

Magnetic Water and Chemical Substances Impact on Growth Parameters and Yield Components of Onion Crop under Assiut Conditions

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Abstract

The experiments of this study were conducted to investigate the effect of magnetized water and two other chemical substances that are known as Agro promotor1 (substance No.48) and Agro promotor2 (substance No.50) on growth, yield and chemical composition of onion variety Giza 6. The substances were obtained from Cairo University. Result revealed that growth parameters, yield and its component and chemical contents increased with using both of magnetic water and Agro promotor1 (substance No.48) at concentration of 3 ml/l comparing with control (untreated) treatment. Using magnetized water and Agro promotor1 (substance No.48) at concentration of 3 ml/l induced positive significant effect on plant height and weight, number of leaves/plant and bulb diameter as well as significantly improved neck and bulb diameters, bulb weight, total soluble solids, total yield and marketable yield percentage than plants of control treatment which showed an increase in percentage of bolters, in both seasons. In general, it might be concluded that application of each of magnetized water and Agro promotor1 (substance No.48) treatments proved to be good technology to enhance growth, yield and quality when compared with untreated treatment. The marketable yield was increased by 30% as compared with control treatment by using magnetized water and increased by 22-235% when substance No.48 at concentration of 3 ml/l was used. The increase in total yield ranged from 12-15.4% when using magnetized water and was 14-15.4% when substance No.48 at concentration of 3 ml/l compared with control treatment. This study recommends using magnetized water to obtain the highest marketable yield and the lowest percentage of bolters. In case of magnetized water un-available, Agro promotor1 (substance No.48) at concentration of 3 ml/l can be applied.

Keyword: *bulbing ratio, bolters, chemical content, marketable yield, TSS, yield quality.*

Introduction

Onion (*Allium cepa* L.) is one of the most important vegetable crops grown in the world. In Egypt, it is ranked as the third important vegetable crops after tomato and potato according to annual production (2024881 ton) FAOSTAT (2012). Utilization of magnetized water technology is considered as a promising technique to improve water use efficiency and crop productivity. The ir-

rigation by magnetized water increased significantly plant height, number of leaves / plant, fresh and dry weight, as well as survival rate, N and P% than those irrigated by non-magnetized water on pear seedlings (Osman *et al.*, 2014) and in tomato (Carbonell, 2011 and Ahmed, 2013). Magnetized water increases plant metabolism in terms of photosynthesis and water uptake (Yano *et al.*, 2004). Magnetized water improved plant

stimulation of synthesis and transport of hormones and enzymes metabolism and increase the final plant yield (Esitken, 2003).

Water molecule consists of hydrogen and oxygen atoms are partly positive and partly negative that forming by weak attraction allowing to the formation of hydrogen bonds. The magnetic and electrical fields are extremely affected in liquid water through hydrogen bond that changes some physical and chemical properties of magnetic water (Nasher, 2008). The magnetic field on ion of positive charge will create magnetic force and move in the direction relative to the right hand rule of Lorantz, while the negative charge particle moved in the opposite direction (Amer *et al.*, 2006). The motion in the direction of water molecules charges will increasing the velocity of the particles that create more collisions between the particles (Gholizadeh *et al.*, 2008). The magnetic field increases the strength of hydrogen bond, which leads to increasing in the refractive index.

Currently, magnetized water is used to increase plant yields (Lin and Yotvat, 1990), many benefits of human health and change in pH of the water (Maheshwari, 2009; Kordas, 2002). The magnetic water treatment can improve acceleration of seeds metabolism and increased yield parameter of the crops such as cereal sunflower and soybean (Özalpan *et al.*, 1999; Yurttas *et al.*, 1999; Oldacay, 2002). Magnetic treated water undergoes several changes in its physical properties. It also exerts several effects on the soil-water-plant system. Leaching the soil with MW

significantly increases available soil phosphorus content compared with the leaching with normal water at all soil depths. Behavior of nutrients under an MF is a function of their magnetic susceptibility (ALI *et al.*, 2014). Therefore, the aim of this research work was to assess response of onion plants Giza 6 cv. to magnetized irrigation water and other two chemical substances i.e., Agro promotor1 (substance No.48) and Agro promotor2 (substance No.50) that were obtained from Cairo university to enhance growth, yield and quality.

