Growth and Vine Nutritional Status of Superior Grapevines as Affected by Foliar Application of Wheat Seed Sprout

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Abstract: This study was carried out during 2016 and 2017 seasons to elucidate the influence of spraying wheat seed sprout once, twice or thrice at 0.5 to 4.0% on main shoot length, number of leaves/shoot, leaf area, wood ripening coefficient, pruning wood weight and cane thickness and vine nutritional status namely chlorophylls a & b, total carotenoids, N, P, K, Mg, Zn, Fe, Mn and Cu in the leaves of Superior grapevines. Supplying the vines with wheat seed sprout at 0.5 to 4.0% once, twice or thrice had an obvious stimulation on all growth aspects and leaf chemical components relative to the control. The stimulation was materially related to the increase in concentrations and frequencies of application. Carrying out two sprays of wheat seed sprout at 2.0% was responsible for stimulating growth and vine nutritional status of Superior grapevines.

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1. Introduction:

Nowadays, many efforts were accomplished for using natural alternatives as partial or complete replacement of chemical fertilizers for avoiding pollution in our environment. Using crop seed sprouts supply's the trees with their requirements from proteins, fats, soluble sugars, nutrients, vitamins, amino acids and antioxidants at balanced rate. **(Cazuola *et al*., 2004; Cairney, 2005; Biommerson, 2007; Abdallah, 2008; Darwish, 2009; Anderson and Cedergreen, 2010; Al- Shereif *et al*., 2013 and El-Sayed- Faten, 2014**).

Amending fruit crops with several crop seed sprouts at 0.2 to 4.0 % substantially enhanced growth, pigments and nutrients in the leaves of different fruit crops **Ahmed and Gad El- Kareem (2014)**, **El-Khawaga and Mansonr (2014), Mohamed, (2014), Refaai (2014 a and b), Abd El-Rahman (2015), Ahmed, (2015), Ahmed and Habasy- Randa (2017), Allam (2017)** and **Masoud (2017).**

The target of this study was detecting the effect of spraying wheat seed sprouts on vegetative growth characteristics and vine nutritional status of Superior grapevines.

2. Materials and Methods:

This study was carried out during 2016 and 2017 seasons on 78 uniform in vigour 10 -years old Superior grapevines grown at El- Hawarta village, Minia district, Minia Governorate. The texture of soil is clay. Cane pruning system with using Gable supporting method was adopted. Vine load was 72 eyes (6 fruiting canes x 10 eyes + 6 renewal spurs x two eyes). The vines are planted at 2 x 3 meters a part (700 vines / fed.) Surface irrigation system using Nile water was followed.

Soil is classified as clay in texture with water table depth not less than two meters deep. Mechanical, physical and chemical analysis of the tested soil were carried out at the start of the experiment according to the procedures that outlined by **Wilde *et al.,* (1985)** are given in **Table (1)**.

Table (1): Analysis of the tested soil:

Constituents	Values
Particle size distribution	
Sand %	4.0
Silt %	24.4
Clay %	71.6
Texture	Clay
pH (1: 2.5 extract)	7.2
EC (1: 2.5 extract) mmhos/ 1 cm 25^{o}cm	0.72
Total CaCO3 %	1.78
O.M. %	2.00
Total N %	0.08
P ppm (Oslen)	5.1
K ppm (ammonium acetate)	615.0
Mg (ppm)	6.1
Available micronutrients (EDTA, ppm):	
Fe	4.2
Zn	3.1
Mn	5.5

Except those dealing with the present treatments (wheat seed sprouts), all the selected vines (78 vines) received the usual horticultural practices which are common used in the vineyard including the application of 20m^3 F.Y.M. (0.25% N, 0.4 % P_2O_5 and 1.4 % K_2O), 150 kg ammonium nitrate (33.5 N), 200 kg triple calcium superphosphate (37.5 % P_2O_5) and 200 kg potassium sulphate (48% K_2O) per one feddan. Farmyard manure (F.Y.M.) was added once at the middle of Jan. Ammonium nitrate was splitted into three unequal batches and applied as 40% at growth start (1st week of Mar.) 30 % just after berry setting and 30% three weeks later. Phosphate fertilizer was divided into two equal batches, the first with F.Y.M. (Mid. Jan.) and the second one just after berry setting (1st week of May). Potassium fertilizer was divided into two equal batches and added at the first bloom (last week of March) and again immediately after berry setting (1st week of May). Other horticultural practices such as irrigation, hoeing and pest management were carried out as usual.

