Behaviour of Wheat Cv. Masr-1 Plants to Foliar Application of Some Vitamins

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Abstract: Plant height, grain yield and its components, some plant pigments as well as leaf and grain mineral content of wheat cv. Masr- 1 plants in response to foliar application of some vitamins namely vitamin B_{12} at 50 ppm, folic acid at 50 ppm and vitamin C at 500 ppm were investigated during 2010/ 2011 and 2011/ 2012 seasons. All vitamins were sprayed twice at 30 and 60 days after planting. Single and combined applications of these vitamins materially was accompanied with stimulating plant height, grain yield and its components, some plant pigments and different minerals in both the leaves and grains in relative to the control treatment. Nitrite in the grains was greatly declined with different vitamin treatments. Using vitamin C, folic acid and vitamin B_{12}, in ascending order was very effective in stimulating growth, grain yield and its components. The best results with regard to grain yield and quality of wheat cv. Masr- 1 were obtained with spraying the plants twice with a mixture of vitamins containing vitamin B12 at 50 ppm, folic acid at 50 ppm and vitamin C at 500 ppm.
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1. Introduction

Wheat (*Triticum aestivum* L.) is considered the first strategic food crop for more than 7000 years in Egypt. It has maintained its position as the basic staple food in urban areas and mixed with maize in rural areas for bread making. In addition, wheat straw is an important fodder **(Gomaa, 1999)**. Egypt strategy aims to minimize the food gap of this crop particularly through vertical improvement and horizontal expansion. The productivity of such crop could be improved by using high yielding varieties, and/ or application of optimum cultural practices.

Recently, a great attention has been focused on the possibility of using natural and safety substances in order to improve plant growth. In this concern, vitamins have synergistic effects on growth, yield and yield quality of many plant species. These compounds have beneficial effects on catching the free radicals or the active oxygen that producing during photosynthesis and respiration processes **(Foyer *et al*., 1991 and Fardet *et al*., 2008).** Leaving these free radicals without chelating or catching leads to lipids oxidation and the loss of plasma membrane permeability and the death of cell within plant tissues **(Budzinski, 2008)**. Vitamins have also, an auxinic action. One of most familiar vitamins is ascorbic acid, vitamins B and folic acid which being synthesized in higher plants and affects plant growth and development **(Samiullah *et al*., 1988)**. **Dat *et al*., (1998)** stated that the primary role of vitamins is to prevent degradation induced by free radical reactions. The same authors confirmed the beneficial effects of vitamins on enhancing cell division and organic foods.

The beneficial effect of different vitamins on growth and production of field crops was mentioned by many authors such as **Rabie and Negm (1992); Mousa *et al*., (1994); Abd El- Messih and Eid (1999); Anton *et al*., (1999); Gamal El- Din-Karima and Reda (2003); Attallah *et al*., (2004); Mohamed (2004); Abd El- Hakim (2006); Abd El- Baky- Hanaa (2009); Abd El- Naeem and Abd El- Hakim (2009) and Al- Qubaie (2012).**

The objective of this study was elucidating the various benefits of spraying some vitamins on growth and production of wheat cv. Masr- 1 grown under Souhag province environmental conditions (upper Egypt).

2. Materials and Methods

Two field experiments were carried out in sandy soil during the two winter seasons of 2010/ 2011 and 2011/ 2012 on wheat cv. Masr- 1 in a private farm located near New Farm of Fac. Agric, El- Kawthar region, Souhag district, Souhag Governorate. Soil sample used for the experimental site was taken to determine mechanical analysis and some physico- chemical properties according to **Chapman and Pratt (1965)** (Table 1). Soil texture is sandy. The tested soil was prepared by ploughing, harrowing and then leveling. It was divided into plots (3×3.5 m^2) each. Grains were drilled in rows at the last week of November (15 cm. apart and the distance between plants within each row was 5 cm.). The seedling rate was 60 kg/ feddan.

The experimental treatments were as follows:-

1. Control (plants sprayed with tap water)
2. Spraying the plants with vitamin B_{12} at 50 ppm.
3. Spraying the plants with vitamin C at 500 ppm.
4. Spraying the plants with folic acid at 50 ppm.
5. Spraying the plants with vitamin B_{12} at 50 ppm plus vitamin C at 500 ppm.
6. Spraying the plants with vitamin B_{12} at 50 ppm plus folic acid at 50 ppm.
7. Spraying the plants with vitamin C at 500 ppm + folic acid at 50 ppm.

