RESPONSE OF SOME ONION CULTIVARS TO MICRONUTRIENTS APPLICATION UNDER MIDDLE DELTA CONDITIONS.
I- Growth, bulbing and nutritional status.

R.M. Khalil, A.A. Midan and O.S. Abu-Grab
Faculty of Agriculture, Minufiya Univ. and Agric. Res. Center, Cairo, Egypt.

استجابة بعض أصناف البصل للمعاملة بالعناصر الصغرى تحت ظروف وسط الدلتا
١ـ النمو والتبصيل والحالة الغذائية

رشدى مختار خليل ـ عبد الرازق عبد القادر ميدان ـ عثمان سيد أحمد أبو جراب

ملخص البحث

تم زراعة ثلاثة أصناف من البصل هى شندويل رقم ١ ، جيزة ٦ محسن (يزرعان فى مصر العليا والوسطى) وجيزة ٢٠ (يزرع فى الدلتا) فى منطقة وسط الدلتا (الجميزة) وتمت دراسة استجابة هذه الأصناف للرش الورقى بمحلول كبريتات النحاس ، كبريتات المنجنيز ، كبريتات الزنك بتركيزات صفر ، ٥٠٠ ، ١٠٠٠ ، ١٥٠٠ ملليجم / لتر لكل منها .

- حقق الصنف جيزة ٢٠ أعلى قياسات نمو وتلاه فى هذا جيزة ٦ محسن وشندويل رقم ١ على الترتيب .
- حقق الصنف جيزة ٦ محسن أعلى محتوى من البوتاسيوم فى الأوراق ، النتروجين فى الأبصال غير الناضجة ، النتروجين والفوسفور والكربوهيدرات الكلية فى الأبصال الناضجة .
- لوحظ اختلاف بين الأصناف فى محتواها من العناصر الصغرى .
- مقارنة بالمنجنيز أو النحاس فان الرش بالزنك ، كان بوجه عام ، أكثر تأثيرا فى زيادة النمو الخضرى ونمو الأبصال .
- لم يكن هناك فروق ملحوظة بين العناصر الصغرى فيما يتعلق بتأثيرها على محتوى الأوراق أو الأبصال من النتروجين والفوسفور والبوتاسيوم .
- أدى الرش بكبريتات النحاس الى زيادة محتوى النحاس فى الأوراق كما أدى الرش بكبريتات المنجنيز الى زيادة محتوى المنجنيز فى الأبصال الغير ناضجة .

ـ أدى الرش بالتركيزات المنخفضة نسبيا (٥٠٠ ملليجم / لتر) من العناصر الصغرى الى زيادة معنوية فى نمو الأوراق والأبصال ٠

ـ كان هناك اختلافات معنوية فى مؤشرات التبصيل عائدة الى التركيزات المختلفة المستخدمة من العناصر الصغرى ٠

ـ كان التركيز ٥٠٠ ، ١٠٠٠ ملليجم / لتر من العناصر الصغرى أكثر تأثيرا فى زيادة النتروجين ، الفوسفور والكربوهيدرات الكلية فى الأوراق والأبصال الى جانب هذا التركيز ١٠٠٠ ، ١٥٠٠ ملليجم / لتر الى زيادة محتوى الزنك فى الأوراق والأبصال الناضجة والمنجنيز فى الأبصال الغير ناضجة ٠

ـ تم دراسة العديد من حالات التفاعل بين العوامل تحت الدراسة ٠

ABSTRACT

Three onion cultivars, i.e., Shandaweel No. 1, Giza 6 M (normally grow in Upper and Middle Egypt) and Giza 20 (grows in Delta Nile region), were cultivated under Middle Delta conditions. The response of tested cultivars to the foliar application of Cu $SO_4.5H_2O$, $MnSO_4.4H_2O$ and Zn $SO_4.7H_2O$, each at concentrations of 0, 500, 1000 and 1500 mg/L. was studied.

Giza 20 cv. attained superior foliage growth parameters, followed by Giza 6M and Shandaweel No. 1 cvs., respectively. Besides, Shandaweel No. 1 cv. approved to be of earlier bulbing. It was followed, in this connection, by Giza 6M and Giza 20 cvs. Superior contents of K in leaves, N in immature bulbs and N,P and total carbohydrates in mature bulbs were observed in Giza 6M. Varietal variations in micronutrients content were also noticed.

Comparing to manganese or copper, zinc sulphate foliar spraying was generally most effective in increasing foliage and bulbs growth. Applied micronutrients exerted no pronounced effect on N,P and K contents in leaves and bulbs. Foliar spraying of copper and manganese sulphate increased Cu and Mn contents, respectively, in leaves and immature bulbs.

The relatively low micronutrient concentrations (500 and 100 mg/L.) significantly improved leaves and bulbs growth. A significant variation in bulbing indices was noticed due to applied micronutrient concentrations. The 500 and 1000 mg/L. micronutrient concentrations approved more effective in increasing N, P and total carbohydrates in leaves and bulbs. Besides, the 1000 and 1500 mg/L concentrations increased Zn in leaves and mature bulbs and Mn in immature bulbs. Several interaction effects were observed.

INTRODUCTION

The most effective micronutrients for onion are Cu, Mn and Zn as they play a key stone role in plant growth, bulbing and nutritional status. Foliage and bulbs growth were favourably affected by Cu (El-Moursi, 1980 and Lal and Maurya, 1981), Mn (Omran et al., 1984) and Zn (Ajakaiye and Greig, 1976) application to onion.

Copper, manganese and zinc were also observed to favour nutritional status in onion. Thus, Cu and Mn increased N, P, Cu and T.S.S. contents in onion foliage and bulbs (El-Moursi, 1980). Zinc application enhanced NPK (Sharabash, 1970), Zn (Badre, 1980) and total and non-reducing sugar (El-Sayed et al., 1985) contents in onion plant organs. It is superfluous to add that plant cultivars varied in their micronutrient requirements (Midan et al., 1985) and susceptibility to these nutrients deficiency in soil (Jones, 1979).

So, this has given rise to micronutrient requirements of some onion cultivars under Middle Delta conditions.

