Response assessment of some sugar beet (*Beta vulgaris* L.) cultivars to organic fertilizers treatments under South Sinai conditions

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Abstract: Sugar beet is considered the leading crop in the arid sugar field in Egypt, and the main goal of this study is to increase the production of sugar varieties in those areas with efficiency, especially since its cultivation is still the most suitable for the region. To achieve this goal, a research experiment was conducted in the development area in South Sinai Governorate for four varieties of sugar beets (Casupia - Salama - Sahar - Faten) with three applications of organic fertilization (0, 5, 10 tons/fad). The experiment was carried out in a split plot design, with a randomized complete block system with four replications, for three agricultural seasons (2019/2020, 2020/2021, and 2021/2022). Field data was taken for 16 morphological and productive characters of sugar beets as indicators to detect the level of productivity under the conditions of the ecosystem of the Al-Tur region in South Sinai. The results of the experiment resulted in the Salama variety being significantly superior to the other studied varieties by 8.5%. It also became clear that organic fertilization had a significant impact on facilitating the absorption of elements and reducing salt stress, considering that under organic fertilization rates, the Salama variety gave the highest productivity with organic fertilization at a rate of 10 ton/fad, and productivity increased by 167% over the variety, Casupia without using organic fertilization. Accordingly, the study recommended the need to use the Salama variety under organic fertilization conditions at a rate of 10 ton/fad, which contributes to improving sustainable sugar beet production in the Al-Tur region, South Sinai, Egypt, and places with comparable ecological characteristics.

Keywords: Sugar beets, assessment, organic fertilizers, morphological characteristics, yield and yield components

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is belonging to caryophyllales order, which is most basic group of dicots. It is a significant root crop around the globe because sugar is made using its foundations. The total world production of sugar beet is about 253 million tones, with an average yield about 42-ton ha^{-1}. About 13 million metric ton of sugar beets were produced in Egypt 2021 (FAOSTAT, 2022). In many nations is one of the primary raw materials used to produce sugar. In terms of generating sucrose, it is regarded as the second-most significant crop in the world as well as in Egypt, right behind sugarcane. The developed countries found alternative crops over than sugar cane and had cultivation to the production of sugar from it, to accomplish public requirement and to improve the country economy by export. Further, sugar beet is one of the better choices for the production of sugar that it contains enough amounts (16 - 20%) of sucrose over than in sugarcane. In addition to the intended product, sugar beet sucrose gives by products like sugar beet pulp, and molasses that plays a vital role in filling energy gap, especially as an excellent alternative resource of green energy (Skorupa *et al*., 2019).Sugar beet crop is one of the most important crops in Egypt. The level of available feed such as fertilizer dramatically influences yield and quality of the crop. Residual and fertilizers levels allowing adequate top growth and maximize root growth and extractable sucrose concentration are desired. However, sucrose yield decreases by over-fertilizing sugar beet with more organic fertilization than needed for maximum sucrose production (Stoši *et al*., 2020). An adequate supply of organic fertilization is essential for optimum yield, but excess may result in an increase in yield of roots with lower sucrose content and juice purity. Yield increased with organic fertilization applied parallel to fertilization with different levels of the fertilizer (Varga *et al*., 2021). The dramatic increase of the used fertilizers requires more attention from producers to reduce the environmental pollution and production cost. This reduction can be obtained by selecting the proper applied fertilizer level that is suitable for the soil and plant species as well as the beneficial application doses to obtain a real increase in the crop yield, and quality as well as in turn, thus has a high economic return. On the other hand, to meet the rapidly rising population consumption, the Egyptian government imports 1.10 million ton of sugar annually. With approximately 37.3% of the local sugar production (1.61 million ton), sugar beet root plays a significant role in sugar production and ranks second in terms of sugar production after sugarcane. However, compost shows up a component of soil organic matter and general soil ecology and management that is less well understood. However, it was intended to become yet another tool that could be used in conjunction with cover crops, animal dung, and other management techniques. Globally, environmental deterioration brought on by human activity has become a serious issue. In addition, it is anticipated that by 2050, there will be 9.6 billion people on the planet (Shabala *et al*., 2015). Existing natural resources are under tremendous strain because of supplementary food needed feeding this expanding. Therefore, the organic fertilization is used to increase a plant's ability to tolerate salt, helps to increase agricultural output and food security. Climate change assessment and mitigation is an indicator that indicates the overall quantity of emissions from a production system. The nitrogen fertilization is used to assess, alleviate degradation of the environment, such as

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eutrophication of the ocean and ozone depletion in the stratosphere, by describing the overall quantity of nitrogen lost because of human activity. The results of (**Habib, 2021)** showed that the highest yield of roots and top fresh weight (69.8- and 19.8-ton ha^{-1}) was obtained under addition 20 m^3ha^{-1} organic manure + 285 kg N ha^{-1} with Salama and/or Faten cultivars in the means of 1st and 2nd seasons. Also, the highest sucrose yield of roots was obtained under fertilization with (20 m^3 organic manure + 285 kg N ha^{-1} with Salama cultivar). While the highest P and K uptake of foliage was obtained with (20 m^3 organic manure + 285 kg N ha^{-1}+ Faten and/or Sahar cultivars). Despite being a crucial industrial cash crop, sugar beet root productivity remains low since few farmers have the requisite technical skills to produce it; as a result, it became important to pay close attention to this issue and search for naturally safe stimulating growth agents that can significantly affect plant growth and yield characteristics. The current study's hypothesis is that the sugar beets cultivars with organic fertilization input would enhance the beetroot cultivars production system's ecological and financial advantages. In particular, the study's goals were (1) a tolerant variety was to compare the yields of roots, their internal technological quality and the technological sugar yields, (2) comparing the reactive organic fertilization emissions and of the various treatments, (3) evaluating the environmental and financial benefits of the four sugar beets with organic fertilization inputs in the El-Tur area, in South Sinai, at Egypt.

