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The Effect Of Calcium On The Growth And Flowering Of The Rose Moss Portulaca Grandiflora L. Using Hydroponic System

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Abstract:

An experiment was conducted at Agriculture faculty - Kufa university during the 2020 to study the effect of different concentrations of calcium in nutritious solution in the vegetative and flowery growth characters in the rose moss plant Portuaca grandiflora L., by use hydroponics system, include five calcium concentrations (0, 61, 122, 185, 246 mg L^{-1} Ca). Results showed calcium concentrations 185 & 246 mg L^{-1} Ca led increase significant length of plant, number of leaves, weight of root dry, number of flowers and calcium percentage in leaves reaching (29, 29.5 cm ; 68.75 , 71.25 leaf .$plant^{-1}$; 3.68 , 3.54 gm ; 9.75 , 9 flower .$plant^{-1}$; 2.31 , 2.37%) respectively to two concentrations. The concentration 122 mg L^{-1} Ca increase significant in number of branches (10.5 branch. $Plant^{-1}$), Also increase concentration 185 mg L^{-1} Ca in dry material percentage weight and the total chlorophyll (12.25% , 25.5 mg. 100 g^{-1} fresh weight).

Keywords: calcium, growth, rose moss, Portulaca grandiflora L, hydroponic system

Introduction:

The rose moss plant Portulaca grandiflora L. is an important ornamental plant locally and internationally, which belongs to the family of Portulaceae, It is a small, but fast-growing annual plant, It is a soil covering plant and considered a succulent plant growing to 30 cm tall, though usually less. The leaves are fleshy and thick. The flowers are 2.5 - 3 cm diameter with five petals, its are bright in color and available in several colors, including white, purple, red, orange and others. They bloom only under bright sunlight, so we find them closed in the early morning and before sunset (Cruz et al., 2020).

Hydroponics system has many advantages, including the possibility of intensive cultivation of plants, because water and nutrients are available, as well as a great reduction in agricultural operations such as plowing and fighting bushes, and water availability is 80% of the water used in traditional agriculture. Hydroponics can be used for commercial production of crops and in places where they are not available, as is the case on ships in the seas and areas covered with ice, as hydroponics is an effective alternative (Al-Bayati et al., 2019; De Anda & Shear, 2017), hydroponics is an effective way to know the needs of the plant is a nutrient and one of the good scientific methods in plant nutrition research in order to fully control the concentrations of nutrients that include all the elements that are the subject of the study (Alwan, 2019; Baxter et al., 2012), the first hydroponic farm in Iraq was implemented by the British government in 1946 during World War II to supply vegetables to the British Army instead of bringing them by plane from Palestine (Bhattacharya, 2017).

Calcium element is of great importance in plant growth, as it is about 0.25-0.5% of the dry weight of a plant, and it is included in the composition of the middle lamella that works to hold the neighboring cells in the form of calcium pectates and is necessary for the process of meristematic cell division and elongation, in addition, it is important in maintaining the waste of cell membranes. Calcium is absorbed in an ionic form, Ca^{++}, and has little transition from ancient to modern plant tissues (Albino-Garduño et al., 2007). This study aimed to find out the effect of calcium in plant nutrition and its effect on the vegetative and flowering growth of the plant.

Materials & Methods

The study was conducted at the University of Kufa - Faculty of Agriculture 2020 to study the effect of different concentrations of calcium on the vegetative and flowering growth characteristics of the rose moss plants Portulaca grandiflora L., by hydroponic system using Cooper's nutrient solution at full strength consisted of (N 236, P 60, K 300, Ca 185, Mg 50, S 68, FE (EDTA) 12, Mn 2, Zn 0.1, Cu 0.1, B 0.3, Mo 0.2 mg L^{-1}). (Shah et al., 2011) 10 containers (2 liters capacity) of transparent plastic were prepared and covered with black polyethylene bags to prevent light from entering the roots and puncturing the lid of the box five holes, one of them to enter the tube that supplies the agricultural solution with air, or the other fourth to install the pens of the rose moss, which were prepared at a height of 10 cm and the pens were transferred on 1/4/2020 to the boxes after completing the preparation of the solutions, which included study the effect of different concentrations of calcium including (0, 61, 122, 185, 246 mg L^{-1} Ca).

The study was carried out in a randomized complete block design with four different concentrations s of calcium in addition to the control, that is, with five treatments and eight replicates. The averages were compared according to Duncan's multiple range test at a 5% probability level (Sanders, 2002).

Results & Discussion

Table (1) shows the effect of calcium concentrations in the nutrient solution on the growth and flowering of plant, the results indicate a significant effect in increasing calcium concentration on plant length. The plants treated with the two concentrations, 185, 246 mg L^{-1} Ca, excelled in plant length (29, 29.5 cm), respectively, compared to the lowest concentrations of 0 mg L^{-1} Ca, which gave the lowest plant length (20.5 cm), this may be due to the fact that calcium enters the composition of the middle plate in the cell wall that works to cohesion adjacent cells that increase the strength of the stem and improve its growth (Wang et al., 2014).

The results indicate that there is a significant effect of calcium concentrations on the number of branches of the rose moss plant, as the plants treated with a concentration of 122 mg L^{-1} led to the most number of branches 10.5 branches. $Plant^{-1}$, the reason for this may be that low concentrations of calcium lead to less cell division and weak elongation, either very high of calcium concentration lead to inhibition of nitrate reductase enzyme activity in plant roots thus reducing nitrate absorption, which leads to a lack of vegetative growth and thus Low number of branches of a plant (Coronel et al., 2008).