MATERIALS AND METHODS

Two field experiments were conducted at the Gemmeiza Agric. Res. Station to study the response of three local onion cultivars, named Shandaweel No. 1, Giza 6M and Giza 20, to foliage application with solutions of $CuSO_4.5H_2O$, $MnSO_4.4H_2O$ or $ZnSO_4.7H_2O$, each at concentrations of 0, 500, 1000 and 1500 mg/L. The experiment was designed using four replications in a split-split system, where the tested cvs. occupied main plots, micronutrients and their applied concentrations were arranged as sub and sub-sub plots, respectively. Plants recieved three successive sprays of the tested micronutrient concentrations at 15 day intervals beginning at 45 days from transplanting. The experimental plot was 10.5 m² in area and includes 6 ridges each of 50 cm. wide and 3.5 m. in long. Seeds were sown in the nursery on 15th of October in both seasons whereas transplanting took place on January 9th and 12th in 1984 and 1985, respectively. The normal practices of growing onion were adopted.

At 90 and 120 days after transplanting, plant samples (ten plants each) were undertaken from the two outer ridges of each sub-sub plot for growth and bulbing studies. The following growth parameters were recorded: 1) Plant height (cm), measured from the base of swelling sheath to the tip of longest assimilative tubular blades. 2) Neck length (cm), from the top of swelling sheath to the end of sheath. 3) Number of assimilative leaves per plant. 4) Fresh and dry weight of leaves, necks and bulbs. 5) Bulbing ratio, measured as the rates of the greatest diameter of bulb to the minimum neck diameter (Mann, 1952).

N,P,K, Cu, Mn and Zn were determined in the leaves and bulbs of plants which were previously used in growth studies (90 days after transplanting). N, P, K, Cu, Mn, Zn and total carbohydrates were determined in the harvested mature bulbs. The methods described by Chapman and Partt (1961), Traug and Mayer (1939), Brown and Lilliland (1946) and Megnetski et al. (1959) were adopted for N, P, K and total carbohydrates, respecting the order. Cu, Mn and Zn were determined using Elemer Atomic Absorption Apparatus.

The obtained data were exposed to the proper statistical analysis of variance (Snedecor and Cochran, 1967) and the Duncan's multiple range test 5% level was used for the comparison among means (Duncan, 1955).

RESULTS AND DISCUSSION

1- Growth:

1-1- Effect of cultivar:

The highest records of plant height, neck length and leaves and necks dry weights being obtained in Giza 20 cv., followed by Giza 6M and Shandaweel No. 1, descendingly (Tables 1 & 2). The obtained results are in confirmity with those of El-Shafie et al. (1971) who explained results as Giza 20 cv. seems to be more resistace to disease incidence under Middle Delta conditions.

Shandaweel No. 1 cv. gave the highest dry weight of bulbs as compared to the other tested cultivars. This result is true at the earlier growth stage, i.e., 90 days after transplanting. Meanwhile, at more advanced stage, i.e. 30 days later, Giza 20 cv. approved more superior in either fresh and dry weights of bulbs.

The variation in bulbs growth that noticed among studied cultivars owe much to the variation in the photoperiod requirements, factor that well known to affect bulbing in onion. The photoperiod in Middle Delta region appeared more fit for Giza 20 cv., cultivar that well adapted in this region. The different photoperiod requirements of various onion cultivars was early reported by Magruder and Allard (1937). Further confirmation was done by Warid and El-Gammal (1957) who decleared that the photoperiod required for good bulbing in Giza 6M and Behairy (in which from it Giza 20 cv. was initiated) cvs. are 11.10-11.56 hrs. and 12.25-13.30 hrs., respectively.

1-2- Effect of applied micronutrient:

Regardless of applied concentrations, plants received zinc sulphate as foliat spraying seem to be, with a slight descrepancies, of highest foliage and bulbs growth parameters as compared to those

Table (1) Effect of cultivars and applied micronutrients, along with their concentrations, on growth characteristics of onion plants grown in 1983/1984 season.

Days after transplanting	90 days									120 days								
Studied variations	Plant height (cm)	Neck length (cm)	No. of leaves per plant	Leaves		Neck		Bulb		Plant height (cm)	Neck length (cm)	No. of leaves per plant	Leaves		Neck		Bulb	
				F.Wt. (gm/plant)	D.Wt. (gm/plant)	F.Wt. (gm/plant)	D.Wt. (gm/plant)	F.Wt. (gm/plant)	D.Wt. (gm/plant)				F.Wt. (gm/plant)	D.Wt. (gm/plant)	F.Wt. (gm/plant)	D.Wt. (gm/plant)	F.Wt. (gm/plant)	D.Wt. (gm/plant)
Cultivars:																		
Giza 20	59.33 a	9.68 a	6.58 b	31.41 a	2.69 a	22.65 a	1.92 a	24.62 b	2.91 b	49.17 a	11.40 a	6.90 a	21.45 a	2.55 a	20.00 a	2.19 a	78.92 a	9.02 a
Giza 6M	48.79 b	8.13 c	6.70 b	19.05 b	1.73 b	15.40 b	1.37 b	27.19 b	3.05 b	41.50 b	9.29 b	5.49 b	10.61 b	1.29 b	10.32 b	1.24 b	52.41 b	5.43 b
Shandaweel No.1	47.16 c	9.00 b	7.06 a	16.46 c	1.66 b	12.34 c	1.20 b	40.10 a	4.81 a	35.64 c	9.22 b	5.62 b	9.99 b	1.21 b	8.61 c	0.91 c	45.50 c	4.76 c
Micronutrients:																		
$CuSO_4.5H_2O$	51.35 a	8.85 a	6.71 a	21.05 b	2.00 a	15.89 b	1.41 b	28.84 b	3.45 b	42.44 a	10.05 a	6.08 a	13.58 b	1.62 b	11.90 b	1.34 b	58.71 a	6.26 a
$MnSO_4.4H_2O$	51.31 a	8.75 a	6.67 a	21.74 b	1.95 b	16.92 ab	1.49 b	29.64 b	3.43 b	41.13 a	9.94 a	5.88 a	13.12 b	1.63 b	13.24 ab	1.49 a	59.36 a	6.49 a
$ZnSO_4.7H_2O$	52.61 a	9.20 a	6.97 a	24.14 a	2.13 a	17.58 a	1.59 a	33.43 a	3.88 a	42.75 a	9.92 a	6.06 a	15.36 a	1.79 a	13.80 a	1.52 a	58.75 a	6.47 a
Micronutrients concentrations (mg/l)																		
0	49.74 b	8.78 a	6.61 a	20.87 b	1.88 b	14.94 b	1.31 b	28.19 b	3.29 b	40.99 b	9.59 c	5.71 b	11.79 c	1.44 c	11.98 c	1.33 b	56.48 b	6.05 b
500	53.50 a	9.11 a	6.93 a	23.86 a	2.13 a	18.52 a	1.62 a	31.41 a	3.81 a	44.48 a	10.33 a	6.30 a	15.48 a	1.84 a	14.33 a	1.63 a	60.49 ab	6.57 ab
1000	52.86 a	8.90 a	6.83 a	23.31 a	2.17 a	17.95 a	1.63 a	32.33 a	3.80 a	42.52 b	10.17 ab	6.24 a	15.71 a	1.8? a	14.08 a	1.46 ab	61.81 a	6.74 a
1500	50.94 b	8.96 a	6.75 a	21.58 b	1.93 b	15.45 b	1.42 b	30.42 ab	3.46 ab	40.44 c	9.80 bc	5.77 b	13.11 b	1.60 b	11.52 b	1.36 b	56.99 b	6.26 ab

