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Influence of Foliar Application by Benzyladenine and Yeast Extract on Growth, Root Yield, Quality and Chemical Compositions of Sugar beet (*Beta vulgaris* L.) Plant

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ABSTRACT

Two field experiments were carried out at the Experimental Research Station, Faculty of Agriculture, Moshtohor, Benha University, Qalyoubia Governorate, Egypt, during 2016/2017 and 2017/2018 seasons, to study the effect of foliar application of benzyladenine (BA at 50 and 100ppm) and yeast extract (at 100 and 200 ml/L) in which were applied three times (50, 70 and 90 days after sowing) on growth, root yield characteristics and chemical compositions of sugar beet plant (*Beta vulgaris* L. cv. Ras-Poly). The obtained results indicated that, the foliar application with different applied treatments of both benzyladenine and yeast extract significantly increased all vegetative growth characteristics of roots (i.e. root length, diameter, fresh and dry weights/ plant) and leaves(i.e. leaves number, total leaves area/ plant and fresh and dry weights/ plant) at 110 days after sowing).The results also indicated that the foliar application of these treatments significantly increased root yield characteristics and quality at harvest time compared with control plants in both seasons. Data also showed that, foliar spraying of BA at 100ppm and yeast extract at 200 ml/L increased photosynthetic pigments, minerals contents, total carbohydrates and crude protein content in sugar beet leaves at 110 days after sowing. Results also gave the highest values of all studied vegetative growth and root yield characteristics as well as root quality in this study. Hence, it could be concluded that foliar application of benzyladenine (BA) at 100 ppm and yeast extract at 200 ml/L have promoting effect on growth, root yield and quality of sugar beet plants.

Keywords: Sugar beet, Benzyladenine (BA), Yeast extract, Growth, Root yield and quality,.

INTRODUCTION

Sugar beet plant (*Beta vulgaris* L.) is belonging to family Chenopodiaceae, is considered one of the most important sugar crops grown in the world and in Egypt for local consumption. It is ranked the second main source of sugar after sugarcane in Egypt. Recently, it has become the first source of sugar production of high quality in Egypt. The Egyptian Government encourages sugar beet growers to increase the cultivated area for decreasing the gap between sugar production and consumption.

The cytokinine groups of plant hormones play an essential role in the regulation of plant growth and development of higher plants. Benzyladenine (BA) belongs to the group of cytokinins, Benzyladenine regulate several plant growth aspects and development processes including cell division, shoot differentiation, nutrient mobilization, organogenesis in developing plants and enhancement of leaf expansion and as well as increasing the sink ability (Davies, 1995 and Mok and Mok, 2001).

Also, it accelerates chloroplast differentiation and promot chlorophyll synthesis (Duszka *et al.*, 2009) synthetic cytokinins can enhance growth of plants by accelerates cambium activity, cell division and delay protein degradation (Elliott *et al.*, 1984 and Letham, 1994). Phytohormones play an important role in the transport and allocation of photosynthates. Gifford and Evans (1981) and Patrick (1982) they reported that the photosynthates transport and sink mobilizing ability were found to be increased by cytokinins (BA and Kinetin) application.

Abd El-Dayem (1999) on fodder beet plant concluded that foliar spraying of kinetin and benzyladenine significantly increased root length and diameter, top and root fresh weight, leaves area/plant, sucrose% and root and sugar yield as well as increased both auxin and cytokinin levels in leaves. Also, Ibrahim *et al.*, (2010) found that foliar application of BA on plants significantly increased all vegetative growth characters, i.e. number of leaves/ plant, leaf area, root length, fresh and dry weights of stem, leaves and roots as well as increased total indoles content in leaves. Also, Zewail *et al.*, (2019) showed that foliar application with putrescine, benzyladenine (BA) and yeast extract significantly increased all growth characteristics of soybean plants as well as photosynthetic pigments and endogenous phytohormones content in leaves.

In addition, exogenous application of cytokinins (BA and kinetin) increased chlorophylls concentration, N, P, K, sugar and carbohydrates contents in different plant species were recorded by several investigators.

