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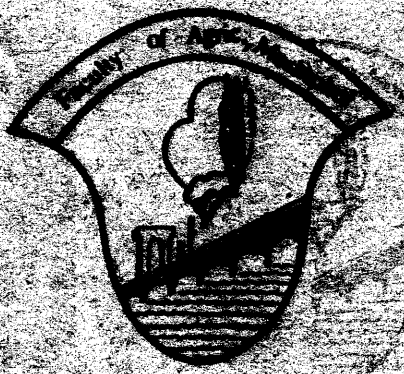

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PLANT VEGETATIVE GROWTH, CHEMICAL COMPOSITION , YIELD AND QUALITY OF CARROT ROOTS AS AFFECTED BY N K-FERTILIZATION AND FOLIAR SPRAY OF ZINC AND MOLYBDENUM

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ABSTRACT

Two field experiments were conducted at the experimental Farm of the Faculty of Agriculture Moshtohor Zagazig University during the winter seasons of 1989/ 1990 and 1990/1991 , to elucidate the effect of nitrogen and potassium fertilizers at three levels (30 kg N + 24 kg k_2O, 45 kg N +48kg k_2O and 60 kg N + 72 kg k_2O/fad.) as well as zinc and Molybdenum foliar spray at concentration of 50 and 100 ppm for each in addition to the control treatment on vegetative growth, chemical composition and yield and its quality of carrot plants.

Obtained results showed that increasing nitrogen and potassium fertilizers level up to the highest used one (60 kg N + 72 kg k_2O/fad.) combined with 100 ppm of either Zn or Mo reflected the maximum values on studied vegetative growth aspects expressed as plant height, number of leaves, top length, root length and dry weight per plant as well as photosynthetic pigments. It also showed significant increments in total N, P, K, Zn and Mo contents of plant foliage. Moreover, such treatment resulted in the highest values for the total yield and its components expressed as plant weight , root weight and root diameter. It also led to statistical increments in total sugars. But the carotene content of roots was not affected. In addition, P, K and Zn content were significantly increased but N and Mo were not affected.

Generally, it could be concluded that , under such condition of this experiment, the application of 60 kg N +72 kg k_2O/fad combined with 100 ppm of either Zn or Mo may be recommended for good vegetative growth with highest total yield and best quality of carrot roots.

INTRODUCTION

Carrot (Daucus carota, L.) is one of the most important vegetable root crops grown in Egypt. Therefore, it is necessary to increase the productivity and the quality of carrot roots. This can be achieved through following proper measures for crop production. Among such measures the application of nitrogen and potassium fertilizers as well as the foliar spray of zinc and molybdenum. In this respect, Habben (1973), Emura and Hosoya (1979), Mesquitafilho et al. (1985) and Abd-Alla et al. (1990) reported that fertilizing carrot plants with N, P and K fertilizers at different levels increased the vegetative growth and total yield as well as its components. In addition, Abd-Alla et al. (1990) indicated that photosynthetic pigments (chlorophyll a, b and carotenoides) macro-elements, (N, P and K) and sugars content of plant foliage and roots were increased with increasing the level of N, P and K fertilizers up to the highest used one (60 Kg N + 48 kg p 2 O 5 + 150 kg k 2 O/ fad.) .

Regarding the effect of micro-nutrients, many investigators mentioned that the application of zinc and molybdenum either as seed soaking or foliar spray increased the vegetative growth parameters, and the total yield and its components (Smagina, 1977 on red beet, Alekseeva and Kutsenko, 1977 on red carrot). Moreover, Abed et al. (1988) and Farag et al. (1989) working on pea found that chlorophyll (a) and (b), total nitrogen , phosphorus, potassium and micro-elements content were increased as a result of either seed soaking or plant spray and the highest content of such chemical constituents were connected with the highest used concentration of such macro-nutrients.

MATERIALS AND METHODS

TWO field experiments were conducted at the Experimental Farm of the Faculty of Agriculture Moshtohor, Zagazig University during the winter seasons of 1989/1990 and 1990/1991. The soil of the Experimental Farm was clay loamy in texture with pH 7.7 and contains 0. 103% available-N 2.747 ppm soluble P, 0.5 meq/L K and 0.25 ppm Zn.

