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GROWTH, PHOTOSYNTHETIC EFFICIENCY AND PRODUCTIVITY OF SNAP BEAN (*Phaseolus vulgaris*, L.) PLANTS AS AFFECTED BY SALINITY AND CYCOCEL APPLICATION

Dawa, K. K.*; S.T. El-Afifi*; N.A. Omar and F. S. Abdel-All****
*** Veget. and Flori. Dept., Fac. of Agric., Mansoura Univ.**
**** National Research Center, Cairo, Egypt.**

ABSTRACT

Two pot experiments were conducted at Agricultural Farm, Faculty of Agriculture, Mansoura University during the two successive seasons of 1990 and 1991 to investigate the effect of salinity (0, 1000, 2000 and 3000 ppm) of irrigation water and cycocel (0, 1000 and 2000 ppm) on vegetative growth, photosynthetic efficiency and productivity of snap bean plants.

The obtained data could be summarized as follows:

1- The irrigation water contained salinity up to 1000 ppm had no adverse effect on the growth parameters, particularly plant height, fresh and dry weight of whole plant and its organs.
2- All plant growth parameters gradually and considerably deceased by increasing level of salinity between 1000 and 3000 ppm.
3- Photosynthetic pigment contents decreased with increasing salinity level, total leaf area and net assimilation rate followed the same trend.
4- Salinity levels had no clear effect on the appearance of the first flowers but the period between flowering to the pod harvesting was more shorter, than control with increasing the salinity levels.
5- The pod yield and pod characteristics of snap bean decreased by increasing salinity levels.
6- With increasing salinity N and K contents in leaves tissues were significantly reduced whereas, P content was not affected.
7- Total fresh and dry weight, total leaf area/plant, net assimilation rate and pigments content tended to increase with the application of cycocel under salinity effect.
8- Cycocel application had no great effect on flowering processes and yield characteristics.
9- Cycocel treatments caused an increase in N and a decrease in P and K contents. Under different salinity levels, cycocel application increased the N and decreased P and K contents.
10- Spraying cycocel on the snap bean plant which were irrigated with saline water could be counteracted the inhibition effect of salinity. Since the results indicated that, using cycocel increase the resistance of snap bean to salinity up to 2000 ppm.

INTRODUCTION

Soil salinity is an important agricultural problem, especially in farm lands dependent on irrigation. The problem is compounded by the relatively low salt tolerance of most crop plants. It has long been known that soil salinity is a major concern in agriculture of arid and semi-arid regions (Ben Rais *et al*., 1993). Egypt as a country always suffers from losses in crop production as a result of secondary salinization by using poor quality water for irrigation and /or mismanagement of irrigation system. The yield could be increased mainly through two ways, by increasing the cultivated area or by increasing yield of area unit. Using good quality water, good drainage system and some growth regulators among the most important factors affecting the yield of area unit. Growth regulators such as cycocel are used to improve the salt tolerance of plants and consequently increase the productivity of crops (Al-Lawandy, 1986). Therefore, this work has been designed to study the effect of irrigation with saline water and the role of cycocel application on minimizing the adverse effect of salinity on productivity of snap bean plants.

MATERIALS AND METHODS

Two pot experiments were carried out during the two successive summer seasons 1990 and 1991 at the Faculty of Agriculture, Mansoura Univ. to investigate the effect of salinity and cycocel on growth, photosynthtic efficiency, flowering, yield and some mineral composition of *Phaseolus vulgaris,* L. The experiment included 12 treatments, which were the simple possible combination between 4 levels of salinity (0, 1000, 2000 and 3000 ppm) and three concentration of CCC (0, 1000 and 2000 ppm).

The containers used in these experiments were unglazed clay pots of 30 cm in diameter. Every pot was filled with 6 kg clean air dry soil taken from the surface layer of the Faculty soil. The physical and chemical properties of the soil are shown as follows:

Organic matter %	N%	P ppm	K ppm	TSS %	pH	E.C. mmhos
1.9	0.16	9.0	216	0.2	7.9	0.89

Four seeds of *Phaseolus vulgaris,* L. Giza 3 were selected for uniformity in size and colour by eye and were directly sown on the second week of March 1990 and 1991 at equal distances and depth in each pot.

Plants were thinned to the most two uniform plants /pot after 20 days from sowing. Tap water was used for irrigation from planting date till complete seedlings stage (3 true leaves, i.e., 21 days after sowing), then the plants were watered with saline solution which contain salt mixture of magnesium sulphate, calcium sulphate, sodium chloride, magnesium chloride and calcium carbonate according to Strogonov, 1962 formula.

The salinity levels used were tap water (control), 1000, 2000 and 3000 ppm, it means 0, 1.56, 3.12 and 4.68 mmhos /cm for EC.

Nitrogen, phosphorus and potassium fertilizers were added to the soil three weeks after sowing in the forms of ammonium sulphate (20.5 % N), calcium superphosphate (15.5 P_2O_5) and potassium sulphate (48 % K_2O) at the rates of 1.2, 2.4, 1.2 gm/pot, respectively.

In order to avoid shocking of the young seedling, the solutions were applied stepwise to the culture to reach the finally required concentration after three days. The pots were irrigated with tap water every two weeks in order to prevent the accumulation of salts. Thirty five days after sowing, the plants were sprayed with CCC at the concentration of 0, 1000 and 2000 ppm. In the two seasons. The salinity treatments occupied the main plots and the levels of CCC were arranged in the sub plots.

The CCC growth regulators were applied 3 times by 7 days intervals beginning 35 days after sowing. Spraying the growth regulator was conducted using a small hand atomizer to cover foliage of the plant till run off.

The experiment was designed as a split –plot with three replicates and each replicate has 5 pots. Statistical analysis were done according to Snedecor and Cochran (1980).