Materials and Methods

The field work of this study was carried out at the Experimental Farm of Faculty of Agriculture, Assiut University, Assiut, Egypt, during 2014/2015 and 2015/2016 winter seasons. The experiments were conducted to study the response of onion plants Giza 6 cv. grown in clay soil to magnetized irrigation water and other two substance i.e., Agro promotor1 (substance No.48) and Agro promotor2 (substance No.50) that were obtained from Cairo university. The component of substance, 48 is (sodium chloride 0.28%, organic matter 0.02%, powder of rock salts 0.01%, hypochlorite and hypochloros acid 0.05%, electro-magnet activated water 5% and electro-magnet activated water till 100 ml. While the component of substance, 50 is (sodium chloride 0.28%, organic matter 0.02%, powder of rock salts 0.01%, hypochlorite and hypochloros acid 0.05%, and electro-magnet activated water till 100 ml. These components according to (Kaoud, 2014). Six treatments were used which were magnetic water (MW), substance No.48, 1.5 ml/l, sub-

stance No.48,3 ml/l substance No.50,1.5 ml/l, substance No.50,3 ml/l and non-magnetized water (NMW) (un treated control). Onion seedlings were planted on 1st and 4th of September in both growing seasons respectively. Treatments were applied in September, 23 and 27 respectively as first time then at 15 d intervals for six times. All agricultural practices for onion crop production were applied as recommended for onion production (Hassan, 1991). The experiment was conducted using three replications in randomized complete-block design. Each experimental plot consisted of three rows. Each row was 3.5 meters long and 70 cm wide. Planting distance were 5-7 cm apart. Onion seedlings were sown on two side of ridge. Three samples were taken. First sample was taken after 30 days from treatments application, then at 30 d-intervals. Five plants of each replicate were randomly taken for recording vegetative growth characteristics, i.e., plant height (cm), (plants was measured from the bulb base to the tip of the leaf blade), plant weight, number of leaves/plant, neck diameter (cm) and bulb diameter (cm). Bulbing ratio was measured according to Manns (1952), using the following formula.

Bulbing ratio= Neck diameter (cm)/ Bulb diameter (cm)

Yield parameters and its components: At harvesting stage (150 days from transplanting date), a sample of 10 onion plants randomly taken from each experimental plot for determining yield characteristics, i.e., neck and bulb diameter (cm), bulbing ratio, and average bulb fresh weight. In addition, total yield (ton/fed.) and

percentage of marketable yield, and flowering plants (bolters) were measured.

Experimental design and statistical analysis: Data from each season, separately, were subjected to analysis of variance according to Snedecor and Cochran (1980). Based on homogeneity of error variance, the two seasons combined data were used in combined analysis of variance. Means of the treatments were compared using the Least Significant Difference (LSD) test at 0.05 probability level.

Results and Discussion

The obtained data present in Table 1, 2 and 3 revealed that there were significantly differences between treatments. Using of magnetized water, Agro promotor1 (substance No.48) and Agro promotor2 (substance No.50) induced positive effect on growth and yield parameters as comparing with control treatments.

Magnetized water treatment gave the proper values for bulb and neck diameter than chemical substance treatments (Table 3). Magnetized water treatment also increased marketable yield by 30% and increased total yield by 12-15, 4% as compared with control treatment (Table 4). Using of magnetized water reduced percentage of bolters and increase total soluble soiled (Table 4).

The stimulatory effect of the application of magnetic water on the growth parameters reported in this study may be attributed to the increase in photosynthetic pigments, endogenous promoters (IAA) (Fomicheva *et al.* 1992 a & b). Also, Belyavskaya (2001) reported that magnetic water significantly induces

cell metabolism and mitosis meristematic cells of pea, lentil and flax, as well as stimulated synthesis and transport of hormones and enzymes metabolism and increased growth (Esitken 2003).

