Influence of foliar application of algae extract and nitrogen fertilization on yield and quality of sugar beet grown in reclaimed sandy soil

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Abstract

The current examination was done at North- Eltahrer, Alnubaria Albuhaira Governorate, during 2018/19 and 2019/20 seasons. The field analyze was led to consider the impact of foliar application with alga extricate (*Spirulina platensis*) and Nitrogen fertilization on creation and nature of sugar beet (*Beta vulgaris* var. MK4200) was planted in a sandy soil under sprinkler water system framework. A split – split plot design with three replicates was utilized in the two seasons. Nitrogen focus was masterminded in the primary plots, while Algae were allotted in the sub plot. the Results demonstrated that foliar utilization of alga extract using 1.0 g/l or 2.0 g/l produced significantly higher values of photosynthetic pigments), vegetative growth traits of sugar beet plants (root diameter, root and foliage fresh weight), (root and top dry weight/plant) and yield and yield components (root and top weight (g/plant and kg/fed), Sugar yield and quality traits. Higher estimations of development ascribe and yield and its segments were gotten with adding 120 N kg/fed. The interaction between alga concentrate and Nitrogen fertilization altogether influenced complete photosynthetic pigments, all development characters, yield and yield components. The blend of 2.0 g/L alga extracts alongside 120 N kg/fed. can be prescribed to get the most extreme root yield/fed. Sugar yield was essentially and emphatically corresponded with Sucrose% followed by juice purity% and Brix% as well. Negative relationship was identified between juice purity%, and brix%.

Keywords: *Spirulina platensis*; Nitrogen fertilizer; Sandy soil; Sugar beet.

1. Introduction

Sugar beet is one of the most basic economic crops. The proceeded with creation of this significant ware requires more harvest the board methods. Moreover, the expansive leaved yield builds soil richness, particularly in recently developed soils which, portrayed with low of natural issue and water holding limit just as high supplement misfortunes by filtering; which prompts show lack manifestations of large scale and miniature supplements (Shafeek *et al.*, 2013). Green growth separate being natural and bio-degradable in nature is considered as a significant wellspring of sustenance for practical horticulture particularly in the recently recovered soil. Synthetic investigation of green growth extricate and have uncovered the presence of a wide assortment of plant

development controllers, for example, auxins and cytokinins in differing sums (Zhang and Ervin, 2004). In this way, green growth separate invigorate root foundation, root prolongation and advance vegetative development of plants. Foliar use of green growth extract has been accounted for to actuate numerous beneficial outcomes, where showering plants had prompted improve crop yield and quality, increment supplement take-up, protection from ice and stress conditions. Green growth were early considered as a significant gathering of microorganisms fit for fixing air nitrogen, just as it causes critical expansion in root development, fresh and dry weight of roots, complete biomass, yield segment, photosynthetic pigments and development advancing hormones (Ghalab and Salem, 2001). Because of the useful movement, there is an expansion of photosynthetic contraption through raising the substance of all out sugars, starch, amino acids and protein (Raupp and Oltmanns, 2006) and (Yassen *et al.*, 2007). *Spirulina platensis* is a rich wellspring of potassium and contains impressive measures of Ca, Cu, Fe, Mg, Mn, P and Zn, consequently it expands take-up and gathering of these components in plants. This thus clarifies the critical increment of vegetative development and yield and its parts just as substance of nitrogen, phosphorus and protein in leaves additionally leaf chlorophyll content for most harvests particularly those become under semiarid and desert conditions (Abd El-Mawgoud *et al.*, 2010) and (Marrez *et al.*, 2014).

Nitrogen is the main agronomic variable known to influence sugar beet yield and quality and it ought to be figured out how to deliver high root weight with high Sucrose focus and virtue levels with insignificant top development (Seadh *et al.*, 2007). A satisfactory flexibly of nitrogen is fundamental for ideal yield and the financial yield is firmly identified with the sugar amassing measure. (Clinton *et al.* 2000) revealed that nitrogen is the main manure component for sugar beet development and yield, and they added that the option of N up to 100 kg N/prevailing fashion. Significantly improved length, diameter and weight of sugar beet roots in any case the best Sucrose yield was acquired with 120 kg/ha and ideal N treatment rates for sugar beet rely upon the locale. Expanding N level up to 100 kg N/fed. Discouraged essentially Sucrose and virtue rates (El-Harriri and Gobarah2001) and (Badr *et.al.,* 2017). Expanding N levels from 60 to 120 kg N/prevailing fashion. Influenced fundamentally root length, width and new weight/plant, root sugar yields. Something else, Sucrose and virtue rates were not influenced by the pre-owned N levels (Ismail 2002). (Ramadan *et al.* 2003) demonstrated that Sucrose and immaculateness rates just as recoverable sugar content altogether diminished with expanding N application from 0 to150 kg N/prevailing fashion. in sandy soil. Then again, contamination credits [Na, K and α-amino N (meq/100 g)] and Sucrose misfortune to molasses altogether expanded with raising N levels up to 150 kg N/fed. (Azzazy 2004) announced that root length, root and top yields and TSS were essentially expanded as the applied N level was expanded from 60 up to 100 kg N/fed. while, Sucrose and virtue rates were essentially diminished. (Ismail and Abo EL-ghait 2005) showed that expanding N levels from 65 to 112 kg N/fed. Brought about a critical impact on root distance across (cm), root new weight/plant (kg), root yield (ton/prevailing fashion) Sucrose rate and alpha amino nitrogen (meq/100 g), however sugar yield (ton/fed.)

