Ass. Univ. Bull. Environ. Res. Vol. 4 No. 2, October 2001

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EFFECT OF SOME EXTERNALLY ADDED VITAMINS ON GROWTH CRITERIA PHOTOSYNTHESIS AND SOME RELATED ACTIVITIES OF $ZnCl_2$- STRESSED CHLORELLA VULGARIS BEIJER CULTURES

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ABSTRACT :

In this investigation some experiments were conducted to test the role of some vitamins (thiamin, pyridoxine or riboflavin) in alleviating the adverse effects on photosynthesis and some related activities of $ZnCl_2$ -stressed *Chlorella vulgaris Beijer* cultures.

In cultures treated with only lower levels (20and 40 ppm) $ZnCl_2$, the values of growth parameters, photosynthesis and respiration rates were significantly raised. However, under relatively higher levels (60,80 and 100 ppm) of $ZnCl_2$, the values of these parameters were significantly lowered.

On the other side, treatment non-stressed *Chlorella vulgaris* cultures with various levels (20,40,60,80 and 100ppm) $ZnCl_2$ and treated with 200ppm of the vitamins applied thiamin, pyridoxine or riboflavin counteracted the adverse effects of $ZnCl_2$. Consequently the rates of photosynthesis and other related activities were considerably significantly raised compared to that of the control culture, whatever the level of $ZnCl_2$ used and the vitamin applied .In other words, vitamin treatments could counteract the adverse effects of relatively higher stressing levels of $ZnCl_2$. Such experiments could be regarded as pilot experiment and should be tested with higher plants.

INTRODUCTION :

Most of the developed countries undergo toxicity and harmful effect of heavy metals, herbicides, fungicides which are considerable pollute the terrestrial and aquatic environments. This pollution causes inhibition of growth criteria and some related activities in both higher plants (Van Assche and Clijsters 1986, a;b) and algae (De-Filipps and Pallaghy 1976; De-Filipps *et al*., 1981a;b). It was intended to continue some previous experi-ments. It was intended to continue some previous experiments (Arafa and Desouky 2001; Desouky and Arafa 2001) via adding some materials as natural products aiming to save the environment.

Zinc is a major industrial pollutant of the terrestrial and aquatic environments (Foy *et al.* 1978; Collins1981;Van Assche and Clijsters 1986 a). In this context, some others authors found that after addition of zinc to the organ-

isms both the light reaction and photochemical reactions were inhibited in chloroplasts of higher plants and algae (Arndt 1974; Davies and Sleep1976; De-Filipps and Pallaghy 1976; Van Assche *et al*., 1978; 1979; De-Filipps *et al*., 1981a;Van Assche and Clijsters 1986 a). In accordance with this some others authors found that, in higher plants and algal cell, inhibition the photosynthetic electron transport closer to the PS II reaction center were observed after zinc accumulation by the organisms (Van Assche *et al*., 1978; 1979; De-Filipps *et al*., 1981a.The main site of action was on the level of the water –splitting system at oxidizing side of PSII (De-Filipps *et al*., 1981a;Van Assche and Clijsters 1986 a;b). It has previously been shown that different heavy metals can interfere with various step of photosynthetic electron transport chain (Tuba and Csintalan, 1992 and Krupa and Baszyski, 1995). Inhibition effects were found on both donor and acceptors sides of Photosystem II (PS II) at the cytochrome b/f complex and Photosystem I (PSI) (Droppa and Horváth, 1990 and Krupa and Baszyski,1995). Similarly. Szalontia *et al*.,1999 found that some heavy metals as Cu,Pb and Zn sharply inhibited the activities of PS II which their consequently damaging effect on the thylakoids membrane of the photosynthetic apparatus.

