Effect of some agricultural treatments on *Beta vulgaris* L. cv. Pleno root

Sakr, M. M.[1,2], O. A. Almaghrabi[1] and S. M. H. Gowayed[1,2]

[1] Biology Department, Faculty of Science, North Jeddah, King Abdul-Aziz University, KSA
[2] Botany Department, Faculty of Agriculture, Suez Canal University, 41522 Ismailia, Egypt.
salahgowed@yahoo.com

Abstract: This research was carried out to study the effect of three sowing dates (15th Oct., 15th Nov. and 15th Dec.) and two cooling treatments (5° C and -20° C) on growth, structure and some chemical components of *B. vulgaris* L. cv. Pleno root. The obtained data are summarize as follows: maximum values of root length, root diameter, fresh and dry weight, cortex thickness, average rows number of cortex, cambium region thickness, sucrose %, T.S.S. and total phenols were recorded with 15th Oct. treatment. On the other hand, most of the studied cooling treatments, in most cases, increased of root diameter, fresh and dry weight, total phenols and auxin like-substances in comparison with the control.

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Keywords: Sugar beet; sowing dates; vernalization; root anatomy; chemical components.

1. Introduction

Both sugar beet (*Beta vulgaris* L., Chenopodiaceae) and sugar cane constitute the only important sources of sucrose; nearly 40 % of world sugar production is obtained from sugar beet. Sucrose sugar has been a valued component of human diet for thousands of years. Sugar beet is an important crop in north Egypt Delta because of its tolerance to salinity. Planting data effect of growth, yield and quality of sugar beet under the environment conditions of Egypt, there is a general agreement that early planting of sugar beet produced the highest sucrose percentage as well as root and sugar yield per unit area (Badawi *et al*., 1995 and Ramadan and Hassanin, 1999). Other studies found that planting sugar beet during October markedly increased diameter, length and weight of roots, sugar content as well as root and sugar yield, compared with the late sowing of November (El-Kassaby and Leilah, 1992, Leilah and Nasr, 1992, Bugbee, 1993, Badawi *et al.,* 1995 and Ozturk *et al.,* 2008). In the same time, Hassan *et al*. (2008) studied the effect of three different sowing dates (15th Oct., 15th Nov. and 15th Dec.) and two vernalization treatments (5° C and -20° C) on growth, structure and some chemical components of *Beta vulgaris* L. cv. Univers root under Ismailia Governorate conditions, and found that the highest values of the root length, root diameter, root fresh, dry weights, cortex thickness, rows number of cortex, cortex cell thickness, rows number of cambium, cambium thickness, cambium cell thickness, total phenols, auxin like substances, % sucrose and T.S.S. were observed with 15 Oct. treatment. Furthermore, most of the studied cooling treatments increased of the periderm thickness, cortex thickness, number of cortex rows, cortex cell thickness, number of cambium rows, cambium region thickness, total phenols, reducing sugars and non reducing sugars.

Exposure of seeds in many plant species to a prolonged period of cold before the sowing promotes flowering. This process termed vernalization (Reeves *et al.,* 2007).

The aim of present work is to study the effect of sowing dates and vernalization treatments on root growth parameters, root anatomy and some chemical components of *B. vulgaris* L. cv. Pleno root under Ismailia governorate conditions.

2- Material and Methods:

Two field experiments were carried out at the Experimental Farm of Suez Canal University, Ismailia Governorate, Egypt. The following treatments were used:-

a- Sowing on 15th October for seeds which cooled at 5° C for 30 days.
b- Sowing on 15th October for seeds which cooled at -20° C for 30 days.
c- Sowing on 15th November for seeds which cooled at 5° C for 30 days.
d- Sowing on 15th November for seeds which cooled at -20° C for 30 days.
e- Sowing on 15th December for seeds which cooled at 5° C for 30 days.
f- Sowing on 15th December for seeds which cooled at -20° C for 30 days.