* Means separation in columns by Duncan's multiple range test 5 % level.

* Values in the same column followed by the same letter don't differ significantly.

Table (2) Effect of cultivars and applied micronutrients, along with their concentrations, on growth charateristics of onion plants grown in 1984/1985 season.

Days after transplanting	90 days									120 days								
Studied Variations	Plant height (cm)	Neck length (cm)	No. of leaves per plant	Leaves		Neck		Bulb		Plant height (cm)	Neck length (cm)	No. of leaves per plant	Leaves		Neck		Bulb	
				F.Wt. (gm/ plant)	D.Wt. (gm/ plant)	F.Wt. (gm/ plant)	D.Wt. (gm/ plant)	F.Wt. (gm/ plant)	D.Wt. (gm/ plant)				F.Wt. (gm/ plant)	D.Wt. (gm/ plant)	F.Wt. (gm/ plant	D.Wt. (gm/ plant)	F.Wt. (gm/ plant)	D.Wt. (gm/ plant)
Cultivars:																		
Giza 20	69.79 a	13.47 a	6.94 b	57.26 a	3.92 a	28.98 a	2.41 a	27.88 c	2.83 c	71.83 a	15.26 a	7.65 a	64.79 a	6.04 a	25.75 a	2.31 a	75.82 a	10.49 a
Giza 6M	59.01 b	11.54 b	7.47 a	43.15 b	3.26 b	20.26 b	1.82 b	32.46 b	3.64 b	56.03 b	12.23 b	6.48 ab	28.48 b	2.85 b	12.82 b	1.19 b	55.96 b	8.10 b
Shandaweel No.1	57.04 b	11.01 b	7.17 ab	38.51 c	3.12 c	15.91 c	1.53 b	39.78 a	5.00 a	54.23 b	11.94 b	6.09 b	25.75 b	2.67 b	10.42 c	1.09 c	62.25 b	8.85 b
Micronutrients:																		
$CuSO_4.5H_2O$	60.76 a	11.72 a	7.07 a	44.21 b	3.22 b	20.50 b	1.74 b	31.56 a	3.42 b	59.92 a	12.99 a	6.63 a	38.35 a	3.76 a	14.89 b	1.42 b	62.86 a	9.00 a
$MnSO_4.4H_2O$	62.37 a	12.29 a	7.20 a	47.03 a	3.51 a	24.07 a	2.17 a	34.58 a	4.00 a	60.94 a	13.58 a	6.85 a	40.42 a	3.98 a	18.67 a	1.70 a	65.68 a	9.28 a
$ZnSO_4.7H_2O$	62.70 a	12.00 a	7.30 a	47.69 a	3.58 a	20.57 a	1.84 b	33.98 a	4.04 a	61.24 a	12.86 a	6.73 a	40.25 a	3.83 a	15.32 b	1.45 b	65.55 a	9.17 a
Micronutrients concentrations (mg/l)																		
0	60.01 b	11.43 a	7.01 a	41.78 b	1.88 b	20.17 c	1.79 b	30.83 b	3.47 c	58.80 b	12.36 b	6.34 c	36.50 b	3.60 b	14.79 b	1.34 b	60.42 b	8.63 b
500	63.78 a	12.24 a	7.31 a	48.85 a	2.13 a	23.35 a	2.00 a	33.51 a	3.75 bc	62.53 a	13.63 a	7.00 a	42.23 a	4.11 a	17.76 a	1.63 a	67.23 a	9.41 a
1000	62.98 a	12.36 a	7.35 a	50.19 a	2.17 a	22.31 ab	2.08 a	35.21 a	4.17 a	61.92 a	13.49 a	6.94 ab	42.61 a	4.04 a	16.56 ab	1.53 a	68.50 a	9.73 a
1500	61.01 b	12.00 a	7.09	44.40 b	1.93 b	21.04 bc	1.61 b	33.95 a	3.88 ab	59.54 b	13.08 a	6.67 b	37.36 b	3.66 b	16.21 ab	1.58 a	62.63 b	8.83 b

x Means separation in columns by Duncan's multiple range test 5 % level.

x Values in the same column followed by the same letter don't differ significantly received manganese or copper sulphate (Tables 1 & 2). This result is true at both sampling dates, i.e., 90 and 120 days after transplanting, and was generally observed in both seasons of study. The superior effect of Zn on plant growth may be interpreted due to its role in the biosynthesis of tryptophan that well known to be the precursor of indol acetic acid (IAA) in plant. This drawn conclusion was previously confirmed by Pillai (1967). Furthermore, zinc was reported to catalize the process of oxidation in plant cell,has a vital role in the transformation of carbohydrates, regulate the consumption of sugars, increase the source of energy for the production of chlorphyll, promote the absorption of water and prevent stunting in plants (Saucelli, 1969), factors that collectively promote plant growth.

1-3- Effect of micronutrient concentrations:

Irrespective of applied micronutrient, all of the tested concentrations seemed to enhance leaves and bulbs growth, although significance were frequently observed using the relatively low concentrations, i.e. 500 and 1000 mg/L. This result was insistently observed at both sampling dates of 1983/1984 and 1984/1985 seasons.

Such results could be explained as lower concentrations provide plant with optimum amounts of micronutrients required for normal growth. Obtained results coincide with those of El-Moursi (1980) and Omran et al. (1984). They reported that the relatively lower concentrations of micronutrients improved onion growth as compared to higher ones.