On the other hand, Desouky, (1995) found that the growth parameters, photosynthesis and some related activities of salinized *Chlorella vulgaris* cultures were raised significant when treated with 200ppm of vitamins applied (200ppm of ascorbic acid, thiamin and pyridoxine). Makled (1995) found that the growth parameters and oxygen evolution of two variously salinized green algae, *Chlorella vulgaris* and *Ankistrodesmus falcatus* were elevated when treated with the vitamins applied (200ppm of thiamin, nicotinic acid and pyridoxine). It was observed that soaking presowing of seeds in either ascorbic acid and pyridoxine increased the shoot and root length as well as dry matter yield of the test plants (Shaddad et al., 1990).

The main goal of this study was to obtain detailed results about the effects of some externally added to vitamins on photosynthesis and some related activities of stressed *Chlorella vulgaris Beijer* cultures. The previous addition of vitamins caused counteracted the toxic effect of zinc on the growth criteria, photosynthesis and some related activities of the algal cell aiming to apply these experiments in future on the higher plants. In addition these materials are environmentally safe and less consume money .

MATERIALS AND METHODS :

Tested Alga:

Chlorella vulgaris Beijer was collected from the River Nile and used a test organism. Beijerinck's nutritive culture the test algal was used as a medium for enrichment and growth of the tested alga, (Stein, 1966).

Treatments:

Chlorella vulgaris Beijer cultures were subjected to different concentrations of $ZnCl_2$ (20,40,60,80 and 100ppm). And, the preliminary experiments showed that the best concentrations for vitamins treatments was 200 ppm (Desouky,1995).Vitamins treatments were separately applied (200 ppm, thiamin, pyridoxine and riboflavin) for 7 days. The control cultures 00 $ZnCl_2$) and 00 vitamins was left without any treatments.

ANALYTICAL METHOD:

1-Determination of Cell Number:

Haemocytometer, (0.1mm depth) having improved Naubuer ruling was used. One drop of the algal suspension was pipetted on the slide, covered and left two minutes for alga setting. The mean counts of three replicates were taken into consideration and the results measured as cells ml^{-1} alga1 suspension.

2-Determination of Dry Weight:

A definite volume (50 ml) of algal suspension was filtered through weighed glass fiber filter. The cells after being precipitated on the filter were washed twice with distilled water and dried over night in an oven at 105°C. The data were measured as µg ml^{-1} algal suspension.

3-Determination of Photosynthetic Pigments:

The pigment fractions (µg $m1^{-1}$ algal suspension) chlorophyll a, chlorophyll b and carotenoids were calculated using the equations mentioned by Metzner *et al*., 1965.

4-Oxygen Evolution:

Oxygen evolution was measured using the site module 97.08 (Lessler *et al*., 1956). The data of oxygen evolution present in the text were calculated as µ mole O_2 ml^{-1} algal suspension hr^{-1}.

5- Oxygen uptake:

The dark respiration was determined using oxygen uptake in the dark as indicator. The system mentioned above was used for the determination of dark respiration. At the end of oxygen evolution measurements, all the lights were switched off and the flasks were wrapped tightly in aluminum foil for complete darkness. The results of oxygen uptake were calculated as µ mole O_2 ml^{-1} algal suspension.

Two replicates were used in this study and the data were statistically analyzed to calculated the Least Significantly Difference (L.S.D) according to Snedecor and Cochran (1972).

RESULTS :

Data in this study showed the effects of some externally added to vitamins on growth, photosynthesis and some related activities of stressed *Chlorella vulgaris* Beijer cultures for 7days. In the (Tab 1-a) the growth criteria (cell number, dry weight) and total pigments were significantly increased. The maximum values of cell number, dry weight and total pigments were, 108%, 118% and 116% of that of the control cultures, for the algal cultures treated with 40 ppm $ZnCl_2$ only, respectively. While, under the moderate and higher concentrations these contents were significantly decreased. The minimum values of cell number, dry weight and total pigments were 58%, 85% and 76% of that of the control cultured, when treated non-stressed *Chlorella vulgaris* cultures with 100 ppm of $ZnCl_2$ only, respectively (Table 1-a).

