Bull. Fac. Agric., Cairo Univ., 71:73-84(2020).

EFFECT OF FISH FARM WASTE WATER IRRIGATION AND GROWTH REGULATORS ON GROWTH, YIELD AND QUALITY OF SUGAR BEET CROP

(Received: 3.5.2020)

By
M.S. El-Kady and Samar A.M. Helmy

Sugar Crops Research Institute, Agriculture Research Center, Giza, Egypt

ABSTRACT

In line with the sustainable agriculture, a field experiment was carried out at the Research Station of Water Management Research Institute, Wadi El-Natrun, Egypt (30°23'19.89″ N latitude, 30°21'41.06″ E longitude and altitude 25.5 m) during 2018/2019 and 2019/2020 seasons to evaluate growth, quality, productivity and net returns of sugar beet crop under effect of two protocols of irrigation (fish farm waste water (Aqua) or ground water irrigation (well)), and spraying two concentrations (100 and 300 ppm) of each of gibberellic acid (GA_3) and indole acetic acid (IAA) compared to zero ppm application. The results revealed that fish farm waste water irrigation (Aqua) was significantly more efficient than ground water irrigation on growth traits (crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR)) as well as root yield (ton/fed) in both seasons. Vice versa, ground water irrigation surpassed fish farm wastewater irrigation in quality parameters (sucrose, purity and extractable sugar (ES) percentages). Significant increases in growth traits and yield were detected for growth regulators especially 300 ppm of gibberellic acid concentrations compared to control unit (zero ppm) during both seasons. On the other hand, quality parameters of sugar beet plants were enhanced under the control unit (zero ppm) followed by the application of 300 ppm of indole acetic acid compared to other growth regulators treatments in both seasons. The maximum net return (11488 LE/fed) was achieved with fish farm waste water (Aqua) irrigation with spraying sugar beet plants by 300 ppm of indole acetic acid during 2019/2020 seasons.

Key words: *fish farm waste water, gibberellic acid, indole acetic acid, new reclaimed area, sugar beet.*

1. INTRODUCTION

In Egypt, limited water and agricultural land are problematic in addition to climate change predictions of increase of temperature and decrease of rainfall in recent years. There are strategies to overcome these sources that depend on modern methods and new sources of non-traditional irrigation. In line with the sustainable agriculture, one of these sources is using waste water of fish farms (Agri-aquaculture). Recycling the drainage water of fish farming, which is rich in organic matter, for agriculture use can improve soil quality and crops productivity (Elnwishy *et al.,* 2006), reduce the total costs since it decreases the fertilizers use, whose demand is affected by the prices and the framer's education (Ebong and Ebong, 2006).

Nutrients, which are excreted directly by fish or generated by the microbial breakdown of organic wastes, are absorbed by plants cultured hydroponically (without soil). Fish feed provides most of the nutrients required for plant growth. Plants grow rapidly with dissolved nutrients that are excreted directly by fish or generated from the microbial breakdown of fish wastes. Dissolved nitrogen, in particular, may occur at very high levels in recirculating systems. Fish excrete waste nitrogen, in the form of ammonia, directly into the water through their gills. Bacteria convert ammonia to nitrite and then to nitrate. Having a secondary plant crop that receives most of its required nutrients at no cost improves a system's profit potential (Abdelraouf and Hoballah, 2014).

There are different growth regulators that manifest physiological effects on crop growth, morphological development and improve yield under marginal conditions. Therefore, spraying sugar beet plants with growth regulators may improve the balance between foliage growth and sucrose content in roots. Gibberellic acid (GA_3) is a very potent growth regulator whose natural occurrence in plants controls their development. Gibberellic acid has the ability to modify the growth pattern by affecting the cell elongation and division, biosynthesis of enzymes, protein, and carbohydrate contents (Gupta and Chakrabarty, 2013 and Milne *et al*., 2013). GA_3 are compounds able to change the morphology and physiology of plants and can be applied at different times (Leite *et al*., 2011), depending on the grower purpose for the crop. The application of plant growth regulators (GA_3) can be useful not only to achieve the technological quality desired by the ethanol industry, but the quality needed for other purposes as forage (Almodares *et al*., 2013). On the other hand, growth regulators regulate growth under normal or stress conditions. Indole acetic acid (IAA) plays a main role in maintaining plant growth under stress conditions including salt stress. Growth regulators are used to improve the biological values of sugar beet seed and growth regulation and development of the vegetation to increase the yield of roots and their sugar content. Also, it inhibits the synthesis of the gibberellic acid which plays a major role in enhancing vegetative growth. Daie (1986) found that IAA modified the activity of sucrose phosphate syntheses enzyme and resulted in altered carbon partitioning between sucrose and starch causing increased level of soluble sugars. Mustafa *et al.* (2001) found that spraying sugar beet foliage with IAA decreased root yield (ton/fed), but increased sucrose %.

Therefore, the present investigation aimed to study the effect of irrigation water with fish farm waste and different concentrations (100 and 300 ppm) of some growth regulators i.e., gibberellic acid and indole acetic acid on growth, quality, productivity and net returns of sugar beet crop at Wadi El-Natrun region as a new reclaimed area in Egypt.