1-4- The interactions effect:

The interaction between cultivar and both micronutrients and their tested concentrations exerted no significant effect on onion growth, so its related data were omitted.

As regards to the combined effect of micronutrients and their tested concentrations, it seems that, excepting for plant height in both sampling dates, leaves fresh and dry weights, all at 90 days from transplanting, and leaves fresh weight 120 days from transplanting, no significant differences in plant growth parameters were observed due to the interactive effect of applied micronutrients and their tested concentrations (Tables 3 & 4). These results are true in 1983/1984 season only. Meanwhile, in 1984/1985, the nutrients concentrations interaction significantly affected plant height, at both sampling dates, neck fresh weight and bulb dry weight, both at 90 days from transplanting, and leaves dry weight 120 days from transplanting.

In spite of all above mentioned, plants received copper, manganese, or zinc sulphate, each at concentration of 500 or 1000 mg/L., exhibited generally superior growth indices as compared to control or those received the higher nutrients concentration. This result was insistently observed at both sampling dates of either seasons of study.

It is worth noting that, comparing to the other micronutrient concentrations, zinc sulphate at 500 and 1000 mg/L exerted the highest records in leaves fresh weight and leaves and bulbs dry weights, all at 90 days from transplanting. Besides, plants received the same concentrations of zinc approved superiority in leaves and bulbs fresh and dry weights as assessed at more advanced growth stage, i.e., 120 days from transplanting. These results were insistently observed in both seasons of study.

Data regarding the three factors combined effect were omitted as no definitive trend was observed.

Table (3) The interactive effect of applied micronutrients, along with their tested concentration on growth characteristics of onion plants grown in 1983/ 1984 season.

90 days after transplanting

Studied interactions: Micronut. X micronut. concen. (mg/1)		Plant height (cm)	Neck length (cm)	No. of leaves per plant	Leaves F.Wt. (gm/ plant)	Leaves D.Wt. (gm/ plant)	Neck F.Wt. (gm/ plant)	Neck D.Wt. (gm/ plant)	Bulb F.Wt. (gm/ plant)	Bulb D.Wt. (gm/ plant)
$CuSO_4$	X 0	50.42 def	8.87 a	6.63 a	20.62 ef	1.92 cd	14.78 a	1.30 a	28.38 d	3.32 a
	X 500	54.38 a	8.95 a	7.00 a	24.09 abc	2.25 a	16.66 a	1.42 a	30.29 cd	3.69 a
	X 1000	51.95 bcd	8.44 a	6.75 a	20.94 def	2.11 abc	16.53 a	1.51 a	28.33 d	3.46 a
	X 1500	48.65 f	9.16 a	6.45 a	18.55 f	1.72 d	15.60 a	1.38 a	28.36 d	3.35 a
$MnSO_4$	X 0	49.03 f	8.33 a	6.62 a	20.60 ef	1.78 d	14.76 a	1.29 a	28.60 d	3.31 a
	X 500	52.53 a-d	9.13 a	6.63 a	22.38 b-e	1.93 bcd	18.24 a	1.64 a	30.58 cd	3.71 a
	X 1000	52.37 a-d	9.08 a	6.79 a	22.78 b-e	2.16 a	18.86 a	1.65 a	31.47 bcd	3.44 a
	X 1500	51.33 cde	8.48 a	6.64 a	21.20 c-f	1.93 bcd	15.81 a	1.43 a	27.92 d	3.28 a
$ZnSO_4$	X 0	49.77 ef	9.13 a	6.58 a	21.39 c-f	1.39 bcd	15.30 a	1.35 a	28.19 d	3.24 a
	X 500	53.58 ab	9.24 a	7.01 a	25.13 a-d	2.15 ab	20.66 a	1.85 a	33.37 abc	4.03 a
	X 1000	54.26 a	9.18 a	7.12 a	26.23 a	2.25 a	18.46 a	1.72 a	37.19 a	4.50 a
	X 1500	52.85 abc	9.25 a	7.15 a	23.79 a-d	2.13 abc	15.89 a	1.45 a	34.99 ab	3.76 a

120 days after transplanting

Studied interactions: Micronut. X micronut. concen. (mg/1)		Plant height (cm)	Neck length (cm)	No. of leaves per plant	Leaves F.Wt. (gm/ plant)	Leaves D.Wt. (gm/ plant)	Neck F.Wt. (gm/ plant)	Neck D.Wt. (gm/ plant)	Bulb F.Wt. (gm/ plant)	Bulb D.Wt. (gm/ plant)
$CuSO_4$	X 0	42.10 b-e	9.33 a	5.77 a	11.63 d	1.47 a	11.43 a	1.24 a	57.87 a	6.15 a
	X 500	45.63 a	10.76 a	6.31 a	16.41 ab	1.90 a	11.99 a	1.50 a	61.85 a	6.54 a
	X 1000	43.45 a-d	10.05 a	6.49 a	14.87 bc	1.69 a	12.65 a	1.33 a	59.94 a	6.36 a
	X 1500	38.57 f	9.86 a	5.74 a	11.42 d	1.41 a	11.52 a	1.27 a	55.22 a	5.98 a
$MnSO_4$	X 0	40.82 def	9.54 a	5.60 a	11.80 d	1.41 a	11.32 a	1.34 a	55.32 a	5.90 a
	X 500	42.50 a-e	10.10 a	6.28 a	12.23 d	1.65 a	14.34 a	1.70 a	60.07 a	6.57 a
	X 1000	41.38 c-f	10.34 a	5.88 a	15.59 ab	1.82 a	15.00 a	1.55 a	63.02 a	6.93 a
	X 1500	39.81 ef	9.79 a	5.73 a	12.85 cd	1.65 a	12.29 a	1.37 a	59.02 a	6.48 a
$ZnSO_4$	X 0	40.06 def	9.70 a	5.77 a	11.93 d	1.44 a	13.21 a	1.40 a	56.27 a	6.03 a
	X 500	45.28 ab	10.12 a	6.32 a	17.79 a	1.97 a	16.66 a	1.78 a	59.55 a	6.59 a
	X 1000	44.28 abc	10.13 a	6.33 a	16.66 ab	2.01 a	14.58 a	1.52 a	62.47 a	6.98 a
	X 1500	41.38 c-f	9.74 a	5.83 a	15.05 bc	1.73 a	10.75 a	1.45 a	56.72 a	6.31 a

* Means separation in columns by Duncan's multiple range test 5 % level .
* Values in the same column followed by the same letter don't differ significantly.