On the other hand, many investigators reported that foliar application of yeast on sugar beet plants significantly increased leaf area, root length and diameter, top and root fresh weights, sugar yield as well as T.S.S, sucrose and purity percentages (Shalaby and El-Nady, 2008; Agamy *et al.*, 2013; Neseim *et al.*, 2014; Abdou, 2015; Nemeat Alla *et al.*, 2015 and Alice *et al.*, 2019). Several auther reported

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that yeast extract increased photosynthetic pigments content, i.e. chlorophyll a, b and carotenoids in leaves of different plants Mekki and Ahamed (2005) on soybean; Wanas (2007) on wheat; El-Desouky *et al.,* (2011) on tomato and Zewail *et al.,* (2019) on soybean plant.

Therefore, the aim of the present study was to investigate the effect of foliar application of benzyladenine (BA) and yeast extract on growth, root yield characteristics and chemical compositions of sugar beet (*Beta vulgaris* L.) plant.

MATERIALS AND METHODS

Two field experiments were conducted at the experimental farm of the Faculty of Agriculture, Moshtohor, Benha University, during two successive seasons of 2016/2017 and 2017/2018. Seeds of sugar beet (*Beta vulgaris* L. variety Ras-Poly) were obtained from Agric. Research Center, Field Crops Research Institute, Giza. Seeds of sugar beet were sown on 15th of October in both 2016/2017 and 2017/2018 seasons.

The experimental plot area was 3.0 x 3.5 m. (i.e. 1/400 feddan) with 5 rows in each plot and 30 cm. a part between hills. The experiment soil was prepared a usually and all plots were fertilizered with 100kg/fed superphosphate 15.5% P_2O_5 and 48 kg K_2O/fed. (potassium sulphate 48K_2O) was applied before planting. While, nitrogen at 80kg N/fed. (Urea 46% N) added in two equal doses the first was 40 days after sowing and second one after 80 days from sowing in both seasons. Plants were thinned to one plant per hill after 35 days from sowing. Other cultural practices were done as recommended for sugar beet plant by the local growers.

Applied treatments: the plants were sprayed with benzyladenine (BA) at 50 or 100 ppm as well as yeast extract at 100 or 200 ml/L. moreover tap water was sprayed as control. All treatments were added as foliar application three times after 50, 70 and 90 days from sowing. The experimental design was a complete randomized block design with 5 treatments and three replicates.

Sampling and collecting data:

Two samples at 110 days after sowing and at harvest time 200 days from sowing were randomly taken from each treatment in both seasons to determine the growth and root yield characteristics.

1. Growth and root yield characteristics: Nine guarded plant samples were randomly taken from each treatment, these plant samples were cleaned and separated into roots and leaves to measurements plant growth and root yield as followings:

Root length (cm), root diameter (cm), root fresh and dry weights (g)/plant and root yield (ton)/feddan, number of leaves/ plant, total leaves area (cm^2)/ plant according to Derieux *et al.,* (1973) and leaves fresh and dry weights (g)/plant.

2. Biochemical compositions were carried out on the sample from sugar beet leaves at 110 days after sowing during second season 2017/2018.

Photosynthetic pigments (chl a, b and carotenoids) were determined in fresh leaves according to Wettestein (1957) and calculated as mg/g fresh weight. Determination of minerals and total carbohydrates content were determined in dry matter of leaves. Total nitrogen was determined by using microkeldahl as described by Horneck and Miller (1998), phosphorus was determined colorimetrically according to the method of Sandell (1950), potassium was determined according to the Horneck and Hanson (1998) and total carbohydrates was determined according to Dubois *et al.,* (1956). Crude protein was calculated according to the following equation: crude protein = Total nitrogen x 6.25 (A.O.A.C., 2005).

3- Root quality: At harvest time three roots were chosen randomly from each treatment to determine: (1) Sucrose percentage was determined according to Le-Docte (1927), (2) Total soluble solids percentage (T.S.S%) was determined by using Hand Refractometer and (3) Juice purity percentage was calculated according to the following formula described by Carruthers *et al.,* (1962) = (Sucrose/ Total soluble solids) x 100.

Statistical analysis: Data obtained on growth and yield characteristics were statistically analyzed by the methods described by Snedecor and Cochran (1991).

