (2011)** found that, sugar beet plants sown later have spent most of their nutrients and energy for storage of sugar in the root.

The presented data in **Table 4** indicated that, root content of K significantly affected by faba bean densities in both seasons. In the 1st season sugar beet plants sown under IS_4 gave the highest root content of K (6.59 mg/g fw.) but this value did not differ significant with all intercropping systems except IS_3. In the second season sugar beet plants sown under IS_3 gave the highest root content of K (6.88 mg/g fw.) but this value did not differ significantly with all intercropping systems except IS_1.

The presented data in **Table 4** showed that, root content of K did not affect significantly by the interaction of intercropping systems (IS) and sowing dates in the the 1st season and significantly affected in the 2nd season.

Sowing sugar beet on Nov. 15th under IS_3 had the highest root content of K (7.25 mg/g fw.), while the lowest root content of K was obtained by sugar beet plants sown on Oct. 15th under $IS_1$with an average of 6.30 mg/g fw.

In this study, the intercropping systems significantly effect in K content in sugar beet root in the same way, **Aboukhadra *et al.*, (2013b)** found an increase in leaf content of N.P.K as well as Ca, Mg and Na. of sugar beet intercropped with low densities of wheat and faba bean, respectively. The high values of K content in the leaf may storage in the roots.

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تقييم سلوك بعض صفات بنجر السكر المحمل مع الفول البلدى

رمضان على الرفاعى[1]، اسامه عبد الحميد عبد الرازق[1] ،

أحمد محمد شيحة [2] و ربيع اسامه البرقى[2]

1 قسم المحاصيل – كلية الزراعة – جامعة طنطا – مصر .

2 قسم بحوث التكثيف المحصولى – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – مصر .

أقيمت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بالجميزة – محافظة الغربية خلال الموسمين الشتويين 2017/2016 و 2017/ 2018 لدراسة تأثير ثلاثة مواعيد زراعة (15 أكتوبر، 1 نوفمبر و 15 نوفمبر) للفول البلدى و ستة أنظمة تحميل لبنجر السكر الصنف حلاوة مع صنف الفول البلدى جيزة 843 (ن ت1: 70000 نبات من الفول البلدى مزروعة فى صف واحد أعلى خط البنجر بمعدل بذرتين/جورة على مسافة 10سم بين الجور، ن ت2: 70000 نبات من الفول البلدى مزروعة فى صفين أعلى خط البنجر بمعدل بذرة/جورة على مسافة 10سم بين الجور، ن ت3: 35000 نبات من الفول البلدى مزروعة فى صف واحد أعلى خط البنجر بمعدل بذرتين/جورة على مسافة 20سم بين الجور، ن ت4: 35000 نبات من الفول البلدى مزروعة فى صفين أعلى خط البنجر بمعدل بذرة واحدة/جورة على مسافة 20سم بين الجور، ن ت5: 17500 نبات من الفول البلدى مزروعة فى صف واحد أعلى خط البنجر بمعدل بذرتين/جورة على مسافة 40سم بين الجور، ن ت6: 17500 نبات من الفول البلدى مزروعة فى صفين أعلى خط البنجر بمعدل بذرة واحدة/جورة على مسافة 40سم بين الجور. صممت التجربة الحقلية فى نظام القطع المنشقة من ثلاث مكررات حيث وضعت مواعيد الزراعة فى القطع الرئيسية و نظم التحميل فى القطع الشقية. أعتبر محصول بنجر السكر هو المحصول الرئيسى بكثافة نباتية 35000 نبات /فدان وعومل الفول البلدى على أنه المحصول الثانوى. تم قياس الصفات التالية لبنجر السكر وهى، عدد الأوراق/نبات، طول

الجذر، قطر الجذر، وزن الجذر، الوزن القمى للنبات، المحصول البيولوجى للنبات، محصول الجذور للفدان، الوزن القمى للفدان و المحصول البيولوجى للفدان.

و قد أكدت النتائج وجود تأثير عالى المعنوية لمواعيد الزراعة على جميع الصفات المدروسة ما عدا الوزن القمى للنبات حيث كان التاثير غير معنوياً. أعطى ميعاد الزراعة المتأخر (15 نوفمبر) أعلى قيم معنوية لجميع الصفات تحت الدراسة يليه ميعاد الزراعة الأوسط (الأول من نوفمبر). أعطى نظام التحميل السادس حيث تم زراعة سطرين من الفول البلدى أعلى مصاطب بنجر السكر مع ترك نبات واحد بالجورة على مسافة 40 سم بين الجور (17500نبات /فدان) أعلى القيم لجميع الصفات تحت الدراسة. تأثرت صفات بنجر السكر معنويا بالتفاعل بين مواعيد زراعة الفول البلدى و نظم التحميل الستة ما عدا الوزن القمى للنبات، أعطى التفاعل بين ميعاد الزراعة الأخير و نظام التحميل السادس أعلى القيم المعنوية لجميع الصفات تحت الدراسة.