MATERIALS AND METHODS

- Plant materials:

Four different sugar beets cultivars (Casupia-Salam-Sahar and Faten) Imported by FINE SEEDS INTERNATIONAL S. A.E. Federal Republic of Germany.

Experimental location and growing seasons:

The investigation was carried out the El-Tur Experimental Station in South Sinai, at Egypt. The test site is situated between 28°19' 13" and 28°21 '12 " N and between 33°35' 50" and 33°31' 52" E with a height above sea level of 47 m. The station is situated in Egypt's South Sinai in the El-Tur region. The growing seasons were planted on 15 October 2019, 17 October 2020, and 16 October 2021.

Characteristics Soil and its climate:

The yearly precipitation averages 20 mm, and the average temperature of soil is 28.6 °C. Figure (1) shows the meteorological parameters for the 2019–2020, 2020–21, and 2021–2022 growth seasons in the El-Tur area of the South Sinai.

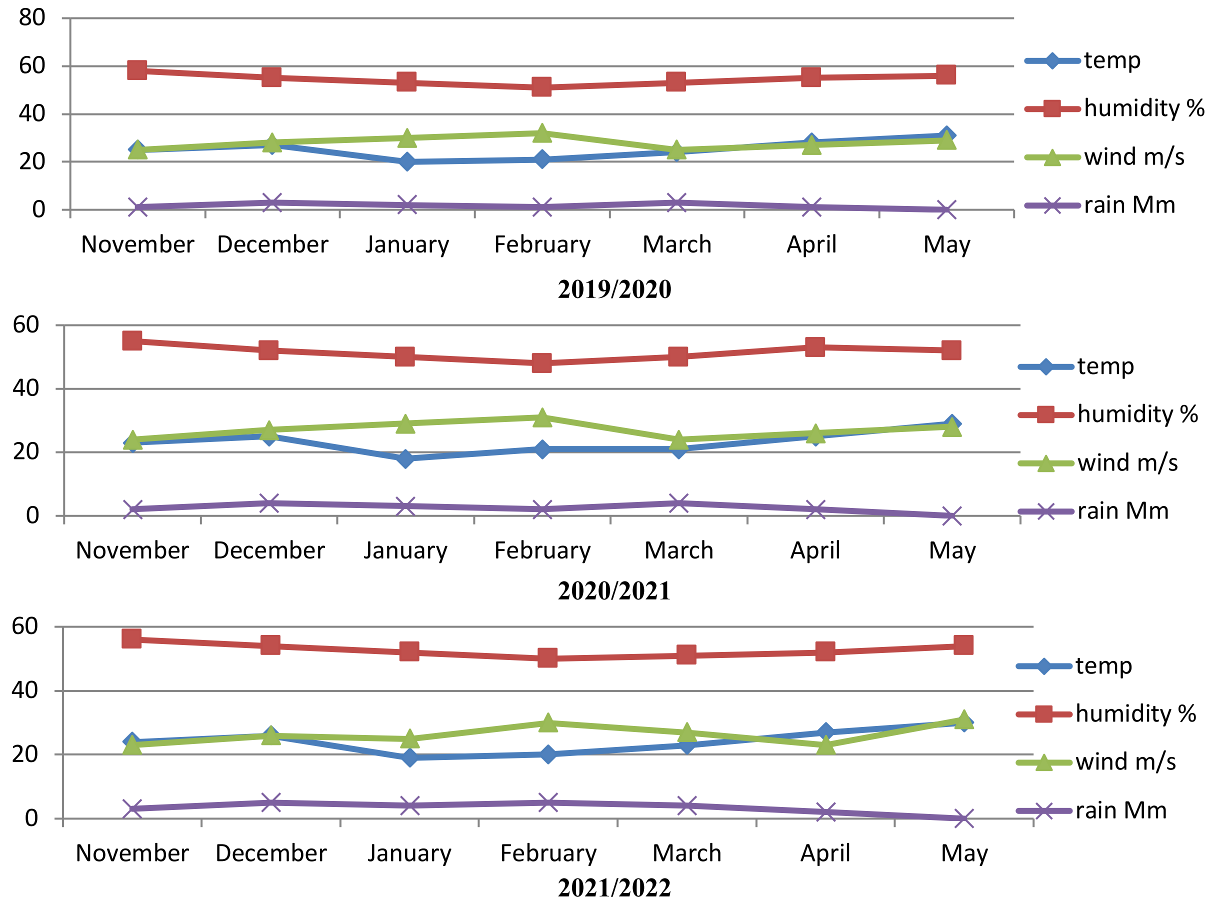

Fig. (1): Meteorological parameters of El-Tur area, South Sinai of Egypt. Station, Desert Res in 2019/2020, 2020/2021 and 2021/2022 growing seasons

The average temperature, humidity %, wind m/s which represent the climate of this area, are at the experimental station's average levels for the El-Tur area of South Sinai, Egypt. Sandy soil, the predominant soil type in this area, is present at the experimental site. The topsoil's original characteristics of chemical and physical properties of representative soil were as follows (Table 1).

