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RESPONSE OF ONION TO WATER STRESS AND BIO-FERTILIZERS

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ABSTRACT

Two field experiments were conducted at the Experimental Farm Faculty Agriculture Mansoura University, Egypt, during 2006/2007 and 2007/2008 seasons to study the effect of water stress (irrigation at 24, 28,32 and 36cb) and mineral as well as bio-fertilizers combinations i.e. 100% of the recommended dose of NPK, 75% of the recommended dose of NPK alone or plus Alga 600 or plus Algreen or plus Amino total or plus Soft guard as a foliar spraying on yield and its components of onion.

Results showed that increasing watering tension from 24cb through 36cb gradually with great significant decreased the averages onion bulb weight (g), bulb diameter (cm), total bulbs yield (t/fad), bulbs marketable yield (t/fad), and significantly reduced the losses percentage after 2+4+6 months in both seasons. However, increasing watering tension from 24cb through 36cb significantly increased culls bulb yield (t/fad) by each increase in irrigation tension. Normal irrigation of water supply at 24cb markedly recorded the heighst losses percentage of bulbs dry weight in both seasons.

Results indicated that application of 75% NPK+ Soft guard significantly increased average bulb weight (g/plant), bulbs diameter (cm), total bulbs yield (t/fad) and marketable bulbs yield (t/fad) compared with the rest fertilization treatments. However, culls bulbs yield was not significantly response to mineral and bio-fertilization in both seasons.

No significant effect was recorded due to the interaction between irrigation tension treatments and mineral as well as bio-fertilization on bulb weight (g), bulb diameter (cm), total bulbs yield (t/fad), culls bulb yield (t/fad) and bulbs marketable yield (t/fad), while significant interaction was recorded on post harvest losses percent after 2+4+6 months in both seasons.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important vegetable and field crops grown and used throughout the world. It can be grown/produced under a wide range of climates from temperate to tropical and on many soils, but medium textured soils are preferred.

The production of the best yield and yield requires require soils must have favorable physical, chemical nutritional and biological conditions in addition to adequate of moist with the frequent irrigation with the satisfied water levels. Good effects of organic nitrogen treatment as well as bio-fertilizer in increasing onion growth and yield have been reported by Awad *et al.* (1993) and Balemi *et al.* (2007).

Sorensen and Grevsen (2002) reported that drought stress during the final growth forced the onions to mature. This effect reduced the yield. The percentage of single-center onion bulbs was lower when the soil-water stress occurred earlier in the growing season than when the stress occurred. Woldetsadik (2003) recognized that soil moisture stresses at all shallot

(*Allium cepa var. ascolonicum*) growth stages severely affected yield and quality. Frequent irrigation at 25% depletion of available moisture throughout the growing season was required to achieve high yields. Mateen (2005) concluded that 5 days of irrigation interval is a better irrigation interval as compared to other treatments in case of plant growth and bulb yield. Maximum seedling survival percentage 98 % and 97 % was observed in plots with 5 days of irrigation interval. And, observed that sprouting after harvest was significantly different in 5 days of irrigation intervals than other treatments. El-Sharkawy, Amal *et al.* (2006) stated that marketable bulbs yield was decreased by 5.85% - 14.19 % with alternative furrow irrigation (AFI) at 30 days interval, while 14.77 – 21.19 % increase was obtained under at AFI at 15 days interval, compared with these plants received water every furrow irrigation. Satyendra Kumar *et al.* (2007) showed that irrigation had significant effects on growth parameters of onion and subsequently influenced the bulb yield with increasing irrigation.

Onion being among the high nitrogen demanding plants, its productivity depends on use of adequate irrigation water and optimum fertilizer rates and if both is not adequate, considerable yield losses are apparent [Jayathilak *et al.* (2002) in India, Jayathilake *et al.* (2003) in Srilanka, Prabu *et al.* (2003) in Srilanka, Tadav *et al.* (2005) in India and Shaheen *et al.* (2007)] in Egypt.

