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EFFECT OF FOLIAR SPRAY ON ONION PRODUCTIVITY UNDER RAINFALL AND SUPPLEMENTARY IRRIGATION CONDITIONS

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ABSTRACT

The field experiment was carried out during two experimental seasons of 2005/2006 and 2006 / 2007 under calcareous soil and rainfall conditions in El-Hammam region at North Western Coastal Zone (NWCZ) of Egypt. The aim of this research was to study the vegetative growth, yield and its components as well as chemical compositions of onion plants (*Allium cepa*, L.) cv. Giza-20 as influenced by 4 treatments of supplementary irrigation (rainfall, rainfall plus 60 mm/fed, rainfall plus 75 mm/fed and rainfall plus 90 mm/fed) and 4 foliar spray treatments (potassium carrying phosphor (K.P), potassium carrying nitrogen (K.N), (K.P plus K.N) and control treatment. The commercial name were Butasin – p and Butasin – N and its interaction. The concentration of each foliar spray treatment was 4 cm \ L. Application of foliar spraying was three times at 30, 45 and 60 days after transplanting.

Rainfall plus 90 mm supplementary irrigation treatment led to obtain the maximum values for all vegetative growth characteristics (survival ratio, plant length, number of leaves per plant, fresh and dry weight per plant. The values of yield, (bulb fresh and dry weight, bulb dry matter%, bulbing ratio and yield ton/fed were increased by increasing the rate of supplementary irrigation. Also, the bulb content of T.S.S., nitrogen, phosphorus and potassium, gave the highest values with using rainfall plus 90 mm/fed supplementary irrigation. Foliar spray treatment with K.P + K.N, gave the highest significant increases when compared with other foliar spray treatments on all characteristics under study,

The interaction treatment, rainfall and 90 mm supplementary irrigation combined with foliar spray treatment with K.P + K.N, led to obtain the maximum values for all characteristics under study in both growing seasons.

Keywords: Onion, *Allium cepa*, foliar spray, K-P, K-N, rainfall, supplementary irrigation, vegetative growth, yield.

INTRODUCTION

In Egypt, onion (*Allium cepa*, L.) is one of the most important vegetable crops. The total grown area amounted by 87.47 thousands fed., produced about 1147.6 thousands ton and by average 13.12 tons/fed. according to Agricultural Economic Research Institute, AERI, (2006). Onion, is a biennial of the Alliacea family. It has beneficial medicine effect due to volatile oil content which are contain antibiotic components, also, it is eaten fresh or with salad. It is cooked with the most vegetables during all the year. Green and spring onions are eaten for their immature bulb and green foliage. Shortage of readily available soil water is eliminated and the technological and biological characteristics of the crop are taken into account, it is possible to achieve high growth and stable yields of irrigated onions, at the level of 40 t ha-1 or higher (Halim and Ener, 2001, Kanton *et al.,* 2003 and Peji *et al.,*

2008). In arid and semiarid areas, irrigation may supply all or most of the crop water needs, because of a shallow root system of onion, the common practice, therefore, is to apply slight and frequent irrigation rates (Pelter *et al.,* 2004). Much lower yields are primarily because of inadequate irrigation scheduling (Mermoud *et al.,* 2005). Kadayifci *et al.* (2005) reported that in Turkey, onion is cultivated under non-irrigated and irrigated conditions with yield of 10 to 40 t ha-1, respectively and pointed out the influence of environmental conditions of each year both on yield and evapotranspiration of onion. Water harvesting and supplemental irrigation was economically viable under local conditions. It is used primarily to supplement infrequent or irregular precipitation during drought periods (Peji *et al.,* 2008).

As regard. Abu-Awwad (1996), Saha *et al.* (1997) and Wright and Grant, (1997) mentioned that significant improvement in onion plant growth, yield attributes and bulb yield were observed with supplemental irrigation. However, marketable yield showed different response; as water application decreased, the percentage of marketable yield increased. Also, Rutkowski and Małecka (1986) tested the reaction of various plants to irrigation when planted on poor soil. It was found that supplemental irrigation increased plant growth and marketable yield of onion. In the same line, Kumar *et al.* (2007) and Enciso *et al.* (2009) found that irrigation highly affected the morphological characteristics of onion bulbs, but did not affect the level of soluble solids in bulbs. Similar results were reported on pea (Fahmya *et al.,* 2010).

It is known that potassium, nitrogen and phosphor play pivotal roles in plant growth and development. Potassium is necessary for the translocation of sugars and formation of carbohydrates, In addition, foliar spray of potassium as a stimulated dose had a significant effect on the dry weight of leaves and N % as well as K % in leaves tissues and significantly increased total yield and fruit quality in eggplant Fawzy *et. al.* (2007) and Abd El-Al *et al.* (2005)

Nitrogen plays an important role to reach the optimum yield of onion and is found essential to increase the bulb size and yield as well as increasing dry weight of bulb and nitrogen content Patel and Patel (1990) and Khan *et al.,* (2002).

The presence of phosphorus in the soil encourages plant growth because the phosphorus is an essential nutrient and a major building block of DNA molecules (Pant and Reddy, 2003). Hinsinger (2001), Ghoname and Shafeek *et al.* (2004) and Shafeek *et al.* (2004) reported that, the phosphorus fertilizer had a major effect on the productivity of onion plant, hence increased total bulb yield and its components. It may be attributed to the enhancement of phosphorus on the plant growth and it's reflected on the bulbs yield. Many investigators had obtained a similar trend of results Ali *et al.* (2001), Almadini *et al. (*2000) and Alkaff *et al. (*2002).