Seeds of carrot (Daucus carota, L.) cv. red core chantenay were sown on September 25th and 29th in 1989 and 1990 respectively. Each experiment included 15 treatments which were the combinations of three nitrogen and potassium fertilization levels i.e. 30 kg N +24 kg k_2O/fad., 45 kg N +

48 kg k_2O and 60 kg N + 72 kg 20/fad. within five concentrations of Zn and Mo, i.e.,50 and 100 ppm for each of them in addition to the control treatment which was sprayed with distilled water only. Phosphorus fertilizer was added at a rate of 32 kg P_2O_5/fed. A split plot design with three replicates was adopted. The fertilization treatments were arranged in the main plots Meanwhile Zn and Mo treatments were randomly distributed in the sub-plots. Each experimental plot included 5 ridges 3.5 min long and 60 cm wide with an area of 10.5 m 2 (1/400 of fad.), one ridge was left without planting between each two plots as a gard one . Ammonium nitrate (33.5% N) calcium superphosphate (16% P 2 O 5) and potassium sulphate (48-52% K 2 O) fertilizers were used as sources of nitrogen, phosphorus and potassium respectively. The amounts of fertilizers were added at two equal portions. The first half was added one month after seed sowing and the second was added 3 weeks after the first portion. Plants were sprayed three times with an aqueous solutions of studied micro-nutrients at three weeks intervals starting after complete seeds germination. Other agricultural practices were done as commonly followed in the district.

For vegetative growth measurements, 15 plants were taken as a representative sample from each experimental plot after 120 days after planting as the following data were recorded. Plant height, top length, root length, plant fresh weight, top weight, root weight, root diameter, number of leaves per plant and plant dry weight.

At harvest, plants of each experimental plot were harvested, counted and weighted and the total yield (ton/fed) was calculated. Chemical constituents, were determined in a representative sample of plant foliage and roots as follows:

Photosynthetic pigments were assayed as chlorophyll a, b and total chlorophyll as well as carotenoides in plant foliage calorimetrically determined as described in the A.O.A.C.(1970). Reducing non-reducing and total sugars as well as carotene content were determined in plant roots according to the methods followed by Morell (1941) for sugars and Umiel and Gabelmoii (1971) for carotenoides determined as B carotene.

Macro and micro-elements were assayed in both plant foliage and roots during the second season only. Total nitrogen, phosphorus and potassium as well as zinc and

molybdenum were determined according to the methods described by Pregl (1945) for total nitrogen, Murphy and Riely (1962) for phosphorus, Brown and Lilleland (1946) for potassium and Chapman and Pratt (1961) for micro elements.

All obtained data were subjected to statistical analysis according to Gomez and Gomez (1983).

RESULTS AND DISCUSSION

1- Vegetative growth characteristics:

Data presented in Table (1) showed the effect of nitrogen and potassium fertilization as well as zinc and molybdenum foliar spray on morphological traits of carrot plant. Such data indicated that all the studied growth measurements, i.e., plant height, number of leaves per plant, top and root length as well as dry weight were increased with increasing nitrogen and potassium fertilization level up to the highest used one (60 kg +72kg k_2O/fed.). Such increment in all forementioned growth aspects reached the level of significancy only in case of plant height and number of leaves during the first season and plant height, top length dry weight during the second one. Obtained results may be attributed to the main role of nitrogen and potassium in meristimatic activity of plant cells and the role of nitrogen in formation of plant growth materials. Similar results were obtained by Habben (1973). Emura and Hosoya (1979) and Abd-Alla et al. (1990)

Regarding the effect of micro-nutrients, it is clear from the same data in Table (1) that irrespective of plant height and dry weight per plant which were statistically increased all the studied growth parameters were not affected due to the application of micro- nutrients compared with the control. In this respect, highest used concentrations of zinc and molybdenum (100ppm) reflected the highest values in all measured growth aspects. Such enhancing effect of Zn and Mo growth parameters may be due to the role of Zn in formation of the amino acid treptophan, which is the precursor of indole acetic acid, in plant and Mo in nitrate-nitrogen assimilation in plant tissues both resulted in plant cell formation and elongation. Obtained results are in agreement with those obtained by Smagina (1977) on red beet and Alekseeva and Kutsenko (1977) on carrot and Abed et al. (1988) and Farag et al. (1989) on pea.

Table (1): Effect of N K-fertilization level and foliar spray with Zn and Mo on vegetative growth of carrot.