The present experiment included the following thirteen treatments from different concentrations and frequencies of application of wheat seed sprout:

1- Control (untreated trees).

2- Spraying wheat seed sprout at 0.05% once at growth start (1st week of March.).

3- Spraying wheat seed sprout at 0.05% twice at growth start (1st week of March.) and just after berry setting (middle of April).

4- Spraying wheat seed sprout at 0.05% thrice at growth start (1st week of March.) and just after berry setting (middle of April) and 21 days after berry setting (first week of May).

5- Spraying wheat seed sprout at 1.0 % once at growth start (1st week of March.).

6- Spraying wheat seed sprout at 1.0 % twice at growth start (1st week of March.) and just after berry setting (middle of April).

7- Spraying wheat seed sprout at 1.0 % thrice at growth start (1st week of March.) and just after berry setting (middle of April) and 21 days after berry setting (first week of May).

8- Spraying wheat seed sprout at 2.0 % once at growth start (1st week of March.).

9- Spraying wheat seed sprout at 2.0 % twice at growth start (1st week of March.) and just after berry setting (middle of April).

10- Spraying wheat seed sprout at 2.0 % thrice at growth start (1st week of March.) and just after berry setting (middle of April) and 21 days after berry setting (first week of May).

11- Spraying wheat seed sprout at 4.0 % once growth start (1st week of March.).

12- Spraying wheat seed sprout at 4.0 % twice at growth start (1st week of March.) and just after berry setting (middle of April).

13- Spraying wheat seed sprout at 4.0 % thrice at growth start (1st week of March.) and just after berry setting (middle of April) and 21 days after berry setting (first week of May).

Each treatment was replicated three times, two vines/ each. Extract of the wheat seed sprouts was prepared by germinating of the seeds and when the height of the plants reached ten cm, they were harvested and put in the refrigerator till use. As the time of application they were blended in electric blinder. Triton B as a wetting agent was added to all plant extract solutions at 0.05 % and spraying was done till runoff (5 L water/ vine). The untreated vines received water containing Triton B.

Analysis of wheat seed sprouts are given in Tables (2)**.**

Table 2: Chemical composition of wheat seed sprout

Constituent Values	**(mg/ 100 g F.W.)**
Aspartic acid	**3.0**
Arginine	**3.8**
Alanine	**3.0**
Glutamic acid	**5.0**
Thiamine (B_1)	**3.0**
Riboflavin (B_2)	**2.9**
Pyridoxine (N_6)	**2.0**
Vitamin E	**0.52**
Ca	**290**
P	**579**
K	**639**
Mg	**315**
Fe	**210**
Zn	**216**

A randomized complete block design was followed where this experiment included thirteen treatments each replicated three times, two vines per each.

During the two seasons, the following measurements were recorded:

***1.* Measurements of vegetative growth characteristics:**

At the middle of June, twenty mature leaves from the opposite side to the basal clusters on the shoots were picked for calculating the leaf area using the following equation outlined by **Ahmed and Morsy (1999)**.

Leaf area (cm$^{2)}$ = 0.45 (0.79 x diameter 2) + 17.77.

The average leaf area was recorded. Average main shoot length (cm) was recorded as a result of measuring the length of ten shoots per vine (cm) and the average shoot length was recorded. Number of leaves per shoot was also recorded. Dynamic of wood ripening coefficient was calculated by dividing the length of the ripened part of shoot that had brownished colour by the total length of the shoots (green colour) in the ten shoots/ vine (middle of Oct.) according to **Bouard (1966)**. Weight of pruning's (kg.)/vine was recorded just after carrying out pruning by weighing the removal one year old wood (1st week of Jan.). Average cane thickness (cm) was estimated in the five basal internodes of the ten canes per vine by using a Vernier caliper.