Woldetsadik (2003), found that nitrogen fertilization promoted vegetative growth, delayed bulb development and exposed plants to soil moisture stresses ahead of maturity and, thus, reduced yield of rainfed shallots. When supplemental irrigation was provided, however, yield increases of about 10-15% from nitrogen fertilization in the range 75-150 kg/ha was achieved. Katung *et al.* (2005) found that the effect of NPK on storability of onion was not significant. Poultry manure at 5 or 10 t/ha significantly increased both marketable number and yield of onion. The higher dose of 10 t/ha significantly reduced loss after 5 months of storage by 19.96% in 2002 and 37.12% during 2003. A significant response with increasing farmyard manure levels was recorded for onion yield and storage quality. EL-Desuki *et al.* (2006) studied the effect of three levels of NPK fertilizers, i. e. 40, 70 and 100% of the recommended dose of NPK fertilizers application and bio-fertilizers (nitrobeine, Phosphorene, nitrobeine + Phosphorene) on yield and quality of onion. They showed that total bulbs yield, marketable yield (exportable and local) and unmarketable yield (cull and doubled bulbs) as well as bulb quality and its components were gradually and significantly increased with increasing the level of NPK-fertilizers from 40, 70 up to 100% of the recommended dose of fertilization. Except doubled bulbs which were not significantly affected by levels of mineral fertilizers application in both seasons. Halvorson *et al.* (2006) reported that onion is a high cash value crop with a very shallow root system that is frequently fertilized with high N rates (>200 lb N/a) to maximize yield and utilizes N fertilizer inefficiently. They found that total marketable fresh onion yield increased with increasing N rate. Balemi *et al.* (2007) found that application of 75 kg N ha^{-1}, along with inoculation of CBD-15 resulted in marked increase for most of the growth and yield parameters. It was followed by M-4 inoculation, compared to application of full dose of nitrogen without the inoculation. Days to bulb initiation were significantly reduced due to inoculation with CBD-15 or M-4 along with 50 kg N ha^{-1}. The finding demonstrated a saving of 50 kg N ha^{-1} without significantly affecting yield and an average increase of 13.5% marketable yield due to Azotobacter inoculation in the presence of 75 kg N ha^{-1}. Halvorson *et al.* (2007) studied the effect of nitrogen fertilizer on onion yield. They found that total marketable fresh onion yield increased with increasing nitrogen rate from (0 to 224 kg N/ha). Mahanthesh *et al.* (2008) reported that the plants provided with Azospirillum+ 100% NPK (Azospirillum+ 125 : 50 : 125 NPK kg/ha) have better storage qualities under irrigated conditions during rabi seasons.

Therefore, the objectives of this study were arranged to study the effect of water stress and mineral as well as bio-fertilizers combinations on some traits of yield and yield components of onion.

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm Faculty Agriculture Mansoura University Egypt, during 2006/2007 and 2007/2008 seasons. The aim of this investigation to study the effect of water stress and mineral as well as bio-fertilizers combinations on yield and quality of onion (Behairy Red cultivar. Seeds of this variety were obtained from Onion Research Center, Giza, Egypt.

Each irrigation treatment (irrigation at 24, 28, 32 and 36cb) was practiced in separate experiment. Every experiment was carried out in randomized complete block design with four replications.

The physical and chemical analyses of the soil of the experimental sites as determined by the methods described by **Page (1982)** are presented in Table 1.

Table 1: The Mechanical and chemical analysis of the experimental soil in both seasons.

Soil analysis	First season 2006/2007	Second season 2007/2008
A: mechanical analysis		
Clay (%)	49.3	49
Silt (%)	27.1	27.3
Fine sand (%)	20.7	20.8
Coarse (%)	2.9	2.9
Txture class	Clayey	Clayey
B: chemical analysis		
$CaCo_3$ (%)	3.8	3.7
Organic matter (%)	1.68	1.70
Total nitrogen	0.078	0.087
Available phosphate ppm.	8.90	9.32
Available potassium ppm.	348.1	369.2
EC (ds/m) at 25 c	1.90	1.86
PH	7.7	7.6

Treatments:

Four irrigation treatments i.e. Irrigation at 24 (control), 28, 32 and 36cb. Six Fertilizer treatments i.e. 100 % NPK (100 kg N+ 30 kg P_2O_5+24 kg K_2O) fed^{-1}, 75 % NPK (75 kg N+ 22.5 kg P_2O_5+18 kg K_2O) fed^{-1}, 75 % NPK (75 kg N+ 22.5 kg P_2O_5+18 kg K_2O) fed^{-1} + Alga 600, 75 % NPK (75 kg N+ 22.5 kg P_2O_5+18 kg K_2O) fed^{-1} + Algreen, 75 % NPK (75 kg N+ 22.5 kg P_2O_5+18 kg K_2O) fed^{-1}+ Amino total and 75 % NPK (75 kg N+ 22.5 kg P_2O_5+18 kg K_2O) fed^{-1}+ Soft guard.

Experimental land area preparation:

The preceding crop was maize (*Zea mays* L.) in both seasons. Land preparation, transplanting and crop management, all agronomic practices and treatments, except both studied factors, were uniformly applied to plants in the nursery and permanent land, as normally done by farmers in their fields of the experimental location. Each experimental basic unit included 5 ridges, each of 60cm width and 3 m length.