Table (1): The mean chemical and physical properties of representative soil samples (0-30 cm depth) in the experimental site before sowing of the irrigation water and organic fertilization Analysis for the three growing seasons

Soil properties	Values	Irrigation Water	Values
pH (Ext. 1:1)	8.25	pH (Ext. 1:1)	7.73
EC (Ext. 1:1), dS m-1	4.78	EC (dS m-1)	4.42
Sand	88.3	Aminouim N (mg L-1)	6.3
Texture Grade	Sandy	Nitrare N (mg L-1)	19.7
Total CaCO3 (%)	44.7	Potassium (mg L-1)	0.38
Potassium (mg kg-1)	49.6	Phosphorus (mg L-1)	0.23
Total Organic Carbon (%)	0.18		
Total Organic Matter (%)	0.35		
Nitrogen (mg kg-1)	11.2		
Phosphorus (mg kg-1)	1.6		
organic fertilization Analysis			
pH (Ext. 1:1)	6.90	Aminouim Nitrogen (mg kg-1)	183
EC(Ext.1:1), dS m-1	2.1	Nitrare Nitrogen (mg kg-1)	397
Total Organic Carbon (%)	4.87	Phosphorus (mg kg-1)	14.3
Total Organic Matter (%)	7.98	Potassium (mg kg-1)	159

Fertilizer Treatments and its applied: Three organic fertilization application rates (0ton/fad (OF0), 5 ton/fad (OF1), and 10 ton/fad (OF2) were applied in this experiment. OF0 represents the rate at which organic fertilizer is typically applied, while OF2 and OF1 represent the amounts of fertilizer that are applied by increase organic fertilization by doubled, respectively. Where, seeds of sugar beets at the rate of 20 cm between the gorges in rows 10.5 m long and spaced 50 cm apart. Each plot has 8 rows, making the total plot size 42 m^2 used in this study. During preparing the soil, calcium superphosphate (15.5% P_2O_5) was applied a rate 30kg P_2O_5/fad. Potassium sulphate (48% k_2O) was broadcast prior to sowing at a rate of 50kg k_2O/fad. Ammonium sulphate (20.6% N) was broadcast at a rate of 60 kg N/fad prior to sowing, and ammonium nitrate (33.5% N) was applied in three equal doses prior to irrigation with a rate of 100 kg N/fad at 30, 60, and 80 days after sowing (300 kg ammonium nitrate).

Experimental design and its management: Randomized complete block design (RCBD) by simple split plot design with four replications was used in this field experimental. The cultivars and organic fertilizations were randomly allocated in the main and sub plots, respectively. Seeds were sown at on 15 October 2019, 17 October 2020, and 16 October 2021. After one month of planting, the plants were thinned to four plants per hill, and then they singled to one plant after 40 days from planting. All cultural practices for cowpea production were applied as recommended at the proper time.

Environmental cost: The cost of purchasing the inputs for agriculture, which also included agricultural capital investments (irrigation, Workers, Land rent, fertilizers, pesticides, seeds and diesel fuel for the agricultural machinery, e.g.) as well as human costs, artificial harvesting, and machinery use for sowing, weevil control), was calculated.

However, the economic evaluation was done as follows,

1- Total gain (LE/ fad) = Root weight (kg/fad×price.
2- Net return (LE/ fad) = Total gain – costs.
3- Cost information for labor, equipment, and all farm inputs were included. A ton of sugar beet cost 700LE. Total costs equal 17857 LE/fad by not using organic fertilizer, 23857 LE/fad by using 5 ton of organic fertilizer per fad, and 29857 LE/fad by using 10 ton of organic fertilizer per fad.

Data collection: -

Growth: Five sugar beet plants were appeared at random selected from each plot after 90 days measure the LAI, which was derived in accordance with (Westtstein, 1957), top fresh weight and the pigments used in photosynthesis (chlorophyll a, b, and carotenoids).

Harvest: After 208 days following sowing at harvest. Ten guarded plants were randomly selected estimating the following characters from each plot: root diameter (cm), root length (cm), Top, Root and Total dry weights (g/plant), overall (g/plant), Sugar yield (kg/fad), crude fiber, crude protein, root fresh weight (kg/plant), root fresh weight (kg/fad), L.E root fresh weight (L.E/fad) and net gain/fad.

Statistical analysis: The analysis of variance of split plots design was used according to (Gomez and Gomez 1984). SPSS 20.0 was used conduct analyses. Means followed by the same alphabetical letters are not statistically different. Last significant differences (LSD at 5% level) were used for comparison between averages.

RESULTS AND DISCUSSION

a- The growth of Sugar beets cultivars: -

I-Leaf area index (LAI): The effects of sugar beets cultivars on leaf area index were significant in the three seasons (Table 2). The highest values of LAI were significantly obtained from planting Salama and Faten cultivars, without significant differences between them in the three seasons. Moreover, the results showed that the relative increase percentages due to cultivation Salama were 11.86, 12.14 and 11.94% for the three seasons, respectively compared with Casupia cultivar. Similar results were also found by (Safina and Abdel Fatah, 2011) and Ahmed et al. 2022.

II-Chlorophyll (a), (b) and carotenoids: The results in Table (2) showed that Chlorophyll (a), (b) and carotenoids were significantly affected by using different sugar beets cultivars. The maximum values were significantly obtained from Chl a, b and carotenoids by planting Salama cultivar in the 2019/2020, 2020l2021 and 2021/2022 seasons. Meanwhile, the lowest values were significantly obtained by cultivation Casupia cultivar in the three seasons. In this respect each of (Höft *et al*., 2018; Antunovi et al., 2021 and Bilir *et al.*, 2021) noted harmonic results with the finding reported in this work.

