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EFFECT OF SOME MICRO-NUTRIENTS AND GROWTH REGULATORS ON PEA PLANTS GROWN UNDER CALCAREOUS SOIL CONDITIONS.

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ABSTRACT

Two experiments were performed to lessen the depressive effects of the highly calcareous soil at Mariut on seedling energence, growth and yield characteristics of pea plants. Seeds were soaked pre-sowing for 3 hours in solutions of each of Mn, Fe, Zn, GA_3, ethrel and CCC. The grown plants were sprayed twice with the same chemicals. Two concentrations of each chemical were used and compared with those treated with distilled water.

Obtained results revealed that soaking seeds either in 1000 ppm CCC or 200 ppm ethrel before sowing in calcareous soil were the most effective treatments in increasing the germination capacity of pea seeds. In addition, spraying the grown plants with each of Mn at 1000 ppm or CCC at 1000 or 2000 ppm resulted in the highest vegetative growth of pea plants. Macro- and Micro-elements content of plant tissues as well as yield of green pods and its components were mostly significanlty improved by all used treatments compared with check treatment. In descending order, Mn (1000 ppm), CCC (1000 ppm), Fe (500 ppm) and Zn (2000 ppm) were the best treatments in improving yield and its components. Furthermore, the investigated treatments increased total carbohydrates, K, Mn, Fe and Zn content of green pea seeds.

INTRODUCTION

Many of the productive soils in the newly reclaimed areas in North Western Coastal zone are of calcareous type, which usually possess a nutrient imbalance and most of the essential elements become unavailable to plants. Numerous studies indicated that the use of micro-nutrients and growth regulators may improve growth and

yield of several plants. Pea (*Pisum sativum*, L.) is one of the most important legume crops grown in Egypt. Therefore, this study aimed to ameliorate the depressive effects of calcareous soil conditions on germination capacity, growth, yield and quality of pea plants through seed soaking and foliar application with some micro-nutrients and growth regulators.

MATERIALS AND METHODS

This study was conducted on a highly calcareous soil with a pH of 8.4 and 42.38% $CaCO_3$ at Mariut, Alexandria Governorate, during 1987-1988 and 1988-1989 winter seasons in order to ameliorate the depressive effects of such soils on germination, growth, yield and quality of pea (*Pisum sativum*, L.) C.V. Little Marvel. Seeds were soaked pre-sowing for 3 hours in solutoins of some micro nutrients and growth regulators and then grown plants were sprayed twice with the same substances at 30 and 45 days after seed sowing. Thirteen treatments, i.e. EDTA salts of each of Mn (500 and 1000 ppm), Fe (500 and 1000 ppm) and Zn (2000 and 4000 ppm), beside the growth regulators, GA_3 (100 and 200 ppm), ethrel (200 and 400 ppm) and CCC (1000 and 2000 ppm) and the control treatment, in which seeds were soaked in and the grown plants were sprayed with distilled water, were practiced in this work. A complete randomized block design with four replicates was followed. Seeds were sown on October 26th and Nov. 1st of 1987 and 1988, respectively, in hills 20 cm apart on both sides of ridges 4 m long and 60 cm wide. Each experimental plot included five ridges with an area of 12 m^2. In order to calculate the seedling emergence %, 3 seeds were sown per hill. Thinning process was practiced after complete seed emergency (21 days from sowing) leaving only one plant per hill.

Nitrogen, phosphours and potassium fertilizers were applied at a rate of 150 kg ammonium sulphate (20.5%-N), 200 kg super phosphate (15-16%-P_2O_5) and 100 kg potassium sulphate (48-52%-K_2O) per faddan. Half amount of phosphorus fertilizer was incorporated into the soil during its preparation, while the second part was added after thinning process. Nitrogen and potassium fertilizers were divided and added in two equal portions. The first

portion was added after thinning, and the second one was added 21 days later (at flowering stage). Other agricultural treatments were carried out as commonly followed in the district.

After complete emergency (21 days from seed sowing), number of emerged seedlings were recorded and emergence percentage was caluclated. At full bloom stage (55-60 days from sowing), a representative sample of 10 plants from each expreimental plot was taken for measuring vegetative growth expressed as plant height and number of branches and leaves as well as fresh and dry weight per plant. Chemical composition of plant foliage was determined in dry powdered foliage samples.