was altogether expanded. (Leilah *et al.*, 2005 and 2007) presumed that expanding N levels from 120 to 216 kg N ha-1 improved root yield and its segments, while, yield and quality (all out solvent solids, Sucrose and immaculateness rate) were diminished. (Montemurro and Maiorana 2007) revealed that adding 250 kg N ha-1 created the most elevated estimations of length, distance across and new weight of roots just as root, top and sugar yields ha-1. Additionally, (Stevens *et al.*, 2007) demonstrated that surplus N lessens the extent of the sugar which can be solidified and amount of N application as the viable factor to upgrade sugar yield and quality. From ecological scene the inordinate nitrogen treatment may bring about a critical reduction in NUE and likely contamination of climate which lessen the monetary advantage of horticulture creation and human wellbeing (Zhenxie *et al.*, 2008). Expanding N application decreased nitrogen use productivity (NUE) in sugar stick (Koochekzadeh *et al.*, 2009). Principal part (PC) examination that was utilized to clarify most of the complete variety (Abo Elenen, *et al.*, 2019). Gomaa *et al.* (2017) reported that nitrogen fertilizer application at a rate of 100.5 kg N/ fed. accompanied with 48 kg K2O/ fed. was found to be the most favorable for improving the yield and quality of sugar beet grown in a sandy soil.

The goal of this analysis to contemplate the impact of foliar application with alga extract (*Spirulina platensis*) and Nitrogen fertilization on creation and nature of sugar beet (*Beta vulgaris* var. Mk4200)

2. Materials and methods

2.1. Site Description

Two field trials were directed at The newly reclaimed lands served by Nubaria Agricultural Research Station, is located at the East side of Cairo-Alexandria desert road, at Al-Naser Central village, North Tahrir, El-Beheira Governorate, Egypt , Throughout 2018/19 and 2019/20 sugar beet growing seasons to study the effect different rates of Nitrogen fertilization and foliar spray of *Spirulina platensis* filtrate on yield components and technological characters of Sugar Beet (*Beta vulgaris* var. MK4200), was planted in a sandy loam soil under surface irrigation regime.

Former to any soil preparation of the experimental site, a multiple soil sample was gathered from the soil depth of (0-30 cm), air-dried, sieved by 2 mm sieve and analyzed. The physical and chemical properties of soil as illustrated in Table (1), were determined according to Klute, 1986 and Page et al., 1982.

2.2. Plant Material

Seeds of the tested sugar beet varieties were commercial and obtained from the under certification pool of sugar beet varieties hold by Sugar Crops Research Institute (SCRI). *Beta vulgaris* subsp. vulgaris was polygerm variety, MK4200.

2.3. The Algae, Spirulina platensis and preparation for the study

S. platensis strain was isolated from Al-Khadra Lake, Wadi Al-Natroon, El-Baheira governorate, Egypt. Isolation, purification, Morphological identification and production to massive scale were performed at Algal Biotechnology Unit, National Research Center. Homogenate was prepared by a suspension of dry *S. platensis* in deionized water (in a ratio 1:10) and mixing (Thermomix TM5; USA) at 37 °C for 40 min. (500 rpm). The obtained solution was centrifuged for 20 min. (4600 rpm) (Heraeus Megafuge 40, rotor

TX-750, Thermo Scientific, and Waltham, MA, USA). Supernatant was separated and treated as an algal filtrate (AF)—100%. Three samples were taken for determination of Macrominerals and trace elements by Algal Biotechnology Unit, National Research Center.

Samples were irradiated, together with standard reference materials; two standard reference materials were used: the European Inter-Institutes Committee (CII) "Alfa-Alfa" and the Bureau Communautaire de Référence "Lucerna Flour". Major components of the used alga filtrate are appeared in Table 2.

Table 1. Some physical and chemical properties of the experimental soil site during 2018/2019 and 2019/2020 sugar beet growing seasons.