2. MATERIALS AND METHODS

A field experiment was carried out at the Research Station of Water Management Research Institute (NWRC), Wadi El-Natrun, Egypt (30°23'19.89″ N latitude, 30°21'41.06″ E longitude and altitude 25.5 m) during 2018/2019 and 2019/2020 seasons.

2.1.Plant material and experimental site

The experimental site had the following characteristics: The average mean temperature was 38.3 C° in the hottest month (July) and 19.3 C° in the coldest month (Jan.). Annual mean relative humidity was 70%. The soil texture was sandy soil (93% sand) with bulk density 1.56 gm/m^3, field capacity 9.1% and wilting point 3.9%. Sugar beet multi-germ variety named "Faten" was sown on the first of October and harvest at 210 days of age in the 2018/2019 and 2019/2020 seasons. A drip irrigation system was used in the experiment, where the dripper types were GR with 4 lit/hr. Nitrogen was added in the form of ammonium nitrates (33.5% N) at a rate of 120 kg N/fed in five equal splits, where the first was applied after thinning at the 4-leaf stage and the other splits were added after every two week later. Phosphorous in the form of super phosphate, (15.5%) at a rate of 30 kg P_2O_5/fed, was added during land preparation. Potassium, in the form of potassium sulfate (48%), was added at the rate of 48 kg K_2O/fed with the last dose of nitrogen. Other culture practices were applied as recommended by the Sugar Crops Research Institute (SCRI) recommendation.

The amount of irrigation water (2556.72 m^3/fed) was calculated at the depth of 608.74 mm for a period of 210 days. The amount of irrigation water requirements was calculated using the following equation as sited from Moursy and El-Kady (2019):

$$IR = \frac{[(\theta_{FC} - \theta_V) \times d] + Lf}{E_s}, \mathrm{mm}$$

Where, IR = Iirrigation water requirements, mm/intervals; E_s = system efficiency (%); θ_{FC} = Soil moisture content at field capacity (%); θ_v = Soil moisture content before irrigation (%) and d = depth of soil layer (mm).

Lf=Leaching factor under drip irrigation systems was calculated according to using the following equation:

$$LR = \frac{ECw}{2 \max Ece}$$

Where:

ECw = Salinity of the applied irrigation water, dS/m; *ECe* = Average soil salinity tolerated by the crop as measured on a soil saturation extract, dS/m.

2.2.Experimental design and treatments

The experiment was set up in split plot design with 10 treatments and three replicates. The experimental unit's area was 12 m^2 (5 ridges, 4 m long and 60 cm apart). Sugar beet was sown on hills spaced 20 cm. The main plots of the experiment were occupied by two irrigation resources ground water (well) and fish farm waste water (aqua)) and growth regulators treatments were distributed and applied at random within the main plots. Gibberellic acid

(GA_3) and indole acetic acid (IAA) were applied in two equal splits after 60 and 75 days from planting in two concentrations (100 and 300 ppm) compared to the control application (zero ppm). Chemical analysis of well irrigation water under study is shown Table 1.

Table (1): Physical and Chemical analysis of well irrigation water under study

EC (dS/m)		Soluble anions and cations (meq/l)							
		CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+
2.5		0.1	4.7	10.6	8.15	1.8	2.8	18.4	0.55
p^H	SAR	Chemical elements (mg/l)							
		NH_4^+	NO_3^-	P	K	Fe	Zn	Mn	Cu
7.14	12.1	0.52	0.34	1.2	2.14	0.02	0.003	0.001	0.002

Some physical, chemical and biological analysis of waste water of fish farm under study is shown in Table 2.

Table (2): Physical, chemical and biological analysis of fish farm waste water

Physical and Chemical analysis		Biological analysis	Counts (CFU/ml)
EC	3.9 dS/m	**Total counts of bacteria**	1.2×10^4
P^H	7.5	**Total count of faecal coliform**	2.4×10^2
Chemical elements (mg/l)		**Total counts of fungi**	400
NH_4^+	1.89	**Total counts of free N2 fixers**	450
NO_3^-	2.45	**Green algae**	
P	9.2	***Chlorella* sp.**	350
K	29.1	***Scenedesmus* sp.**	120
Fe	1.45	***Pediastrum* sp.**	100
Zn	0.95	**Cyanobacteria**	
Mn	0.52	***Oscillatoria* sp.**	80
Cu	0.23	***Nostoc* sp.**	40

2.3.Data recorded

2.3.1.Growth traits

Plant samples were taken at 90, 105, 120 and 135 days after planting, each sample was separated into foliage and root to determine dry weight (g/plant) of foliage and root and leaf area. Leaf area measurement, according to the disk method using 10 disks of 0.91 cm diameter (Watson, 1958). The following growth parameters were calculated:

1. Crop growth rate (CGR) (g. $week^{-1}$) = (W_2 - W_1) / (T_2 - T_1).
2. Relative growth rate (RGR) (g. $g^{-1}.week^{-1}$) = (Ln. W_2 - Ln. W_1) / (T_2 - T_1)
3. Net assimilation rate (NAR) (g. $cm^{-2}.week^{-1}$) = (W_2 - W_1) (Ln. A_2 - Ln. A_1) / (A_2 - A_1) (T_2 - T_1).

Where: W_1, A_1 and W_2, A_2, refer to dry weight per plant and leaf area at time T_1 and T_2, respectively.