8. Spraying the plants with all vitamins (vitamin B_{12} at 50 ppm, folic acid at 50 ppm and vitamin C at 500 ppm).

Each treatment was replicated four times, one plot (10.5 m^2) per each. The experimental design was randomized complete blocks with four replicates. The three vitamins were sprayed twice at 30 and 60 days from planting. Triton B as a wetting agent was added to all vitamin solutions at 0.05 %. Spraying was done till runoff (1000 L/ fed.). The untreated plants received tap water containing Triton B at 0.05 %.

Table (1): Analysis of the tested soil:

Constituents	Values
Particle size distribution:	
Sand %	: 78.70
Silt %	: 10.28
Clay %	: 11.02
Texture	: Sandy
pH (1:2.5 extract)	: 7.5
EC (1: 2.5 extract) (dS m^{-1}) 1cm/ 25° C	: 3.39
O.M. %	: 0.64
$CaCO_3$ %	: 12.0
Total N %	: 0.95
Available P (Olsen, ppm)	: 13.0
Available K (ammonium acetate, ppm)	: 232

In both seasons, after heading stage, a random sample of ten plants were labeled in each plot to record plant height (cm.).

Flag leaves were collected at two weeks after heading stage and grains after harvest were taken in both seasons for determining the plant pigments namely chlorophylls a & b and total carotenoids (according to **Moran, 1982**) as well as total chlorophylls was estimated (as mg/ 1.0 g fresh weight), N %, P %, K % and Mg % in the leaves as well as Ca, P and K (as mg/ 100 g seeds) in the seeds (according to the methods that outlined by **Chapman and Pratt, 1965**) and (**A.O.A.C., 1995**).

After harvesting (2nd week of April during both seasons), spike length (cm.); number of grains per spike, 1000 seed weight (g.), number of grains per plant, grain yield/ plant (g.) and per feddan (tons), straw yield/ plant (g.) and per feddan (tons), biomass/ fed (tons) were recorded per both seasons. The individual plant traits were calculated on the basis of ten plants chosen randomly in each plot, while grain, straw and biomass, yields were determined on the bases of hole plots. Proteins %, fats % and nitrite in the seeds (as ppm) were determined according to **A. O.A.C., 1995 and Ridnour- Lisa *et al*., (2000).**

All data in both seasons were subjected to the proper statistical analysis according to **Mead *et al*., (1993)** using new L.S.D (revised L.S.D) at 0.05 to compare among treatment means.

3. Results and Discussion

1-Plant height:-

The plant height is considered an important growth character directly linked with fodder and grain yield. It is obvious from the data in Table (2) that single and combined applications of the three vitamins namely vitamins B_{12} at 50 ppm, vitamin C at 500 ppm or folic acid at 50 ppm significantly stimulated plant height in relative to the check treatment. The promotion was significantly associated with using vitamin C, folic acid and vitamin B, in ascending order. Double and triple applications of these vitamins were significantly very favourable than using any vitamin alone in this connection. Treating wheat plants twice with a mixture of vitamins B12, folic acid and vitamin C gave the tallest plants. The shortest plants were observed with the neglection use of these vitamins. These results were true during both seasons.

The essential roles of these vitamins on enhancing cell division as well as the biosynthesis of organic foods, natural hormones and plant pigments are indicated by **Robinson (1973); Oretli (1987); Samiullah *et al*., (1988) and Tzeng and Devay (1989).**

These results are in concordance with those obtained by **Gamal El- Din- Karima and Reda (2003); Attallah *et al*., (2004); Abd El- Baky- Hanaa (2009) and Al- Qubaie (2012).**

2-Yield components:-

It is obvious from the data in Tables (2 & 3) that foliar application of vitamins B12 at 50 ppm, vitamin C at 500 ppm and folic acid at 50 ppm either alone or in all possible combinations had significant promotive effect on all yield components namely spike length, number of grains/ spike, 1000 seed weight as well as proteins % and fats % in the seeds as compared with the check treatment. The promotion on the investigated was in proportional to using vitamin C, folic acid and vitamin B_{12}, in ascending order. Combined applications (double and triple applications) was significantly very effective in improving these parameters than using each vitamin alone. The maximum values of these treats were recorded with treating the plants with all vitamins together. The untreated plants produced the lowest values. Similar trend was noticed during both seasons.

