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# ENHANCEMENT OF SUGAR BEET SEED GERMINATION, PLANT GROWTH, PERFORMANCE AND BIOCHEMICAL COMPONENTS AS CONTRIBUTED BY ALGAL EXTRACELLULAR PRODUCTS

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## ABSTRACT

Effect of culture filtrates of nine algal strains belonging to Nostocales and Chlorellales on seeds germination, growth and certain biochemical characteristics of sugar beet was tested for their contents of Indole acetic, gibberellic and abscisic acids. Plant seeds soaked in algal culture filtrates for 24 hrs showed maximum germination percentage when soaked in filtrates of *Spirulina platensis* (72.9%), *Anabaena oryzae* (70.0%), *Oscillatoria* sp (69.8%) and *Nostoc muscorum* (68.7%) over the counterparts which were soaked in water. Greenhouse pot experiments were conducted during the winter growing seasons of 2005/2006 and 2006/2007 to investigate the effect of algal culture filtrates application methods as phytohormones source on growth stimulation and yield quality of sugar beet.

Results revealed that different application methods had no significant effect on leaves and roots dry weight as well as total soluble solids, sucrose and purity percentages in root juice during the two seasons, while the positive significancy was conducted by the treatments of *Nostoc muscorum, Anabaena oryzae, Spirulina platensis, Nostoc humifusum, Anabaena flous aquae and Phormedium fragile* culture filtrates.

The combination of seed-presoaking and foliar application method significantly increased leaves chlorophyll contents, as well as, nitrogen, phosphorus and potassium percentages in roots over the control in both seasons.

**Keywords:** Algal culture filtrates, *Beta vulgaris*, foliar application, plant growth regulators, seed-soaking,.

**Abbreviations used:** ABA, abscisic acids; FS, Foliar spray; GA, Gibberellic acid; IAA, Indole acetic acid; PGRs, plant growth regulators; SP, Seed presoaking; TSS, Total soluble solids.

## INTRODUCTION

Sugar beet *(Beta vulgaris* L.*)* is a temperate biennial root crop cultivated for sugar production, as forage and organic matter supply for soil. It has multiple uses in industry (Çamaş and Esendal, 1999), production of oxygen during vegetation period and recently considered for production of bio-ethanol (Rinaldi and Vonella, 2006). Although, approximately 70% of total sugar production is supplied by sugar cane, sugar beet remains as a unique source of sugar for temperate zones (FAO, 2006). Physiological control in the plants is governed by four classes of hormones: inhibitors such as abscisic acid that block germination; auxins that control root formation and growth; the gibberellins that regulate protein synthesis and stem elongation; and cytokinins that control organ differentiation (Riley, 1987).

Blue-green algal extracts comprise a great number of bioactive compounds that influence plant growth and development. They mostly contain growth phyto-regulators like gibberellins, auxin, cytokinin, ethylene and abscisic acid (Metting and Pyne, 1996; Manickavelu *et al.*, 2006). This group of microorganisms have been reported to benefit plants by producing growth promoting regulators resemble gibberellin and auxin, vitamins, amino acids, polypeptides, antibacterial and antifungal substances that exert phytopathogen biocontrol and polymers especially exopolysaccharides that were reported to enhance growth and productivity of plants like *Daucus carota* (Wake *et al.*, 1992), *Santalum album* (Bapat *et al*. 1996)*, Oryzae sativa* (Zaccaro *et al.* 2002; Storni de Cano *et al.*, 2003) and *Lilium alexandrae* hort (Zaccaro *et al.*, 2006). Non-nitrogen fixing cyanobacteria can enrich phosphorus and potassium contents in soils, playing indirect major role in plant growth promotion (Selvarani, 1983).

This work targeted evaluation of extracellular plant growth regulators in the algal culture filtrates such as indole acetic, gibberellic and abscisic acids and its effect on seed germination, growth stimulation and yield quality of sugar beet throughout seed presoaking and/or plant foliar spray application methods to figure out the most proper algal filtrate(s) and method(s) of field application to enhance crop growth and performance.

## MATERIALS AND METHODS

**Preparation of algal culture filtrates:**

Cyanobacteria strains (*Nostoc muscorum*, *Anabaena flous aquae*, *Anabaena oryzae*, *Wollea saccata, Phormedium fragile*, *Oscillatoria* sp.*, Nostoc humifusum* and *Spirulina platensis*) were obtained from the Microbiology Department, Soils, Water and Environment Res. Inst., ARC, while the green alga (*Chlorella vulgaris*) was contributed by the Pests and Diseases Res. Section, Sugar crops Res. Inst., ARC. The cyanobacteria strains were grown on BG11 medium (Rippka *et al.*, 1979) except the *Spirulina platensis* which was grown on Zarrouk medium (Zarrouk, 1966). Bold medium (Nichols and Bold, 1965) was used for the green alga *Chlorella vulgaris*. The cultures were incubated in growth chamber under continuous illumination (2000 lux) and temperature of 25˚C± 2˚C for all strains except the mesophilic alga *Spirulina platensis* which was grown on 35˚C± 2˚C. After 30 days of incubation, the algal biomass were separated from the culture media by filtration and the filtrates were kept under refrigeration on 4˚C until used for greenhouse experiments.

**Determination of culture growth parameters and extracellular growth regulators:**

Culture growth parameters and extracellular growth regulators in culture filtrates were determined,(Table,1). pH values and algal dry weight were estimated according to Vonshak (1986). Cultures concentration was determined as optical density (OD) by spectrophotometer at 560 nm (Leduy and Therien, 1977). Chlorophyll-a was determined spectrophotometrically after extraction by absolute methanol as reported by Vonshak and Richmond

(1988). Electric conductivity (EC) of algal culture filtrates was measured using glass electrode conductivity meter Model Jenway 4310. Growth regulation substances (indole acetic, gibberellic and abscisic acids) were fractioned according to Shindy and Smith (1975) and quantified by HPLC apparatus (Hewlett-Pakard 1050) as described by Kowalczyk and Sandberg (2001).

**Table (1): Algal cultures growth parameters and extracellular growth regulators analyses**

| Algal strains | Algal cultures | | | | Cultures filtrate | | | |
|---|---|---|---|---|---|---|---|---|
| | (OD) at 560 nm | DW | Ch-a | pH | EC | IAA | Gibbrillic acid | Abscisic acid |
| | | $mgl^{-1}$ | | | ($dSm^{-1}$) | | $ngl^{-1}$ | |
| ***Nostoc muscorum*** | 1.198 | 800 | 5.76 | 8.16 | 0.65 | 1823.1 | 2859.0 | 5230.5 |
| ***Anabaena flous aquae*** | 1.214 | 918 | 1.39 | 7.01 | 0.55 | 3437.1 | 3732.0 | 1860.8 |
| ***Chlorella vulgaris*** | 0.979 | 728 | 3.49 | 8.98 | 1.53 | 1164.3 | 9088.0 | 94.87 |
| ***Oscillatoria* sp** | 0.200 | 142 | 1.35 | 7.93 | 1.06 | 1245.3 | 119.7 | 4.05 |
| ***Spirulina platensis*** | 2.998 | 2706 | 12.23 | 10.27 | 21.08 | 3500.0 | 7674.0 | 0.000 |
| ***Anabaena oryzae*** | 0.733 | 520 | 1.23 | 6.77 | 0.22 | 1118.3 | 8839.6 | 174.9 |
| ***Wollea saccata*** | 1.941 | 1526 | 9.51 | 7.45 | 0.22 | 1147.3 | 8710.9 | 128.7 |
| ***Nostoc humifusum*** | 1.452 | 946 | 9.76 | 7.28 | 0.21 | 1109.9 | 9384.9 | 163.4 |
| ***Phormedium fragile*** | 1.966 | 1448 | 2.03 | 5.89 | 0.27 | 1186.2 | 9329.4 | 18.79 |

**Seed germination tests:**

Hundred sugar beet seeds were soaked in each algal culture filtrate for 24 hrs and then placed on Whatman No.1 filter paper in Petri plates and watered regularly. Water soaked seeds were used as control.