Season			1989/1990					1990/1991				
N and K levels (kg/fad.) N	K_2O	Micro-nutrients (ppm)	Plant height (cm)	Number of leaves/ plant	Top length (cm)	Root length (cm)	Dry weight/ plant(g)	Plant height (cm)	Number of leaves/ plant	Top length (cm)	Root length (cm)	Dry weight/ plant(g)
30	24	Control	52.0	6.0	37.5	14.5	9.1	56.3	6.3	40.4	15.9	10.9
		Zn 50	59.6	7.3	44.4	15.2	11.5	64.6	7.3	48.3	16.3	15.5
		Zn 100	61.0	7.6	45.1	15.9	13.3	66.0	8.0	49.4	16.6	17.7
		Mo 50	55.0	7.0	40.0	15.0	11.7	63.3	7.0	46.9	16.0	16.4
		Mo 100	59.6	7.3	44.3	15.3	14.6	65.0	8.0	48.6	16.3	19.9
45	48	Control	57.3	6.6	42.0	15.3	11.1	60.0	6.7	44.0	16.0	13.2
		Zn 50	60.6	7.7	44.8	15.8	13.3	68.3	7.6	51.8	16.5	16.5
		Zn 100	62.3	8.3	46.4	16.3	14.3	70.0	8.3	53.0	16.9	17.6
		Mo 50	58.0	6.7	42.4	15.6	13.3	65.3	7.3	48.9	16.4	18.9
		Mo 100	61.6	8.0	45.4	16.2	15.5	66.0	8.3	49.3	16.6	20.9
60	72	Control	59.6	8.0	44.1	15.5	13.7	60.7	7.3	44.3	16.3	16.1
		Zn 50	61.3	8.3	45.0	16.6	14.8	69.0	7.7	52.3	16.7	19.2
		Zn 100	64.7	8.7	47.8	16.8	15.6	76.0	8.7	55.4	17.2	19.2
		Mo 50	59.6	8.0	43.3	16.3	14.9	68.6	7.6	52.1	16.5	19.9
		Mo 100	63.0	8.3	46.4	16.6	18.8	69.3	8.6	52.4	16.9	21.0
L.S.D. at 0.05			N.S	N.S	N.S.	N.S	N.S	N.S	N.S	N.S	N.S	N.S
30	24		57.5	7.1	42.4	15.2	12.0	63.0	7.3	46.8	16.2	16.1
45	48		60.0	7.5	44.2	15.8	13.5	65.9	7.7	47.5	16.5	17.4
60	72		61.7	8.3	45.5	16.4	15.6	68.1	8.0	51.3	16.8	19.1
L.S.D at 0.05			3.1	0.8	N.S	N.S	N.S	2.5	N.S	2.6	N.S	1.5
		Control	56.3	6.9	41.2	15.1	11.3	59.0	6.8	42.9	16.1	13.4
		Zn 50	60.6	7.8	44.7	15.9	13.2	67.3	7.6	50.8	16.5	17.1
		Zn 100	62.7	8.2	46.5	16.3	14.4	69.6	8.3	52.6	16.9	18.2
		Mo 50	57.6	7.2	41.9	15.6	13.3	65.7	7.3	49.4	16.3	18.4
		Mo 100	61.4	7.9	45.7	16.0	16.3	66.8	8.3	50.0	16.8	20.6
L.S.D. at 0.05			4.4	N.S	N.S	N.S	2.1	4.6	N.S	4.7	N.S	2.

As for the effect of interaction, no significant differences in all studied growth parameters were obtained as a result of the interaction between applied macro- and micronutrients. In this connection, the highest used fertilization level (60 kg N+72 kg k_2O/fad.) and spraying plants with 100 ppm of Zn or Mo reflected the maximum values of all growth parameters.

2- Chemical composition of plant foliage:

a- Photosynthetic pigments:

Data in Table (2) showed the effect of nitrogen and potassium fertilization as well as zinc and molybdenum spray on photosynthetic pigments of plant foliage, i.e., chlorophyll (a), (b), total chlorophyll and carotenoides. It is obvious from such data that chlorophyll a, b and total chlorophyll as well as carotenoides materials were significantly and steadily increased with increasing nitrogen and potassium fertilizer. In this regard, the highest content in photosynthetic pigments were obtained as a result of the highest fertilizer level (60 kg N + 72 kg k_2O/fad.). Obtained results are due to the role of nitrogen and potassium in formation and constancy of photosynthetic pigments. Afifi et al, (1989) on cowpea, khalil (1989) on cucumber and Abd-Aalla et al. (1990) on carrot reported similar results on studied vegetable crops.

Concerning the effect of zinc and molybdenum, it is evident from the same data in Table (2) that all determined photosynthetic pigments were significantly increased as a result of spraying plant with either Zn or Mo compared with the control treatments during both season of growth. In this respect, the highest used concentration (100ppm) from each of Zn and Mo proved to be the most effective treatment in increasing different constituents of photosynthetic pigments. These results may attributed to the role of Zn and MO on chlorophyll assimilation by plants. Similar results were obtained by Abed et al. (1988) and Farag et al. (1989) on pea.

Regarding the interaction effect, no significant differences were obtained in determined photosynthetic pigments except in case of carotenoides during the first season only. Moreover, the highest photosynthetic content was obtained in case of plants fertilized by 60 kg N +72kg k_2O/fed. and sprayed with 100 ppm of each of Zn or Mo.

Table (2): Effect of N K-fertilization, Zn and Mo foliar spray on photosynthetic pigments of carrot plants (mg/100 g F.W.).