2.3.2.Technological characteristics

At harvest, ten sugar beet roots were taken at random from each plot to assess:

1. Sucrose percentage was determined in the fresh minced roots using “Saccharometer” according to the method of Carruthers and Oldfield (1960).
2. Extractable sugar percentage (ES %) was determined according to the following equation: ES% = pol - [0.343(K + Na) + 0.094 α-amino N + 0.29] according to Renfield *et al.* (1974), where Pol = sucrose percentage.
3. Juice purity percentage (QZ) = (ES% / pol) × 100

2.3.3.Yields

1. Root yield (ton/fed): Sugar beet plants of two ridges of each experimental unit (subplot) were harvested, separated into roots and tops and weighted in kg/plot, which was converted into (ton/fed) to estimate root yield.
2. White sugar yield (ton/fed) = root yield/fed (ton) × extractable white sugar %.

2.4. Statistical analysis

Statistical analysis was carried out using a split-plot procedure of the M STAT-C statistical package. LSD comparison was used to identify means that were different at probabilities of 5 % or less (Snedecor and Cochran, 1967).

2.5. Economic analysis

Sugar beet crop prices of inputs and output were calculated for the studied treatments. The inputs included costs of the irrigation network, irrigation, labors, seeds, fertilizers, and pesticides. The output was the price (LE) paid for the harvested root yield/fed. Net return was calculated by using the following equation (Younis *et al.*, 1991): Net return (LE/fed) = total return - total costs.

3. RESULTS AND DISCUSSION

3.1. Growth traits

The results presented in Fig.1 showed that, crop growth rate (CGR) increased under the irrigation by fish farm waste water (aqua) compared to well irrigation water (well) and that the increase was higher with spraying by gibberellic acid as a growth regulator compared to indole acetic acid (IAA) and the control specially in 2019/2020 season. the increased was more noticed by the conduct from period to another period, were this difference was higher during the period between 120 and 135 days after planting (DAP) compared to the period between 90 and 115 days after planting (DAP) during 2018/2019 and 2019/2020 seasons. Also, the results in Fig.1 showed that, sprayed sugar beet plants by 300 ppm of gibberellic acid (GA2) increased crop growth rate (CGR) compared to 100 ppm of gibberellic acid (GA1). On the other hand, sprayed sugar beet plants by 300 ppm of indole acetic acid (IAA2) decreased crop growth rate (CGR) compared to 100 ppm of indole acetic acid (IAA1) in both seasons. The results shown in Fig. 2 cleared that, the relative growth rate (RGR) increased by increasing the period after planting from 90-115 DAP and 115-120 DAP to 120-135 DAP in two successive seasons. On the other hand, RGR slightly increased under aqua water compared to well irrigation water, This increase was slightly noticed by sprayed plants by GA2 compared with other growth regulators treatments in both seasons. As shown in Fig. 3, net assimilation rate (NAR) during the period between 90 and 105 days after planting decreased under fish farm drain irrigation water compared to well irrigation water especially under growth regulators application compared to the control in 2018/19 and 2019/20 seasons. On the other hand, NAR during 105-120 and 120-135 DAP increased under irrigation by fish farm drain water (aqua) and the application of 300 ppm of gibberellic acid during both seasons.

The daily application of fish feed provides a steady supply of nutrients to the plants and thereby eliminates the need to discharge and replace depleted nutrient solutions or adjust nutrient solutions as in hydroponics. The plants remove nutrients from the culture water and eliminate the need for separate and expensive biofilters. There is a growing body of evidence that healthy plant development relies on a wide range of organic compounds in the root environment (Abdelraouf and Hoballah, 2014). The results in Table (2) showed that Nitrogen (as NH_4 and NO_3), Phosphorus and Potassium reached 1.89, 2.45, 9.2 and 29.1 mg/l, respectively. The data mentioned above showed quantitative fertigation capacity of the drainage water of fish farm under study to be used as irrigation water. Drainage water of fish farm could supply seasonally the soil with 11.1, 23.5 and 74.4 kg/fed of Nitrogen, Phosphorus and Potassium from the whole quantities of irrigation water during the growing season (2556.72 m^3/fed).

Also, these compounds, generated by complex biological processes involving microbial decomposition of organic matter, include vitamins, auxins, gibberellins, antibiotics, enzymes, coenzymes, amino acids, organic acids, hormones and other metabolites. Directly absorbed and assimilated by plants, these compounds stimulate growth, enhance yields, increase vitamin and mineral content and hinder the development of pathogens, the result is reduced plant growth (James *et al.*, 2006). In addition, fish farm waste water samples showed various phytoplankton structures belonging to two main groups, namely, Chlorophyceae (Green Algae) and Cyanophyceae (Blue-Green Algae). The algae biomass contains nutrients such as C, N, P and K essential for microorganism development. The general microalgae biochemical structure had been successfully utilized as feedstock for digesters and as nutrient supplements in dairy farming (Abdelraouf and Hoballah, 2014).

