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Effect of Ploughing Depths, Irrigation Intervals and Plant Densities on Sugar Beet Yields and Quality

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ABSTRACT

Under field conditions, two trials were performed through two years of 2015/2016 and 2016/2017 at Galia Al-Kobra, Belqas district, Dakahlia Governorate to investigate the effect of four ploughing depths (15, 20, 25 and 30 cm), two irrigation intervals (every 3 and 5 weeks) and three planting hill spacings (15, 20 and 25 cm) resulted in three plants densities (46666, 35000 and 28000 plants/fed) on sugar beet Oscar poly cultivar growth, yields and quality. The factors were set in s strip-split plot design with 4 replicates. Four ploughing depths, 2 irrigation intervals and 3 planting densities were occupied randomly in the vertical, horizontal and sub-plots, correspondingly . The attained outcomes pointed out that all factors under study individually significantly influenced leaf area index, root fresh weight/plant, dimensions of roots and yields/fed as roots and sugar. Contrary of that, % of sucrose and purity were insignificantly affected by ploughing depth treatments in mutually time of years. All the interactions among the three studied factors significantly affected the above mentioned traits in both years. From the achieved results, it could be suggested that ploughing the soil at 30 cm depth and irrigated sugar beet plant every 3 weeks at the medium planting density (35000 plants/fed) resulted from sowing on 20 cm a part between hills to give the utmost yields and quality beneath the ecological circumstances of this study.

Keywords: sugar beet, ploughing depth, irrigation intervals, plant density, LAI, yields and quality.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is a major vital crop as a source of high energy and an imperative source of livestock feeding. Lately, sugar beets have turn into an vital source of sugar production in Egypt, due to a deficiency of sugar formed that does not assemble the growing consumption of the population. Sugar beet is a winter crop that necessitates less water than cane and can tolerate soil salinity. Consequently, it can be successfully grown in newly reclaimed areas. Sugar beet production can be improved by improving cultural practices for instance ploughing depth, planting densities and irrigation requirements.

Soil ploughing is one of the main practiced operations before sugar beet planting which control the suitability of the physical conditions of the soil (Khalifa *et al.*, 2000).Tillage depth and intensity alter the soil physical and chemical properties that affect plant growth and crop yields (Strudley *et al.*, 2008). Soil loosening by means of deep-tillage systems improves water infiltration, internal drainage, and aeration in the soil; increases root depth, intensity, and development; and allows for deeper fertilizer placement (Diaz-Zorita, 2000 and Strudley *et al.*, 2008). Abdou *et al.* (2008) found that increasing number of ploughings from zero (without plough) up to three times significantly increased root weight with 22.96 and 21.31 %, root span with 22.82 and 18.25 %, root yield (t/fed) with 23.19 and 21.03 % and sugar yield (t/fed) with 21.23 and 16.60 % in the 1st and 2nd years, correspondingly . Enan *et al.* (2008) found that increasing plowing depth from 25 up to 40 cm, significantly increased root dimensions and root sucrose percentage in equally years and total soluble solids (TSS) in the 2nd season. While, increasing plowing depth from 20 up to 40 cm, significantly increased yields/fed as roots and sugar in together years. Despite the fact that, plowing depth in significantly affected root purity percentage in mutually years. El-Maghraby *et al.* (2008) stated that mechanical practices significantly augmented sugar beet root length. The highest averages were observed at 150 days after sowing. Laser leveling + deep plowing significantly produced longer roots. Shallow plowing significantly produced the shortest roots. Jabro *et al*. (2010) interpreted that increased tillage depth promoted the formation of air-filled pores, possibility increasing soil aeration to the plow depth. It was concluded that tillage depth enhanced soil physical qualities and had slight effect on sugar yield. Abdou *et al.* (2014 a) accomplished that rising ploughing depths from 0.0 up to 30 cm significantly increased weight of the fresh root, length of the roots, percentage of the total soluble solids (TSS %) as well as yields/feddan as roots and sugar. In contrast, it significantly decreased root juice purity percentage in both years.

Adequate irrigation is necessary to provide moisture for seed germination, and in many areas to control salinity for irrigation in the early stages may tend to filter nitrates, and seedling diseases promote soil leveling that produces more water circulation. During periods of growth, many light irrigation may be more important. In the middle of the season, sugar beet plants get most of their moisture from the top 3 feet of soil and need heavier watering to supply this moisture. Moderate moisture before

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harvest tends to increase sugar without reducing sugar production. The last irrigation may be two to five weeks before harvest (Saied, 2000). Moiller (2001) established that appropriate irrigation method rising the yields. Zaid (2005) stated that raise the content of soil organic matter managing of the water, that adequate to plants constraint for extensive time and sluggish the discharge of the macro and microelements. Gouranga and Singh (2006) confirmed that irrigation water is essential to accomplish the require of recovery and keep water necessities of the dissimilar crops. Ibrahim (2017) reported that every one studied traits of sugar beet except purity percentage significantly influenced irrigation intervals. Irrigation sugar beet plants every 35 day interval recorded the highest means of every one studied characters, whilst irrigation every 25-day interval recorded the maximum % of TSS, sucrose and purity. Abd El-Rehem (2018) showed that in both years, increasing water stress up to 50 % of irrigation water requirements significantly decreased yields/fed as tops, roots and sugar, while it augmented percentage of extractable sugar.