Table (4) The interactive effect of applied micronutrients, along with their tested concentrations on growth charactristics of onion plants grown in 1984 / 1985 .

Days after transplanting		90 days									120 days								
Studied interactions		Plant height (cm)	Neck length (cm)	No.of leaves per plant	Leaves F.Wt. (gm/ plant)	Leaves D.Wt. (gm/ plant)	Neck F.Wt. (gm/ plant)	Neck D.Wt. (gm/ plant)	Bulb F.Wt. (gm/ plant)	Bulb D.Wt. (gm/ plant)	Plant height (cm)	Neck length (cm)	No.of leaves per plant	Leaves F.Wt. (gm/ plant)	Leaves D.Wt. (gm/ plant)	Neck F.Wt. (gm/ plant)	Neck D.Wt. (gm/ plant)	Bulb F.Wt. (gm/ plant)	Bulb D.Wt. (gm/ plant)
Micronut;	X micronut.concen.(mg/l)																		
$CuSO_4$	X 0	59.33 cd	11.43 a	6.87 a	42.46 a	3.21 a	19.68 d	1.70 a	29.61 d	3.27 e	59.24 b-e	12.29 a	6.33 a	37.03 a	3.64 cde	12.54 a	1.23 a	61.07 a	8.91 a
	X 500	64.08 a	12.26 a	7.16 a	47.61 a	3.39 a	20.26 cd	1.63 a	34.93 abc	3.41 e	63.75 a	13.91 a	6.88 a	41.31 a	4.25 a	16.10 a	1.46 a	66.89 a	9.46 a
	X 1000	61.14 bc	12.41 a	7.19 a	45.74 a	3.23 a	21.76 bcd	1.96 a	31.59 bcd	3.64 d-e	59.43 b-e	13.23 a	6.72 a	39.94 a	3.72 b-e	15.34 a	1.48 a	65.08 a	9.28 a
	X 1500	58.31 d	10.78 a	7.08 a	41.03 a	3.04 a	20.29 cd	1.68 a	30.16 d	3.37 e	57.25 e	12.52 a	6.59 a	34.13 a	3.41 e	15.60 a	1.50 a	58.38 a	8.35 a
$MnSO_4$	X 0	60.09 bcd	11.38 a	7.03 a	41.39 a	3.17 a	20.36 cd	1.86 a	30.98 cd	3.46 e	58.74 cde	12.42 a	6.38 a	36.33 a	3.56 e	16.29 a	1.42 a	59.64 a	8.52 a
	X 500	64.18 a	12.44 a	7.15 a	49.02 a	3.61 a	26.65 a	2.33 a	34.74 abc	3.85 b-e	62.01 ab	13.79 a	7.12 a	42.69 a	4.08 ab	19.69 a	1.83 a	67.26 a	9.38 a
	X 1000	62.88 ab	12.57 a	7.50 a	51.86 a	3.68 a	24.98 ab	2.41 a	37.60 a	4.43 ab	63.13 a	14.06 a	7.03 a	44.23 a	4.29 a	20.23 a	1.72 a	71.08 a	10.06 a
	X 1500	62.31 ab	12.78 a	7.13 a	45.86 a	3.56 a	24.31 ab	2.08 a	35.00 abc	4.26 abc	59.87 b-e	14.04 a	6.87 a	39.44 a	3.96 a	18.90 a	1.80 a	64.74 a	9.17 a
$ZnSO_4$	X 0	60.40 bcd	11.48 a	7.13 a	41.49 a	3.20 a	20.45 cd	1.80 a	31.88 bcd	3.69 cde	58.40 de	12.37 a	6.33 a	36.13 a	3.59 de	15.52 a	1.38 a	60.55 a	8.45 a
	X 500	63.08 ab	12.01 a	7.63 a	49.91 a	3.60 a	23.13 bc	2.04 a	35.64 ab	4.20 a-d	61.84 abc	13.20 a	6.55 a	42.70 a	4.00 ab	17.51 a	1.89 a	67.54 a	9.39 a
	X 1000	64.93 a	12.09 a	7.37 a	53.03 a	4.04 a	20.19 cd	1.88 a	36.48 a	4.45 a	63.20 a	13.18 a	7.06 a	43.66 a	4.10 ab	14.12 a	1.38 a	71.35 a	[illegible]
	X 1500	62.41 ab	12.44 a	7.08 a	46.32 a	3.48 a	18.52 d	1.66 a	31.91 bcd	3.80 cde	61.51 a-d	12.68 a	6.56 a	38.50 a	3.61 de	14.13 a	1.44 a	64.75 a	8.99 a

* Means separation in columns by Duncan's multiple range test 5 % level .

* Values in the same column followed by the same letter don't differ significantly

2- Bulbing behaviour:

2-1- Effect of cultivar:

Data in Table (5) show that the tested onion cultivars significantly varied in bulbing behaviour. Shandaweel No. 1 cv. showed earlier bulbing, since it achieved the highest bulbing ratio at earlier growth stage, i.e., 90 days from transplanting. Using the same bulbing measurement, Giza 6M and Giza 20 cvs. could be considered of medium and latent bulbing, respectively.

Shandaweel No. 1 cv. continued to be of highest bulbing ratio up to more advanced growth stage, i.e., 120 days from transplanting. In this connection, it was followed by Giza 6M and Giza 20 cvs., in descending order. It is worthy to mention that although Giza 20 cv. was observed to be of least bulbing ratio at either 90 or 120 days after transplanting, it recorded the highest bulb and neck diameters at latent growth stage. Results may be explained as Shandaweel No. 1 cv. is of shortest photoperiod requirement for bulb initiation, so it was followed in this connection by Giza 6M and Giza 20 cv. . This drawn suggestion was previously confirmed by the results of Warid and El-Gammal (1957) who reported that the photoperiod required for Giza 6M and Giza 20 cvs. was 11.10-11.56 and 12.25-13.30 hrs, respectively. The variation among onion cultivars in photoperiod requirements as recorded long time ago by Magruder and Allard (1937).

Obtained results go along with those of Ahmed et al. (1977) who observed that Shandaweel No. 1 cv. produced mature bulbs 12-15 days earlier than Giza 6M. Further confirmation was done by El-Shafie et al. (1971) under Delta conditions. They reported that Giza 6M cv. reached bulbing ratio (neck/bulb) of 0.50 at 12-30th of March, while Behairy cv. (in which from it Giza 20 was initiated) achieved this record at 12-14 April.