According to the response of chemical substance to growth parameters and yield components, Agro promotor1 (substance No.48) was superior to Agro promotor2 (substance No.50) as it gave proper value for percentage of marketable yield and total yield (ton/fed) and gave lower percentage of bolters than Agro promotor2 (substance No.50) (Table 4). Agro promotor1 (substance No.48) accelerating growth and yield parameters as it increased plant height, plant weight, number of leaves per plant, bulb diameter and decreased neck diameter (Table 1,2 and 3).

Using different concentrations i.e 1.5 and 3 ml/l induced significant effect on growth parameter such as, plant height, plant weight and number of leaves/plant. Also different concentrations had significant effect on yield and its components such as, bulb and neck diameter, bulbing ratio, bulb weight, percentage of marketable yield, and percentage of bolters.

Application of Agro promotor1 (substance No.48) at concentration of 3 ml/l gave higher values for plant height, plant weight, number of leaves per plant than using of Agro promotor1 (substance No.48) at concentration of 1.5 ml/l.

According to bulb and yield parameter, using of Agro promotor1 (substance No.48) at concentration of 3 ml/l lead to increase in bulb weight and percentage of marketable yield than using of Agro promotor1 (substance No.48) at concentration of 1.5 ml/l. Percentage of marketable yield was increased by 22-23%, while total yield was increased by 14-15.4 % as compared with control treatment (Table 4). However, there was no significant effect on total yield and total soluble soiled when using either Agro promotor1 (substance No.48) at concentration of 1.5 or 3 ml/l (Table 4).

It was quite evident from Table 4 that, using of both magnetized water and Agro promotor1 (substance No.48), significantly improved neck and bulb diameters, bulbing ratio, bulb weight and total soluble soiled, total yield and marketable yield percentage than plants of control treatment, which was increased flowering bulb percentage. Obtained results agreed with those found by (Hozayn 2010; Ahmed 2013 and Rawabdeh *et al*, 2014).

Conclusion

In general, it might be concluded that irrigation with magnetized water proved to be good technology to enhance growth, yield and quality when compare with non-magnetized water. When magnetized water is not available, we can use Agro promotor1 (substance No.48) at concentration of 3 ml/l.

Table 1. Growth parameters after 30 days from applying treatments (first sample) as affected by magnetic water and chemical substances during 2014-2015 and 2015-2016 seasons ⁽¹⁾

Treatments	Bulb diameter (cm)	Neck diameter (cm)	Plant height (cm)	Plant weight (g)	Bulbing ratio (cm)	No. of leaves/pl.	
2014-2015							
*48,(1.5 cm/l)	2.48 b	1.44 d	54.63 b	80.533 c	0.581 d	12.06 c	
48,(3 cm/l)	2.82 a	1.26 f	57.46 a	86.067 a	0.447 f	14.33 a	
**50,(1.5cm/l)	2.40 c	1.57 b	50.63 c	70.233 e	0.654 b	10.8 e	
50,(3cm/l)	2.43 bc	1.49 c	51.43 c	73.500 d	0.613 c	11.26 de	
***M w	2.85 a	1.36 e	56.33 ab	83.267 b	0.475 e	13.00 b	
Control	2.33 d	1.62 a	51.26 c	70.530 e	0.697 a	11.62 dc	
2015-2016							
48,(1.5 cm/l)	2.49 bc	1.46 c	55.46 b	81.73 b	0.584 d	12.43 c	
48,(3 cm/l)	2.83 a	1.25 e	58.30 a	84.56 a	0.443 f	14.66 a	
50,(1.5cm/l)	2.50 b	1.55 b	52.30 c	71.16 d	0.619 b	11.43 e	
50,(3cm/l)	2.45 c	1.47 c	52.03 c	74.86 c	0.601 c	12.23 cd	
M w	2.87 a	1.36 d	57.10 ab	84.03 ab	0.475 e	13.33 b	
Control	2.31 d	1.65 a	51.76 c	73.43 cd	0.715 a	11.53 de	
Source of variation	d.f.	Mean Square					
Year	1	0.00613	0.00006944	6.76000	8.02777	0.000220	1.62137778
Rep(within year)	4	0.0060	0.00017778	3.1105556	4.040278	0.000355	1.1074888
Treat	5	0.30401*	0.11031611*	49.51577*	238.9837*	0.05886*	9.3208000*
Treat × year	5	0.00229*	0.00055611*	0.257333 (N.S.)	3.022444*	0.00046*	0.1856444*
Error	20	0.000782	0.00012444	1.3528889	2.043611	0.000066	0.1466222