At harvesting time, the green pods of each experimental plot were harvested, weighed and counted for recording each of number and weight of pods per plant and calculating the total green pod yield (ton/fed).

A representative sample of 100 pods was taken from each experimental plot for recording pod weight, length and diameter, number of seeds per pod and shilling out percentage. 100 gm samples of green seeds from each plot were oven dried for chemical determinations.

Total nitrogen was determined according to Pregl (1945) using micro-kjeldahl apparatus. Total protein if needed was then calculated. Phosphorus was assayed colorimetrically following Murphy and Riley (1962) as modified by John (1970). Calcium, potassium and sodium were determined Flame Photometrically as described by Brown and Lilleland (1946). Manganese, iron and zinc were assayed using Atomic Absorption according to Chapman and Pratt (1961). Total hydrolizable carbohdyrates were determined colorimetrically as described by Michel *et al.*. (1956). All data were subjected to statistical analysis according to Gomez and Gomez (1983).

RESULTS AND DISCUSSION

Seedling emergence :

Data in Table (1) indicate that soaking seeds pre-sowing in aqueous solution of either micro-nutrients or growth regulators improved generally its seedling emergence. CCC at 1000 ppm

Table (1) Effect of some micro-nutrients and growth regulators application on seedling emergence percentage and vegetative growth characteristics of pea plants grown under calcareous soil conditions.

Treatment	Conc. ppm	1987 - 1988						1988 - 1989					
		Seedling emergence %	Plant height cm	No.of branches/ plant	No.of leaves/ plant	Fresh weight/ plant (gm)	Dry weight/ plant (gm)	Seedling emergence %	Plant height cm	No.of branches/ plant	No.of leaves/ plant	Fresh weight/ plant (gm)	Dry weight/ plant (gm)
Cntrol	00	42.80	42.4	1.2	12.3	42.0	5.88	55.43	57.6	2.0	16.7	36.1	5.77
Mn	500	65.00	50.3	1.3	13.6	56.9	8.42	61.25	63.2	2.7	17.7	56.3	9.57
Mn	1000	60.00	60.9	1.4	15.6	66.2	10.57	52.20	69.3	3.1	21.9	60.3	11.03
Fe	500	68.90	55.7	1.4	12.7	59.5	8.75	64.03	78.5	2.6	18.8	56.1	10.32
Fe	1000	55.40	50.8	2.0	17.1	58.0	8.36	63.30	70.1	3.6	19.8	56.9	10.30
Zn	2000	69.50	54.3	1.4	14.5	55.6	8.06	62.08	67.6	2.4	18.1	56.8	9.86
Zn	4000	40.40	53.4	1.2	14.4	53.0	7.75	48.50	67.4	2.4	18.8	52.6	8.99
GA_3	100	56.00	88.8	1.2	14.3	51.5	7.75	63.33	80.3	1.8	19.2	42.8	7.28
Ga_3	200	53.30	99.9	1.3	15.2	51.7	7.50	52.08	99.0	2.4	19.6	43.9	7.35
Ethrel	200	75.00	42.4	2.1	17.1	56.2	7.99	70.40	54.4	2.0	16.3	49.1	8.72
Ethrel	400	42.80	43.4	2.0	17.8	59.1	8.47	49.43	52.7	2.3	17.1	54.4	9.33
CCC	1000	85.00	51.9	1.8	15.3	59.9	9.46	80.40	59.9	2.5	17.0	57.7	10.88
CCC	2000	56.10	46.7	1.4	14.7	59.8	9.76	57.78	57.9	2.5	19.1	59.0	11.39
L.S.D.		7.41	5.2	0.4	2.3	5.7	1.75	5.05	7.0	0.4	3.2	9.8	1.84

followed by ethrel (200 ppm) and iron (500 ppm) reflected the highest values. However, Zn and ethrel at their higher doses, i.e. 4000 and 400 ppm, respectively showed the lowest values. Obtained results are in agreement with those reported by Choe (1972), Khafagi *et al.* (1986-b) and Ebad *et al.* (1987).