III-Leaf area index (LAI): The results in Table (3) indicated those leaf area indexes were significantly affected by organic fertilization treatments in the three seasons. The highest values of LAI were significantly gained from the maximum dose of organic fertilization in the three seasons. Moreover, the results showed that the relative increase percentages due to 10 ton/fad were 41.34, 42.02 and 41.38 % for the three seasons, respectively compared with 0 ton/fad organic fertilization.

IV-Chlorophyll (a), (b) and carotenoids: The effects of organic fertilization on Chlorophyll (a) were significant in the three seasons (Table 3). The highest values were significantly obtained from control treatment followed by the highest dose in the three seasons. Moreover, the results showed that the relative increase percentages due to 0 ton/fad were 37.83, 37.85 and 28.27 % for the three seasons, respectively compared with 5 ton/fad organic fertilization. Also, the results in Table (3) showed that chlorophyll (b) was significantly affected by using different organic fertilization. The maximum values were significantly obtained by untreated plants, while the lowest values were significantly gained from the highest fertilization in the 2019/2020, 2020/2021 and 2021/2022 seasons. On the other hand, the effects of organic fertilization on Carotenoids were significant in the three seasons (Table 3). The highest values of Carotenoids were significantly obtained from the maximum dose of fertilization. Moreover, the results showed that the relative increase percentages due to 10 ton/fad were 49.11, 45.23 and 48.13 % for the three seasons, respectively compared with 0 ton/fad organic fertilization. Harmonic results were noted by (Martin, 1980; Melino *et al.,* 2022 and Pulkrábek *et al*., 2021).

b- Harvest of sugar beets cultivars: -

I-Root length and root diameter (cm): In three seasons, the results showed those root lengths and root diameters were significantly affected by sugar beet cultivars (Table 4). There were remarkable increases in root length as well as root diameter by planting Salama cultivar in the three seasons. Generally, the lowest root lengths and diameters were significantly given by planting Casupia cultivar in all seasons. In comparison with Salama cultivar, the relative decrease percentages in root lengths due to planting Casupia were 13.78, 12.89 and 12.82% in three seasons, respectively. In the same direction, the relative decrease percentages in root diameters were 9.96, 10.31 and 9.68% in three seasons, respectively. These outcomes follow the same pattern as those attained by (Harveson et al., 2002; Cucina et al., 2021 and Ernst et al., 2021).

II-Top, Root and Total dry weights (g/plant): The effects of sugar beets cultivars on Top, Root and Total dry weights (g/plant) were significant in the three seasons (Table 4). The highest values of these traits were significantly obtained from cultivation Salama cultivar followed by Faten cultivar with significant differences between them in the three seasons. Meanwhile, Casupia cultivar gave lower values than the other cultivars (Ahmed et al., 2022 and Cucina et al., 2021), obtained similar results.

III-Sugar yield (kg/fad): The productivity of sugar from Casupia cultivar reached 5309, 5757 and 6207 kg/fad and significantly gave the lowest values in the three seasons. On the other hand, Salama cultivars significantly gave the highest production 6450, 7000 and 7593 kg/fad for the years 2019/2020, 2020/2021 and the 2021/2022 seasons, respectively (Fig. 4). In this respect, our findings reported are harmonic with the results noted by both of (El-Mansuob et al., 2020 and Galal et al., 2022).

IV-Crude Protein and crude fiber: Data illustrated in Table (5) show the Casupia cultivar scored 2.323, 2.401 and 2.521 (%), while the Salama culivar scored 2.604, 2.731 and 2.822 (%) for the crude protein characteristic in the seasons 2019/2020, 2020/2021 and 2021/2022, respectively (Safina *et al*., 2012; Idris *et al*., 2021 and Issukindarsyah *et al*., 2021), also reported similar results. The effects of sugar beets cultivars on crude fiber were significant in the three seasons (Table 5). The highest values of crude fiber were significantly taken in the three seasons. Moreover, the results showed that the relative increase percentages due to cultivation Salama were 12.60, 13.50 and 13.91% for the three seasons, respectively compared with Casupia cultivar. (Safina *et al*., 2012; Idris *et al*., 2021 an

Table (2): Performance of sugar beets cultivars concerning growth during 2019/ 2020, 2020/2021 and 2021/ 2022 seasons.

Sugar beets cultivars	LAI	Chlorophyll (a)	Chlorophyll (b)	Carotenoids
2019/2020				
Casupia	12.40c	5.312d	2.579b	1.166c
Salama	13.87a	6.041a	2.936a	1.321a
Sahar	12.97b	5.603c	2.649b	1.237b
Faten	13.62a	5.910b	2.659b	1.283Ab
LSD. 0.05	0.4223	0.1139	0.1572	0.0568
2020/2021				
Casupia	12.77c	5.475d	2.702B	1.220c
Salama	14.32a	6.231a	3.061A	1.369a
Sahar	13.36b	5.774c	2.732B	1.309b
Faten	14.09a	6.113b	2.781B	1.330b
LSD. 0.05	0.4162	0.1082	0.1568	0.0559
2021/2022				
Casupia	13.40c	5.746d	2.802b	1.260c
Salama	15.00a	6.543a	3.201a	1.440a
Sahar	14.02b	6.092c	2.870b	1.336b
Faten	14.70a	6.390b	2.906b	1.392b
LSD. 0.05	0.5201	0.2041	0.2124	0.0614

Table (3): Performance of Organic Fertilization (OF) concerning growth during 2019/ 2020, 2020/2021 and 2021/ 2022 seasons