***2.* Measurements of leaf photosynthetic pigments:**

Plant pigments namely chlorophylls a & b and carotenoids were determined as (mg/1 g F.W.). Samples of five mature and fresh leaves from those leaves opposite to the basal clusters on each main shoot were taken on the last week of May in both seasons. The fresh leaves were cut into small pieces and 0.50 g weight from each sample was taken, homoyenized and extracted by 25% acetone in the presence of little amount of Na_2CO_3 and silica quartz, then filtered through central glass funnel G4. The residue was washed several times with acetone until the filtrate became colorless. The extract was completed to a known volume (20 ml) with 85% acetone. A portion of this extract was taken for the colormetric determination of pigments. Acetone (85% v/u) was used as a blank (according to **Fadle and Seri El- Dean, 1978**)

The optical density of the filtrate was determined using Carl Zeis spectrophotometer at the wave length of 662, 644 and 440 nm to determine chlorophylls a & b and totals carotenoids, respectively. Content of each pigment was calculated by using the following equation (according to **Von- Wettstein, 1957 and Hiscox and Isralstam, 1979**)

Chl.A = (9.784 – E 662) – (0.99- E 644) = mg/L

Chl.B = (21.426- E 644) – (4.65 x E 662) = mg/L

Total carotenoids (4.965 x E440 – 0.268 (chlorophyll a + chlorophyll b)

E = optical density at a given wave length. These plant pigments were calculated as mg /100 g. F.W.

***3.* Measurements of leaf content of N, P, K, Mg, Zn, Fe, Cu and Mn:**

Twenty leaves picked form those opposite to the basal clusters (According to **Summer, 1985**) for each vine were taken at the first week of June in both seasons. Blades and petioles of leaves were separated where blades were discarded and petioles were saved for determining of the different nutrients. Petioles were oven dried at 70°C and grounded then 0.5 g weight of each sample was digested using H_2SO_4 and H_2O_2 until clear solution was obtained (**Wilde *et al.*, 1985**). The digested solutions were quantitatively transfer to 100 ml volumetric flask and completed to 100 ml by distilled water. Thereafter, leaf contents of N, P, K and Mg (as percentages) and Zn, Fe and Mn (as ppm) for each sample were determined as follows:

1- Nitrogen % was determined by the modified microkjeldahle method as described by **Horneck and Miller (1998)**.

2- Phosphorus % was determined by using Olsen method as reported by **Cottenie *et al.*, (1982)**.

3- Potassium % was Flame photometrically determined using the method outlined by **Cottenie *et al.*, (1982)**.

4- Magnesium % was determined by using titration against EDTA using the method outlined by **Wilde *et al.*, (1985)**.

5- The four micronutrients namely Zn, Fe, Cu and Mn were determined using the atomic absorption apparatus spectrophotometer (**A.O.A.C. 2000**).

All the obtained data were tabulated and statistically analyzed using New L.S.D at 5% for made all comparisons among the investigated treatment means (according to **Snedecor and Cochran, 1972 and Mead *et al.*, 1993**).

3. Results and Discussion:

1-Vegetative growth characteristics:

It is noticed from the obtained data in Table (3) that treating Superior grapevines once, twice or twice with whea seed sprouts at

0.5 to 4.0% caused a significant stimulation on the six growth traits namely main shoot length, number of leaves/shoot, leaf area, wood ripening coefficient, pruning wood weight and cane thickness relative to the control. There was a gradual stimulation on these growth traits with increasing concentrations of wheat seed sprout from 0.5 to 4.0% and frequencies of application from once to thrice. Significant differences on these growth traits were observed between all concentrations except between 2.0 and 4.0 % and frequencies of application from once to thrice except between twice and thrice applications. Carrying out three sprays of wheat seed sprout at 4.0 % gave the maximum values of main shoot length **(117.0 & 120.0 cm)**, number of leaves/shoot **(30.0 & 31.0 leaf)**, leaf area **(114.6 & 117.3 cm^2)**, wood ripening coefficient **(0.95 & 0.99)**, pruning wood weight **(2.00 & 2.05 kg/vine)** and cane thickness **(1.71 & 1.62 cm)** during both seasons, respectively. The untreated vines produced the lowest values. These results were true during both seasons.