The research was applied through big project in El- Hammam North Western Coastal Zone (NWCZ) area under implementation to cultivate 62,500 hectare by applying two or three supplemental irrigations (according to the available water from River Nile) beside the natural precipitation. Many countries in West Asia and North Africa (WANA) region applied the supplemental irrigation to improve the productivity of the unit area under

different rates of supplemental irrigation with respect to amount and numbers for different crops under fertilization programmed.

This study was designed to provide information about the effect of foliar spray with potassium carrying nitrogen and potassium carrying phosphor as well as application of levels supplementary irrigation on onion plants to assess the feasibility of onion production under the conditions of El-Hammam region at North Western Coastal Zone**.**

MATERIALS AND METHODS

The productivity of onion was determined under calcareous soil and rainfall conditions in El-Hammam region at North Western Coastal Zone (NWCZ) of Egypt. The field experiment was conducted through two growing seasons i.e. 2005/2006 and 2006/2007. The treatments were the combination between 4 treatments as supplementary irrigation, i.e. rainfall, rainfall plus 60 mm/fed, rainfall plus 75 mm/fed and rainfall plus 90 mm/fed and 4 foliar spray treatments (the phosphorus carried on potassium (K.P), the nitrogen carried on potassium (K.N), mixture of phosphor and nitrogen carried on potassium (K.P + K.N) and control (without spray). The comercial names are Butasin – P and Butasin - N, which were used at a concentration of 4 cm \ L for each. Plants were sprayed three times, i.e. at 30, 45 and 60 days after transplanting started on 1st and 15th of December in the first and second growing seasons, respectively.

Mechanical and chemical analyses of soil and underground water are shown in Tables (A, B and C) according to Black and Editor (1965), Jackson (1967) and Richards (1954), respectively. Mean values of precipitation of rainfall throughout seasons and the main climatological data are recorded in Table (C).

During soil preparation just before sowing were added 10 m^3 compost /feddan plus 100 kg super phosphate (15.5% P_2O_5) were added. The experimental area was 3.5 m length and 3 m width (10.5 m^2), included 5 rows with 0.6 m apart and 10 cm distance between transplants. Planting irrigation from underground water was applied at rate 45 mm for all the experimental units on 1st and 15th of December in the first and second growing seasons, respectively, (because precipitation rainfall suitable for planting was late).

Developed surface irrigation system was implemented by using Git pipes system and gated pipe. Water counter was used to calculate the amount of water during two growth seasons from underground water source

The experiments were arranged in split plot design with three replicates .Irrigation treatments were occupied in the main plots ,while the subplots were assigned to foliar spray treatments. The statistical analysis were carried out according to procedure of Steel and Torrie (1960).The differences among means were tested using LSD at the level of 0.05..

Table (A): Soil properties and chemical analysis of the experimental site at El–Hammam (NWCZ).

Characters		Depth (cm)	
		0-30	30-60
Cations	pH	7.89	7.91
	T.S.S	2.4	1.43
	Na^{+}	15.2	6.2
	K^{+}	0.08	0.03
	Ca^{+2}	3.15	5.51
	Mg^{+2}	-	2.56
Anions	CO_3	-	-
	HCO_3	0.45	0.32
	Cl^{-}	19.4	8.5
	SO_4	4.15	5.48
Soil properties			
	Saturation percentage	40.0	40.0
	Sand	54.9	56.3
	Silt	18.15	19.9
	Clay	27.0	24.8
Soil texture		sandy	sandy

Table (B): Chemical analysis of the underground irrigation water at El – Hammam (NWCZ),

Elevation	Depth to water(m)	Water level (m)	EC (mmohs/cm)	TDS ppm	pH	K^{+} (ppm)	Na^{+}	Mg^{+2}	Ca^{+2}	Cl^{-}	SO_4	HCO_3
24	9.55	11.5	2.48	1587	8.65	18	299	63	107	590	125	285

Table (C): Meteorological parameters at El –Hammam area (NWCZ),

Items		Relative humidity (%)	Dew Point (C^{O})	Temperature (C^{O})	Rainfall (mm)
2005-2006	Dec.	74.33	10.40	15.33	25.20
	Jan.	70.67	8.70	13.36	49.00
	Feb.	72.00	8.86	14.10	8.61
	Mar.	64.67	9.10	16.20	8.40
	Apr.	66.33	12.46	19.33	4.20
					106.12*
2006-2007	Dec.	70.495	9.83	15.795	19.35
	Jan.	67.00	8.50	14.83	6.37
	Feb.	64.33	8.76	14.66	32.90
	Mar.	68.00	10.26	17.60	15.40
	Apr.	63.495	12.545	19.615	0.0
					93.27*

*** sum of rainfall amounts during 2005/2006 and 2006/2007 growing seasons.**

Data recorded:

A. Vegetative growth characters: five plants were taken at 120 days after transplanting from each plot as a representative sample for recording survival ratio, plant length, number of leaves per plant and fresh and dry weight per plant.

B. Yield and its components

Total yield, bulb fresh and dry weight /plant, bulb Dry matter%, bulbing ratio were determined after 150 days from transplanting.