The beneficial effects of vitamins on enhancing growth and nutritional status of the plants surely reflected on improving yield components.

These results are in agreement with those obtained by **Rabie and Negm (1992); Anton *et al*.,**

(1999); Mohamed (2004) and Abd El- Naeem and Abd El- Hakim (2009).

3-Grain and straw yields per plant and per fed and biomass/fed:-

It is evident from the data in Tables (2 & 3) that single and combined applications of vitamin B_{12} at 50 ppm, vitamin C at 500 ppm and folic acid at 50 ppm significantly improved the grain and straw yields per plant and per feddan as well as biomass/ fed in relative to the check treatment. Significant promotion on these yields was observed with spraying the wheat plants with vitamin C, folic acid and vitamin B_{12}, in ascending order. Double and triple applications of these vitamins significantly were favourable than using each vitamin alone in improving the grain and straw yield/ plant and per feddan as well as biomass/ fed). Using all vitamins together gave the maximum grain yield per plant (4.90 and 4.80 g) and per feddan (2.45 and 2.40 tons) as well as straw yield/ plant (5.8 and 5.7 g.) and per feddan (2.90 and 2.85 tons) during both seasons, respectively. Control plants produced the minimum values of grain yield/ plant (3.0 and 31.0 g) and per feddan (1.50 and 1.55 tons) and straw yield per feddan (2.0 and 1.95 tons) during both seasons, respectively. These results were true during the two experimental seasons.

The beneficial effects of these vitamins on producing vigour plants as well as improving yield components surely reflected on improving production of wheat plants.

These results are in harmony with those obtained by **Anton *et al*., (1999); Mohamed (2004); Abd El- Hakim (2006) and Abd El- Naeem and Abd El- Hakim (2009).**

4-Leaf and seed chemical composition:-

Data in Tables (3 & 4 & 5) clearly show that single and combined applications of vitamins B_{12} at 50 ppm, vitamin C at 500 ppm and folic acid at 50 ppm significantly stimulated plant pigments (chlorophylls a & b, total chlorophylls and total carotenoids) as well as N, P, K, Mg, Zn, Fe, Mn and Cu in the leaves and Ca, P, K, Mg, Zn, Fe and Mn in the seeds in relative to the check treatment. However, the vice versa was obtained with regard to the effect of the present treatments on seed content of nitrite. Seed nitrite content considerably tended to reduce with single and combined applications of these vitamins in relative to the check treatment. The effect in terms of increase and reduce was related to using vitamin C, folic acid and vitamin B_{12}, in ascending order. Using two or three vitamins was significantly superior than using each vitamin alone in enhancing these organic and mineral nutrients as well as reducing nitrite content in the seeds. The maximum values of plant pigments as well as different nutrients in the leaves and seeds as well as the minimum values of nitrite in the seeds were recorded in the plants that received two sprays of a mixture of vitamins containing vitamin B_{12} and folic acid each at 50 ppm and vitamin C at 500 ppm. The vice versa was obtained on untreated plants. These results were true during both seasons.

The effect of vitamins on enhancing root development and the uptake of water and nutrients **(Tzeng and Devay, 1989)** could explain the present results**.**

These results are in conformity with those obtained by **Mousa *et al*., (1994); Abd El- Messih and Eid (1999) and Mohamed (2004).**

As a conclusion, treating wheat plants cv. Masr– 1 two times at 30 and 60 days from sowing with a mixture of vitamins containing vitamin B_{12} at 50 ppm, folic acid at 50 ppm and vitamin C at 500 ppm resulted in great promotion on yield quantitively and qualitatively.

Table (2): Effect of spraying some vitamins on plant height as well as yield and yield components of wheat cv. Masr – 1 plants during 2010/ 2011 and 2011/ 2012 seasons.