2- Leaf chemical composition:

It is clear from the obtained data in Tables (4 & 5) that subjecting Superior grapevines to wheat seed sprout once, twice or thrice at 0.5 to 4.0% significantly enhanced chlorophylls a & b, total carotenoids, N, P, K, Mg (as %) and Zn, Fe, Cu and

Mn (as ppm) in the leaves relative to the control. There was a gradual promotion on these pigments and nutrients with increasing concentrations and frequencies of application of wheat seed sprouts. Increasing concentrations of wheat seed sprout from 2.0 to 4.0 % and frequencies of application from twice to thrice had no significant promotion on these leaf chemical components. The maximum values of chlorophyll a **(3.33 & 2.84 mg/1.0 g FW)**, chlorophyll b **(1.24 & 1.19 mg/1.0 g FW)**, total carotenoids **(1.20 & 1.16 mg/1.0 g FW)**, N **(2.02 & 2.06%)**, P **(0.161 & 0.162%)**, K **(1.59 & 1.61 %),** Mg **(0.82 & 0.87 %)**, Zn **(72.3 & 73.5 ppm),** Fe **(64.7 & 65.0 ppm)**, Mn **(75.6 & 76.5 ppm)** and Cu **(1.53 & 1.57 ppm)** were recorded on the vines that treated with wheat seed sprout at 4.0% thrice during both seasons, respectively. The minimum values of these plant pigments and nutrients were recorded on the untreated vines. These results were true during both seasons.

Table (3): Effect of different concentrations and frequencies of application of wheat seed sprout on some growth aspects of Superior grapevines during 2016 and 2017 seasons.

Treatments	Main shoot length (cm.)		Number of leaves/shoot		Leaf area (cm^2)		Wood ripening coefficient		Pruning wood weight / vine (kg.)		Cane thickness (cm)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control (untreated trees)	96.7	101.1	18.0	17.3	96.3	98.0	0.66	0.64	1.40	1.49	1.14	1.12
Spraying wheat seed sprout at 0.05% once	104.0	105.3	20.0	18.0	98.3	101.0	0.70	0.70	1.49	1.56	1.20	1.20
Spraying wheat seed sprout at 0.05% twice	105.9	107.3	22.0	20.3	100.6	103.3	0.74	0.76	1.59	1.63	1.26	1.28
Spraying wheat seed sprout at 0.05% thrice	106.0	108.0	22.0	22.3	101.0	104.0	0.75	0.76	1.60	1.64	1.27	1.29
Spraying wheat seed sprout at 1.0 % once	108.0	110.0	24.0	23.0	104.0	106.0	0.78	0.81	1.69	1.74	1.35	1.36
Spraying wheat seed sprout at 1.0 % twice	111.0	113.0	26.0	26.7	107.0	109.0	0.82	0.86	1.79	1.84	1.41	1.43
Spraying wheat seed sprout at 1.0 % thrice	111.0	113.2	26.0	28.0	107.7	109.3	0.82	0.87	1.80	1.85	1.42	1.44
Spraying wheat seed sprout at 2.0 % once	113.3	115.3	28.0	29.3	110.9	114.0	0.83	0.94	1.90	1.95	1.50	1.52
Spraying wheat seed sprout at 2.0 % twice	116.0	119.0	30.0	31.0	114.0	117.0	0.88	0.98	1.98	2.03	1.56	1.60
Spraying wheat seed sprout at 2.0 % thrice	116.6	119.3	30.0	31.0	114.4	117.0	0.88	0.99	1.99	2.04	1.57	1.61
Spraying wheat seed sprout at 4.0 % once	114.0	115.6	28.0	29.3	111.0	114.1	0.90	0.95	1.91	1.96	1.64	1.53
Spraying wheat seed sprout at 4.0 % twice	116.6	119.3	30.0	31.0	114.0	117.0	0.94	0.98	1.99	2.04	1.70	1.61
Spraying wheat seed sprout at 4.0 % thrice	117.0	120.0	30.0	31.0	114.6	117.3	0.95	0.99	2.00	2.05	1.71	1.62
New L.S.D. at 5%	**1.2**	**1.3**	**1.7**	**1.6**	**1.3**	**1.4**	**0.04**	**0.05**	**0.04**	**0.05**	**0.05**	**0.07**