NPK fertilizers levels applied as previously mentioned rates. All dose of phosphorus as calcium super phosphate (15.5%P_2O_5) was applied after dividing and before transplanting. Only half dose of nitrogen in the form of Ammonium sulphate (20.5%N) and potassium sulphate (48%K_2O) were applied after transplanting immediately and before irrigation. The other half of nitrogen and potassium was applied before the first irrigation for irrigated treatments at 32 and 36cb, while it was applied before the second irrigation for plants irrigated at 24 and 28cb respectively. Transplanting took place during the first week of January, which seedlings were handy transplanted on both sides of ridges. The top portion of the transplants was pruned to a considerable extent, immediately before transplanting, for reducing transpiration. Seedlings were irrigated immediately after transplanting and afterwards, irrigation treatments were given as the aforementioned irrigation schemes. Bio-fertilizers were foliar added three times, at about 30, 45 and 60 days after transplanting, where most plots of the experiment were relatively wet.

Studied characters:

At harvest time ten guarded plants were chosen at rand on from the outer ridges of each plot to determine the following characters: Bulb weight (g), Bulb diameter (cm), total bulbs yield (t/fed), marketable bulbs yield (t/fed) and %Loss assessments (t/fad) at 2+4+6 months after storage.

Statistical procedures:

All obtained data were statistically analyze according to the technique of analysis of variance (ANOVA) for the randomized complete block design to each experiment (irrigation tension), then combined analysis was done between irrigation treatments (Gomez and Gomez 1984). New least significant differences between treatment means at 5% level of probability as described by Waller and Duncan (1996).

RESULTS AND DISCUSSION

1- Irrigation tension effect:

Results in Tables 2 and 3 showed that increasing watering tension from 24cb through 36cb gradually with great significant decreased in the average of onion bulb weight (g), bulb diameter (cm), total bulbs yield (t/fad), bulbs marketable yield (t/fad) and significantly reduced the losses percentage after 2+4+6 months in both seasons. Vice versa, increasing watering tension from 24 cb through 36cb significantly increased culls bulb yield (t/fad) by each increase in irrigation tension.

Table 2: Averages bulb weight (gm), bulb diameter (cm) and total bulbs yield (t/fad) as affected by water tension as well as mineral and bio-fertilization during 2006/2007 and 2007/2008 seasons.

Characters / Treatments	Bulb weight (g/plant)		Bulb diameter (cm)		Total bulbs yield (t/fad)	
	2006/2007	2007/2008	2006/2007	2006/2007	2006/2007	2007/2008
Irrigation Tension:						
Irrigation at 24cb	80.807	79.683	5.913	6.263	17.675	15.854
Irrigation at 28cb	73.847	76.117	5.404	5.842	15.465	15.200
Irrigation at 32cb	66.678	62.117	4.975	5.213	12.318	12.751
Irrigation at 36cb	59.954	53.333	4.696	4.450	11.301	10.989
F test	**	**	**	**	**	**
NLSD (5%)	2.140	1.116	0.012	0.730	0.354	0.242
Fertilization:						
100% NPK	71.434	70.175	5.206	5.581	14.516	13.939
75% NPK	63.065	59.625	4.925	4.956	11.925	12.092
75% NPK+ Alga 600	72.683	68.400	5.350	5.394	14.356	13.762
75% NPK+ Algreen	70.875	67.150	5.212	5.262	14.273	13.524
75% NPK+ Amino total	71.573	70.125	5.387	5.681	15.006	14.325
75% NPK+ Soft guard	72.299	71.400	5.400	5.775	15.064	14.550
F test	**	**	**	**	**	**
NLSD (5%)	2.390	1.229	0.138	0.088	0.535	0.233
Interaction :						
F test	N.S	NS	NS	NS	NS	NS

The highest mean values of onion bulb weight (g/plant) were produced by normal irrigation recommendation at 24cb and the corresponding data were 80.807 and 79.683 (g) in the first and second seasons, respectively. The highest bulb diameter (cm) was recorded under normal irrigation tension i.e. 24cb and the corresponding results were 5.913 and 6.263 (cm) in the first and second season, respectively. The drought stress under watering tension 32cb and 36cb recorded the lowest mean values of growth parameters, i.e. bulb diameter, length and consequently onion total bulb yield in both seasons of study. However, the heaviest mean value was produced when onion plants were grown under normal watering tension at 24cb.