⁽¹⁾Means within column followed by the same letter(s) are not significantly different at 0.05 level of probability.

* Agro promotor1 (substance No.48).

** Agro promotor2 (substance No.50).

*** MW (Magnetic water)

Table 2. Growth parameters after 60 days from applying treatments (second sample) as affected by magnetic water and chemical substances during 2014-2015 and 2015-2016 seasons(1).

Treatments	Bulb diameter (cm)	Neck diameter (cm)	Plant height (cm)	Plant weight (g)	Bulbing ratio (cm)	No. of leaves /pl.	
2014-2015							
*48,(1.5 cm/l)	3.72 a	1.68 d	61.00 a	144.030 b	0.451 d	12.90 c	
48,(3 cm/l)	3.18 b	1.48 f	62.6 a	151.400 a	0.466 d	15.00 a	
**50,(1.5cm/l)	3.13 b	1.80 b	55.20 b	134.400 d	0.575 b	11.80 d	
50,(3cm/l)	3.23 b	1.72 c	55.33 b	136.860 cd	0.535 c	12.50 dc	
*** M w	3.66 a	1.58 e	61.50 a	148.630 a	0.432 d	14.03 b	
Control	2.83 c	1.88 a	56.23 b	139.167 c	0.664 a	12.86 c	
2015-2016							
48,(1.5 cm/l)	3.40 ab	1.65 d	62.03 a	144.200 c	0.494 c	13.03 c	
48,(3 cm/l)	3.21 bc	1.46 f	62.06a	151.733 a	0.454 dc	15.00 a	
50,(1.5cm/l)	3.14 bc	1.78 b	55.26 b	134.267 e	0.566 b	12.20 d	
50,(3cm/l)	3.34 ab	1.69 c	55.20 b	139.800 d	0.507 bc	12.60 cd	
M w	3.67 a	1.57 e	62.13 a	147.633 b	0.429 d	14.00 b	
Control	2.86 c	1.87 a	56.06 b	140.400 d	0.654 a	12.30 dc	
Source of variation	d.f.	Mean Square					
Year	1	0.00360	0.00302500	0.9025000	3.12111	0.00007803	0.00027778
Rep(within year)	4	0.034063	0.00045556	2.9672222	4.926111	0.00104489	0.4211111
Treat	5	0.53906*	0.12628944*	77.971611*	249.26511*	0.0430413*	7.443611*
Treat × year	5	0.03349*	0.00011167 (N.S.)	0.3405000 (N.S.)	2.760444*	0.00088369*	0.1529444*
Error	20	0.03204	0.00026556	1.4958889	3.070111	0.00084919	0.17077778

(1) Means within column followed by the same letter(s) are not significantly different at 0.05 level of probability.

* Agro promotor1 (substance No.48).

** Agro promotor2 (substance No.50).

*** MW (Magnetic water)

Table 3. Growth parameters after 90 days from applying treatments (third sample) as affected by magnetic water and chemical substances during 2014-2015 and 2015-2016 seasons⁽¹⁾.

