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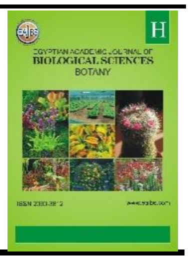

Growth of Some Sugar Beet Varieties Under Different Locations as Affected by Foliar Application with Salicylic Acid on Yield and Quality

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ABSTRACT

Two field experiments were conducted to evaluate the effect of foliar application of salicylic acid (SA) on the growth, yield and quality characters of five sugar beet varieties (MARWA KWS, SUGAR KING, MiRAGE, DREEMAN and ESTORA KWS) under two types of soil in the two different locations in Nubaria and Sakha regions during 2018/2019 and 2019/2020 seasons. The experiments were conducted in split-split plot design in the three replications, where the main plots assigned by the two soil types (sandy soil in Nubaria and clay soil in Sakha), while the subplots were occupied by the three foliar application concentrations of SA (control, 1000 and 2000 ppm) and the five sugar beet varieties (Marwa kws, Sugar king, Mirage, Dreeman and Estora kws) were allocated randomly the sub- subplots. The results revealed that the foliar application of 2000 ppm SA significantly influenced the top fresh mass and root biomass of sugar beet plants. Conversely, the increasing concentration of SA led to significant differences in fresh mass, sugar yield, and sucrose % as well as purity % of sugar beet in both seasons. The Dreeman and Estora kws exhibited better performance in terms of root length under Nubaria conditions. The interaction effect between the three factors gave the maximum levels of increment for most of the studied characters, particularly for the cultivar ESTORA KWS.

INTRODUCTION

World sugar production depends upon two main crops sugar cane and sugar beet. The percentage of recovered sugar out of cane and beet amount is about 70 and 30 % of the total world production of sugar, respectively. Sugar is considering a strategic commodity in many countries over the world. It comes after wheat from the strategic view for many countries in Africa, Europe, America and Australia. The sugar beet crop occupies ranked second in the production of sugar in the world. Egypt suffers from a gap between the consumed and produced sugar which reaches nearly one million tons (Aly *et al*., 2017). So, Researchers are pressing hard to narrowing the gap between production and consumption through increasing horizontal and vertical expansion. As, it is difficult to increase the horizontal expansion in the old valley, so, that it is promising to try to cultivate

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this strategic crop in the newly reclaimed lands. These lands are characterized as sandy saline soil and high salinity irrigation water (Abd El-Razek, and Ghonema, 2016). Also, the economic way of increasing sugar productivity could be achieved through developing appropriate new technology package for sugar beet crop that includes agronomic management to improve yield and quality of sugar beet *(Beta vulgaris* L.) such as nitrogen fertilization, which are the most important factors that affect the quantity and type of crop (Zaki *el al*., 2018). The last three decades showed a gradual increase in sugar beet cultivation in Egypt. This is considered one of the important national targets to minimize the gap between production and consumption of sugar. The importance of sugar beet crop to agriculture is not only confined to sugar production, but also to its wide adaptability to grow in poor, saline, alkaline and calcareous soils. The crop is annual planting during the winter season from September till mid-November and is highly adapted to grow in moderate saline soils especially in newly reclaimed land which has a water shortage. There is a high potential for using sugar beet to reducing the imported sugar from abroad. Salicylic acid (SA) is recognized as a phytohormone produced after a chain of chemical reactions as benzoic acid derivative and plays a vital role in many physiological processes such as photosynthesis, nutrient uptake, membrane permeability and also help to survive under different biotic and abiotic stress playing a key role in systemic acquired resistance (Noreen *et al*., 2009; Abdelaal, 2015b). Abido *et al*. (2015) revealed that foliar application of SA led to improve plant growth characters and enhanced the tolerance capacity of plants under abiotic stress as well as it protects the plant from oxidative stress by increasing antioxidant enzymes activity, finally increasing the fresh root and shoot mass of sugar beet and sunflower plants (Noreen *et al*., 2009; Merwad, 2015). Furthermore, the foliar application of 100 mg l-1 SA gave the highest values for growth characters of stevia plants; soybean plants (Mishra and Prakash, 2013). Gomaa *el al.* (2020 a and b) showed that foliar application of SA increased the growth and yield of soybean crops under stress.

The aim of this investigation studied the effect of foliar application salicylic acid (SA) on the growth, yield, and quality of five sugar beet varieties under the two soil types in Nubaria and Sakha locations.

