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EFFECT OF POTASSIUM AND PHOSPHORUS FERTILIZATION AND SPRAYING WITH SEAMINO ON GROWTH AND YIELD OF LETTUCE AND SPINACH GROWN UNDER SALINE CONDITIONS.

BY

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ABSTRACT

An out door trial was conducted in plastic pots at the Research Farm at Faculty of Agriculture, Moshtohor, Benha University, during 2007/2008 and 2008/2009 seasons, to study the effect of K and P fertilizers application as mono potassium phosphate (KH_2PO_4) and spraying with seamino (contained 17 kinds of L amino acids with herbage and sea algae extracts) on lettuce and spinach plants grown under saline conditions. Nine treatments were used in this study as follows:

- Salinity: 0, 1500 and 3000 ppm as NaCl.
- Chemical substances:
- 2 mM of KH_2PO_4.
- 1 ml of Seamino.
- Tap water (control).

This experiment was designed as a factorial in complete randomized block design, with three replicates. Obtained results can be summarized as follow:

- Vegetative growth characteristics as plant height, number of leaves, root length, fresh and dry weight for lettuce and spinach plants were significantly decreased with increasing NaCl level.
- Application of K, P and seamino resulted in the highest values of plant growth characters for lettuce and spinach compared with control, with superiority to K and P in the form of KH_2PO_4.
- Under saline conditions, plants that treated with K, P and seamino were less badly affected than those sprayed with tap water.
- Leaves content of chlorophyll a, b and total, K and P were significantly decreased with increasing NaCl. On the other hand leaves content of Na and Cl were significantly increased with increasing NaCl.
- Application of K, P and seamino led to increase leaves content of chlorophyll fractions, K and P as well as decrease Na and Cl content compared to control.
- Under saline conditions, plants that treated with K, P and seamino minimized the harmful effects of salinity on leaves content of chlorophyll, K, P as well as Na and Cl compared to control.
- Generally, application of K, P and seamino exhibited favourite results on vegetative growth and leaves chemical composition of lettuce and spinach plants that grown under saline conditions. In this connection, under saline conditions, spinach plants were less badly affected than lettuce plants.

INTRODUCTION

Salinity is an environmental stress that limits growth and development of plant. The response of plants to excess NaCl is complex and involves changes in their morphology, physiology and metabolism (Hilal *et al.*, 1998).

Translocation of salt into roots and then to shoots is an outcome of the

transpiration flux required to maintain the water status of the plant and unregulated transpiration may cause toxic levels of ion accumulation in the shoot (Yeo, 1998). The supply of mineral ions to the leaf growing region may decline. Lower transpiration rate, decline coupled with reduced ion uptake by the roots, or reduced xylem loading, may cause poor supply via the ylem. So it is possible that an adequate supply of ions to the expanding region may restrict cell division and/or expansion when plants are grown at high levels of NaCl (Berstein *et al.*, 1995). In expanding leaves, salinity has disturbed concentration of K (Jeschke and Wolf, 1985) and P (Martinez and Lauchli, 1991).

The responses of plants to high Salinity may be expected to vary with different growth stages. This has been shown by Chartzoulakis and Klapaki (2000) in pepper; Chartzoulakis and Loupassaki (1997) in eggplant; Dumbroff and Copper (1974) in tomato.

One of the major factors inducing leaf senescence is the decrease of chlorophyll content under saline conditions (Chen *et al.*, 1991). Leaf senescence is also correlated with increased membrane permeability at high salt concentration (Dhindsa *et al.*, 1981).

It was reported that excess NaCl in the growth medium induces structural changes in bean roots, as well as leakage of ions correlated with alterations of the cell membranes (Cachorro *et al.*, 1995).

Investigation on tolerance to saline environments frequently pointe to restricted ion accumulation and organic solutes synthesis as major adaptations leading to salt resistance in glycophytes (Greenway and Munns, 1980).

Other workers have linked NaCl stress with macronutrient deficiencies, for example high NaCl concentration has been shown to induce phosphorus and potassium deficiencies in tomato (Adams, 1988, 1991) and in cucumber (Sonneveld and Kreij, 1999).