On the other hand, the increase in growth traits using gibberellic acid may be due to the increase in cell division and expansion, which in

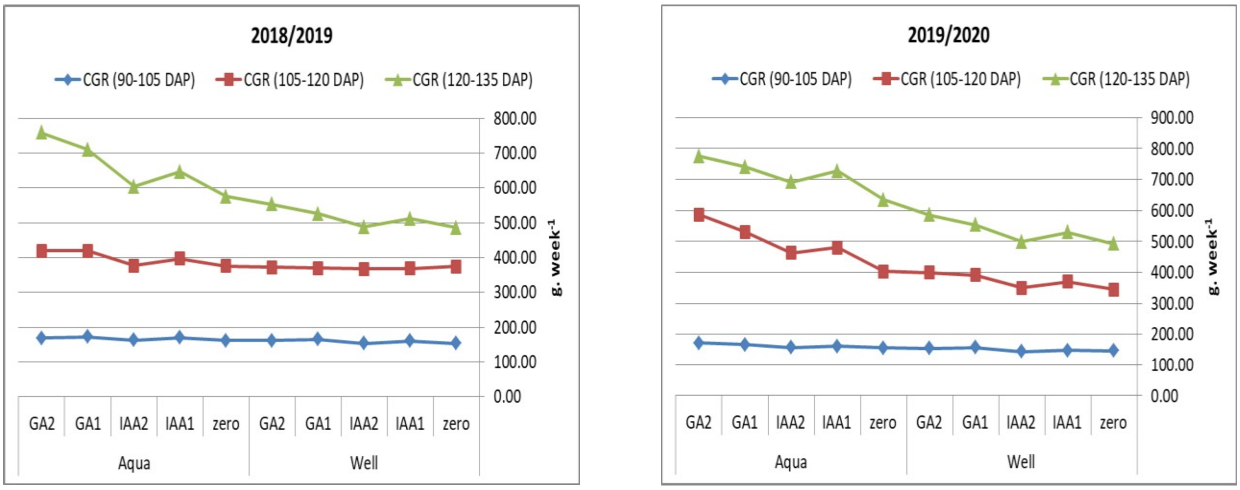

Fig. (1): Crop growth rate during the period of 90-105, 105-120 and 120-135 days after planting under different treatments during 2018/2019 and 2019/2020 seasons.

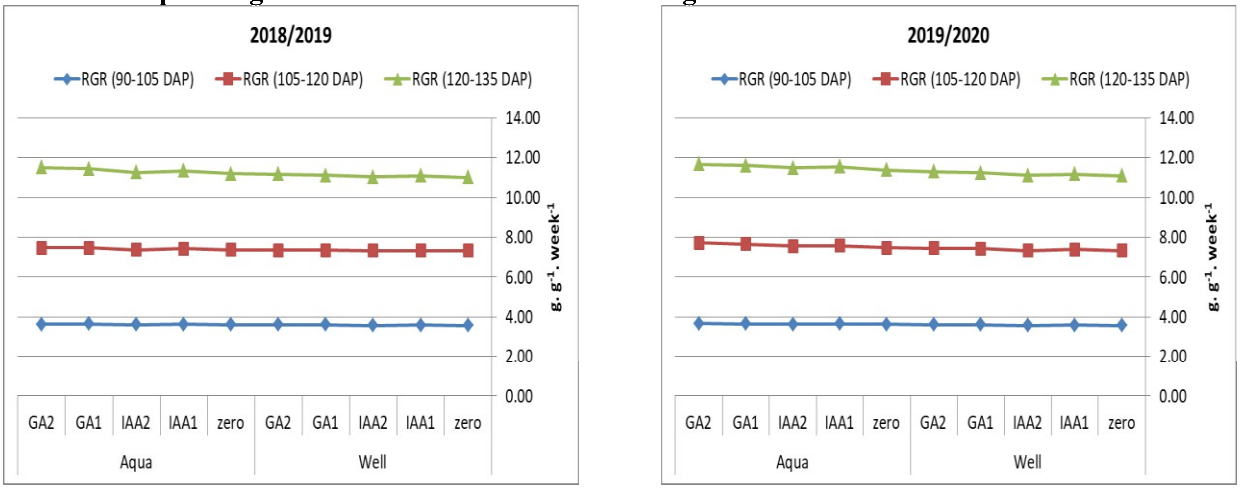

Fig. (2): Relative growth rate during the period of 90-105, 105-120 and 120-135 days after planting under different treatments during 2018/2019 and 2019/2020 seasons