On the other side, treatment non-stressed *Chlorella vulgaris* cultures with various levels (20,40,60,80 and 100 ppm) $ZnCl_2$ and treated with the vitamins applied (200 ppm of thiamin, pyridoxine and riboflavin) the growth parameters (cell number and dry weight) and total pigments were significantly raised .

Addition of thiamin in concentration of 200 ppm to non-stressed and stressed *Chlorella vulgaris* cultures the growth parameters were significantly raised. The cell number, dry weight and total pigments reached, 104%, 147% and 102% of that the control cultures,

when non-stressed *Chlorella vulgaris* cultures treated with 200 ppm thiamin only, respectively. Thus, the maximum values of cell number and total pigments amounted to 125% and 136% of that of the control cultures, when algal cultures treated with 60 ppm of $ZnCl_2$ and treated with 200 ppm thiamin, respectively .The maximum value of dry weight amounted to 197% of that of the control cultures, when algal cultures treated with 40 ppm of $ZnCl_2$ and treated with 200 ppm thiamin. The minimum values of cell number and dry weight and total pigments reached to 106%, 123% and 111% of that of the control cultures, for the algal treated with 100 ppm $ZnCl_2$ and treated with 200 ppm thiamin, respectively (Table 1-b).

Similarly, the cell number, dry weight and total pigments reached, 114%, 109% and 103% of that the control cultures, when non-stressed *Chlorella vulgaris* cultures treated with 200 ppm pyridoxine only, respectively. The maximum values of cell number and dry weight 145% and 138% of that of the control cultures, for the algal cultures treated with 60 ppm $ZnCl_2$ and treated with 200 ppm of pyridoxine, respectively. Also, the maximum value of total pigments is 150% of that of the control cultures, for the algal cultures treated with 40 ppm $ZnCl_2$ and treated with 200 ppm pyridoxine, respectively. Also, the minimum values of cell number, dry weight and total pigments amounted to 108%, 121% and 102% of that of the control cultures, for the algal cultures treated with 100 ppm $ZnCl_2$ and treated with 200 ppm of pyridoxine, respectively (Table 1-c).

Using riboflavin, as an external added to stressed and non stressed *Chlorella vulgaris* cultures the growth parameters were significantly raised. The cell number, dry weight and total pigments reached, 103%, 110% and 142% of that the control cultures, when non-stressed *Chlorella vulgaris* cultures treated with 200 ppm riboflavin only, respectively. Thus, the maximum values of cell number total pigments were 143% and 151of that of the control cultures, for the algal cultures treated with 60ppm $ZnCl_2$ and treated with 200 ppm of riboflavin, respectively. The maximum value of dry weight amounted to 157% of that of the control cultures,for the algal cultures treated with 40ppm $ZnCl_2$ and treated with 200 ppm of riboflavin. While, the minimum values of cell number, dry weight and total pigments were 107%,105% and 115% of that of the control cultures,for the algal cultures treated with 100ppm $ZnCl_2$ and treated with 200 ppm of riboflavin, respectively (Table 1-d).

Photosynthesis (oxygen evolution) and dark respiration (oxygen uptake) of *Chlorella vulgaris* cultures were increased significant under lower concentrations (20 and 40 ppm) of $ZnCl_2$ only. Thereabove, these contents were significantly decreased. Thus, the maximum and minimum values of oxygen evolution rate were 155% and 50% of that the control cultures, when treated algal cultures with 40 and 100 ppm, respectively (Table 2-a).

On the other hand, also the respiration rate was significantly raised, when *Chlorella vulgaris* cultures treated with 20 and 40 ppm $ZnCl_2$ only. Under higher concentrations (60, 80 and 100 ppm) $ZnCl_2$ only, the respiration rate was significantly decreased. The maximum and minimum values of respiration rate amounted to 130% and 27% of that the control cultures, for the algal cultures treated with 20and 100 ppm $ZnCl_2$ only, respectively (Table 2-a).

