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ORIGINAL ARTICLE

EFFECT OF DIFFERENT SALT CONCENTRATIONS ON RATIO, SPEED, GROWTH AND DEVELOPMENT OF SEEDLINGS OF SOME VEGETABLE CROPS

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Abstract: A one factor laboratory experiment was conducted in the Department of Biology, College of Education for Women, Anbar University to study the effect of salinity levels of irrigation water on the rate, speed of germination and the growth development of piumule and root for six types of vegetable crops. The crops used in the study, namely celery, Spinach, Parsley, Garden Cress, Cauliflower, Swiss chard. A completely randomized design (CRD) with three replications was used, the one factor used in this study was irrigation water with different levels of salinity which are 0, 0.6, 1.75, 2.9, 3.9 and 4.9 ds.m^{-1}, the aforementioned levels took the symbols of 1, 2,3,4,5 and 6 respectively. A Petri dishes and sterile filter papers were used for cultivation. The obtained results indicated that there were significant differences in terms of speed of germination, where there were significant differences for celery and cauliflower seeds at level (4-5-6), while the speed of germination of Parsley and Swiss chard was significant at the level (6). Whilst the significant were at level (3) for Garden Cress, while there were no significant differences for Spinach þseeds. Regarding the percentage of germination, also the significant differences were observed for the seeds of celery, where it was significant at all salinity levels, while in spinach and cauliflower seeds the percentage of germination was significant at the levels (5-6), meanwhile, the significant was at the levels (4-5-6) for Parsley seeds, while the seeds of Garden Cress was significant at the level (3). They were not significant for Swiss chard seeds. So as to the length of piumule, there were significant differences at the levels (4-5-6) for each of celery and Garden Cress seeds, whereas the significant difference was observed at the levels (2-5-6) for spinach and cauliflower seeds and at level (5-6) for Swiss Chard seeds and in all levels of Parsley seeds. Also, there were significant differences in the root length of the seeds at level (4-5-6) for celery seeds, Garden Cress and Swiss Chard and at level (5-6) for spinach and cauliflower seeds and all the levels were significant for Parsley seeds.

***Key words*:** Germination percentage, Germination speed, Salt water levels, Vegetable crops.

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1. Introduction

Soil salinity is one of the most detrimental factors for agricultural production for a long time and up to the present, due to its impact on the growth and yield of many plants through its effect on the availability of nutrients and water to the plant, specifically at the germination stage and growth of the seedlings in arid and semi-arid areas. Salt-affected soils occupy around 800 million ha of the total land area in the world [Sharma *et al*. (2016)]. There are two kinds of soil salinization resources, namely primary (natural) and secondary (results from human activities, such as soil fertilization and irrigated land). In spite of the major part of saline soils has developed naturally due to accumulation of salts for a long time in arid and semi-arid regions. One of the most important salts that cause soil salinity is sodium chloride, it increases in the soil negative affects the absorption of nitrogen, which has a vital role in the formation of amino acids consequently reduces the formation of proteins, also calcium, magnesium and

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potassium [AL-Sahaf (1989)]. Also, the high salinity leads to make the cell life shorter and the cell expansion rate slower, consequently affects the size of the leaf cells, moreover it causes a change in the hormonal balance in the plant by encouraging it to change the signals in the roots thereby affects the growth of the vegetative system and the growth of the roots [Volkmar *et al*. (1998)]. Plant growth decreases significantly under the influence of salt stress however, the plants differ considerably in their sensitivity and ability to tolerate salinity stress [Amzallag *et al*. (1993)]. Therefore, saline water should be used optimally and carefully to get the desire results from the irrigated crops [Alsaadawi and Mohamed (2000)]. The study was conducted to investigate the effect of irrigation water salinity levels on the rate, speed of germination, the growth development of piumule and root for six types of vegetable crops.

2. Materials and Methods

A laboratory experiment was carried out in the Department of Biology, College of Education for Women, Anbar University. A completely randomized design (CRD) with three replications was used, the one factor used in this study was irrigation water with different levels of salinity, namely 0, 0.6, 1.75, 2.9, 3.9, and 4.9 $ds.m^{-1}$, the aforementioned levels took the symbols of 1, 2, 3, 4, 5 and 6 respectively. The levels of saline water were prepared by taking water with a salinity level of 5.48 $ds.m^{-1}$ then diluted with distilled water to obtain the desired salinity levels according to Equation (1).

$$\text{Mixed water salinity} = (A \times B) + (C \times B) \qquad (1)$$

Where, A is the saline water, B is the mixing ratio, C is the non-saline water.

