INFLUENCE OF SOIL MOISTURE STRESS, NITROGEN AND SOME MICRONUTRIENTS FERTILIZATION ON YIELD AND NUTRIENT CONTENT OF ONION GROWN ON SANDY CALCAREOUS SOIL AMENDED WITH NILE SEDIMENTS.

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Abstract: This study was conducted at El-Ghorieb experimental Farm, Faculty of Agriculture, Assiut University, Egypt during 1998-99 and 1999-2000 growth seasons. The effects of three irrigation regimes (irrigation at 25, 50 and 75% depletion of available soil moisture, three levels of nitrogen fertilization (90, 120 and 150 Kg N/fed) and foliar application of Mn, Zn and their mixture once or twice compared on onion yield and its contents of some nutrient elements were tested.

The obtained results revealed the followings:

1- Decreasing the depletion of available soil moisture (ASM) from 75 to 25% caused significant increases in onion yield and the total uptake of N, P, K, Fe, Mn and Zn by onion plants in both seasons.

2- Increasing the N fertilization level from 90 to 150 Kg/fed caused significant increases in onion yield and total uptake of measured nutrients.

3- Foliar application of Mn, Zn and their mixture once or twice significantly increased the yield of onion plants and the total uptake of all measured nutrients in both seasons.

4- The interaction between the tested factors exerted, in general, significant effects on yield and nutritional status in onion plants.

5- The best onion yield and the highest nutrient contents were obtained by irrigation when soil moisture deficit reached 25% of available soil moisture combined with application of 150 Kg N/fed and foliar application of Mn+Zn two times.

Introduction

Onion production in Egypt is mainly dependent, along with other factors, on soil and water management practices. The optimum combinations of soil moisture regime and mineral fertilization play an important role in increasing onion productivity especially under newly reclaimed soils conditions which are mostly sandy or sandy calcareous. These newly reclaimed soils are usually characterized by the coarse texture, low water holding capacity, high pH and content of $CaCO_3$, low fertility and their content of available micronutrients are too small.

Fertilization with essential nutrients, especially N, P, K and micronutrients, therefore, is a vital practice for crops grown in these soils (El-Neklawy *et al*., 1985; Al-Rajabi, 1987; Badr *et al*., 1996; Zahran and Abdoh, 1998).

Application of some micronutrients such as Fe, Mn, Zn and Cu were found to increase onion growth and bulb yield (Abo Bakr *et al*. 1994). The response of onion plants to foliar application of some micronutrients may be improved with the addition of N together with the micronutrients.

Water stress resulting from limited irrigation, i.e. apply less water than what is required for potential evapotranspiration, has a great impact on growth and production of most vegetable crops. Hedge (1986) stated that inadequate water supply was the most important factor limiting onion productivity. Wahba (1988), Aujla and Madan (1992) and Koriem *et al*. (1994) reported that the short-term irrigation or increasing available soil moisture maximized the productivity of onion plants.

The aim of the present work is to determine the suitable combination of water regime and N fertilization along with foliar application of some micronutrients for onion plants grown in sandy calcareous soils.

Materials and Methods

A field experiment was conducted at El-Ghorieb Agricultural Research Station, Faculty of Agriculture, Assiut University. The soil of the experimental site was classified as a Torrepsement. Nile sediments have been previously added to the soil and thoroughly mixed with the 0.6 m surface layer. Table 1 shows some physical and chemical characteristics of the soil.

The experiment was excuted during seasons of 1998/99 and 1999/2000 to study the effect of irrigation regime, nitrogen fertilization and micronutrient treatments of Mn and Zn and their mixture once or twice in addition to untreated control on yield and nutrients contents of onion plants. The treatments can be described as follows:

A: Irrigation regimes (3):

I_{25}, I_{50} and I_{75}: irrigation when 25, 50 or 75% of the available soil moisture (ASM), respectively, depleted.

B: Nitrogen fertilization (3):
90, 120 or 150 kg N fed^{-1} added as NH_4NO_3 (33.5 % N) in three equal doses.