In addition the control treatments during 2009/2010 and 2010/2011 growing seasons were cultivated. The experiments were designed in randomized split-plot arrangement with three replicates for multigerm *Beta vulgaris* L. cv. Pleno. The seeds were obtained from Sugar Institute Research, Agricultural Center Research, Ministry of

Agriculture, Giza, Egypt. Nitrogen, phosphorous and potassium fertilization were incorporated in soil at the rate of 60, 15 and 50 unit/feddan, respectively. The following parameters were calculated:-

Growth parameters:

Random samples of five plants were taken from each sub plot at 90, 120, 150 and 180 days after sowing to determined root length (cm), root diameter (cm), fresh weight of root (gm) and dry weight of root (gm).

Root anatomy:

For studying the characters of transverse sections of the root to describe, periderm thickness (mm), cortex thickness (mm), average rows number of cortex, average cortex cell thickness (mm), average rows number of cambium region, thickness of cambium region (mm) and average thickness of cambium (mm). killing and fixation in 50 % F.A.A. solution, dehydration and clearing in pure paraffin wax (M.P. 56o C) were carried out as described by Willey (1971). Using a rotary microtome, sections (10 µ) were obtained and stained with Safranin and Light green.

Chemical analysis of root:

For determination, total sugars, total phenols and auxin like-substances, root samples were taken at 90, 120, 150 and 180 days from each treatment and extracted as described by Abdel-Rahman *et al.,* (1975). Total phenols determined using a modified Folin-Cicoalteu method described by William *et al*., (1965), in addition, auxin like-substances determined according to the method of Gordon and Weber (1951) with a slight modification of the Ehrlish reagents (Fliosson, 1969). Total sugars were determined by anthrone method according to Sadasivam and Manickam (1991). T.S.S. was determined in the root juice using a hand refractometer (Anon., 1990).

The data were subjected to One-way analysis of variance (ANOVA) one using Costat Version 6.311 (CoHort soft- ware, Berkeley, CA 94701) according to Steel and Torrie (1980) with probability ≤ 0.05.

3- Results and Discussion:

Growth parameters:-

Data in (Table 1) indicate that most of the studied growth parameters (root length, root diameter, fresh weight and dry weight) were very high under 15 Oct. treatment in the two studied seasons accept, root length, root fresh weight and root dry weight in the 2009/2010 and 2010/2011 seasons at 90 days from sowing, 150 days from sowing and 120 days from sowing under 15 Nov. treatment, respectively. Moreover, minimum values of the all above mentioned growth parameters were found at 15 Dec. treatment in the two studied seasons. Such results were obtained by Karbalei *et al*. (2012) who pointed out that sowing dates affected on root size.

Generally, most of the studied cooling treatments decreased of the root length; in the same time, most of the root length was insignificant over the cooling treatments in comparison with control. In addition, in most cases, root diameter, fresh and dry weight was increased significantly as a result of cooling treatments than the control. Such results are in agreement with the data which obtained by El-Kassaby and Leilah (1992), Leilah and Nasr (1992), Bugbee (1993), Badawi *et al*. (1995), Ozturk *et al*. (2008) and Hassan *et al.* (2008).

Root anatomy:-

Table 2 and Figure 1 show that the highest values of periderm, average rows number of cambium region and average thickness of cambium were observed with 15 Dec. treatment. In addition, maximum values of cortex thickness, average rows number of cortex and cambium region thickness were shown at 15 Oct. treatment. On the other hand, the lowest ones of periderm, cortex thickness, cortex cell thickness, average rows number of cambium region and cambium region thickness were noticed at 15 Nov. treatment.

Data in (Table 2) shows that generally, most of the cooling treatments decreased of the most different tissues of root especially under 5 and -20^{o} C at 15 Dec. treatments in comparison with the control. These results are in agreement with Hassan *et al.* (2008) who showed that sowing dates and cooling treatments affected on various tissues of *B. vulgais* cv. Univers root.

Chemical analysis:-

Total sugars:

Table 3 and Figure 2 shows that the maximum values of total sugars were observed with 15 Nov. treatment after 90 and 120 days from sowing and 15 Dec. treatment after 150 and 180 days from the sowing. While, the minimum values of the total sugars were noticed at 15 Oct. treatment after 90 days from sowing, 15 Nov. treatment after 120 days and 15 Oct. treatment after 150 and 180 days from the sowing.

Data in (Table 3 and Figure 2) point out that most of the cooling treatments decreased of total sugars in comparison with control.