Vitamin treatments	Plant height (cm.)		Spike length (cm.)		No. of grains/ spike		1000 seed weight (g.)		No. of grains/ plant		Grain yield per plant (g.)		Grain yield per fed. (g.)		Straw yield per plant (g)	
	2010/ 2011	2011/ 2012	2010/ 2011	2011/ 2012	2010/ 2011	2011/ 2012	2010/ 2011	2011/ 2012	2010/ 2011	2011/ 2012	2010/ 2011	2011/20 12	2010/ 2011	2011/20 12	2010/ 2011	2011/20 12
Control (untreated plants)	52.2	55.1	7.1	6.6	31.1	31.9	24.1	24.3	124.4	127.6	3.00	3.10	1.50	1.55	4.0	3.9
Vitamins B complex at 50 ppm	63.0	68.0	9.6	9.1	34.9	35.7	26.5	26.7	139.6	142.8	3.70	3.81	1.85	1.91	5.0	4.8
Vitamin C at 500 ppm	55.5	59.2	7.7	7.2	33.0	33.8	25.0	25.3	132.0	135.2	3.30	3.42	1.65	1.71	4.3	4.1
Folic acid at 50 ppm	58.2	64.0	8.9	8.4	34.0	34.8	25.7	26.0	136.0	139.2	3.50	3.62	1.75	1.81	4.6	4.4
Vitamins B + vitamin C	66.6	75.5	11.6	11.0	35.4	36.4	28.5	28.7	141.6	145.6	4.04	4.18	2.02	2.09	5.4	5.2
Vitamins B + folic acid	70.0	80.0	12.5	12.0	36.0	36.8	29.5	29.7	144.0	147.2	4.25	4.37	2.12	2.19	5.5	5.3
Vitamin C + folic acid	64.5	72.0	10.6	10.1	35.2	36.0	27.2	27.4	140.8	144.0	3.83	3.95	1.92	1.98	5.3	5.1
All vitamins	79.9	84.0	12.8	12.5	39.9	38.3	30.7	31.3	159.6	153.2	4.90	4.80	2.45	2.40	5.8	5.7
New L.S.D at 0.05	2.9	3.0	0.6	0.5	0.9	1.0	0.7	0.6	2.0	2.2	0.21	0.20	0.12.	0.11	0.3	0.2

One feddan = 0.42 ha^{-1}

Table (3): Effect of spraying some vitamins on yield, yield components and plant pigments of wheat cv. Masr – 1 plants during 2010/ 2011 and 2011/ 2012 seasons.

Vitamin treatments	Straw yield per fed. (tons)		Yield biomass per fed (tons)		Seeds proteins %		Seeds Fat %		Chlorophyll a (mg/ 1.0 g. F.W)		Chlorophyll b (mg/ 1.0 g. F.W)		Total chlorophylls (mg/ 1.0 g. F.W)		Total carotenoids (mg/ 1.0 g. F.W)	
	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012
Control (untreated plants)	2.00	1.95	3.50	3.50	11.1	11.3	2.11	2.05	1.99	2.00	1.18	1.21	3.17	3.21	1.22	1.25
Vitamins B complex at 50 ppm	2.50	2.40	4.35	4.31	12.0	12.2	2.35	2.29	2.30	2.32	1.38	1.41	3.68	3.73	1.42	1.45
Vitamin C at 500 ppm	2.15	2.05	3.80	3.76	11.5	11.7	2.19	2.12	2.11	2.12	1.23	1.26	3.34	3.38	1.27	1.30
Folic acid at 50 ppm	2.30	2.20	4.05	4.01	11.8	12.0	2.27	2.20	2.22	2.23	1.28	1.31	3.50	3.54	1.31	1.36
Vitamins B + vitamin C	2.70	2.60	4.72	4.69	12.9	13.2	2.66	2.60	2.50	2.51	1.59	1.62	4.09	4.13	1.64	1.67
Vitamins B + folic acid	2.75	2.65	4.87	4.84	12.8	13.1	2.72	2.66	2.57	2.58	1.69	1.72	4.26	4.30	1.74	1.77
Vitamin C + folic acid	2.65	2.55	4.57	4.53	12.5	12.7	2.61	2.55	2.40	2.41	1.50	1.55	3.90	3.96	1.55	1.60
All vitamins	2.90	2.85	5.35	5.25	13.2	13.5	2.78	2.71	2.66	2.67	1.70	1.73	4.33	4.40	1.86	1.87
New L.S.D at 0.05	0.12	0.14	0.21	0.22	0.2	0.3	0.05	0.06	0.07	0.06	0.04	0.05	0.07	0.08	0.05	0.04

One feddan = 0.42 ha^{-1}

Table (4): Effect of spraying some vitamins on leaf mineral content of wheat cv. Masr – 1 plants during 2010/ 2011 and 2011/ 2012 seasons.