C: Foliar application of Mn and Zn (7 treatments):

Three different spray solutions containing Mn, Zn and Mn+Zn were sprayed either once (four weeks after transplanting) or twice (four and seven weeks after transplanting). The spray solutions were prepared by dissolving enough amounts of Mn-EDTA (12% Mn) and/or Zn-EDTA (14% Zn) to give a final concentration of 0.25% w/v. The total volume of spray solution used was 300 or 400 l fed^{-1} for the first and the second spraying time, respectively. A control treatment that was sprayed with water was also included.

Table (1): Some physical and chemical characteristics of a representative soil sample from the experimental site*.

Soil properties	Depth (cm)		
	0-20	20-40	40-60
Mechanical analysis			
Sand (%)	43.8	41.5	48.2
Silt (%)	37.8	38.3	35.3
Clay (%)	18.4	20.2	16.5
Texture	loam	loam	loam
Water saturation (%)	46.53	42.96	44.60
Field capacity (%)	24.23	26.59	23.01
Permanent wilting (%)	11.38	14.41	13.51
Bulk density (g/cm^3)	1.44	1.48	1.53
pH (1:1 suspension)	8.47	8.54	8.50
Ec (1:1 extract) dSm^{-1}	1.71	1.98	2.25
Calcium carbonate (%)	7.67	6.56	6.19
Organic matter (%)	0.26	0.24	0.15
Total N (%)	0.093	0.045	0.039
CEC meq/100 g soil	12.87	12.33	14.22
$NaHCO_3$-extractable P (ppm)	7.84	5.72	4.80
NH_4-OAC-extractable K (ppm)	243.7	279.8	254.6
DTPA-extractable Fe (ppm)	4.73	6.49	6.84
" " Mn (ppm)	2.85	2.42	3.05
" " Zn (ppm)	0.72	0.63	0.80
" " Cu (ppm)	0.94	0.89	0.70

- Each value represents the mean of 3 soil samples.

* The soil was sandy calcareous amended with Nile sediments at a rate of 150 m^3/fed.

The experiment was arranged in three-factors factorial split-split- plot design with three replications, where irrigation regimes were applied in the main plots, N fertilization levels were distributed in the sub-plots and the micronutrients treatments were allocated in the sub-sub plots.

In both growth seasons, 40-day age seedlings of onion, cv Giza 6 were transplanted on November 15 and 8 in the first and second growth season, respectively. The plot area was 10.5 m^2 (3x3.5 m). Plants were transplanted in rows 20 cm apart and 7 cm between plants. Basal phosphatic and potassium fertilization at 240 kg superphosphate (15.5 % P_2O_5) and 150 kg potassium sulfate (48% K_2O) fed^{-1} were applied in two doses, at transplanting and 30 days later.

For scheduling the irrigation regime, soil samples were taken every 3 days to determine the correct date(s) of irrigation according to water deficit in the root zone. Irrigation treatments were started 21 days after transplanting. The other cultural practices were applied properly during the two growing seasons.

At harvest, total bulb yield (kg $plot^{-1}$) was recorded. To determine the dry matter content (%), five guarded bulbs were randomly taken from each plot, cut and mixed together and two sub-samples were taken. The sub-samples were freshly weighed, dried at 70 C for 48 hrs, re-weighed and the % dry matter content was calculated. The dry materials of the bulbs were ground to pass through 20 mesh sieve and stored for chemical analysis. Total N in dry sub-samples was determined according to Bremner and Mulvancy (1982). Other dry samples were wet-digested using a mixture of HNO_3 + $HClO_4$ (2:1) and utilized for phosphorus determination spectrophotmetrically using the chlorostannous phosphomolybdic acid in sulfuric acid system (Jackson, 1958). Total potassium was determined flamephotometerically (Jackson, 1958). Iron, Mn and Zn were determined using the flame-atomic absorption spectrophotometer (GBC 2080). Nutrients uptake were calculated from the collected data of dry matter % and nutrients contents. All data were subjected to statistical analysis according to Steel and Torrie (1980) using the MSTAT computer program.

Results and Discussion

The separate effects of irrigation regimes, N fertilization rates and foliar application of Mn and/or Zn on onion plants for the two growth seasons are presented in Table 2. Increasing water deficit up to 75% of available soil moisture (ASM) significantly decreased the total yield of onion and the uptake of N, P, K, Table (2): Separate effects of moisture stress, N fertilization and foliar application of Mn and/or Zn on yield and uptake of N, P, K, Fe, Mn and Zn by onion plants during 1998/1999 and 1999/2000 seasons.