Season			1989/1990				1990/1991			
N kg/fad.	K-fertilizers kg/fad.	Micronutrients (ppm)	Chlorophyll A	Chlorophyll B	Total	Carotenoides	Chlorophyll A	Chlorophyll B	Total	Carotenoides
30	24	Control	115	50	165	71	117	53	170	81
		Zn 50	117	52	169	73	119	55	174	83
		Zn 100	118	53	171	78	121	59	180	88
		Mo 50	121	59	180	78	127	61	188	91
		Mo 100	129	59	188	82	131	62	193	93
45	48	Control	120	53	173	70	125	55	180	80
		Zn 50	121	56	177	78	127	57	184	84
		Zn 100	123	59	182	79	127	61	188	89
		Mo 50	131	60	191	81	133	65	198	93
		Mo 100	134	61	195	84	137	69	206	96
60	72	Control	124	55	179	69	131	57	188	80
		Zn 50	126	60	186	81	137	63	200	83
		Zn 100	126	62	188	85	137	65	202	93
		Mo 50	133	63	196	90	139	69	208	96
		Mo 100	139	69	208	97	143	73	216	100
L.S.D. at 0.05			N.S	N.S	N.S	3	N.S	N.S	N.S	N.S
30	24		120	55	175	76	123	58	181	87
45	48		126	58	184	78	130	61	191	88
60	72		130	62	191	84	137	65	202	90
L.S.D. at 0.05			3	2	3	2	5	3	6	2
		Control	120	53	173	70	124	55	179	80
		Zn 50	121	56	177	77	128	58	186	83
		Zn 100	122	58	180	81	128	62	190	90
		Mo 50	128	61	189	83	133	65	198	93
		Mo 100	134	63	197	88	137	68	205	96
L.S.D. at 0.05			2	3	5	1	4	3	5	3

b- Macro-elements content:

Data illustrated in Table (3) showed the effect of nitrogen and potassium fertilization as well as micro-nutrient foliar spray on total nitrogen, phosphorus and potassium content of carrot plant foliage. Such data revealed that, total nitrogen, phosphorus and potassium content were statistically increased as a result of increasing nitrogen and potassium fertilizers level up to the highest used one. Obtained results may be attributed to the increasing of the uptake by plant as a result of increasing the concentration of such macro-nutrients in roots growth media due to the fertilizers addition. In this regard, the increasing in N P K were connected with highest vegetative growth rate expressed in different studied growth parameters. Obtained results are agree with those obtained by Abd-Alla et al. (1990)on carrot.

Regarding the effect of micro-nutrients application, it is clear from the same data in Table(3) that total nitrogen, phosphorus and potassium content of plant foliage were increased as a result of spraying plant with either Zn or Mo with its different concentrations compared with the control treatment. In this respect, the highest values of N, P and K content were obtained due to using 100ppm of either Zn or Mo. Similar results were found by Abed et al. (1988) and Farag et al. (1989) on pea.

Concerning the effect of interaction, the same data in Table (3) revealed that using 60 kg N + 72 kg k_2O/fad. and spraying the plants with 100 ppm of either Zn or Mo reflected the highest content of N P K content.

c- Micro-elements content:

Data in Table (3) showed that both Zn and Mo content of plant foliage was increased as a result of increasing the level of nitrogen and potassium fertilizers. In this regard, the highest Zn and Mo values were connected with the highest used level (60 kg N +72kg k_2O/fad. obtained result may be due to the increase of plant growth aspects (Table, 1) that required much uptake of micro-elements.

With respect to the effect of micro- nutrients, the same data in Table (3) showed that spraying carrots plants with Zn or Mo at its different studied concentrations led to a significant increase in the content of Zn and Mo of plant foliage obtained results are in conformity with those recorded by Farag et al. (1989) on pea.

Table (3): Nitrogen, phosphorus, potassium, zinc and molybdenium contents in carrot plant foliage as affected by N K-fertilization level and Zn and Mo foliar spray.

Season			1990/1991				
N K-fertilizers kg/fad.	Micro-nutrients (ppm)		N	P	K	Zn	Mo
			(mg/100 g D.W.)			(ppm)	
30 24	Control		1500	220	3510	164	64
	Zn	50	1880	380	3870	243	98
		100	2140	410	4180	329	154
	Mo	50	2200	540	4560	448	180
		100	2320	620	5900	622	214
45 48	Control		1620	250	3660	176	82
	Zn	50	2000	330	3920	288	111
		100	2040	450	4380	380	164
	Mo	50	2180	520	4870	452	193
		100	2240	590	5260	547	220
60 72	Control		1740	260	3790	284	82
	Zn	50	2020	360	3990	350	172
		100	2160	390	4500	416	199
	Mo	50	2220	560	4910	630	212
		100	2370	600	5380	728	252
L.S.D. at 0.05			85	29	34	5	4
30 24			2008	434	4404	361	142
45 48			2016	438	4418	368	154
60 72			2102	434	4514	481	183
L.S.D. at 0.05			57	N.S	27	2	1
	Control		1620	243	3653	208	76
	Zn	50	1966	356	3926	293	127
		100	2113	416	4353	375	172
	Mo	50	2200	540	4780	510	195
		100	2310	603	5513	632	228
L.S.D. at 0.05			49	16	19	2	2

With regard to the interaction effect, it is obvious from such data that the highest Zn and Mo values were resulted due to fertilizing carrot plants with 60 kg N +72 kg k_2O/fad. Combined with 100 ppm of either Zn or Mo as foliar spray.