**Greenhouse experiment:**

Two pot experiments were carried out in the greenhouse of the Agric. Res. Center (ARC), Giza, Egypt in the two successive winter seasons 2005/2006 and 2006/2007 to study the effect of seed soaking and/or foliar spraying of the plants with algal culture filtrates on growth and some biochemical characteristics of sugar beet..

Ten sugar beet seeds (*Kawemira multigerm*), obtained from Sugar Crops Res. Inst. (ARC), were soaked in water (control) or in each of the algal culture filtrate for 24 hr before sowing in pots of 35 cm width and 40 cm length each contained 15 Kg clay loam soil collected from ARC farm, Giza, Egypt. Table (2) shows the physical and chemical properties of the used soils in the experimentation seasons. Nitrogen fertilizer was added as urea (46 % N) at a rate simulating 168 kg N $ha^{-1}$, applied as two equal doses one month after sowing and three weeks later. Phosphorus and potassium fertilizers were applied along with the first nitrogen dose at doses simulating 72 kg $P_2O_5$ $ha^{-1}$ as calcium super phosphate (15% $P_2O_5$) and 57.6 kg $K_2O$ $ha^{-1}$ as potassium sulphate (48% $K_2O$).

The filtrate of algal cultures at the rate of 1.2 ml $pot^{-1}$, simulating application of 125 L. $ha^{-1}$ were applied as foliar spray after 75 days from sowing (Reddy *et al.*, 1986).

The statistical design was the complete randomized blocks with five replications for each treatment.

**Table (2): Mechanical and chemical analyses of the used soil .**

| | 2005/2006 | 2006/2007 |
|---|---|---|
| **Particle size distribution** | | |
| Course sand % | 3.84 | 4.00 |
| Fine sand % | 11.86 | 11.79 |
| Silt % | 48.99 | 49.92 |
| Clay % | 35.31 | 34.29 |
| Texture | Clay loam | Clay loam |
| **Chemical analyses** | | |
| pH | 7.91 | 8.00 |
| $CaCO_3$ % | 0.54 | 0.58 |
| EC (Soil paste) $dSm^{-1}$ | 0.88 | 0.90 |
| **Soluble ions ($megL^{-1}$)** | | |
| $Ca^{++}$ | 3.45 | 3.40 |
| $Mg^{++}$ | 1.27 | 1.26 |
| $Na^{+}$ | 0.78 | 0.77 |
| $K^{+}$ | 0.61 | 0.59 |
| $HCO_3^{-}$ | 3.73 | 3.76 |
| $CO_3^{-}$ | - | - |
| $Cl^{-}$ | 1.18 | 1.17 |
| **Available nutrients (ppm)** | | |
| N | 53.8 | 50.60 |
| P | 24.00 | 21.00 |
| K | 438.00 | 413.00 |

**Plant growth parameters and biochemical analyses:**

Plants were harvested after 7 months from sowing. Fresh and dry weight of leaves and roots and chlorophyll content of leaves were determined (Wettstein, 1957). Percentage of soluble solids (TSS) in juice of fresh roots was measured using Hand Refractometer. Sucrose percentage in fresh macerated roots was determined polarmetrically on lead acetate extract and purity percent was calculated as ratio between sucrose % and TSS % (Carruthers and Oldfield, 1960). Total nitrogen, phosphorus and potassium percent in dry roots after oven dry on 70°C for 24 hours were determined according to A.O.A.C (1984).

**Statistical analysis:**

Data of each season were subjected to statistical analysis as complete randomized block design using M-STAT package. Significance of the differences between means were tested using the least significant differences (LSD) at the 95% confidence level (Gomez and Gomez, 1984).

## RESULTS

Germination percentage of sugar beet seeds pre-soaked for 24 hrs in certain algal culture filtrates significantly increased as compared to those which presoaked in water (Table 3). Maximal seed germination percentages were recorded with soaking culture filtrates of *Spirulina platensis* (72.09), *Anabaena oryzae* (70.00), *Oscillatoria* sp (69.76) and *Nostoc muscorum* (68.73) as compared to the control (61.02). Soaking in the rest of the tested culture filtrates showed no significant differences in germination percentage than in case of seed soaking in water.

**Table (3): Germination percentage of sugar beet seeds presoaked in algal culture filtrates**

| Algal strains | Germination percentage |
|---|---|
| Control | 61.02 |
| *Nostoc muscorum* | 68.73 |
| *Anabaena flous aquae* | 59.98 |
| *Chlorella vulgaris* | 65.99 |
| *Oscillatoria* sp | 69.76 |
| *Spirulina platensis* | 72.09 |
| *Anabaena oryzae* | 70.00 |
| *Wollea saccata* | 60.16 |
| *Nostoc humifusum* | 64.41 |
| *Phormedium fragile* | 61.09 |
| L.S.D. (P>0.05) = 5.2 | |

**Effect of different application methods of algal culture filtrates on sugar beet yield components:**

**Leaves fresh weight:**

Different applied methods had no significant effect on leaves fresh weight in the first season while, in the second season the highest mean value (258.8 g.plant$^{-1}$) was obtained when the combination of seed presoaking and foliar spray of algal culture filtrates was applied (Table 4).

Algal culture filtrates treatments revealed significant effects in leaves fresh weight in both cultivated seasons. The maximum mean values in the first season were by *Nostoc humifusum* (344.6 g.plant$^{-1}$), *Anabaena oryzae* (343.3 g.plant$^{-1}$) and *Anabaena flous aquae* (339.1 g.plant$^{-1}$). Meanwhile, the lowest means were recorded by *Phormedium fragile*, *Wollea saccata* and *Oscillatoria* sp. (307.9, 302.1 and 298.6 g.plant$^{-1}$, respectively). In the second season, *Anabaena oryzae* (274.7 g.plant$^{-1}$), *Nostoc muscorm* (272.6 g.plant$^{-1}$) and *Anabaena flous aquae* (260.3 g.plant$^{-1}$) recorded the highest leaves fresh weight means, on the other hand, *Wollea saccata* (243.7 g.plant$^{-1}$), *Oscillatoria* sp (241.9 g.plant$^{-1}$) and *Phormedium fragile* (234.6 g.plant$^{-1}$) significantly decreased leaves fresh weight comparing to the control treatment.

**Leaves dry weight:**

Leaves dry weight (Table 4) significantly unaffected by different application methods, while, algal culture filtrates treatments significantly affected Leaves dry weight in both seasons. in the first season, the highest mean values were recorded for culture filtrate of *Nostoc humifusum* (62.0 g.plant$^{-1}$), *Anabaena oryzae* (61.9 g.plant$^{-1}$) and *Anabaena flous aquae* (61.0 g.plant$^{-1}$). likewise, *Anabaena oryzae* (49.4 g.plant$^{-1}$) and *Nostoc muscorm* (49.0 g.plant$^{-1}$) significantly increased leaves dry weight over the control treatment (45.1 g.plant$^{-1}$) in the second season.