Factor	Total uptake													
	1998/1999							1999/2000						
	Total yield	N	P	K	Fe	Mn	Zn	Total yield	N	P	K	Fe	Mn	Zn
	ton/fed	(kg/fed.)			(g/fed.)			ton/fed	(kg/fed.)			(g/fed.)		
Water depletion*														
25% ASM	5.61	13.56	3.37	19.54	141.8	151.5	55.2	5.51	12.89	3.00	18.63	143.59	135.56	43.84
50% ASM	4.63	10.78	1.62	15.59	113.5	94.4	36.1	4.27	9.99	1.66	14.25	106.96	84.07	27.30
75% ASM	2.99	6.91	0.82	9.36	71.2	49.4	18.3	3.03	6.99	0.92	9.71	74.18	45.69	15.75
$LSD_{0.05}$	0.71	1.20	0.26	2.9	13.5	9.9	7.8	0.47	1.13	0.21	1.34	12.08	6.15	4.63
Nitrogen fertilization**														
90 kg/fed.	3.63	6.20	1.40	10.94	74.4	69.0	26.3	3.54	5.99	1.35	10.61	74.04	62.25	20.63
120 kg/fed.	4.53	10.85	1.97	15.20	114.4	101.7	37.2	4.37	10.40	1.88	14.54	113.22	91.56	29.62
150 kg/fed.	5.07	14.20	2.45	18.35	137.8	124.7	46.1	4.90	13.47	2.34	17.45	137.46	111.52	36.63
$LSD_{0.05}$	0.07	0.27	0.04	0.23	2.13	2.3	1.3	0.06	0.19	0.04	0.27	3.50	2.23	0.76
Foliar micronutrient applications***														
Control	4.17	8.61	1.60	18.06	97.2	75.5	27.2	4.02	8.30	1.52	16.98	96.25	74.14	20.36
Mn_1	4.24	9.07	1.84	12.86	96.6	81.9	21.9	4.08	8.67	1.75	12.30	101.39	76.30	17.91
Zn_1	4.48	10.75	1.85	13.72	108.1	88.1	43.8	4.36	10.31	1.82	13.40	108.96	85.42	34.62
$Mn_1 + Zn_1$	4.54	11.16	2.18	15.13	112.3	98.2	40.6	4.40	10.65	2.10	14.27	111.28	90.31	32.32
Mn_2	4.29	9.53	2.00	13.72	108.3	117.4	30.2	4.14	9.19	1.91	12.94	103.69	94.43	24.20
Zn_2	4.59	11.90	1.80	14.53	117.7	102.5	43.9	4.46	11.23	1.73	14.45	116.87	95.64	38.32
$Mn_2 + Zn_2$	4.57	11.90	2.30	15.78	121.7	125.6	43.9	4.43	11.33	2.18	15.04	119.25	102.85	35.02
$LSD_{0.05}$	0.10	0.41	0.07	0.36	3.25	3.51	2.04	0.08	0.29	0.06	0.41	5.34	3.41	1.16

ASM = Available soil moisture

*, ** and *** = Each value represents the mean of 63, 63 and 27 replicates, respectively.

Fe, Mn and Zn. There were significant increases in all measured traits due to irrigation at 25% water deficit compared to that obtained when irrigation water was applied at either 50 or 75% depletion of ASM. The opposite was also true in both growth seasons since increasing the soil moisture deficit up to 75 % of the ASM was associated with significant ($P<0.01$) decreases in the total yield and total contents of all studied nutrients. Keeping the soil moisture near to field capacity may enhance the photosynthetic activities in leaves of onion plants and storage processes in the bulb. The effect of soil moisture on plant dry matter and nutrients contents can also be attributed to the effect of soil moisture on the availability of nutrients and activities of microorganisms in the root zone, being probably favourable for nutrient uptake by plant roots. Similar results were reported by Ahmed et al. (1987); Aujla and Madan (1992); Koriem et al. (1994) and Thabet et al. (1994). Water stress imposed on onion plants before or during the development of bulb may also reduce the activities of translocation and storage processes that are responsible for building up the onion bulb. Hegde (1986) reported that water stress imposed either at pre-bulb development stage or during the bulb development period resulted in significant reduction in onion yield. Water stress may also increase the internal water deficit of plant and, therefore, impaire the internal physiological processes such as stomatal opening, photosynthesis, cell enlargement and division (El-Oksh *et al.*, 1993).