During the two successive growing seasons the following data were recorded:

A- Vegetative growth characters:

Height of plant, number of leaves /plant, fresh weight of total plant (gm /plant) and dry weight of total plant and its different organs, i.e., leaves, stems and roots.

B- Photosynthetic efficiency parameters:

Net assimilation rate (NAR). The NAR ($g/m^2/day$) was determined by using the equation as suggested by Gregory (1926). Leaf area /plant (cm^2) was calculated according to Kotter (1972) and the photosynthetic pigments concentrations were calculated using Wettestein formula (1957). pigments were expressed in mg/g fresh weight of leaves.

C- Flowering:

Total number of flowers per plant, number of days requiring in appearance the first flower and number of days from flowering to harvesting time.

D- Yield and its components:

At harvesting time the following data were recorded:
Total number of pods /plant, total weight of pods per plant, length of pods, average number of seeds /pod, diameter of pod and average pod weight.
E- Mineral content:

Nitrogen content in dry weight of leaves was determined according to the method described by Kock and McMeekin (1924). Phosphorus was determined according to Trough and Mayer (1939). Potassium was determined by flame photometer (Perkin-Elmeter model 149) as reported by Brown and Lileland (1946).

RESULTS AND DISCUSSION

A- Plant growth characters:

1- Plant height:

Increasing salinity levels more than 1000 ppm caused a significant decrease in the height of snap bean plants. It means that the highest salinity levels, the shortest plants were resulted. Similar results obtained by Hussein *et al*. (1984).

Regarding the height of snap bean plant and its relationship with CCC application, results of Table (1) clearly indicated that, increasing CCC concentration caused a progressive decrease in plant height. Such effect might be due to being CCC reduced GA_3 content by inhibiting its biosynthesis which results in the inhibition of stem elongation. The obtained results are in agreement with those of Abdul and Said (1984) on broad bean and Nimer (1985) on cowpea.

Table (1): Effect of salinity, CCC and their interactions on the plant height, average number of leaves and whole fresh weight of snap bean plants in two seasons of 1990 and 1991.

Treatments (ppm)	1990			1991		
	Height of plant (cm)	**No. of leaves/ plant**	**Fresh weight /plant (gm)**	**Height of plant (cm)**	**No. of leaves/ plant**	**Fresh weight /plant (gm)**
A- Salinity:						
0 (control)	20.2	11.0	42.0	20.5	9.7	43.2
1000	21.5	11.5	44.7	21.7	6.8	44.8
2000	19.1	7.8	37.7	19.0	6.2	39.5
3000	15.5	7.3	33.7	17.2	5.7	36.5
L.S.D. at %	0.8	0.8	1.3	0.7	1.1	1.7
B- CCC:						
0 (control)	21.9	9.8	34.7	21.0	7.7	37.0
1000	18.4	9.6	38.3	19.5	7.3	40.3
2000	16.9	8.8	38.3	18.4	7.5	40.4
L.S.D. at %	0.4	0.6	0.7	0.5	N.S	1.2
C: Interaction: (A x B)	N.S	N.S	*	N.S	N.S	*

*** Significant at 5 %**

The interaction between salinity and CCC had no significant effect on the height of *Phoseolus vulgaris* plant, as shown in Table (1). The results obtained by Hussein *et al.* (1984) confirmed these findings.

2- Number of leaves:

The averages number of snap bean leaves per plants significantly reduced in both seasons of 1990 and 1991 with increasing salinity. The highest salinity level (3000 ppm) had the lowest leaves number /plant in comparising with control treatment.

Number of leaves per plant tended to decrease with increasing CCC application as compared with the control treatment. The obtained results are in good agreement with those of Abdul and Said (1984) on broad bean and Nimer (1985) on cowpea plants. Contradication results were obtained by Hassan and El-Moursi (1982) on *Vicia faba,* L..

The interaction between salinity and CCC had no significant effect on the average number of leaves /plant in two seasons (Table 1).

3. Fresh weight:

Data tabulated in Table (1) clearly indicated that, the fresh weight of whole snap bean plant was significantly depressed with 2000 or 3000 ppm levels of salinity during the two seasons of 1990 and 1991.

The application of cycocel as a foliar spray at concentrations of 1000 and 2000 ppm caused a significant increment in fresh weight of whole plant in both seasons. The increase value due to 2000 ppm CCC amount about 3.6 and 3.4 gm /plant above control for first and second seasons, respectively. Al-Lawandy (1986) on soybean, cowpea and pigeon pea attained the same trend of results. On the contrary, El-Beheidi *et al.* (1991) reported that, CCC treatments with broad bean plants, resulted in a depressive effect on fresh weight.

Concerning the interaction between salinity and CCC at different levels, data in Table (1) show that, the highest concentration of salinity (3000 ppm) combined with CCC (2000 ppm) caused a great depression in plant fresh weight. Moreover, 1000 ppm CCC sprayed to snap bean plants which irrigated with water containing salinity up to 1000 ppm attained an increase in values of fresh weight as compared with the control plant.

4- Dry weight of plant and its different organs:

Data on the effect of salinity levels on dry weight of whole snap bean plant and its different parts, i.e., leaves, stems and roots are presented in Table (2).

The irrigation with salinity water containing up to 1000 ppm caused no adverse effect on plant growth as expressed by the dry matter accumulation. On the other hand, increasing salinity more than 1000 ppm caused a great reduction in dry weight of whole plant and its different parts. This may be attributed to a reduction in water uptake which can regulate the activities of certain enzymes particulary those of photosynthesis and /or the biosynthesis and destruction of certain growth hormones. In this connection El-Banna and Attia (1999) reported that, salinization may be alter the hormone balance in plants or decrease the transport of some promoters from roots to leaves and an increase in the leaf ABA. As well as complete damage to the internal structure of plant organelles such as chloroplasts and mitochondria.