Table (5) _ Effect of cultivars and applied micronutrients, along with their concentrations on some bulbing indices in onion .

Days after transplanting	1983/1984						1984/1985					
	90 days			120 days			90 days			120 days		
Bulbing indices	Bulb diameter (cm)	Neck diameter (cm)	Bulbing ratio (Bulb/ Neck).	Bulb diameter (cm)	Neck diameter (cm)	Bulbing ratio (Bulb/ Neck)	Bulb diameter (cm)	Neck diameter (cm)	Bulbing ratio (Bulb/ Neck)	Bulb diameter (cm)	Neck diameter (cm)	Bulbing ratio (Bulb/ Neck)
Cultivars												
Giza 20	3.49 b	1.63 a	2.14 c	5.84 a	1.94 a	3.01 b	3.05 c	1.83 a	1.68 c	5.99 a	1.96 a	3.07 c
Giza 6M	3.75 b	1.47 b	2.56 b	4.86 b	1.38 b	3.55 a	3.46 b	1.70 b	2.06 b	5.23 b	1.49 b	3.53 b
Shandaweel No.1	4.78 a	1.56 ab	3.09 a	4.51 c	1.21 c	3.73 a	3.67 a	1.65 b	2.37 a	5.42 b	1.44 b	3.79 a
Micronutrients												
$CuSO_4 \cdot 5H_2O$	3.90 a	1.53 a	2.56 a	5.05 a	1.50 a	3.43 a	3.41 a	1.69 a	2.06 a	5.54 a	1.61 a	3.51 a
$MnSO_4 \cdot 4H_2O$	3.96 a	1.51 a	2.64 a	5.14 a	1.51 a	3.49 a	3.43 a	1.75 a	2.00 a	5.60 a	1.66 a	3.42 a
$ZnSO_4 \cdot 7H_2O$	4.16 a	1.61 a	2.59 a	5.02 a	1.53 a	3.37 a	3.54 a	1.74 a	2.06 a	5.51 a	1.62 a	3.46 a
Micronutrients concentrations (mg/1)												
0	3.91 b	1.54 a	2.56 a	4.89 b	1.46 c	3.38 a	3.37 b	1.72 a	1.96 a	5.33 b	1.56 b	3.50 a
500	4.05 ab	1.58 a	2.65 a	5.17 a	1.56 a	3.39 a	3.49 ab	1.75 a	2.10 a	5.66 a	1.73 a	3.38 a
1000	4.15 a	1.55 a	2.62 a	5.19 a	1.54 ab	3.47 a	3.60 a	1.73 a	2.03 a	5.77 a	1.64 ab	3.50 a
1500	3.91 b	1.54 a	2.57 a	5.03 ab	1.48 bc	3.49 a	3.38 b	1.68 a	2.06 a	5.44 b	1.60 b	3.47 a

* Means separation in columns by Duncan's multiple range test 5 % level .

* Values in the same column followed by the same letter dont differ significantly .

2-2- Effect of applied micronutrient:

No significant differences were observed in bulbing behaviour due to applied micronutrient, although plants received foliar spraying of zinc or manganese sulphate being superior in bulb and neck diameters and bulbing ratio at one or either sampling dates (Table 5). Zinc and manganese was previously discussed to paly a vital role in plant metabolism particularly what dealing with carbohydrates synthesis and translocation, thereby may encourage bulbing in onion plants.

2-3- Effect of micronutrient concentrations:

Applied micronutrient concentrations seemed to possitively affect bulbing behaviour, hence significances were frequently observed at both sampling dates, i.e., 90 and 120 days from transplanting, in either 1983/1984 and 1984/1985 seasons (Table 5). Plants received micronutrients spraying at concentrations of 500 or 1000 mg/L seemed to be of generally improved bulbing indices as compared to control or those received higher concentration.

The lower micronutrient concentrations were observed also by Omran et al. (1984) to improve bulbing behaviour in onion plants.

2-4- The interactions effect:

Statistical analysis showed no significant interactions between studied factors on bulbing behaviour, indicating independent acts for each, so related data were excluded.

3- Chemical constituents:

3-1- Nitrogen, phosphorus, potassium and total carbohydrates:

3-1-1- Effect of cultivar:

Nitrogen, phosphorus potassium and total carbohydrate contents seemed to differ according to grown cultivar (Figs. 1&2). As compared to the other tested cvs., Giza 6M showed superior K content in leaves and approved of highest N in immature bulbs. It showed also higher N, P and total carbohydrate contents in mature bulbs.

Results may be explained as Giza 6M cv. is known to be of limited growth, and consequently increasing nutrients concentration in plant tissues was quite expected due to the dillution effect.

An increase in nutrients concentration in onion plant tissues was previously suggested by Midan et al. (1982) to be due to the dillution effect of reduces growth. Obtained results are in harmony with those of El-Shafie (1979) and El-Kafoury (1986).

3-1-2- Effect of applied micronutrient:

Applied micronutrients did not differ pronouncely in regards to their effects on N, P and K contents in either leaves or bulbs of onion plant (Figs. 1&2). However, plants received $CuSO_4.5H_2O$ foliar application seemed to be of higher total carbohydrate contents in mature bulbs as compared to those received $MnSO_4.4H_2O$ or $ZnSO_4.7H_2O$.

Each of the applied micronutrients plays distinct vital role in plant metabolism and has the same importance of others, thus, the unpronounced differences among them regarding their effects on mineral contents of plants could be explained. However, the particular superior of Cu and Mn may explained as these nutrients have a distnict role in transpiration, process that well known to affect nutrients absorption and translocation within plant. The effect of manganese in increasing transpiration rate was previously reported by Midan (1978) on beans. He added that foliage application of manganese sulphate increased nutrients absorption and accumulation in plant tissues.