Sucrose and total soluble solids (T.S.S.):

From (Table 3 and Figure 2) indicate that the highest values of sucrose % and T.S.S. at 180 days from the sowing were observed by 15 Oct. and 15 Dec. treatments, respectively. Moreover, the minimal ones were recorded at 15 Nov. and 15 Oct. treatments respectively. Most of the cooling treatments decreased

of sucrose % at 180 days from the sowing except, 5°C and -20° C treatments at 15 Nov. In addition T.S.S. were increased under all -20° C treatments and decreased under all 5° C treatments in comparison with the control. These results are in accordance with the data which obtained by Refay (2010) who revealed that T.S.S. %, total sugars and sucrose percent were affected by planting dates.

Table (1): Effect of the sowing dates and vernalization treatments on root growth of *B. vulgaris* cv. Pleno during the two growing seasons 2009/2010 and 2010/2011.

Sowing dates	Vernalization treatments	Root length (cm)								Root diameter (cm)							
		90 days		120 days		150 days		180 days		90 days		120 days		150 days		180 days	
		2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11	2009/10	2010/11
15 Oct.	Control	20.7	21.7	28.7	33	38.9	40	36	36	13.4	14.7	25	26	29	28	35	36
	5 °C	20.4	22	25.4	27	38.4	39	32	31	13.2	14.7	19.3	19.3	30	31	36	36.3
	-20 °C	22.5	24	28	23.3	32	32	38	39	13	11.3	22	23.7	27	27.3	36	37
15 Nov.	Control	20.9	23	23.7	22.7	23.4	22	27.2	21.3	10.5	8.3	19.3	18.7	22.8	24.3	2.8.7	30
	5 °C	21.9	25	22.7	24	27	26	29.2	32	10.7	12.3	22.3	21.3	22.5	24	29	31
	-20 °C	19.5	16	22	22	25.3	23.3	29	27	9.3	9.7	23	24	19.3	21.3	30.2	33
15 Dec.	Control	19.0	18.3	20.3	21.3	23.3	24.7	21	20.3	7.7	7	13.7	14.7	15	14.7	18	15
	5 °C	18.7	18.3	18.3	17.7	23.3	21.7	22.4	24.7	7.7	7.8	12.7	13	16.7	17	19.2	17
	-20 °C	16.0	15.7	19.3	20	19.3	19.3	23	25.7	6	6	11.9	13	17	18	20.7	25
L.S.D at 0.05		n. s.	n. s.	n. s.	n. s.	3.5	n. s.	4.2	n. s.	1.99	1.8	n. s.	2.8	3.5	2.8	n. s.	3.3
		Fresh weight of root (gm)								Dry weight of root (gm)							
15 Oct.	Control	72.2	96.3	197	203	609	607	1088.5	1087	12	17.3	47.7	46	169	168	281.5	297
	5 °C	69.4	89.7	177	199	957	955	1303	1558	15.9	24	41.9	48.7	246	245	317.5	389
	-20 °C	83.4	111.7	204	205	705.5	715	1128.5	1088	19.5	31	48	56	168	165	279.5	287
15 Nov.	Control	42.9	66	193	194	672	857	652	683	11.4	18.7	52.9	59	157	129	169.5	154
	5 °C	73.4	100	232	232.3	542.5	552	659.5	520	15.9	21.3	53.2	52.7	112	126	166	144
	-20 °C	42	40	223.7	231.3	479	339	745.5	883	12.2	12.3	53.7	51	118.5	78	189.5	215
15 Dec.	Control	22.5	26	103.7	109	238	243	246.5	363	5	5	22.4	25	56.5	56	60.5	88
	5 °C	26	26	78.5	68	260	219	322	456	5.7	6	16.8	19.3	71.7	79.3	77.5	109
	-20 °C	16.7	18	70.7	78.7	261.5	245	297.5	429	4	3	17.6	17.6	66	64	65.5	91
L.S.D at 0.05		4.03	4	6.5	3.8	10.03	4.7	12.9	3.6	1.9	1.9	6.8	3.1	3.5	9.4	5.6	6.8

Table (2): Effect of the sowing dates and vernalization treatments on root anatomy (mm) of *B. vulgaris* cv. Pleno 180 days from sowing.