C- Chemical composition

The contents of N, P and K were estimated using wet ashing method according to Johnson and Ulrich (1959). The total nitrogen was determined according to the method of Huphries (1965) by a modified micro-Kjildahle apparatus. But, Phosphorus was determined calorimetrically according to the method of Frie *et al.* (1964). While, potassium was measured flame photometrically as described by Brown and Lilliland (1964). Total soluble solids (T. S. S.) were determined by refractometer.

RESULTS AND DISCUSSION

1 - Vegetative growth characters:

1-1- Effect of supplementary irrigation:

Results in Table (1) showed that increasing rates of supplementary irrigation increased growth characteristics of onion plants, namely, survival ratio, plant length, number of leaves, fresh and dry weight. The highest values were obtained from application of rainfall plus 90 mm supplementary irrigation treatment. The same trend of results was observed in the two seasons. The results agree with those obtained by Abu-Awwad (1996) who reported that with supplemental irrigation, winter onion production per unit area could be increased by two to three times than of non-irrigated onion. Also, Koriem *et al.* (1994), Saha *et al.* (1997), Wright and Grant (1997) mentioned that significant improvement in onion plants growth were observed with supplemental irrigation. Halim and Ener (2001) and Peji *et al.* (2008) showed that in case of shortage of readily available soil water, it is possible to achieve high growth by water supply in irrigation. This may be due to supplemental that irrigation increase the availability of nutrient in soil and plants could absorb the required nutrients for growth.

Table (1): Effect of supplementary irrigation on onion vegetative growth, in 2005 / 2006 and 2006 / 2007 growing seasons.

Supplementary irrigation	Survival ratio		Plant length (cm)		No. of leaves /plant		Leaf fresh weight g/plant		Leaf dry weight g/plant	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rainfall	36.61	40.37	27.00	28.35	4.05	4.25	26.28	27.59	4.11	4.53
Rainfall+ 60 mm	46.33	51.08	38.86	40.80	4.80	5.04	40.41	42.43	6.31	6.95
Rainfall+ 75 mm	52.75	58.15	49.57	52.04	5.43	5.70	47.28	49.64	5.87	6.47
Rainfall+ 90 mm	56.62	62.42	61.72	64.81	6.10	6.41	59.40	62.37	6.95	7.67
LSD	**0.45**	**0.11**	**0.75**	**0.19**	**0.23**	**0.01**	**0.75**	**0.17**	**0.56**	**0.02**

1st = First season 2nd = Second season

1-2- Effect of foliar spray:

The leaves are green factories where photosynthesis produces compounds needed for growth. Data in Table (2) revealed that all characters of plant growth during two growth seasons increased with applying

foliar spray treatments. The highest values of all growth characters were obtained with application of foliar spraying with mixture of phosphor and nitrogen carrying on potassium (K.P + K.N). Many studies reported several roles of such elements on onion plant growth such as plant height, number of leaves/ plant, fresh and dry weight of plant (Singh and Mohanty, 1998, Al-Moshileh (2001) and Singh *et al.* (2002) reported that plant growth of onion was the highest with basal application of NPK and foliar application of 1% Multi-K at 30, 45 and 60 days after planting. El Bassiony (2006) found that using potassium sulfate plus a stimulated dose of potassium oxide as foliar application resulted in the highest plant growth (plant length, number of leaves/plant, and fresh weight of leaves). The obtained results may be due to that It is known that potassium, nitrogen and phosphor play pivotal roles in plant growth and development. Potassium is necessary for the translocation of sugars and formation of carbohydrates, In addition, foliar spray of potassium as a stimulated dose had a significant effect on the dry weight of leaves and N % as well as K % in leaves tissues and significantly increased total yield and fruit quality in eggplant Fawzy *et. al.* (2007) and Abd El-Al *et al.* (2005). The presence of phosphorus in the soil encourages plant growth because the phosphorus is an essential nutrient and a major building block of DNA molecules (Pant and Reddy, 2003).

Table (2): Effect of nutrient foliar spray on onion vegetative growth, in 2005/2006 and 2006/2007 growing seasons.

Foliar application	Survival ratio		Plant length (cm)		No. of leaves /plant		Leaf fresh weight g/plant		Leaf dry weight g/plant	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
without.	40.61	44.77	36.50	38.32	4.18	4.38	35.93	37.72	5.29	5.84
K. P	44.58	49.15	43.17	45.33	5.10	5.36	42.36	44.48	5.71	6.30
K.N	51.12	56.36	46.00	48.29	5.23	5.49	45.59	47.87	5.80	6.39
KP+N	56.00	61.74	51.49	54.06	5.88	6.17	49.48	51.95	6.43	7.09
LSD	**0.56**	**0.21**	**0.74**	**0.18**	**0.31**	**0.02**	**0.94**	**0.17**	**0.43**	**0.01**

1st = First season 2nd = Second season

1-3- Effect of interaction:

Data in Table (3) showed that the highest values of onion growth characters were obtained from interaction of, ranifed plus 90 mm with spraying plants with mixture of phosphor and nitrogen carrying on potassium (K.P + K.N). The results were true in the two growing seasons. The results are also corroborated by Abu-Awwad (1996) and Saha *et al.* (1997) on supplementary irrigation, as well as by Al- Moshileh (2001) and Singh *et al.* (2002) on effect of N. P. K. on plant growth.

Table (3): Effect of interaction between supplementary irrigation and foliar application on onion vegetative growth, in 2005 / 2006 and 2006 / 2007 growing seasons.