Soil parameters		
	Seasons	
Particles size ditrbution %	2018/2019	2019/2020
Sand	58.41	56.10
Silt	11.00	12.00
Clay	30.59	31.91
Textural class	Sandy loam	Sandy loam
Chemical properties		
PH (1:1) (soil: water suspension)	7.91	8.10
EC (1:1) (soil: water extract), dS/m	3.71	3.79
Soluble cations (1:2) (meq/l)		
K^+	0.46	6.59
Ca^{++}	0.61	8.30
Mg^{++}	3.49	4.11
Na^{++}	12.11	12.49
Soluble anions (1:2) (meq/l)		
HCO^-_3	5.98	6.22
CL	7.91	8.41
SO^-_4	4.41	4.11
Calcium carbonate,%	12.27	12.91
Total Nitrogen, %	0.77	0.87
Available P (mg/ kg)	4.52	4.61
Organic matter, %	1.51	1.60

2.4. *Experimental design*

The accomplished work included fourty eight experimental units as a factorial arranged split plot design with Nitrogen fertilizer rates (Without, 60, 90 and 120 kg\fed.) in main plots and Algae, *Spirulina platensis* was sprayed as foliar application at four filtrate concentrations (Without, 0.5, 1.0 and 2.0 g/L/400 liter water/fed) were allocated in the subplots, Mineral fertilization consists of nitrogen as in form of ammonium nitrate (NH4NO3 33.5 %), with Three replicates were used. subplots consisted of six rows (50 cm

spacing) by 7.0 m in length (3 m ×7.0 m = 21.0 m^2) i.e. 1/200 Fed. Sugar beet plants were cultivated on 14th Oct. in both investigated seasons. The experimental setup was repeated for the successive trial in 2018/19 and 2019/20.

All recommended agriculture practices for sugar beet cultivation other than experimental treatments needed for growing as sowing, irrigation, hoeing and pest control were taken whenever it were required and accomplished according to the approvals of Ministry of Agriculture, Egypt.

Table 2. Macrominerals and trace elements contents of the The Algae, *Spirulina platensis*. *Elements determined by Algal Biotechnology Unit, National Research Center Values are the mean (RSD in brackets) of five determinations.

Elements	Sample1	Sample2	Sample3	Mean	[a]Refs
N	11.2	12.3	11.8	11.8	9.3–24.42
P	1.65	1.54	1.6	1.6	1.3–9.21-3
K	0.900 (0.141)	0.88	1.0	0.9	0.233–1.9361-4
Mg	0.067 (0.021)	0.22	0.14	0.1	0.120–0.5451-4
Na	0.35 (0.6)	0.01	0.18	0.2	0.027–5.431-4
Ca	0.432 (0.005)	0.33	0.381	0.4	0.042–2.610 [1-4]
Fe	1176 (25)	1936	1553	1555.0	220–20161-4
Zn	18.5 (0.4)	21	19.8	19.8	18.4–1851-4
Mn	54.5 (0.4)	68	61.3	61.3	13–2051-4
Cu	16.2 (1.1)	18	17.3	17.2	2.6–48.01-3

[a] References: 1. (Ortega-Calvo *et al.,* 1993); 2. (Dillon *et al*., 1995); 3. (Mannino and Benelli, 1980); 4. (Johnson and Shubert, 1986).

2.5.   Data Recorded

The outer two ridges were considered as a belt, while plants of the 2nd ridge was used for growth analysis. The other ridges, 3rd, 4th and 5th were kept for determination of yield, yield components and technological quality.

For determining growth analysis, a random sample of five plants was taken from each plot of every replication after 6 months (at harvest) from sowing during both seasons to determine the following parameters:

2.5.1.   Growth characters
1.   Root length (cm).
2.   Root diameter (cm).
3.   Root fresh weight (g/plant).
4.   Leaf fresh weight (g/plant).

2.5.2. Yield components
1-   Root yield (Ton/Fed.)
2-   Top yield (Ton/Fed.)
3-   Sugar yield (Ton/Fed.)

2.5.3. Quality traits
Sucrose percentage was determined by using Sacharimeter according to Le-Docte (1927). Total Soluble Solids (TSS %) was determined by using digital referactometer. Juice purity percentage (%) was determined according to the method of Carruthers and Oldfield (1961).

Potassium (K) and Sodium (Na) were measured in the root dry weight at harvest time, by using the Flame photometer. α-amino nitrogen was also calculated by double beam filter photometry using the blue number method (Sheikh_Aleslami 1997).

Sucrose loss to molasses (SLM) = 0.343*(K+ Na) + 0.0393* α- amino N + 0.31

Extractable sugar % was calculated using the following equation according to (Cooke & Scott 1993):

Quality% (QZ%) = QZ = (ZB × 100)/ (α-amino N)

Extractable white sugar % (ZB %) = (Pol % - 0.29) - 0.343 (K + Na) - α- amino N (0.0939).