Sowing dates	Vernalization treatments	Periderm thickness	Cortex thickness	Average rows number of cortex	Average cortex cell thickness	Average rows number of cambium region	Thickness of cambium region	Average thickness of cambium
15 Oct.	Control	0.31	3.2	23	0.20	13	1.9	0.08
	5 °C	0.20	2.3	20	0.20	14	1.2	0.16
	-20 °C	0.39	4	22	0.31	10	0.9	0.12
15 Nov.	Control	0.20	2.4	22	0.19	8	0.5	0.12
	5 °C	0.39	2.7	18	0.20	7	0.7	0.11
	-20 °C	0.23	2.3	16	0.20	16	1.2	0.16
15 Dec.	Control	0.39	2.8	20	0.20	14	1.5	0.13
	5 °C	0.23	1.8	18	0.16	10	0.5	0.12
	-20 °C	0.35	2	15	0.16	11	0.8	0,08

Table (3): Effect of the sowing dates and vernalization treatments on some chemical constituents of *B. vulgaris* cv. Pleno roots taken at 90, 120, 150 and 180 days from sowing in 2009/2010 and 2010/2011 seasons (as mg/g D.W.).

Sowing dates	Vernalization treatments	Total sugars				Total Phenols				Auxin like-substances				Sucrose % at 180 days	T.S.S.
		90 days	120 days	150 days	180 days	90 days	120 days	150 days	180 days	90 days	120 days	150 days	180 days		
15 Oct.	Control	0.39	0.43	0.69	0.44	1.59	1.01	0.45	0.82	0.15	0.34	0.41	0.10	17.2	25
	5 °C	0.67	0.55	0.64	0.63	1.29	0.81	1.36	1.95	0.58	0.32	0.41	0.29	16.6	23
	-20 °C	0.91	0.36	0.59	0.42	1.10	0.40	1.28	1.10	0.53	0.13	0.33	0.11	15.7	25.7
15 Nov.	Control	1.11	0.86	0.55	0.34	0.66	0.91	0.23	0.95	0.22	0.57	0.44	0.12	15.4	25.7
	5 °C	0.98	0.72	0.54	0.75	1.04	2.59	0.45	1.03	0.31	0.35	0.33	0.10	15.8	22.5
	-20 °C	0.51	0.43	0.52	0.48	0.61	1.31	0.55	0.79	0.23	0.37	0.46	0.16	15.6	28.3
15 Dec.	Control	0.58	0.37	0.73	0.98	0.40	0.46	0.58	1.21	0.52	0.10	0.10	0.08	15.7	26.3
	5 °C	.038	1.00	0.85	0.43	1.20	0.77	0.85	0.51	0.33	0.38	0.28	0.12	15.5	22
	-20 °C	1.04	0.50	0.43	0.83	0.63	1.20	0.63	1.39	0.07	0.22	0.14	0.37	15.2	27