Kaya *et al.* (2002) found that seedling growth, vegetative growth, total chlorophyll were significantly reduced in spinach and lettuce by high salinity. He also pointed out that supplementary K and P produced fresh weight, chlorophyll concentration values similar to or slightly lower than the controls. With regard to the effects of NaCl on lettuce and spinach, Kaya *et al.* (2002) reported that spinach growth parameters appeared to be less affected than those of lettuce, and sodium (Na) concentration in plant tissues increased for both species, especially in lettuce.

MATERIALS AND METHODS

An outdoor pots experiment was conducted at The Experimental Farm of the Faculty of Agriculture, Moshtohor, Benha University, during the two winter seasons of 2007/2008 and 2008/2009, to study the response Balady cv. of lettuce (*Lactuca sativa* L.) from Qalyoubia Governorate and spinach (*Spinacia oleracea* L.) c.v. Saloniki plants that grown under saline conditions to the possibility of alleviating deterious effects of different levels of salinity through the use of some chemical substances (KH_2PO_4 and Seamino).

The chemical analysis of the soil and Seamino (is a chemical compound contains of 17 kinds of free amino acids in the form of L., in addition to herbage and sea algae extracts. that used in this investigation is shown in Tables (1 and 2), respectively.

Seeds of lettuce were sown on October 1th in nursery during the two seasons of this work. Forty days after sowing, two uniform seedlings were transplanted in each pot (30 cm in diameter), placed in the open field, thinning took place leaving one plant in a pot. With respect to spinach, ten seeds per pot were sown on October 20th in the two seasons. Two weeks later, plants were thinned into four plants.

The experiment included 9 treatments which were the interaction of the two factors that used in this work as follows:

a- Salinity: 0(S0),1500(S1) or 3000 (S2) ppm as Na Cl .

b- Chemical substances: 2mM of $KH_2 PO_4$, 1ml of Seamino and tap water (control).

Table (1): Chemical analysis of experimental soil before and after investigation.

Cations (meq./L.)	Before Investigation	After investigation (at 3000 ppm NaCl)
Ca^{++}	11.0	12.6
Mg^{++}	8.8	6.4
K^{+}	1.14	1.13
Na^{+}	4.24	14.8
Anions (meq./L.)		
CO_3^{-}	-	-
HCO_3^{-}	0.80	0.58
$SO\,4^{-}$	17.38	23.85
Cl^{-}	7.0	10.5
Macro elements (ppm)		
N	80	75
P	5	20
K	456	520
Micro elements (ppm)		
Fe	6.72	5.46
Cu	1.84	2.18
Zn	1. 36	0.76
Mn	8.20	8.42
PH	7.7	7.6
E.C. (mmho/cm)	2.65	3.11
$Ca\,CO_3$ (%)	2.00	1.60

Table (2): Chemical analysis of seamino

Organic matter	12%
Herbage and sea algae extracts	18%
Free amino acids	10%
Nitrogen	4%
Potassium	3%
Magnesium	47 ppm
Calcium	70 ppm
Iron	270 ppm

This experiment includes 108 pots resulting from the combination of 9 treatments within 3 replicates and every replicate consisted of 2 pots for each crop (lettuce and spinach). Each pot was filled with 7 kg of clay loam and sand in the ratio of 1:1. Sodium chloride salt was added by the different doses that mixing with soil before filling pots with the used amount of soil (0,10.5 and 21 gm of NaCl salt for S0, S1, and S2, respectively).

Plants were sprayed three times with an aqueous solution of $KH_2 PO_4$ and seamino (2mM and 1 ml/litre) respectively. The spraying times were 1, 3 and 6 weeks after transplanting.

Plants were weekly irrigated 1-2 times with tap water.

All pots received 2 gm of N fertilizer twice during the growing seasons. This experiment was conducted as a factorial design in complete randomized block with three replicates.

Average temperature and relative humidity of the experimental region are presented in Table (3).

Table (3): Average temperature and relative humidity of the experimental region during 2007/2008 and 2008/2009 seasons

Season	2007/2008				2008/2009			
	Min. °C	Max. °C	Mean. °C	R.H. %	Min. °C	Max. °C	Mean. °C°	R.H. %
October	16.5	30.5	23.2	59	15.3	30.2	23.2	63
November	13.4	26.2	19.8	68	13.7	26.5	20.1	64
December	9.1	22.8	15.9	75	9.0	21.7	15.3	65

Data recorded:

I- Vegetative growth:

All plants were taken from each treatment (60 days after sowing spinach seeds and 70 days after transplanting lettuce plants) to record the following data:

1- Plant height (cm).
2- Number of leaves per plant.
3- Root length (cm).
4- Fresh weight per plant (gm).
5- Dry weight per plant (gm).