Where: K, Na and α-amino N were determined as meq/100 g beet.

2.6.   Statistical analysis

The obtained data of the two seasons and their combined analysis were computed according to Snedecor and Cochran (1980). Combined analysis between two seasons were calculated according to Mc Intosh, M. S. (1983). The treatment means were compared by using the least significant difference (L.S.D) test (Waller and Duncan, 1969) at 5% level of significance.

3. Results and Discussion

3.1. Growth characters

3.1.1. Effect of nitrogen fertilizer

Information introduced in Table (3) showed that increasing application Nitrogen fertilization rates from 60 to 120 kg N/fed. Was related with critical expansions in completely contemplated characters' root length and diameter (cm) and fresh weight (root and leaf). The most noteworthy estimations of previously mentioned characters were gotten with the expansion of 120 kg N/fed. compared with other treatments. These outcomes affirm that the function of nitrogen in division just as building natural metabolites which thusly trans situated to be put away in sugar beet roots. It could be inferred that high rates of nitrogen application empower creation of new vegetative organ which uncovered an articulated augmentation in leaf yield.

Comparable outcomes were acquired by (Montemurro and Maiorana 2007), (Badr 2006) who expressed that expanding Nitrogen fertilization 100 kg N/fed. of delivered the most elevated development qualities. Badr *et al.* (2017) development ascribes essentially expanded by expanding Nitrogen fertilization levels from 40 to 80 and 120 kg N/fed.

3.1.2. Effect of foliar application with alga extract

Information in Table (3) showed that a critical impact of alga extract on root diameter, length root and root, leaf fresh weight/plant. Splashing beet plants with (2 g/L) Spirulina extricate brought about higher estimations of root thickness just as new weight of leaves and roots when contrasted with different levels The obvious impact of alga concentrate might be credited with its impact in expanding cell layer penetrability and advancing plant productivity in the retention of supplements, for example, nitrogen, which has an immediate connection with leaf chlorophyll fixation. In addition, green growth concentrate may assume a part through its substance of cytokinins in postponing the maturing of leaves by decreasing the debasement of chlorophyll. Likewise, alga extricate as a bio-controller influencing the harmony among photosynthesis and breath measures in plants (Raupp & Oltmanns, 2006, Yassen *et al.*, 2007 and Enan et.al 2016).

Table 3. The effect of foliar application with alga extract and nitrogen fertilizer on growth characters of sugar beet (combined analysis of the two seasons 2018/2019 and 2019/2020).

Treatment	Root length (cm)	Root diameter (cm)	Root fresh W.(gm)	Leaf fresh W.(gm)
60 Nkg/fed	28.02	29.26	765.58	439.92
90Nkg/fed	32.76	32.87	848.67	499.75
120Nkg/fed	36.98	37.11	973.42	605.33
LSD 0.05	0.35	0.42	13.65	7.67
Control	30.64	31.70	820.84	480.89
0.5 g/L	32.32	32.64	851.44	503.78
1.0 g/L	33.32	33.39	875.11	526.44
2.0 g/L	34.06	34.58	902.78	548.89
LSD $_{0.05}$	0.26	0.12	6.90	2.08

3.1.3. The interaction

The interaction between foliar application with alga extract and Nitrogen fertilization significantly affected growth characters. The results in Table (4) showed that were responded to the increase of foliar applied Spirulina extract level, but was highly magnitude by adding 120

kg/N. Therefore, the highest value of growth characters recorded by 120 kg/N and 2 gm/L alga extract finding may be due to algae extract contains cytokines which induce the physiological activities and increase total chlorophyll in plants

which, reflects on the activity of photosynthesis and the synthesized materials which will positively reflects on the growth characteristics (Ghalab and Salem, 2001) and (Enan *et al.*,2016).

Table 4. The interaction effect of foliar application with alga extract and Nitrogen fertilization on growth characters of sugar beet (combined analysis of the two seasons 2018/2019 and 2019/2020).