Increasing watering tension from 24cb to 28cb markedly decreased total bulb yield by 8.54% over both seasons. The maximum culls bulb yield (t/fad) were recorded under irrigation tension at 36cb in both seasons with corresponding data were 0.687 and 0.784 t/fad in the first and second seasons, respectively.

Table (3): Averages of Marketable bulbs yield (t/fad), Culls bulbs yield (t/fad) and % Loss assessments after 2+4+6 Months as affected by water tension as well as mineral and bio-fertilization during 2006/2007 and 2007/2008 seasons.

Characters / Treatments	Marketable bulbs yield (t/fad)		Culls bulbs yield (t/fad)		% Loss assessments after 2+4+6 Months	
	2006/2007	2006/2007	2006/2007	2007/2008	2006/2007	2007/2008
Irrigation Tension:						
Irrigation at 24cb	17.090	15.276	0.585	0.578	8.062	9.217
Irrigation at 28cb	14.855	14.579	0.611	0.621	7.249	7.663
Irrigation at 32cb	11.689	12.102	0.629	0.649	6.720	5.921
Irrigation at 36cb	10.614	10.205	0.687	0.784	5.433	5.121
F test	**	**	**	**	**	**
NLSD (5%)	0.348	0.230	0.038	0.041	0.480	0.414
Fertilization:						
100% NPK	13.898	13.292	0.618	0.647	7.656	8.294
75% NPK+ Water	11.319	11.421	0.606	0.670	7.065	6.563
75% NPK+ Alga 600	13.703	13.091	0.653	0.671	6.801	6.869
75% NPK+ Algreen	13.640	12.907	0.633	0.617	6.760	6.956
75% NPK+ Amino total	14.373	13.641	0.632	0.684	6.410	6.950
75% NPK+ Soft guard	14.438	13.890	0.625	0.660	6.504	6.250
F test	**	**	NS	NS	**	**
NLSD (5%)	0.535	0.239	-	-	0.421	0.346
Interaction :						
F test	NS	NS	NS	NS	**	**

Normal irrigation of water supply at 24cb markedly recorded the heighst losses percentage of bulbs dry weight in both seasons.

The results indicated that increasing the irrigation tension means to increase the dryness through little value for soil water holding capacity and then decreased onion total yield with increasing irrigation tension which resulted in less available moisture contents to supply onion plants and intern reduced growth and development of bulbs with lower yields. **Rita (1998), Woldetsadik (2003) and Satyendra Kumar *et al.* (2007)** came to the same conclusion.

A Surplus supply of water under normal watering recommendation (24cb) the post harvest losses increased because of increasing the sprouting of onion bulbs.

2- Mineral and bio-fertilization effect:

Results presented in Tables 2 and 3 showed that application of 75% NPK+ Soft guard significantly increased averages bulb weight (g/plant), bulb diameter (cm), total bulbs yield (t/fad) and marketable bulbs yield (t/fad) as compared with application of 75%NPK fertilizer combinations which gave the least values of losses assessments bulbs yield after 2+4+6 months (t/fad) in both seasons.

The heighst bulb weight values in both seasons were realized with foliar spraying of soft guard at 300 ppm under application of 75% NPK. The maximum bulb diameter with great significant was recorded by foliar spraying of Amino total or Soft guard with application of 75% NPK fertilizers application in both seasons. Also, the results indicated that the combination of 75 % NPK plus Amino total or plus Soft guard recorded the heighst and the most significant increase in total bulb yield.

The results indicated that the combination of 75% NPK+ Amino total or Soft guard recorded the heighst and the most significant increase in bulbs marketable yield. Application of 100% NPK increased marketable yield by 16.36% as compared with application of 75% NPK. More, application 75% NPK + Alga 600 or 75% NPK+ Algreen recorded a reduction in bulbs marketable yield by 5.32% as compared with 75% NPK plus Amino total or plus Soft guard over both seasons (Table 3). Such increases in onion yield bulbs due to addition of 100% NPK fertilizer combination (normal recommendation) may be attributed to the role of nitrogen in increasing meristematic activity of onion tissues and increasing internal length of bulbs which reflecting increases in bulbs marketable yield. Moreover addition of P, K together with nitrogen my increase the metabolic components synthesized on the plant and these in turn contribute much increase in the amount of metabolites translocated from different parts of the plant to the bulb. These results are in agree with those reported by **Brown *et al.* (1997), EL-Sheekh (1997), Thilakavathy and Ramaswamy (1999) and Halvorson *et al.* (2007)**.

Data clear that culls bulbs yield was not significantly response to mineral and bio-fertilization in both seasons.