Vitamin treatments	Leaf N %		Leaf P %		Leaf K %		Leaf Mg %		Leaf Zn content (ppm)		Leaf Fe content (ppm)		Leaf Mn content (ppm)		Leaf Cu content (ppm)	
	2010 /2011	2011 /2012	2010 /2011	2011/ 2012	2010 /2011	2011 /2012	2010 /2011	2011/ 2012	2010/ 2011	2011/ 2012	2010 /2011	2011 /2012	2010/ 2011	2011/ 2012	2010/ 2011	2011 /2012
Control (untreated plants)	1.99	2.00	0.11	0.14	1.51	1.44	0.31	0.33	32.0	32.9	35.0	36.1	30.0	31.1	1.92	1.82
Vitamins B complex at 50 ppm	2.16	2.20	0.21	0.25	1.70	1.63	0.44	0.46	40.0	42.0	44.1	45.2	36.0	37.2	2.11	2.01
Vitamin C at 500 ppm	2.08	2.12	0.14	0.18	1.57	1.50	0.35	0.37	35.0	37.0	39.0	40.2	32.5	33.8	1.96	1.86
Folic acid at 50 ppm	2.12	2.16	0.17	0.21	1.63	1.57	0.39	0.41	37.0	39.0	41.2	42.5	34.2	35.3	2.01	1.91
Vitamins B + vitamin C	2.28	2.29	0.28	0.32	1.85	1.78	0.37	0.40	45.0	47.0	49.0	51.1	41.0	42.1	2.27	2.16
Vitamins B + folic acid	2.36	2.40	0.31	0.35	1.92	1.85	0.40	0.43	47.2	50.0	52.2	53.3	43.3	44.4	2.33	2.23
Vitamin C + folic acid	2.22	2.26	0.25	0.30	1.77	1.70	0.34	0.40	42.3	44.9	48.0	49.1	38.2	39.3	2.20	2.11
All vitamins	2.50	2.55	0.35	0.40	1.97	1.90	0.47	0.48	55.9	61.0	63.0	64.1	46.0	47.2	2.41	2.37
New L.S.D at 0.05	0.07	0.08	0.04	0.02	0.07	0.05	0.03	0.04	2.1	2.0	2.3	2.4	1.1	1.0	0.05	0.04

One feddan = 0.42 ha^{-1}

Table (4): Effect of spraying some vitamins on seed chemical composition of wheat cv. Masr – 1 plants during 2010/ 2011 and 2011/ 2012 seasons.

Vitamin treatments	Seed Ca (mg/ 100 g D.W)		Seed P (mg/ 100 g D.W)		Seed K (mg/ 100 g D.W)		Seed Mg (mg/ 100 g D.W)		Seed Zn (mg/ 100 g D.W)		Seed Fe (mg/ 100 g D.W)		Seed Mn (mg/ 100 g D.W)		Seed nitrite (ppm)	
	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012	2010 /2011	2011 /2012
Control (untreated plants)	31.3	32.0	501.0	502.5	411.0	412.7	144.0	146.5	3.31	3.35	4.51	4.55	3.02	3.07	2.29	2.31
Vitamins B complex at 50 ppm	37.0	37.8	508.0	509.5	420.0	421.6	152.0	154.5	3.44	3.46	4.70	4.75	3.16	3.21	1.80	1.67
Vitamin C at 500 ppm	32.5	33.2	504.0	505.5	414.0	415.6	147.0	149.5	3.34	3.37	4.57	4.62	3.07	3.12	2.00	1.87
Folic acid at 50 ppm	34.5	35.2	506.0	507.5	417.5	419.0	149.2	251.2	3.39	3.42	4.62	4.67	3.11	3.16	1.91	1.77
Vitamins B + vitamin C	41.0	41.8	514.0	515.5	429.0	430.8	161.2	163.2	3.59	3.62	4.86	4.90	3.27	3.32	1.22	1.09
Vitamins B + folic acid	44.0	44.8	516.2	517.7	433.0	434.8	164.0	166.0	3.66	3.69	4.91	4.95	3.33	3.38	1.00	0.87
Vitamin C + folic acid	38.3	39.0	511.9	513.5	425.0	426.7	156.0	158.0	3.50	3.55	4.81	4.86	3.22	3.27	1.50	1.37
All vitamins	46.6	47.3	541.0	544.0	442.5	444.0	167.9	171.0	3.71	3.75	4.95	5.02	3.41	3.44	0.77	0.55
New L.S.D at 0.05	1.0	0.9	2.1	1.9	2.1	2.3	2.0	1.9	0.04	0.02	0.03	0.05	0.04	0.03	0.17	0.15

One feddan = 0.42 ha^{-1}

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