Treatments		Root length (cm)	Root diameter (cm)	Root fresh w.(gm)	Top fresh w.(gm)
60 N kg/fed	Control	25.83	28.03	725.67	410.33
	0.5 g/L	27.73	28.87	759.67	438.00
	1.0 g/L	28.80	29.57	782.33	450.00
	2.0 g/L	29.70	30.57	794.67	461.33
90 N kg/fed	Control	30.50	31.57	814.38	476.44
	0.5 g/L	32.57	32.47	838.00	487.00
	1.0 g/L	33.57	33.03	859.33	505.00
	2.0 g/L	34.40	34.40	883.00	530.67
120 N kg/fed	Control	35.60	35.50	922.67	556.00
	0.5 g/L	36.67	36.60	956.67	586.34
	1.0 g/L	37.60	37.57	983.77	624.49
	2.0 g/L	38.07	38.77	1030.82	654.67
L.S.D		**0.45**	**0.22**	**11.95**	**3.60**

3.2. Yield and yield components

3.2.1. Effect of Nitrogen fertilizer

All yield segments altogether expanded because of expanding Nitrogen fertilization levels from 60 to 90 and 120 kg N/fed. in Table (5). Preparing sugar beet plants with120 kg N/fed. of delivered the most noteworthy estimations of all contemplated yield components.

Use of 90 kg N/fed. brought about the best discoveries after the most elevated level of Nitrogen fertilization with critical contrasts correlation with different levels. While, the most reduced ones were acquired because of plant did got Nitrogen fertilization (60 kg N/fed.). Such impact of nitrogen on these attributes might be gotten back to its function in working up metabolites and initiation of compounds that partner with aggregation of starches, which made an interpretation of from leaves to creating roots just as expanding division and lengthening of cells, subsequently

expanding root size. The current outcomes are in accordance with those got by (Salami *et al.*,2013), (Awad *et al.*, 2013a and b), (Amin *et al.*,2013), (Hamad *et al.*,2015) and (Badr *et al.*,2017). The most elevated estimations of root and sugar (21.01and 3.15 ton/fed.) were delivered from preparing beet plants with 120 kg N/fed. The least estimations of root yield/fed. were acquired from treatment (60 kg N/fed). The increment in root yield because of utilization of nitrogen preparation can be clarified through the way that nitrogen has a crucial function in working up metabolites, initiating compounds and upgraded root length, diameter just as root new weight lastly root yield.

3.2.2. Effect of foliar application with alga extract

Data in Table (5) indicate a significant effect on root, top and sugar yields/fad due to the fertilization with Spirulina extract levels Feeding sugar beet plants with1.0 or 2.0 g/l

alga extract/fad without significant difference between them gave higher values of these traits compared with check treatment and those that received 0.5 g/l alga extract. Application of 2.0 g/l alga extract led to an increase in root, top and sugar yields/fed amounted to 20.6, 7.15 and 3.02 ton/fed,

compared to the untreated treatment with alga extract. The increase in root, top and sugar yields/fed may be due to the increase in plant growth parameters (Tables 3 and 4), which in turn is reflected on root, top yields/fed depending on the theory of the Source and downstream.

Table 5. The effect of foliar application with alga extract and Nitrogen fertilization on yield and yield components of sugar beet (combined analysis of the two seasons 2018/2019 and 2019/2020).

Treatments	Root yield (ton/fed)	Top yield (ton/fed)	Sugar yield (ton/fed)
60 Nkg/fed	15.74	4.33	2.15
90Nkg/fed	16.21	6.58	2.44
120Nkg/fed	21.01	7.07	3.15
L.S.D	0.66	0.11	0.06
Control	13.92	3.22	2.05
0.5 g/L	15.11	4.47	2.21
1.0 g/L	18.44	5.15	2.63
2.0 g/L	20.6	7.15	3.02
L.S.D	0.74	0.21	0.2

3.3. *The interaction*

The interaction between foliar application with alga extract and Nitrogen fertilization significantly affected all yield characters. The results in Table (6) showed that were responded to the increase of foliar applied Spirulina extract level, but was highly magnitude by adding 120 kg/N. Therefore, the highest value of yield characters.

Except for Sugar yield recorded higher values by spraying beets with 1.0 or 2.0 g/l Spirulina extract, and adding 60 kg N/fed.

3.4. *Quality traits*

It qualified to make reference to that sugar beet quality is convoluted cycle affected by a few elements (Tawfik *et al.* 2010). The specialized nature of sugar beet is basic for

prudent sugar fabricating. Specifically, it relies upon the synthetic organization of the beet. The substance creation of sugar beet is the main boundary influencing its preparing. Sugar manufacturing plants require beet with high groupings of Sucrose and low centralizations of melassigenic substances to boost the measure of extractable sugar (Kenter and Hoffmann, 2005). It is notable that the main components which influence the nature of sugar beet are the level of sugar, immaculateness and TSS of root. Besides, different substances that disable white sugar recuperation. These are called root pollutants. Dissolvable substances, for example, potassium, sodium, alpha-amino N and different nitrogenous mixes, which can't be wiped out before the Sugar is solidified, increment the measure of Sucrose lost to molasses .

Table 6. The interaction effect of foliar application with alga extract and Nitrogen fertilization on yield components of sugar beet (combined analysis of the two seasons 2018/2019 and 2019/2020).