The influence of nitrogen fertilization on total onion yield and uptake of N, P, K, Fe, Mn and Zn in the two growth seasons are also summarized in Table 2. Nitrogen fertilization had significantly ($P<0.01$) elevated yield and uptake of all studied nutrients in both seasons. Total bulb yield and nutrient uptake were linearly increased with increasing N fertilization rate. Application of 150 kg N fed^{-1} gave the highest yield as well as the highest uptake of all measured nutrients. These results are in agreement with those of Khalil *et al.* (1988), El-Gamili (1996) and Zahran and Abdoh (1998).

Foliar application of Mn and/or Zn once and/or twice in both growth seasons significantly ($P<0.01$) increased the total yield of onion bulb and the uptake of all measured nutrients (Table 2). The obtained results are in accordance with those obtained by Khalil *et al.* (1988), Abo El-Magid et al. (1988), Mishra *et al.* (1990) and Sliman *et al.* (1999) who reported that onion plants sprayed with Mn and /or Zn exhibit generally superior growth, yield and nutrient uptake comparing to unsprayed plants.

Foliar application of Mn and/or Zn, generally, increased their uptake by onion plants. As shown from Table 1, DTPA-extractable Mn and Zn in the experimental soil were very low. Therefore, applying these two micronutrients either once or twice replenished plant demands of these nutrients during the growth period. This was reflected on the remarkable response of onion plants (increases of Mn and Zn uptake and yield of onion bulb) to foliar application of Mn+Zn either once or twice during the growth period. Spraying with Mn+Zn had higher effects than those resulting from application of either element alone.

The interaction effects of soil moisture deficit and N fertilization on total yield and uptake of N, P, K, Fe, Mn and Zn in both growth seasons are presented in Tables 3 and 4. In all irrigation treatments, increasing the N fertilization rate from 90 to 150 kg N fed^{-1} significantly ($P<0.01$) increased total yield and uptake of all measured nutrients. Moreover, adding 150 kg N fed^{-1} in combination with irrigation treatment I_{25} (irrigation at 25% depletion of SAM) gave the highest significant increases in total yield and uptake of all measured nutrients. The lowest response was obtained with the irrigation treatment I_{75} (irrigation at 75% depletion of SAM) in combination with the lowest rate of N fertilization (90 kg N fed^{-1}). Keeping soil moisture near field capacity along with an adequate N level in the root zone have probably stimulated the growth of root system that thoroughly proliferated large soil volume and thus increased the amounts of absorbed water and nutrients. This lead to increasing the vegetative growth and increasing the rate of dry matter and nutrients accumulation in plants as well as the total yield and nutrients uptake. Gamiely *et al.* (1991), Patel *et al.* (1992) and Sadaria *et al.* (1997) reported similar findings.

The interaction effects of soil moisture deficit and foliar application of Mn and/or Zn on total yield and nutrients uptakes in both growth seasons are presented in Table 5. These data reveal that in both growth seasons, total onion yield was not significantly affected by this interaction. At all levels of soil moisture deficit, spraying of either Mn and/or Zn did not significantly affect the yield of onion plant. However, plants sprayed with the same micronutrient solution gave higher yield when irrigated at 25% than at 75% depletion of ASM. This means that the soil moisture deficit is responsible for most of the variations in total onion yield. At any level of micronutrients application the lower the level of soil moisture deficit (as

Table (3): Interaction effects of moisture stress and N fertilization on yield and uptake of N, P, K, Fe, Mn and Zn by onion plants during 1998/1999 season.