On the other hand, when subjected *Chlorella vulgaris* cultures to various levels (20,40, 60, 80 and 100 ppm) $ZnCl_2$ and 200 ppm of vitamins applied (thiamin, pyridoxine or riboflavin) the photosynthesis (oxygen evolu-

tion) and dark respiration (oxygen uptake) were significantly increased.

Using thiamin as an addition treatment to these *Chlorella vulgaris* cultures, the photosynthesis (oxygen evolution) and dark respiration (oxygen uptake) were significantly increased. The photosynthesis and respiration rates reached, 143% and 113% of that the control cultures, for the algal cultures treated with 200 ppm thiamin only, respectively. Thus, the maximum and minimum values photosynthesis rate amounted to 246% and 104% of that of the control cultures for the algal cultures treated with 60 and 100 ppm $ZnCl_2$ and 200 ppm thiamin, respectively. Also, the maximum and minimum values oxygen uptake reached, 175% and 101% of that of the control cultures for the algal cultures treated with 60 and 100 ppm $ZnCl_2$ and 200 ppm thiamin, respectively (Table 2-b).

Also, Using, pyridoxine as an addition treatment to these *Chlorella vulgaris* cultures, THE photosynthesis and respiration rates reached, 140% and 106% of that the control cultures, for the algal cultures treated with 200 ppm pyridoxine only, respectively. The maximum and minimum values of photosynthesis rate amounted to 282% and 156% of that of the control cultures for the algal cultures treated with 60 and treated with 100 ppm $ZnCl_2$ and 200 ppm pyridoxine, respectively. Also, the maximum and minimum values oxygen uptake reached to 150% and 103% of that of the control cultures for the algal cultures treated with 60 and 100 ppm $ZnCl_2$ and 200 ppm pyridoxine, respectively (Table 2-c).

Similarly, using riboflavin as an addition treatment to these *Chlorella vulgaris* cultures, The photosynthesis and respiration rates reached, 173% and 106% of that the control cultures, for the algal cultures treated with 200 ppm riboflavin only, respectively. The maximum and minimum values of photosynthesis rate amounted to 273% and 221% of that of the control cultures for the algal cultures treated with 40 and 100 ppm $ZnCl_2$ and 200 ppm pyridoxine, respectively. Also, the maximum and minimum values oxygen uptake reached to 175% and 108% of that of the control cultures for the algal cultures treated with 20 and 100 ppm $ZnCl_2$ and 200 ppm riboflavin, respectively (Table 2-d).

At end, that can be said the effects of some externally added to vitamins (thiamin, pyridoxine or riboflavin) on growth criteria photosynthesis and some related activities of $Zncl_2$- stressed *Chlorella vulgaris Beijer* cultures countered the adverse and toxicity effects of $Zncl_2$.

DISCUSSION :

In this study the effects of some externally added vitamins on growth, photosynthesis and some related activities of $ZnCl_2$ stressed *Chlorella vulgaris* Beijer cultures for 7days were followed.

The growth criteria (cell number, dry weight) and total pigments of $ZnCl_2$- *Chlorella vulgaris Beijer* were significantly raised under the effect of lower concentrations of (20 and 40 ppm) of $ZnCl_2$, but under moderate and higher concentrations (60, 80 and 100 ppm) of $ZnCl_2$ these values were significantly lowered. This is accordance to the results obtained by, Collins, 1981 who reported that Zn^{+2} assimilated easily by plants and can be strongly phytotoxic, growth inhibitor. Also, in alga zinc reduced the plant growth and biomass production (Arndt, 1974; De Filippis and Pallaghy, 1976; Davies and Sleep, 1979; Van Assche *et al*., 1979; De Filippis *et al*., 1981, Collins 1981; Van Assche *et al*., 1979; 1980; Van Assche and Clijsters, 1986).