Vegetative growth characteristics:

Table (1) Showed also the effect of micro-nutrients and growth regulators on vegetative growth characteristics of pea plants expressed as plant height, number of branches and leaves as well as fresh and dry weight per plant. Data indicated generally that growth of pea plants was positively affected by soaking seeds and spraying plants with the tested chemicals. Such effects seemed to be fluctuated according to the dose used and the chemical substance itself. Mn at 1000 ppm or CCC at either 1000 or 2000 ppm resulted in the highest vegetative growth values.

Obtained results are in confirmity with those found by Abed et al. (1988), Farag *et al.* (1989-a) and Ibrahim (1989) using micro-nutrients, and Midan and Omran (1982), Gabal *et al.* (1985), Farag *et al.* (1989-b) and Khalil (1990) using growth regulators.

Macro-elements content of pea foliage:

Data presented in Table (2) indicate that total nitrogen, phosphorus and potassium contents of plant foliage were positively affected as a result of soaking seeds and spraying plants with either micro-nutrients or growth regulators. As for the effect on Ca and Na of pea foliage, data tabulated in Table (2) show clearly that neither micro-nutrients nor growth regulators induced significant effects in this respect compared with the untreated control during both seasons. Obtained results are in agreement with those reported by Abed *et al.* (1988) and Farag *et al.* (1989-a) using micro-nutrients, and Khafagi *et al.*. (1986-a), Shende *et al.* (1987) and Khalil (1990) using growth regulators.

Micro-elements content of pea foliage:

Data in Table (3) show clearly that the content of micro-elements (Mn, Fe and Zn) in pea foliage was enhanced during both

seasons as a result of soaking seeds and spraying pea plants with either micro-nutrients or growth regulators. In this respect, such enhancing effect was more obvious in case of micro-nutrients treatments than that of growth regulators. In addition, the highest content of each of Mn, Fe and Zn in the foliage of pea plants was linked with the use of each of such micro-nurients during the growing season. Such results were expected for each micro- nutrient. In addition, there is a synergistic effect for zinc on the absorption and the accumulation of Mn during both seasons of growth. The enhancing effect of micro-nutrients application on their concentrations in pea plants are in accordance with those of Reddy et al. (1987), Abed et al. (1988), Ibrahim (1989) and Badawy (1990).

Table (2) Effect of some micro-nutrients and growth regulators application on N, P, K, Ca and Na concentration (mg/100 gm dry weight) in foliage of pea plants grown under calcareous soil conditions.

Treatment	Conc. ppm	1987 - 1988					1988 - 1989				
		N	P	K	Ca	Na	N	P	K	Ca	Na
Control	00	3010	472	1538	2312	492	2760	316	1570	1850	362
Mn	500	3680	597	2087	2125	471	3400	406	1729	1542	250
Mn	1000	3840	634	2134	2258	478	3740	456	1746	1688	300
Fe	500	4210	567	2092	2125	470	3140	385	1779	1625	305
Fe	1000	4300	631	2175	2292	467	3410	454	1829	1792	279
Zn	2000	4070	489	1954	2000	488	3040	342	1854	1563	346
Zn	4000	4280	497	2029	2292	469	3350	348	1879	1750	323
GA_3	100	3517	497	1759	2083	460	3000	373	1750	1683	321
GA_3	200	3790	483	1754	1875	421	3070	338	1608	1558	279
Ethrel	200	4100	650	2038	2167	431	3250	468	1667	1750	277
Ethrel	400	3980	656	2066	2280	429	3135	479	1775	1780	260
CCC	1000	4143	547	1975	2250	410	3410	372	1642	1417	250
CCC	2000	3800	695	2083	2283	454	3350	480	1758	1658	273
L.S.D. 5%		575	120	292	N.S.	N.S.	442	84	169	N.S.	N.S.

Table (3) Effect of some micro-nutrients and growth regulators application on Mn, Fe and Zn concentration (ppm) in foliage of pea plants grown under calcareous soil conditions.