Table (4): Effect of different concentrations and frequencies of application of wheat seed sprout on chlorophylls a & b, total carotenoids (mg/1 g FW) and percentages of N, P and K in the leaves of Superior grapevines during 2016 and 2017 seasons

Treatments	Chlorophyll a (mg/1 g FW)		Chlorophyll b (mg/1 g FW)		Total carotenoids (mg/1 g FW)		Leaf N %		Leaf P %		Leaf K %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control (untreated trees)	1.94	1.70	0.91	0.84	0.88	0.81	1.59	1.64	0.114	0.113	1.14	1.18
Spraying wheat seed sprout at 0.05% once	2.11	1.80	0.96	0.88	0.93	0.85	1.66	1.70	0.120	0.120	1.20	1.24
Spraying wheat seed sprout at 0.05% twice	2.38	1.94	1.02	0.92	1.00	0.89	1.72	1.77	0.127	0.128	1.27	1.30
Spraying wheat seed sprout at 0.05% thrice	2.40	1.95	1.03	0.93	1.01	0.90	1.73	1.79	0.128	0.130	1.28	1.31
Spraying wheat seed sprout at 1.0 % once	2.60	2.1	1.08	1.00	1.05	0.97	1.80	1.84	0.135	0.136	1.34	1.36
Spraying wheat seed sprout at 1.0 % twice	2.80	2.38	1.12	1.05	1.09	1.02	1.87	1.90	0.141	0.142	1.41	1.41
Spraying wheat seed sprout at 1.0 % thrice	2.81	2.40	1.13	1.06	1.10	1.03	1.88	1.91	0.142	0.143	1.42	1.42
Spraying wheat seed sprout at 2.0 % once	3.11	2.60	1.17	1.11	1.14	1.07	1.95	1.97	0.151	0.154	1.50	1.56
Spraying wheat seed sprout at 2.0 % twice	3.31	2.81	1.22	1.17	1.19	1.14	2.00	2.04	0.160	0.160	1.57	1.60
Spraying wheat seed sprout at 2.0 % thrice	3.32	2.82	1.22	1.18	1.19	1.15	2.01	2.05	0.161	0.161	1.58	1.61
Spraying wheat seed sprout at 4.0 % once	3.12	2.61	1.18	1.12	1.15	1.09	1.96	1.98	0.152	0.158	1.51	1.57
Spraying wheat seed sprout at 4.0 % twice	3.32	2.82	1.23	1.18	1.19	1.15	2.02	2.05	0.160	0.161	1.58	1.60
Spraying wheat seed sprout at 4.0 % thrice	3.33	2.84	1.24	1.19	1.20	1.16	2.02	2.06	0.161	0.162	1.59	1.61
New L.S.D. at 5%	**0.04**	**0.05**	**0.03**	**0.04**	**0.03**	**0.03**	**0.04**	**0.05**	**0.005**	**0.004**	**0.04**	**0.05**

Table (5): Effect of different concentrations and frequencies of application of wheat seed sprout on the leaf content of Mg (as %) and Zn, Fe and Mn (as ppm) in the leaves of Superior grapevines during 2016 and 2017 seasons