RESULTS AND DISCUSSION

1. Vegetative growth characteristics at 110 days after sowing:

Root length and diameter:

Data in Table (1) showed that the foliar application with two assigned concentrations of benzyladenine and yeast extract caused a significant increase in studied growth characteristics of root length and diameter compared with untreated plants at 110 days from sowing in both seasons. It is well observed that benzyladenine (BA) at 100 ppm followed by yeast extract at 200 ml/L gave the highest significant values of root parameters in the two growing seasons when compared with control plants and other used treatments. Regarding to yeast extract it well be mentioned that Yeast extract is a natural bio-product was suggested to participate a beneficial role on vegetative growth and yield of crops due to its contents of carbohydrates, amino acids, minerals (Macro and micro-nutrients), vitamins, cytokinins and auxins and other growth regulating substances (Nagodawithana, 1991) and it is considered as a new promising plant growth promoting for different crops. yeast may affect directly or indirectly plant root growth as studied by Mok and Mok (2001) concluded that the promoting effect of yeast on rapeseed yield and its components may be resulted in it's action as a co-facor for over 60 enzymes which catalase many biochemical pathways involving amino acids synthesis and several bioactivities including cell division. In addition, El-Tarabily (2004) concluded that application of yeasts increased root and top fresh weights and sugar content of sugar beet. This promoting effect due to yeast is considered as a natural source of cytokinins and protein that enhance cell divisions and enlargement and protein and nucleic acids synthesis (Barnett *et al.,* 1990).

The increment in root length and diameter of sugar beet in response to foliar application with benzyladenine (BA) and yeast extract may be due to the stimulating effect of treatments on cell division, enlargement and differentiation also accelerate cambial activity in roots by increasing levels of endogenous phytohormones (IAA, Cyk and GA) which in turn increasing root length and diameter.

In this connection, cytokinins has known to accelerate cambium activity (Letham, 1994). And Bondok (1996) mentioned that spraying sugar beet plants with kinetin lead to increase cell division in both shoots and roots tissue and consequently increased root length and diameter. Also presented results of BA are agreement with those obtained in different plants by Abd El-Dayem, (1999) on fodder beat; Ibrahim *et al.,* (2010) on croton plants and Ismail (2016) one wheat plants.

Table 1. Effect of foliar application of benzyladenine and yeast extract on growth characteristics of sugar beet root and leaves at 110 days after sowing during 2017 and 2018 seasons.

Characters / Treatments		Root				Leaves			
		Root length (cm)	Root diameter (cm)	Root fresh weight (g)/plant	Root dry weight (g)/plant	Number of leaves/ plant	Total leaves area/plant (cm^2)	Fresh weight (g)/plant	Dry weight (g)/plant
1st season 2016/2017									
Control	0.0	22.0	8.6	470.7	60.2	21	3163.8	527.3	84.4
Benzyladenine (BA)	50 ppm	26.3	9.7	660.7	84.6	25	4746.0	791.0	134.5
Benzyladenine (BA)	100ppm	29.3	10.7	836.7	107.1	26	5593.7	917.0	155.9
Yeast extract	100ml/L	25.0	9.4	515.4	66.0	23	4648.2	762.0	129.5
Yeast extract	200ml/L	27.7	10.1	731.3	93.6	24	5459.5	895.0	152.2
L.S.D. at 5%		1.14	0.38	25.3	8.5	2.06	403.1	21.8	8.44
2nd season 2017/2018									
Control	0.0	25.3	9.4	580.3	75.4	23	4470.0	745.0	126.6
Benzyladenine (BA)	50 ppm	29.3	10.2	755.3	98.2	27	5764.5	945.0	170.1
Benzyladenine (BA)	100ppm	32.0	11.0	937.0	121.8	38	6954.0	1140.0	193.8
Yeast extract	100ml/L	28.0	10.0	686.7	89.3	25	4926.0	821.0	139.6
Yeast extract	200ml/L	30.3	10.6	837.0	113.5	28	5712.0	952.0	171.4
L.S.D at 5%		1.5	0.28	39.7	7.59	1.71	223.5	15.6	8.65

As for, the promotive effect of yeast extract may be due to that yeast extract is considered as a natural source of cytokinins that stimulates cell division and enlargement also synthesis of protein and chlorophyll as well as it contains amino acids, vitamins and sugar which in turn on improving root growth and development (Nagodawithana, 1991 and Agamy *et al.,* 2013).