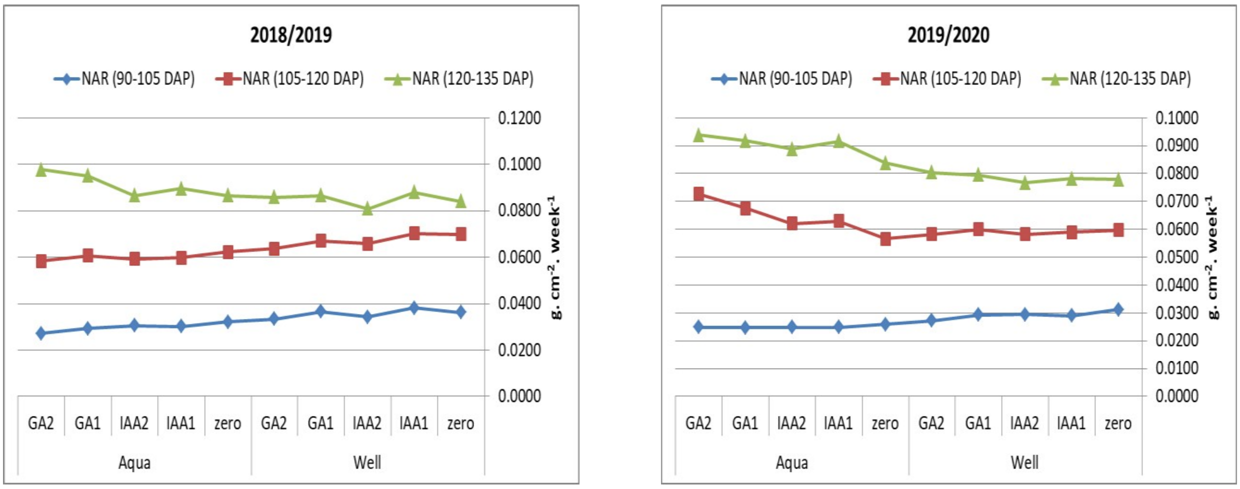

Fig. (3): Net assimilation rate during the period of 90-105, 105-120 and 120-135 days after planting under different treatments during 2018/2019 and 2019/2020 seasons

Turn increase photosynthetic surface of sugar beet plant (Almodares *et al*., 2013).

3.2.Quality parameters

Data presented in Table (3) showed that, significant increases in sucrose, purity and extractable sugar (ES)% amounted to 2.48, 6.76 and 3.51% accompanying the irrigation by well ground water compared to fish farm waste water. this was gained in the 1st season, corresponding to 3.47, 8.19 and 4.48% in the 2nd one, respectively. The maximum values in sucrose, purity and extractable sugar (ES) % were noticed with 0 ppm (control) treatment. While, the minimum values among growth regulators were recorded with 300 ppm of gibberellic acid (GA2) treatment during both seasons. Whereas sucrose, purity and extractable sugar (ES) % with the control treatments significantly increased by (2.04, 6.42 and 3.02%) and (2.74, 6.74 and 3.56%) compared to the application of GA2 in the 1st and 2nd seasons, respectively.

The interaction between irrigation water resources and growth regulators treatments was significant on purity% in the first season and sucrose, purity and extractable sugar (ES) % in the second season (Table 3). The difference between zero and IAA2 as well as between IAA1 and GA1 as growth regulators in purity % was significant under fish farm wastewater (Aqua). However, insignificant variance in these traits was detected between the same treatments under well irrigation water. On the other hand, extractable sugar (ES) % significantly increased in the 2nd season under the control compared to 300 ppm of IAA under aqua irrigation water. While, insignificant deference in this trait was found between zero and 300 ppm of IAA under well irrigation water in the same season.

Indole acetic acid is a growth regulator that has been widely used to reduce vegetative growth to allow plants to direct more metabolic energy towards the productive structure (Fletcher *et al*., 1994). Also, El-Kady *et al.* (2019) stated that irrigation by well ground water surpassed irrigation by waste water fish farm in quality parameters. While, it decreased by increasing gibberellic acid concentrations from zero up to 400 ppm.

3.3. Yields

Data in Table (4) revealed that sugar beet grown under fish farm irrigation water significantly recorded higher values of root yield (ton/fed) in the 1st and 2nd seasons, compared to beets irrigated using well irrigation water. The efficiency of using fish farm irrigation over well irrigation water was markedly distinguished in the 2nd season as compared with the 1st one. Applying fish farm irrigation resulted in producing 4.54 and 7.02 tons of roots per fed higher than that attained in case of using well irrigation water in 1st and 2nd seasons, respectively. Moreover, root yield (ton/fed) increased significantly by 4.01 and 5.08 ton roots/fed under application of 300 ppm of GA_3 compared to control treatments in the first and second seasons, successively. There is no significant difference between the two irrigation resources on the data of white sugar yield (ton/fed) during both seasons as shown in Table (4). On the other hand, the results cleared that using growth regulators had a significant influence on the produced sugar yields/fed. The maximum value of white sugar yield/fed was significantly noticed when spray the plants by 100 ppm of GA_3 (3.77 ton/fed) and 300 ppm of IAA (3.96 ton/fed) in the 1st and 2nd season, respectively. But also, there is no significant difference between the values of white sugar yield under the application of two concentrations of indole acetic acid (IAA) and control treatment in the first season; also, there was no difference between the values under the application of zero, IAA1, IAA2 and GA2 in the second seasons. Increasing yields as GA_3 level was raised can be referred to the increase in quantitative traits.

There was a significant difference between root and white sugar yield (ton/fed) under the effect of the interaction between irrigation water resources and different application of growth regulators during both seasons (Table 4). But this significant difference was not gained between the values of root yield/fed under the application of two concentrations of gibberellic acid (GA1 and GA2) with the irrigation by fish farm drain water compared to the same GA_3 concentrations with well irrigation water in both seasons.

These findings may be due to the additional amount of dissolved biological nitrogen and other nutrients inherent in waste water of fish farm which positively reflected on plant performance in producing more dry matter. Also, blue-green algal extracts in fish farm waste water 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 and Manickavelu *et al*., 2006).

Table (3): Sucrose, purity and extractable white sugar (ES) % of sugar beet plants under the effect of irrigation resources and growth regulator concentrations during 2018/2019 and 2019/2020 seasons.