With regard to the effect of foliar application of CCC, data presented in Table (2) show clearly that, spraying 1000 ppm CCC had a stimulatory effect on total dry weight of bean plants, dry weight of leaves and roots as compared with control for both two seasons. On the contrary, stem dry weight was progressively decreased with increasing CCC concentration during the two seasons. Many other workers obtained similar results (Hassan and El-Moursi, 1982 on *Vicia faba, L.* Nimer, 1985 on cowpea.

The interaction between irrigation water salinity and CCC treatment significantly affected whole dry weight of plant and its different organs except dry weight of leaves. The dry weight of whole plant and roots were markedly increased after 1000 or 2000 ppm CCC under 1000 and 2000 ppm salinity. While, the dry weight of stem decreased by CCC application under various salinity levels.

Table (2): Effect of salinity, CCC and their interactions on the dry weight of whole plant, leaves, stems and roots of snap bean plants in two seasons of 1990 and 1991.

Treatments (ppm)	Dry weight /plant (gm)							
	1990				1991			
	Whole plant	Leaves	Stems	Roots	Whole plant	Leaves	Stems	Roots
A- Salinity:								
0 (control)	12.8	4.4	7.7	0.72	13.1	4.4	7.7	1.0
1000	13.2	4.5	8.0	0.76	13.7	4.6	8.1	1.0
2000	11.9	4.0	7.1	0.80	12.1	4.0	7.2	0.9
3000	10.1	3.2	6.4	0.50	11.2	3.9	6.5	0.8
L.S.D. at %	0.8	0.5	0.3	0.04	1.10	0.1	0.2	N.S
B- CCC:								
0 (control)	11.5	3.0	7.9	0.64	11.9	3.4	7.9	0.7
1000	12.9	4.8	7.3	0.81	13.2	4.8	7.4	1.0
2000	11.8	4.4	6.7	0.78	12.6	4.6	6.8	1.2
L.S.D. at %	0.7	0.5	0.2	N.S	0.6	0.3	0.2	0.1
C: Interaction: (A x B)	*	N.S	*	*	*	N.S	*	*

*** Significant at 5 %**

However, application of CCC to salt affected snap bean plant counteracted the adverse effect of salinty imposed on plant dry weight. Kishk and Shalaby (1983) on cowpea, and Khafagi *et al.* (1984) on broad bean plants, came to similar conclusion. On the contrary, Hussein *et al.* (1984) reported that, the interaction between salinity and CCC had no effect on dry matter of broad bean shoots.

B- Photosynthetic efficiency:

1- Leaf area as a photosynthetic apparatus):

Data presented in Table (3) show that in two experimental seasons increasing salinity in irrigation water up to 1000 ppm resulted in the largest leaf area compared with the control and/or that of irrigation water contained higher salt concentration (2000 and 3000 ppm). Whereas, the values of leaf area gradually and consistently decreased with increasing salinity level above 1000 ppm.

Regarding the response of leaf area to the CCC application, the largest leaf area obtained with the application of CCC at concentration of 1000 CCC ppm. But CCC at 2000 ppm had an adverse effect in this trait. It could be summarized that, applied CCC as a foliar at a dose up to 1000 ppm caused an enhancement in leaf area of snap bean. Hassan and El-Moursi (1982) on *Vicia faba*, L. Nimer (1985) on cowpea and Al-Lawndy (1986) on soybean, common bean and pigeon pea obtained similar findings.

Table (3): Effect of salinity, CCC and their interactions on the leaf area and net assimilation rate of snap bean plants in two seasons of 1990 and 1991.

Treatments (ppm)	1990		1991	
	Leaf area /plant (cm^2)	**NAR mg /m^2 / day**	**Leaf area /plant (cm^2)**	**NAR mg /m^2 /day**
A- Salinity:				
0 (control)	413	1.5	405	1.8
1000	418	1.5	441	1.6
2000	379	1.4	341	1.5
3000	328	1.3	352	1.4
L.S.D. at %	15	N.S	13	0.2
B- CCC:				
0 (control)	377	1.3	396	1.4
1000	387	1.2	425	1.5
2000	383	1.7	379	1.8
L.S.D. at %	9	0.2	13	N.S
C: Interaction: (A x B)	*		*	*

*** Significant at 5 %**

The interaction between salinty and CCC significantly affected the total leaf area/plant during the two seasons. However, spraying snap bean which irrigated with water contained salinity up to 1000 ppm with 1000 ppm CCC gave larger leaf area than those of control in both seasons. With a little exception, Al-Lawandy (1986) found insignificant effect due to CCC on leaf area of soybean and pigeon pea plants grown under the low level of salinity.

2- Net assimilation rate (NAR):

There was a tendency towards decreasing NAR values by increasing the concentration of salinity (Table 3). The depression was more remarkable in the second season. Many other investigators came to the same conclusion Bhivare *et al*., 1988).

Cycocel at 2000 ppm caused a marked increase in the values of NAR in comparison with control or other concentration of CCC in both years (Table 3). This increment above control treatment amounted to: 31 and 29 % for 1990 and 1991 seasons, respectively (Table 3). In this connection, El-Tahawi *et al.* (1982) reported that Cycocel treatment exerts a clear effect on metabolic activities of plant. Photosynthesis and respiration are the two most important processes in this area. El-Fouly *et al.* (1988) on *Vicia faba,* L. reported that, foliar application of CCC at a concentration up to 1200 ppm had insignificant effect on the net dry weight.

The interaction between salinity and CCC treatments on the assimilation rate is shown in Table (3). CCC application at 2000 ppm caused an increase in the values of NAR under 3000 ppm salinity condition in the two seasons.