WaterDepletion % ASM	N fert. kg N/fed.	Total yield ton/fed.	Total uptake					
			N	P	K	Fe	Mn	Zn
			(kg/fed.)			(g/fed.)		
25	90	4.69	8.06	2.49	14.25	94.59	106.03	40.23
	120	5.76	14.07	3.44	19.82	151.74	158.65	55.92
	150	6.39	18.57	4.19	24.54	179.04	189.92	69.37
	Mean	5.61	13.56	3.37	19.54	141.80	151.50	55.2
50	90	3.85	6.47	1.16	11.91	80.46	68.05	25.84
	120	4.73	11.30	1.62	16.15	117.89	95.17	36.70
	150	5.31	14.58	2.09	18.71	142.22	120.02	45.88
	Mean	4.63	10.78	1.62	15.59	113.50	94.40	36.10
75	90	2.36	4.06	0.54	6.65	48.16	32.81	12.74
	120	3.09	7.20	0.85	9.62	73.45	51.17	18.95
	150	3.51	9.47	1.07	11.80	91.98	64.15	23.08
	Mean	2.99	6.91	0.82	9.36	71.2	49.4	18.3
$LSD_{0.05}$		0.36	0.68	0.14	1.48	7.23	5.68	4.20

Table (4): Interaction effects of moisture stress and N fertilization on yield and total uptake of N, P, K, Fe, Mn and Zn by onion plants during 1999/2000 season.

Water Depletion % ASM	N fert. kg N/fed.	Total yield ton/fed.	Total uptake					
			N	P	K	Fe	Mn	Zn
			(kg/fed.)			(g/fed.)		
25	90	4.65	7.70	2.23	13.92	97.19	95.55	31.07
	120	5.62	13.55	3.03	18.95	149.83	140.83	44.85
	150	6.26	17.43	3.73	23.00	183.74	170.31	55.59
	Mean	5.51	12.89	3.00	18.63	143.59	135.56	43.84
50	90	3.51	6.03	1.18	10.75	73.92	59.21	19.46
	120	4.36	10.37	1.66	14.62	112.12	86.55	27.67
	150	4.93	13.56	2.13	17.39	134.83	106.46	34.76
	Mean	4.27	9.99	1.66	14.25	106.96	84.07	27.30
75	90	2.46	4.24	0.65	7.14	51.02	32.01	11.36
	120	3.12	7.29	0.95	10.04	77.72	47.29	16.33
	150	3.49	9.43	1.17	11.97	93.82	57.78	19.57
	Mean	3.03	6.99	0.97	9.71	74.18	45.69	15.75
$LSD_{0.05}$		0.24	0.61	0.12	0.74	7.38	4.12	2.49

ASM = Available soil moisture. - Each value represents the mean of 21 replicates.

Table (5): Interaction effects of moisture stress and foliar application of Mn and/or Zn on yield and total uptake of N, P, K, Fe, Mn and Zn by onion plants during 1998/1999 and 1999/2000 seasons.