Organic Fertilization	LAI	Chlorophyll (a)	Chlorophyll (b)	Carotenoids
2019/2020				
Without	11.011c	6.656a	3.018a	1.010c
5 ton/fad	13.069b	4.829c	2.371c	1.239b
10 ton/fad	15.563a	5.665b	2.730b	1.506a
LSD. 0.05	0.0330	0.0895	0.1235	0.0446
2020/2021				
Without	11.342c	6.869a	3.159a	1.079c
5 ton/fad	13.461b	4.983c	2.456c	1.276b
10 ton/fad	16.108a	5.842b	2.842b	1.567a
LSD. 0.05	0.0297	0.0867	0.1157	0.0435
2021/2022				
Without	11.903c	7.217a	3.299a	1.099c
5 ton/fad	14.135b	5.228c	2.572c	1.344b
10 ton/fad	16.829a	6.134b	2.963b	1.628a
LSD. 0.05	0.0431	0.0924	0.1351	0.0537

Table (4): Performance of sugar beets cultivars concerning yield attributes and sugar yield during 2019/ 2020, 2020/2021 and 2021/ 2022 seasons

sugar beets cultivars (SB)	Root Length (cm)	Root Diameter (cm)	Top dry weight (g/plant)	Root dry weight (g/plant)	Total dry weight (g/plant)	Sugar yield (kg/fad)
2019/2020						
Casupia	23.960d	13.060c	85.184c	342.25b	427.58c	5309d
Salama	27.487a	14.504a	95.262a	366.75a	462.00a	6450a
Sahar	26.113c	13.637b	90.203b	344.42b	434.83Bc	5629c
Faten	26.802b	13.060c	92.734Ab	355.75Ab	448.58Ab	6034b
LSD. 0.05	0.4613	0.2545	2.5338	16.004	16.229	145.48
2020/2021						
Casupia	24.699d	13.491d	88.132c	353.04b	441.65c	5757d
Salama	28.353a	15.042a	99.021a	379.01a	477.04a	7000a
Sahar	26.896c	14.085c	93.031b	356.07b	450.91Bc	6051c
Faten	27.605b	14.408b	96.032Ab	368.03Ab	464.67Ab	6508b
LSD. 0.05	0.4598	0.2487	2.5269	15.681	15.832	131.87
2021/2022						
Casupia	25.880d	14.163d	93.042c	371.07b	464.78c	6207d
Salama	29.687a	15.681a	103.073a	398.04a	501.16a	7593a
Sahar	28.218c	14.785c	98.045b	373.02b	471.78Bc	6711c
Faten	28.972b	15.121b	100.026b	386.06Ab	486.97Ab	7168b
LSD. 0.05	0.5147	0.3261	2.6148	16.363	16.874	135.005

Table (5): Performance of sugar beets cultivars concerning yield attributes, L.E root fresh weight and net gain during 2019/ 2020, 2020/2021 and 2021/ 2022 seasons

sugar beets cultivars	Crude Protein (%)	Crude Fiber (%)	Root fresh Weight (g/plant)	Root fresh Weight (kg/fad)	L.E Root fresh weight (L.E/fad)	Net gain (L.E/fad)
2019/2020						
Casupia	2.323d	0.873c	1352c	47332c	33132c	9275c
Salama	2.604a	0.983a	1467a	51345a	35942a	12085a
Sahar	2.426c	0.923b	1378c	48218c	33753c	9896c
Faten	2.502b	0.951ab	1423b	49805b	34864b	11006b
LSD. 0.05	0.0408	0.0345	32.260	1129.1	790.37	790.37
2020/2021						
Casupia	2.401d	0.904c	1410c	49335c	34535c	10678c
Salama	2.731a	1.026a	1528a	53465a	37426a	13569a
Sahar	2.524c	0.953b	1419c	49662c	34764c	10907c
Faten	2.619b	0.983b	1482b	51882b	36317b	12460b
LSD. 0.05	0.0395	0.0289	30.758	1023.7	787.58	787.58
2021/2022						
Casupia	2.521d	0.942c	1461c	51118c	35783c	11926c
Salama	2.822a	1.073a	1593a	55746a	39023a	15166a
Sahar	2.653c	1.005b	1513c	52952c	37067c	13210c
Faten	2.728b	1.044b	1554b	54375b	38063b	14206b
LSD. 0.05	0.0486	0.0438	31.321	1047.8	808.77	808.77

Issukindarsyah *et al*., 2021), also reported similar results.

Root fresh weight (g/plant): The results in Table (5) showed that root fresh weight/plant was significantly affected by using different sugar beets cultivars. The maximum values were significantly obtained by applications Salama followed by Faten and Sahar cultivars in the 2019/2020, 2020/2021 and 2021/2022 seasons in respectively, with significant differences among them.

Root fresh weight (kg/fad): The effects of sugar beets cultivars on root fresh weight/fad were significant in the three seasons (Table 5). The highest values of root fresh weight were significantly obtained from Faten and Sahar cultivars in the 2019/2020, 2020/2021 and 2021/2022 seasons in respectively, with significant differences among them. Moreover, and compared with Casupia cultivar, the results showed that the relative increase percentages due to cultivation Salama were 8.48, 8.37 and 9.05% for the three seasons, respectively.

Root fresh weight (L.E/fad): The results in Table (5) showed that L.E root fresh weights/fad were significantly affected by using different sugar beets cultivars. The maximum prices from root fresh weights were significantly obtained by applications Salama (35942, 37426 and 39023 L.E/fad) followed by Faten and Sahar cultivars in the 2019/2020, 2020/2021 and 2021/2022 seasons in respectively, with significant differences among them. These outcomes follow the same pattern as those attained by (Shalaby *et al*., 2011; Juriši *et al*., 2021 and Khan *et al.,* 2020).