MATERIALS AND METHODS

Two field experiments were carried out in two different locations during 2018/2019 and 2019/2020 seasons to study the effect of the three foliar concentrations of salicylic acid (control=0, 1000 and 2000 ppm) on five sugar beet varieties (Marwa kws, Sugar king, Mirage, Dreeman and Estora kws) under the two soil types (Sandy soil in the first location is Nubaria located at the Cairo-Alexandria Desert Road 70 km to Alexandria) and (Clay soil in the second location is the Experimental Farm of Sakha Agricultural Research Station, Kafrel-Sheikh Governorate).

The study area (Nubaria) is located in the North Western of Egypt (NWE), about 47 km South of Alexandria. It lies at longitudes 30° 10' and latitudes 30° 52'. And Kafrel-Sheikh lies in the northern part of the country, along the western branch of the Nile in the Nile Delta. It lies at Latitude: N 31° 19.2'. Longitude: E 31° 14.55

The area is characterized by a short warm winter and long-hot summer. The annual average rainfall and relative humidity are about 40.4 mm and 65.4 %.

The area of study exhibits certain desertification features because the surface Nile water does not adequately reach the ends of canals.

Groundwater is the major source of irrigation. Soil samples were air-dried crushed and prepared for physical and chemical property determination as shown in Table (1).

Table 1: Some physical and chemical properties of the experimental soil sites.

Soil properties	Nubaria		Sakha	
	2018/2019	2019/2020	2018/2019	2019/2020
Particle size distribution %				
Clay	25.40	25.90	56.45	55.42
Silt	15.70	16.80	26.56	27.36
Fine sand	48.90	46.20	15.10	14.65
Course sand	10.00	11.10	1.89	2.57
Textural class	Sandy loam		Clay	
$CaCo_3$	16.40	17.10	6.33	6.97
S.P.	33.20	34.80	128.30	133.20
Chemical analysis				
PH (1:2.5)	8.67	8.72	8.45	8.36
EC (dS/m)	7.15	7.11	4.46	4.50
Soluble cations (1:2) (cmol/kg soil)				
Na^+	39.70	38.50	29.20	29.90
K^+	3.59	3.67	1.22	1.58
Ca^+	14.50	13.40	4.88	4.71
Mg^+	13.90	14.90	9.54	9.73
Soluble anions (1 : 2) (cmol/kg soil)				
CO_3^-	-	-	-	-
HCO_3^-	11.60	11.96	8.91	9.12
Cl^-	46.00	44.00	33.54	34.27
SO_4^-	14.08	14.53	2.41	2.55
Organic matter (%)	0.43	0.47	0.62	0.65
Organic carbon (%)	0.27	0.30	0.35	0.37
Total N (%)	0.13	0.14	0.17	0.18
C/N ratio	2.3	2.41	5.55	5.78
Available contents (mg/kg soil)				
N	115.1	118.3	130.2	131.3
P	5.27	5.36	4.18	4.21
K	247	251	336	339
Fe	3.47	3.52	8.45	8.51
Mn	2.04	2.08	5.30	5.35
Zn	1.34	1.36	1.84	1.87

Experimental Treatments, Design and Plant Materials:

Split- split-plot design in three replications was used in both seasons, where the main plots were allocated by the two locations (Nubaria and Sakha), meanwhile, the subplots were distributed by three foliar application concentration (control, 1000 and 2000 ppm SA), while the five sugar beet varieties (Marwa kws, Sugar king, Mirage, Dreeman and Estora kws) were occupied the sub-sub plots in both seasons.

The soil of field experiments was prepared through two ploughing and leveling. Nitrogen fertilizer was added at a rate of 90 kg N/fed after thinning and before the second irrigation time after sowing, Calcium superphosphate (15.5 % P_2O_5) was applied during tillage operation at a rate of 100 kg/fed. Potassium sulfate (48.0 % K_2O) was applied at the rate of 24 kg K_2O/fed with the first irrigation. Plants were kept free from weeds, which were manually controlled by hand hoeing three times. The common agricultural practices for growing sugar beet according to the recommendations of the Ministry of Agriculture were followed, except the factors under study.

The experiment unit was 10.5 m^2; each experimental individual unit included 5 ridges, 60.0 cm apart and 3.5 m long.

Plants were kept free from weeds, which were manually controlled by hand hoeing three times. The common agricultural practices for growing sugar beet according to the recommendations of Sugar Crops Research Institute (SCRI) were followed, except the factors under this study.

Sugar beet varieties were obtained from Sugar Crop Research Institute Agricultural Research Center, Giza. Seeds were hand sown as the usual dry sowing on one side of the ridge in hills 25 cm apart at the rate of 4-5 seed ball per hill on sown at 10^{th} and 11^{th} October and harvested after 6 months in both seasons, respectively.

Random samples of five plants were taken from each subplot after 120, 140, 160, 180 and 200 days from sowing which reflected the growth stages, i.e., the initial, establishment, mid-season, late-season and ripening stages, respectively (Cooke, D.A. and R.K. Scott 1995).