Water depletion % ASM	Foliar application of Mn and Zn	Total uptake													
		1998/1999							1999/2000						
		Total yield ton/fed	N (kg/fed.)	P (kg/fed.)	K (kg/fed.)	Fe (g/fed.)	Mn (g/fed.)	Zn (g/fed.)	Total yield ton/fed	N (kg/fed.)	P (kg/fed.)	K (kg/fed.)	Fe (g/fed.)	Mn (g/fed.)	Zn (g/fed.)
25	Control	5.32	11.05	2.81	25.25	126.34	115.95	43.29	5.19	10.75	2.49	23.83	126.81	114.00	30.46
	Mn_1	5.39	11.76	3.21	16.80	125.19	125.66	33.12	5.25	11.19	2.81	15.90	140.61	115.71	26.75
	Zn_1	5.72	13.92	3.22	17.89	139.94	135.98	65.41	5.65	13.26	2.96	17.19	142.16	130.06	52.37
	$Mn_1 + Zn_1$	5.80	14.55	3.78	19.43	147.42	150.51	60.51	5.71	13.88	3.41	18.51	147.67	137.37	48.78
	Mn_2	5.44	12.46	3.46	17.80	141.26	184.59	45.91	5.32	11.93	3.07	16.87	138.17	148.24	37.31
	Zn_2	5.84	15.61	3.15	19.11	152.58	155.76	73.36	5.80	14.55	2.79	18.71	153.28	145.88	58.59
	$Mn_2 + Zn_2$	5.79	15.57	4.00	20.46	159.82	192.26	65.48	5.66	14.69	3.45	19.36	156.42	157.66	52.61
	Mean	5.61	13.56	3.37	19.54	141.8	151.5	55.2	5.51	12.89	3.00	18.63	143.59	135.56	43.84
50	Control	4.38	8.86	1.32	18.61	100.89	71.41	25.54	4.01	8.22	1.32	16.64	94.59	68.86	19.21
	Mn_1	4.46	9.33	1.51	13.27	100.99	78.27	21.54	4.09	8.65	1.54	12.29	96.17	72.13	16.83
	Zn_1	4.69	11.19	1.55	14.46	114.06	84.33	43.65	4.35	10.43	1.61	13.54	109.62	81.02	32.72
	$Mn_1 + Zn_1$	4.75	11.66	1.82	16.28	117.76	94.39	41.00	4.39	10.74	1.87	14.44	112.27	86.15	30.82
	Mn_2	4.51	9.73	1.68	14.32	109.96	109.12	29.44	4.17	9.17	1.70	12.95	101.15	91.15	22.40
	Zn_2	4.81	12.34	1.50	15.27	123.68	101.52	47.87	4.43	11.26	1.54	14.62	116.24	91.07	35.82
	$Mn_2 + Zn_2$	4.83	12.36	1.98	16.91	126.33	121.86	43.94	4.46	11.44	2.01	15.31	118.67	98.13	33.30
	Mean	4.63	10.78	1.62	15.59	113.5	94.4	36.1	4.27	9.99	1.66	14.25	106.96	84.07	27.30
75	Control	2.32	5.92	0.67	10.33	64.36	38.99	13.71	2.85	5.95	0.75	10.47	67.37	39.58	11.40
	Mn_1	2.88	6.13	0.78	8.50	63.53	41.84	10.90	2.90	6.18	0.90	8.71	67.40	41.06	10.15
	Zn_1	3.02	7.14	0.79	8.81	70.30	43.87	21.72	3.08	7.24	0.90	9.46	75.10	45.18	18.77
	$Mn_1 + Zn_1$	3.06	7.28	0.93	9.67	71.82	49.68	20.28	3.10	7.32	1.02	9.86	73.89	47.39	17.35
	Mn_2	2.92	6.40	0.87	9.04	73.61	58.51	15.20	2.93	6.46	0.96	9.00	71.77	43.91	12.89
	Zn_2	3.11	7.75	0.76	9.22	76.88	50.19	23.85	3.15	7.89	0.85	10.03	81.09	49.97	20.57
	$Mn_2 + Zn_2$	3.11	7.76	0.93	9.95	77.86	62.55	22.16	3.16	7.86	1.06	10.46	82.67	52.77	19.14
	Mean	2.99	6.91	0.82	9.36	71.2	49.4	18.3	3.03	6.99	0.92	9.71	74.18	45.69	15.75
$LSD_{0.05}$		N.S.	1.35	0.28	2.95	14.39	11.26	8.36	N.S.	1.21	0.23	1.48	N.S.	8.12	4.95

ASM = Available soil moisture NS = Not significant. - Each value represents the mean of 9 replicates.

Table (6): Interaction effects of N fertilization and foliar application of Mn and/or Zn on yield and total uptake of N, P, K, Fe, Mn and Zn by onion plants during 1998/1999 and 1999/2000 seasons.