In this regard, Kishk and Shalaby (1983) reported some enhansive effects of CCC on the net dry matter accumulation in cowpea plants grown under salinty levels (2000, 4000 and 6000 ppm NaCl). In addition, Khafagi *et al.* (1984) found that CCC stimulated dry matter production in broad bean plants grown in saline soils.

3- Pigment content:

Data in Table (4) show that increasing salinity in irrigation water tended to decrease the amount of total pigments, chlorophyll a and chlorophyll b as well as carotendoids during the two seasons. However, the differences among treatments were not significant. These results are in accordance with those obtained by Bhivare (1988) on French bean and Khan *et al*. (1997) on rice plants.

The photosynthetic pigments of snap bean leaves were increased significantly (except carotenoids of 1991 experiment) due to CCC application. The chlorophylls as well as carotenoids contents were higher in tissues of snap bean leaves treated with CCC than those of control in both years (Table 4). This increment above the control amount to: 62.5, 25.4, 53.8 and 33.9 % in first season and 60.0, 40.0, 46.2 and 20.9 % in second seasons, respectively for chlorophyll (a), chlorophyll (b), total chlorophyll (a+b) and carotenoids.

Table (4): Effect of salinity, CCC and their interactions on chlorophylls and carotenoids (mg /100 gm fresh weight) of snap bean plants in two seasons of 1990 and 1991.

Treatments (ppm)	Dry weight /plant (gm)							
	1990				1991			
	Chl. (a)	Chl. (b)	Chl. (a+b)	Carot.	Chl. (a)	Chl. (b)	Chl. (a+b)	Carot.
A- Salinity:								
0 (control)	1.1	0.78	1.88	0.74	1.1	0.69	1.79	0.84
1000	1.1	0.63	1.73	0.68	1.0	0.62	1.62	0.70
2000	0.9	0.53	1.40	0.57	0.8	0.65	1.65	0.79
3000	1.0	0.67	1.60	0.72	1.0	0.62	1.44	0.62
L.S.D. at %	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
B- CCC:								
0 (control)	0.8	0.59	1.3	0.59	0.75	0.55	1.3	0.67
1000	1.0	0.53	1.6	0.66	1.00	0.61	1.6	0.74
2000	1.3	0.74	2.0	0.79	1.20	0.77	1.9	0.81
L.S.D. at %	0.04	0.06	0.10	0.03	0.10	N.S	0.1	N.S
C: Interaction: (A x B)	*	*	*	N.S	*	*	*	N.S

*** Significant at 5 %**

These results are in the line with those reported by Kandil *et al*. (1988) on soybean. Opposite results were obtained by other workers (El-Tahawi *et al*., 1982 on *Phaseolus vulgaris,* L. and El-Beheidi *et al*., 1991 on broad bean plants).

Data of the interaction treatments of salinity and CCC revealed that chlorophylls a, b and total responded significantly to salinity and CCC interaction in both seasons. Since, under different salinity levels treating snap bean plant with CCC as foliar application gave an increase in almost photosynthetic pigments except carotenoid content in both seasons of study.

As a result of the interaction of salinity and CCC, it could be concluded that the used CCC promoted the photosynthetic pigment. Such effect could be an evidence in favoured CCC application to decrease the adverse effect of salinity on photosynthetic pigments.

C- Flowering:

1- Date of flowering:

Data presented in Table (5) show clearly that the different levels of salinity (0, 1000, 2000 and 3000 ppm) caused a significant decrease in the number of required days for appearance the first flower on snap bean plant. It means that, the vegetative stage period was shorter under the saline conditions, comparing with the control plants. The results of our study are in good agreement with those obtained by Siddique and Kumar (1986) on pea plants.

The different treatments of cycocel caused a significant decrease in the average number of days required for appearance the first flower in two seasons. However, this effect was more clear at the highest concentration of CCC. El—Beltagy *et al*. (1979) on *Vicia faba*, L. noticed that, CCC delayed the beginning of flowering. On the contrary, Mohamad (1976) on snap bean, found that CCC did not affect the opening of first flowering. All different combination treatments between salinity and cycocel had insignificant effect in both two seasons (Table, 5).

Table (5): Effect of salinity, CCC and their interactions the flowering of snap bean plant in two seasons of 1990 and 1991.

Treatments (ppm)	1990			1991		
	Days required		Average No. of flowering plant	Days required		Average No. of flowering plant
	To appearance of first flower	From flowering to harvesting		To appearance of first flower	From flowering to harvesting	
A- Salinity:						
0 (control)	41	10	13	43	9	12
1000	42	9	12	41	7	11
2000	40	8	14	41	6	13
3000	41	7	12	41	6	12
L.S.D. at %	0.3	N.S	N.S	0.9	0.8	N.S
B- CCC:						
0 (control)	42	9	14	42	8	12
1000	41	9	13	42	8	12
2000	40	9.5	12	41	6	12
L.S.D. at %	0.2	N.S	1.3	0.5	0.6	N.S
C: Interaction: (A x B)	N.S	N.S	N.S	N.S	*	N.S

*** Significant at 5 %**

2- Date of harvesting:

Salinity resulted in shortening the period between opening the flower and pod harvesting, compared with the control plant. Snap bean pods harvested earlier when plants were irrigated by water containing 3000 ppm salinity than control by 3 and 4 days, respectively for the 1999 and 1991 seasons (Table, 5).

Cycocel at different concentrations had no significant effect on the date of pod harvesting in the first season, but there are significant differences in the second one (Table 5).

Regarding the influence of the combined effects between salinity and CCC, the data indicated that, under non-salinity, CCC at 1000 or 2000 ppm give rises to earlier pods. The same trend was observed in case 2000 ppm CCC spraying to snap plants and irrigated with 1000 or 3000 ppm salinity.