Sup. irrig.	Foliar app.	Survival ratio		Plant length (cm)		No. of leaves /plant		Leaf fresh weight g/plant		Leaf dry weight g/plant	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rainfall	without.	29.70	32.74	25.47	26.74	3.60	3.78	23.64	24.82	4.09	4.51
	K. P	34.38	37.90	26.47	27.79	4.10	4.31	25.18	26.44	3.86	4.25
	K.N	36.04	39.74	27.11	28.47	4.10	4.31	26.14	27.45	3.95	4.35
	KP+N	46.33	51.08	28.96	30.41	4.40	4.62	30.15	31.66	4.52	4.99
Rainfall+ 60 mm	without.	37.09	40.89	33.14	34.80	3.90	4.10	35.64	37.42	5.79	6.39
	K. P	43.62	48.09	38.25	40.16	4.60	4.83	40.31	42.33	6.58	7.25
	K.N	50.18	55.32	38.41	40.33	4.80	5.04	40.75	42.79	5.83	6.43
	KP+N	54.43	60.00	45.64	47.92	5.90	6.20	44.92	47.17	7.03	7.75
Rainfall+ 75 mm	without.	45.93	50.64	41.25	43.31	4.30	4.52	38.21	40.12	5.14	5.67
	K. P	49.28	54.33	45.64	47.92	5.60	5.88	46.31	48.63	5.70	6.29
	K.N	56.97	62.81	50.25	52.76	5.70	5.99	48.94	51.39	5.93	6.53
	KP+N	58.80	64.83	61.12	64.18	6.10	6.41	55.64	58.42	6.70	7.39
Rainfall+ 90 mm	without.	49.70	54.79	46.12	48.43	4.90	5.15	46.21	48.52	6.16	6.79
	K. P	51.04	56.27	62.32	65.44	6.10	6.41	57.64	60.52	6.71	7.40
	K.N	61.28	67.56	68.21	71.62	6.30	6.62	66.54	69.87	7.48	8.25
	KP+N	64.45	71.06	70.23	73.74	7.10	7.46	67.21	70.57	7.47	8.24
LSD		0.89	0.45	0.75	0.75	0.43	0.04	1.32	0.69	0.26	0.06

1st = First season 2nd = Second season

2- Yield and its components

2-1- Effect of supplementary irrigation:

The yield and its components of onion bulb (Table 4) was significantly increased with supplementary irrigation treatment than rainfall conditions only. The highest values of total yield bulb fresh and dry weight, and the lowest values of dry matter and bulbing ratio were obtained with increasing supplementary irrigation up to 90 mm under rainfall conditions. Therefore, irrigation schedule of onion has to be adjusted to the climatic conditions of each year, mostly to amount and distribution of precipitation. Results are in agreement with those of Abu-Awwad (1996) who reported that with supplemental irrigation at 2 or 3 times for winter onion could increase the yield than of non-irrigated onion. Also, Saha *et al.* (1997) mentioned that significant improvement in onion yield attributes and bulb yield were observed with supplemental irrigation. Wright and Grant(1997)showed that increasing soil water supply increased total onion bulb yield significantly. Kadayifci *et al.* (2005) in Turkey, reported that, onion is cultivated under non-irrigated and irrigated conditions gave yield of 10 to 40 t ha-1, respectively. The improvement of yield with supplemental irrigation due to the increase of water help nutrients to be available in soil and uptake by plants (Halim and Ener, 2001) which was reflected on stimulation of plant growth (Table1)

Table (4): Effect of supplementary irrigation on onion yield and its components, in 2005 / 2006 and 2006 / 2007 growing seasons.

Supplementary irrigation	Bulb fresh W. (g)/plant		Bulb dry W. (g)/plant		Bulb dry matter%		Bulbing ratio		Yield ton/fed.	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rainfall	30.36	32.50	4.29	4.50	14.14	14.85	0.46	0.65	0.95	0.99
Rainfall+ 60 mm	38.56	37.46	5.16	5.42	13.41	14.08	0.30	0.44	1.53	1.60
Rainfall+ 75 mm	46.13	42.42	6.01	6.31	13.05	13.70	0.22	0.33	2.07	2.18
Rainfall+ 90 mm	60.11	45.42	7.29	6.26	12.17	12.78	0.17	0.26	2.92	3.07
LSD	**0.98**	**0.07**	**0.81**	**0.01**	**0.77**	**0.10**	**0.12**	**0.00**	**0.22**	**0.01**

1st = First season 2nd = Second season

2-2- Effect of foliar spray:

Data in Table (5) indicated that the highest values of yield, bulb fresh and dry weight but the lowest values of dry matter and bulbing ratio were obtained from foliar application of mixture of phosphor and nitrogen carried on potassium (K.P + K.N) treatment compared with single or without spray treatments. This might be due to that during plant growth development, soil potassium supply is seldom adequate to support crucial processes such as sugar transport from leaves to bulbs, enzyme activation, protein synthesis and cell extension which were reflected on improving plant growth (Table 2) and that ultimately determine bulb yield and quality (Williams and Kafkafi, 1998). Many investigators had a good accordance with that which was obtained in this script (Ali *et al.,* 2001, Almadini *et al.,* 2000, Alkaff *et al.* (2002). Sadanandan *et al.* (2002) and Singh *et al.* (2002) reported that bulb diameter, bulb size index, dry matter, weight of bulbs, and marketable yield of onion were the highest with basal application of NPK and foliar application of 1% Multi-K applied at 30, 45 and 60 days after planting. In another study, El Bassiony (2006) found that using potassium sulfate plus a stimulation dose of potassium oxide as foliar application resulted in the highest yield and bulb quality.