II- Chemical composition of leaves:

a- Photosynthesis pigments:

Chlorophyll a, b and total chlorophyll (mg/100gm fresh weight) in recently expanded leaves were determined calorimetrically as described in A.O.A.C. (1970).

b- Macro and micro elements:

1- Total phosphorus (%) was determined calorimetrically according to, the method described by Murphy and Riely (1962), as modified by John (1970).
2- Potassium (%) was assayed flam-photometrically as described by Brown and Lilleland (1946).
3- Sodium (%) was determined flam-photometrically as described by Brown and Lilleland (1946).
4- Chloride (mg/100gm dry weight) was assayed according to the method described by Jackson (1958).

Statistically analysis: All recorded data were statistically analyzed according to the method described by Gomez and Gomez (1983).

RESULTS AND DISCUSSION

I- Vegetative growth:

Effect of salinity:

Data presented in Tables (4 and 5) revealed that, plant growth of lettuce and spinach expressed as plant height, number of leaves, fresh and dry weight per plant significantly decreased with increasing salinity level. These results were the same for all of lettuce and spinach plants during the two seasons. The deterious effect of the salinity on growth might be due to the role of NaCl on plants grown under salinity stress in which cause harmful changes in their morphology and physiology and metabolism. Increasing NaCl in plant growth medium may cause unregulated transpiration water, restrict cell division and cell expansion.

These results are in agreement with those reported by Hilal *et al.* (1998), Yeo (1998), Berstein *et al.* (1995) and Kaya *et al.* (2002).

Effect of chemical substances:

Data in Tables (4 and 5) illustrated that vegetative growth characters of lettuce and spinach plants exhibited the highest values when plants received mono potassium pho-sphate with significantly differences than plants sprayed with seamino or tap water. Plants that treated with seamino showed more vigorous growth than those treated with tap water alone with significant differences. Obtained results indicated that lettuce and spinach plants that treated with P and K or seamino were less affected to NaCl in

comparison to plants that received tap water alone. Application P and K in the form of mono potassium phosphate resulted in high values in plant growth characters for lettuce and spinach that grown under saline condition with significant differences compared with control. These results might be due to the physiological role of NaCl on disturbance the concentration of K and P elements in plants cells that reflected in plant showed deficiencies of macro and micro elements, so plants need to be compensated with these elements.

These results are in harmony with those reported by Jeschke and Wolf (1985), Adams (1988 and 1991), Martinez and Lauchli (1991), Sonneveld and Kreij (1999) and Kaya *et al.* (2002).

With respect to the interaction between salinily and chemical substances, data (Tables 4 and 5) indicate significant differrences with all vegetative growth characters for lettuce and spinach during the two seasons. It is clearly shown that increasing NaCl led to decrease obviously all growth parameters of lettuce and spinach plants, but when plants treated with P and K or seamino, plant growth was less affected than those did not receive each of these materials during both seasons. The highest values of plant height, number of leaves per plant, fresh and dry weight and root length per plant were recorded with plants treated with P and K or seamino under the different rates of salinity, with superiority to P and K under low, medium or high salinity, compared to seamino or control. Differences were significant, thus it mean that with increasing salinity up to 3000 ppm to the medium for lettuce or spinach, plant growth show the least deterious effects when plants were provided with P and K or seamino.

Table (4): Vegetative growth of lettuce plants as affected by salinity, fertilizing with P, K and spraying with seamino.