The interaction between methods and treatments had no significant effect on fresh or dry weight of leaves in both seasons (Table 4).

**Leaf chlorophyll content :**

The interaction between methods of application and the different culture filtrates had no significant effect on chlorophyll content in the first

season, while was significantly effective in the second season (Table 4). Highest significant increases in leaf chlorophyll contents, 43.0 and 41.0 mg.g$^{-1}$ DW, were recorded to be due to *Anabaena oryzae* culture filtrate and in cases of SP+ FS and FS application methods, respectively.

**Root fresh weight:**

Root fresh weight significantly affected by the interaction between SP+SF application method and algal culture filtrates (Table 5). Highest root fresh weight mean values referred to positive effects for using culture filtrates of *Anabaena oryzae* (479.1 g.plant$^{-1}$) and *Nostoc muscorum* (472.4 g.plant$^{-1}$) in the first season. while, *Nostoc muscorum* acheived the highest root fresh weight (389.9 g.plant$^{-1}$) in the second season.

**Root dry weight:**

Data of root dry weight in both cultivation seasons (Table 5) show no significant differences between the three application methods or the first order interaction between the methods and the different culture filtrates. Application of the different culture filtrates treatments showed significant differences in root dry weight among the two seasons. In the first season, the highest dry weight mean values were attained by culture filtrates of *Nostoc humifusum, Anabaena oryzae, Nostoc muscorm* and *Spirulina platensis* (79.4, 78.1, 77.2 and 76.8 g.plant$^{-1}$, respectively) while, *Anabaena oryzae, Nostoc muscorm*, *Chlorella vulgaris* and *Anabaena flous aquae* recorded the highest values (64.2, 63.6, 61.2 and 60.2 g.plant$^{-1}$, respectively) in the second season.

**Root nitrogen, phosphorus and potassium contents:**

Table (6) showed significant responses of root nitrogen, phosphorus and potassium contents due to application of the different algal culture filtrates, methods of application and their interaction throughout the two cultivation seasons. SP combined with SF was the best application method in both seasons. Nitrogen content of sugar beet root significantly increased by the interaction between SP+FS application method and application of by different algal culture filtrates in both seasons. Nitrogen content of sugar beet roots significantly increased by the culture filtrates of *Anabaena oryzae* (1.72%) and *Spirulina platensis* (1.69%) in the first season while, *Anabaena oryzae* and *Phormedium fragile* gave the maximum nitrogen percentages (1.79 and 1.73, respectively) in the second season due to SP+FS application method.

The root phosphorus content (Table 6) significantly enhanced by the interaction between SP+FS application method and culture filtrates of *Nostoc muscorum* (0.57% 1$^{st}$ season and 0.49% 2$^{nd}$ season) and *Anabaena oryzae* (0.53% 1$^{st}$ season and 0.47% 2$^{nd}$ season).

Same trend was found in potassium content of roots (Table 6). The culture filtrates of *Nostoc muscorum* and *Anabaena oryzae* enhancing root potassium content in first season (1.31 and 1.22%, respectively) and in the second season (1.46 and 1.41%, respectively) when the combination of seed presoaking and foliar spray of algal culture filtrates was applied.

**Root yield quality:**

Different application methods had no significant effect on TSS, sucrose and purity percentages of sugar beet root juice while, the significancy

was due to the treatments in both cultivated seasons. The highest TSS% contents (Table 7) of sugar beet root juice (18.94 and 18.60%) were found with application of *Anabaena oryzae* and *Nostoc muscorum* culture filtrates, respectively, in the first season while, *Anabaena flous aquae* (20.28%) and *Nostoc muscorum* (19.88%) in the second season.

The culture filtrates of *Nostoc muscorum* and *Nostoc humifusu*m resulted in the greatest sucrose contents of root juice in the first season (15.26% and 15.03%, respectively) While, In the second season, use of *Nostoc muscorum* and *Anabaena oryzae* culture filtrates recorded the highest sucrose contents of 15.49 and 15.00%, respectively (Table 7).

Regarding the juice purity in the first season, the highest significant increases of 73.3 and 73.1%, were obtained in cases of *Nostoc muscorum* and *Anabaena oryzae,* respectively via SP+FS application method. On the other hand, Only *Anabaena oryzae* gave the highest juice purity of 73.2% in the second season.

Application methods and algal culture filtrates did not interact significantly for the TSS and sucrose% in both the two seasons while, Juice purity markedly affected by this interaction in both seasons.

## DISCUSSION

**Effect of pre-soaking treatment in algal culture filtrates on sugar beet seeds germination:**

The increase in seed germination percentages (Table 3) was noticed after 7 days when seeds were soaked in algal culture filtrates for 24 hrs., while it took between 10 to 12 days for the tap water soaked seeds. The highest germination percentages were found attributable with high GA, IAA and zero or relatively low ABA concentrations in the culture filtrates.

The cultivated forms of *Beta vulgaris* mostly propagated from seed which has relatively low germination rate compared to other crop seeds. Germination usually takes between 10 days (under ideal growth conditions) up to 24 days. Factors that negatively influence germination have been identified: i) about 75% of seed surface (seedball) are surrounded by mucilaginous layer. ii) the ovary cap which acts as a barrier to gas exchange, and iii) the presence of cork-like layer around the seed in the seedball contains chemicals inhibitory for germination. Soaking of beet seed in water prior to sowing is recommended for improveed germination,an hour is sometime beneficial, but twelve hours or overnight in lukewarm water or water at room temperature (around 21°C) is recommended. Soaking washs out the germination inhibitors present in the cork-like layer of the seedball (Nottingham, 2004).

ABA and GA are the hormones most frequently suggested to control seed dormancy and germination processes (Hilhorst and Karssen, 1992). ABA delays or prevents seed germination and determines the depth of dormancy during development, whereas GA breaks dormancy and promotes germination upon imbibitions by the mature seeds. The quantitative amounts of ABA during development result in different depths of dormancy, which in

turn require different amounts of GA to stimulate germination. Hence, ABA-deficient mutants produce non dormant seeds that germinate rapidly whereas GA-deficient mutant seeds can not germinate without additional GA (Ni and Bradford, 1993). Kucera *et al.* (2005) focused the interactions between ABA, GA, ethylene, auxin and cytokinins in regulating the interconnected molecular processes that control dormancy release and germination. Rawat *et al.* (2006) reported that, seed soaking for 24 hours in GA solution had shown maximum germination in three important coniferous species *Abies pindrow* (45.0±4.19%), *Cupressus torulosa* (57.0±3.40%) and *Picea. smithiana* (56±6.01%) as compared to untreated (control) seeds.

Although, *Chlorella vulgaris, Wollea saccata*, *Nostoc humifusum* and *Phormedium fragile* excrete high amounts of GA and IAA (Table 1) they recorded low results in germination, plant growth and root yield quality. The present results are in agreement with Baydar (2002) who stated that, exogenously applied ($GA_3$) strongly influenced the endogenous hormone levels of the seeds by decreasing the levels of $GA_3$ and zeatin, and increasing the levels of IAA and ABA. The lowered endogenous $GA_3$/ABA and zeatin/IAA ratios in the seeds significantly decreased the germination percentage. Therefore, it might be suggested that those algal culture filtrates could be diluted before applying as seed presoaking treatment. This result is in harmony with a study on *Vigna sinensis* indicated that soaked seeds in aqueous extract of lower concentrations of seaweed performed better when compared to the water soaked controls, while higher concentrations of the extracts inhibited germination (Sivasankari *et al.*, 2006).