3- Yield and its components:

Data presented in Table (4) showed the effect of nitrogen and potassium fertilizers as well as Zn and Mo foliar spray on the total yield and its components. Such data indicated that plant weight, root weight and root diameter as well as the total yield were increased with increasing the fertilization level up the highest used one. In this regard, such increments in total yield and its components reached the level of significancy only in case of root diameter during the first season of growth and all studied yield measurements during the second one. In addition, the highest values of the total yield and its components were obtained in case of the highest level of fertilization (60 kg N + 72 kg k_2O/fad.). The increase in total yield was due to the increase in plant weight, root weight, root diameter and the other studied vegetative growth parameters(Table , 1). Such increments in vegetative growth aspects and the total produced yield and its components were due to the increase in net rate of photosynthetic assimilation and mineral accumulation as shown in Tables (2 and 3). Obtained results are agree with those obtained by Mesquitafilho et al .(1985) and Abd-Alla et al.(1990) on carrot.

With regard to the effect of micro- nutrients, the same data in Table(4) showed that of the studied yield measurements expressed as plant weight, root diameter and the total yield were statistically increased as result of spraying plants with either Zn or Mo in its different concentrations compared to the control. In this respect, 100 ppm of each Zn or Mo reflected the highest values of the total yield and its components during both season of growth. Obtained results may be due to the effect of micro-nutrients on plant vegetative growth and consequently on produced total yield . Similar results were obtained by Alekseeva and kutsenko (1977) on carrot. As for the effect of the interaction, no significant differences were obtained in the total yield and its components.

Table (4): Effect of N K-fertilization, Zn and Mo foliar spray on total yield and its components of carrot.

Season			1989/1990				1990/1991			
N kg/fad.	K-fertilizers kg/fad.	Micronutrients (ppm)	Plant weight (gm)	Root weight (gm)	Root diameter (cm)	Total yield /fad. (Ton)	Plant weight (gm)	Root weight (gm)	Root diameter (cm)	Total yield /fad. (Ton)
30	24	Control	70.3	52.0	2.4	19.216	83.5	62.8	2.6	20.530
		Zn 50	82.3	58.7	3.5	20.533	109.3	82.3	3.6	22.100
		Zn 100	95.3	64.7	3.3	21.683	124.0	91.3	3.4	22.950
		Mo 50	86.6	65.0	3.3	21.233	121.3	97.6	3.5	22.300
		Mo 100	101.0	72.7	3.5	21.933	137.3	106.7	3.6	23.100
45	48	Control	82.0	55.4	3.0	19.566	97.8	68.2	3.1	21.800
		Zn 50	94.9	61.6	3.6	20.766	118.7	83.7	3.8	24.300
		Zn 100	102.3	63.3	3.5	22.866	126.6	86.3	3.6	24.850
		Mo 50	93.7	62.7	3.6	21.633	133.3	102.6	3.7	24.600
		Mo 100	104.3	72.0	3.8	23.200	140.0	104.7	4.1	25.300
60	72	Control	103.3	70.0	3.3	21.900	120.0	85.6	3.7	22.400
		Zn 50	109.3	72.7	3.7	23.166	136.0	96.7	3.8	25.200
		Zn 100	115.0	73.0	3.5	23.850	140.0	89.3	3.7	25.950
		Mo 50	107.0	74.4	3.9	23.250	141.0	103.7	3.9	25.800
		Mo 100	125.0	87.0	4.0	23.866	141.8	101.2	4.2	26.650
L.S.D. at 0.05			N.S	N.S	N.S	N.S.	N.S	N.S	N.S	N.S
30	24		87.1	62.6	3.2	20.920	115.1	88.2	3.4	22.189
45	48		95.4	63.0	3.5	21.697	123.3	88.4	3.7	24.170
60	72		111.9	75.4	3.7	23.207	135.8	96.0	4.0	25.200
L.S.D. at 0.05			N.S.	N.S.	0.3	N.S.	15.4	3.8	0.4	0.772
		Control	85.2	59.1	2.9	20.233	100.4	72.2	3.2	21.578
		Zn 50	95.5	64.3	3.6	21.489	121.3	87.6	3.8	23.867
		Zn 100	104.2	67.0	3.4	22.800	130.2	89.0	3.6	24.589
		Mo 50	95.8	67.4	3.6	22.044	131.9	101.4	3.7	24.233
		Mo 100	110.1	77.2	3.8	23.000	139.7	104.2	4.0	25.011
L.S.D. at 0.05			28.8	N.S	1.0	N.S	1.359	16.0	6.5	1.223

4- Chemical composition of roots:

a- Sugars and carotene content:

Data indicated in Table (5)showed the effect of nitrogen and potassium fertilization as well as Zn and Mo spray on reducing, non-reducing and total sugars as well as carotene content of carrot roots. It is clear from such data that increasing the level of nitrogen and potassium fertilization led to significant increases in sugars and carotene of carrot roots during both season of growth. In addition, the highest values of determined sugars fraction and carotene were connected with the highest level of fertilization. Obtained results, may be due the increase of photosynthetic pigments Table (2) and the role of macro-nutrients especially potassium element in increasing translocation of carbohydrate from plant foliage in the form of sugars to be accumulated in the plant roots. Similar results are reported by Habben (1973), Emura and Hosoya (1979) and Abd-Alla et al.(1990) on carrot and Said et al. (1984) on sweet potato.

With respect to the effect of Zn and Mo, the same data in Table (5) revealed that spraying carrot plants with either Zn or Mo with its different used concentrations resulted in increasing reducing, non-reducing and total sugars as well as carotene content of carrot roots compared to the control treatment. In this regard the maximum values of sugars constituents and carotene were obtained as a result of spraying plants with 100 ppm of Zn or Mo during both growing season.

Referring to the effect of the interaction it is evident from the same data in Table (5) that reducing and non-reducing and total sugars were significantly increased while carotene was not affected as a result of increasing the level of both macro-and micro-nutrients during both season of growth. In this concern using 60 kg N + 72 kg k_2O/fad. and spraying plants with 100 ppm of with Zn or Mo reflected the highest content of sugars and carotene.

b- Mineral elements content:

1- Macro-elements content:

Data in Table (6) showed clearly that the content of macro-elements, i.e. total nitrogen, phosphorous and potassium of carrot roots were continuously increased with increasing the level of nitrogen and potassium fertilizers up to the highest used one. Such increments may be due to

Table (5): Effect of N K-fertilization, Zn and Mo foliar spray on chemical constituents of carrot plant roots.

Season			1989/1990				1990/1991			
N K-fertilizers (kg/fad.)		Micronutrients (ppm)	Soluble sugars (mg/100 g D.W.) Reducing	Non-reducing	Total	Carotene mg/100g F.W.	Soluble sugars (mg/100 g D.W.) Reducing	Non-reducing	Total	Carotene mg/100 g F.W.
30	24	Control	5548	1983	7531	13	5563	2011	7574	15
		Zn 50	5621	2011	7632	14	5632	2019	7651	16
		Zn 100	5632	2341	7973	14	5644	2345	7989	16
		Mo 50	5620	2229	7849	16	5644	2235	7879	18
		Mo 100	5624	3221	8845	19	5647	3229	8876	20
45	48	Control	5565	2113	7678	17	5567	2118	7685	17
		Zn 50	6420	2175	8595	16	6433	2189	8622	18
		Zn 100	6424	2450	8874	16	6428	2461	8889	19
		Mo 50	6500	2331	8831	21	6525	2339	8864	19
		Mo 100	6720	3359	10079	22	6731	3361	10992	23
60	72	Control	5670	2239	7909	19	5679	2249	7928	21
		Zn 50	6697	2280	8977	20	6681	2291	8972	23
		Zn 100	6711	2568	9279	20	6723	2575	9298	24
		Mo 50	6823	2438	9261	23	6834	2440	9274	25
		Mo 100	6980	3589	10569	24	6990	3565	10555	26
L.S.D. at 0.05			118	44	199	N.S	N.S	33	62	N.S
30	24		5609	2357	7966	15	5626	2368	7994	17
45	48		6326	2486	8812	18	6337	2494	8831	19
60	72		6576	2623	9199	21	6581	2624	9205	24
L.S.D. at 0.05			13	22	52	1	15	17	32	1
		Control	5594	2112	7706	16	5603	2126	7729	18
		Zn 50	6246	2155	8401	17	6249	2166	8415	19
		Zn 100	6255	2453	8708	17	6265	2460	8725	20
		Mo 50	6314	2333	8647	20	6334	2338	8672	21
		Mo 100	6441	3390	9831	22	6456	3385	9841	23
L.S.D. at 0.05			68	23	115	1	20	20	35	2

Table (6): Nitrogen, phosphorus, potassium, zinc and molybdenum contents in carrot roots as affected by N K-fertilization level and Zn and Mo foliar spray.