Growth regulators treatments	Sucrose %			Purity %			ES %			Sucrose %			Purity %			ES %		
	Well	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**
	2018/2019									**2019/2020**								
Control	22.10	19.51	**20.80**	93.29	87.42	**90.36**	20.61	17.05	**18.83**	21.91	19.62	**20.77**	91.01	83.95	**87.48**	19.94	16.48	**18.21**
IAA,100ppm	21.01	18.51	**19.76**	91.16	85.17	**88.16**	19.15	15.77	**17.46**	21.03	17.61	**19.32**	87.92	79.40	**83.66**	18.49	13.99	**16.24**
IAA,300ppm	21.55	19.25	**20.40**	92.32	86.54	**89.43**	19.90	16.66	**18.28**	21.82	18.39	**20.10**	89.64	81.79	**85.71**	19.56	15.04	**17.30**
GA,100ppm	20.65	18.12	**19.38**	90.11	83.24	**86.67**	18.61	15.08	**16.84**	20.68	16.52	**18.60**	86.55	77.73	**82.14**	17.90	12.84	**15.37**
GA,300ppm	20.00	17.53	**18.76**	88.58	79.29	**83.94**	17.72	13.90	**15.81**	20.07	15.99	**18.03**	85.09	76.38	**80.74**	17.08	12.21	**14.65**
Mean	**21.06**	**18.58**	**19.82**	**91.09**	**84.33**	**87.71**	**19.20**	**15.69**	**17.45**	**21.10**	**17.63**	**19.63**	**88.04**	**79.85**	**83.95**	**18.59**	**14.11**	**16.35**
L.S.D at 0.05 level for:																		
Water resource (A)			0.16			0.66			0.23			0.11			0.22			0.10
Growth regulators (B)			0.11			0.39			0.13			0.26			0.28			0.27
A × B			NS			0.55			NS			0.37			0.39			0.39

Well= well water irrigation **Aqua= fish wastewater irrigation**

Table (4): Root and white sugar yield (ton/fed) of sugar beet as affected by irrigation resources and growth regulators concentrations during 2018/2019 and 2019/2020 seasons.

Growth regulators treatments	Root yield (ton/fed)			White sugar yield (ton/fed)			Root yield (ton/fed)			White sugar yield (ton/fed)		
	Well	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**	**Well**	**Aqua**	**Mean**
2018/2019							**2019/2020**					
Control (zero)	16.49	23.01	**19.75**	3.40	3.92	**3.66**	17.64	23.61	**20.63**	3.52	3.89	**3.70**
IAA,100ppm	19.52	22.99	**21.25**	3.74	3.62	**3.68**	19.50	26.96	**23.23**	3.61	3.77	**3.69**
IAA,300ppm	17.76	22.56	**20.16**	3.53	3.76	**3.65**	19.45	27.35	**23.40**	3.80	4.11	**3.96**
GA,100ppm	20.50	24.66	**22.58**	3.81	3.72	**3.77**	21.23	28.45	**24.84**	3.80	3.65	**3.73**
GA,300ppm	21.88	25.64	**23.76**	3.87	3.56	**3.72**	22.42	28.99	**25.71**	3.83	3.54	**3.69**
Mean	**19.23**	**23.77**	**21.50**	**3.67**	**3.72**	**3.69**	**20.05**	**27.07**	**23.56**	**3.71**	**3.79**	**3.75**
L.S.D at 0.05 level for												
Water resource (A)			0.42			NS			0.32			NS
Growth regulators (B)			0.22			0.05			0.36			0.08
A × B			0.31			0.07			0.51			0.12

Well= well water irrigation **Aqua= fish wastewater irrigation**

Table (5): Effect of water resources and growth regulators on the total production cost, the total income and net return during 2018/2019 and 2019/2020 seasons.

Growth regulators	Irrigation cost	Fertilization Cost	and pest control	Total cost (LE/fed)	Yield (ton/fed)		Price (LE/ton)		Total return (LE/fed)		Net return (LE/fed)	
					2018/19	2019/20	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20
Well water irrigation												
Control (zero)	1970.5	2047	820	4837.5	16.49	17.64	702.42	697.67	11585.19	12306.84	6747.69	7469.34
IAA,100ppm	1970.5	2247	820	5037.5	19.52	19.50	675.25	675.83	13178.63	13176.50	8141.13	8139.00
IAA,300ppm	1970.5	2396	820	5186.5	17.76	19.45	688.75	695.50	12232.20	13525.16	7045.70	8338.66
GA,100ppm	1970.5	2546	820	5336.5	20.50	21.23	666.25	667.00	13655.90	14160.41	8319.40	8823.91
GA,300ppm	1970.5	2652	820	5442.5	21.88	22.42	650.00	651.83	14219.83	14611.93	8777.33	9169.43
Fish wastewater irrigation (Aqua)												
Control (zero)	1970.5	2047	820	4837.5	23.01	23.61	637.67	640.58	14670.58	15126.31	9833.08	10288.81
IAA,100ppm	1970.5	2247	820	5037.5	22.99	26.96	612.75	590.33	14087.12	15915.39	9049.62	10877.89
IAA,300ppm	1970.5	2396	820	5186.5	22.56	27.35	631.33	609.67	14242.88	16674.38	9056.38	11487.88
GA,100ppm	1970.5	2546	820	5336.5	24.66	28.45	602.92	562.92	14869.93	16016.86	9533.43	10680.36
GA,300ppm	1970.5	2652	820	5442.5	25.64	28.99	588.17	549.75	15078.63	15939.09	9636.13	10496.59

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 (Storni de Cano *et al.*, 2003 and Zaccaro *et al.*, 2006). While, Cyanobacteria in waste water can enrich phosphorus and potassium contents in soils, playing indirect major role in plant growth promotion (Selvarani, 1983).