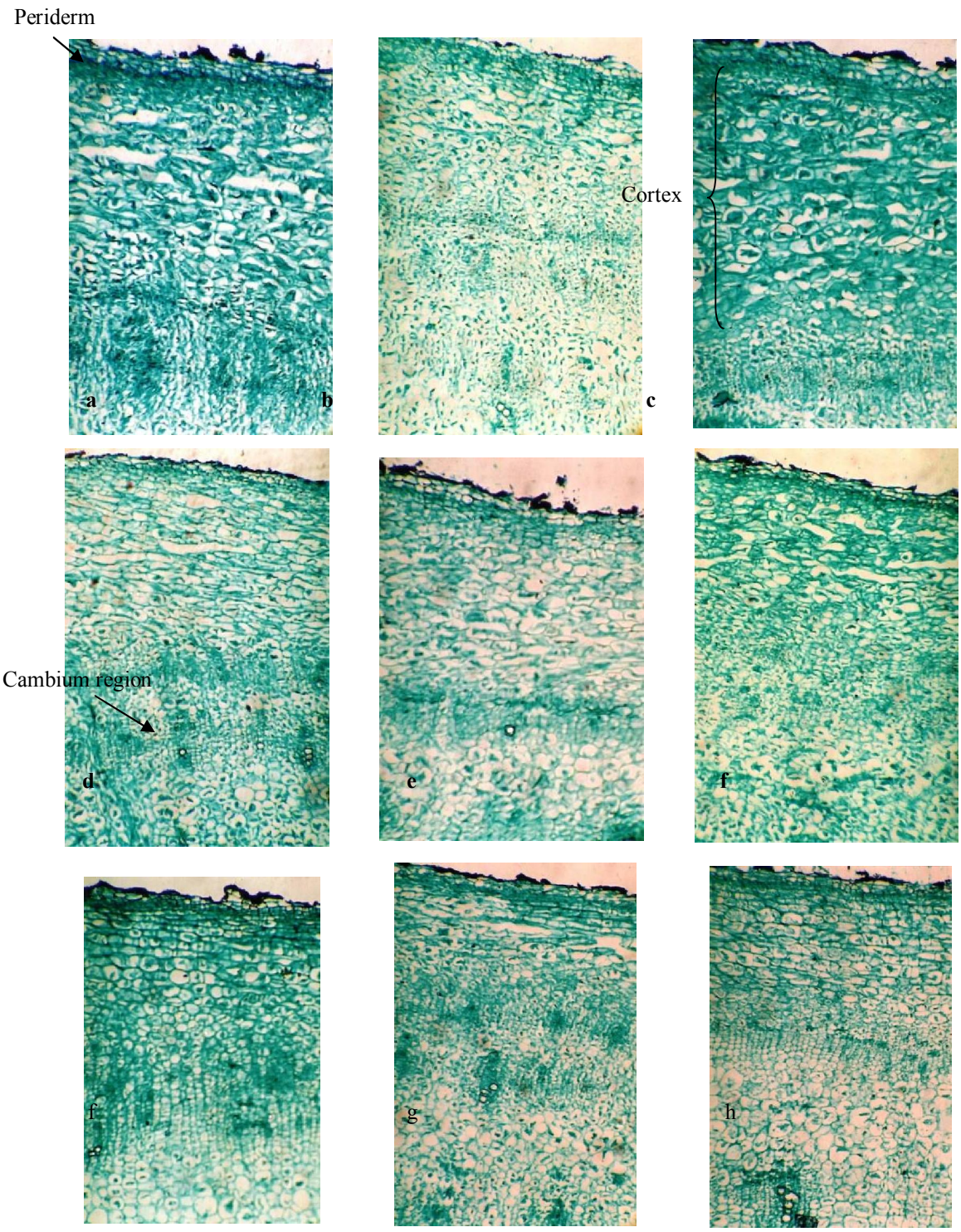

Figure (1): Cross sections of *B. vulgaris* cv. Pleno roots (x 25.6).

a- 15 Oct. control treatment b- 15 Oct. under 5°C c- 15 Oct. under -20°C
d- 15 Nov. control treatment e- 15 Nov. under 5°C f- 15 Nov. under -20°C
g- 15 Dec. control treatment h- 15 Dec. under 5°C i- 15 Dec. under -20°C