Treatments		Root yield (ton/fed)	Top yield (ton/fed)	Sugar yield (ton/fed)
60 N kg/fed	Control	10.23	3.11	1.21
	0.5 g/L	11.27	3.51	1.39
	1.0 g/L	12.2	3.95	1.94
	2.0 g/L	16.31	4.98	2.25
90 N kg/fed	Control	17.39	5.12	2.47
	0.5 g/L	17.41	5.32	2.49
	1.0 g/L	18.29	5.91	2.56
	2.0 g/L	18.53	6.70	2.84
120 N kg/fed	Control	19.03	6.92	2.91
	0.5 g/L	20.51	7.53	3.02
	1.0 g/L	22.63	8.71	3.41
	2.0 g/L	24.23	9.01	3.59
L.S.D		**1.6**	**0.68**	**0.25**

3.4.1. Effect of Nitrogen fertilization

Data in Fig (1&2) indicated that expanding Nitrogen fertilization up to 60 N/fed. Fundamentally expanded Sucrose rate, TSS, α-amino N, K rate, Na rate, extractable sugar rate and sugar lost molasses rate. Be that as it may, purity% was not influenced by nitrogen rates expanding nitrogen manure prompted diminishing juice virtue rate. These outcomes are in concurrence with those got by Ramadan

et al. (2003), Leilah *et al.* (2005) and Gomaa *et al.* (2017) in sandy soil.

Higher rates of Nitrogen fertilization (120 N/fed.) had altogether impact on α-amino-N, K and Na content These outcomes might be because of the explanation that high pace of N expanded solvent non-sugar in root juice (pollutants) and they meddle with sugar extraction which reflected by raising the level of sugar misfortunes to molasses and therefore decreasing sugar recuperation.
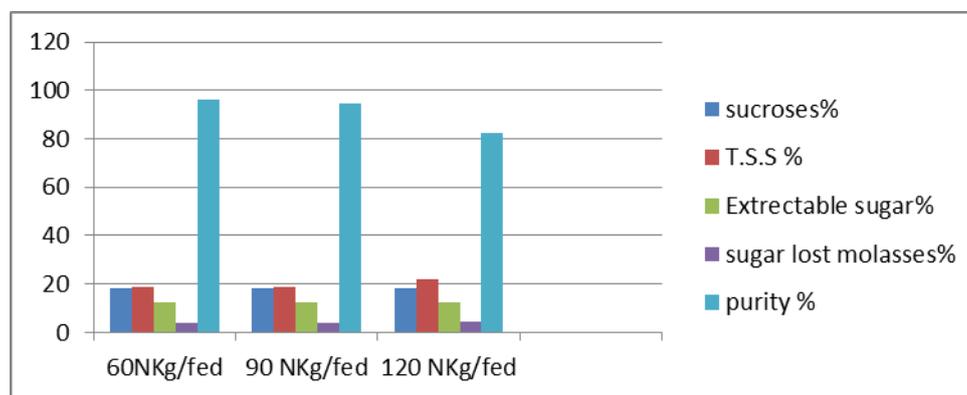
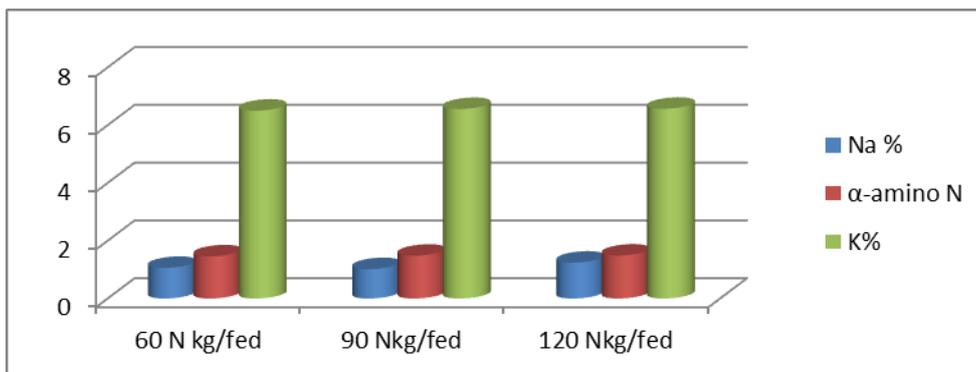**Figure 1.** The effect of Nitrogen fertilization on Sugar beet quality traits

Figure 2. The effect of nitrogen fertilizer on sugar beet quality Traits.