**Growth parameters as affected by different methods of algal culture filtrates:**

The usage of *Anabaena oryzae*, *Nostoc muscorum*, *Spirulina platensis*, *Nostoc humifusum, Chlorella vulgaris* and *Anabaena flous aquae* algal culture filtrates as seed presoaking and/or foliar biofertilizers at the early stage of vegetation led to a significant increase in leaves and roots dry weight over the control treatment in both seasons (Tables 4 and 5).

The growth of sugar beets is slow at the early stage of vegetation. If growth regulators are used in the early stages of growth and development, the plant grow faster and require less time to develop a maximal assimilation surface of leaves, the processes of photosynthesis and metabolism are more intense, the assimilation of nutrients by plants improves and the yield of plants becomes higher and of better quality (Jakienė *et al*., 2007).

The stimulative effect of these filtrates could be attributed to the elevated levels of GA and IAA of the filtrates (Table 1). It is seems that the effect of GA tend to promote rooting, leaf and fruit retention and directional growth (Wright, 1993).

Application of gibberellic acid ($GA_3$) to the roots of young sugar beet plants caused a significant increase in root dry weight shortly after treatment and the rate at which supernumerary cambia were produced was increased. Application of $GA_3$ to a single petiole caused a significant increase in both root and shoot dry weight. $GA_3$ applied to either root or shoot caused a reduction in the rate of leaf formation although total leaf area per plant and shoot dry weight were unaffected (Garrod, 1974).

**Table (4): Effect of seeds presoaking and/or foliar spray application of algal filtrates on sugar beet leaves fresh and dry weight and total chlorophyll during 2005/2006 and 2006/2007 seasons**

| Treatments | Leaves fresh weight (g. plant$^{-1}$) | | | | Leaves dry weight (g. plant$^{-1}$) | | | | Total chlorophyll (mg. g$^{-1}$ DW) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Application methods | | | | | | | | | | | |
| | SP | FS | SP+ FS | Mean | SP | FS | SP+ FS | Mean | SP | FS | SP+ FS | Mean |
| | 2005/2006 season | | | | | | | | | | | |
| Control | 329.3 | 319.4 | 315.2 | 321.3 | 55.0 | 49.2 | 69.1 | 57.8 | 33.3 | 37.0 | 38.0 | 36.1 |
| *Nostoc muscorum* | 328.1 | 319.0 | 342.1 | 329.7 | 59.0 | 57.2 | 61.6 | 59.3 | 38.4 | 39.2 | 40.4 | 39.3 |
| *Anabaena flous aquae* | 337.9 | 330.2 | 349.2 | 339.1 | 60.7 | 59.6 | 62.8 | 61.0 | 39.2 | 40.0 | 40.0 | 39.7 |
| *Chlorella vulgaris* | 321.8 | 316.1 | 329.4 | 322.5 | 57.8 | 56.9 | 59.2 | 58.0 | 39.0 | 41.0 | 42.0 | 40.7 |
| *Oscillatoria* sp | 301.6 | 292.6 | 301.6 | 298.6 | 54.2 | 52.6 | 54.2 | 53.6 | 40.0 | 41.2 | 41.0 | 40.7 |
| *Spirulina platensis* | 341.1 | 320.0 | 339.8 | 333.6 | 61.4 | 57.4 | 61.0 | 59.9 | 39.8 | 41.4 | 43.2 | 41.4 |
| *Anabaena oryzae* | 349.3 | 329.0 | 351.5 | 343.3 | 62.8 | 59.2 | 63.8 | 61.9 | 40.2 | 41.0 | 42.5 | 41.2 |
| *Wollea saccata* | 302.8 | 300.2 | 303.3 | 302.1 | 54.4 | 54.0 | 54.5 | 54.3 | 37.8 | 36.0 | 35.2 | 36.3 |
| *Nostoc humifusum* | 342.7 | 341.0 | 350.2 | 344.6 | 61.6 | 61.4 | 63.0 | 62.0 | 36.7 | 36.2 | 36.9 | 36.6 |
| *Phormedium fragile* | 302.2 | 309.1 | 312.4 | 307.9 | 54.4 | 55.6 | 56.2 | 55.4 | 37.0 | 37.1 | 36.0 | 36.7 |
| Mean | 325.7 | 317.7 | 329.5 | 324.3 | 58.1 | 56.3 | 60.5 | 58.3 | 38.1 | 39.0 | 39.5 | 38.9 |
| (L.S.D. at 0.05) | | | | | | | | | | | | |
| Application methods | | | NS | | | | NS | | | | 0.54 | |
| Treatments | | | 7.5 | | | | 5.2 | | | | 1.7 | |
| Interactions | | | NS | | | | NS | | | | NS | |
| | 2006/2007 Season | | | | | | | | | | | |
| Control | 251.8 | 245.0 | 252.4 | 251.4 | 44.4 | 42.0 | 49.0 | 45. 1 | 34.4 | 36.0 | 35.1 | 35.2 |
| *Nostoc muscorum* | 273.1 | 263.6 | 281.1 | 272.6 | 49.1 | 47.3 | 50.6 | 49.0 | 36.9 | 37.0 | 39.2 | 37.7 |
| *Anabaena flous aquae* | 263.0 | 251.0 | 267.0 | 260.3 | 47.2 | 45.2 | 47.9 | 46.7 | 34.0 | 35.9 | 34.1 | 34.7 |
| *Chlorella vulgaris* | 259.9 | 253.2 | 261.0 | 258.0 | 46.6 | 45.5 | 47.0 | 46.4 | 38.2 | 36.2 | 38.3 | 37.5 |
| *Oscillatoria* sp | 243.7 | 237.6 | 244.4 | 241.9 | 43.7 | 42.7 | 43.9 | 43.4 | 35.9 | 35.1 | 37.2 | 36.1 |
| *Spirulina platensis* | 264.0 | 250.0 | 259.7 | 257.9 | 47.5 | 45.0 | 46.6 | 46.4 | 37.0 | 37.9 | 39.2 | 38.0 |
| *Anabaena oryzae* | 279.1 | 261.9 | 283.0 | 274.7 | 50.2 | 47.0 | 50.9 | 49.4 | 40.3 | 41.0 | 43.0 | 41.4 |
| *Wollea saccata* | 242.7 | 239.1 | 249.2 | 243.7 | 43.7 | 43.0 | 44.8 | 43.8 | 34.9 | 35.1 | 35.1 | 35.0 |
| *Nostoc humifusum* | 252.1 | 247.1 | 254.0 | 251.0 | 45.4 | 44.5 | 45.5 | 45.1 | 37.2 | 36.8 | 35.0 | 36.3 |
| *Phormedium fragile* | 230.6 | 237.5 | 235.8 | 234.6 | 41.4 | 42.7 | 42.3 | 42.1 | 35.2 | 35.6 | 36.0 | 35.6 |
| Mean | 256.0 | 249.1 | 258.8 | 254.6 | 45.9 | 44.5 | 46.9 | 45.8 | 36.4 | 36.7 | 37.2 | 36.8 |
| (L.S.D. at 0.05 ) | | | | | | | | | | | | |
| Application methods | | | 4.5 | | | | NS | | | | 0.5 | |
| Treatments | | | 7.5 | | | | 3.4 | | | | 1.7 | |
| Interactions | | | NS | | | | NS | | | | 2.9 | |

**NS: Not significant (P>0.05)** **SP : Seeds Presoaking** **FS : Foliar Spray**

IAA generates the majority of auxin effects in intact plants, and is the most potent native auxin. it is affecting both cell division and cellular expansion. Depending on the specific tissue, auxin may promote axial elongation (as in shoots), lateral expansion (as in root swelling), or isodiametric expansion (as in fruit growth). In a living plant it appears that auxins and other plant hormones nearly always interact to determine patterns of plant development (Taiz and Zeiger, 1998 ).

it is well established that when ABA is supplied to roots their elongation is usually inhibited, quantitative changes in auxin and ABA levels may together provide the root with a flexible means of regulating its growth (Pilet and Barlow, 1987 ).