3- Average number of flowers/plant:

Data presented in Table (5) show clearly that different salinity levels had no significant effect on the average flower number /plant.

Data in the same table show that, the number of flowers was decreased with increasing CCC rates comparing with the control treatments in the first year only. The reduction in flowers number from applied CCC at higher concentration (2000 ppm), compared with control treatment, amounted to: 14.3 and 1.6 % for the first and second seasons respectively. The obtained results are in good agreement with those found by El-Fouly *et al*. (1975) on bean plants. On the other hand, El-Beltagy *et al*. (1979) and Hassan and El-Moursi (1982) on broad bean reported that, CCC at low concentration (up to 1000 ppm) had a promotive rather than a retardant effect on flowering.

The interaction treatments between salinity and CCC, had no significant effect on the average number of flowers /plant during the two experimental seasons.

D- Yield of pods:

1- Average number of pods /plant:

Data presented in Table (6) indicated that, salinity levels of 0, 1000, 2000 and 3000 ppm significantly influence the average number of pod /plant in the first season only. Using irrigation water containing salinity of 3000 ppm reduced the number of pods per plant compared with the control. Similar trend was observed in the second season. However the differences did not reach to significant levels. Similar results were reported by Ansari *et al.* (1998) on wheat plants.

Table (6): Effect of salinity, CCC and their interactions on pod yield snap bean plant in two seasons of 1990 and 1991.

Treatments (ppm)	1990			1991		
	Average No. of pods/ plant	Average Wt. Of pods /plant (gm)	Average pod weight (gm)	Average No. of pods/ plant	Average Wt. Of pods /plant (gm)	Average pod weight (gm)
A- Salinity:						
0 (control)	11.3	42.7	3.78	11.8	41.2	3.49
1000	11.9	41.7	3.50	9.2	37.1	4.03
2000	10.3	30.4	2.95	8.7	32.6	3.75
3000	6.8	29.6	4.35	8.3	29.0	3.49
L.S.D. at %	1.5	4.6	N.S	N.S	3.3	N.S
B- CCC:						
0 (control)	11.1	39.4	3.55	9.7	38.3	3.95
1000	10.9	37.2	3.44	9.4	35.0	3.72
2000	8.2	31.8	3.88	9.3	31.6	3.40
L.S.D. at %	1.3	6.2	N.S	N.S	3.5	N.S
C: Interaction: (A x B)	*	*	N.S	N.S	*	N.S

*** Significant at 5 %**

Cycocel treatment significantly reduced the average pods number/ plant only in the first season. Since CCC application of 2000 ppm caused a depression in average pods number compared with control. In this connection El-Beltagy *et al*. (1979) on *Vicia faba*, L. plants reported that CCC as foliar spray at lower rate caused a higher yield. On the other hand, El-Fouly *et al*. (1975) on *Vicia faba*, L. reported that CCC did not significantly affected pod yield. Many other workers investigated the effect of CCC on pod yield snap bean (Mohamad, 1976) and cowpea (Nimer, 1985). All of them found an increase in pod yield after CCC application. The contradiction among investigators might be attributed to the plant species, variety, mineral status in the soil stage of growth and environmental factors as well as CCC concentration and time of application.

The interaction between salinity and CCC, had a significant effect on the total yield of pod (pods number /plant) only in the first season. Since under 2000 ppm levels of salinity or no salinity foliar application of CCC at 2000 ppm had a decreasing effect on number of pods /plant.

2- Pods weight /plant:

Data presented in Table (6) show the effect of different salinity levels on the total yield of snap bean (number of pods/ plant and average pod weight). The pod yield of plants gradually and consistentnly decreased by increasing salinity levels in the two seasons. However, there is no significant effect due to salinity on the average pod weight in both seasons.

Regarding foliar application of CCC and its effects on pod yield, data in Table (6) indicate that the higher concentration of CCC, i.e. 2000 ppm caused a significant decrease in yield of pods during the two experimental seasons. The average weight of pod was not changed due to CCC application in both years.

The literature concerning the effect of CCC application on the pods yield is contradicting. However, Kandil *et al*. (1988) on soybean found that, the pod yield was greatly reduced by CCC application. On the other hand, Nimer (1985) on cowpea, reported that, CCC treatments particularly at lower rates enhanced the pod yield. The depression effect of CCC on the pod yield of snap bean plant might be attributed to the high concentrations used in this study. Also the contradiction among investigators might be attributed to plant species, variety, mineral status in the soil, as well as the rate of CCC and other factors.

The interaction between salinity and CCC application had a negative significant effect on the yield of pod in both seasons. In general, the data showed that, combinations between saline treatments and application of CCC at 2000 ppm caused a marked reduction in the weight of pods /plant. The average pod weight was not changed due to the interaction between CCC and salinity in both seasons.

E- Characteristics of pods:

1- Pod length:

Data presented in Table (7) show that the effect of different salinity levels on the length of pod. The salinized irrigation water caused significant reduction in the length of pod. However, differences did not reach significant level at 5%. Similar results were obtained by Uprety and Sarin (1976) on pea plants.

Foliar spray of CCC had no effect on pods length compared with control in both two seasons. These results are in agreement with those obtained by Sebanek (1966) on pea plants. On the other hand, higher doses of CCC inhibited cell division in plant tissues (Kabarity and Khodar, 1974).

Table (7): Effect of salinity, CCC and their interactions on some characters of snap bean pods in two seasons of 1990 and 1991.