Seeing as light distribution in field is an important source for energy captured for photosynthesis and as a control factor of numerous growth processes thus the plant density in the field is one of the most important aspects in energy utilization for dry matter production, which in turn affects the crop yield. High plant density is a good strategy to obtain high yield (Sher *et al*., 2016) to meet the current and future food necessities of high population and their rising dietary needs (Gau *et al*., 2011). Only in proper plant density plants can achieve highest yield (Manneveux *et al*., 2005). El-Bakary (2006) found that root fresh weight, dimensions of roots, parentages of TSS and sucrose and yields/fed as roots and sugar significantly affected by row width and hill spacing. Masri (2008) observed a positive effect of increasing plant density significantly increased sucrose content and purity % additionally sugar yield per fed. Ahmed *et al*. (2010) showed that biomass decreases as the number of plants increases in a given area because the production of the individual plants was reduced. Sarhan *et al.* (2012) mentioned that the uppermost total income of sugar beet to the farmers resulted from following the optimum distribution. Abdou *et al.* (2014 b) found that the significant augments in yields per fed as the roots, gross and the white sugar in addition to extractable white sugar % outcome from sowing seeds of sugar beet in mutually parts of terrace 80 cm size at 25 cm connecting the hills. Brar *et al.* (2015) established that planting as two rows/bed (12 plants/m^2) induced the better growth and higher yields of sugar beet. Al-Jbawi *et al.* (2016) elucidated that uppermost traits of sugar beet were obtained when using the following distribution; 25 cm as hill spacing and 50 cm as row width, but to get a higher percentage of sucrose it must be planting beet at 30 cm as hill spacing and 60 cm as row width. Malik *et al.* (2016) showed that planting at 30 cm as hill spacing and 90 cm resulted in the utmost sugar beet sugar yield/ha of sugar beet.

The objective of the present work was to throw light on response of yields and quality of sugar beet (Oscar poly variety) to some cultural management practices, *i.e.*, soil ploughing depths, irrigation intervals and planting densities as well as their interactions beneath the ecological circumstances of Dakahlia Governorate.

MATERIALS AND METHODS

Under conditions of field, 2 trails were done through 2 years of 2015/2016 and 2016/2017 at Galia Al-Kobra, Belqas district, Dakahlia Governorate to examine the effect of ploughing depths, intervals of the irrigation and planting densities on growth, yields and juice quality of sugar beet Oscar poly cultivar. The experimental design was strip-split plot design with 4 replications. Ploughing depths (15, 20, 25 and 30 cm) were occupied in the vertical-plots. The two irrigation intervals (3 and 5 weeks) were assigned in the horizontal-plots. While, the three plant densities (46666, 35000 and 28000 plants /fed, which obtained by planting on ridges 60 cm width and 15, 20 and 25 cm between hills, correspondingly) were occupied randomly in the sub-plots.

Each experimental basic unit (15.0 m^2 *i.e.* 1/280 fed) included 5 ridges, every one 60 cm in the width and 5.0 m in the length. The mechanical in addition to chemical soil analyses according to the technique explained by Jackson (1973) superior 35-cm depth of the investigational site in both the two respective years showed that the texture of soil was clay containing 14.9 and 15.3 sand %, 26.2 and 24.6 silt % and 58.9 and 60.1 clay %. It contained 47.1 and 43.7 ppm, 20.3 and 21.8 ppm, and 408.3 and 399.2 ppm of available N, P and K correspondingly with pH of 7.9 and 8.2 in the 1st and 2nd years, correspondingly .

Phosphorus, potassium and nitrogen fertilizer were applied as the recommendation of Sugar Crops Research Institute. Sugar beet cultivar Oscar poly seed balls were hand sown as the usual dry sowing on one elevation of the ridge and in hills according to plant distance treatments (15, 20 and 25 cm apart) at the rate of 2-3 seed balls per hill on 15th and 17th October in 1st and 2nd years, correspondingly . Irrigation of sugar beet plant was done according to irrigation interval treatments (every 3 and 5 weeks). Supplementary agricultural observes were practical as optional via the Sugar Crops Research Institute, ARC, Egypt.

The recorded data were taken from each sub-plot to decide the subsequent characters:

At 150-days after sowing, 5 secured plants were taken randomly from outer ridges of each sub-plot to determined leaf area index (LAI). Leaf area estimated via the disk method according to Watson (1958) as following equation.

$$\text{LAI} = \frac{\text{Unit leaf area per plant (cm}^2\text{)}}{\text{Plant ground area (cm}^2\text{)}}$$

At harvesting (210 days after planting), 5 plants were chosen from the 3 inner ridges of each sub-plot to approximation yield components and quality parameters *i.e.* fresh weight of the roots (g per plant), span and thickness of the roots (cm). According to the method of Carruthers and OldField (1960), sucrose percentage was determined. Also, according to Carruthers and OldField (1960), purity percentage was calculated. All plants produced from the three inner ridges of each sub-plot at harvest were collected and cleaned. Roots and tops were carefully separated and weighed in kilograms, then converted to estimate tons per fed. Sugar yield (t/fed) was calculated by multiplying root yield by sucrose %.