Application of ABA in agriculture and horticulture was investigated as a metabolizable plant growth regulator or herbicide. Abscisic acid (ABA) can

affect processes of senescence, cold resistance, changes in the activity of some enzymes, regulation of the permeability of membranes and a variety of effects in the growth and development of higher plants. However, its stability in aqueous solution is low and its rapid chemical and biological deactivation represents a great obstacle for practical use. ABA increased the nitrogenase activity of the nitrogen fixing cyanobacterium *Nostoc muscorum* (Maršálek and Šimek, 1992). This result may be explained the superiority of *Nostoc muscorum* in this work in spite of the high ABA concentration (5230.5 $ngl^{-1}$) in its culture filtrate (Table 1).

**Table (5): Effect of seeds presoaking and/or foliar spray application of algal filtrates on sugar beet roots fresh and dry weight during 2005/2006 and 2006/2007 seasons**

| Treatments | Roots fresh weight (g. plant$^{-1}$) | | | | Roots dry weight (g. plant$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| | Application methods | | | | | | | |
| | SP | FS | SP+ FS | Mean | SP | FS | SP+ FS | Mean |
| | 2005/2006 season | | | | | | | |
| Control | 392.1 | 409.4 | 401.9 | 401.2 | 69.2 | 71.8 | 75.6 | 72.2 |
| *Nostoc muscorum* | 430.0 | 439.8 | 472.4 | 447.4 | 81.0 | 78.3 | 72.4 | 77.2 |
| *Anabaena flous aquae* | 407.9 | 411.8 | 402.2 | 407.3 | 74.3 | 70.7 | 74.7 | 73.3 |
| *Chlorella vulgaris* | 418.2 | 431.0 | 439.4 | 429.6 | 78.0 | 75.0 | 72.7 | 75.2 |
| *Oscillatoria* sp | 392.5 | 409.2 | 400.3 | 400.7 | 68.0 | 73.6 | 70.1 | 70.6 |
| *Spirulina platensis* | 425.3 | 431.5 | 442.1 | 433.0 | 80.2 | 71.7 | 78.5 | 76.8 |
| *Anabaena oryzae* | 434.1 | 453.0 | 479.1 | 455.4 | 79.4 | 77.3 | 77.2 | 78.1 |
| *Wollea saccata* | 398.1 | 408.9 | 414.4 | 407.1 | 70.2 | 75.6 | 69.2 | 71.6 |
| *Nostoc humifusum* | 441.0 | 422.1 | 439.6 | 434.2 | 82.4 | 80.7 | 75.0 | 79.4 |
| *Phormedium fragile* | 382.5 | 391.5 | 399.4 | 391.1 | 66.4 | 68.0 | 71.9 | 68.8 |
| Mean | 412.2 | 420.8 | 429.1 | 420.1 | 74.9 | 74.3 | 73.7 | 74.3 |
| (L.S.D. at 0.05) | | | | | | | | |
| Application methods | | 6.5 | | | | NS | | |
| Treatments | | 7.9 | | | | 3.8 | | |
| Interactions | | 13.6 | | | | NS | | |
| | 2006/2007 Season | | | | | | | |
| Control | 329.0 | 320.0 | 320.4 | 323.1 | 55.0 | 59.1 | 56.6 | 56.9 |
| *Nostoc muscorum* | 381.4 | 373.2 | 389.9 | 381.5 | 61.4 | 63.4 | 66.1 | 63.6 |
| *Anabaena flous aquae* | 350.9 | 344.1 | 369.6 | 354.9 | 59.5 | 58.5 | 62.7 | 60.2 |
| *Chlorella vulgaris* | 342.0 | 359.7 | 379.0 | 360.2 | 58.1 | 61.0 | 64.4 | 61.2 |
| *Oscillatoria* sp | 321.9 | 329.9 | 335.6 | 329.1 | 54.6 | 55.9 | 57.0 | 55.8 |
| *Spirulina platensis* | 330.5 | 342.1 | 359.9 | 344.2 | 56.1 | 58.1 | 61.0 | 58.4 |
| *Anabaena oryzae* | 379.0 | 381.0 | 373.1 | 377.7 | 64.4 | 64.8 | 63.4 | 64.2 |
| *Wollea saccata* | 318.2 | 321.2 | 319.4 | 319.6 | 54.1 | 54.6 | 54.2 | 54.3 |
| *Nostoc humifusum* | 354.9 | 342.0 | 356.8 | 351.2 | 60.2 | 58.1 | 60.5 | 59.6 |
| *Phormedium fragile* | 309.3 | 318.0 | 322.0 | 316.4 | 52.5 | 54.1 | 54.6 | 53.7 |
| Mean | 341.7 | 343.1 | 352.6 | 345.8 | 57.6 | 58.8 | 60.1 | 58.8 |
| (L.S.D. at 0.05) | | | | | | | | |
| Application methods | | 6.5 | | | | NS | | |
| Treatments | | 7.9 | | | | 3.8 | | |
| Interactions | | 13.6 | | | | NS | | |

**NS: Not significant (P>0.05)** **SP : Seeds Presoaking** **FS : Foliar Spray**

Adam (1999) investigated the effect of the cyanobacterium *Nostoc muscorum* as a biofertilizer on seed germination and related processes in wheat, sorghum, maize and lentil. Germination of the seeds either in live inoculum, algal filtrate (exogenous), or boiled algal extract (endogenous) by the nitrogen fixing cyanobacterium *Nostc muscorum* significantly increased growth as well as nitrogenous compounds over controls. These promotion

could be attributed to the nitrogenase as well as nitrate reductase activities of the alga associated with the surface of plants; or the amino acids and peptides produced in the algal filtrate and/or other compounds that stimulate growth of crop plants.

The significant increase in leaves chlorophyll content (Table-4) in both cultivation seasons by *Nostc muscorum*, *Anabaena oryzae* and *Spirulina platensis* culture filtrates led to a significant increase in roots dry weight (Table 5). Whapham *et al.*, (1993) demonstrated that seaweed extract, applied either to foliage or the soil, significantly increased the chlorophyll content in plant leaves. Ordog (1999) documented that the suspension of extract of cyanobacteria and microalgae contain a special set of biologically active compounds including plant growth regulators, which can be used for treatment to decrease senescence, transpiration as well as to increase leaf chlorophyll, protein content and root and shoot development. Simiarly, Haroun and Hussein (2003) stated that, presoaking of *Lupinus termis* seed in cyanobacterial cultures filtrates increased ch-a, ch-b, total chlorophylls and total pigments content of the leaves, increasing pigment production in leaves led to increase the photosynthetic activity and carbohydrate contents in plant tissues. This stimulative effect of these filtrates could be attributed to the elevated level of GA of the filtrates which may play important role in enhancement of the biosynthesis of enzyme protein, enzyme activation and/or membrane permeability. The observed significant increases in the determined enzyme in *Lupinus* shoot in response to pretreatment with the algal filtrates are in good conformity with the increment in growth rate as well as nitrogen and protein content.

