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THE INFLUENCE OF SALINE STRESS OVER THE GERMINATION PROCESS OF CUCUMBER SEEDS – *CUCUMIS SATIVUS* L.

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Abstract
The significant reduction in precipitation caused by global warming has led to a marked increase in the concentration of salts in the soil, thus causing the plants to tolerate a much higher salinity. The response of plants to salinity consists of numerous processes that must work together to alleviate both cellular hyperosmolarity and ionic imbalance. Salinity tolerance and plant growth stability are complex genetic traits that are difficult to establish in crops, as saline stress can occur as a catastrophic episode or be imposed continuously or intermittently, and can gradually become more severe at any stage of plant development. Given these conditions, we aimed to identify the influence of saline stress on the germination process of cucumber seeds. To perform the experiment, saline solutions were prepared in different concentrations: 0.25 mM and 0.12 mM, over which sea buckthorn extract (5 ml /l) was added. 18 repetitions were performed, 3 for each solution. Our results indicated that salt stress significantly reduced the cucumber seedlings shoots and roots growth. Also, the cucumber seeds germination was significantly inhibited at concentrations of 0.12 and 0.25 mM of NaCl solution supplemented with sea buckthorn extract.

Keywords: cucumber, saline stress, seed germination.

1. INTRODUCTION

In many semi-arid and arid regions of the world, crop yields are limited because of the high rate of soil salinity. Salinity and drought are the most common abiotic stresses, which have strongly affected plant growth and biomass production.

One of the most harmful effects of salinity is the accumulation of Na^+ and Cl ions in the tissues of plants that grow on soils with high concentrations of NaCl (Maathuis et al., 2014).

Cucumber (*Cucumis sativus L.*) is an important vegetable, often consumed by the population, being a light food, which contains in small quantities: proteins, fats, carbohydrates, organic acids, pectin, minerals (Ca, Fe, P, K, Si, S, Na, Cl, Mg); vitamins A, B (B_1, B_2), C, carotene but also a significant amount of water - 95%. It contains an enzyme that facilitate the digestion of hard-to-digest foods especially of proteins. Most of the active ingredients, vitamins and minerals are found in the cucumber peel. Cucumber, being a diuretic, low in calories and rich in water is often used by overweight people.

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Cucumber is also used in the cosmetics industry to obtain facial creams, but it can be applied as such in the eye area to reduce dark circles and wrinkles.
The inhibitory effect of saline stress on seed germination is attenuated by phytohormines such as cytokine (Khan and Huang, 1988), ethylene (Khan and Huang, 1988; Kepczynski and Kepczynska, 1997; Gul and Weber, 1998), gibberyl acid (GA) (Khan and Ungar, 1998; Khan et al., 2004).
The aim of this study was to identify the maximum concentration of NaCl and sea buckthorn extract on the germination of cucumber seeds.

2. MATERIALS AND METHODS

The saline solutions were tested on cucumber seeds, thus determining the degree of their germination under *in vitro* conditions.
To perform the experiment, Petri dishes were used which were sterilized in an oven for 2 hours at 160°C. Five experiments were performed, 3 repetitions for each experimental variant and another being the control sample.
The assembly of the experiment consisted in adding 9 seeds/ Petri dish, thus using 27 seeds for all 3 repetitions and 162 seeds to make all the variants (figure 1).

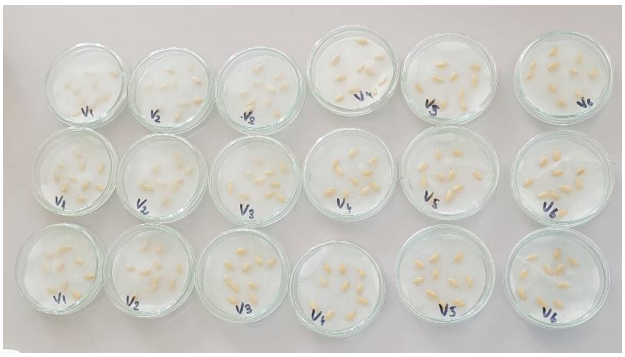

Figure 1. Petri dishes with experimental variants used in the salinity tolerance testing process

Thus we had the following contractions:
- V_1 or control variant, distilled water;
- V_2 NaCl solution of 0.25 mM concentration;
- V_3 0.25 mM NaCl solution + sea buckthorn extract (5ml/l);
- V_4 NaCl solution of 0.12 mM concentration;
- V_5 NaCl solution of 0.12 mM concentration + sea buckthorn extract (5ml/l);
- V_6 sea buckthorn extract (5ml/l).