As summarized by Gomez and Gomez (1984), all obtained data were statistically analyzed according to ANOVA for strip-split plot design. As described by Snedecor and Cochran (1980), least significant difference test (5% level of probability) was used.

RESULTS AND DISCUSSION

Individual studied factors effect on:

Growth and yield components:

Growth and yield components *i.e.* leaf area index at 150 days after planting, fresh weight of the roots, length and diameter of the roots at harvest as affected by ploughing depths, irrigation intervals and plant densities in both years are presented in Table 1.

The acquired results in Table 1 demonstrated that uppermost values of leaf area index (3.22 and 3.98), root fresh weight (1175 and 1275 g/plant), root span (32.65 and 32.07 cm) and root thickness (9.70 and 9.72 cm) in both season, correspondingly were obtained under the deepest ploughing depth (30 cm) conditions in the 1st and 2nd years, correspondingly . These results may be due to deep ploughing exerted had positive impact on physical, chemical and biological status of soil by improving its aeration, microbial activity and water infiltration and consequently increases root volume and growth of sugar beet plant. Comparable results were obtained by Abdou *et al.* (2008), Enan *et al.* (2008), El-Maghraby *et al.* (2008) and Abdou *et al.* (2014 a).

Relation to the effect of irrigation intervals on LAI and root fresh weight as well as root dimension *i.e.* root span and thickness, it is obvious that these parameters had a significant effect due to irrigation intervals in both years (Table 1). Irrigation every 3 weeks gave the higher leaf area index (2.93 and 3.51) at sample 150 days after planting in the 1st and 2nd years, correspondingly . The same trend was obtained for root fresh weight and root thickness, where these values reached to 1174 and 1198 g/plant and 8.83 and 8.80 cm in the 1st and 2nd years, correspondingly. While, Irrigation every 5 weeks gave taller root span (31.42 and 31.42 cm) than irrigation every 3 weeks (29.89 and 30.15 cm) in the 1st and 2nd years, correspondingly . Extending irrigation intervals up to 5 weeks decreased suitability of soil water moisture of plant, and consequently promoted the downward vertical extension of root and alternately increased plant root span on the expense of its root diameter. Moreover, adequate soil- plant water conditions improves the initiations of more new leaves and increases areas of plant leaves. Parallel results trend were obtained by Ibrahim (2017) and Abd El-Rehem (2018).

Data also in Table 1 indicated that planting densities had a significant effect on LAI, root fresh weight (g/plant) as well as root span and thickness (cm) in both years. The longest distance between plants (25 cm) which created the lowest plant density (28000 plants/fed) had the uppermost values of these traits. While, the shortest distance (15 cm) produced the highest plant density (46666 plants/fed) gave the lowest values. This may be due to that high planting densities result in inter plants competition (particularly for light, water and nutrients), which effects the vegetative and reproductive growth of plant (Antonietta *et al*., 2014). Increased plant density led to increase the shading of leaves (Hashemi-Dezfouli and Herbert, 1992), and reduced the net assimilation of individual plants, thus decreased root fresh weight. Parallel results were obtained by El-Bakary (2006), Brar *et al.* (2015) and Al-Jbawi *et al.* (2016).

Juice quality and yields:

Results presented in Table 2 showed that ploughing depths did not cause any significant effect on sucrose and purity %, while it had significant effect on root and sugar yields (t/fed) during the two growing years. Ploughing at 30 cm depth gave the maximum values of root yield (31.708 and 32.058 t/fed) and sugar yield (6.354 and 6.408 t/fed) as compared with the other ploughing depths (15, 20 and 25 cm) in the 1st and 2nd years, correspondingly . Whereas, surface ploughing at 15 cm depth resulted in the minimum values of root yield (26.928 and 27.369 t/fed) and sugar yield (5.302 and 5.372 t/fed) as compared with the other ploughing depths (15, 20 and 25 cm) in the 1st and 2nd years, correspondingly . Such finding was expected since the deepest ploughing (30 cm) treatment gave the uppermost values of root fresh weight/plant, root span, root thickness at harvest (Table 1) in both experimental years as mentioned and discussed formerly. These results were confirmed by those obtained by Enan *et al.* (2008), Jabro *et al.* (2010) and Abdou *et al.* (2014 a).

Table 1. Leaf area index (LAI), fresh weight of the roots, root span and thickness as affected by ploughing depths, irrigation intervals and plant distances during 2015/2016 (I) and 2016/2017 (II) years.