Matulova, (1979) reported that the green alga *Scenedesmus quadricauda* is so sensitive effect to zinc even at the concentration of 0.002 mg l^{-1}Zn .The lethal concentration of is mg l^{-1}Zn.. Also, Coleman *et al*., (1971) reported that the lower concentration of 2.4 mg l^{-1}Zn promoted the growth criteria of green algae (*Chlorella vulgaris, Euglena viridis* and *Pediastrum tetras*), while the concentration of 8.7 mg l^{-1}Zn caused a retardation in growth (*Chlorella,*and *Euglena*) while the growth of *pediastrum was* not affect. Desouky (2001), reported that the growth paramters, photosynthesis and respiration of *Chlorella vulgaris* Beijer were increased for algal cultures treated with 40 ppm of $ZnCl_2$ only,thereabove, these contents were decreased.

Similarly, the effects some of externally added vitamins applied 200 ppm (thiamim, pyridoxine or riboflavin) on the growth parameters (cell number, dry weight) and total pigments, photosynthesis and respiration of $ZnCl_2$ stressed *Chlorella vulgaris* Beijer cultures were significantly raised. In accordance with this, Desouky, (1995) reported that the growth parameters, photosynthesis and some related activities of salinized *Chlorella vulgaris* cultures were raised significant when treated with 200ppm of vitamins applied applied 200 ppm (ascorbic acid, thiamin and pyridoxine). In this respected, Makled (1995) found that the growth parameters and oxygen evolution of two variously salinized green algae, *Chlorella vulgaris* and *Ankistrodesmus falcatus* were elevated when treated with the vitamins applied (200ppm of thiamin, nicotinic acid and pyridoxine). Similarly, Shaddad *et al.,*(1990) suggested that the ascorbic acid and pyridoxine could counteract the suppressive effects of the relatively higher salinity levels on seed germination or seedling growth of *Lupins termis* and *Vicia faba.* Also,presowing soaking of seeds in either ascorbic acid or pyridoxine increased the shoot and root length as well as dry matter yield of the test plants.

Table (1): Effect of some externally added vitamins on cell number (cell ml^{-1} algal suspension), dry weight (µg ml^{-1} algal suspension) and Total pigments (µg ml^{-1} algal suspension) of stressed *Chlorella vulgaris Beijer* for 7 dayes.

1-a

Treatments $ZnCl_2$(ppm): Vitamins (ppm)	Cell number	% control	Dry weight	% control	Chloro. a	Chloro. b	Carot.	Total pigments	% control
00 : 00	480x 10^4	100.00	420	100.00	3.73	1.47	2.45	7.65	100.00
20 : 00	500x 10^{4**}	104.16	450**	107.14	3.75**	2.87**	2.14	8.76*	114.50
40 : 00	520x $10^{4*/*}$	108.33	498**	118.57	3.89**	2.90**	2.15	8.94**	116.86
60 : 00	450x 10^{4**}	93.75	400**	95.23	3.26**	2.01	2.27	7.54	98.56
80 : 00	390 x 10^{4**}	81.25	380**	90.47	2.79**	1.71	1.33**	5.83**	76.20
100: 00	280x 10^{4**}	58.33	360**	85.71	2.50**	1.53	1.17**	5.20**	76.97
*L.S.D at 5%	19.0827		17.3702		0.0682	0.8480	0.5716	0.7960	
**L.S.D at 1%	28.8967		26.3142		0.1033	0.8658	0.8658	1.2053	

1-b

Treatments $ZnCl_2$ (ppm): Thiamine (ppm)	Cell number	% control	Dry weight	% control	Chloro. a	Chloro.b	Carot.	Total pigments	% control
00: 200	500x 10^{4**}	104.16	620	147.00	3.66	1.43	2.78	7.87	102.87
20 : 200	550x 10^{4**}	114.58	696**	165.71	3.65	2.65**	2.64**	8.94**	116.86
40 : 200	580 x10^{4**}	120.83	830**	197.61	3.92**	2.68**	3.43	10.31**	131.11
60 : 200	600x 10^{4**}	125.00	750**	178.57	4.02**	2.94**	3.49	10.45**	136.60
80: 200	530x 10^{4**}	110.41	548**	130.57	4.04**	2.27*	2.36	8.67*	113.33
100: 200	510x 10^{4**}	106.28	517**	123.09	3.77	2.02	2.77	8.56*	111.89
*L.S.D at 5%	17. 2932		42.7289		0.2379	0.6257	0.2579	0.7285	
**L.S.D at 1%	26.1868		64.7037		0.3602	0.9475	0.3905	1.1031	