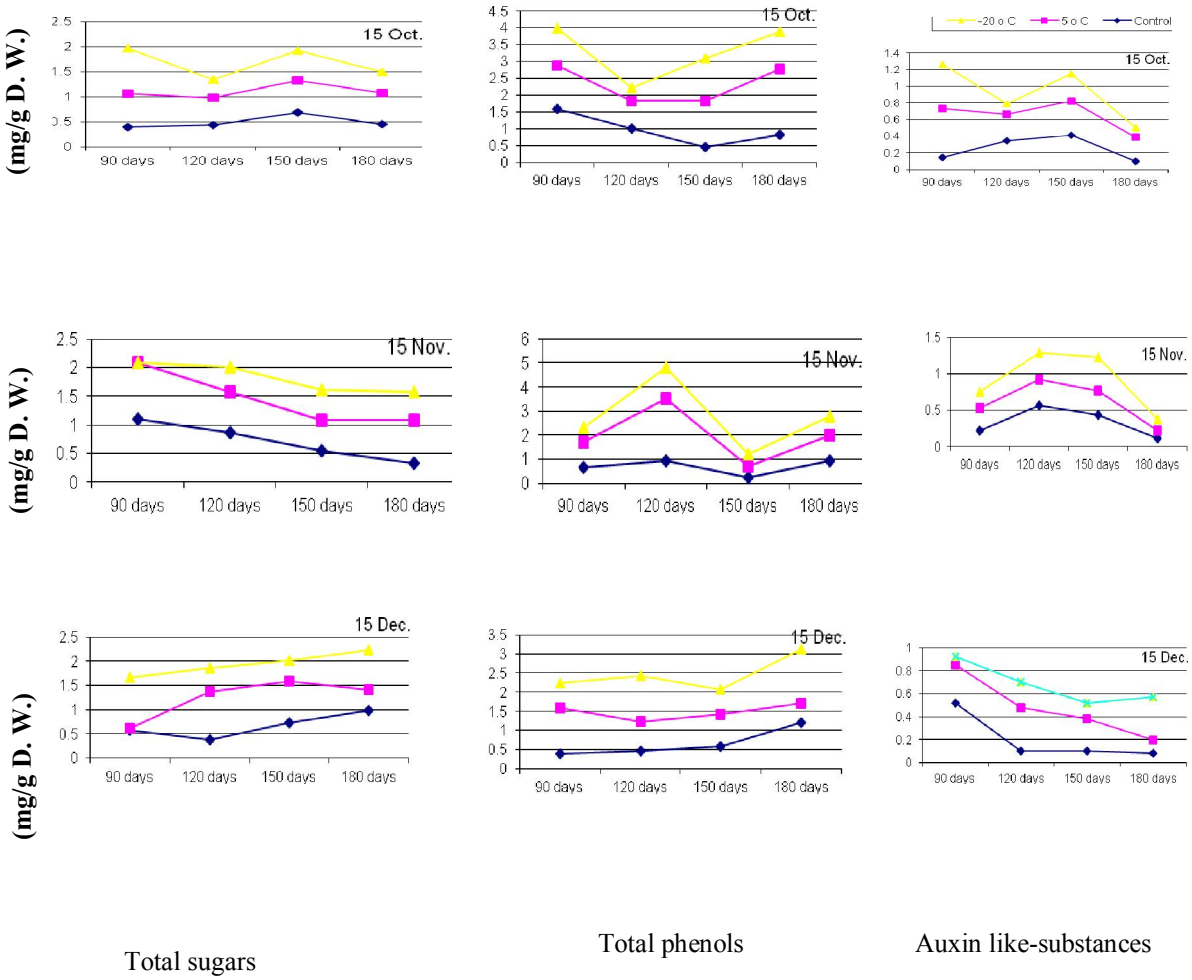

Figure (2): Effect of the sowing dates and vernalization treatments on some chemical constituents of *B. vulgaris* cv. Pleno roots taken at 90, 120, 150 and 180 days from sowing in 2009/2010 and 2010/2011 seasons (as mg/g D.W.)

Total phenols:

Table (3) indicate that the highest values of total phenols were recorded at 15 Oct. treatment after 90 and 120 days from sowing and 15 Dec. treatment after 150 and 180 days from the sowing. Whereas, the lowest ones were shown at 15 Dec. treatment at 90 and 120 days, 15 Nov. treatment at 150 days and 15 Oct. at 180 days. In most cases, most of the cooling treatments increased of total phenols compared with the control.

Auxin like-substances:

Data in (Table 3) shows that, in most cases, the highest values of auxin like-substances were noticed with 15 Nov. treatment. While, the lowest ones, in most cases were observed at 15 Dec. treatment. Generally, most of the studied cooling treatments, in most cases, increased of auxin like-substances in comparison the control. Such results are in agreement with Hassan *et al.* (2008) who mentioned that, in most cases, most of the cooling treatments increased of sugars, phenols and auxin like-substances in comparison the control.

Corresponding author
S. M. H. Gowayed[1,2]
[1] Biology Department, Faculty of Science, North Jeddah, King Abdul-Aziz University, KSA
[2] Botany Department, Faculty of Agriculture, Suez Canal University, 41522 Ismailia, Egypt.
salahgowed@yahoo.com

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