Treatments		LAI		fresh weight of the roots (g/plant)		Span of root (cm)		Thickness of root (cm)	
		I	II	I	II	I	II	I	II
		At 150 days after planting		At harvest		At harvest		At harvest	
Ploughing depths	15 cm	2.22	3.13	1053	986	28.81	29.31	8.03	8.16
	20 cm	2.78	3.28	1086	1051	30.05	30.29	8.11	8.23
	25 cm	3.10	3.33	1134	1129	31.13	31.48	8.48	8.52
	30 cm	3.22	3.98	1175	1275	32.65	32.07	9.70	9.72
LSD at 0.05		0.14	0.17	38	40	0.76	0.85	0.68	0.53
Irrigation intervals	3 weeks	2.93	3.51	1174	1198	29.89	30.15	8.83	8.80
	5 weeks	2.72	3.34	1049	1022	31.42	31.42	8.32	8.51
F. test		*	*	*	*	*	*	*	*
Plant distances	15 cm	2.61	3.09	1016	1036	30.12	29.71	7.71	8.01
	20 cm	2.88	3.48	1120	1115	30.55	30.77	8.35	8.45
	25 cm	2.99	3.73	1199	1180	31.30	31.89	9.69	9.53
LSD at 0.05		0.18	0.13	28	31	0.53	0.62	1.34	1.26

Data also in Table 2 revealed that irrigation intervals significantly affected sucrose % and purity % in both years. Irrigated sugar beet every 5 weeks was significantly better than irrigation every 3 weeks for sucrose and purity %. Where, it gave the higher values of sucrose (20.11 and 20.21%) and purity (86.08 and 85.79 %) in the 1st and 2nd years, correspondingly . Exposing plant to soil moisture deficit (5 weeks irrigation intervals) absolutely stimulate hydrolysis of starch and others polysaccharides to simple sugars and therefore sucrose and purity % were increased. Ibrahim (2017) and Abd El-Rehem (2018) confirmed these results. Also, from data presented in Table 2, it could also be seen that in both years, root and sugar yields were significantly affected by irrigation intervals. Application of irrigation every 3 weeks was better than 5 weeks, where it gave the higher values of root yield (30.887 and 31.490 t/fed) and sugar yield (6.069 and 6.115 t/fed) in the 1st and 2nd years, correspondingly . Superiority of little irrigation interval (3 weeks) could be ascribed to its higher values of root fresh weight/plant and root thickness in both years (Table 1) and consequently root yield increased. The increases of sugar yield by irrigation every 3 weeks may be due to the maximum values of root yield although low sucrose % as mentioned above.

Table 2. Juice quality (sucrose and purity %) and yields (root and sugar/fed) as affected by ploughing depths, irrigation intervals and plant distances during 2015/2016 (1st) and 2016/2017 (2nd) years.

Treatments		Sucrose (%)		Purity (%)		Root yield/fed (ton)		Sugar yield/fed (ton)	
		I	II	I	II	I	II	I	II
Ploughing depths	15 cm	19.69	19.66	84.59	84.81	26.928	27.369	5.302	5.372
	20 cm	19.81	19.80	84.69	84.92	30.914	31.361	6.118	6.198
	25 cm	19.98	19.82	85.69	85.43	31.683	31.893	6.323	6.318
	30 cm	20.04	20.01	85.78	85.61	31.708	32.058	6.354	6.408
LSD at 0.05		N.S.	N.S.	N.S.	N.S.	1.000	1.043	0.096	0.127
Irrigation intervals	3 weeks	19.65	19.42	84.29	84.58	30.887	31.490	6.069	6.115
	5 weeks	20.11	20.21	86.08	85.79	29.729	29.850	5.979	6.033
F. test		*	*	*	*	*	*	*	*
Plant distances	15 cm	18.68	19.12	77.81	73.87	31.350	31.750	5.865	5.908
	20 cm	20.23	19.95	88.13	90.37	31.090	31.300	6.296	6.244
	25 cm	20.73	20.40	89.62	91.34	28.485	28.960	5.912	6.071
LSD at 0.05		1.52	1.63	2.87	3.03	1.861	2.032	0.135	0.209

Regarding the effect of planting densities (28.000, 35000 and 46666 plants/fed), the obtained results that accessible in Table 2 showed that sucrose and purity % as well root and sugar yields/fed were significantly affected by studied planting densities in the two growing years. The longest distance between hills (25 cm), which resulted lowest plant density (28000 plants/fed), had the uppermost values of sucrose (20.73 and 20.40 %) and purity % (89.62 and 91.34 %) in both years, correspondingly . It is important to mention that there were no significant differences between planting distance at 20 and 25 cm for sucrose % and purity % in both years. Dense planting created intra-specific competition between sugar beet plants on water and others environmental factors. Limitation in amount of available water per plant mostly decreased values of sucrose and purity %. These results were established by those found by El-Bakary (2006), Masri (2008) and Al-Jbawi *et al.* (2016). However, highest plant density (46666 plants /fed) which obtained when planting on ridges 60 cm width and 15 cm between hills gave the uppermost values root yield (31.350 and 31.750 t/fed), although gave the lowest values of sugar yield (5.865 and 5.908 ton/fed) in the 1st and 2nd years, correspondingly . While, the medium planting distance between hills (20 cm, which resulted intermediate plant density about 35000 plants/fed) was the best treatment, where it produced the second best root yield values (31.090 and 31.300 t/fed) without significant differences between it and highest plant density, furthermore it gave the highest sugar yield (6.296 and 6.244 t/fed) in the 1st and 2nd years, correspondingly . The increases in root yield by medium planting distance may be due to increase the yield potential per unit area as a function of higher population density with higher root fresh weight and consequently increase sugar yield Duvick, (2005). These results are in agreement with those obtained by Abdou *et al.* (2014 b), Brar *et al.* (2015), Al-Jbawi *et al.* (2016) and Malik *et al.* (2016).