These results of yeast extract are in harmony with those obtained by El-Tarabily, 2004; Agamy *et al.*, 2013; Nemeat-Alla, *et al.*, 2015; also Alice *et al.*, (2019) on sugar beet plants, they showed that the foliar application of yeast extract significantly increased root characters, i.e., their length and diameter.

Leaves characteristics:

Data illustrated in Table (1) clearly indicated that leaves number and total leaves area per plant were significantly increased by applying benzyladenine (BA) and yeast extract at two concentrations compared with control plants at 110 from sowing in both seasons. Also, the data pointed that the highest significant increase was obtained in response to BA at 100ppm and yeast extract at 200ml/L in the two growing seasons when compared with control plants and other tested treatments. Meanwhile, number of leaves was insignificantly affected by the application of yeast extract at 100ml/L. during the first season.

In this regard, the promotive effects of benzyladenine (BA) and yeast extract on leaves characteristics (number and total leaves area /plant) may be due to the role of BA and yeast on the regulation of cell division and cell cycle, enlargement differentiation activity and enhancement of leaf expansion (Davies, 1995 and Arigita *et al.,* 2005) which in turn stimulate leaf growth rate. These results of BA are in agreement with those obtained by many investigators in different plants, Abd El-Dayem (1999) reported that foliar spraying of BA significantly increased total leaves area/ plant of fodder beat plant. Also, Ibrahim, *et al.,* (2010) on croton plants; Abd El-Dayem *et al* ., (2012) on sesame plant; Ismail (2016) on wheat plant El-Emary *et al.,* (2018) on moringa plants and Zewail, *et al.,* (2019) found that foliar application of benzyladenine (BA) and yeast extract increased growth characters i.e. number of leaves and leaves area/plant of soybean plants.

Fresh and dry weights of root and leaves (g/plant):

The presented data in Table (1) reveal that fresh and dry weights of root and leaves were significantly and positively affected by applying BA and yeast extract at two used concentration at 110 days after sowing in both seasons compared with untreated plants. However, the highest significant values of fresh and dry weights of root and leaves were occurred in response to BA at 100ppm and yeast extract at 200ml/L. in both seasons when compared with control plants and other tested treatments. Such increment of fresh and dry weights of root and leaves due to benzyladenine (BA) and yeast extract may be attributed to the increment total leaves area (Table, 1) chlorophyll content and enhances photosynthetic activity and efficiency and consequently increase the total carbohydrates and crude protein in leaves (Table, 3) translocation and their accumulation in the storage sink organ of roots which directly reflected on roots and leaves growth and its fresh and dry weights as well. Also, these increases in fresh and dry weights of roots and leaves could be referred to the stimulation of cell division and cell enlargement and also due to the increase in root length and diameter (Table, 1). In this respect, Bondok (1996) on sugar beet plants and Abd El-Dayem (1999) showed that foliar application of BA at 100 mg/L. significantly increased fresh and dry weights of both roots and shoots of fodder beet plants. Also, similar results were reported by Ramadan, Amany *et al.,* (2005); Ibrahim *et al.,* (2010); Ismail (2016); El-Emary *et al.,* (2018). and Zewail *et al.,* (2019) They found that foliar application with BA and yeast extract increased fresh and

dry weights of shoots, endogenous phytohormons levels and photosynthetic pigments content in leaves of soybean plants.

Also, the above mentiond results of yeast extract are in harmony with those obtained by Mahmoud, Asmaa (2004); El-Tarabily (2004); Mekki and Ahamed (2005); Wanas (2007); El-Desouky *et al.,* (2011) and Zewial *et al* .,(2019). In addition, Agamy *et al.,* (2013); Neseim *et al.,* (2014); Nemeat-Alla *et al.,* (2015) and Alice *et al.,* (2019) they reported that foliar application of yeast extract significantly increased fresh weights of root, top and total weight per plant of sugar beet plants.