Characters / Treatments	Plant height (cm)		No. of leaves/plant		Fresh weight/plant (gm)		Dry weight/plant (gm)		Root length (cm)	
	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009
So	24.3	25.3	34.1	32.2	451	494	36.3	39.9	20.7	20.3
S1	18.6	21.0	30.2	28.5	352	395	32.8	36.2	18.0	16.8
S2	16.0	17.1	25.0	21.2	249	265	28.7	30.7	15.5	14.8
L.S.D. at 5 %	**1.3**	**1.7**	**1.7**	**1.9**	**19.5**	**19.6**	**1.4**	**2.1**	**1.5**	**0.8**
Tap. W	17.9	19.5	27.4	25.3	307	340	30.2	32.9	16.6	15.9
PK	21.2	22.7	31.5	29.1	394	423	35.2	38.1	19.7	18.7
Seamino	19.7	21.2	30.5	27.5	351	390	32.4	35.8	18	17.3
L.S.D. at 5 %	**1.2**	**2.3**	**2.4**	**1.6**	**19.3**	**10.1**	**2.1**	**1.3**	**1**	**0.9**
So+Tap. W	22.5	23.8	32.1	31.4	416	440	34.3	36.0	19.1	18.4
So+PK	26.1	27.1	35.4	33.1	490	540	38.5	43.2	22.7	22.4
So+Seamino	24.0	25.1	34.9	32.1	447	501	36.0	40.4	20.4	20.1
S1+Tap. W	17.4	21.4	28.1	26.4	310	370	30.1	34.5	16.4	15.4
S1+PK	20.1	21.1	31.9	30.7	395	420	35.5	37.5	19.4	18.1
S1+Seamino	18.8	20.4	30.7	28.4	350	395	32.9	36.5	18.2	16.9
S2+Tap. W.	14.5	13.4	22.0	18.1	195	211	26.1	28.1	14.2	13.9
S2+PK	17.4	19.9	27.1	23.4	297	310	31.7	33.5	16.9	15.7
S2+Seamino	16.4	17.9	25.9	22.0	255	275	28.2	30.5	15.4	14.9
L.S.D. at 5 %	**2.2**	**3.7**	**3.7**	**3.0**	**33.4**	**24.1**	**3.2**	**2.7**	**2.0**	**1.5**

II- Chemical composition of leaves:

- Effect of salinity:

Data in Tables 6 and 7 indicate that increasing NaCl resulted in significant and gradual decrease in leaves content of chlorophyll a, b and total, as well as P and K in lettuce and spinach plants during the two seasons. These results may be due to the deterious effects of NaCl ions on decreasing water absorption from the soil and conesquently plants growth will be affected. With respect to the effect of NaCl on leaves content

of Na and Cl, data show that, increasing NaCl led to significant increase in lettuce and spinach leaves regarding Na and Cl content during both season. These results are in agreement with those reported by Dhindsa *et al.* (1981), Chen *et al.* (1991), Cachorro *et al.* (1995) and Kaya *et al.* (2002).

– Effect of chemical substances:

It is clearly shown in Tables 6 and 7 that application of P,K or seamino led to the highest values in leaves content of chlorophyll a, b and total, as well as leaves content of P and K . These effects were significant during the two seasons compared to control in which plants received tap water only. These favourite effects may be due to the beneficial role of P, K and seamino as a nutrient materials that enhance leaves content of chlorophyll, K and P and consequently plant growth. On the other hand, plant that receive tap water only as a control treatment exhibited the highest values in content of Na and Cl in there leaves, whereas, the least values were recorded with plants received P, K and seamino, these results held true during the two seasons. Obtained results are in harmony with those reported by Greenway and Munns (1980) Adams (1988 and 1991), Sonneveld and Kreij (1999) and Kaya *et al.* (2002).

With respect to the effect of interaction between salinity and chemical substances on lettuce and spinach leaves content of chlorophyll and minerals, data shown in Tables 6 and 7 indicate that, significant effects have been recorded during the two season. It is clearly shown that, leaves content of chlorophyll and macro elements such as K and P, were slightly decreased under the high level of salinity when lettuce and spinach plants treated with chemical substances such an P, K and seamino compared with that did not receive these substances. With respect to Na and Cl, data indicate that leaves content of these elements were gradually increased with increasing salinity level, but, with the application of the used chemical substances, plants exhibited less affect than those of control.

Generally, application of K, P. and seamino exhibited favourite results on vegetative growth and leaves chemical composition of lettuce and spinach plants that grown under saline conditions. In this connection, under saline conditions, spinach plants were less badly affected than lettuce plants.

Table (5): Vegetative growth of spinach plants as affected by salinity, fertilizing with P, K and spraying with seamino.