Recently, it was found that, solutions used for foliar nutrition of urea, molybdenum, benzyladenine BA (cytokinin) and sucrose individually or mixed had a significant effect on the plant leaf mass, while had no effect on the mass of the radish roots or on the total plant mass of plants (mass of roots + mass of leaves). Neither any significant changes were noted in the dry matter content in the leaves or in the roots (Smoleń and Sady, 2008).

**The impact of algal culture filtrates and their application method on sugar beet yield quality:**

The tested algal culture filtrates, the application methods and their interaction showed a significant effect on macro nutrient contents (N, P and K) of sugar beet roots (Table 6)

Nitrogen, phosphorus and potassium are essential nutrients for crop growth and high yield with good quality. Nitrogen is the most important fertilizer element for sugar beet growth and yield. The increase in root yield with the increase in nitrogen levels might be attributed to the role of nitrogen in enhancing growth, chlorophyll formation, photosynthesis process and hence increasing yield and its attributing variables (Leilah *et. al.*2005).

Phosphorus is an important nutrient for all the crops, it is a key constituent of ATP and plays significant role in energy transformation in plant and also in various roles in seed formation (Sanker, 1984). Phosphorus known to help developing a more extensive root system and thus enabling plants to extract water and nutrients from more depth. This in turn could enhance the plants to produce more assimilates which was reflected in higher

biomass (Gobarah *et al.*, 2006). Furthermore, the increases in yield due to phosphorus fertilizer may be attributed to the activation of metabolic processes, where its role in building phospholipids and nucleic acid is known (Marschner, 1986).

**Table (6): Effect of seeds presoaking and/or foliar spray application of algal filtrates on nitrogen, phosphorus and potassium percentages of sugar beet roots during 2005/2006 and 2006/2007 seasons .**

| Treatments | N% | | | | P% | | | | K% | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Application methods | | | | | | | | | | | |
| | SP | FS | SP+ FS | Mean | SP | FS | SP+ FS | Mean | SP | FS | SP+ FS | Mean |
| | 2005/2006 season | | | | | | | | | | | |
| Control | 1.22 | 1.29 | 1.66 | 1.39 | 0.38 | 0.31 | 0.48 | 0.39 | 0.92 | 0.97 | 0.90 | 0.93 |
| *Nostoc muscorum* | 1.43 | 1.59 | 1.63 | 1.55 | 0.46 | 0.43 | 0.57 | 0.48 | 1.01 | 0.94 | 1.31 | 1.08 |
| *Anabaena flous aquae* | 1.41 | 1.38 | 1.44 | 1.41 | 0.35 | 0.37 | 0.42 | 0.38 | 1.09 | 0.99 | 1.13 | 1.07 |
| *Chlorella vulgaris* | 1.49 | 1.52 | 1.59 | 1.53 | 0.38 | 0.32 | 0.39 | 0.36 | 0.99 | 1.03 | 1.19 | 1.07 |
| *Oscillatoria* sp | 1.38 | 1.59 | 1.66 | 1.54 | 0.44 | 0.38 | 0.48 | 0.43 | 1.03 | 1.00 | 0.99 | 1.00 |
| *Spirulina platensis* | 1.40 | 1.62 | 1.69 | 1.57 | 0.39 | 0.42 | 0.44 | 0.41 | 0.98 | 0.99 | 1.08 | 1.01 |
| *Anabaena oryzae* | 1.58 | 1.43 | 1.72 | 1.57 | 0.49 | 0.45 | 0.53 | 0.49 | 1.21 | 1.11 | 1.22 | 1.18 |
| *Wollea saccata* | 1.30 | 1.33 | 1.45 | 1.36 | 0.31 | 0.32 | 0.40 | 0.34 | 0.97 | 0.95 | 1.00 | 0.97 |
| *Nostoc humifusum* | 1.43 | 1.58 | 1.66 | 1.55 | 0.33 | 0.34 | 0.42 | 0.36 | 0.96 | 0.97 | 0.99 | 0.97 |
| *Phormedium fragile* | 1.37 | 1.51 | 1.59 | 1.49 | 0.30 | 0.29 | 0.35 | 0.31 | 0.92 | 0.96 | 0.90 | 0.92 |
| Mean | 1.40 | 1.48 | 1.61 | 1.49 | 0.38 | 0.36 | 0.44 | 0.39 | 1.00 | 0.99 | 1.07 | 1.02 |
| (L.S.D. at 0.05) | | | | | | | | | | | | |
| Application methods | | | 0.08 | | | | 0.02 | | | | 0.03 | |
| Treatments | | | 0.09 | | | | 0.04 | | | | 0.07 | |
| Interactions | | | 0.15 | | | | 0.07 | | | | 0.12 | |
| | 2006/2007 Season | | | | | | | | | | | |
| Control | 1.31 | 1.42 | 1.50 | 1.41 | 0.29 | 0.34 | 0.36 | 0.33 | 1.02 | 1.19 | 1.15 | 1.12 |
| *Nostoc muscorum* | 1.49 | 1.58 | 1.63 | 1.56 | 0.41 | 0.34 | 0.49 | 0.41 | 1.39 | 1.20 | 1.46 | 1.35 |
| *Anabaena flous aquae* | 1.34 | 1.53 | 1.48 | 1.45 | 0.38 | 0.31 | 0.43 | 0.37 | 1.17 | 1.03 | 1.09 | 1.09 |
| *Chlorella vulgaris* | 1.53 | 1.47 | 1.69 | 1.56 | 0.36 | 0.30 | 0.45 | 0.37 | 1.22 | 1.09 | 1.32 | 1.21 |
| *Oscillatoria* sp | 1.51 | 1.42 | 1.57 | 1.50 | 0.30 | 0.33 | 0.39 | 0.34 | 1.03 | 0.98 | 1.11 | 1.04 |
| *Spirulina platensis* | 1.47 | 1.63 | 1.55 | 1.55 | 0.37 | 0.39 | 0.44 | 0.40 | 1.16 | 1.00 | 1.03 | 1.06 |
| *Anabaena oryzae* | 1.58 | 1.72 | 1.79 | 1.69 | 0.40 | 0.38 | 0.47 | 0.41 | 1.28 | 1.18 | 1.41 | 1.29 |
| *Wollea saccata* | 1.46 | 1.50 | 1.63 | 1.53 | 0.32 | 0.30 | 0.35 | 0.32 | 1.11 | 0.98 | 1.08 | 1.05 |
| *Nostoc humifusum* | 1.40 | 1.61 | 1.57 | 1.52 | 0.34 | 0.40 | 0.38 | 0.37 | 1.19 | 1.13 | 1.10 | 1.14 |
| *Phormedium fragile* | 1.45 | 1.39 | 1.73 | 1.52 | 0.29 | 0.33 | 0.36 | 0.32 | 1.02 | 0.97 | 0.99 | 0.99 |
| Mean | 1.45 | 1.52 | 1.61 | 1.53 | 0.34 | 0.34 | 0.41 | 0.36 | 1.16 | 1.07 | 1.17 | 1.13 |
| (L.S.D. at 0.05) | | | | | | | | | | | | |
| Application methods | | | 0.08 | | | | 0.02 | | | | 0.03 | |
| Treatments | | | 0.09 | | | | 0.04 | | | | 0.07 | |
| Interactions | | | 0.15 | | | | 0.07 | | | | 0.12 | |

SP : Seeds Presoaking FS : Foliar Spray

Potassium has been given a credit for several important roles in plant nutrition associated with quality of the product. It increases sugar content of beets and has an important biochemical role for sugar transport in plants. Moreover, sucrose, total soluble solids and purity of sugar beet juice increased with increasing K level (Khalil *et al.*, 2001). Fresh water algae contain high percentage of macro and micronutrients bounded in their major biochemical constituents and metabolites such as carbohydrates and proteins (Sergeeva *et al.*, 2002).