Treatment	Conc. ppm	1987 - 1988			1988 - 1989		
		Mn	Fe	Zn	Mn	Fe	Zn
Control	0	129	488	150	62	262	95
Mn	500	151	523	165	109	296	102
Mn	1000	172	495	175	155	273	106
Fe	500	129	608	154	63	319	108
Fe	1000	132	580	166	66	316	118
Zn	2000	144	497	313	82	276	258
Zn	4000	145	487	340	82	257	335
GA_3	100	134	540	167	64	303	97
GA_3	200	136	537	169	65	280	102
Ethrel	200	139	527	152	67	277	100
Ethrel	400	135	509	177	65	268	121
CCC	1000	130	490	164	65	273	111
CCC	2000	131	495	157	66	280	104
L.S.D. 5%		20	58	31	10	25	18

Yield and its components and pod quality:

Data presented in Table (4) indicate that total green pods yield and its components expressed as number of pods per plant, average pod weight and green pod quality, i.e. pod length and diameter, number of seeds per pod as well as weight of 100 green seeds and the shell out percentage, were markedly affected by the used treatments. It is also evident, in general that micro-nutrients treatments showed a superior effect on all measured yield quantity and quality parameters compared with that of the growth regulators. Moreover, Mn at higher concentration (1000 ppm) followed by CCC at 1000 ppm, Fe at 500 ppm and Zn at 2000 ppm, reflected the highest increments in number of pods and pod yield per plant as well as total yield per faddan. On

Table (4) Effect of some micro-nutrients and growthregulators application on total green pods yield and its components and pod quality of pea plants grown under calcareous soil conditions.

Treat.	Conc.	1987 - 1988									1988 - 1989								
		No.of pods/ plant	Pod parameters				Weight of 100 seed (gm)	Shell out (%)	Green pod yield		No.of pods/ plants	Pod parameters				Weight of 100 seeds (gm)	Shell out (%)	Green pod yield	
	ppm		Weight (gm)	Length (cm)	Dia-meter (cm)	No.of pod			/plant (gm)	/fad (ton)		Weight (gm)	Length (cm)	Dia-meter (cm)	No.of pod			/plant (gm)	/fad (ton)
Cont.	00	4.5	4.4	8.3	1.5	4.4	50.63	50.1	19.5	1.288	3.7	4.9	7.7	1.5	5.4	51.88	51.5	18.2	1.086
Mn	500	6.6	4.7	8.6	1.6	4.5	53.78	48.8	30.4	1.987	5.6	5.4	8.2	1.6	5.5	50.80	52.0	30.1	1.778
Mn	1000	7.7	4.7	8.3	1.5	5.0	55.52	51.0	36.1	2.377	7.0	5.7	7.5	1.5	5.8	54.77	54.4	40.2	2.372
Fe	500	7.2	4.8	8.5	1.5	4.9	57.10	50.3	33.9	2.227	6.3	5.4	8.4	1.6	5.6	57.50	56.9	33.7	1.991
Fe	1000	6.4	4.7	8.5	1.5	5.0	54.08	51.6	30.5	2.012	5.9	4.9	8.3	1.6	5.9	53.79	59.0	28.3	1.673
Zn	2000	7.0	5.0	8.4	1.5	4.4	56.51	50.0	33.9	2.238	5.8	5.7	7.6	1.6	5.3	61.48	56.5	32.9	1.948
Zn	4000	5.4	4.6	8.3	1.5	5.0	53.11	51.4	24.5	1.607	5.2	5.3	7.6	1.6	5.9	53.47	57.8	27.5	1.617
GA_3	100	3.8	4.4	8.3	1.5	4.6	50.11	50.9	16.3	1.074	3.5	5.1	8.2	1.6	5.5	44.58	46.3	17.2	1.010
GA_3	200	3.7	4.5	8.6	1.6	4.9	50.31	47.3	16.2	1.060	3.2	5.0	8.5	1.7	5.6	43.28	48.2	16.3	0.959
Ethrel	200	5.9	4.4	8.1	1.5	4.5	50.94	49.1	25.5	1.676	5.0	5.5	7.3	1.5	5.5	49.31	49.7	27.5	1.617
Ethrel	400	5.5	4.2	8.1	1.5	4.3	51.94	50.8	22.8	1.495	5.2	4.6	7.6	1.5	4.8	51.28	54.5	23.9	1.409
CCC	1000	7.5	4.7	8.3	1.5	4.8	55.31	53.3	35.0	2.299	7.3	5.2	7.7	1.6	5.5	52.62	54.7	38.2	2.255
CCC	2000	5.9	4.6	8.5	1.5	4.6	59.17	50.8	26.9	1.789	6.2	5.2	8.4	1.6	5.5	55.69	55.4	32.6	1.926
L.S.D.		1.9	N.S.	N.S.	N.S.	N.S.	4.26	N.S.	6.95	0.456	1.9	0.45	0.32	0.08	0.29	3.52	3.14	9.63	0.554