Characters / Treatments	Plant height (cm)		No. of leaves/plant		Fresh weight/plant (gm)		Dry weight/plant (gm)		Root length (cm)	
	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009
So	17.7	19.4	7.8	7.2	18.5	17.5	5.6	5.1	21.3	22.2
S1	16.7	17.0	7.1	6.8	16.4	17	4.7	4.3	19.3	20
S2	15.6	16.2	6.6	5.8	16	14.8	4.4	4	18.4	19.3
L.S.D. at 5 %	**1.7**	**0.9**	**0.4**	**0.3**	**0.8**	**0.2**	**0.2**	**0.2**	**1.8**	**1.5**
Tap. W	16.0	16.1	5.8	6.1	15.9	15.2	4.4	4.3	18.5	19.6
PK	17.4	18.7	8.1	7.0	18	17.4	5.4	4.7	21.0	21.3
Seamino	16.6	17.9	7.5	6.7	17	16.6	4.9	4.4	19.6	20.6
L.S.D. at 5 %	**0.8**	**0.9**	**0.7**	**0.3**	**0.7**	**0.5**	**0.2**	**0.2**	**1**	**1.4**
So+Tap. W	16.8	17.4	6.4	6.8	17.3	16.1	5.1	4.9	20.1	21.1
So+PK	18.5	20.9	8.8	7.5	19.9	18.7	5.9	5.3	22.4	23.2
So+Seamino	17.8	19.9	8.2	7.4	18.3	17.7	5.7	5.1	21.3	22.4
S1+Tap. W	15.9	16.4	6.0	6.4	15.4	15.7	4.3	4.3	18.1	19.1
S1+PK	17.5	17.9	7.9	7.2	17.1	18.2	5.2	4.6	20.7	21
S1+Seamino	16.8	16.8	7.5	6.9	16.6	17.1	4.7	4.1	19.1	19.9
S2+Tap. W.	15.4	14.4	5.1	5.1	14.9	13.9	3.9	3.7	17.4	18.7
S2+PK	16.3	17.3	7.7	6.4	16.9	15.4	5	4.3	19.9	19.7
S2+Seamino	15.2	16.9	6.9	5.9	16.1	15	4.2	4.1	18.3	19.4
L.S.D. at 5 %	**2.0**	**1.5**	**1.0**	**0.6**	**1.3**	**0.8**	**0.4**	**0.4**	**2.3**	**2.5**

Table (6): Chemical composition of lettuce plants as affected by salinity, fertilizing with P, K and spraying with seamino

Characters / Treatments	Chlorophyll (a) (mg/100 gm FW)		Chlorophyll (b) (mg/100 gm FW)		Total Chlorophyll (mg/100 gm FW)		P (%)		K (%)		Na (%)		Cl (%)	
	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009	2007/ 2008	2008/ 2009
So.	95.7	106.3	60.4	54.7	156.1	161.0	0.500	0.484	5.888	5.813	0.783	0.855	0.534	0.467
S1	89.0	91.9	50.9	45.1	139.9	137.0	0.392	0.360	5.178	4.881	1.064	1.144	0.850	1.017
S2	80.3	82.7	45.5	40.5	125.8	123.2	0.267	0.230	4.114	3.837	1.383	1.297	1.207	1.112
L.S.D. at 5 %	**3.5**	**2.0**	**2.6**	**1.7**	**1.8**	**4**	**0.03**	**0.023**	**0.198**	**0.299**	**0.145**	**0.075**	**0.032**	**0.082**
Tap. W	81.7	86.5	47.5	42.7	129.2	129.2	0.338	0.300	4.351	4.314	1.284	1.340	0.923	0.890
PK	93.9	100.5	56.8	50.6	150.7	151.1	0.441	0.400	5.778	5.444	0.900	0.898	0.800	0.787
Seamino	89.3	93.9	52.5	47.1	141.8	141.0	0.381	0.373	5.050	4.774	1.047	1.057	0.867	0.827
L.S.D. at 5 %	**3.3**	**2.0**	**3.0**	**1.4**	**2.6**	**2.2**	**0.02**	**0.02**	**0.32**	**0.29**	**0.05**	**0.07**	**0.03**	**0.04**
So+Tap. W	94.0	103	58.8	51.7	152.8	154.7	0.450	0.420	5.432	5.210	0.850	0.921	0.590	0.490
So+PK	99.0	111	63.1	58.4	162.1	169.4	0.571	0.521	6.411	6.820	0.700	0.773	0.450	0.440
So+Seamino	94.0	105	59.3	54.1	153.3	159.1	0.480	0.510	5.820	5.410	0.800	0.870	0.561	0.470
S1+Tap. W	85.0	85.1	46.7	41.3	131.7	126.4	0.353	0.300	4.511	4.321	1.301	1.290	0.870	0.940
S1+PK	93.0	99.4	55	49.1	148.0	148.5	0.442	0.410	6.012	5.311	0.900	0.940	0.830	0.910
S1+Seamino	89.0	91.1	51.1	44.9	140.1	136.0	0.381	0.370	5.010	5.012	0.990	1.201	0.850	0.900
S2+Tap. W.	66.0	71.3	37.1	35.1	103.1	106.4	0.211	0.180	3.110	3.411	1.700	1.810	1.310	1.240
S2+PK	89.0	91.0	52.4	44.2	142.1	135.2	0.310	0.270	4.912	4.200	1.100	0.980	1.120	1.010
S2+Seamino	85.0	85.7	47.1	42.3	132.1	128.0	0.281	0.240	4.320	3.901	1.350	1.100	1.190	1.110
L.S.D. at 5 %	**5.8**	**3.5**	**4.9**	**2.6**	**4.1**	**5.1**	**0.04**	**0.035**	**0.487**	**0.506**	**0.159**	**0.126**	**0.049**	**0.095**