2. Root yield characteristics and root quality at harvest time:

Root yield characteristics:

The obtained results in Table (2) indicated that root yield characteristics expressed as root length and diameter, root fresh yield per plant and ton per feddan were significantly increased with different applied treatments during the two growing seasons compared with untreated plants. However, the foliar application of BA at 100 ppm following by yeast extract 200 ml/L. indicated the highest values of root yield per plant and ton per feddan when compared with control treatment and other used concentrations in both seasons. Here, root yield ton/fed. were 26.16 and 28.86 ton/fed. with BA at 100ppm and 24.8 and 27.04 ton/fed. with yeast extract at 200ml/L respectively, in both seasons.

The abovementioned results of benzyladenine (BA) are in harmony with those obtained by Bandok (1996) found that foliar spraying of kinetin significantly increased all root length and diameter, root yield/plant and ton per feddan. As well as the same results are recorded by several investigators in different plant species Abd El-Dayem (1999) on fodder beet plants, Abd El-Dayem *et al.,* (2012) on sesame plants; Ismail (2016) on wheat plants and Zewail *et al.,* (2019) they showed that foliar application of BA increased yield and its components of soybean plants.

Table 2. Effect of foliar application of benzyladenine and yeast extract on root yield characteristics and quality of sugar beet plant at 200 days after sowing during 2017 and 2018 seasons.

Characters / Treatments		Root yield					Root quality		
		Root length (cm)	Root diameter (cm)	Root fresh weight (g)/plant	Root dry weight (g)/plant	Root yield (ton)/feddan	Sucrose %	TSS %	Juice purity %
1st season 2016/2017									
Control	0.0	35	12.0	1314	328.5	21.01	17.2	21	81.9
Benzyladenine (BA)	50 ppm	39	13.0	1520	387.6	24.32	18.4	21	85.7
Benzyladenine (BA)	100ppm	41	14.0	1635	417.0	26.16	18.8	22	85.5
Yeast extract	100ml/L	38	12.9	1473	371.2	23.57	18.2	22	82.7
Yeast extract	200ml/L	40	13.5	1550	390.6	24.80	18.6	22	84.5
L.S.D. at 5%		1.95	1.12	15.66`	8.93	1.72	0.26	N.S	1.80
2nd season 2017/2018									
Control	0.0	37	12.6	1420	355.0	22.70	17.5	22	79.5
Benzyladenine (BA)	50 ppm	42	14.2	1650	429.0	26.40	18.8	23	81.7
Benzyladenine (BA)	100ppm	44	15.6	1810	470.6	28.86	19.7	24	82.1
Yeast extract	100ml/L	41	13.4	1580	410.8	25.30	18.5	23	80.4
Yeast extract	200ml/L	42	14.2	1690	437.8	27.04	19.2	23	83.5
L.S.D at 5%		2.25	0.77	11.21	8.06	1.36	0.44	N.S	1.72

This increments in root yield characteristics of sugar beet plants may be due to a reflection of BA and yeast extract beneficial effects on vegetative growth, total leaves are (Table, 1) photosynthetic pigments content, the amount of metabolites (total carbohydrates and crude protein in leaves), absorption and translocation mineral contents (N, P and K) (Table, 3), as well enhancing sink activity and endogenous growth hormone levels Bondok (1996); El-Desuoky *et al.,* (2011) and Zewail *et al.,* (2019) which in turn could lead to an increase in the rate of net amount of photosynthetic assimilate production and transport from sites of synthesis in leaf tissue source to sites of accumulation in storage organs (sink) of roots Patrick (1982) and consequently increase root yield of sugar beet plants. In this regard, Bondok (1996) concluded that kinetin treatments nearly lead to an increase of cytokinin levels in both shoots and roots which increase chlorophyll content also lead to accelerate cambial activity and cell division which reflected itself on root and sugar yield of sugar beet plants.

Regarding to the simulative effects of yeast extract application on root yield characteristics could be explained by Agamy *et al.,* (2013); Neseim *et al.,* (2014); Abdou (2015); Nemeat-Alla *et al.,* (2015) and Alice *et al.,* (2019) they reported that foliar application of yeast extract significantly increased root yield characters, their length, diameter and fresh weights of top and root per plant and ton per feddan. Such increments effects of yeast extract application may be due to yeast contained cytokinins and other growth factors also increased endogenous phytohormone levels which in turn promote the accumulation of soluble metabolites and translocation (Mekki and Ahamed, 2005; El-Desouky *et al.,* 2011 and Zewail *et al.,* 2019).