2 ml of solution specific to each experimental variant were added to each Petri dish once every three days, checking the degree of seeds germination daily.

3. RESULTS AND DISCUSSIONS

From the data collected during the experiment (7 days of monitoring) large differences can be observed regarding the germination rate and the effect of the solutions on the seeds.
Starting with the second day the control variant determined an effective seed growth rate. The same result was recorded in the case of the experimental variant with sea buckthorn extract dissolved in

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water (5 ml/l). These two experimental variants showed the highest germination rate of cucumber seeds.
The dynamics of germination of seeds subjected to saline treatment and sea buckthorn extract in different molar concentrations can be seen in Figure 2.

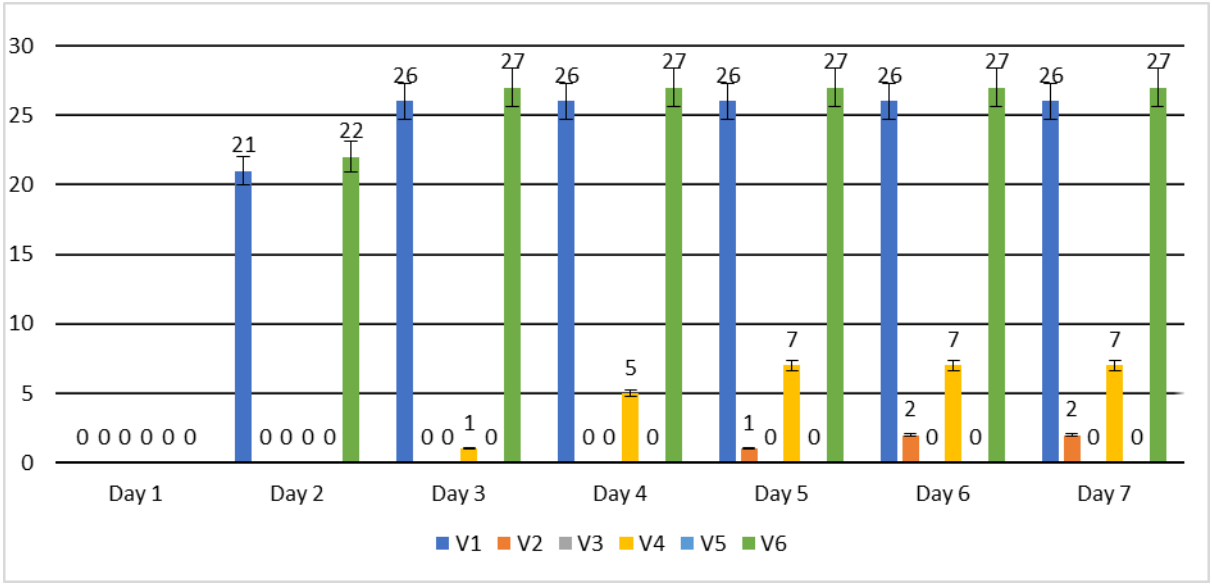

Figure 2. Dynamics of Cucumis sativus L. seeds germination

The cucumber seeds germination process was clearly affected by the treatment with NaCl solution. Thus, in the case of the experimental variant number 2 (V_2), a germination of seeds was observed starting with the 5th day of observation, until the end of the experiment (after the 7 days of observation) germinating only two seeds out of a total of 27.