Plants were separated into roots and tops from the inner fortified rows of each plot to determine the following characters:

Root fresh weight (g/plant), Root dry weight (g/plant), Leaf fresh weight (g/plant), Leaf dry weight (g/plant), Root length (cm/plant), Root diameter (cm/plant) and Number of leaves.

Root yield (ton/fed) and sugar yield (ton/fed), where sugar yield (ton/fed) was calculated using the following equation: sugar yield (ton/fed) = root yield × sucrose %.

In fresh samples of sugar beetroots, total soluble solids percentage (TSS %) was determined using Hand Reflectometer, as well sucrose percentage (%) estimated by using digital Sacharometer after preparing the samples according to the method described by AOAC (1995). Juice purity% was calculated using the following equation:

Juice Purity % = (sucrose % ÷ TSS %) ×100.

The growth analysis, viz. leaf area index (LAI) and crop growth rate (CGR) in g.day-1 were computed according to (Beedle, 1993) as the following formulae:

• Leaf area index (LAI) = leaf area (cm^2/plant)/plant ground area.

• Crop growth rate (CGR) = (W2 – W1) / (T2- T1). G/week

Where. W1, A1 and W2, A2 refer to dry weight for top or root (g) and leaf area, respectively at time T1 and T2 (day or week).

• Alkalinity coefficient (Ac): AC was determined as described by Harvey and Dutton (1993).

• Sugars lost to molasses % (SLM %) was calculated according to the equation of Devillers (1988): SLM% = 0.14 (Na + K) + 0.25 (α-amino N) + 0.50.

Chemical analyses were carried out on the samples of leaves during the two seasons.

• Photosynthetic pigments:

Chlorophyll a, b, and carotenoids were colorimetrically determined in the leaves of sugar beet plants at 90 days after planting according to methods described by Wettstein (1957) and calculated as mg/g fresh weight.

• Determination of minerals content:

1-Total nitrogen Was determined in the dry matter of sugar beet leaves and Roots at 70, 90, 120 days after transplanting by using wet digestion according using microkeldahl as described by Horneck and Miller (1998), then calculated as mg/g dry weight. Then, the crude protein was calculated according to the following equation:

Crud protein (mg/g) =total nitrogen (mg/g) x5.75 as mentioned in A.O.A.C. (1990).

2- Phosphorus: was determined colorimetrically according to the method described by Sandell (1950) and calculated as mg/g dry weight.

3- Potassium: was determined by the flame photometer model C- Z according to the method described by Horneck and Hanson (1998) and calculated as mg/g dry weight.

• Total carbohydrates content: Total carbohydrates were determined according to the method described by Dubios et al. (1956) and calculated as mg/g dry weight.

• Determination of soluble sugar: Total and reducing sugar: were determined in sugar beet leaves at 90 days after sowing during both seasons colorimetrically with the picric acid method as described by Thomas and Dutcher (1924) and calculated as mg/g dry fresh weight.

• Determination of phenols content:

Extraction: As for fresh samples, 1g was weighed, ground in a porcelain mortar with 80% aqueous ethanol, a small amount of fine purified sand and 0.5gm calcium carbonate, boiled for 10 min. then filtered many times. The obtained extracts were quantitatively made up to 50 ml with 80% ethanol then used for the following determinations

Total phenols (µg/g fresh weight) were determined according to the method was described Bray and Thrope (1954). A known volume (0.20 ml) of the extract plus ten drops of conc. HCl was heated rapidly to boiling over a free flame, with provision for condensation and placed in boiling water both for 10 min. after cooling 1 ml of the folin and ciocatalteus reagent and 2.50 ml with 20 % sodium carbonate were added then completed to 10 ml with warm distilled water. The developing color was measured at 520 nm.

To determine the free phenols, 1 ml of the ethanolic extract was mixed with 1 ml of folin and ciocatalteus reagent and 1 ml sodium carbonate (14 %) then the reaction mixture was completed to 5 ml with distilled water, thoroughly mixed, heated in boiling water both for 10 min., then cooled and the developing color was measured at 650 nm using the spectrophotometer. A standard curve from catechol was used to calculate the amount of phenolsin in different samples. Conjugated phenols were calculated by subtracting free phenols from total phenols.

Statistical Analysis:

The experimental design was a randomized complete block design. Data analyses using (SAS Institute 1994). Not statistically significant between the means followed by the same alphabetical letters at the 0.05 level of significance according to (Duncun, 1955).