These results are in accordance with these obtained by (Elnwishy *et al.*, 2006) who stated that, recycling the drainage water of fish farming, rich with organic matter for agriculture use can improve soil quality and crops productivity. In addition, Abdelraouf and Ragab (2017) found that the yield under waste water of fish farm was higher than the yield under well ground water. On the other hand, Gibberellic acid has the ability of effect on yield by modifying the growth pattern by affecting the cell elongation and cell division, biosynthesis of enzymes, protein, and carbohydrates contents (Gupta and Chakrabarty, 2013 and Milne *et al.*, 2013).

3.4. Economic analysis

It can be concluded that the highest total income (16674.38 LE/fed) was gained under aqua irrigation water and 300 ppm of indole acetic acid in the 2nd season, while the lowest value (11585.19 LE/fed) was gained under well irrigation water and the control treatments of growth regulators in the 1st season (Table 5). Meanwhile, the minimum value of net return (7469.34 LE/fed) was observed under well irrigation and zero growth regulator, while the maximum value of net return (11487.88 LE/fed) was observed under aqua irrigation water and 300 ppm of indole acetic acid in 2nd season.

These results are accordance with Moursy, (2018) how found that the highest net return were 8427 LE/fed with used aquaculture, while the lowest value was 6144 LE/fed with well water. Therefore, a farmer owning fish pond, water source and agricultural land at one location should go for agri-aquaculture for optimum utilization of resources, better income and ecologically sustainable development (Ray *et al.,* 2010).

Conclusions

In line with strategies that depend on modern methods and new sources of non-traditional irrigation especially in new reclaimed area, the present study revealed that the irrigation by fish farm waste water and spray plants by 300 ppm of gibberellic acid was more efficient on growth traits and yields of sugar beet crop. On the other hand, quality parameters of sugar beet plants enhanced under the application of 300 ppm of indole acetic acid. Also, the maximum value of net return was observed under the irrigation by fish farm wastewater with spraying sugar beet plants by 300 ppm of indole acetic acid in Wadi El-Natrun region. Finally, it can be concluded that the use of wastewater of fish farms for plant irrigation could help to achieve higher yields, while using less chemical fertilizers and higher income for farmers.

4. REFERNCES

Abdelraouf R.E. and Hoballah E.M.A. (2014). Impact of irrigation systems, fertigation rates and using drainage water of fish farms in irrigation of potato under arid regions conditions. Int'l. J. Sci. Res. Agric. Sci., 1(5): 67-79

Abdelraouf R.E. and Ragab R. (2017). The benefit of using drainage water of fish farms for irrigation field and modeling study using the saltmed model. Irrig. Drain., 66: 758-772.

Almodares A., Usofzadeh M. and Daneshvar M. (2013). Effect of nitrogen and ethephon on growth parameters, carbohydrate contents and bioethanol production from sweet sorghum. Sugar Tech., 15: 300-304.

Carruthers A. and Oldfield J.ET. (1960). Methods for the assessment of beet quality. Int. Sugar J., 63(1): 103-105.

Daie J. (1986). Hormonal mediated enzyme activity in source leaves. Plant Growth Reg., 4(3): 287-291.

Ebong V. and Ebong M. (2006). Demand for fertilizer technology by smallholder crop farmers for sustainable agricultural development in Akwa, Ibom State, Nigeria. Int'l. J. Agric. Biotech., 8(6): 728-731.

El-Kady M.S., Helmy Samar A.M. and El-Zeny Maha. M. (2019). The influence of gibberellic acid and different irrigation resources on morphological, quality and yield parameters of some sweet sorghum varieties in new reclaimed area. Alex. Sci. Exch. J., 40(4): 585-598

Elnwishy N., Salh M. and Zalat S. (2006). Combating desertification through fish farming. Future Drylands Proc. Int'l. Sci. Conf. Des. Drylands Res., Tunisia, 19-21 June, UNESCO.

Fletcher D.C., Silertooth J.C., Norton E.R., Unruch B.L. and Lowis E.A. (1994). Evaluation of feedback vs. schedual approach to Mepiquate chloride application. Proc. Beltwide Cotton Conf., 1259-1260.

Gupta R. and Chakrabarty S.K. (2013). Gibberellic acid in plant: still a mystery unresolved. Plant Signal Behav., 8(9). Pp: 2550.

James E.R., Michael P.M. and Thomas M.L. (2006). Recirculating aquaculture tank production systems: Aquaponics-Integrating Fish Plant Culture SRAC Publication No. 454.

Leite G.H.P., Crusciol C.A.C. and Silva M.A. (2011). Desenvolvimento produtividade da cana-de-açúcar após aplicação de reguladores vegetais em meio de safra. Semina: Ciências Agrárias 32: 129-138.