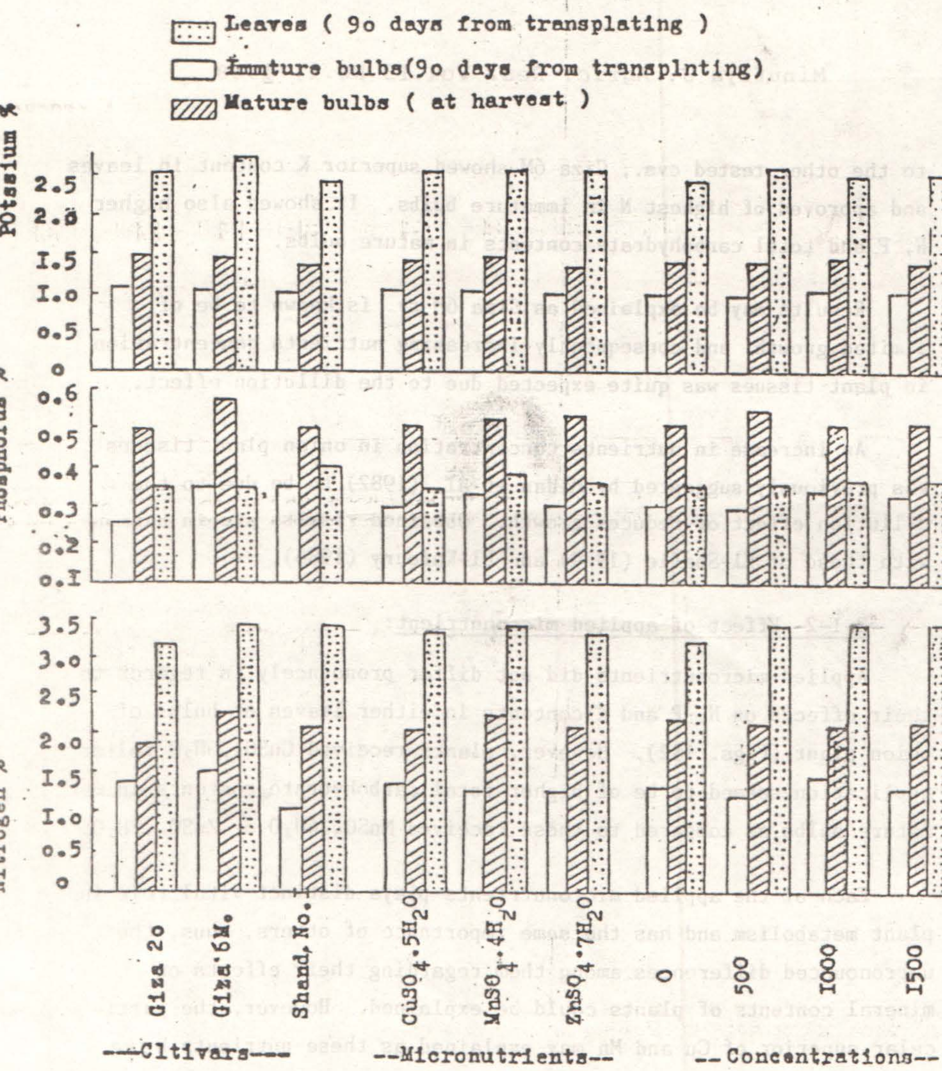
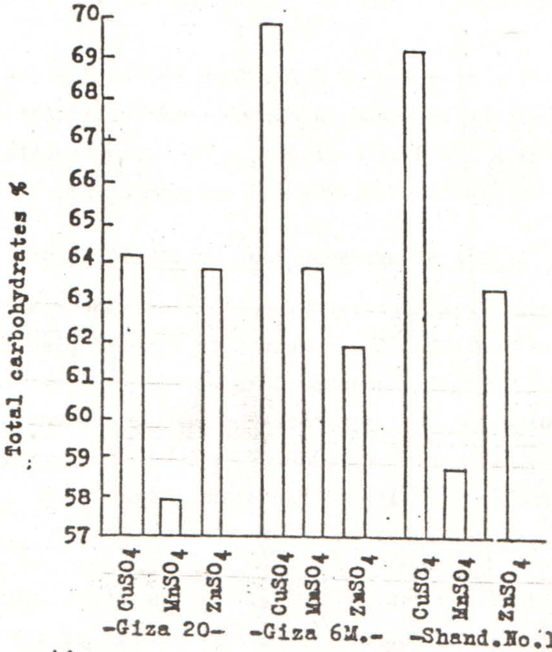


Fig. (1).Effect of cultivars and applied micronutrients along with their concentrations on N, P and K contents in onion grown in 1984/1985 season .



. The interactive effect of cultivars and applied micronutrients on total carbohydrate contents in mature onion bulbs in 1984/1985

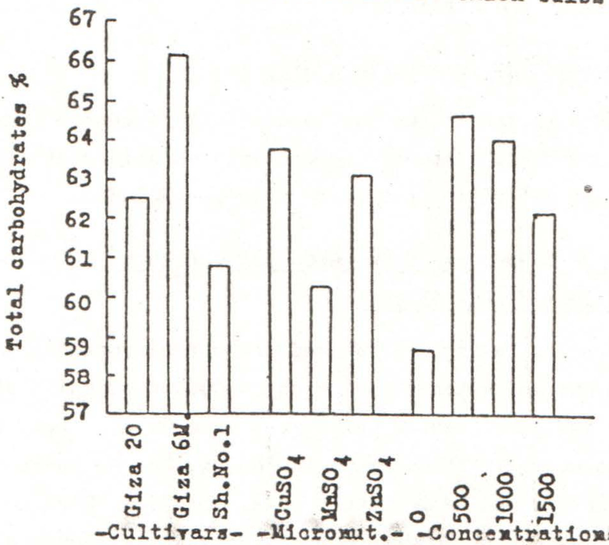


Fig.(2). Effect of cultivars and micronutrients along with their concntrations on total carpohydrate contents in mature onion bulbs produced from 1984/1985 Planting

The foliar spraying of $CuSO_4.5H_2O$ may be improve photosynthesis process, thus the increase in carbohydrate assimilation and accumulation in bulbs could be explained. Obtained results are in harmony with those of El-Moursi (1980) and Ibrahim et al. (1980).

3-1-3- Effect of micronutrient concentrations:

The tested micronutrient concentrations generally improved N, P,K and total carbohydrate contents in studied plant organs, although 500 and/or 1000 mg/L concentrations approved more effective (Figs. 1&2). Results may be interpreted as medium concentrations, i.e., 500 and 1000 mg/L, provide plant with adequate nutrients amount and lead to normal metabolism within plant, thereby may increase nutrients absorption and accumulation.

The relatively low and medium micronutrient concentrations were observed also by El-Moursy (1980) and Ibrahim et al. (1980) to be more effective in increasing nutrient contents in onion plants as compared to the higher ones.