RESULTS AND DISCUSSION

A. Growth Analysis:

The sugar beet varieties were significant for most of the parameters except leaf area, root length and sugar yield. Results for the number of leaves per plant given in Table (2) showed that sugar beet plants were able to produce more leaves at Nubaria then the number of leaves decreased by about 39.5% at Sakha electrical conductivity (EC) as against control. In terms of varieties, more leaves per plant were observed on Marwa kws followed by sugar king, mirage, dreeman and estora kws. Leaf area was slightly reduced at Nubaria beyond that it decreased rapidly (Table 2). More leaf area was noted for estora kws, followed by Marwa kws. The lower leaf area was shown by Marwa kws. In case of location × varieties interaction, a larger leaf area was observed in Estora kws at Sakha followed by sugar king, mirage at the control and Nubaria respectively. Lower leaf area was recorded in Estora kws at root length was also significantly ($P<0.05$) influenced by salinity Table (2). Maximum root length was observed under control and minimum at Nubaria. It is observable from the data that leaf number and area, biomass production (fresh /dry root weight) and beet and sugar yields enhanced under Nubaria region. This is was possibly because of a reduction in new leaf formation, decrease in leaf and beet size and photosynthetic activities in plants due to the combined effect of osmotic and specific ions Na+ and Cl^{-1} (Munns and Tester, 2008) and (Farkhondeh *et al.*, 2012). These results are in the same line with those revealed by Munns and Tester (2008) and Rozema and Schat (2013). Salinity encouraged the leaf area up to Sakha and then decreased it by about 28.6 and 48.3% at Nubaria. These findings results are in harmony with Dadkhah (2011) they reported that leaf area increased under low salinity level. After two years of observation, the results of the study revealed that foliar application of 100 ppm SA at 30 DAP and 14 days after first application significantly influenced the top fresh mass and root biomass of sugar beet plants under both the two growing seasons. Conversely, the increasing concentration of SA led to significant differences in fresh mass, sugar yield, and sucrose % as well as purity % in both seasons.

In terms of varieties, the well-developed and lengthy root system was noted Estora kws and Dreeman, while less developed and shortest root system was displayed Mirage and Marwa kws. The Dreeman and Estora kws exhibited better performance in terms of root length under Nubaria conditions. Fresh beetroot biomass (Table 2) indicated that maximum fresh beetroot weight was recorded under Nubaria region conditions. In the case of varieties, maximum fresh beetroot biomass was obtained from Estora kws, Dreeman and Mirage. The minimum fresh beetroot obtained from was Marwa kws genotype. Similarly, dry root biomass was also significantly decreased under clay soil conditions. Higher dry root reduction was noted in Estora kws genotype than other varieties (Table 2).

Table 2: Leaf area index (LAI), Root fresh and dry weight, leaf fresh and dry weight, root diameter, root length and the number of leaves/plants of some sugar beet varieties as affected by soil types with foliar application of Salicylic acid (SA) during 2018/2019 and 2019/2020 seasons.

Treatments	Root fresh weight (g)/plant		Root dry weight (g)/plant		Leaf fresh weight (g) /plant		Leaf dry weight(g) /plant		Root diameter (cm)/Plant		Length Root (cm) /Plant		Number of Leaves /Plant		LAI	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Soil types (locations) = A																
Sandy soil (Nubaria)	1075.4	1288.8	95.39	114.49	451.4	545.03	40.68	48.84	10.97	11.36	25.29	26.56	25.166	28.19	9.50	11.49
Clay soil (Sakha)	879.02	1050.8	78.43	93.61	378.46	453.22	34.13	40.81	10.22	9.65	25.27	23.16	23.168	26.40	7.90	9.46
LSD at 0.05	11.86	15.55	0.99	1.42	4.91	6.29	0.42	0.53	0.094	0.101	0.088	0.204	0.118	0.100	0.13	0.13
Foliar application of SA (B)																
Control= 0	974.23	1153.68	86.44	103.12	413.3	487.59	36.88	42.93	9.88	10.212	24.685	23.417	24.037	23.807	8.18	10.13
1000 (ppm) SA	978.33	1165.03	86.86	103.87	414.84	498.98	37.42	44.93	10.71	10.508	25.433	24.470	24.102	26.547	8.8	10.60
2000 (ppm) SA	979.07	1190.69	87.43	105.16	416.66	510.32	39.93	46.92	11.20	10.800	25.722	26.698	24.364	31.53	9.13	10.70
LSD at 0.05	2.07	8.089	0.15	0.83	0.817	2.12	0.12	0.32	0.115	0.071	0.123	0.23	0.065	0.454	0.1	0.077
Sugar beet varieties (C)																
MARWA KWS	770.89	903.68	67.63	82.02	295.23	357.25	26.63	31.64	7.65	9.527	24.005	22.686	22.967	26.227	6.69	7.32
SUGAR KING	993.39	1117.36	86.61	99.47	391.34	464.52	34.68	41.24	9.96	9.952	24.655	24.288	23.111	26.467	7.97	9.53
MiRAGE	993.89	1214.03	89.37	108.33	418.85	507.02	37.64	45.48	10.21	10.232	24.813	24.936	23.727	26.804	8.47	10.15
DREEMAN	1022.72	1271.57	92.13	110.67	459.1	554.29	42.17	50.63	12.26	10.647	25.574	25.411	24.579	27.933	10.15	12.14
ESTORA KWS	1105.17	1342.35	98.83	119.76	510.13	612.55	45.93	55.14	12.9	12.172	27.353	26.988	26.451	29.042	10.25	13.26
LSD at 0.05	35.03	48.02	3.3	4.03	22.73	27.27	2.09	2.55	0.586	0.287	0.363	0.445	0.403	0.332	0.43	0.66
Interaction																
AXB	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AXC	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
BXC	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AXBXC	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