the contrary GA_3 induced the worst effect on pod yield and number of pods per plant as well as total yield per faddan but it showed the most enhancive effect on pod length and diameter. Obtained results may be attributed to the effect of such treatments on the vegetative growth of plants (Table, 1) and hence it affected the productivity of plants. Obtained results are going in line with those obtained by Midan *et al.* (1981), El-Assiouty (1983), El-Nagar and Awad (1987), Abed *et al.* (1988), Farag *et al.* (1989-a) and Hassan *et al.* (1990) using micro-utirents and Saleh and Shahin (1980), Gabal *et al.* (1985) and Farag *et al.* (1989-b) using growth regulators.

Protein and macro-elements content of seeds:

Data presented in Table (5) show that, irrespective of potassium, the protein percentage as well as phosphorus, calcium and sodium contents in green pea seeds were not significantly affected during both seasons of growth. In this respect, treating pea seeds and grown plants with all studied micro-nutrients as well as growth regulators treatments tended to increase protein, phosphorus and potassium content of developed green pea seeds compared with untreated ones. However, contra trend was detected in case of the content of both calcium and sodium. The highest K-concentration was detected in green seeds obtained from plants previously treated with either Mn (1000 ppm) or ethrel (400 ppm) during both seasons of growth. Such results are going in line with those of Midan and Omran (1982), El-Assiouty (1983), Shende *et al.* (1987), Abed *et al.* (1988) and Ibrahim (1989).

Micro-elements content of seeds:

Data in Table (6) show clearly that soaking seeds and spraying the growing pea plants with either micro-nutrients or growth regulators at its different studied concentrations had a positive effect on all estimated micro-elements. In this regard, the maximum increment in each micro-element content was connected with its application as micro-nutrient. In addition, Mn and Zn at the higher concentration (1000 and 4000 ppm, respectively) and Fe at the lower concentration (500 ppm) reflected the maximum values in Mn, Zn and Fe during both seasons of growth. Such results are similar to those obtained in case of plant foliage content (Table, 3). Obtained results agreed with those found by Abed et al. (1988) and Singh et al. (1988).

Table (5) Effect of some micro-nutrients and growth regulators application on protein % and P, K, Ca and Na concentration (mg/100 gm. dry wt.) in green seeds of pea plants grown under calcareous soil conditions.

Treatment	Conc. ppm	1987 - 1988					1988 - 1989				
		Protein %	P	K	Ca	Na	Protein %	P	K	Ca	Na
Control	00	31.62	636	783	1167	112	30.13	594	720	1275	115
Mn	500	34.05	719	869	1000	96	33.72	525	877	1000	85
Mn	1000	32.80	725	939	1000	100	33.40	675	991	996	110
Fe	500	32.45	656	829	1000	112	33.47	600	999	996	110
Fe	1000	32.89	678	894	1153	101	34.37	625	918	1042	100
Zn	2000	32.58	706	827	1033	130	32.99	672	917	917	101
Zn	4000	34.42	730	850	1167	87	34.32	636	942	1017	96
GA_3	100	33.93	803	846	1150	85	35.95	600	929	1083	108
GA_3	200	32.88	744	820	1100	83	34.01	578	839	1033	100
Ethrel	200	33.02	833	921	1050	100	33.92	692	984	913	92
Ethrel	400	32.95	775	933	1096	89	33.41	597	956	1100	81
CCC	1000	33.57	747	825	1065	.98	30.23	650	870	913	98
CCC	2000	34.11	761	838	1125	99	33.68	650	946	1000	99
L.S.D. 5%		N.S.	N.S.	95	N.S.	N.S.	N.S.	N.S.	108	N.S.	N.S.