Treatments	Bulb diameter (cm)	Neck diameter (cm)	Plant height (cm)	Plant weight (g)	Bulbing ratio (cm)	No. of leaves /pl.	
2014-2015							
*48,(1.5 cm/l)	4.20 b	2.33 b	71.46 b	250.800 c	0.555 b	14.00 c	
48,(3 cm/l)	4.77 a	1.97 c	74.33 a	318.730 a	0.413 c	16.96 a	
**50,(1.5cm/l)	4.15 c	2.40 ab	64.23 c	230.330 f	0.576 b	12.93 d	
50,(3cm/l)	4.40 b	2.36 ab	65.46 c	234.133 e	0.536 b	14.50 c	
***M w	4.76 a	2.00 c	70.46 b	258.500 b	0.420 c	15.96 b	
Control	3.54 d	2.55 a	65.53 c	243.000 d	0.720 a	13.76 dc	
2015-2016							
48,(1.5 cm/l)	4.13 c	2.33 b	70.46 ab	253.267 c	0.564 b	13.93 c	
48,(3 cm/l)	4.70 a	1.96 c	74.30 a	322.90 a	0.419 c	16.60 a	
50,(1.5cm/l)	4.17 bc	2.44 ab	61.56 c	232.500 e	0.584 b	12.66 d	
50,(3 cm/l)	4.35 b	2.40 ab	65.76 bc	241.00 d	0.551 b	14.06 c	
M w	4.77 a	2.10 c	70.73 a	259.83 b	0.440 c	15.16 b	
Control	3.56 d	2.55 a	65.00 c	244.700 d	0.715 a	13.10 d	
Source of variation	d.f	Mean Square					
Year	1	0.004011	0.008100	3.361111	87.42250	0.000693	1.690000
Rep (within year)	4	0.003011	0.00171667	1.991111	14.16333	0.00020911	0.41805556
Treat	5	0.211211*	0.30815333*	112.99177*	6366.79117*	0.073435*	12.847111*
Treat ×year	5	0.002944 (N.S.)	0.00242667 (N.S.)	1.895111 (N.S.)	6.50317*	0.00011224 (N.S.)	0.10666667 (N.S.)
Error	20	0.013464	0.01325667	4.2131111	5.47600	0.0009777	0.19005556

⁽¹⁾ Means within column followed by the same letter(s) are not significantly different at 0.05 level of probability.

* Agro promotor1 (substance No.48).

** Agro promotor2 (substance No.50).

*** MW (Magnetic water)

Table 4. Yield and its component as affected by magnetic water and chemical substances during 2014-2015 and 2015-2016 seasons⁽¹⁾.

Treatments	Bolters (%)	Bulb weight (g)	Bulb diameter (cm)	Bulb neck diameter (cm)	Bulbing ratio	marketable yield (%)	Total yield (ton /fed)	TSS	
2014-2015									
*48,(1.5 cm/l)	23.60 c	125.33 d	5.70a	0.633 d	0.110 d	70.0 c	9.016 a	13.0 ab	
48,(3 cm/l)	19.23 d	145.00 b	5.40 b	0.823 c	0.152 c	74.76 b	9.166 a	13.26 a	
**50,(1.5cm/l)	26.27 b	122.00 d	5.10 c	0.817 c	0.159 bc	64.33 e	8.400 b	12.86 ab	
50,(3cm/l)	23.80 c	135.00 c	5.40 b	0.893 b	0.165 b	68.0 d	8.500 b	12.70 b	
*** M w	12.07 e	149.66 a	5.53 b	0.907 b	0.163 b	78.5 a	9.000 a	13.0 ab	
Control	27.70 a	76.00 e	4.52 d	1.023 a	0.226 a	60.33 f	8.030 c	11.73 c	
2015-2016									
48,(1.5 cm/l)	23.30 c	125.900 d	5.76 a	0.650 c	0.112 c	71.2 c	9.166 a	13.13 a	
48,(3 cm/l)	19.50 d	147.433 b	5.56 a	0.850 b	0.152 b	75.16 b	9.250 a	13.23 a	
50,(1.5cm/l)	25.83 b	122.800 d	5.10 b	0.816 b	0.160 b	66.20 e	8.416 c	12.60 b	
50,(3cm/l)	22.93 c	134.333 c	5.60 a	0.873 b	0.155 b	70.03 d	8.550 b	12.70 b	
M w	11.93 e	151.700 a	5.60 a	0.866 b	0.154 b	80.0 a	9.250 a	13.17 a	
Control	27.86 a	79.333 e	4.66 c	1.006 a	0.215 a	61.43 f	8.016 d	11.60 c	
Source of variation	d.f.	Mean Square							
Year	1	0.42250	18.06250	0.10454444	0.00027778	0.000191	16.2677	0.07111	0.00444
Rep (within year)	4	0.09055	7.69667	0.00837778	0.00021389	0.000005	0.3752	0.02694	0.0513888
Treat	5	192.90*	4130.459*	1.0400111*	0.0891666*	0.00734*	260.4664*	1.3897*	1.96533*
Treat × year	5	0.2591*	3.15917*	0.0085444*	0.0009244*	0.00004*	0.526444*	0.0142*	0.039777*
Error	20	0.20822	4.18433	0.01217778	0.00114056	0.000026	0.4532	0.01536	0.0477222