S_1= the first season 2018/2019, S_2= the second season 2019/2020, * = significant difference at 0.05 level of probability.

Regarding beet yield, it can be observed from (Table 3) that beet yield increased from 30.31 to 34.31 ton/fed under Nubaria region conditions. In case of varieties, a higher beet yield was given by Estora kws genotype, followed by Mirage and Dreeman. Sugar yield enhanced from 5.5 to 6.5 and 6.3 t ha with the increase in SA level from control to 2000 ppm respectively (Table 3). Moreover, maximum sugar yield was noted in the case of Estora kws, followed by Dreeman and Marwa kws. Minimum sugar yield was obtained for Mirage. At varying levels Salicylic acid (SA), the highest sugar yield was noted in the case of Estora kws as against other varieties at 2000 ppm SA under sakha region. Where Estora kws produced the lowest sugar yield at Nubaria. However, the leaf area of the plant decreased under clay soil conditions. The reduction in leaf area might be related to inhibition of leaf expansion due to the closing of stomata (Manivannan *et al*., 2007), and reduced photosynthetic activities and respiration rate in plants under salinity (Mundree *et al.,* 2009; Shahid *et al.,* 2011). The varieties, Estora kws, Dreeman and Mirage produced significantly greater leaf area than the others. The result suggested that the varieties of a crop species may have different behavior towards soil type and salt tolerance (Farkhondeh *et al.,* 2012). The beet yield increased from control to 2000 ppm with the production of 30.31 and 34.31 ton/fed under Nubaria conditions. The result is supported by the findings of Mustafavi (2012). The Marwa kws, Sugar king, Mirage, Dreeman and Estora kws, genotype showed better performance in terms of high beet yield over the other varieties. It indicates that different sugar beet varieties showed different behavior in terms of beet yield. The negative impact of high (Nubaria) salinity on sugar yield can be the result of the accumulation of Na^+ ions by plants. These findings are in line with the previous findings of Zaki *et al.* (2014) who reported that sugar yield is reduced due to absorbed Na^+ ions. The varieties SDPAK 09/07, California and SDPAK 03/06 performed well and produced higher sugar yield under a salt-stress environment. Zaki *et al.* (2014) also reported that maximum sugar yields were given by top variety and less by Ghazile variety under salt-stress environment. The result is also in agreement with Kaloi *et al.* (2014). In the present study, increasing the application of SA with 2000 ppm under sandy soil conditions gave the highest levels of root fresh mass and top fresh mass in both seasons. However, the increment of root and sugar yield was significant and obtained with SA concentrations. Regarding the effect of cultivars, the maximum levels of root fresh mass, top fresh mass, and root yield, as well as sugar yield, were obtained with the variety Estora kws and Dreeman compared to other varieties. The results of the present study concerning cultivars are similar to the findings of Ramadan, (1999) and Awad *et al*. (2012) who also observed significant variations between different varieties, due to the application of SA.

The interaction effects between soil types (locations) and foliar applications of SA (2000 ppm) with all different varieties were significant on most of the characters of sugar beet in both seasons under the study. The valuable effect of SA on root fresh mass, top fresh mass, and root yield may be due to its role in increasing chlorophyll concentration and enhancement photosynthetic process as well as decreasing the injurious effect of water deficit on plants Abdelaal (2015b). These effects are in agreement with those recorded by Azooz *et al.* (2011) and Kang *et al.* (2013).

Table 3: Means of crop growth rate (CGR), Root yield, Sugar yield, total soluble solids, Extractable and Alkaline co-efficient of some sugar beet varieties as affected by soil types with foliar application of salicylic acid (SA) during 2018/2019 and 2019/2020 seasons.

