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Effects of Sea Salt on Plant Growth and Moisture: A Case Study on Sweet Basil (*Ocimum basilicum L.*)

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천일염이 식물 성장 및 수분도에 미치는 영향: 스위트 바질(*Ocimum basilicum*)에 대한 사례 연구

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Abstract The purpose of this study was to investigate the effect of sea salt on the growth and moisture content of sweet basil, soil moisture content, and salt stress. As a research method, sweet basil was treated with sea salt at 0, 5, 50, 100, and 200 mM concentration of sea salt was investigated to determine the growth and stress time of sweet basil. As a result of the study, it was confirmed that the leaf width increased by 11% when treated with 5 mM, 49% when treated with 50 mM, and 44% when treated with 100 mM. Leaf length was confirmed to grow by 16% at 5 mM, 59% at 50 mM, and 82% at 100 mM treatment. As a future study, based on the effect of sea salt on the leaf and length growth of sweet basil by concentration, it was considered that more research is needed on the beneficial effects of sea salt on edible, medicinal, and aromatic plants. In addition, although salt has only been studied on stress in crops, we intend to contribute to providing basic data for research on ingredients more beneficial to the environment by finding various edible, medicinal, and aromatic plants using the sun-dried salt used in this study.

Key Words : Sweet basil, Sea salt, Growth, Moisture, Salinity

요 약 염도와 관개용수는 작물에 있어서 물의 증발과 토양에 축적됨으로서 다양한 영향을 준다. 이러한 환경에 작물들은 영향을 받기에 본 연구에서는 천일염이 스위트 바질의 생장과 수분도, 토양의 수분도 및 염 스트레스에 미치는 영향을 알아보고자 한다. 연구 방법으로 스위트 바질에 천일염을 0, 5, 50, 100, 및 200 mM 농도별로 처리하여 천일염의 농도가 스위트 바질의 성장과 염 스트레스 시간을 알아보았다. 본 연구 결과로 잎의 면적의 경우, 5 mM 처리에서 11%, 50 mM 처리에서 49%, 및 100 mM 처리에서 44% 증가한 것을 확인하였다. 잎의 길이는 5 mM 처리에서 16%, 50 mM 처리에서 59%, 및 100 mM 처리에서 82% 성장한 것으로 확인하였다. 향후 연구로 천일염이 스위트 바질의 잎과 길이 성장에 농도별 영향을 미치는 내용을 기초로 식용, 약용, 그리고 방향성 식물의 천일염 영향에 대해 더 연구가 필요하리라 사료된다. 염은 작물에 있어서 스트레스에 관한 연구만 있었지만, 본 연구에서 사용한 천일염을 활용하여 다양한 식용, 약용, 방향성 식물을 찾아 환경에 더 유익한 성분을 연구하는데 기초자료로 제공하는데 이바지 하고자 한다.

키워드 : 스위트 바질, 천일염, 성장, 수분, 염도

1. Introduction

Sea salt is salt made by drawing seawater into a salt farm and evaporating moisture with wind and sunlight. This refers to salt produced by using the natural conditions of sunlight and sea breeze by purifying seawater from the west coast in a salt field 50km away from the land [1]. The taste and composition of salt differ depending on the soil of mudflat, and it is a salt rich in minerals with a low sodium chloride content [2]. Unlike salt, the function of sea salt is to promote metabolism aid digestion, and de-

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toxify and sterilize. It acts as antipyretic and geothermal to generate cells [1]. According to the agricultural manual of seawater for the production of eco-friendly agricultural products. Promoting crop growth and controlling pests and weeds when seawater or sea salt is used depending on the type of crop [3].

Perhaps one of the biggest challenges facing today is how to feed the world's growing population while minimizing its impact on the environment. The climate crisis is the biggest food challenge of our century, exploring ways to increase global food production in a sustainable way and reduce the mass use of chemicals commonly found in conventional agriculture [4].

Today, we are in an era where food is abundant due to the development of technology and the improvement of living standards. However, in the second year of the COVID-19 pandemic, we have found some problems in abundance. It is the food problem caused by the environment and climate crisis. According to the Climate Crisis Food Report provided by Greenpeace [5], the production of most vegetables, fruits and nuts that we eat is greatly reduced, causing a global food shortage, such as honey, apple, coffee, potato, rice, chili pepper, clam, and beans, etc.

Basil is a kind of mint, and sweet basil is the most popular ingredient. Looking at the appearance, it has quare, branching stems, opposite leaves, brown or black seeds, and flower spikes. The proper growing temperature for basil is 7 to 27 °C, and it is vulnerable to cold temperatures, and it grows in the sun all day long. Also, basil does not withstand drought because its texture is very soft [6].