Root quality:

The presented data in Table (2) showed root quality i.e. sucrose and juice purity percentages in root of sugar beet plants were significantly increased with different applied concentrations of BA and yeast extract compared with control treatment in both seasons. The exception was that insignificant increase existed in T.S.S%. here, the highest value were recorded as a result of spraying plants with BA at 100ppm followed by yeast extract at 200 ml/L when compared with control and other tested concentrations in both seasons. Such increments in root quality aspects as result using the tested BA and yeast extract which lead to an

increase photosynthetic efficiency of solar energy conversion and assimilation rate and translocation also sugar storage ability which in turn increase sugar percentage and final sugar and root yield Gifford and Evans (1981) and Bondok (1996) the reported that photosynthates transport and sink ability were found increased by cytokinins (BA and Kinetin) application. these results of benzyladenine are in harmony with those reported by Bondok (1996) showed that foliar spraying sugar beet plant with different kinetin concentrations increased cytokinin levels and sugar percentage increased sugar percentage and root yield (ton/fed.).

As for yeast extract the abovementioned results of yeast extract are in agreement with those obtained by Agamy *et al.,* (2013); Neseim *et al.,* (2014); Abdou (2015); Nemeat-Alla *et al., (2015) and Alice et al.,* (2019) they showed that foliar application if yeast extract significantly increased root quality i.e., sugar percentage and sugar yield ton/fed., purity percentage and sodium, potassium and α – amino N percentage in root of sugar beet plants in both seasons.

3. Biochemical compositions of leaves:

Photosynthetic pigments content:

Data present in Table (3) indicate that photosynthetic pigments content (i.e. chlorophyll a, b and carotenoids) in leaves were increased with different applied treatments of benzyladenine (BA) and yeast extract in the second season. Also, it could be noticed that maximum increase of chlorophyll a, b and carotenoids in leaves of sugar beet plants existed in case of benzyladenine (BA) at 100pm followed by yeast extract at 200 ml/L. in the second season compared with control treatment and other tested treatments.

Such increment in photosynthetic pigments content with BA application may be attributed to the role of BA in the promotion effects on chlorophyll biosynthesis and/or inhibition of chlorophyll degradation also retard the senescence of leaves (Bondok, 1996; Davies, 1995 and 1996 and Duszka *et al.,* 2009).

These results of benzyladenine (BA) are in conformity with those obtained by Bondok (1996) on sugar beet plants and Abd El-Dayem (1999) on fodder beet plants. Also, similar promoting effect of BA on photosynthetic pigments content in different plants had been reported by Abd El-Dayem *et al.,* (2012) and Ismail (2016).

Zewail *et al.,* (2019) showed that foliar application of BA and yeast extract increased photosynthetic pigments content (chlorophyll a, b, carotenoids and total chlorophylls) in leaves of soybean plants.

Table 3. Effect of foliar application of benzyladenine and yeast extract on photosynthetic Pigments (mg/g fresh weight), minerals percentage, total carbohydrates and crude protein content (mg/g DW) in leaves of sugar beet Plant at 110 days after sowing during 2018 seasons.

Treatments		Chlorophylls mg/g FW				Minerals percentage			Total carbohydrates mg/g DW	Crude protein mg/g DW
		Chlorophyll a	Chlorophyll b	Chlorophyll a+b	Carotenoids	N %	P %	K %		
Control	0.0	0.81	0.40	1.21	0.43	2.36	0.25	3.18	474	148
Benzyladenine (BA)	50ppm	0.92	0.43	1.35	0.47	2.75	0.28	3.65	535	172
Benzyladenine (BA)	100ppm	0.98	0.52	1.50	0.56	2.82	0.31	3.90	556	176
Yeast extract	100ml/L	0.89	0.41	1.30	0.48	3.06	0.28	3.72	540	191
Yest extract	200ml/L	0.96	0.47	1.43	0.51	3.11	0.33	3.96	565	194

This increments in photosynthetic pigments content due to yeast extract treatments may be explained according to the effect of yeast extract on endogenous cytokinins, auxins levels and vitamins which induced a higher chlorophylls synthesis and retard degradation (Nagodawithana (1991) and Mekki and Ahamed (2005).