Interactions effect:

All the interactions among ploughing depths, irrigation intervals and plant densities significantly affected growth and yield components (leaf area index at 150 days after planting, fresh weight of the roots, root span and thickness at harvest), juice quality (sucrose and purity %) and yields (root and sugar yields/fed) in both years. Although, the authors force discuss only several of them regarding root and sugar yields/fed.

Interaction between ploughing depths and irrigation intervals:

It is important to note that ploughing depth at 30 cm with irrigation every 3 weeks gave the highest root yield, whereas the lowest root yield was obtained under ploughing depth at 15 cm treatment with irrigation intervals every 5 weeks for the 1st and 2nd years as shown from results graphically illustrated in Fig. 1. However, the interaction between ploughing depth at 30 cm and irrigation intervals every 3 weeks gave the highest sugar yield values in the both years as shown from results graphically illustrated in Fig. 2.

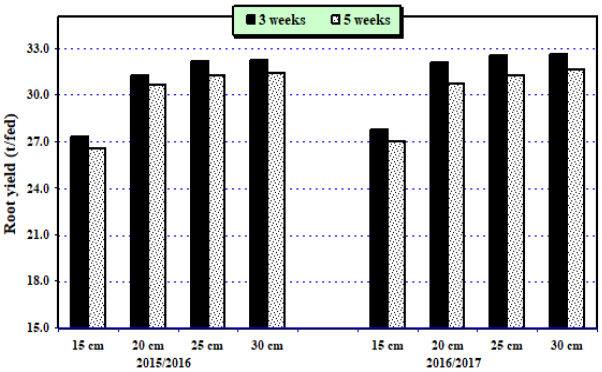

Fig. 1. Root yield/fed as exaggerated via the contact amid ploughing depths and irrigation intervals throughout 1st and 2nd years.

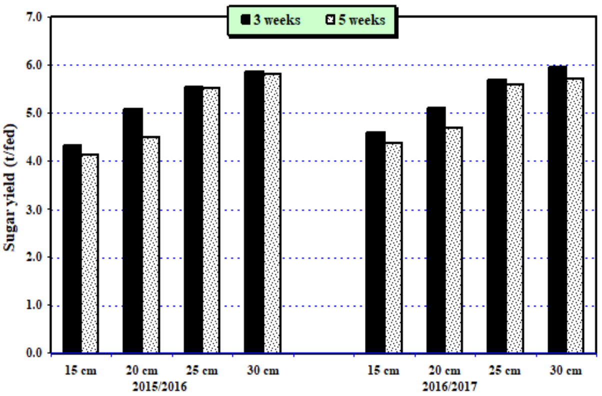

Fig. 2. Sugar yield/fed as exaggerated via the contact amid ploughing depths and irrigation intervals throughout 1st and 2nd years.

Interaction between ploughing depths and planting distances:

The uppermost values of root yield were resulted from ploughing depth of 30 cm at the lowest planting distance between hills (15 cm) in the 1st and 2nd years, correspondingly . On the other hand, the lowest values of root yield were produced from ploughing depth of 25 cm with planting distance at 25 cm as shown from results graphically illustrated in Fig. 3. For sugar yield, application of ploughing depth of 30 cm at the medium planting distance 20 cm a part between hills led to the uppermost values of sugar yield, as shown from results graphically illustrated in Fig. 4.

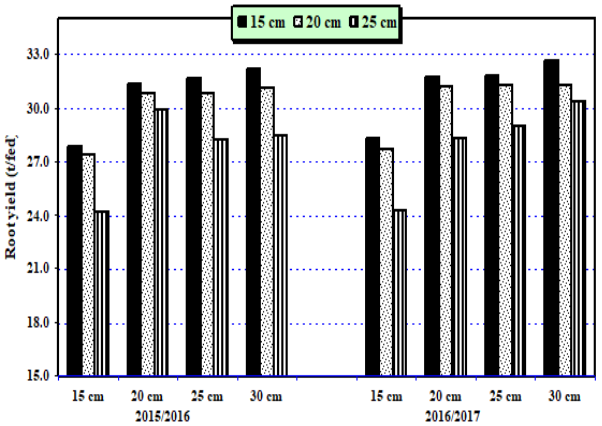

Fig. 3. Root yield/fed as exaggerated via the contact amid ploughing depths and plant distances throughout 1st and 2nd years.