Treatments	CGR Leaves (g)/day		CGR Root (g)/day		Root yield (ten/fed)		Sugar yield (ten/fed)		T.S.S %		Extractable		Alkaline co-efficient	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Soil types (locations) = (A)														
Sandy soil (Nubaria)	2.51	3.08	5.96	8.72	30.308	34.316	5.439	6.253	23.78	23.16	3.95	4.38	5.19	8.67
Clay soil (Sakha)	2.09	2.78	4.93	6.36	25.442	28.776	4.724	5.244	23.56	23.11	3.53	2.37	5.06	2.29
LSD at 0.05	0.02	0.02	0.05	0.09	0.18	0.27	0.34	0.44	0.03	0.02	0.02	0.06	0.02	0.20
Foliar application of SA (B)														
Control= 0	2.21	2.43	5.37	6.52	26.910	30.954	4.769	5.482	23.44	22.85	3.62	3.04	4.98	5.11
1000 (ppm) SA	2.31	3.11	5.44	7.85	28.302	31.737	5.073	5.821	23.76	23.15	3.74	3.35	5.01	5.13
2000 (ppm) SA	2.39	3.26	5.52	8.25	28.414	31.947	5.398	5.941	23.82	23.36	3.85	3.74	5.39	6.21
LSD at 0.05	0.01	0.04	0.05	0.11	0.13	0.28	0.40	0.36	0.03	0.03	0.01	0.04	0.02	0.05
Sugar beet varieties (C)														
MARWA KWS	1.63	2.56	4.58	6.39	26.430	29.949	4.856	5.747	22.93	21.89	2.82	2.91	3.33	4.54
SUGAR KING	2.13	2.53	5.33	6.72	25.719	31.107	4.866	5.346	23.4	22.89	3.38	3.14	4.58	5.14
MiRAGE	2.32	2.77	5.34	7.14	29.321	30.987	5.271	5.940	23.69	23.2	3.62	3.53	5.23	5.57
DREEMAN	2.61	3.04	5.92	8.67	28.448	33.362	4.809	6.166	24.12	23.54	3.88	3.56	5.72	5.99
ESTORA KWS	2.83	3.75	6.06	8.79	29.458	32.322	5.598	5.542	24.22	24.06	4.98	3.73	6.28	6.18
LSD at 0.05	0.08	0.09	0.11	0.21	0.32	0.25	0.65	0.61	0.10	0.15	0.15	0.07	0.18	0.13
Interaction														
AXB	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AXC	*	*	*	*	*	*	*	*	*	*	*	*	*	*
BXC	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AXBXC	*	*	*	*	*	*	*	*	*	*	*	*	*	*

S_1=the first season 2018/2019, S_2= the second season 2019/2020, * = significant difference at 0.05 level of probability

The results presented in (Table 3) showed the effect of soil types and foliar application concentrations of SA on different sugar beet varieties. Results showed a highly significant increase in the crop growth rate of roots and leave in the sandy soil of Nubaria region compared with clay soil of Sakha region with foliar application 2000 ppm SA in both seasons. Regarding sugar beet verities, results indicated that Estora-kws and Dreeman recorded the high mean values of crop growth rate in both seasons. The interaction showed a highly significant effect of all study factors on crop growth rate.

Data presented in Table (3) revealed that total soluble solids, Extractable sugar and Alkaline co-efficient were significantly affected by foliar application levels on sugar beet varieties under two locations conditions in both seasons. Increasing foliar spraying levels up to 2000 ppm SA gave the highest mean values of T.S.S and Alkaline co-efficient, while the lowest one was recorded by control treatment in both seasons. This effect may be due to the vital role of SA in sucrose synthesis. The influence of SA affects an important role in plant formation and translocation and encouragement photosynthesis in plants. Regarding sugar beet varieties, results indicated that the variety Estra kws and Dreeman recorded the highest values of T.S.S and Extractable and Alkaline co-efficient followed by sugar king variety and Mirage followed by the lowest values of Marwa kws in both seasons.

Interaction effect between sugar beet varieties and foliar SA concentration under two study locations was significant on T.S.S, Extractable and Alkaline co-efficient in both seasons (Table 3). The highest values were produced by applying 2000 ppm SA on Estra kws and Dreeman varieties under Nubaria region conditions.

In respect to the effect of the two locations, the results indicated that planting sugar beet under Nubaria conditions recorded the highest mean values of total chlorophyll and chlorophyll b and carotenoids (7.07 – 5.53 and 2.33 – 2.96) in both seasons. This increase in these traits may be due to suitable conditions in Nubaria as compared with Sakha conditions (Table 4).

Table 4: Chemical characters of some sugar beet varieties as affected by soil types with foliar application of Salicylic acid (SA) during 2018/2019 and 2019/2020 seasons.