Total carbohydrates content :

Data presented in Table (6) show clearly that total carbohydrates content in green pea seeds was significantly increased due to application of either micro-nutrients or growth regulators. Maximum increases were observed by the application of Mn at 1000 ppm as well as CCC at 1000 ppm. It's worthy to mention that such treatments were also superior in their yielding ability (ton/fad.) as it was obvious from Table (4). This means that addition of either Mn or CCC at 1000 ppm for each may be capable to ameliorate the depressive effects of calcareous soils leading to the highest yield productivity of pods with the best carbohydrates in produced seeds. Obtained results

Table (6) Effect of some micro-nutrients and growth regulators application on Mn, Fe, Zn concentration (ppm) and total carbohydrate % in in green seeds of pea plants grown under calcareous soil conditions.

Treatment	Conc. ppm	1987 - 1988				1988 - 1989			
		Mn	Fe	Zn	Total Carbo-hydrate %	Mn	Fe	Zn	Total Carbo-hydrate %
Control	00	28	348	97	24.7	27	316	84	22.3
Mn	500	38	424	118	27.0	33	420	106	25.0
Mn	1000	44	380	124	32.3	41	417	119	30.7
Fe	500	33	450	114	25.7	30	432	97	27.3
Fe	1000	36	445	120	32.7	33	429	117	27.7
Zn	2000	39	381	128	31.3	31	386	118	22.7
Zn	4000	38	352	148	32.3	31	379	136	27.3
GA_3	100	29	370	119	29.7	28	426	101	23.3
GA_3	200	32	362	123	31.7	31	361	104	27.7
Ethrel	200	39	382	111	25.7	29	394	99	23.3
Ethrel	400	37	359	119	29.0	29	389	112	29.0
CCC	1000	39	346	118	34.7	32	320	112	29.7
CCC	2000	28	364	101	26.3	29	335	96	26.3
L.S.D. 5%		5	58	17	3.3	5	27	22	3.1

are in accordance with those of Midan and Omran (1982), El-Assiouty (1983) and Abed et al (1987).

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تأثير بعض العناصر المغذية الصغرى ومنظماتالنمو على نباتات البسلة النامية تحت ظروف الأراضى الجيرية

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أجريت تجربتان حقليتان بمريوط بهدف خفض الأثار السيئة للأراضى الجيرية على انبات ونمو وصفات محصول نباتات البسلة صنف لتل مارفل. استعمل فى تلك الدراسة ١٣ معاملة فى تصميم قطاعات كاملة العشوائية. واشتملت المعاملات نقع البذور لمدة ٣ ساعات قبل الزراعة فى محاليل المنجنيز ، الحديد ، الزنك ، حمض الجبريليك ، الايثريل أو السيكوسيل. كما تم رش النباتات النامية مرتين بنفس المحاليل المختبرة. واستعمل تركيزين لكل مادة ، وقورنت بتلك المعاملة بالماء المقطر.

أسفرت النتائج أن نقع البذور قبل الزراعة ثم رش النباتات النامية بتركيز ١٠٠٠ جزء فى المليون سيكوسيل أو ٢٠٠ جزء فى المليون ايثريل أعطى أعلى قيم للقدرة على الانبات. كما دلت النتائج على أن المعاملة بالمنجنيز بتركيز ١٠٠٠ جزء فى المليون أو سيكوسيل ١٠٠٠ أو ٢٠٠٠ جزء فى المليون أدى الى أفضل نمو لنباتات البسلة. وتشير نتائج محتوى العناصر الكبرى والصغرى فى المجموع الخضرى للنباتات وكذلك محصول القرون ومكوناته الى زيادة قيمتها فى معاملات العناصر الصغرى ومنظمات النمو وذلك بالمقارنة بمعاملة الماء. وكانت أفضل المعاملات فى التاثير على المحصول ومكوناته هى: المنجنيز (١٠٠٠ جزء فى المليون) ، والسيكوسيل (١٠٠٠ جزء فى المليون) ، والحديد (٥٠٠ جزء فى المليون) ، والزنك (٢٠٠٠ جزء فى المليون.) وعلاوة على ذلك فقد أدت معاملات العناصر الصغرى ومنظمات النمو الى زيادة محتوى الكربوهيدرات الكلية ، والبوتاسيوم ، والمنجنيز ، والحديد والزنك فى بذور البسلة الخضراء.