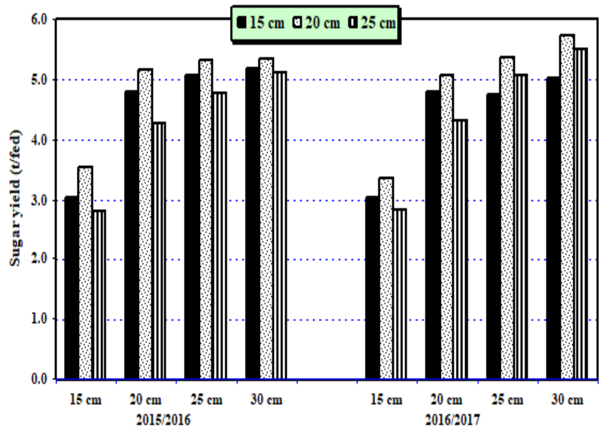

Fig. 4. Sugar yield/fed as exaggerated via the contact amid ploughing depths and plant distances throughout 1st and 2nd years.

Interaction between irrigation intervals and planting distances:

The uppermost values of root yield were obtained by irrigation every 3 weeks and planting distance of 15 cm in both years as shown from results graphically illustrated in Fig. 5. While, the highest sugar yield values were produced from medium planting distance (20 cm) and irrigated every 3 weeks in both years as shown from results graphically illustrated in Fig. 6.

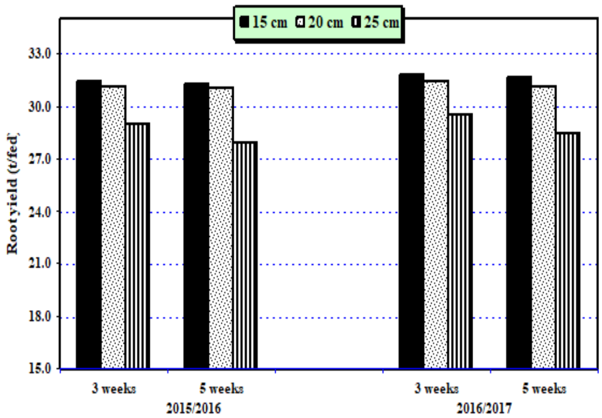

Fig. 5. Root yield/fed as exaggerated via the contact amid irrigation intervals and plant distances throughout 1st and 2nd years.

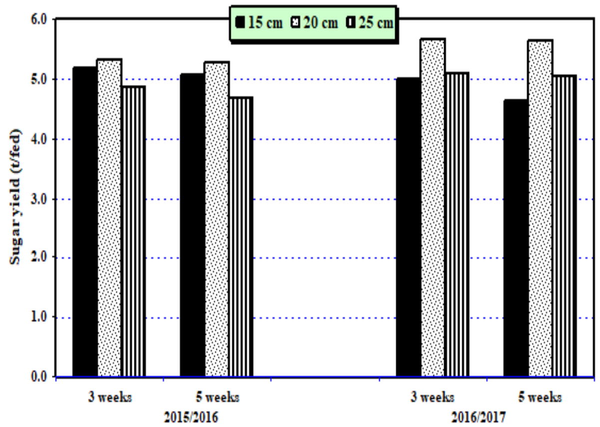

Fig. 6. Sugar yield/fed as exaggerated via the contact amid irrigation intervals and plant distances throughout 1st and 2nd years.

Interaction among ploughing depths, irrigation intervals and planting distances:

The uppermost values of root yield/fed as shown from results graphically illustrated in Fig. 7 and sugar yield/fed as shown from results graphically illustrated in Fig. 8 were obtained from sugar beet plants which grown under the ploughing depth of 30 cm , irrigation every 3 weeks and the shortest planting distance 15 cm or the medium planting distance 20 cm, without significant differences between two plant distances, in both years.

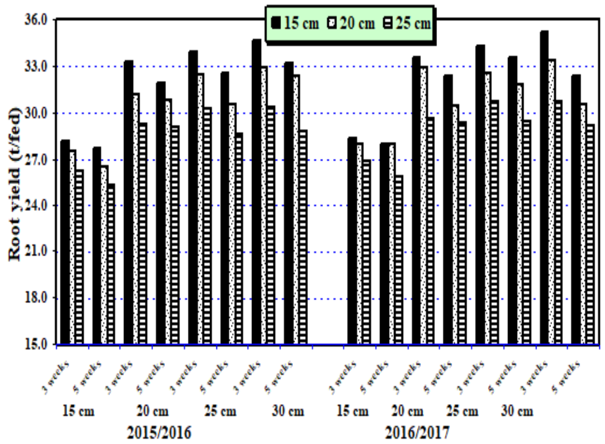

Fig. 7. Root yield/fed as exaggerated via the contact among ploughing depths irrigation intervals and plant densities throughout 1st and 2nd years.

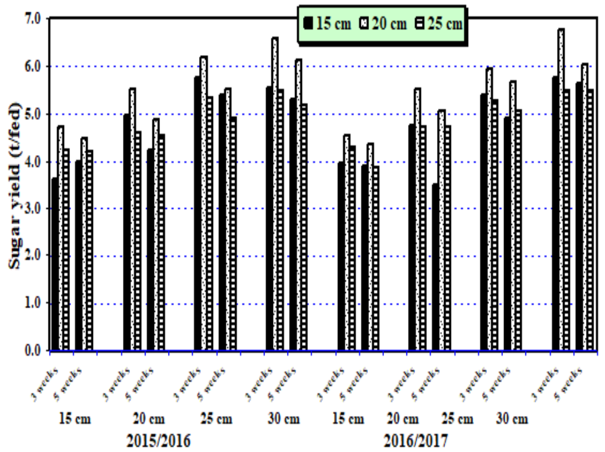

Fig. 8. Sugar yield/fed as exaggerated via the contact among ploughing depths irrigation intervals and plant densities throughout 1st and 2nd years.