Interaction effect:

No significant effect was recorded due to the interaction between irrigation tension treatments and mineral as well as bio-fertilization on bulb weight (g), bulb diameter (cm), total bulb yield (t/fad), culls bulb yield (t/fad) and bulbs marketable yield (t/fad) in both seasons. While, Significant interactions were recorded on post harvest losses percent after 2+4+6 months as shown in Table (4).

After 2+4+6 months from storage period the maximum losses percentage (10.176 and 11.650%) were obtained by the treatment including irrigation at 24cb with 100% NPK fertilization in the first and second season, respectively. The lowest values of post harvest losses percentage were (5.087 and 4.525%) and recorded under irrigation at 36cb and application of 75% NPK + Soft guard.

Table (4): Averages of losses assessment percentage after 2+4+6 months as affected by interaction between water tension as well as mineral and bio-fertilization during 2006/2007 and 2007/2008 seasons.

	% Loss assessment after 2+4+6 months							
	2006/2007				2007/2008			
	I_1	I_2	I_3	I_4	I_1	I_2	I_3	I_4
100% NPK	10.17	8.227	6.182	6.040	11.65	9.075	6.375	6.075
75% NPK + Water	8.668	7.297	6.882	5.414	9.075	6.850	5.600	4.725
75% NPK+ Alga 600	8.330	6.246	7.123	5.505	9.275	7.350	6.100	4.750
75% NPK+ Algreen	7.467	7.144	7.083	5.346	8.200	7.900	6.075	5.650
75% NPK+ Amino total	6.806	7.314	6.313	5.206	8.675	7.525	6.600	5.000
75% NPK+ Soft guard	6.922	7.269	6.737	5.087	8.425	7.275	4.775	4.525
F-test	**				**			
NLSD 5%								

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إستجابة البصل للإجهاد المائي والتسميد الحيوي

أحمد أبـو النجـا قنـديل ، أحمـد نـادر السـيد عطيـه ، علـى السـعيد شـريف و أحمد عبد الرحيم ليله
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أقيمت تجربتان حقليتان في مزرعة التجارب والبحوث بكلية الزراعة جامعة المنـصورة خلال موسمي ٢٠٠٦/٢٠٠٧ و ٢٠٠٧/٢٠٠٨ وذلك لدراسة تأثير الإجهاد المائى (الري عند شـد رطوبى ٢٤ ، ٢٨ ، ٣٢ و ٣٦ سم بار) بالإضافة إلى ست معاملات من مخـاليط مـن الأسـمدة المعدنية والحيوية (١٠٠% من الكمية الموصى بها من العناصر السمادية النيتروجين والفوسـفور والبوتاسيوم ، ٧٥% من الكمية الموصى بها ، ٧٥% من الكمية الموصى بها +الأسمدة الحيويـة ألجا ٦٠٠ أو ألجرين أو امينوتوتال أو سوفت جارد) على صفات المحصول ومكوناته في البصل.
أوضحت النتائج أن تدرج الري من ٢٤ إلى ٣٦ سم بار شد الرطوبى أدت إلى إنخفاض تـدريجى ومعنوى لصفات متوسط وزن البصلة ، قطر البصلة ، المحصول الكلى للأبصال(طـن/فـدان) ، محصول الأبصال الصالحة للتصدير(طن/فدان) و إنخفاض معنوى أيضا لنسبة الفقد الكلـى بعـد شهرين و أربعة شهور وستة شهور من التخزين أى زيادة القدرة التخزينية. في حين زادت صـفة الأبصال النقضة (طن/فدان) معنويا بزيادة الشد الرطوبى. سجل الري العادى عند ٢٤ سـم بـار أعلى نسبة للفقد في الوزن الجاف للأبصال في كلا الموسمين.
كما أثبتت النتائج أن إضافة ٧٥% من النيتروجين والفوسفور والبوتاسيوم + سوفت جـارد أدت إلى زادة معنوية في صفات متوسط وزن البصلة ، قطر البصلة ، المحصول الكلى للأبـصال (طن/فدان) محصول الأبصال الصالحة للتصدير(طن/فدان) مقارنـة ببـاقي معـاملات التـسميد الأخرى، بينما لم يتأثر محصول الأبصال النقضة معنويا بمعاملات التسميد الحيوى والمعدنى.
لايوجد تأثي معنوى للتفاعل بين معاملات الشد الرطوبى ومعاملات التسميد علـى جميـع الصفات المدروسة ما عدا صفة نسبة الفقد الكلية بعد الحصاد للأبصال المخزنة بعد شهرين وأربعة شهور وستة أشهر حيث كانت عالية المعنوية في كلا الموسمين.