Table (7): Chemical composition of spinach plants as affected by salinity, fertilizing with P, K and spraying with seamino.

Characters / Treatments	Chlorophyll (a) (mg/100 gm FW)		Chlorophyll (b) (mg/100 gm FW)		Total Chlorophyll (mg/100 gm FW)		P (%)		K (%)		Na (%)		Cl (%)	
	2007/2008	2008/2009	2007/2008	2008/2009	2007/2008	2008/2009	2007/2008	2008/2009	2007/2008	2008/2009	2007/2008	2008/2009	2007/2008	2008/2009
So	126.4	94.6	80.7	73.1	207.1	167.5	0.518	0.545	6.017	5.760	0.704	0.651	0.530	0.550
S1	116.5	84.2	76.0	73.3	192.5	157.2	0.422	0.411	4.907	4.490	0.923	0.932	0.830	0.856
S2	111.0	78.6	65.5	61.4	176.4	139.7	0.345	0.364	3.710	4.147	1.011	0.957	0.953	1.092
L.S.D. at 5 %	5.0	2.0	5.7	1.9	2.0	1.0	0.017	0.016	0.172	0.330	0.046	0.057	0.019	0.023
Tap. W	113.2	80.7	69.9	66.4	183.1	147.1	0.352	0.386	4.310	4.250	1.017	0.914	0.843	0.874
PK	122.0	91.1	78.3	72.1	200.3	162.5	0.492	0.495	5.410	5.350	0.768	0.798	0.720	0.797
Seamino	118.6	85.5	74.0	69.3	192.6	154.7	0.441	0.437	4.920	4.800	0.854	0.827	0.747	0.828
L.S.D. at 5 %	2.1	2.0	2.5	2.3	4.5	1.0	0.031	0.028	0.207	0.244	0.029	0.032	0.031	0.022
So+Tap. W	121.7	91.0	75.0	71.1	196.7	162.1	0.412	0.473	5.410	5.110	0.750	0.710	0.550	0.561
So+PK	130.4	99.1	84.3	75.1	214.7	174.2	0.591	0.617	6.710	6.400	0.651	0.601	0.520	0.540
So+Seamino	127.1	92.9	82.7	73.2	209.8	166.1	0.551	0.545	5.930	5.770	0.710	0.641	0.510	0.550
S1+Tap. W	112.7	80.1	71.4	69.1	184.1	149.2	0.353	0.373	4.410	4.090	1.505	0.982	0.970	0.870
S1+PK	118.1	89.4	81.4	76.4	199.5	165.8	0.493	0.450	5.300	4.930	0.810	0.893	0.730	0.810
S1+Seamino	118.7	83.0	75.1	74.3	193.8	157.3	0.421	0.411	5.010	4.460	0.910	0.921	0.790	0.890
S2+Tap. W.	105.3	71.1	63.2	59.1	168.5	130.2	0.292	0.313	3.100	3.550	1.251	1.050	1.010	1.190
S2+PK	117.5	84.1	69.1	64.7	186.6	148.8	0.393	0.419	4.220	4.710	0.842	0.901	0.910	1.040
S2+Seamino	110.1	80.7	64.1	60.3	174.2	141	0.350	0.360	3.810	4.180	0.941	0.920	0.940	1.045
L.S.D. at 5 %	5.7	3.5	6.7	3.7	6.6	1.7	0.047	0.042	0.338	0.473	0.062	0.072	0.048	0.038