Net gain (L.E /fad): The effects of sugar beets cultivars on net gain/fad were significant in the three seasons (Table 5). The highest values of net gain were significantly taken from Salama cultivar in the three seasons. Moreover, the results showed that the relative increase percentages due to cultivation Salama were 30.30, 27.07 and 27.17 % for the three seasons, respectively compared with Casupia cultivar. In this coonection (El adaw *et al*., 2016; Kristek *et al*., 2020 and Leilah *et al*., 2021), noted results which were harmonic with the results detected.

Effect of organic fertilization treatments

Root length and root diameter (cm): The results in Table (6) showed that root length was significantly affected by using different organic fertilization. The maximum values were significantly increased by increasing organic fertilization from 0.0 to 10 ton/fad in the 2019/2020, 2020/2021 and 2021/2022 seasons in

Crude protein and Crude fiber: The results in Table (7) showed that crude protein was significantly affected by using different organic fertilization treatments. The maximum values were significantly obtained by applications 10 ton/fad in the 2019/2020, 2020/2021 and 2021/2022 seasons, with significant differences among the three rates. The effects of organic fertilization on crude fiber were significant in the three seasons (Table 7). Increasing organic rates gradually and significantly increased crude fiber during the three seasons. Moreover, the results also showed that the relative increase percentages due to using 10 ton/fad were 39.75, 40.91 and 41.45% for the three

respectively, with significant differences among them. Similar results also found by (Heidarian *et al*., 2018; Pogłodziński and Barłóg, 2021 and Rašovský *et al*., 2021). The effects of organic fertilization on root diameters were significant in the three seasons (Table 6). The highest root diameters were significantly taken from the highest fertilization rate in the three seasons. Moreover, the results showed that the relative increase percentages due to application 10 ton/fad were 17,86, 18.86 and 19.29 % for the three seasons, respectively compared with 0 ton/fad organic fertilization. These outcomes follow the same pattern as those attained by (Sarhan *et al*., 2020 and Stoši *et al*., 2020).

Top, Root, and Total dry weights (g/plant): The results in Table (6) showed that top dry weights/plant were significantly affected by using different organic fertilizations. Remarkably maximum values were obtained with applications of 10 t/fad, followed respectively by the lowest rates in the seasons 2019/2020, 2020/2021 and 2021/2022, with significant differences between them. The effects of organic fertilization on root dry weights were significant in the three seasons under study (Table 6). Increasing organic fertilizations rates significantly increased root dry weights/plant in the three seasons. Moreover, the results showed that the relative increase percentages due to fertilization 10 ton/fad were 71.95, 72.62 and 73.95% for the three seasons, respectively, compared with 0 ton/fad organic fertilization. The data in Table (6) showed that total dry weights/plant were significantly affected by using different organic fertilization rates. The maximum values were significantly obtained by applications 10 ton/fad, followed respectively by the other rates in the 2019/2020, 2020/2021 and 2021/2022 seasons, with significant differences among them. Similar results were reported (Wael *et al*., 2015; Varga *et al*., 2020 and Varga *et al.,* 2022).

Sugar yield (kg/fad): The effects of organic fertilization rates on sugar production/fad were significant in the three seasons (Table 6). The highest values of sugar production were significantly taken from the highest organic fertilization rates in the three seasons. Moreover, the results showed that the relative increase percentages due to using 10 ton/fad were 57.18, 54.64 and 53.23 % for the three seasons, respectively compared with untreated plants by organic fertilization. Harmony discoveries were made, such **(**Lv *et al.,* 2018 and 2019; Yassin *et al*., 2022; Safy, 2021 and Abu-Ellail *et al*., 2021**).**

seasons, respectively compared with untreated plants by organic fertilization. The same results were also reported by (Yassin *et al*., 2022; Varga *et al*., 2020 and Varga *et al*., 2021).

Root fresh weight (g/plant): The results in Table (7) showed that root fresh weight/plant was significantly affected by using different organic fertilization. The maximum values were significantly obtained by applications 10 ton/fad compared to the two other treatments in the 2019/2020, 2020/2021 and 2021/2022 seasons, with significant differences among them.

Root fresh weight (kg/fad): The effects of organic fertilization treatments on root fresh weight/fad were significant in the three seasons (Table 7). The highest values of root fresh weight were significantly obtained from the maximum organic rate in the three seasons. Moreover, the results showed that the relative increase percentages due to fertilization (10 ton/fad) were 72.74, 68.72 and 68.90 % for the three seasons, respectively compared with 0 ton/fad organic fertilization. Harmony discoveries were made by (Jaskulska *et al.,* 2017; Abofard *et al*., 2021 and Yassin *et al*., 2021).

Root fresh weight (L.E/fad): The results in Table (7) showed that root fresh weights (L.E/fad) were significantly affected by using different organic fertilization. Significant maximum values of L.E/fad were obtained with the applications 10 ton/fad, followed respectively by a decrease in the other two rates in the 2019/2020, 2020/2021 and 2021/2022 seasons with significant differences among them.

Net gain (L.E /fad): The effects of organic fertilization rates on Net gain (L.E /fad) from planting sugar beet were significant in the three seasons (Table 7). The maximum net gains from sugar beet were significantly taken from the highest organic rate in the three seasons. Moreover, the results showed that the relative increase percentages due to application 10 ton/fad were 86.65, 71.91 and 72.02 % for the three seasons, respectively compared with 0 ton/fad organic fertilization. Harmony discoveries were made by (Abd El-Aziz and El Sahed., 2021; Abu-Ellail and El-Mansoub, 2020 and Abou-Elwafa *et al*., 2020).