CONCLUSION

the attained results demonstrated that the upmost sugar beet yields and quality were obtained through ploughing sugar beet fields at 30 cm depth, irrigated plants every 3 weeks at the medium planting density (35000 plants/fed) resulted from sowing on 20 cm a part between hills beneath the ecological conditions of this study.

REFERENCES

Abd El-Reheem, M.K (2018). Effect of some soil amendments on physiological traits and productivity of sugar beet under water stress in sandy soil in Egypt and Morocco. M. D. Thesis, Institute of African Research and Studies, Cairo Univ., Egypt.

Abdou M.A.; N.M.M. Awad and M.E.M. Ibrahim (2014 a). Influence of ploughing depth, phosphorus fertilizer levels and thinning dates on sugar beet productivity and quality .J. Plant Production Mansoura Univ., Vol. 5 (12): 2037– 2045.

Abdou, M.A. ; Dalia, I.H. El-Geddawy and A.M. Elwan (2014 b). Productivity and quality of sugar beet as affected by plant distribution pattern and nitrogen fertilizer level. J. Plant Production, Mansoura Univ., 5(12): 2155- 2167.

Abdou, M.A. ; N.M.M. Awad and E.H.H. Selim (2008). Effect of ploughing and phosphorus fertilizer levels on sugar beet productivity and quality. J. Agric. & Env. Sci., Alex Univ., Egypt, 7(2): 1-11.

Ahmed, Z.P.S. ; K.M. Kakar ; H. El-Sharkawi ; P.B.S. Gama ; E.A. Khan ; T. Homa and S.Y. Amanoto (2010). Sugar beet (*Beta vulgaris* L.) response to different planting method and row geometric. II: Effect on plant growth and quality. J. Food, Agric. and Environ., 8 (2): 785-791.

Al-Jbawi, E.; S. Al-Geddawi; G. Alesha and H. Al-Zubi (2016). Productivity of fodder beet (Beta vulgaris var. Crassa) cultivars as affected by plants spacing in Al Ghab, Syria. J. Agric. Crop Res., 4(6): 91-99.

Antonietta, M.; D. D. Fanello ; H. A. Acciaresi and J. J. Guiamet (2014). Senescence and yield responses to plant density in stay green and earlier-senescing maize hybrids from Argentina. Field Crops Res. 155: 111–119.

Brar, N.S.; B.S. Dhillon; K.S. Saini and P.K. Sharma (2015). Agronomy of sugar beet cultivation-A review. Agric. Rev., 36 (3): 184-197.

Carruthers, A. and J.F.T. Oldfield (1960). Methods for the assessment of beet quality. Int. Sugar J., 63: 72-74.

Diaz-Zorita, M. (2000). Effect of deep-tillage and nitrogen fertilization interactions on dry land corn (*Zea mays* L.) productivity. Soil Till. Res., 54 (1): 11-19.

Duvick, D.N. (2005). The contribution of breeding to yield advances in maize (*Zea mays* L.). Adv. Agron., 86: 83-145.

El-Bakary, H.M.Y. (2006) Studies on yield and quality parameters of some sugar beet varieties. M. Sc. Thesis, Fac. of Agric., Al-Azhar Univ.

El-Maghraby, Samia S. ; M.A. Gomaa ; I.F. Rehab and Hala M.S. Hassan (2008). Response of sugar beet to some mechanical management practices, irrigation and plant densities: Growth parameters. Meeting the Challenges of Sugar Crops & Integrated Industries in Developing Countries, Al Arish, Egypt, pp: 75-82.

Enan, S.A.A. ; Dalia I.H. El-Geddawy and N.M.M. Awad (2008). Reponse of sugar beet yield and quality to ploughing depth and nitrogen fertilization levels. Egypt. J. of Appl. Sci., 23(11B): 491-510.

Gau, S.F. ; C.M. Lee ; M.C. Lai ; Y.N. Chiu ; Y.F. Huang ; J.D. Kao and Y.Y. Wu (2011). Psychometric properties of the Chinese version of the social communication questionnaire. Res. in Autism Spectrum Disorders, 5: 809-818.

Gomez, K.N. and A.A. Gomez (1984). Statistical procedures for agricultural research. 2nd Ed., John Wiley and Sons, Inc., New York, pp: 95-109.

Gouranga, K.V.and H.N.R. Singh (2006). Effect of winter crop and supplemental irrigtion on crop yield , water use efficiency and proeastern india. Agricultural Water Management, 79 (3): 280-292.

Hashemi-Dezfouli A. and S. J. Herbert (1992). Intensifying plant density response of corn with artificial shade. Agron. J. 84 547–551.

Ibrahim, M. E. M. (2017). Plant distribution patterns and irrigation intervals effects on yield and quality of sugar beet in North Delta. J. Plant Production, Mansoura Univ., Vol. 8(6): 679 -684.