Treatments (ppm)	1990			1991		
	Length of pod (cm)	Diameter of pod (cm)	Av. No. of seeds /pod	Length of pod (cm)	Diameter of pod (cm)	Av. No. of seeds /pod
A- Salinity:						
0 (control)	8.5	0.52	2.6	8.2	0.48	3.2
1000	8.4	0.50	3.5	7.9	0.34	3.6
2000	7.8	0.38	2.8	7.5	0.32	3.2
3000	7.4	0.39	3.1	7.5	0.50	3.1
L.S.D. at %	N.S	N.S	N.S	0.2	N.S	N.S
B- CCC:						
0 (control)	8.4	0.44	2.9	7.9	0.41	3.3
1000	8.1	0.42	2.7	7.6	0.41	3.1
2000	7.0	0.48	2.8	7.6	0.41	3.0
L.S.D. at %	N.S	N.S	N.S	N.S	N.S	N.S
C: Interaction: (A x B)	*	N.S	*	*	N.S	*

*** Significant at 5 %**

In respect to the effect of combined treatments between salinity and CCC on the length of pod, there was a significant response in both seasons. Since, salinity at 1000 ppm combined with 2000 CCC ppm treatment caused a marked increase in pod length compared with control in both seasons. On the other hand, the snap bean plants irrigation with high level of salinity (3000 ppm) and sprayed with the highest dose of CCC gave the shortest pod in the two seasons.

2- Diameter of pod:

Data tabulated in Table (7) indicated that, salinity levels had no significant effect on diameter of snap bean pod.

As well as cycocel had no significant effect on pod diameter in the two seasons. The combination treatments between salinity and CCC application had no effect on pod diameter in both seasons.

3- Seeds number/pod:

The effect of irrigation water salinity on the average seeds number/pod is shown in Table (7). The different levels of salinity had no significant effect on seed number /pods. Also there was no significant effect obtained due to application of CCC on number of seeds /pod in both seasons. Similar results were reported by El-Fouly *et al*. (1988) on *Phaseolus vulgaris*, L. Opposite results were reported by El-Beheidi *et al*. (1991) on broad bean.

Regarding the effect of salinity and CCC treatments on the average seeds number /pod, data in Table (7) show that, the differences between combined treatments were significant in both seasons. Meanwhile, under high salinity level, spraying cycocel at 2000 ppm reduced the number of seeds/pod compared with control in both seasons.

F- Mineral composition:

1- Nitrogen:

Data in Table (8) show that nitrogen content in snap bean tissues was progressively reduced by increasing salinity levels in both seasons. The results reported by Uprety and Sarin, 1976) on peas, Al-Lawandy (1986) and Cordovilla *et al*. (1995) on legumes are in good agreement with present study.

Regarding the effect of different concentration of CCC on the nitrogen content of leaves, data in Table (8) indicated that cycocel application as foliar had superiority in nitrogen content over the untreated plants in both seasons.

The stimulatory effect of CCC on nitrogen accumulation in tissues of snap bean leaves reported in the present investigation was noticed by several authors with other plants. For instance, Mohsin and Smith (1972) on frensh bean, Nimer (1985) on cowpea and Al-Lawandy (1986) on pigeon pea, common bean and soybean plants.

With respect to the effect of the interaction between salinity and CCC, data in Table (8) show that, under 1000 or 2000 ppm levels of irrigation water salinity, foliar application of cycocel caused more N accumulation compared with control in both seasons. However, the highest nitrogen level in tissues of snap bean leaves detected in plants irrigated by the medium (2000 ppm) salinity level and sprayed with the highest CCC concentration (2000 ppm). On the contrary, the plants irrigated with 3000 ppm salinity and sprayed with 2000 ppm CCC had the lowest nitrogen values.

In this regard, Schindler (1974) indicated that application of CCC either to the soil or as foliar spray to bean plants increased the plant tolerance to sybsequent saline treatments with solutions of various chloride and sulphate salts. Uprety and Sarin (1976) on pea plants suggested that the reduction in protein level may be one of the primary plant injuries caused by salinity. They also reported that application of the growth retardant helped to maintain the protein status of plants and prevented growth and yield reduction.

2- Phosphorus:

Salinity caused a significant depression on phosphorus concentration in leaves tissues by increasing salinity level in the first season. However, in the second season, the highest level of salinity seemed to increase P content.

Phosphorus content was reduced gradually by increasing the concentration of CCC. However, the highest and the lowest phosphorus values were noticed in case of control treatment and 2000 ppm CCC, respectively. These results were similar to those noticed by Al-Lawandy

(1986) on cowpea and El-Beheidi *et al*. (1991) on broad bean plants. Opposite trend was reported by Mohsin and Smith (1972) on dwarf fresh bean, Nimer (1985) on cowpea and Al-Lawandy (1986) on soybean, common bean and pigeon pea.

Data in Table (8) show that phosphorus content in leaves of snap bean plants was significantly reduced with the combined treatments between salinity and CCC during the two experimental seasons. Meanwhile, the highest P values determined in the tissues of control plants. On the contrary, the lowest P values accumulated under the condition of applying irrigation water contained salinity (2000, 3000 ppm) and treated with CCC (2000 ppm).

Table (8): Effect of salinity, CCC and their interactions on N, P and K content in leaves of snap bean plants in two seasons of 1990 and 1991.

Treatments (ppm)	1990			1991		
	N &	P %	K %	N &	P %	K %
A- Salinity:						
0 (control)	4.4	0.50	4.7	4.2	0.54	4.7
1000	4.2	0.40	4.3	4.1	0.52	4.4
2000	4.1	0.37	4.2	4.0	0.53	4.1
3000	3.0	0.32	3.6	2.9	0.43	3.6
L.S.D. at %	0.1	0.05	0.1	0.1	N.S	0.1
B- CCC:						
0 (control)	3.6	0.43	4.9	3.6	0.53	4.9
1000	3.9	0.38	4.0	4.0	0.51	4.0
2000	3.9	0.39	3.7	4.1	0.46	3.7
L.S.D. at %	0.1	0.05	0.03	0.1	0.03	0.02
C: Interaction: (A x B)	*	*	*	*	*	*

*** Significant at 5 %**

3- Potassium:

The effect of different levels of salinity, on the K content of snap bean leaves had a significant effect in the two seasons. With increasing the rate of salinity, the K values decreased, consistently and gradually to reach its minimum by using the highest salinity levels in both seasons (Table 8) Similar conclusion was reported by Al-Lawandy (1986) on some species.