Interactions effects between cultivars and organic fertilization treatments

Root fresh weight kg/fad: As illustrated in Fig.2, sugar beet plants cultivated by Salama cultivar with 10 ton/fad organic fertilization a statistically and significantly gave the maximum root fresh weights compared with the other interactions in the three-year average. Similar results were also found by (Abd El-Aziz *et al.,* 2017; Ikhajiagbe *et al*., 2020 and Ali *et al*., 2023).

Net gain L.E/fad: Maximum net gains from sugar beet/fad were recorded with the interaction between Salama cultivar and organic fertilization (10 ton/fad) with significant differences among the other interactions (Fig 3). Also, Salama cultivar without organic fertilization gave higher net gain than the other interactions without organic fertilization. It is clear that the lowest net gains were significantly obtained from the interaction between any cultivars without organic fertilizations (Fig. 3). These finding results were in agreement with the results noted by (Abd El-Aziz *et al*., 2018 and El-Metwally *et al*., 2010).

Table (6): Performance of Organic Fertilization (OF) concerning yield attributes and sugar yield during 2019/ 2020, 2020/2021 and 2021/ 2022 seasons

Organic Fertilization (OF)	Root Length (cm)	Root Diameter (cm)	Top dry Weight (g/plant)	Root dry weight (g/plant)	Total dry Weight (g/plant)	Sugar yield (kg/fad)
2019/2020						
Without	24.008c	12.643c	76.96c	255.13c	332.19c	4652c
5 ton/fad	26.050b	13.704b	90.59b	357.94b	448.56b	5412b
10 ton/fad	28.214a	15.027a	104.98a	443.81a	549.00a	7313a
LSD. 0.05	0.3624	0.2000	1.9905	12.573	12.749	125.99
2020/2021						
Without	24.732c	13.065c	80.98c	265.24c	345.24c	5110c
5 ton/fad	26.851b	14.184b	94.57b	370.98b	463.68b	5794b
10 ton/fad	29.098a	15.529a	109.99a	457.85a	566.36a	7902a
LSD. 0.05	0.3479	0.1875	1.8793	11.974	12.603	123.251
2021/2022						
Without	25.933c	13.663C	84.94c	278.16c	362.38c	5582c
5 ton/fad	28.516b	14.866B	98.55b	388.99b	486.87b	6407b
10 ton/fad	30.498a	16.298A	114.94a	479.88a	593.92a	8553a
LSD. 0.05	0.3942	0.2136	2.0531	13.145	12.942	127.102

Table (7): Performance of Organic Fertilization (OF) concerning yield attributes, L.E root fresh weight and net gain during 2019/ 2020, 2020/2021 and 2021/ 2022 seasons

Organic Fertilization	Crude Protein (%)	Crude Fiber (%)	Root fresh weight (g/plant)	Root fresh weight (kg/fad)	L.E Root fresh weight (L.E/fad)	Net gain (L.E/fad)
2019/2020						
Without	2.046c	1.162a	1021c	35717c	25002c	7145c
5 ton/fad	2.463b	0.689c	1432b	50111b	35078b	11221b
10 ton/fad	2.883a	0.946b	1763a	61696a	43187a	13330a
LSD. 0.05	0.0320	0.0271	25.344	887.03	620.92	620.92
2020/2021						
Without	2.156c	1.201a	1076c	37662c	26364c	8507c
5 ton/fad	2.536b	0.711c	1487b	52052b	36436b	12579b
10 ton/fad	3.013a	0.988b	1816a	63545a	44481a	14624a
LSD. 0.05	0.0275	0.0247	24.284	881.83	587.34	587.34
2021/2022						
Without	2.227c	1.267a	1127c	39452c	27616c	9759c
5 ton/fad	2.666b	0.753c	1559b	54558b	38191b	14334b
10 ton/fad	3.150a	1.028b	1904a	66633a	46644a	16787a
LSD. 0.05	0.0389	0.0357	26.889	894.86	643.51	643.51

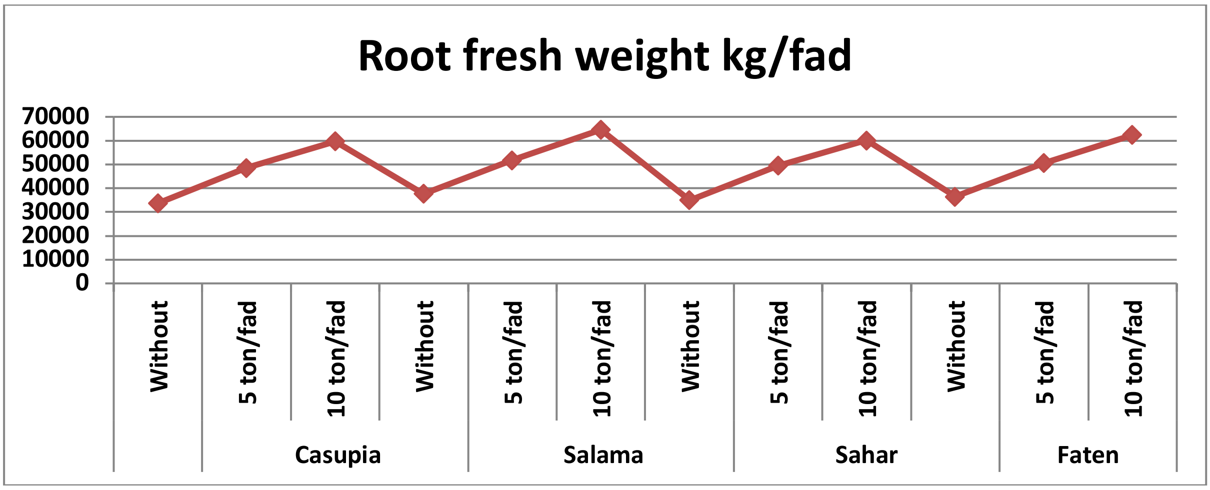

Fig. (2): Effect of the interaction between sugar beet varieties and organic fertilization on root fresh weight kg/fad in the three-year average. LSD. 0.05 (2537.0)