2-3- Effect of interaction:

Data in Table (6) showed that the best values for yield ,bulb fresh and dry weight, and the lowest values of dry matter and bulbing ratio were obtained from interaction between foliar spraying with mixture of phosphor and nitrogen carried on potassium (K.P + K.N) and rainfall plus 90 mm supplementary irrigation treatments.

Table (5): Effect of foliar application on onion yield and its component, in 2005 / 2006 and 2006 / 2007 growing seasons.

Foliar application	Bulb fresh weight g/plant		Bulb dry weight g/plant		Bulb dry matter%		Bulbing ratio		Yield ton/fed.	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
without.	33.62	35.13	4.46	4.42	13.39	14.06	0.41	0.63	1.18	1.24
K. P	43.26	39.95	5.65	5.43	13.24	13.90	0.32	0.44	1.67	1.76
K.N	45.53	41.85	5.92	6.06	13.19	13.85	0.24	0.35	2.04	2.14
KP+N	52.75	40.88	6.71	6.58	12.95	13.60	0.19	0.27	2.57	2.70
LSD	**1.36**	**0.08**	**0.25**	**0.03**	**0.14**	**0.10**	**0.11**	**0.00**	**0.19**	**0.02**

1st = First season 2nd = Second season

Table (6): Effect of interaction between supplementary irrigation and foliar application on onion yield and its component, in 2005 / 2006 and 2006 / 2007 growing seasons.

Sup. irrig.	Foliar app.	Bulb fresh W. g/plant		Bulb dry W. g/plant		Bulb dry matter%		Bulbing ratio		Yield ton/fed.	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rainfall	without.	26.31	30.72	3.76	3.95	14.31	15.03	0.67	0.91	0.66	0.69
	K. P	30.21	32.46	4.26	4.47	14.10	14.81	0.52	0.78	0.87	0.92
	K.N	31.50	33.68	4.46	4.68	14.15	14.86	0.37	0.55	0.95	1.00
	KP+N	33.41	33.14	4.68	4.91	14.00	14.70	0.27	0.36	1.30	1.37
Rainfall+ 60 mm	without.	31.21	32.14	4.26	4.47	13.64	14.32	0.46	0.78	0.97	1.02
	K. P	38.25	37.45	5.16	5.41	13.48	14.15	0.34	0.40	1.40	1.47
	K.N	40.15	39.67	5.38	5.65	13.41	14.08	0.24	0.32	1.69	1.78
	KP+N	44.64	40.59	5.85	6.14	13.11	13.77	0.18	0.27	2.04	2.14
Rainfall+ 75 mm	without.	35.64	38.73	4.71	4.94	13.21	13.87	0.28	0.45	1.38	1.44
	K. P	45.64	42.52	6.00	6.30	13.14	13.80	0.23	0.33	1.89	1.98
	K.N	48.94	45.45	6.41	6.73	13.10	13.76	0.21	0.30	2.34	2.46
	KP+N	54.31	42.99	6.92	7.27	12.75	13.39	0.17	0.25	2.68	2.82
Rainfall+ 90 mm	without.	41.31	38.93	5.13	4.33	12.41	13.03	0.24	0.39	1.72	1.81
	K. P	58.94	47.36	7.20	5.52	12.22	12.83	0.17	0.24	2.53	2.65
	K.N	61.54	48.58	7.45	7.18	12.10	12.71	0.16	0.21	3.17	3.33
	KP+N	78.64	46.81	9.40	8.00	11.95	12.55	0.13	0.18	4.26	4.47
LSD		**0.94**	**0.27**	**0.45**	**0.05**	**0.61**	**0.40**	**0.01**	**0.01**	**0.22**	**0.04**

1st = First season 2nd = Second season

3- Chemical composition

3-1- Effect of supplementary irrigation

Results in Table (7) showed that the bulb content of nitrogen, phosphorus and potassium were increased with increasing supplementary irrigation but the total soluble solids were decreased Halim and Ener (2001), Meranzova and Babrikov (2002) and Peji *et al.,* 2008). Halim and Ener (2001) found that the values of total soluble solids increased in bulbs grown in the treatment without irrigation as compared with the irrigated treatments. On the other hand, Kumar *et al.* (2007) and Enciso *et al.* (2009) found that irrigation, but did not affect the level of soluble solids in bulbs. Supplemental irrigation could be increase availability of nutrient in soil and up take by plants.

Table (7): Effect of supplementary irrigation on chemical constituents of onion bulbs, in 2005 / 2006 and 2006 / 2007 growing seasons.

Supplementary irrigation	T.S.S %		N %		P %		K %	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rainfall	16.02	17.81	0.73	0.69	0.27	0.28	1.01	1.11
Rainfall+ 60 mm	15.17	17.28	1.04	0.99	0.31	0.32	1.32	1.44
Rainfall+ 75 mm	14.88	16.48	1.17	1.12	0.38	0.41	1.81	2.01
Rainfall+ 90 mm	14.90	15.58	1.37	1.27	0.50	0.54	2.17	2.40
LSD	**0.18**	**0.19**	**0.17**	**0.16**	**0.10**	**0.06**	**0.11**	**0.13**

1st = First season 2nd = Second season

Table (8): Effect of foliar application on chemical constituents of onion bulbs, in 2005 / 2006 and 2006 / 2007 growing seasons.