3.4.2. *Effect of foliar application with alga extract*

significantly influenced by the applied alga extract concentrations. Meantime, the fertilization with1.0 g/l and/or 2.0 g/l alga extract led to higher values of extractable sugar percentage, Sucrose % and purity %. Meanwhile TSS %, alpha-amino-N, K%, Na% and sugar lost molasses % were significantly influenced by the applied alga extract concentrations. However increases alga extract concentrations decrease TSS %, alpha-amino-N , K% , Na% and sugar lost molasses % . These finding are in agreement with that mentioned by (Enan *et al.*, 2016).
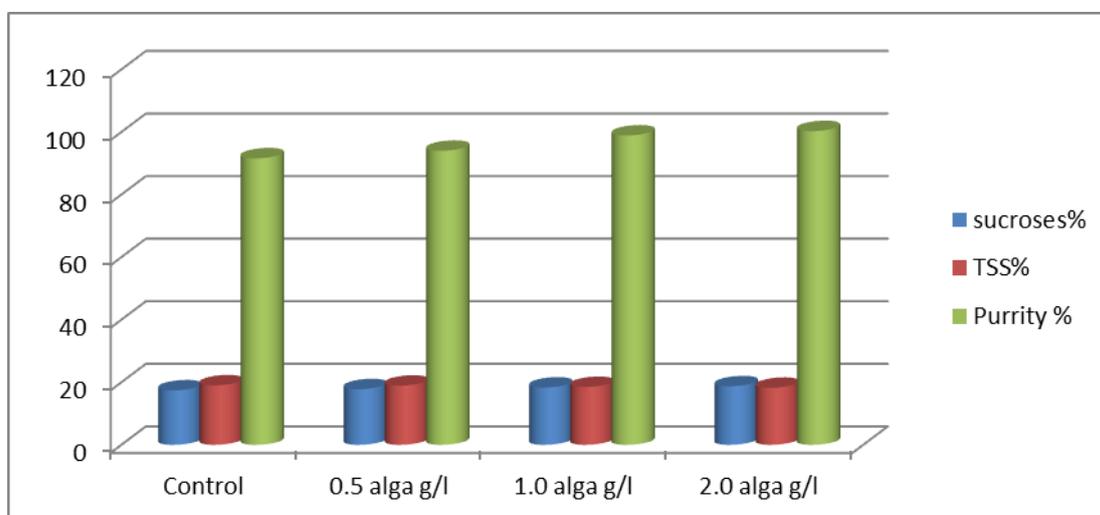

Figure 3. The effect of foliar application of alga extract on Sugar beet quality traits.
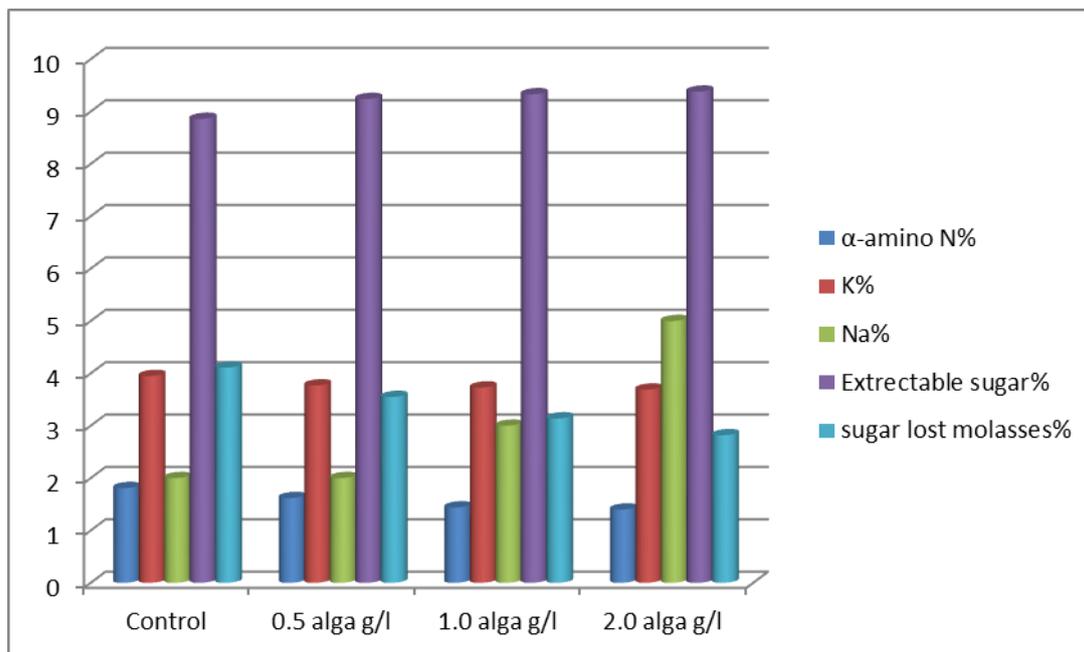
Figure 4. The effect of foliar application of alga extract on Sugar beet quality traits.