Regarding the relation of K accumulation to CCC as foliar application, data in Table (8) reveal that, K accumulation was decreased with increasing CCC concentration in both seasons. Opposite results were obtained on cowpea (Nimer, 1985) and soybean, common bean and Pigeon pea (Al-Lawandy, 1986). On the other hand, El-Beheidi *et al*. (1991) on broad bean plants, noticed that, the high rates of CCC indicated a marked reduction in K content, but the lower concentration caused an increase in K values in tissues of plant.

The interaction between salinity and CCC on the K content is shown in Table (8). There was a significant differences between salinity and CCC combination for K content. All CCC levels under almost salinity condition caused a marked decrease in K content in snap bean leaves in both seasons.

REFERENCES

Abdul, K.S. and M.M. Said (1984). Effect of cycocel and gibberellic acid on growth of broad bean seedlings. Iraq, J. Agric. Sci., 2 (1): 45 – 57.

Al-Lawandy, W.I. (1986). Physiological studies on the adaption of some plants to salinity by using some growth substances. M.Sc. Thesis in Botany, Al-Azhar Univ. Fac. Sci., Girls Branch.

Bhivare, V.N.; J.D. Nimbalkar and P.D. Chavan (1988). Photosynthetic carbon metabolism in french bean leaves under saline condition. Environmental and Experimental Botany, 28 (2): 117 – 121.

Brown, J.D. and O. Lileland (1946). Rabid determination of potassium and sodium in plant material and soil extracts by flame photometry. Proc. Amer. Soc. Hort. Sci., 48: 341 – 346.

Cordovilla, M.P.; A. Ocaina; F. Libero and C. Lluch (1995). Salinity effects on growth analysis and nutrient composition in four grain legumes-Rhizobium Synbiosis. J. of plant nutrition, 18 (8): 1595 – 1609.

El-Banna, Y. and T. Attia (1999). Root tip meristematic cell and leaf chloroplast structure in three Barley (*H. vulgare*, L.) genotypes exposed to salinity stress. Cytologia, 64: 69 – 76.

El-Beheidi, M.A.; M.H. El-Sawah; M.El- Ghamriny and F.H. Afia (1991). Effect of foliar spray with kinetine, CCC and GA_3 on growth and yield of broad bean plants. Zagazig J. Agric., 18 (6): 1935 – 1945.

El-Beltagy, A.S.; M.S. El-Beltagy and M.A. Hall (1979). Modification of vegetative development, flowering and fruiting behaviour in *Vicia faba*, L. by treatment with growth regulators. Egyptian J. of Hort., 6 (2): 237 – 260.

El-Fouly, M.M.; G. Abo-Elleil and M.H. El-Hindi (1975). Effect of cycocel on growth, flowring and yield of *Vicia faba*, L.. J. Agro-chemica, XIX, No. 5.

El-Fouly, M.M.; R. Sakr and M.K. Fouda (1988). Effect of GA_3, CCC and B-9 on morphology, physiological characters and yield of kidney bean (*Phaseolus vulgaris, L.*) . J. Agron. And Crop Sci., 160 (2): 94 – 101.

El-Tahawi, B.S. ; M.A. Diab; Z.A. Hadid; M.A. Habib and I.N. Dras (1982). Effect of GA_3 and CCC on carbohydrate metabolism in *Phaseolus vulgaris*, L. Minufiya J. of Agric. Research, 6: 289 – 301.

Gregory, F.G. (1926). The effect of climate conditions on the growth of barley Ann Bot., 40: 1 – 26.

Hassan, E.A. and A. El-Moursi (1982). Response of broad bean plants to low cycocel concentration treatments in comparison to a commercial source of cytokinins and together. Zeitschift Fur Acker. Und Pflanzenbau, 151 (2): 81 – 88.

Hussein, M.M.; M.A. Ashoul and M.A. Abd-Rasoul (1984). Organic and amino acids concentration in broad bean seedlings as affected by salinity and cycocel. Annals of Agric. Sci. Ain Shams Univ., 29 (1): 239 – 256.

Kabarity, A. and S. Khodar (1974). Cytological studies upon cycocel as plant growth retardant. Beitr. Biol. Pflanzen, 50: 1-9.

Kandil, M.M.; A.A. Abdel-Rahman; M.M. Hussein and N.F. Abd El-Hadi (1988). Growth, photosynthetic pigments and yield supply and growth retardants. Bulletin of Egypt. Soc. Physiol. Sci., 8 (3): 185 – 206.

Khafagi, O.A.; A.A. Shalaby and E.T. Kishk (1984). Effect of CCC on the salt tolerance of wheat, barley and broad bean. Desert. Inst. Bull A.R.E., 43 (1): 323 – 336.

Khan, M.S.A.; A.Hamid; A.B.M. Salahuddin; A. Quasem and M.A. Karim (1997). Effect of sodium chloride on growth, photosynthesis and mineral ions accumulation of different types of rice (*Oryza sativa*, L.). J. Agric. And Crop. Sci., 179 (3): 149 – 161.

Kishk, E.T. and A.A. Shalaby (1983). Effect of 2-chloroethyl trimethyl ammonium chloride (CCC) and 2,4-Dichlorophenoxy acetate acid (2,4-D) on salt tolerance of *Vigna sinensis*, L. in calcareous soil. 1st Conf. Of Agron. Egypt. Sci. of Crop Sci.