3-1-4- The interactions effect:

Data regarding the combined effect of tested growth factors on N,P,K and total carbohydrate contents in different plant organs showed no definitive trend, so it were excluded.

3-2- Copper manganese and zinc contents:

3-2-1- Effect of cultivar:

Results in Fig. (3) showed pronounced varietal variations in Cu, Mn and Zn contents in leaves and bulbs of onion plants. Comparing to the other tested cultivars, Giza 20 cv. seems to have the highest concentrations of Cu in leaves, Cu, Mn and Zn in immature bulbs and Cu and Mn in mature ones. Besides, Giza 6M cv. being of higher Zn content in mature bulbs, meanwhile Shandaweel No. 1 cv.

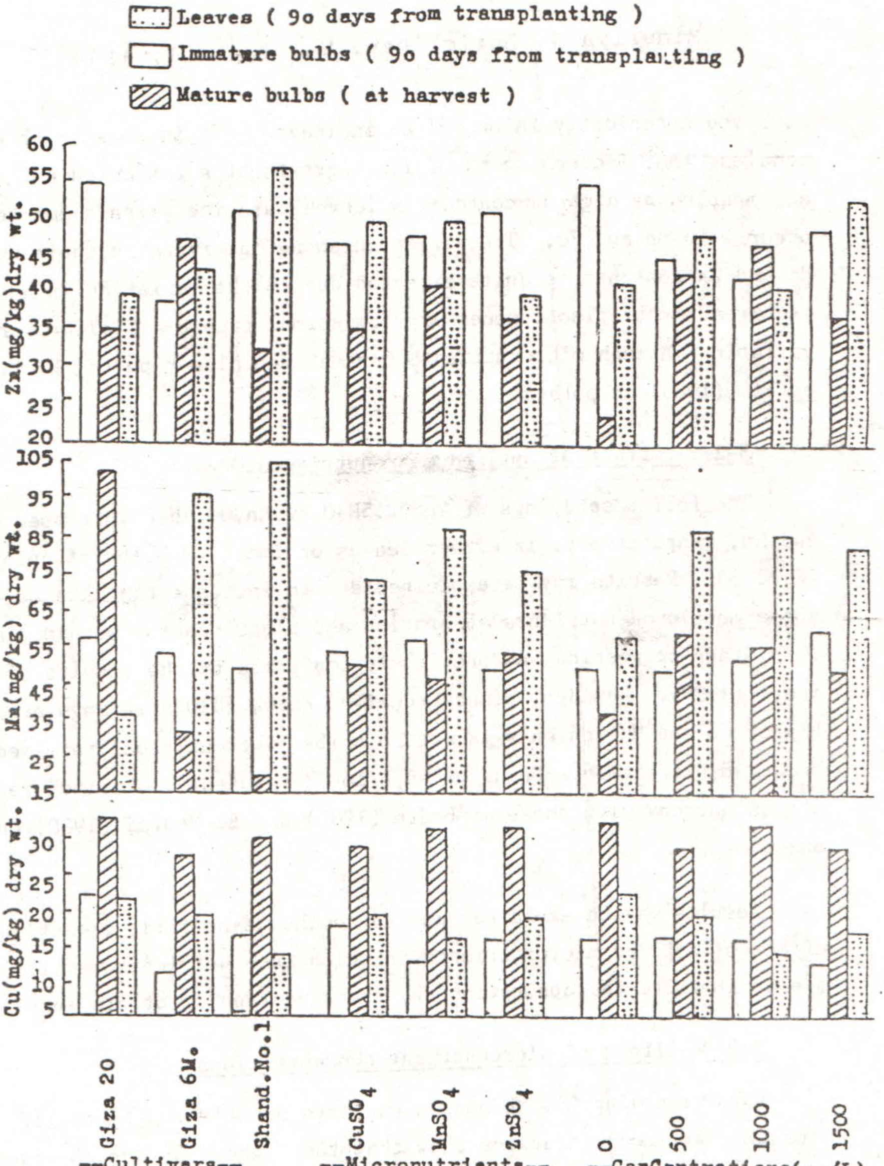


Fig.(3).Effect of cultivars and micronutrients along with their concentrations on Cu,Mn and Zn contents in onion grown in 1984/1985 season approved superiority in Mn and Zn in leaves. It is eassily then to conclude that increasing the foliage growth of a respected cv. was accompanied by high Cu content in leaves but vice versa seems to occur with Mn and Zn. The variation among cultivars in their Cu, Mn and Zn contents is quite expected due to the variation in nutrient requirements of plants necessary for normal growth. Similar varietal variation in such micronutrients content was also reported by Midan et al. (1985) on potato.

3-2-2- Effect of applied micronutrients:

The foliar sprayings of $CuSO_4.5H_2O$ or $MnSO_4.4H_2O$ increased Cu and Mn, respectively, in either leaves or immature bulbs of onion (Fig. 3). Results may be explained due to increase the rate of the above mentioned nutrients absorption and translocation within plant. This drawn suggestion was previously confirmed by the results of Badre (1980). Besides, plants received $ZnSO_4.7H_2O$ sprayings are of higher Cu and Mn contents in mature bulbs, whereas those received $MnSO_4.4H_2O$ treatments being of superior Zn content. Obtained results are in harmony with those of Badre (1980) and El-Moursi (1980) on onion.

Results may be explained due to somehow synergitic or antigonism effect of applied micronutrients in which such nutrients may encourage or inhibite the absorption and translocation of others in plant.

3-2-3- Effect of micronutrient concentrations:

Data regarding Cu, Mn and Zn contents as affected by tested micronutrient concentrations show that the highest Cu was observed in leaves and either initiated and mature bulbs of the check plants (Fig. 3). Also, plants received no micronutrients application seemed to be of higher Zn content in immature bulbs. The lowest concentration, i.e., 500 mg/L of applied micronutrients caused the highest

Mn content in leaves and mature bulbs. Whereas, medium and higher concentrations, i.e., 1000 and 1500 mg/L, are of superior effect on Zn in leaves and mature bulbs and Mn in immature bulbs. The lower concentration of spraying micronutrients solution was also reported by Basilious (1983) to increase Mn and Zn contents in onion bulbs, whereas higher spraying concentrations exerted a negative effect.

3-2-4- The interactions effect:

The interaction of tested growth factors exerted no definitive trend as regards its effect on Cu, Mn and Zn contents in onion plant organs and its related data were too large, so it was annulled.

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