Treatments	Leaf Mg %		Leaf Zn (ppm)		Leaf Mn (ppm)		Leaf Fe (ppm)		Leaf Cu (ppm)	
	2016	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Control (untreated trees)	0.51	0.49	51.1	49.8	54.5	55.0	46.6	45.1	1.11	1.08
Spraying wheat seed sprout at 0.05% once	0.55	0.54	53.1	54.0	57.0	58.0	49.0	49.5	1.15	1.20
Spraying wheat seed sprout at 0.05% twice	0.60	0.60	56.0	56.9	60.0	61.0	52.0	52.3	1.20	1.24
Spraying wheat seed sprout at 0.05% thrice	0.61	0.60	56.3	57.20	60.3	61.3	52.3	52.6	1.21	1.25
Spraying wheat seed sprout at 1.0 % once	0.66	0.66	60.0	60.9	64.0	64.0	55.0	55.4	1.26	1.30
Spraying wheat seed sprout at 1.0 % twice	0.71	0.72	63.9	64.8	67.9	68.0	57.9	58.2	1.32	1.36
Spraying wheat seed sprout at 1.0 % thrice	0.72	0.73	64.0	64.9	68.0	68.3	58.0	58.4	1.33	1.37
Spraying wheat seed sprout at 2.0 % once	0.77	0.80	67.9	68.8	71.9	73.0	61.5	61.9	1.45	1.50
Spraying wheat seed sprout at 2.0 % twice	0.81	0.85	71.3	72.2	75.0	76.0	64.0	64.3	1.51	1.56
Spraying wheat seed sprout at 2.0 % thrice	0.82	0.86	71.6	72.5	75.3	76.0	64.3	64.3	1.52	1.57
Spraying wheat seed sprout at 4.0 % once	0.77	0.81	70.0	71.0	72.0	73.3	61.6	61.9	1.46	1.50
Spraying wheat seed sprout at 4.0 % twice	0.81	0.86	72.0	73.0	75.5	76.2	64.3	64.7	1.52	1.56
Spraying wheat seed sprout at 4.0 % thrice	0.82	0.87	72.3	73.5	75.6	76.5	64.7	65.0	1.53	1.57
New L.S.D. at 5%	**0.03**	**0.02**	**1.9**	**2.1**	**1.7**	**1.8**	**2.0**	**2.1**	**0.02**	**0.03**

4. Discussion:

Germination or sprouting of seeds in various crops may change all complex substances such as proteins, carbohydrates and fats to simple ones and stimulates the occurrence of soluble sugars, amino acids, natural hormones and antioxidants. The higher content of sprouts from amino acids like cysteine, cysteine, methionine, tryptophan, glutamic acid, arginine, aspartic acid, thiamin, alanine, leucine and isolcucin, vitamins A, B & B_2 & B_6, C and E and nutrients such as N, P, K, Mg, Ca, Fe, Mn and Cu is accompanied with protecting the trees from aging and unfavourable conditions and enhancing cell division and biosynthesis of carbohydras and plant pigments (**Camacho *et al*., 1992; Abdallah *et al*., 2000; Crews and Peoples, 2004; Cazuola *et al*., 2004; Cairney, 2005; Biommerson, 2007; Abdallah, 2008; Darwish, 2009; Anderson and Cedergreen, 2010; Al- Shereif *et al*., 2013 and El-Sayed-Faten, 2014**).

Camacho *et al.* (1992), Cairney (1995); Aballah *et al* (2000) and Crews and Peoples (2004) found that foliar application of crop seed sprouts such as barley, wheat, fenugreek and rocked had an obvious promotion on growth and vine nutritional status through supplying the plants with their requirements from organic and mineral nutrients, natural hormones and antioxidants and they are responsible for reducing reactive oxygen species consequently protecting plan cells from death.

The current results regarding the beneficial effects of crop seed sprouts on vegetative growth and vine nutritional status are in concordance with those obtained by **Ahmed and Gad El- Kareem (2014)**, **El-Khawaga and Mansonr (2014)**, **Mohamed, (2014) Refaai (2014 a and b)**, **Ahmed, (2015) Abd El-Rahman (2015)**, **Ahmed and Habasy- Randa**

(2017), Allam (2017), Ibrahim- Asmaa, (2017) and **Masoud (2017).**

5. Conclusion:

Carrying out two sprays of wheat seed sprout at 2.0% was responsible for stimulating growth and vine nutritional status of Superior grapevines.

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