Season			1990/1991				
N K-fertilizers kg/fad.		Micronutrients (ppm)	N	P	K	Zn	Mo
			(mg/100 g D.W.)			(ppm)	
30	24	Control	1200	190	2560	137	36
		Zn 50	1370	260	2770	176	72
		Zn 100	1680	320	2960	229	123
		Mo 50	1830	420	3090	430	159
		Mo 100	2180	500	3220	454	188
45	48	Control	1340	220	2680	154	54
		Zn 50	1490	280	2890	180	89
		Zn 100	1770	360	3110	234	137
		Mo 50	2070	440	3240	454	169
		Mo 100	2220	480	3310	473	200
60	72	Control	1380	230	2500	192	64
		Zn 50	1500	390	2840	264	99
		Zn 100	1900	430	3140	366	152
		Mo 50	2140	480	3220	580	178
		Mo 100	2300	530	3410	585	210
L.S.D. at 0.05			N.S	2	4	15	N.S
30	24		1652	338	2920	285	116
45	48		1778	356	3046	299	130
60	72		1844	412	3022	397	141
L.S.D. at 0.05			14	3	4	8	5
		Control	1307	213	2580	161	51
		Zn 50	1453	310	2833	207	87
		Zn 100	1783	370	3070	276	137
		Mo 50	2013	447	3183	488	169
		Mo 100	2233	503	3313	504	199
L.S.D. at 0.05			16	1	1	9	3

the increase of the concentration and consequently the uptake and the accumulation of macro-nutrients as a result of fertilizers addition. Obtained results are in conformity with those reported by Mazur and Lukaszuk (1977) and Abd-Alla et al. (1990) on carrot.

Referring to the effect of Zn and Mo, the same data indicate that content from assayed macro-elements were significantly increased as a result of spraying the plants with different concentrations of either Zn or Mo. In this regard the maximum values of nitrogen, phosphorus and potassium were connected with the highest used concentration of Mo, i.e., 100 ppm.

According to the interaction effect, it is evident that phosphorus and potassium content were increased while nitrogen was not effected the highest level of nitrogen and potassium fertilizers and the highest concentrations of Zn and Mo reflected the maximum values of nitrogen, phosphorus and potassium content of roots.

2- Micro-elements content:

The same data in table (6) showed clearly that Zn and Mo content of carrot roots were significantly increased as a result of nitrogen potassium fertilizers application. In this respect, the addition of 60 kg N + 72 k_2O/fad. proved to be most effective treatment in this respect.

Concerning the effect of Zn and Mo, it is evident that there is a gradual increase in the concentration of Zn and Mo as a result of spraying carrot plants with different concentration of Zn and Mo. Such results were expected due to the application of these macro- elements. As for the interaction effect, the maximum contents of Zn and Mo were obtained in case of the highest N and k fertilizers level and the highest concentration of Mo, i.e., 60 kg N + 72 kg k_2O and 100 ppm of Mo

Generally, it could be concluded that under such condition of this experimental trail, the fertilization with 60 kg N + 72 kg k_2O/fad. combined with 100 ppm of either Zn or Mo recommended for obtaining the highest total yield with best quality of carrot roots.

REFERENCES

Abd-Alla, I.M.; Nadia, S. Shafshak, Abo-Sedera, F.A. and Abd-El-Rahman, L.A. (1990): Effect of some agricultural practices on yield and quality of carrot. Annals of Agric. Sci. Moshtohor, 28 in press.

Abed, T.A.; Abo-Sedera, F.A. and Eid, S.M. (1988): Effect of soaking seeds of pea (pisum sativum, L.) in some micro-nutrients solutions on growth, yield and quality of pea. Annals of Agric. Sci. Moshtohor, 26 (4): 2644-2674.

Afifi, S.T.; Hawail, A.F. and Sakr, M.T. (1989): Effect of NPK fertilizers on growth, photosynthetic pigments, mineral composition and yield of cow pea plants. J. Agric. sci. Mansoura Univ. 14: 1294-1300.

Alekseeva, A.M. and Kutsenko, E.M. (1977): [The effect of fertilizers on the yield, quality and storability of carrot mother plants of the cultivars chantenay-2461.]. Nauoh uge tryby voronezh S-Kh institut (1975) 33:109-116 (C.F. Hort. Abstr. 47:8551, 1977).

A.O.A.C.(1970): Official methods of analysis association of agricultural chemists. 11th ed. P.O. Box: 540, Washington, D.C., U.S.A.

Brown, J.D. and Lilleland, O. (1946): Rapid determination of potassium and sodium in plant material and soil extracts by flame photometry. photometer. proc. Amer. Soc. Hort. Sci. 48:341-346.

Emura, K. Hosoya, T. (1979): Effect of fertilizer on the quality and yield of spring sown carrot. Japan. Bull. Saitama Hort. Exp. St. No. 8:13-23. (C.F. hort. Abstr., 50:9153, 1980).

Farag, S.A.; Abo-Sedera, F.A. and Farrag M.Z. (1989): Effect of some micro-nutrients foliar spray on plant growth chemical composition, flowering and dry seed yield of pea (pisum sativum, L.). Annals of Agric. Sci. Mosht ohor, 27(1):542-556.

Gomez, K.A. and Gomez, A.A. (1983): Statistical procedures for Agric. Res. 2nd Ed. 686 pp.