Foliar application	T.S.S %		N %		P %		K %	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
without.	14.78	16.38	0.90	0.84	0.26	0.28	1.15	1.28
K. P	15.16	16.63	1.02	0.95	0.39	0.40	1.56	1.72
K.N	15.34	16.93	1.12	1.05	0.36	0.38	1.69	1.87
KP+N	15.69	17.22	1.27	1.22	0.45	0.48	1.90	2.10
LSD	0.24	0.26	0.06	0.08	0.12	0.07	0.20	0.12

1st = First season 2nd = Second season

Table (9): Effect of interaction between supplementary irrigation and foliar application on chemical constituents of onion bulbs, in 2005 / 2006 and 2006 / 2007 growing seasons.

Sup. irrig.	Foliar app.	T.S.S %		N %		P %		K %	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd
Rainfall	without.	15.45	17.34	0.64	0.61	0.20	0.23	0.85	0.94
	K. P	15.94	17.65	0.66	0.63	0.27	0.29	0.94	1.03
	K.N	16.01	18.03	0.75	0.71	0.25	0.27	1.00	1.11
	KP+N	16.67	18.23	0.85	0.80	0.34	0.34	1.23	1.35
Rainfall+ 60 mm	without.	14.88	16.96	0.82	0.76	0.25	0.27	0.97	1.06
	K. P	15.02	17.12	0.95	0.86	0.31	0.31	1.31	1.44
	K.N	15.21	17.31	1.05	0.99	0.29	0.30	1.42	1.54
	KP+N	15.55	17.73	1.35	1.33	0.38	0.41	1.56	1.73
Rainfall+ 75 mm	without.	14.23	16.11	1.02	0.96	0.28	0.32	1.34	1.49
	K. P	14.85	16.39	1.12	1.08	0.42	0.44	1.86	2.06
	K.N	15.11	16.52	1.22	1.17	0.38	0.41	1.92	2.13
	KP+N	15.32	16.89	1.31	1.27	0.42	0.46	2.12	2.35
Rainfall+ 90 mm	without.	14.54	15.11	1.11	1.05	0.29	0.32	1.45	1.61
	K. P	14.84	15.34	1.34	1.22	0.54	0.56	2.11	2.34
	K.N	15.01	15.86	1.45	1.33	0.51	0.56	2.43	2.70
	KP+N	15.22	16.02	1.58	1.49	0.64	0.71	2.67	2.96
LSD		0.21	0.23	0.34	0.38	0.07	0.09	0.12	0.15

1st = First season 2nd = Second season

3-2- Effect of foliar spray:

Data in Table (8) showed that spraying onion plants with mixture of phosphor and nitrogen carried on potassium (K.P + K.N), gave the highest values of total soluble solids, nitrogen, phosphorus and potassium in bulbs, Similar results was obtained by Rizk and Shafeek (2000). Also, Sadanandan *et al.* (2002) and Singh *et al.* (2002) reported that total soluble solids, of onion bulbs, were highest with basal application of NPK and foliar application of 1% Multi-K at 30, 45 and 60 days after planting. Shaheen *et al.* (2011) reported that foliar application of stimufol resulted in more nutritional values if compared with the control treatment. Moreover, onion plants which sprayed by 3g/l of stimufol gained the best nutritional values.

3-3- Effect of interaction:

Data in Table (9) showed that the interaction between rainfall plus 90 mm supplementary irrigation and foliar spray with mixture of phosphor and nitrogen carried on potassium (K.P + K.N) gave the highest values of bulb content of total soluble solids, nitrogen, phosphorus and potassium.

REFERENCES

Abd El-Al, F.S., M. R. Shafeek, A.A. Ahmed and A.M. Shaheen (2005). Response of growth and yield of onion plants to potassium fertilizer and humic acid. J. of Agric. Science, Mansoura University, 30 (1): 315-326.

Abu-Awwad, A.M. (1996). Irrigation water management for onion trickle irrigated with saline drainage water. Dirasat Series-B, Pure and Applied Science. 23 (1) 46-54.

Agricultural Economic Research Institute, AERI, (2006)

Ali, A.H., M.M. Abdel-Mouty and A.M. Shaheen, 2001. Effect of bio-nitrogen, organic and in-organicfertilizer, on the productivity of garlic (*Allium sativum, L*.) plants. Egypt. J. Appl. Sci., 16(3): 173-188.

Alkaff, H.A., O.S. Saeed and A.Z. Salm (2002). Effect of bio-fertilizer inorganic organic and foliar application of power 4 on the productivity of onion (Arabic). University of Aden Journal of Natural and Applied Sciences, University of Aden, Aden, Yemen, 6(1): 1-14.

Almadini, A.M., S.S. Al-Thabt and A.F. Hamail (2000). Effect of different application rates of two compound fertilizers on growth, yield and yields mineral composition of onion (*Allium cepa,* L.). Egypt. J. Appl. Sci., 15(10).

Al-Moshileh, A.M. (2001). Effect of nitrogen, phosphorus and potassium fertilizers on onion productivity in central region of Saudi Arabia. Assiut Journal of Agricultural Science, 32 (1): 291-305.

Bandyopadhyay, PK, S. Mallick and S.K. Rana (2003). Actual evapotranspiration and crop coefficient of onion (*Allium cepa* L*.)* under varying soil moisture levels in the humid tropics in India. Trop. Agric. (Trininad), 80: 83-90.