Kock, F.G. and T.L. McMeekin (1924). The chemical analysis of food and food products. J. Amer. Chem. Soc., 46: 2066.

Koller, H.R.C. (1972). Leaf area- leaf weight relationship in the soybean canopy. Crop. Sci., 12: 180 – 183.

Mohamad, T.G. (1976). Effect of some growth regulator on the yield and keeping quality of snap bean. M.Sc. Thesis Fac. Of Agric. Al-Azhar Univ.

Mohsin, M. and M.S. Smith (1972). The influence of some growth regulators on growth and mineral composition of bean plants. Pesticide Science, 3 (3): 333 – 344. (C.F. Hort. Abst., 43 (4): 2031, 1973).

Nimer, N (1985). Effect of salinity and some growth regulators on growth of cowpea and spinach. Ph. D. Thesis, Faculty of Agric. Minufiya Univ.

Schindler, E. (1974). Increasing salt tolerance of food plants by treatment with cloromequat chloride (CCC). Landwirtschaftiliche Forschung, 27 (3/4): 349 – 357.

Sebanek, J. (1966). The effect of CCC on the development of the pea variety Raman under various photoperiodic conditions. Rastlinna Vyroba, 12: 413 – 420. (Hort. Abst., 36 (2): 6672).

Siddque, S. and S. Kumar (1986). Effect of salinization and desalinzation on growth and development of pea. Indian J. of Plant physiology, 28 (2): 151 – 156. . (C.F. Hort. Abst., 56 (6): 4256, 1986).

Snedecor, G. W. and W.G. Cochran. (1980). Statistical Methods. The Iowa state Univ. Press, Ames, Iowa, USA.

Trough, E. and A.H. Mayer (1939). Improvement the deiness colorimetric method for phosphorus and arsenic. 2nd Eng. Chem. Anal. Ed. 1: 136 – 139.

Uprety, D.C. and M.U. Sarin (1976). Effect of soil salinity and growth regulators on growth and naturation of peas *Pisum sativum*, L. Agric. Agro. Ind. J., 6 (11): 27 – 33.

Wettestein, V. (1957). Chlorophyll lethal und der submicropische form Wechelder plastidn. Exptal. Cell. Res. 12: 427 – 488.

J. Agric. Sci. Mansoura Univ., 25 (8), August, 2000.

تأثير الرى بماء ملحى والرش بمنظم النمو السيكوسيل على النمو والصبغات وانتاجية محصول الفاصوليا الخضراء

كوثر كامل ضوه* ، سمير طه عفيفى* ، نادية عمر ، فاتن عبدالعال****
*** قسم الخضر والزينة ـ كلية الزراعة ـ جامعة المنصورة.**
**** المركز القومى للبحوث ـ القاهرة .**

أجريت تجربة قصارى فى كلية الزراعة ـ جامعة المنصورة وقسم البساتين بالمركز القومى للبحوث لدراسة تأثير 4 مستويات من الملوحة ماء الرى (الكنترول، 1000، 2000، 3000 جزء / المليون) و3 تركيزات من السكوسيل (صفر، 1000، 2000 جزء / المليون) على النمو الخضرى والجهاز التمثيلى ومحصول القرون الخضراء وصفات جودة القرون ومحتوى الأوراق من عناصر النتروجين والفوسفور والبوتاسيوم وتضمن أهم النتائج مايلى:

ـ رى نبات الفاصوليا بماء رى يحتوى على ملوحة حتى 1000 جزء / المليون لم يؤثر على عناصر النمو الخضرى (طول النبات ، الوزن الغض، الوزن الجاف للنبات واجزائه المختلفة ـ زيادة تركيز الملوحة أكثر من 1000 جزء / المليون أدت إلى نقص فى صفات النمو الخضرى وكذلك مساحة الأوراق وقيم صافى التمثيل الضوئى.

ـ نقص محتوى أوراق نبات الفاصوليا من الصبغات النباتية (كلورفيل أ ، كلورفيل ب ، الكاروتين) وذلك بزيادة تركيز الملوحة فى ماء الرى .

ـ رى نبات الفاصوليا بالسيكوسيل 3 مرات بفاصل زمنى أسبوع من كل رشة أدى إلى نقص فى تركيز الصبغات النباتية فى أوراق النبات ـ بينما كان هناك اتجاه نحو الزيادة فى قيم الوزن الغض والجاف ومساحة الأوراق والكفاءة التمثيلية.

لم يكن هناك تأثير واضح لملوحة ماء الرى على ميعاد ظهور أو زهرة على النبات ولكن المدة من الإزهار حتى حصاد القرون كانت أقصر بزيادة ملوحة ماء الرى ـ وبالمثل لم يؤثر رش نباتات الفاصوليا بالسيكوسيل بتركيزات حتى 2000 جزء / مليون على عمليات الإزهار.

2ـ نقص محصول القرون بزيادة ملوحة الرى حيث كانت العلاقة عكسية بينهما حيث أقل محصول سجل مع رى النباتات بماء يحتوى على أعلى تركيز من الملوحة (3000 جزء / المليون). بالمثل رش النباتات بالسيكوسيل أدى إلى نقص فى محصول القرون الخضراء مقارنة بمعاملة الكنترول.

3ـ كانت قرون الفاصوليا أقل جودة مع استعمال ماء رى يحتوى على ملوحة مقارنة بمعاملة الكنترول.

4ـ بزيادة ملوحة ماء الرى نقص محتوى أوراق النبات من عنصرى النتروجين والبوتاسيوم، الرش بالسيكوسيل أدى إلى زيادة فى محتوى أوراق نبات الفاصوليا من النتروجين ـ وبينما نقص كل من محتوى عنصرى الفوسفور والبوتاسيوم.