In addition the increase in growth characters, yield and its attributes by foliar fertilization may be due to that the sprayed solution of nutrients is readily absorbed by the leaves and not lost through fixation, decomposition or leaching (Abdel-Hadi *et al.*, 1985).Moreover, It is worthy to mention that the efficiency of foliar nutrition does not only depend on the concentrations and combination of nutrients, but also on carriers of the nutrient (Kariem *et al.*, 1991).

Plant growth promoting cyanobacteria can stimulate plant growth directly, by providing nutrients to plants, or by facilitating the uptake of certain nutrients from the environment. it can also promote plant growth indirectly, by suppressing the growth of pathogens (Zaccaro, 2000)**.** In this respect, field experiment conducted on sugar beet fertilized with 50% of recommend nitrogen dose, demonstrated an increase in shoot fresh weight, chlorophyll a, root fresh weight and total soluble solids in the plants inoculated with phytostimulatory bacteria (*Azospirillum* and *Azotobacter* strains) above the plants fertilized with recommended dose of nitrogen. This are due to production of the plant hormone indole-3-acetic acid (IAA) by bacterial strains as those which used in this study. These *Azospirillum* strains and their transconjugants positively influencing on plant growth by any mechanisms referred to as plant growth promotinion. These bacteria significantly affect root T.S.S. by increasing nutrient cycling, suppressing pathogens by producing antibiotics and siderophores or bacterial and fungal antagonistic substances and/or by producing biologically active substances such as auxins and other plant hormones (Zaied *et al.*, 2007).

TSS%, sucrose% and purity% of sugar beet root juice did not influenced significantly by the different application methods of the algal culture filtrates while, significantly affected by the different culture filtrates in the two experimentation seasons (Table 7). This result agreed with the finding of Lozano *et al.* (1999) who stated that, the application of an extract from algae to soil or foliage increased ash, protein and carbohydrate contents of potatoes (*Solanum tuberosum*). While, Anitha *et al.* (2004) reported that, soaking seeds of cowpea (*Vigna unguiculata* L. Walp.) in 500 ppm thiourea solution followed by two sprays (at vegetative and flowering stages) was most effective and increased seed yield by 26% over control. On the other hand, Fecková *et al.*, (2005) found that, foliar preparations affected more significantly quantity of sugar beet production than its quality**.**

**Table (7): Effect of seeds presoaking and/or foliar spray application of algal filtrates on total soluble solids, sucrose and juice purity percentages of sugar beet roots during 2005/2006 and 2006/2007 seasons.**

| Treatments | TSS% | | | | Sucrose% | | | | Juice purity% | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SP | FS | SP+ FS | Mean | SP | FS | SP+ FS | Mean | SP | FS | SP+ FS | Mean |
| | **2005/2006 season** | | | | | | | | | | | |
| Control | 18.1 | 17.8 | 18.7 | 18.2 | 13.9 | 13.8 | 14.6 | 14.1 | 69.5 | 70.2 | 70.6 | 70.1 |
| *Nostoc muscorum* | 18.4 | 18.5 | 18.9 | 18.6 | 15.6 | 14.4 | 14.8 | 15.3 | 73.4 | 72.0 | 73.3 | 72.9 |
| *Anabaena flous aquae* | 18.3 | 18.1 | 18.1 | 18.2 | 14.8 | 14.7 | 14.9 | 14.8 | 71.2 | 69.7 | 69.5 | 70.1 |
| *Chlorella vulgaris* | 18.5 | 17.7 | 18.0 | 17.9 | 14.0 | 14.2 | 14.3 | 14.2 | 70.6 | 68.3 | 68.6 | 69.2 |
| *Oscillatoria* sp | 18.1 | 18.3 | 18.6 | 18.3 | 14.5 | 14.8 | 14.4 | 14.6 | 68.2 | 67.9 | 70.2 | 68.8 |
| *Spirulina platensis* | 17.8 | 17.9 | 18.0 | 17.9 | 14.0 | 14.1 | 14.5 | 14.2 | 70.2 | 69.9 | 71.2 | 70.4 |
| *Anabaena oryzae* | 19.0 | 18.8 | 19.0 | 18.9 | 14.8 | 14.9 | 14.8 | 14.9 | 72.0 | 71.1 | 73.1 | 72.1 |
| *Wollea saccata* | 17.8 | 17.9 | 18.0 | 17.9 | 13.9 | 14.0 | 14.2 | 14.0 | 67.8 | 67.6 | 69.2 | 68.2 |
| *Nostoc humifusum* | 18.0 | 18.3 | 18.4 | 18.2 | 14.9 | 14.8 | 15.4 | 15.0 | 69.9 | 68.1 | 69.0 | 69.7 |
| *Phormedium fragile* | 18.3 | 18.1 | 18.4 | 18.3 | 14.7 | 14.9 | 14.8 | 14.8 | 69.0 | 70.0 | 69.9 | 69.6 |
| Mean | 18.2 | 18.2 | 18.4 | 18.2 | 14.5 | 14.5 | 14.8 | 14.6 | 70.2 | 69.5 | 70.5 | 70.0 |
| (L.S.D. at 0.05) | | | | | | | | | | | | |
| Application methods | | NS | | | | NS | | | | NS | | |
| Treatments | | 0.4 | | | | 0.3 | | | | 0.8 | | |
| Interactions | | NS | | | | NS | | | | 1.4 | | |
| | **2006/2007 Season** | | | | | | | | | | | |
| Control | 18.7 | 19.0 | 19.6 | 19.1 | 14.1 | 14.0 | 14.8 | 14.3 | 71.4 | 71.8 | 71.3 | 71.5 |
| *Nostoc muscorum* | 14.8 | 19.7 | 20.1 | 19.9 | 15.1 | 15.4 | 16.0 | 15.5 | 72.1 | 71.3 | 71.2 | 71.5 |
| *Anabaena flous aquae* | 20.0 | 20.0 | 20.8 | 20.3 | 14.7 | 14.5 | 14.3 | 14.5 | 70.8 | 70.5 | 70.7 | 70.7 |
| *Chlorella vulgaris* | 18.7 | 18.7 | 18.7 | 18.7 | 14.5 | 14.4 | 14.1 | 14.3 | 71.4 | 71.2 | 71.1 | 71.2 |
| *Oscillatoria* sp | 19.0 | 18.9 | 18.8 | 18.9 | 14.0 | 14.2 | 14.4 | 14.4 | 69.0 | 70.1 | 70.2 | 69.8 |
| *Spirulina platensis* | 18.1 | 18.3 | 18.0 | 18.1 | 14.6 | 14.0 | 14.3 | 14.1 | 70.0 | 69.8 | 70.0 | 69.9 |
| *Anabaena oryzae* | 19.2 | 19.4 | 19.6 | 19.4 | 14.8 | 15.0 | 15.2 | 15.0 | 73.1 | 70.9 | 73.2 | 72.4 |
| *Wollea saccata* | 19.1 | 19.0 | 19.2 | 19.1 | 13.9 | 14.1 | 14.2 | 14.1 | 70.1 | 71.0 | 71.7 | 70.9 |
| *Nostoc humifusum* | 19.4 | 19.5 | 19.6 | 19.5 | 14.0 | 14.3 | 14.1 | 14.1 | 68.7 | 69.2 | 69.8 | 69.2 |
| *Phormedium fragile* | 18.9 | 19.1 | 19.0 | 19.0 | 14.4 | 14.1 | 14.2 | 14.2 | 69.1 | 69.4 | 70.2 | 69.6 |
| Mean | 19.1 | 19.2 | 19.3 | 19.2 | 14.4 | 14.4 | 14.6 | 14.5 | 70.6 | 70.5 | 70.9 | 70.7 |
| (L.S.D. at 0.05) | | | | | | | | | | | | |
| Application methods | | NS | | | | NS | | | | NS | | |
| Treatments | | 0.4 | | | | 0.3 | | | | 0.8 | | |
| Interactions | | NS | | | | NS | | | | 1.4 | | |