The seeds of the six vegetable crops were provided from the agricultural office, College of Agriculture. The seeds were cleaned from impurities. After that, the healthy seeds were selected, where 10 seeds were put in each Petri dishes with a diameter of (10) cm after placing the filter paper (Wathmann. No. 1) inside the Petri dishes. Then 20 ml of saline water that prepared previously was added to each petri for each level of water salinity, the seedlings were watered with saline water when needed. Regarding the control treatment, distilled water was used for watering. The experiment continued for three weeks during which the following was calculated:

1. Germination rate%.
2. Seed germination.day^{-1}: calculated through the germinated seeds divided by the number of days required from the beginning of germination.
3. The length piumule and the root (cm): Three weeks after the end of germination, the plant has been taken. The length of the piumule and the root was measured using the averages [AOSA (1983)].
4. The data were analyzed statistically for the studied characteristics by analyzing the variance and averages. The averages were compared using the least significant difference at 0.05 probability level.

3. Results and Discussion

Table 1 showed that there was a significant difference in the germination speed of plants seeds in levels 4-5-6 for celery and cauliflower seeds, which amounted to 0.11, 0.08, 0.00 for celery seeds respectively and (0.20, 0.15, 0.22) for seeds of cauliflower, respectively. The best level of celery is (1) while the best level for cauliflower is (2). There are significant differences in level (6) only for Parsley and Swiss chard seeds that reached (0.03) for Parsley and (0.10) for Swiss Chard. The best level for Parsley (4) and the best level in Swiss chard was (2), and at the level (3) for Garden Cress seeds which reached (1.90), while there were no significant differences for Spinach seeds.

The results of Table 2 show the percentage of germination, there were significant differences in all levels of celery seed, but the best level was (2) and at the level (5-6) of spinach and cauliflower seeds, it reached (63.3 and 50.0) for spinach seeds respectively, reached 26.7 for cauliflower seeds and the best level for them was 2 and at the levels 4-5-6 for Parsley seeds reached 30.0, 10.0, 3.30, respectively and the best level was 1 and at level 3 for the seeds of Garden Cress, which reached 93.3 and the best level was 1. While there were non-significant differences for Swiss Chard seeds. These results agree with the results of Zowain (2014), who reported in his study on corn, that increasing the concentration of sodium chloride leads to a deterioration of the germination percentage for all the germination period. The imbalance in the transfer of salts to and from the cell may be due to an increase in the concentration of salts in the medium of germination, thereby leads to the accumulation of salts within the cell. This leads to negative effects on the vitality of the

Table 1: Effect of different salt concentrations on the speed of germination of some vegetable crops.

Speed Germination							
EC	**OP**	**Celery**	**Spinach**	**Parsley**	**Garden Cress**	**Cauliflower**	**Swiss Chard**
0	0	0.29	1.18	0.20	0.80	0.53	0.31
0.6	0.216	0.24	1.46	0.19	1.20	0.69	0.36
1.75	0.63	0.2	1.25	0.20	1.90	0.35	0.19
2.90	1.044	0.11	1.52	0.25	0.69	0.20	0.15
3.90	1.404	0.08	1.42	0.08	1.20	0.15	0.20
4.90	1.764	0.00	1.04	0.03	0.43	0.22	0.10
LSD 5%		0.1198	0.7375	0.1548	0.988	0.1813	0.218

Op = Ec × 0.36

Table 2: Effect of different salt concentrations on the percentage of germination of some vegetable crops.

Percentage Germination							
EC	**OP**	**Celery**	**Spinach**	**Parsley**	**Garden Cress**	**Cauliflower**	**Swiss Chard**
0	0	100	100	63.3	96.7	66.7	46.7
0.6	0.216	73.3	93.3	46.7	100	66.7	60
1.75	0.63	56.7	90	43.3	93.3	56.7	26.7
2.90	1.044	16.7	80	30	90	43.3	30
3.90	1.404	10	63.3	10	76.7	26.7	23.3
4.90	1.764	0	50	3.3	50	26.7	26.7
LSD 5%		19.27	22.45	27.32	19.27	24.56	49.45

Op = Ec × 0.36

seeds embryo, the results have agreed with some studies, which indicated that the increase in salt concentrations causes an inhibition of seed growth**.** Al-Fahdawe (2019) studied the effect of saline water on wheat and cucurbita pepo, respectively, and showed that salt concentrations affected the rate and speed of germination of seeds, which led to slow their growth.