1-c

Treatments $ZnCl_2$(ppm): Pyridoxine(ppm)	Cell number	% control	Dry weight	% control	Chloro. a	Chloro. b	Carot.	Total pigments	% Control
00 : 200	50x 10^{4**}	114.58	485*.	109.00	3.81	1.63	2.44	7.88	103.00
20 : 00	620x 10^{4**}	129.16	615**	146.42	4.70**	2.24**	3.79**	10.73**	147.26
40 : 200	680x 10^{4**}	141.66	684**	162.85	4.99**	2.84**	3.67**	11.50**	150.32
60 : 200	700x 10^{4**}	145.83	580**	138.09	4.93**	2.70**	3.39**	11.02**	144.05
80 : 200	540x 10^{4**}	112.50	522.**	124.28	4.23**	2.00**	2.08*	8.31	108.62
100 : 200	520x 10^{4**}	108.33	510**	121.42	3.42**	1.78	2.67	7.87	102.87
*L.S.D at 5%	39.7071		49.5118		0.1132	0.1977	0.2574	0.9388	
** L.S.D at 1%	60.1279		74.9750		0.1715	0.2994	0.3898	1.4216	

1-d

Treatments $ZnCl_2$(ppm): Riboflavin(ppm)	Cell number	% control	Dry weight	% control	Chloro. a	Chloro. b	Carot.	Total pigments	% control
00 : 200	495 x 10^{4**}	103.12	460*	110.71	5.94**	3.65**	1.33**	10.92**	142.74
20 : 00	580x 10^{4**}	120.83	550**	130.95	6.94**	3.75**	1.17**	11.86**	155.03
40 : 200	640x 10^{4**}	133.33	660**	157.14	6.85**	2.67**	1.25**	10.77**	140.78
60 : 200	690x 10^{4**}	143.75	601**	143.09	6.18**	3.24**	2.18	11.60**	151.63
80 : 200	533 x 10^4	111.04	487**	115.95	5.08*‘	3.36**	2.44	10.88**	142.22
100 : 200	514 x 10^4	107.08	441	105.00	4.21	2.06	2.55	8.82**	115.29
*L.S.D at 5%	53.6768		36.2290		0.6852	0.6852	0.2811	1.0331	
**L.S.D at 1%	81.2820		54.8611		1.0376	0.9134	0.4527	1.5644	

Table (2): Effect of some externally added vitamins on Oxygen evolution (µ mole ml^{-1} algal suspension h^{-1}) and oxygen uptake (µ mole ml^{-1} algal suspension hr^{-1}) of stressed- *Chlorella vulgaris* cultures for 7days.

2-a :

Treatments $ZnCl_2$ (ppm) : Vitamins (ppm)	Oxygen evolution µ mole ml^{-1} algal suspension hr^{-1}	% control	Oxygen uptake µ mole ml^{-1} algal suspension hr^{-1}	% control
00:00	1.140	100.000	1.10	100.00
20:00	1.480**	129.825	1.350**	122.00
40:00	1.775	155.700	1.440**	130.909
60:00	1.106	97. 017	0.800**	72.720
80:00	0.920**	80.701	0.300**	27.272
100:00	0.580**	50.877	0.300**	27.272
*L.S.D. at 5%	0.03475		0.0366	
**L.S.D. at 1%	0.07025		0.0555	

2-b :