The characteristic of Shinan Sea Salt is that the content of sodium chloride is low, but the content of water and sulfuric acid ions is high. In addition, the content of calcium, potassium, magnesium and other minerals is much higher than that of Guerande salt in France. In addition, the NaCl content (%) of Shinan Sea Salt is 80-85, and alkaline. On the other hand, sea salt from China, Australia and Mexico has a NaCl content (%) of 85-95 and acidity [7].

Based on several previous studies, the cultivation period was decided from April to July among the Korean weather to protect against cold and frost, get good sunlight, and avoid drought. In addition, we tried to verify the salinity effect with Sinan Sea Salt. This is because Shinan Sea Salt has a low sodium chloride content, high water content, and alkaline properties.

We are all constantly exposed to the dangers of ecological disturbance, and the dangers have penetrated into our daily life. We are already experiencing the seriousness of climate change. The increase in the number of summer heat days also affects the production of food. In 2021, the global food production showed a decreasing trend due to the prolonged COVID-19 due to adverse climate change factors such as natural destruction caused by wildfires and insufficient agricultural water due to heat waves.

Therefore, we intend to try a study to reduce the degree of pollution in the environment and reduce the calorific value of water.

This study aims to establish a foundation for education to develop plants that can be grown in daily life, grow them without chemical fertilizers, and prevent environmental pollution. In addition, it is intended to provide basic data for solving economic problems by cultivating fruits and vegetables that are not significantly affected by climate change and abnormal climates in an easy way.

2. Materials & Methods

2.1 Materials & Methods

The sweet basil used in this experiment was purchased from a flower garden in April 2022 and grown for 3 months. The soil used for cultivation was vermiculite and general top soil for horticulture. To facilitate irrigation treatment, 4 pieces of basil were distributed in a plastic pot (diameter 10 cm× height 15 cm), and the state of drainage was checked and the experiment was carried out. In or-

der to grow sweet basil, which loves sunlight and water, it was grown on a veranda with good sunlight. As the water mixed with the culture solution, general tap water was used. A culture solution (100 ml) containing sea salt concentrations of 0, 5, 50, 100, and 200 mM was treated.

To compare plant growth, plant height, leaf length, leaf width, and flowering were investigated. The number of harvested plants was tested three times with 3-5 plants depending on the growth situation.

2.2 Statistics

All experiments were repeated 3 times for each treatment, and the arrangement of experimental groups was performed by Randomized Block Design. For statistical analysis, significance was verified for each treatment using IBM SPSS Statistics Ver. 20 (IBM, Inc., USA).

3. Results & Discussion

The leaf width and length of sweet basil were measured after treatment with a sea salt culture solution divided into 0, 5, 50, 100, and 200 mM for 7 weeks. Through this, it was possible to confirm the concentration of the most suitable culture medium for the growth state of sweet basil.

Looking at the leaf width by sea salt concentration, it was found that as a result of measurement 30 days after cultivation, the growth rate was 11% at 5 mM, 49% at 50 mM, and 44% at 100 mM when compared to the untreated group as shown in Fig. 1.

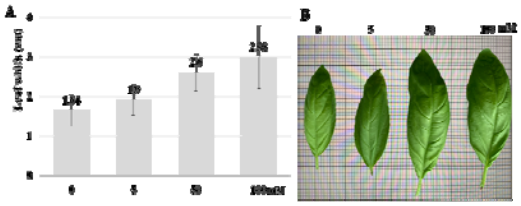

Fig. 1. Effects on leaf width growth by concentration (mM) of sea salt

Looking at leaf length by sea salt concentration, compared to the group without sea salt treatment, 5 mM showed 16% growth, 50 mM increased 59%, and 100 mM showed 82% more growth as shown in Fig. 2.

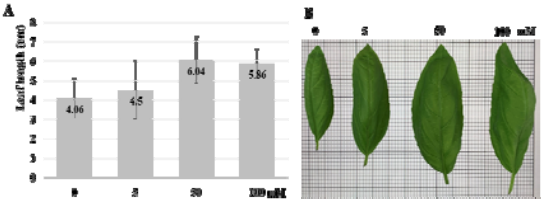

Fig. 2. Effects on leaf length growth by concentration (mM) of sea salt

Salinity and moisture stress treatment by concentration determined dry root and leaf weight, yield, and root/stem ratio in sweet basil. In particular, both salt and water treatment had significant effects on plant growth and development [8].

After treatment for each concentration of sea salt, the length was measured after 30 days and 40 days of growth. In the group treated with sea salt concentration of 50 and 100 mM, length growth was not seen compared to the group not treated. However, the 5 mM treatment group was found to grow more length than the untreated group. According to the results of this study, it was found that the concentration of 5 mM of sea salt had an effect on the length growth as shown in Fig. 3.