Black, C. and A. Editor (1965). Methods of soil analysis. Part 1 and 2 Amer. Soc. of Agron Inc., Pub. Madison, Wisconison, U.S.A.

Brown, J.D. and O. Lilliland (1964). Rapid kaus determination of potassium and sodium in plant materials and soil extracts by flame photometer. Proc. Amer. Soc. tbrt. Sci., 48: 341-346.

El-Bassiony, A.M. (2006). Effect of potassium fertilization on growth, yield and quality of onion plants. Journal of Applied Science Research, 2(10): 780-785.

Enciso J., B. Wiedenfeld, J. Jifon, S. Nelson (2009). Onion yield and quality response to two irrigation scheduling strategies. Sci. Horti., 120: 301-305.

Fahmya, Sherif H.; Mehdi Sharifib; Sheldon W. R. Hanna; Tien L. Chowa (2010). Crop productivity and Nutrient Bioavailability in a Potato-Based Three-Year Rotation as Affected by composted pulp fiber residue application and supplemental irrigation. communications in Soil Science and Plant Analysis. Volume 41, Issue 6, 2010, Pages 744 – 756.

Fawzy, Z.F., M.A. El-Nemr and S.A. Saleh, (2007). Influence of Levels and Methods of Potassium fertilizer application on growth and yield of Eggplant. J. of Applied Sciences Research, 3(1): 42-49.

Frie, E., K. Peyer and E. Schultz, (1964). Determination of phosphorus by ascorbic acid, Schw. Landwirtschaft Forshung Heft, 3:318 – 328.

Ghoname, A.A. and M.R. Shafeek (2004). Growth and productivity of sweet pepper (*Capsicum annum*, L.) grown in plastic house as affected by organic, mineral and bio-N-fertilizer. Pakistan Journal of Agronomy, 4(4): 369-372.

Halim OA, M. Ener (2001). A study on irrigation scheduling of onion (*Allium cepa* L.) in Turkey. J. Biol. Sci., 1(8): 735-736.

Hinsinger, P. (2001). Bioavailability of soil inorganic P in the rhizosphere as affected by root-induced chemical changes: a reviw. Plant and Soil, 237(2): 173-195.

Huphries, B.C. (1965). Mineral components and ash analysis, modern methods of plant analysis edited by Peach, K and Tracey, M.V. Springer Verlag Berlin, 1: 468.

Jackson, M.L. (1967). Soil chemical analysis. Prin. Hall, India, Private, New Delhi.

Johnson, C.M. and A. Ulrich (1959). Analytical methods for use in plant analysis. U.S. Dept. Agric.. Calif. Univ., Agric., Inform. Bull., 766 .

Kadayifci, A., GI. Tuylu, Y. Ucar and B. Cakmak (2005). Crop warer use of onion (*Allium cepa* L.) in Turky. Agric. Water Manage. 72: 59-68.

Kanton, RA, L. Abbey and RH. Gbene (2003). Irrigation schedule affects (*Allium cepa* L.) growth, development, and yield. J. Veg. Prod., 9(1): 3-11.

Khan, H., M. Iqbal, A. Ghaffoor and K. Waseem (2002). Effect of various plant spacing and different Nitrogen levels on the growth and yield of onion. Online, J. Biol. Sci., 2: 545–7.

Koriem, S.O., M.M.A. El-Koliey and M.F. Wahba (1994). Onion bulb production from "Shandweel 1" sets as affected by soil moisture stress. Assiut Journal of Agricultural Sciences, 25 (5): 185-193.

Kumar, S., M. Imtiyaz, A. Kumar and S. Rajbir (2007). Response of onion (Allium cepa L.) to different levels of irrigation water. Agric. Water Manage, 89: 161-166.

Meranzova, R and T. Babrikov (2002). Evapotranspiration of long-day onion, irrigated by micro sprinklers. J. Cent. Eur. Agric, 3: 190-193.

Mermoud A, TD. Tamini and H. Yacouba (2005). Impact of different irrigation schedules on the water balance components of an onion crop in a semi-arid zone. Agricultural Water Management, (77): 282-295.

Pant, H.K. and K.R. Reddy (2003). Potential internal loading of phosphorus in a wetlands constructed in agricultural land water research, Water Res., Vol. 37, pp.965–972.

Patel, J.J. and A.T. Patel (1990). Effect of nitrogen on growth and yield of onion (*Allium cepa L.*) cultivar, pusa red. Gujrat Agriculture University Res. J., India, 15: 1–5.

Peji_ B, J. Gvozdanovi-Varga, M. Vasi_, L Maksimovi and S. Mili (2008).Yield and evapotranspiration of onion depending on different preirrigation soil moisture. (In Serbian) A Periodical of Sci. Res. Field and Veg. Crops, 44: 195-202.

Pelter, Q.G, R. Mittelstadt and B.G Leib (2004). Effects of water stress at specific growth stages on onion bulb yield and quality. Agricultural Water Management, 68: 107-115.

Rana, D.S. and R.P. Sharma (1994). Effect of irrigation regime and nitrogen fertilization on bulb yield and water use of onion. Indian J. Agri. Sci., 64: 223–226.

Richards, S. (1954). Diagnosis and improvement of saline and alkaline soil. Agric. Hand book. U.S.A. (60).

Rizk, Fatma, A. and M.R. Shafeek (2000). Response of growth and yield of Vicia faba plants to foliar and bio-fertilizers. Egyptian Journal of Applied Sciences, 15(12): 652-670.