The results also show that the average number of leaves had a significant effect on the concentration of calcium in the nutrient solution. The plants treated with the two concentrations 185, 246 mg L^{-1} gave the most average number of leaves amounted to (68.75, 71.25 leaves. $plant^{-1}$) respectively, compared to plants treated at the concentration 0 mg L^{-1} which gave the lowest average number of leaves (38 leaves. $Plant^{-1}$) and this may be due to the basis of the role of calcium in the processes of cell division, cellular expansion and elongation and in the composition of the intermediate plates of the cell walls and its relationship to the water balance in cells and the increase in the growth of bud meristem and thus increase the number of leaves (Lautner & Fromm, 2010).

Table (1) shows that there is a significant effect in the calcium concentration in the nutritional solution on the percentage of dry matter in the plant, as the plants treated at the concentration 185 mg L^{-1} gave the highest percentage of dry matter amounted to (12.25%) compared to the lowest percentage of dry matter for plants treated at the concentration 0 mg L^{-1} It reached (5.2%), the results shown in the same table, it is noted that the effect of increasing calcium concentrations on the dry matter ratio is in line to some extent. This may be due to the important role of calcium in activating the photosynthesis process through its effect on the interaction of light and thus increasing the efficiency of synthesis carbohydrates and its reflection on the accumulation of dry matter in the plant (Ottow et al., 2005).

Also Table (1) indicates the significant effect of the dry weight of the root when increasing the calcium concentration in the nutrient solution. The plants treated with the two concentrations, 185, 246 mg L^{-1} excelled in the dry weight of the root (3.68 and 3.54 g), respectively, The increase in the dry weight of the root may be attributed to the increase in the calcium concentration to the abundance of calcium in the vicinity of the roots, which allowed the roots to take sufficient calcium for the processes of cellular division, which is reflected in the growth and vitality of the roots and thus increase its weight (Johnson et al., 2019).

The results shows that the number of flowers exceeded when the calcium concentration was increased in the nutritional solution, as the plants treated at the concentrations 185, 246 mg L^{-1} gave the highest number of flowers (9.75, 3 $flower^{-1}$) and this is similar to what was found by Wolt & Admse 1979 The increase in calcium concentrations led to an increase in the number of flowering.

Table (1) shows that there is a significant effect of calcium concentration on the total chlorophyll content of leaves, as the plants at the concentration 185 mg L^{-1} gave the highest average leaf content of total chlorophyll amounted to (25.5 mg. 100 g^{-1} fresh weight) and this may be due to the reason To the role of calcium in the formation of chlorophyll in activating and preventing the inhibition of some enzyme systems in the plant by preventing the accumulation of oxalate in the dissolved forms of leaves (Morris et al., 2007), and that high concentrations of calcium lead to competition between ammonia and calcium ions for absorption sites on Competitive absorption, which reduces the absorption of nitrogen, which enters the composition of the chlorophyll molecule (Chow et al., 2002).

It is noted from the table (1) that the increase in calcium concentrations in the nutrient solution led to a significant increase in the percentage of calcium in the leaves, as the leaves of plants treated with the concentrations 185, 246 mg L^{-1} gave the highest percentage of calcium (2.31, 2.37%) compared to the leaves of plants treated at the 0 mg L^{-1} concentration, which amounted to (0.84%), which is less than the critical concentration of calcium in the leaves, which is 1%, which negatively affected the growth and flowering of the rose moss plant, the reason for the increase in the percentage of calcium in the leaves may be due to the increase in calcium concentration in the nutritional solution.

It is concluded from the experiment that plants treated with 185 mg L^{-1} concentration gave the best rate for most of the studied vegetative and flowering.

Table (1) shows the effect of calcium concentrations in the nutrient solution on the growth and flowering of the rose moss, Portulaca grandiflora L. using hydroponic technology.

Calsium concentrations	plant length	N of branches (Branch. $Plant^{-1}$)	Number of leaves (Leaf. $Plant^{-1}$)	Dry matter percentage (%)	Root weight dry weight (gm)	Number of flowers (flower $.plant^{-1}$)	Chlorophyll (mg.100 gm^{-1})	Calcium (%)
0 mg L^{-1} Ca	**20.5 c**	**4.25 c**	**38 d**	**5.2 c**	**1.92 c**	**2.25 c**	**10.37 e**	**0.84 d**
61 mg L^{-1} Ca	**24.75 b**	**7 b**	**54.25 c**	**6.5 bc**	**2.16 c**	**3.08 bc**	**15.25 d**	**1.85 c**
122 mg L^{-1} Ca	**25.75 b**	**10.5 a**	**61.13 b**	**7.5 b**	**2.60 b**	**5.25 b**	**18.75 c**	**2.14 b**
185 mg L^{-1} Ca	**29 a**	**8.5 b**	**68.75 a**	**12.25 a**	**3.68 a**	**9.75 a**	**25.5 a**	**2.31 a**
246 mg L^{-1} Ca	**29.5 a**	**8.25 b**	**71.25 a**	**8.5 b**	**3.54 a**	**9 a**	**22.25 b**	**2.37 a**

Averages with the same alphabet are not significantly different according to the Duncan Polynomial test at a probability level of 0.05.

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