**NS: Not significant (P>0.05)** **SP : Seeds Presoaking** **FS : Foliar Spray**
**TSS: Total soluble solids**

Smoleń and Sady (2008) established that, the foliar nutrition treatments have a significant effect on the plant leaf mass and on concentration of soluble sugars and ascorbic acid in the radish roots.

Liquid extracts obtained from seaweeds have gained importance as foliar spray for several crops because the extract contains growth promoting hormones (IAA and IBA), cytokinins, trace elements (Fe, Cu, Zn, Co, Mo, Mn, Ni), vitamins and amino acids. Thus, these extracts when applied to seeds or added to the soil, stimulate growth of the plants (Challen and Hemingway, 1965; Blunden, 1971 and Bokil *et al.*, 1974).

Possibilities of utilization of various biologically active matters including plant hormones (auxins, cytokinins) for regulation of sugar beet growing process have been investigated. Biologically active matters often use to be the components of foliar fertilizers of new generation being mixed together with macro- and micronutrients (Anitha *et al.*, 2004).

Exogenic growth regulators are becoming more and more significant for the productivity of field plants. The growth regulators are synthetic compounds representing physiological analogues of natural phytohormones and are used to control the processes of growth and development as well as to fortify immune system of plants. Depending on the conditions of application of growth regulators as well as on their concentration and the physiological state of a plant, it is possible to stimulate the formation of roots, growth of a stem, time of blooming and ripeness of a plant (Jakienė *et al*., 2007).

Zaccaro (2000) reported that, cyanobacteria excrete a great number of substances that influence plant growth and development by producing growth-promoting regulators that improve soil structure and exoenzyme activity.

**Conclusion:**

Results obtained by this study indicate powerful effects of algal culture filtrates, mainly those of *Anabaena oryzae*, *Nostoc muscorum*, *Spirulina platensis* and *Nostoc humifusum* on sugar beet seed germination as well as plant growth and root yield quality. Such enhancement in growth characters by soaking seeds for 24 hrs and foliar spraying of the plants with algal culture filtrates is suggested to be attributed to extracellular production and liberation of growth regulators by the organisms in their culture filtrates

Therefore, future studies may be needed to establish and recommended the use of algal culture filtrates as a source of plant growth regulators beside other benefits substances polysaccharides, micronutrients, vitamins and amino acids in seeds presoaking and foliar application for crops rather than sugar beet.

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Tables

## تنشيط إنبات البذور ونمو والمكونات البيوكيميائية و محصول بنجر السكر بمعاونة منتجات الخلايا الطحلبية

**محـــي الـــدين حســـن أحمـــد علـــي* ، عـــزة أحمـــد محمـــد عبـــد العـــال** و سها سيد محمد مصطفى****

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تـم دراسـة تـأثير راشـح مـزارع سـلالات طحلبيـة تنتمـي إلـى رتبتـي Nosocalles و Chlorellales علـى إنبـات و نمـو وبعـض الخصـائص البيوكيميائيـة لنبـات بنجـر السـكر ومـدى استجابتها لمحتوى الراشح من إندول حمض الخليك وحمضـي الجبريلك و الأبسيسك. تم نقع بـذور النبات في مترشحات مزارع الطحالب لمدة 24 ساعة حيث أعطت أعلى نسب للإنبات باستخدام راشح الطحالب

*Spirulina platensis* (%72.96) ، *nabaena oryzae* (%70) ، *Oscillatoria* sp (%69.8) وكذلك *Nostoc muscorum* (%68.7) عن مثيلاتها التي نقعت في الماء.

أجريت تجارب زراعة أصص تحت ظروف الصوب الزجاجية خلال موسمي الزراعة الشتويين المتتاليين 2006/2005 و 2007/2006 بهدف دراسة تأثير راشح مزارع الطحالب كمنظمات نمو حيويـة لتنشـيط إنبـات البـذور ونمـو محصـول بنجـر السـكر وأثـر ذلـك علـى خـواص المحصـول البيوكيميائيـة ومحتوى عصير الجذور من السكريات وتركيز المواد الصلبة الذائبة وكذلك نقاوة العصير باستخدام ثلاث طرق لإضافة راشح الطحالب وهي نقع البذور فقط أو رش النبات فقط بعد 75 يوم من الزراعة أو كلاهما معاً.

وأوضـحت نتـائج هذه التجـارب أن طـرق الإضـافة المختلفـة لـم يكـن لهـا تـأثير معنـوي علـى الـوزن الجـاف لكـل مـن الأوراق و الجـذور بينمـا أدت معـاملات الراشـح فيمـا بينهـا لتـأثير معنـوي إيجـابي باستخدام :

*Nostoc muscorum, Anabaena oryzae, Spirulina platensis, Nostoc humifusum, Anabaena flous aquae, Phormedium fragile*

بينما كان تأثير الإضافة التي تجمع بين نقع البذور و رش الأوراق معنوياً في محتوى الأوراق من الكلوروفيل ومحتوى الجذر من النيتروجين ، الفوسفور و البوتاسيوم .

كذلك لم تؤثر طريقة الإضافة معنوياً على تركيز المواد الصلبة و السكروز في الجذر بينما أعطت طريقة الجمع بين النقع والرش تأثير معنوي إيجابي لنقاوة عصير الجذر عند استخدام راشح *Nostoc muscorum* و*Anabaena oryzae* عـن التـي لـم يـتم معاملتهـا بالراشـح (Control).

وبناءًا على نتائج هذا البحث فإنـه يمكن التوصـية بعمل تجربـة حقليـة للدراسـة التطبيقيـة و للتوسع في استخدام تكنولوجيا منظمات النمو الحيوية لتحسين نمو المحاصيل الهامة و تقليل الاعتماد على المركبات الكيميائية المكلفة و الملوثة للبيئة.