Jabro, J.D. ; W.B. Stevens ; W.M. Iversem and R.G. Evans (2010).Tillage depth effect on soil physical properties, sugar beet yield and sugar beet quality. Soil Sci. and plant Ana., 41: 908- 916.

Jackson, R. D. (1973). Diurnal changes in soil water content during drying, in Field Soil Water Regime, Spec. Pub. 5, edited by R. R. Bruce, pp: 37-55.

Khalifa, M.R. ; A.A. Balba ; S.A. Mashali and S.A. Morssi (2000). Impact of soil ploughing depth and different rates of NPK fertilizers on some soil properties yield and quality of sugar beet plant grown in salt affected soil. J. Agric. Res., Tanta Univ., 26(1): 108-121.

Malik, S.U.; E.A. Khan and I. Hussain (2016). Morphological response of row spacing on sugar beet (*Beta vulgaris*) with sugarcane (*Saccharum officinarum* L.) intercropping. Gomal Univ. J. Res. Pakistan, 32(2): 1-12.

Manneveux, P. ; P.H. Zaidi and C. Sanchez (2005). Population density and low nitrogen affects yield-associated traits in tropical maize. Crop Sci., 45: 535-545.

Masri, M.I. (2008). Effect of nitrogen level and plant density on sugar beet yield and its attributes. Egypt. J. Agron., 30 (2): 119-136.

Moiller, J.W. (2001). Irrigation ,agriculture and poverty reduction: general relationships and specific needs. In: Hussain, I, biltonen, E.(Eds.), Managing water for the poor: Proceedings of the regional Workshop on Pro- poor Intervention strategies in Irrigated agriculture in Asia: Bangladesh, China, India, Indonesia, Bakistan and Vietnam , International Water management Institute, Colombo, Srilanka.

Saied, M.M. (2000). Effect of irrigation intervals, furrow irrigation system and nitrogen fertilizer levels on sugar beet yield and its water relations at north Delta. J. Agric. Sci. Mansoura Univ., 27(6): 4303-4310.

Sarhan, H.M.; M.A.E. Abdou and H.M. Al-Sayed (2012). Effect of planting systems, plant density and nitrogen fertilizer levels on productivity and quality of sugar beet. J. Plant Production, Mansoura Univ., 3(10): 2567-2580.

Sher, A. ; F. Hassan ; H. Ali and W. Hassan (2016). Seed rate and nitrogen application effects on production and brix value of forage sorghum cultivars. Grasses Sci., 62: 119-127.

Snedecor, G.W. and W.G. Cochran (1980). Statistical methods. 7th Ed. Iowa State Univ. Press, Iowa, USA.

Strudley, M.W. ; T.R. Green and J.C. Ascough (2008). Tillage effects on soil hydraulic properties in space and time. Soil Tillage Res., 99(1): 40-48.

Watson, D.J. (1958). The dependence of net assimilation rate on leaf area index. Ann. Bot. Lond. N.S., 22:37-54.

Zaid, B.A. (2005). The effect of different farmyard manures levels and different modes of urea application on rice productivity under salt affected soil. Egypt. J. Agric. Res. , 2(2): 631-642.

تأثير عمق الحرث وفترات الري والكثافة النباتية على انتاجية وجودة نبات بنجر السكر

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أقيمت تجربتان حقليتان بناحية جالية الكبرى- بلقاس- محافظة الدقهلية خلال موسمي 2015 / 2016 و 2017/2016 لدراسة تأثير أربعة أعماق للحرث (15 ,20 ,25 و30 سم) وفترتان للري (3 و 5 أسابيع) وثلاث مسافات للزراعة بين الجور (15 ,20 و25 سم) والتى أنتجت الكثافات النباتية (46666 , 35000 و28000 / فدان) على نمو ومحصول وجودة بنجر السكر صنف أوسكار بولي. كان التصميم التجريبي المستخدم الشرائح المتعامدة المنشقة في أربع مكررات. أظهرت النتائج أن جميع العوامل الفردية تحت الدراسة (أعماق الحرث وفترات الري والكثافات النباتية) أثرت معنوياً على صفات النمو (دليل مساحة الأوراق) ، الوزن الطازج للجذر/ نبات ، طول الجذر ، , قطر الجذر , النسبة المئوية للسكروز والنقاوة ، محصول الجذور/ فدان و محصول السكر / فدان. بينما النسبة المئوية للسكروز والنقاوة لم تتأثر معنوياً بمعاملات عمق الحرث في كلا الموسمين. كان للتفاعل بين عوامل الدراسة الثلاث تأثيراً معنوياً على جميع الصفات المدروسة في كلا الموسمين. من النتائج المتحصل عليها من هذه الدراسة، يمكن التوصية بحرث الأرض لعمق 30 سم وري نباتات بنجر السكر كل 3 أسابيع مع الزراعة على مسافة 20 سم بين الجور للحصول على كثافة نباتية قدرها 35000 نبات/فدان لزيادة إنتاجية وجودة بنجر السكر تحت الظروف البيئية لمنطقة الدراسة.