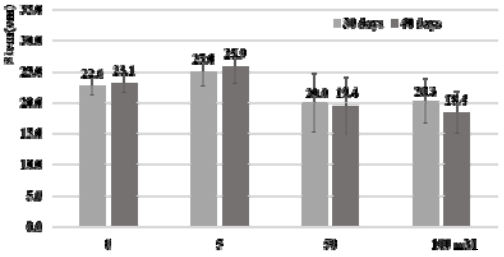

Fig. 3. Effects on stem growth by concentration (mM) of sea salt

Flowering was measured 40 days after treatment by concentration of sea salt. In the group treated

with sea salt concentration of 50 and 100 mM, compared to the group not treated, length growth was not seen, but it was confirmed that the flowering period was faster as shown in Fig. 4.

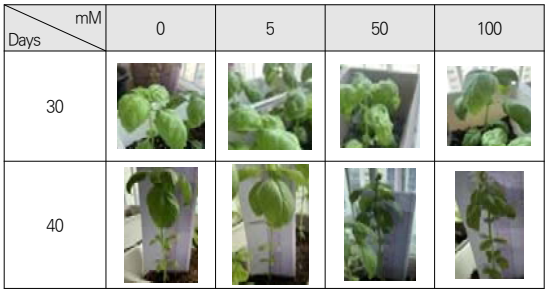

Fig. 4. Effects on flowering growth by concentration (mM) of sea salt

The growth process is shown after 1, 5, 10, and 20 days after treatment by concentration of sea salt. It was watered at 100ml/pot about once every 3 days, but in the pot using sea salt, the moisture level of the soil remained after 10 days, so water was supplied once a week. In the case of 50 and 100 mM, it was confirmed that the color of the soil was dark brown as shown in Figure 5. However, in the group treated with sea salt concentration of 200 mM, salt stress occurred after 5 days and almost died after 10 days. So, the result of 200mM is not seen in the results after 10 days as shown in Fig. 5.

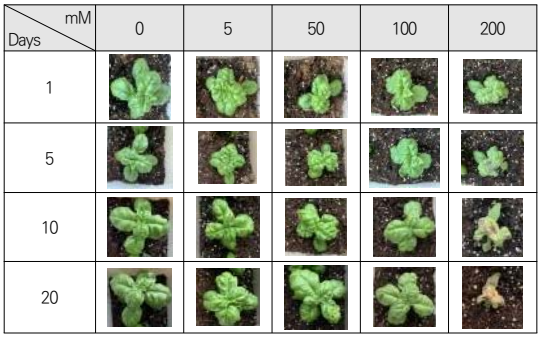

Fig. 5. Effect on daily sweet basil growth by concentration (mM) of sea salt

The effect of salinity stress on the physiological response and post-harvest quality characteristics of sweet basil (*Ocimum basilicum L.*) was investigated. Yield and stem length were significantly decreased under salinity stress in only two Iranian cultivars. Salinity significantly reduced leaf thickness and parenchymal cell area in both green Iranian and Genoese basil [9].

Sea salt showed different results according to concentration. As a result of this study, 5, 50, and 100 mM were found as appropriate concentrations for leaf length and area, 5 mM as appropriate for stem growth, and 50 and 100 mM as appropriate concentrations for flowering. Also, 200 mM sea salt is an inappropriate concentration for growing sweet basil.

As a result of checking the oil content and composition, essential oil and maintenance rate, and essential oil yield by varying the salinity of various basil varieties, the higher the soil salinity, the lower the yield of the main essential oil [10].

A salinity eventually increases the salt concentration in the soil and affects the yield of various components of the oil as well as the growth of plants.

Chamomile (*Matricaria recutita L.*) is used as an annual herb and is highly adaptable to climate and soil, and is closely related to fresh water. It also showed that the yield decreased as salinity increased [11]. The yield of lemon balm (*M. officinalis*) varied according to the salinity level, and it is said to have excellent resistance to water stres. Essential oils decreased with each increase in salinity stress, whereas the proportion increased with each increase in moisture deprivation [12].

The use of edible, medicinal and aromatic plants continues to increase, becoming an economically important factor in demand. Basil is one of the most important plants in this matter. Oils are used extensively in many countries for flavoring and toiletries products in food, confectionery products and seasonings. Currently, there are references related to salt, but there are few papers related to sea salt.

4. Conclusions

This study was attempted to find edible, medicinal and aromatic plants that can be easily grown in daily life. This study showed the results of improving the growth and moisture content of sweet basil by using sea salt in the growth environment of sweet basil used as a food ingredient. In addition, sweet basil likes moisture, so it requires a lot of water, but using sea salt showed that water usage could be reduced. In the future, we will find more diverse species of edible, medicinal and aromatic plants to find more beneficial ingredients for the environment.

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