Minerals, total carbohydrates and crude protein content in leaves:

Data in Table (3) indicate that the foliar application of benzyladenine (50 or 100ppm) and yeast extract (100 or 200 ml/L) increased the concentrations each of N, P and K, total carbohydrates and crude protein in leaves of sugar beet plants at 110 days after sowing during second season compared with untreated plants. Moreover, the foliar application of benzyladenine (BA) at 100pm followed by yeast extract at 200 ml/L gave the highest concentrations each of NPK, total carbohydrates and crude protein in leaves when compared with control plants and other tested treatments.

This increase in total carbohydrate and crude protein content in sugar beet leaves in response to BA and yeast extract application were supported by stimulation of total leaves area (Table,1) and photosynthetic pigments (Table, 3) and accumulation of dry weights in leaves and roots (Table, 1). Meanwhile, the increment in minerals (N, P and K) in leaves may be attributed to the increase in absorption and translocation from roots to leaves and consequently affect positively mineral contents. Hence, a great amount of these chemical constituents could be directed to root as sink sites and reflected on the final root yield and sugar percentage in sugar beet plants. The present results of BA are in agreement with those reported in different plants by Abd El-Dayem *et al.,* (2012) and Ismail (2016).

These results of yeast extract are in agreement with those obtained by El-Desouky *et al.,* (2011).

Finally, because each of benzyladenine and yeast extract significant increase of root characteristics and leaves as well (Table, 1) as well as the root yield and its quality (Table, 2), beside the increment of the photosynthetic pigments as the increase of minerals, total carbohydrate and crude protein (Table, 3). Thereby, the present study strongly admits the use of these treatments on sugar beet plant.

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تأثير الرش الورقى بالبنزيل أدينين ومستخلص الخميرة على النمو ومحصول الجذور وجودته والمكونات الكيميائية لنبات بنجر السكر

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أقيمت تجربتين حقليتين بمحطة بحوث التجارب بكلية الزراعة بمشتهر- جامعة بنها خلال موسمى 2017/2016 و 2017/ 2018 لدراسة تأثير الرش الورقي بكل من البنزيل أدينين ومستخلص الخميرة على النمو ومحصول الجذور وجودته والمكونات الكيمائية لنبات بنجر السكر وتم رش النباتات ثلاث مرات بعد (50، 70 و 90) يوم من الزراعة بتركيزات مختلفة من: 1 - البنزيل أدينين بتركيز : 50 و 100 جزء فى المليون. 2- مستخلص الخميرة بتركيز : 100 و200 ملليلتر/ لتر. 3- بالإضافة إلى الرش بالماء المقطر للمقارنة (صفر). وأوضحت النتائج المتحصل عليها ما يلى :- أدت المعاملة بكل من البنزيل أدينين ومستخلص الخميرة بالتركيز العالي لكل منها (BA 100 جزء فى المليون و 200 مللي / لتر من مستخلص الخميرة) إلى زيادة معنوية فى صفات النمو الخضري للجذور (طول ، قطر، والوزن الطازج & الجاف لجذور النبات) والأوراق (عدد الأوراق ، مساحة الأوراق الكلية للنبات والوزن الطازج &الجاف لأوراق النبات) كما أدت إلى زيادة محتوى المكونات الكيميائية فى الأوراق (صبغات البناء الضوئى (الكلوروفيلات والكاروتينويدات) وايضا زيادة النيتروجين والفوسفور والبوتاسيوم والكربوهيدرات الكلية والبروتين فى الأوراق فى عمر 110 يوم من الزراعة فى الموسم الثانى. وايضاً أعطت أعلى قيم معنوية فى محصول الجذور وصفاته وجودة بنجر السكر (طول – قطر ومحصول الجذور/ للنبات ومحصول الجذور طن/ فدان وزيادة النسبة المئوية لكل من السكروز والنقاوة) فى موسمى النمو لذا يمكن التوصية باستخدام التركيز العالي من البنزيل أدنيين بتركيز100 جزء فى المليون ومستخلص الخميرة بتركيز200 جزء فى المليون لزيادة النمو ومحصول الجذور وجودة بنجر السكر.