Manickavelu A., Nadarajan N., Ganesh S.K., Ramalingam R., Raguraman S.and Gnanamalar R.P. (2006). Organogenesis induction in rice callus by cyanobacterial extracellular product. Afric. J. Bio. 5(5): 437-439.

Metting B. and Pyne J.W. (1996). Biologically active compounds from micro algae, enzyme. Microb. Tech. 8:386-394.

Milne R.J., Byrt C.S., Patrick J.W. and Grof C.P.L. (2013). Are sucrose transporter expression profiles linked with patterns of biomass partitioning in Sorghum phenotypes? Frontiers Plant Sci., 4: 1-12.

Moursy M.A.M. (2018). Influence of agri-aquaculture and seed treatment techniques on sugar beet crop. J. Soil. Sci. and Agric. Eng., Mansoura Univ., 9(1): 63-68.

Moursy M.A.M. and El-Kady M.S. (2019). Study planting methods to improve water use efficiency and productivity of sugar beet in a newly reclaimed area. Life Sci. J., 16(12):11-19.

Mustafa, Shafika N., Zeniab, Mustafa R. and Ahmed F.A. (2001). Effect of preharvest treatments with ABA and IAA on metabolism and productivity of sugar beet. Annals Agric. Sci., Moshtohor, 39(2): 1011-1022.

Ray L. I.P., Panigrahi P.K., Moulick S., Mal B.C., Das B.S. and Bag N. (2010). Integrated aquaculture within irrigation options- an economic analysis in indian context. Int'l. J. Sci. Nature, 1(2): 253-258.

Reinefeld E., Emmerrich A., Baumgarten G., Winner C. and Beiss U. (1974). ZurVaraussage des Melasse Zuchersaus Rbenanalysen. Zucker, 27: 2-25. The Sugar Beet Crop. Cook, D.A. and R.K. Scott Seriess, London, UK.

Selvarani V. (1983). Studies on the influence on nitrogen fixing and non-nitrogen fixing blue green algae on the soil, growth and yield of paddy (*Oryzae sativa*-IR 50). M.Sc., Madurai Kamaraj University, Madurai.

Snedecor G.W. and Cohran W.G. (1967). Statistical method 6*th* ed., Iowa State Univ. Press, Ames, Lowa, USA., P. 593.

Storni C.M., Zaccaro M.C., Garcia I., Stella A.M. and Zulpa G. (2003). Enhancing rice callus regeneration by extracellular products of *Tolypothrixtenuis* (Cyanobacteria). World J. Micro. Bio., 19(1): 29-34.

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

Younis S.M., Shibon M.A. and Aref A.O. (1991). Evaluation of some mechanical methods of rice production in Egypt. Misr J. Agric. Eng., 8 (1): 39-49.

Zaccaro M.C., Kato A., Zulpa G., Storni M.M., Steyerthal N., Lobasso K. and Stella A.M. (2006). Bioactivity of *Scytonema hofmanni* (Cyanobacteria) in *Lilium alexandrae in vitro* propagation. Elec. J. Bio., 9(3): 210-214.

تأثير الري بمياه صرف المزارع السمكية ومنظمات النمو على نمو وانتاجية وجودة محصول بنجر السكر

محمد سعيد القاضي - سمرعبد العاطي محمد حلمى

معهد بحوث المحاصيل السكرية - مركز البحوث الزراعية - الجيزة - مصر

ملخص

اجريت تجربة حقلية في أراضي رملية بمنطقة وادى النطرون بمصر خلال موسمي 2019/2018 و2020/2019 لتقييم النمو والجودة والانتاجية والعائد الاقتصادي لمحصول بنجر السكر تحت تأثير نوعين من مصادر الري (الري بمياه صرف المزارع السمكية و الري بالمياه الجوفية) والرش بتركيزين من حامض الجبرليك والأندول استيك اسيد (100 و300 جزء في المليون) في مقارنة مع عدم الرش بأي من منظمات النمو (صفر جزء في المليون). أظهرت النتائج:

1. تفوقا معنويا للري بمياه صرف المزارع السمكية مقارنة بالري بالمياه الجوفية في صفات النمو (معدل نمو المحصول (CGR) ومعدل النمو النسبي (RGR) وصافى التمثيل الغذائي (NAR)) والمحصول (محصول الجذور ومحصول السكر الابيض (طن/الفدان))، بينما تفوق الري بالمياه الجوفية في نسبة السكروز والنقاوة ونسبة السكر المستخلص مقارنة بالري بمياه صرف المزارع السمكية خلال موسمي الزراعة.
2. زادت صفات النمو ومحصول الجذور لنباتات بنجر السكر معنويا تحت تركيز 300 جزء في المليون من حامض الجبرليك المستخدمة، بينما زاد محصول السكر المستخلص وصفات الجودة عند استخدام 300 جزء في المليون من الاندول استك اسيد خلال موسمي النمو.
3. تحقق اعلى عائد اقتصادي بمعدل 11488 جنيه/فدان في موسم 2020/2019 عند الري بنواتج المزارع السمكية مع رش النباتات بمعدل 300 جزء في المليون من منظم النمو الاندول استيك اسيد (IAA).

المجلة العلمية لكلية الزراعة - جامعة القاهرة- المجلد (71) العدد الثانى ابريل (2020): 73-84.