⁽¹⁾ Means within column followed by the same letter(s) are not significantly different at 0.05 level of probability.

* Agro promotor1 (substance No.48).

** Agro promotor2 (substance No.50).

*** MW (Magnetic water)

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تأثير الماء الممغنط والمواد الكيميائية على صفات النمو، المحصول ومكوناته في محصول البصل تحت ظروف اسيوط

شرين يعقوب عطالله

قسم الخضراوات - كلية الزراعة - جامعة اسيوط

الملخص

اجريت هذه الدراسة بمزرعة الخضراوات البحثية - كلية الزراعة - جامعة اسيوط وذلك خلال عامي ٢٠١٤-٢٠١٥ ، ٢٠١٥-٢٠١٦ باستخدام الماء الممغنط ورش بعض المواد الكيميائية التي تم الحصول عليها من جامعة القاهرة. وتم دراسة تأثير الماء الممغنط وايضا مادة ٤٨، مادة ٥٠ بتركيز ١,٥ مل/لتر ، ٣ مل/لتر وذلك بالرش ٦ مرات خلال الموسم على النمو والمحصول ومكوناته في صنف البصل جيزة ٦. ووضحت النتائج الاتي:

كان لكل من الماء الممغنط والمادة الكيميائية ٤٨ بتركيز ٣ سم/لتر تأثير واضح على صفات النمو والمحصول ومكوناته مقارنة بالكنترول. فكان لهما تأثير على طول النبات ووزنه، وعدد الاوراق/نبات ، وقطر البصلة. وايضا على وزن البصلة والمحصول الصالح للتسويق والمحصول الكلي والمواد الذائبة الكلية مقارنة بمعاملة الكنترول التي ادت الى زيادة نسبة النباتات المزهرة ونستخلص من ذلك ان استخدام كلا من الماء الممغنط والمادة ٤٨ ادى الى تحسين النمو والمحصول والجودة في البصل. فلقد زاد المحصول الصالح للتسويق بمقدار ٣٠% عن معاملة الكنترول عند استخدام الماء الممغنط ، وزاد بمقدار ٢٢-٢٣ % عند استخدام المادة الكيميائية ٤٨ بتركيز ٣ مل/لتر. وتراوحت مقدار الزيادة في المحصول الكلي من ١٢-١٥,٤ % عند استخدام الماء الممغنط، وبمقدار ١٤-١٥,٤ % عند استخدام المادة الكيميائية ٤٨ بتركيز ٣ مل/لتر. وأدى استخدام الماء الممغنط الى الحصول على أعلى محصول صالح للتسويق واقل نسبة من النباتات المزهرة عن استخدام المادة الكيميائية ٤٨ بتركيز ٣ مل/لتر. اما بالنسبة للمحصول الكلي، والمواد الصلبة الذائبة الكلية فلم تكن هناك فروق معنوية بين استخدام الماء الممغنط والمادة الكيميائية ٤٨ بتركيز ٣ مل/لتر. لذلك توصي الدراسة باستخدام الماء الممغنط للحصول على أعلى محصول صالح للتسويق واقل نسبة من النباتات المزهرة ، وفي حالة عدم توفر هذه المعاملة يمكن استخدام المادة الكيميائية ٤٨ بتركيز ٣ مل/لتر.