This confirms the role of sodium chloride in preventing or inhibiting germination of seeds because of its direct role in increasing or discarding the osmotic effort outside or inside the cell and this affects the amount and speed of nutrient and water transfer into the seeds, which has a direct role in the seed embryo speed to initiate metabolic processes that lead to germination and seedling growth. In addition to its role in inhibiting the stimulating enzymes by demolishing them, the results are consistent with the findings of previous studies that disrupting the dissolution of substances stored in seeds and the mechanics of their transport are due to the negative effect of salts on germination. As the high absorption of chlorine and sodium ions during germination may lead to cell toxicity and then inhibition or slow rate and germination rate [Yakit and Tuna (2006)].

The results listed in Table 3 showed that there were significant differences in the piumule length of plant seeds, at the level (4-5-6) in each of celery and Garden Cress, which amounted to (0.83, 0.83 and 0.67) for celery seeds, respectively reached (4.00, 3.67 and 3.33) for the Garden Cress seeds respectively, and the best level of celery and Garden Cress was (2) and (1), respectively. Significant differences were observed in the levels (2-5-6) for spinach and cauliflower seeds, which amounted to (7.83, 1.33 and 0.70) for spinach seeds, respectively and reached (7.33, 2.00 and 1.00) for cauliflower seeds, respectively. The best level for spinach and cauliflower was (2) and (3), respectively. As for Parsley seeds, there were significant differences at all levels, while the best level was (1). There were significant differences for Swiss Chard seeds at level (5-6), which amounted to (4.00 and 3.33), respectively and the best level was (2). These results are consistent with the results of Ethbeab *et al.* (2013) who indicated in his study on the faba bean plant that, the growth rates of plants increases as the concentration of sodium chloride solution decreases. The increase in vegetative growth in low salt concentrations may be due to an increase in the plant's proline content, but when the

Table 3: Effect of different salt concentrations on the plumule growth of some vegetable crops.

The plumule (cm)							
EC	**OP**	**Celery**	**Spinach**	**Parsley**	**Garden Cress**	**Cauliflower**	**Swiss Chard**
0.00	0.00	2.5	5.67	4.83	6.33	8.83	7.17
0.60	0.216	2.67	7.83	3.67	5.67	7.33	9.12
1.75	0.63	2.5	6.83	3.00	5.67	9.17	6.33
2.90	1.044	0.83	5.33	0.50	4.00	7.5	5.40
3.90	1.404	0.83	1.33	0.50	3.67	2.00	4.00
4.90	1.764	0.67	0.70	0.00	3.33	1.00	3.33
LSD 5%		0.83	1.842	0.945	1.085	1.501	2.271

Table 4: Effect of different salt concentrations on the root growth of some vegetable crops.

Lengths of seedlings (cm)							
The Root							
EC	**OP**	**Celery**	**Spinach**	**Parsley**	**Garden Cress**	**Cauliflower**	**Swiss Chard**
0.00	0.00	2.33	4.83	4.00	6.67	9.00	8.67
0.60	0.22	1.67	4.33	2.33	7.33	10.00	7.33
1.75	0.63	1.33	6.67	2.00	6.00	8.00	7.50
2.90	1.04	0.50	5.33	1.00	1.00	7.00	1.00
3.90	1.40	0.67	0.73	0.50	1.00	1.50	1.10
4.90	1.76	0.50	0.63	0.00	0.50	1.00	1.50
LSD 5%		1.06	2.36	1.54	2.77	2.11	2.71

salinity concentration increased, lead to increases the plant's sugar content (glucose, sucrose).

Table 4 showed the effect of saline concentrations on the root length, there were significant differences for celery seeds, Garden Cress and Swiss Chard in the levels (4-5-6) and they reached (0.50, 0.67 and 0.50) for celery seeds, respectively. It reached (1.00, 1.00, 0.50) for Garden Cress seeds and respectively (1.00, 1.10 and 1.50) for Swiss Chard seeds, respectively, and the best level of celery and Swiss Chard was (1) while the best Garden Cress level was (2). There were also significant differences for spinach and cauliflower seeds in the levels (5-6), which amounted to (0.73, 0.63) for spinach seeds while amounted to (1.50, 1.00) for cauliflower seeds. The best level for spinach seeds was (3) and for cauliflower seeds was (2). As for the Parsley seeds, they were significant at all levels, and the best level was (1) due to the effect of sodium chloride, which inhibits root growth, where salinity leads to a reduction in the rate of root growth and its branches, these results agree with Al-Akeedi (2012).

4. Conclusion

We conclude from the results of the research that the increase in salinity levels affected the percentage and speed of germination in addition to its effect on the shoots and roots in terms of inhibiting its growth.

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