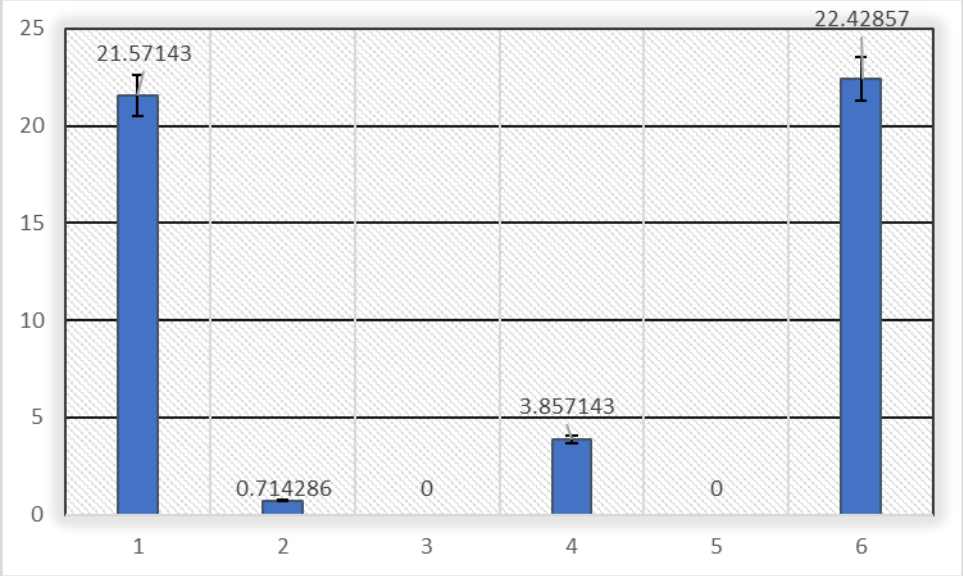

Figure 3. Average value of germinated seeds

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In the case of experimental variant number 4 (V_4) there was a slight increase in the seeds germination rate, the germination starting from the third day, until the end of the experiment registering a number of 7 germinated seeds out of a total of 27.
The solutions in variants 3 and 5 (V_3 and V_5) had a strong inhibitory effect on seed germination. Figure 3 shows the average value of germinated seeds in all six experimental variants.
When the maximum number of germinated seeds was reached, the roots and stems of the seedlings were measured (figure 4).
There is no considerable decrease between the first and last variant (V_1 and V_7), there is a slight difference between the length of the roots and stems under the influence of sea buckthorn extract.

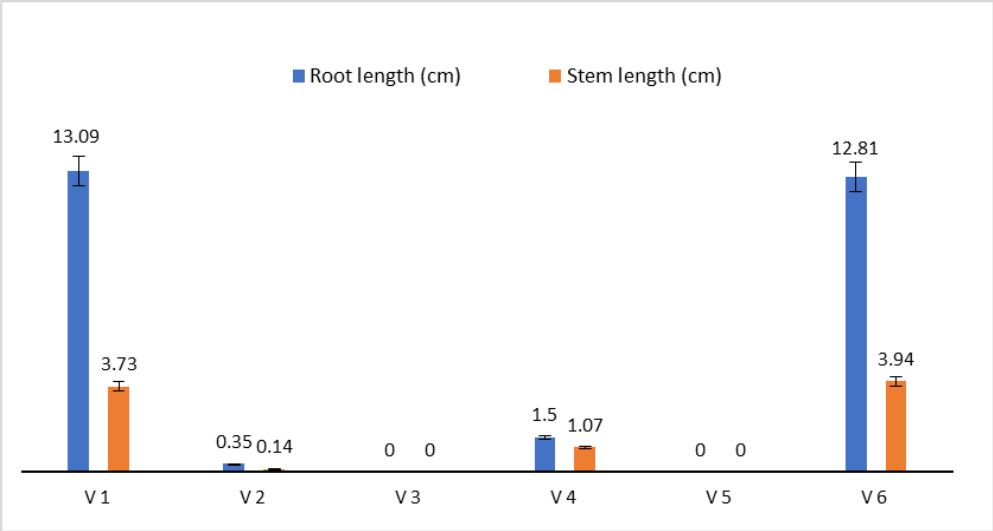

Figure 4. Average length of roots and stems

4. CONCLUSIONS

Our results indicated that the germination of cucumber seeds had a more pronounced decrease at concentrations of 0.12 and 0.25 mM NaCl solution supplemented with sea buckthorn extract.
Salt stress reduced shoot growth and root growth (root length and root number).
However, we demonstrated that the saline solution depending on the concentration had progressive results because it allowed the germination of a limited number of seeds while the sea buckthorn extract did not have an inhibitory effect.

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