3.4.3. *The interaction*

The interaction between foliar application with alga extract and Nitrogen fertilization significantly effect on Sucrose's %, TSS% and QZ%. The results in Table (7) showed that the highest values of Sucrose's% and QZ % by spraying beets with 1.0 or 2.0 g/l Spirulina extract, and adding 60 kg N/fed. (18.70%, 19.20% and 77.37 %, 81.18%). Except for TSS% give lowest value by spraying beet with 0.5 g/l Spirulina extract and adding 60 kg N/fed (18.00%). Meanwhile alpha-amino-N, K%, Na%, extractable sugar % and Sugar lost molasses (SLM %) not significant effect by foliar application with alga extract and Nitrogen fertilization.

Table 7. The interaction effect of foliar application with alga extract and Nitrogen fertilization on quality traits of sugar beet (combined analysis of the two seasons 2018/2019 and 2019/2020).

Treatments		Sucrose %	TSS%	QZ %
60 N kg/fed	Control	17.20	18.90	79.65
	0.5 g/L	17.83	18.00	77.73
	1.0 g/L	18.70	18.87	77.37
	2.0 g/L	19.20	19.47	81.18
90 N kg/fed	Control	17.43	18.50	75.92
	0.5 g/L	17.87	18.70	77.73
	1.0 g/L	18.10	19.27	80.30
	2.0 g/L	18.47	19.90	81.40
120 N kg/fed	Control	17.60	20.53	75.92
	0.5 g/L	17.67	21.57	75.94
	1.0 g/L	18.13	22.17	78.19
	2.0 g/L	18.47	22.90	78.32
L.S.D		**0.46**	**0.25**	**1.70**

3.5. *Principal components analysis*

Data in Figure (5) show Sugar yield was significantly and positively correlated with

Sucrose% followed by juice purity%, then and brix%. Negative correlation was detected between juice purity%, and brix%. These results are agreement with those stated by (Gadallah and Mehareb 2020) and (Mehareb and El-Mansoub 2020), who mentioned that

purity% was negatively and significantly correlated with brix %. On the other hand, results in Figure (5) showed that top yield was significantly and positively correlated with Root weight followed by Top yield and Top weight.
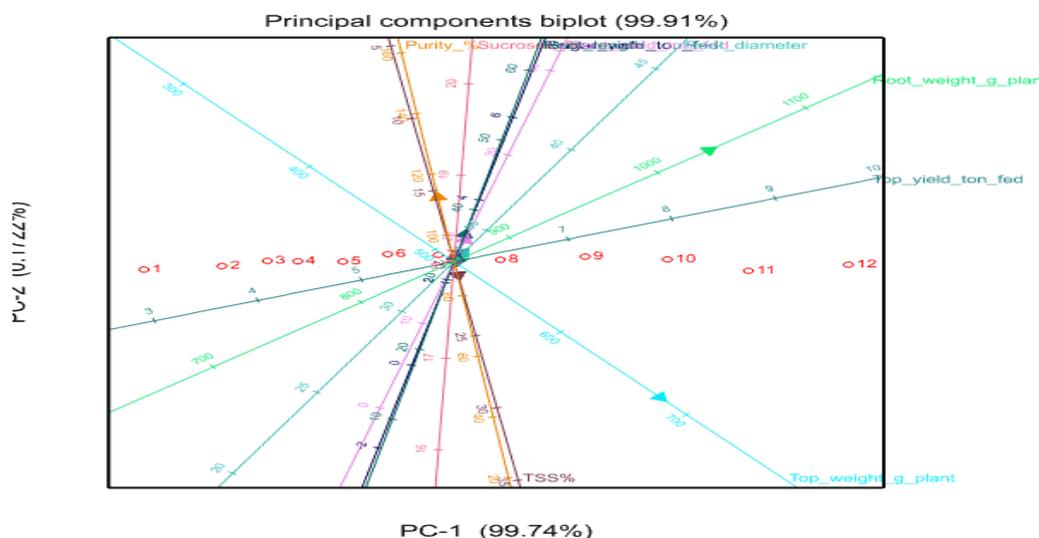

Figure 5. show highly significant and positive correlation between root yield and root length followed by root yield and root diameter then root yield and root weight.

4. Conclusion

Spirulina extract when applied as a foliar application, can contribute to the supply of plant nutrients and substitute nutrients. On the results of this study, it can be recommended to spray sugar beet with1.0 or 2.0 g/L of Spirulina extract along with 120 N k/fed for maximum yields of root but sugar yield, Sucrose % and purity adding 90 N k/fed to spray with 1.0 or 2.0 g/L of Spirulina extract under sandy soil conditions.

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