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تأثير التسميد بالبوتاسيوم والفسفور والرش بمركب "سى أمينو" على نمو وإنتاج الخس والسبانخ النامية فى ظروف ملحية

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تم تنفيذ تجربة حقلية في عبوات بلاستيكية في المزرعة البحثية بكلية الزراعة بمشتهر – جامعة بنها خلال موسمي ٢٠٠٧/٢٠٠٨م و ٢٠٠٨/٢٠٠٩م لدراسة تأثير التسميد بعناصر البوتاسيوم والفسفور والرش بمركب " سى أمينو" والذي يحتوي على ١٧ حمض أميني مع مستخلص من الأعشاب والطحالب البحرية،على نباتات الخس والسبانخ النامية في ظروف ملحية . تضمنت الدراسة تسع معاملات تمثل تداخل عاملين هما:

- **الملوحة:** صفر، ١٥٠٠ و ٣٠٠٠ جزء في المليون (على صورة كلوريد الصوديوم)
- **المواد الكيماوية:**
- ٢ ملليمول من KH_2PO_4
- ١ مل من مركب سي أمينو
- ماء الصنبور (مقارنة)

وقد صممت التجربة بتصميم القطاعات الكاملة العشوائية كتجربة عامليه بثلاثة مكررات. ويمكن تلخيص أهم النتائج المتحصل عليهما كالآتي:-

- انخفضت معنوياً صفات النمو الخضري المعبر عنها بارتفاع النبات، عدد الأوراق، طول الجذر، الوزن الغض والجاف لنباتات الخس والسبانخ بزيادة تركيز كلوريد الصوديوم في بيئة النمو.
- أدت إضافة البوتاسيوم والفوسفور وكذا مركب سي أمينو إلى تحقيق أعلي قيم النمو الخضري مقارنة بالكنترول، مع تفوق واضح للمعاملة بالبوتاسيوم والفوسفور.
- أظهرت نباتات الخس والسبانخ المعاملة بالبوتاسيوم والفوسفور وكذا سي أمينو أقل تأثراً سلبياً في صفاتها الخضرية في ظروف الملوحة المختلفة مقارنة بالنباتات الغير معاملة.
- انخفض معنوياً محتوى نباتات الخس والسبانخ من الكلوروفيل أ، ب والكلي وكذا عناصر البوتاسيوم والفوسفور نتيجة لارتفاع مستوى الملوحة في بيئة النمو. بينما زاد محتواها من عناصر الصوديوم والكلوريد.
- أدت إضافة البوتاسيوم والفوسفور وكذا سي أمينو إلى زيادة محتوى أوراق نباتات الخس والسبانخ من الكلوروفيل أ، ب والكلي، وعملت على خفض محتواها من عناصر الصوديوم والكلوريد مقارنة بالكنترول.
- أدت معاملة نباتات الخس والسبانخ النامية في الظروف الملحية بالبوتاسيوم والفوسفور وكذا سي أمينو إلى خفض التأثيرات الضارة للملوحة على محتوى الأوراق من الكلوروفيل والبوتاسيوم والفوسفور وكذا الصوديوم والكلوريد مقارنة بالنباتات الغير معاملة.

عموماً فقد أدى إضافة البوتاسيوم والفوسفور وكذا مركب السي أمينو إلى تحقيق أفضل النتائج على صفات النمو الخضري والتركيب الكيماوي لأوراق نباتات الخس والسبانخ النامية في ظروف ملحية وفي هذا الاتجاه وجد أن نباتات السبانخ كانت أقل تأثراً بالملوحة من نباتات الخس.