Treatments	N(mg/g) DW		P(mg/g) DW		K (mg/g) DW		Total chl (a+b) (mg/g) FW		Carotenoid (mg/g) FW		SLM	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Soil types (locations) = (A)												
Sandy soil (Nubaria)	56.24	59.02	4.05	4.62	53.85	50.39	7.07	5.53	2.33	2.96	3.193	2.783
Clay soil (Sakha)	37.75	29.94	3.12	3.08	35.33	40.40	5.12	4.81	1.75	1.67	2.438	2.686
LSD at 0.05	0.7	0.91	0.03	0.05	0.59	0.43	0.07	0.03	0.02	0.04	0.032	0.018
Foliar application of SA (B)												
Control= 0	45.78	43.26	3.52	3.72	43.13	44.87	5.602	4.877	1.966	2.206	2.546	2.65
1000 (ppm) SA	45.81	43.54	3.53	3.89	44.32	44.97	6.066	5.255	2.076	2.29	2.918	2.573
2000 (ppm) SA	49.39	46.65	3.71	3.93	46.31	46.36	6.622	5.385	2.097	2.464	2.982	2.879
LSD at 0.05	0.3	0.15	0.10	0.01	0.14	0.25	0.049	0.025	0.018	0.011	0.028	0.018
Sugar beet varieties (C)												
MARWA KWS	42.77	39.26	3.79	3.64	42.16	40.57	5.077	4.052	1.601	1.946	2.419	2.427
SUGAR KING	45.13	42.79	3.36	3.47	42.1	42.28	5.312	4.454	1.869	2.144	2.836	2.583
MiRAGE	48.68	44.80	3.54	3.94	44.04	43.94	6.122	5.191	2.101	2.289	2.856	2.698
DREEMAN	50.59	46.62	3.65	3.81	45.56	47.26	6.950	5.707	2.322	2.494	2.912	2.836
ESTORA KWS	48.11	48.96	3.58	4.36	49.09	52.94	7.052	6.458	2.338	2.727	3.054	3.127
LSD at 0.05	0.37	0.70	0.03	0.06	0.54	0.91	0.170	0.183	0.059	0.058	0.043	0.51
Interaction												
AXB	*	*	*	*	*	*	*	*	*	*	*	*
AXC	*	*	*	*	*	*	*	*	*	*	*	*
BXC	*	*	*	*	*	*	*	*	*	*	*	*
AXBXC	*	*	*	*	*	*	*	*	*	*	*	*

S_1=the first season 2018/2019, S_2= the second season 2019/2020, * = significant difference at 0.05 level of probability.

Data in Table (4) showed the significant effect of foliar application with 2000 ppm of Salicylic acid (6.62 – 5.38 and 2.09 – 2.46) compared with the lowest values in the control treatment (5.6 – 4.8 and 1.96 – 2.21) in the first and second season respectively. Sugar beet variety (Estra kws) recorded the highest values of total chlorophyll and chlorophyll b and carotenoids (7.05 – 6.45 and 2.34 – 2.73) in both seasons. While variety (Marwa kws) registered the lowest values in both seasons. Results showed a highly significant effect of the interaction between different factors on total chlorophyll and chlorophyll b and carotenoids in both seasons.

In regard to the effect of the two locations, the results in Table (5) showed a significant difference between sowing sugar beet under Sakha and Nubaria conditions on sucrose percentage, purity percentage and T-Sugars in both seasons. Where, sowing sugar beet under Nubaria location gave the highest sucrose percentage (19.67 – 19.85), purity (83.98 – 82.82) and T-Sugars (0.90 – 0.95) in both seasons.

Table 5: Chemical characters of some sugar beet varieties as affected by soil types with foliar application of Salicylic acid (SA) during 2018/2019 and 2019/2020 seasons.