N fert. kg N/fed.	Foliar application of Mn and Zn	Total uptake													
		1998/1999							1999/2000						
		Total yield	N	P	K	Fe	Mn	Zn	Total yield	N	P	K	Fe	Mn	Zn
		ton/fed	(kg/fed.)			(g/fed.)			ton/fed	(kg/fed.)			(g/fed.)		
90	Control	3.43	4.95	1.14	13.37	64.25	51.58	22.35	3.30	4.85	1.10	12.59	64.67	51.03	13.74
	Mn_1	3.48	5.38	1.33	9.47	64.93	57.14	15.56	3.34	5.16	1.28	9.12	66.14	53.12	12.95
	Zn_1	3.70	6.41	1.34	9.99	72.64	60.68	31.11	3.63	6.19	1.36	10.00	74.63	59.47	24.85
	$Mn_1 + Zn_1$	3.75	6.68	1.58	11.32	76.50	68.71	28.65	3.69	6.51	1.54	10.84	76.07	64.22	23.03
	Mn_2	3.54	5.74	1.46	10.10	77.35	84.79	21.66	3.39	5.51	1.41	9.70	72.57	67.83	17.30
	Zn_2	3.78	7.21	1.30	10.68	80.43	70.67	34.15	3.79	6.99	1.30	11.00	82.46	67.77	28.13
	$Mn_2 + Zn_2$	3.75	7.02	1.64	11.64	84.70	89.16	30.42	3.65	6.71	1.51	10.99	81.76	72.34	24.41
	Mean	3.63	6.20	1.40	10.94	74.4	69.0	26.3	3.5	5.99	1.35	10.61	74.04	62.25	20.63
120	Control	4.27	8.95	1.61	18.52	102.39	77.48	25.98	4.08	8.69	1.53	17.45	101.28	76.61	20.81
	Mn_1	4.33	9.40	1.86	13.06	101.30	83.94	21.91	4.16	9.06	1.78	12.54	102.28	78.83	17.83
	Zn_1	4.60	11.34	1.90	14.24	116.60	92.48	45.07	4.44	10.87	1.82	13.85	115.89	89.93	35.67
	$Mn_1 + Zn_1$	4.68	11.72	2.23	15.57	119.34	102.55	42.08	4.51	11.17	2.12	14.61	118.74	94.22	33.41
	Mn_2	4.38	9.85	2.03	14.12	111.72	120.93	30.51	4.26	9.61	1.96	13.34	110.00	96.95	24.60
	Zn_2	4.73	12.37	1.83	14.90	123.73	106.30	49.65	4.54	11.67	1.74	14.63	120.67	99.52	38.94
	$Mn_2 + Zn_2$	4.73	12.32	2.31	15.98	125.46	127.97	45.12	4.57	11.76	2.22	15.35	12369	104.85	36.04
	Mean	4.53	10.85	1.97	15.20	114.4	101.7	37.2	4.37	10.40	1.88	14.54	113.22	91.56	29.62
150	Control	4.83	11.93	2.04	22.30	124.95	97.30	33.32	4.66	11.38	1.94	20.91	122.81	94.79	26.51
	Mn_1	4.91	12.43	2.32	16.04	123.46	104.69	28.09	4.73	11.80	2.20	15.25	135.76	96.95	22.94
	Zn_1	5.14	14.51	2.32	16.94	135.06	111.02	54.60	5.00	13.88	2.30	16.33	136.36	106.87	43.33
	$Mn_1 + Zn_1$	5.18	15.08	2.73	18.49	141.16	123.33	51.00	4.99	14.25	2.64	17.36	139.02	112.47	40.50
	Mn_2	4.95	13.00	2.53	16.94	135.76	146.50	38.38	4.77	12.45	2.37	15.78	128.51	118.52	30.70
	Zn_2	5.25	16.13	2.28	18.03	148.98	130.50	61.28	5.05	15.05	2.15	17.73	147.48	119.65	47.90
	$Mn_2 + Zn_2$	5.25	16.35	2.96	19.71	154.84	159.54	56.04	5.06	15.51	2.80	18.79	152.30	131.37	44.60
	Mean	5.07	14.20	2.45	18.35	137.8	124.7	46.1	4.90	13.47	2.34	17.45	137.46	111.52	36.64
$LSD_{0.05}$		N.S.	0.30	0.03	0.05	1.48	2.76	1.07	N.S.	0.15	0.04	0.26	N.S.	N.S.	0.56

NS = Not significant. - Each value represents the mean of 9 replicates.

% of ASM) the higher the onion yield would be expected.

Interaction between soil moisture deficit and Mn and/or Zn spraying significantly ($P<0.01$) affected the uptake of all measured nutrients except Fe uptake in the second growth season. At any level of soil moisture deficit, foliar application of Mn+Zn either once or twice significantly raised up the uptake of all studied nutrients compared to either control or spraying of either nutrients. The enhancing effects of spraying Mn+Zn may be ascribed to the increases of absorbing area of leaves that was associated with the increases of vegetative growth.