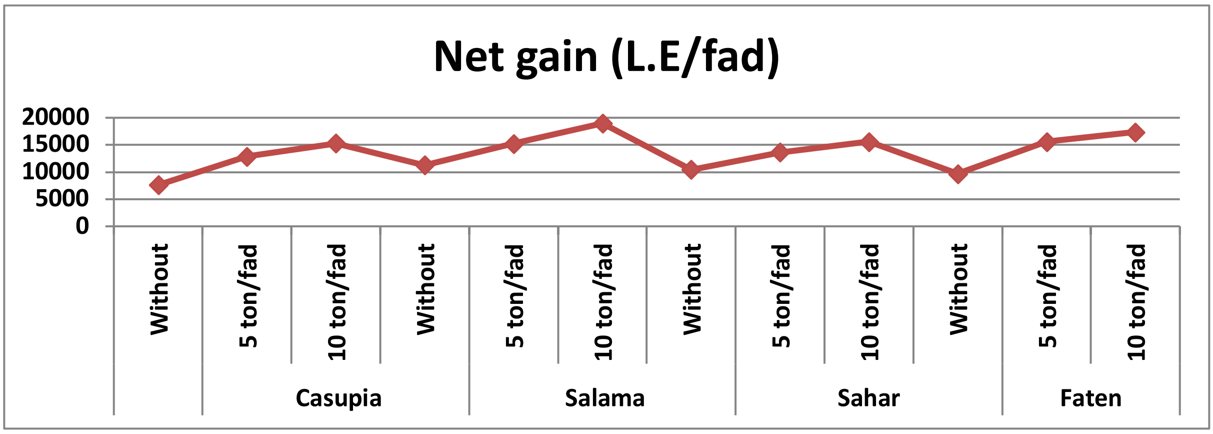

Fig. (3): Effect of the interaction between sugar beet varieties and organic fertilization on net gain (L.E/fad) in the three-year average. LSD. 0.05 (1775.9)

CONCLUSION

One of the regions is the Tur Sinai world's driest, with an annual rainfall rate of just 20 ml, which is insufficient for any form of agriculture. Having to rely on groundwater with a 3000 PPM level was necessary to develop sugar beets the cultivation of the sugar beet cultivar Salama with 10 ton/fad organic fertilization yielded the most cost-effective sugar beet output in the El-Tur area in the South Sinai region.

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تقييم إستجابة بعض أصناف بنجر السكر لمعاملات السماد العضوي تحت ظروف جنوب سيناء

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قسم الانتاج النباتى- شعبة البيئة وزراعات المناطق الجافة-مركز بحوث الصحراء.

يعتبر بنجر السكر هو المحصول الأساسي لإنتاج السكر في الأراضي القاحلة بمصر، حيث يعد الهدف الرئيسي لهذه الدراسة هو زيادة انتاجية أصناف بنجر السكر في تلك المناطق عن طريق استخدام الأسمدة العضوية، لاسيما وان زراعته لا تزال هي الأنسب لتلك المنطقة. ولتحقيق هذا الهدف تم إجراء تجربة حقلية بمنطقة الطور بمحافظة جنوب سيناء لأربعة أصناف من بنجر السكر (كاسيوبيا - سلامة - سحر- فاتن) مع ثلاثة معدلات من التسميد عضوي (0، 5،10 طن/فدان). نفذت التجربة بتصميم القطع المنشقة بنظام القطاعات الكاملة العشوائية ذات أربعة مكررات ولمدة ثلاثة مواسم زراعية (2020/2019، 2021/2020، و 2022/2021). تم اخذ بيانات ميدانية ل 16 صفة مورفولوجية وانتاجية لبنجر السكر كمؤشرات للكشف مستوى الإنتاجية تحت ظروف لنظام البيئي لمنطقة الطور بجنوب سيناء. اسفرت نتائج التجربة عن تفوق صنف سلامة معنوياً على الأصناف الأخرى المدروسة بنسبة 8.5%. أتضح أيضا أن التسميد العضوي كان له تأثير كبير على تيسير امتصاص العناصر وتقليل اجهاد الأملاح، مع الأخذ في الاعتبار أنه تحت معدلات التسميد العضوي فإن الصنف سلامة قد اعطى أعلى انتاجية مع التسميد العضوي بمعدل10 طن/فدان ، كما وزادت الانتاجية بنسبة 167% عن الصنف كاسيوبيا وبدون استخدام التسميد العضوي. وبناءً عليه أوصت الدراسة بضرورة استخدام الصنف سلامة تحت ظروف التسميد العضوي بمعدل10 طن/فدان ، الأمر الذي يساهم في تحسين إنتاج بنجر السكر في منطقة الطور، جنوب سيناء، مصر والأماكن ذات الخصائص البيئية المشابهة.

الكلمات المفتاحية: بنجر السكر- تقييم - التسميد العضوي - المحصول ومكوناته – الصفات المرفولوجية لبنجر السكر