Treatments	T. phenol mg/g F.W		Carbohydrate mg/g F.W		Protein mg/g F.W		T. sugars mg/g F.W		Sucrose %		Purity %	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Soil types (locations) = (A)												
Sandy soil (Nubaria)	185.37	188.38	38.10	49.18	23.68	23.86	0.90	0.95	19.67	19.85	83.98	82.82
Clay soil (Sakha)	175.47	173.18	36.55	28.51	22.91	18.02	0.83	0.92	18.08	18.45	81.26	78.27
LSD at 0.05	0.40	0.89	0.15	0.64	0.049	0.184	0.003	0.004	0.055	0.051	0.097	0.187
Foliar application of SA (B)												
Control= 0	180.21	179.73	37.22	38.23	22.74	20.75	0.84	0.91	18.43	18.83	82.31	79.61
1000 (ppm) SA	180.34	180.02	37.35	38.61	23.12	20.78	0.86	0.93	18.91	19.14	82.76	80.81
2000 (ppm) SA	180.72	182.58	37.42	39.7	24.02	21.29	0.90	0.96	19.28	19.48	82.79	81.21
LSD at 0.05	0.046	0.74	0.02	0.18	0.111	0.098	0.006	0.04	0.045	0.032	0.067	0.126
Sub Sub plots(C)												
MARWA KWS	175.61	172.77	34.12	36.16	22.17	20.65	0.798	0.84	18.23	18.48	81.45	77.27
SUGAR KING	178.53	164.01	35.33	36.08	22.61	20.18	0.828	0.87	18.54	18.82	82.09	79.09
MiRAGE	179.46	182.19	37.42	37.93	23.53	20.4	0.883	0.94	18.94	19.05	82.86	79.92
DREEMAN	183.37	192.94	39.13	41.25	23.59	21.61	0.906	0.98	19	19.42	82.67	82.14
ESTORA KWS	185.15	191.96	40.65	42.81	24.56	21.86	0.912	1.03	19.67	19.99	84.02	84.31
LSD at 0.05	0.72	2.34	0.5	0.52	0.18	0.141	0.01	0.015	0.1	0.11	0.18	0.515
Interaction												
AXB	*	*	*	*	*	*	*	*	*	*	*	*
AXC	*	*	*	*	*	*	*	*	*	*	*	*
BXC	*	*	*	*	*	*	*	*	*	*	*	*
AXBXC	*	*	*	*	*	*	*	*	*	*	*	*

S_1=the first season 2018/2019, S_2= the second season 2019/2020, * = significant difference at 0.05 level of probability.

Data presented in Table (5) showed that the application of foliar SA (2000 ppm) increased sucrose percentage, purity percentage and T-Sugars compared with control and 1000 ppm of SA in both seasons. However, the treated plants with high concentrations gave the highest values of sucrose (19.28 – 19.48), purity (82.79 – 81.21) and T-Sugars (0.90 – 0.96) in both seasons. Regarding sugar beet varieties, data in the same table showed significant differences between varieties. The highest mean values of Sucrose percentage, purity percentage and T-Sugars were recorded by variety (Estra kws) followed by variety Dreeman and Mirage in both seasons.

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ARABIC SUMMARY

نمو بعض أصناف بنجر السكر تحت مناطق مختلفة المتأثرة بالرش الورقي لحامض السالسليك على المحصول والجودة

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بنجر السكر من المحاصيل السكرية الهامة محلياً ودوليا في انتاج السكر كمصدر أساسي وقد يساهم بأكثر من قصب السكر في مصر ومعظم الدول الأوربية لأنه يصلح في المناطق الجديدة المستصلحة ويتحمل الملوحة خاصة تحت ظروف المعاملة بمنشطات حيوية مثل حامض السالسليك الذي قد يزيد من الأنتاجية تحت تلك الظروف وفي هذا الصدد تم زراعة 5 أصناف من بنجر السكر في منطقتين مختلفتين في نوع التربة (رملية أو طينية) لدراسة تأثير ذلك على نمو وجودة محصول بنجر السكر تحت الرش بحامض السالسليك في موسمين زراعيين 2019/2018 و 2020/2019 وزعت المعاملات عشوائياً في ثلاثة مكررات في تصميم قطع منشقة مرتين بحيث كانت المنطقتين (رملية وطينية) في القطع الرئيسية والأصناف في القطع تحت الشقية الأولى بينما الرش الورقي بحامض السالسليك (0 و 1000 و 2000 جزء في المليون) وزع في القطع الشقية الثانية. أوضحت النتائج أن زيادة الرش الورقي بحامض السالسليك حتى 2000 جزء في المليون زاد معه النمو والمحصول والجودة لبنجر السكر. كما وجد ان صنف دريمان وصنف إستورا (Estora KWS) حقق اعلى أداء تحت ظروف النوبارية مقارنة بباقي الأصناف الأخرى تحت الدراسة حيث سجلت أعلى قيم لصفات النمو والمحصول والجودة خلال موسمي الدراسة.

من النتائج المتحصل عليها خلال الزراعة في الحقل في موسمي 2019/2018 و2020/2019 توصى الدراسة بزراعة الأصناف المناسبة لظروف كل منطقة ومن الأفضل التوسع في زراعة الأراضي الجديدة المستصلحة والخفية الرملية والمعاملة بالرش الورقي لحامض السالسليك حتى 2000 جزء في المليون لأن ذلك يزيد من تحمل النبات للضغوط الحيوية او اللاحيوية مما يزيد من نمو وإنتاجية وجودة محصول بنجر السكر.