No interaction was proven between N fertilization and foliar application of Mn and/or Zn on total yield of onion in both growth seasons (Table 6). However, the uptake of all studied nutrients, except Fe and Mn, in the second growth season were significantly affected by this interaction. All rates of N fertilization and foliar application of either Mn or Zn once or twice, significantly increased the total uptake of both N and P. Meanwhile, foliar application of Mn + Zn enhanced the uptake of all studied nutrients. Spraying of Mn+Zn either once or twice in combination with the high level of N fertilization resulted in increasing the nutrients uptake by onion plants.

From the aforementioned results, it is concluded that under conditions of the experiment, the best onion yield and the highest nutrient contents were obtained by irrigation when soil moisture deficit reached 25% of available soil moisture combined with application of 150 kg N fed^{-1} and foliar application of Mn + Zn two times.

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تأثير الاجهاد الرطوبى للتربة والتسميد النيتروجينى وبعض العناصر المغذية الصغرى على محصول البصل ومحتوى نباتاته من العناصر الغذائية المزروعة فى أرض رملية جيرية مطماه بطمى النيل

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أقيمت تجربة حقلية بمحطة التجارب والبحوث الزراعية بمزرعة الغريب - كلية الزراعة جامعة أسيوط خلال موسمى ١٩٩٩/٩٨ و ٢٠٠٠/١٩٩٩ لدراسة تأثير ثلاث مستويات مختلفة من الرطوبة الأرضية (استنزاف ٢٥ و ٥٠ و ٧٥% من الماء الميسر) وثلاث مستويات من التسميد النيتروجينى (٩٠ و ١٢٠ و ١٥٠ كجم نيتروجين فى صورة نترات أمونيوم / فدان) والتسميد الورقى بعنصرى الزنك والمنجنيز على انفراد أو مع بعضهما مرة واحدة أو مرتين بالاضافة لمعاملة المقارنة وكذلك دراسة التداخل الممكن بينهما على محصول البصل ومحتواه من بعض العناصر الغذائية وكانت أهم النتائج المتحصل عليها :

- أدى الرى عند فقد ٢٥% من الرطوبة الميسره فى التربة للنبات الى زيادة معنوية فى وزن محصول الابصال وتراكم المادة الجافة والمحتوى الكلى للعناصر الغذائية تحت الدراسة مقارنة بالرى عند استنفاذ ٧٥% من الماء الميسر .

- اضافة السماد النيتروجينى كان له أثر موجب على المحصول والمحتوى الكلى من العناصر الغذائية حيث زاد المحصول والكمية الممتصة من تلك العناصر الغذائية زيادة معنوية بزيادة السماد النيتروجينى حتى ١٥٠ كجم نيتروجين / فدان مقارنة باضافة ٩٠ كجم ن / فدان وذلك خلال موسمى الدراسة .

- أظهر الرش بعنصرى الزنك والمنجنيز سواء على انفراد أو مع بعضهما مرة واحدة أو مرتين زيادة معنوية فى المحصول والكمية الممتصة من العناصر الغذائية بالنسبة لمعاملة المقارنة (عدم الرش بتلك العناصر).

- مقارنة بالمنجنيز فإن الرش بالزنك كان بوجه عام أكثر تأثيرا فى زيادة المحصول والكمية الممتصة من العناصر الغذائية وذلك خلال موسمى الدراسة .

- التفاعل بين العوامل تحت الدراسة ، بوجه عام ، لها تأثير معنوى على المحصول والمادة الجافة للبصل ، كما أن العديد من حالات التفاعل قد تم مناقشتها فيما يتعلق بالحالة الغذائية للنبات.

وبناء على تلك النتائج أمكن الحصول على أعلى محصول بصل تحت ظروف هذه التجربة بالرى عند استنزاف ٢٥% من الرطوبة الأرضية الميسرة للنبات والتسميد بمعدل ١٥٠ كجم نيتروجين / فدان والرش بالزنك والمنجنيز مرتين ومن هذا يمكن التوصية بهذه المعاملة تحت ظروف مماثلة لهذه التجربة .