Rutkowski, M. and I. Małecka (1986). Economic effects of irrigation of some cultivated plants. Zesz. Probl. Post. Nauk. Rol., 268: 535-540.

Sadanandan, A.K., K.V. Peter and S. Hamza (2002). Role of potassium nutrition in improving yield and quality of spice crops in India. International Potash Institute, Switzerland, pp: 445-454.

Saha, U.K., M.S.I. Khan, , J. Haider and R.R. Saha, (1997). Yield and water use of onion under different irrigation schedules in Bangladesh. Japanese Journal of Tropical Agriculture, 41. (4): 268-274.

Shafeek, M.R., S. Faten, Abd El-Al and Aisha, H. Ali (2004). The productivity of broad bean plant as affected by chemical and/or natural phosphorus with different bio-fertilizer. J. Agric. Sci. Mansoura Univ., 29(5): 2727-2740.

Shaheen, A.M., Fatma A. Rizk, A.M.M. El-Tanahy and E.H. Abd El-Samad (2011).Vegetative Growth and Chemical Parameters of Onion as Influenced by Potassium as Major and Stimufol as Minor Fertilizers. Vegetables Crop Research Dept., National Research Centre, Dokki, Cairo, Egypt. Australian Journal of Basic and Applied Sciences, 5(11): 518-525,

Singh, D. K., A. K. Pandey, U. B. Pandey and S. R. Bhonde (2002). Effect of farmyard manure combined with foliar application of NPK mixture and micronutrients on growth, yield and quality of onion. Newsletter-National Hort. Res. and Development Foundation, 21-22(1):1-7.

Singh, S.P. and C.R. Mohanty (1998). A note on the effect of nitrogen and potassium on the growth and yield of onion. Orissa J. Horticulture, 26(2): 70-71. (CAB Abstracts).

Steel, R.G.D. and J.H. Torrie (1960). Principles and procedures of statistics. McGraw-Hill Co., New York.

Williams, L. and U. Kafkafi (1998). Intake and translocation of potassium and phosphate by tomatoes by 2 4 late sprays of KH PO (MKP). In: El-Fouly, M.M., F.E. Abdalla, and A.A. Abdel Maguid (eds). Proceeding of the symposium on foliar fertilization: A technique to improve production and decrease pollution, 10-14 Dec. 1995, NRC, Cairo, Egypt.

Wright, P.J. and D.G. Grant (1997). Effect of cultural practices at harvest on onion bulb quality and incidence of rot in storage. Newzealand Jornal of Crop and Horticultural Science, 25(4): 353-358.

تأثير الرش الورقي علي إنتاجية البصل تحت ظروف الري المطري والتكميلي

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أجريت تجربتان حقليتان علي محصول البصل صنف جيزة 20 في ارض جيرية تحت ظروف الزراعة المطرية خلال موسمي النمو 2005/2006 و 2006/2007 بمنطقة الحمام بالساحل الشمالي الغربي بجمهورية مصر العربية (منطقة شبة جافة 150 – 200 مم مطر/ السنة) مما يعرضها للإجهاد المائي. بهدف دراسة تأثير 4معاملات من الري التكميلي (مطري & مطري + 60 مم / فدان & مطري + 75 مم / فدان & مطري + 90 مم / فدان) و 4 معاملات رش ورقي (بوتاسيوم محمل بالفوسفور (KP) & بوتاسيوم محمل بالنيتروجين (KN) & مخلوط من المعاملتين(KN + KP) ومعاملة بدون رش حيث كان الاسم التجاري للمركبين هو بوتاسين - ف وبوتاسين – ن. وتم رش المعاملات بتركيز 4 سم \ للتر ثلاث مرات في مراحل النمو المختلفة كل 15 يوما بعد 30 و 45 و 60 يوم من الشتل.

وقد أدت معاملة ري مطري + 90 مم ري تكميلي / فدان للحصول أعلى قيم لجميع صفات النمو الخضري (نسبة البقاء خلال فترة نمو النباتات، طول النبات ، عدد الأوراق للنبات، الوزن الطازج والجاف للنبات) وكذلك المحصول و مكوناته (وزن البصلة الطازج والجاف / نبات، نسبة المادة الجافة للبصلة ونسبة التبصيل) لنباتات البصل تحت الدراسة عند مقارنتها مع غيرها من معاملات الري التكميلي و حققت نفس المعاملة أعلا القيم لمحتوي البصلة من النيتروجين والفوسفور والبوتاسيوم.

2 – أدي رش النباتات بمعاملة المخلوط بوتاسين – ف و بوتاسين – ن (KN + KP)، إلي زيادة جميع الصفات تحت الدراسة عند مقارنتها مع غيرها من معاملات الرش الورقي

الخلاصة

ينصح بتطبيق معاملة الري ال مطري + 90 مم ري تكميلي ورش أوراق نباتات البصل بمخلوط من بوتاسين - ف وبوتاسين – ن بمعدل 4سم/للتر لكل منهما ثلاث مرات في مراحل النمو المختلفة كل 15 يوما بعد 30 و 45 و 60 يوم من الشتل تحت ظروف الساحل الشمالي الغربي (منطقة الحمام).

و البحث تم تطبيقه من خلال مشروع دراسة تطوير النظم المحصولية بالساحل الشمالي الغربي تحت نظام الري التكميلي.

قام بتحكيم البحث

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