Habben (1973): Quality constituents of carrots (Daucus carota, L.) as influenced by nitrogen and potassium fertilization. Acta Horticulturae 29:295-305.

Khalil, M.A.I. (1989): Effect of various of fertilizers on growth yield and quality of some cucumber hybrids. grown under plastic houses in sandy soils. Egypt. J. Appl. Sci. 4:118-136.

Mazur, T. and Lukaszuk, L. (1977)): Fertilization of fadder carrots with increasing rates of N, P and k. Zesyty Naukowe Akademii Rolniczotechiczney W. Olsztynie Rolnictwo No, 175:65-78. (C.F. soils and Fertilizers 41:6116, 1978).

Mesquitafilho, M.V.D.E.; Crisostomo, L.A. and Silva, T.G.D.A.(1985): Carrot yield in relation to nitrogen and phosphorus application on acorrado soil. Horticultura Brasileira, 3:39-40. (C.F. Hort. Abstr. 56:3454, 1986).

Morell, A.S. (1941): Rapid determination of reducing sugars. Indus, J Eng. Chem. Anal. Ed. 13:249-251.

Murphy, J. and Riely, J.P. (1962): A modified single solution method for the determination of phosphate in natural water. Annal. Chem. Acta. 27:31-36.

Pregl, E. (1945): Quantitative organic micro-analysis 4th Ed. J. Chundril, London.

Said, M.S.; El-Beheidi, M.A.; Khalil, M.A.I.; El-Gazar, T.M. and El-Hassan, O.M. (1984): Studies on the effect of some cultural practices on sweet potato yield (Ipomea batatas, Lam.). I. Effect of water supply and nitrogen fertilization. J. Agric. Sci Mansoura univ., 9:422-427.

Smagina, V.N. (1977): The effect of micro-elements on red beet yield. Trudy plodoovoshchnogo Instituta I.V. Michurina (1970), 22:178-184. From Refera a tivnyt Zhuval, 55 (1971), 10:55o-562. (C.F. Hort. Abstr., 42(2), 1977.

Umiel N. and Gabelmoii, W.H. (1971): Analytical procedure for detecting carotenoides of carrot (Daucus carota, L.) roots and tomato (Lycopersicon esculentum) fruits. J. Amer. Soc. Hort. Sci. 96:702-704.

تأثير التسميد النيتروجينى والبوتاسى والرش بعنصرى الزنك والمولبيدنم على النمو الخضرى والتركيب الكيماوى والمحصول وجودة جذور الجزر

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اجريت تجربتان حقليتان بمزرعة كلية الزراعة بمشتهر - جامعة الزقازيق - أثناء الموسم الشتوى لعامى ١٩٨٩/١٩٩٠ ، ١٩٩٠/١٩٩١ لدراسة تأثير ثلاثة مستويات من الاسمدة الازوتيه والبوتاسيه (٣٠ كجم ن + ٢٤ كجم بو م أ ، ٤٥ كجم ن + ٤٨ كجم بو م أ و ٦٠ كجم ن + ٧٢ كجم بو م أ / فدان مع الرش بالزنك أو المولبيدنم بكل تركيز ٥٠ أو ١٠٠ جزء فى المليون بالاضافة الى معاملة الكنترول وذلك على النمو وتركيب الكيماوى والمحصول والجودة فى الجزر).

وأظهرت النتائج المتحصل عليها أن زيادة مستوى الاسمدة الازوتيه والبوتاسيه حتى أعلى مستوى مستخدم (٦٠ كجم ن + ٧٢ كجم بوم أ /فدان) مع الرش بتركيز ١٠٠ جزء فى المليون لكل من الزنك أو المولبيدنم قد عكس أعلى قيم فى مواصفات النمو معبرا عنه بارتفاع النبات ، عدد الاوراق ، طول العرش طول الجذر والوزن الجاف للنبات وايضا صبغات التمثيل الضوئى . وقد ظهر أيضا زيادة معنويه فى النيتروجين الكلى والفوسفور والبوتاسيوم والزنك والمولبيدنم بالنبات علاوة على ذلك فقد زاد المحصول ومكوناته معبرا عنه بوزن النبات ووزن الجذور وقطر الجذور . أيضا نتج عن هذه المعاملة زيادة احصائيه فى السكريات الكليه ولكن الكاروتين بالجذور لم يتأثر بالاضافة الى ذلك فقد زاد معنويا كل من الفوسفور والبوتاسيم والزنك ولكن لم يتأثر كل من النيتروجين والمولبيدنم فى الجذور.

وعموما يمكن أن نخلص الى أنه تحت مثل هذه الظروف يعتبر اضافة ٦٠ كجم ن + ٧٢كجم بوم أ / فدان مع الرش بأى من الزنك أو المولبيد نم بتركيز ١٠٠ جزء فى المليون يمكن النصح بها حيث أمكن الحصول على أعلى محصول وأفضل جودة لجذور الجذور.