Treatments $ZnCl_2$ (ppm) : Thiamine (ppm)	Oxygen evolution µ mole ml^{-1} algal suspension hr^{-1}	% control	Oxygen uptake µ mole ml^{-1} algal suspension hr^{-1}	% control
00:200	1.530**	134.210	1.250	113.636
20:200	1.830**	160.526	1.360**	123.636
40:200	2.229**	195.526	1.810**	164.545
60:200	3.010**	246.035	1.930**	175.454
80:200	1.280**	112.280	1.690**	153.636
100: 200	1.190**	104.385	1.120**	101.818
*L.S.D. at 5%	0.0487		0.0475	
**L.S.D. at 1%	0.0738		0.0720	

2-c :

Treatments $ZnCl_2$ (ppm) : Pyridoxine (ppm)	Oxygen evolution µ mole ml^{-1} algal suspension hr^{-1}	% control	Oxygen uptake µ mole ml^{-1} algal suspension hr^{-1}	% control
00:200	1.600**	140.350	1.168*	106.181
20:200	1.895**	166.228	1.195**	108.636
40:200	2.070**	181.578	1.325**	120.454
60:200	3.223**	282.719	1.658**	150.727
80:200	2.010**	176.315	1.140	103.636
100:200	1.785**	156.578	1.140	103.636
*L.S.D at 5%	0.0578		0.0432	
**L.S.D. at 1%	0.0875		0.0655	

2-d:

Treatments $ZnCl_2$ (ppm) : Riboflavin (ppm)	Oxygen evolution µ mole ml^{-1} algal suspension hr^{-1}	% control	Oxygen uptake µ mole ml^{-1} algal suspension hr^{-1}	% control
00 : 200	1.975**	173.245	1.140*	103.636
00 : 200	3.235**	283.771	1.927*	175.181
40 : 200	3.114**	273.157	1.846**	167.818
60 : 200	2.865**	251.315	1.445**	131.363
80: 200	2.546**	223.333	1.300**	118.181
100 : 200	2.530**	221.929	1.195**	108.636
*L.S.D at 5%	0.5796		0.0506	
**L.S.D. at 1%	0.8735		0.0766	

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تأثير الإضافات الخارجية لبعض الفيتامينات على محددات النمو والبناء الضوئى وبعض الأنشطة الفسيولوجية لمز راع طحلب " كلوريللا فولجاريس بيجر " المجهدة بكلوريد الزنك

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الهدف من البحث إظهار دور الفيتامينات فى إيقاف وتثبيط التأثير العكسى الضار الناتج من وجود العناصر الثقيلة وعلى رأسها الزنك ، وقد لوحظ أن إضافة الفيتامينات إلى المزراع الطحلبية يؤدى إلى زيادة ملحوظة فى محددات النمو وبعض الأنشطة الفسيولوجية كالبناء الضوئى .

وقد أظهرت هذه الدراسة أنه عند معاملة مزارع طحلب " كلوريللا فولجاريس بيجر" بتركيزات منخفضة من كلوريد الزنك (٢٠ و ٤٠ جزء/ مليون) ، فقد زادت محددات النمو زيادة معنوية كبيرة (عدد الخلايا والوزن الجاف) وكمية الأصباغ النباتية ومعدل البناء الضوئى ، وكذا التنفس. أما عند التركيزات المتوسطة والمرتفعة (٦٠ و٨٠ و ١٠٠ جزء/مليون) فإنه يؤدى إلى تثبيط تلك المعدلات.

وقد لوحظ أنه عند إضافة أى من الفيتامينات الثيامين والبيرودوكسين والريبوفلافين بتركيز ٢٠٠ جزء/مليون ، لمزارع طحلب " كلوريللا فولجاريس بيجر المجهدة بتركيزات مختلفة من كلوريد الزنك (٢٠، ٤٠، ٦٠، ٨٠و ١٠٠جزء/مليون) فإنها تؤدى هذه الإضافة إلى زيادة معنوية كبيرة فى محددات النمو والبناء الضوئى والتنفس تفوق معدلات المزرعة الضابطة ؛ ولذا يمكن تطبيق هذه التجارب مع النباتات الراقية المحصولية ، والتى تتعرض لنفس الظروف السابقة.