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EFFECT OF LIME ON SHOOT LENGTH AND ROOT LENGTH OF RAPHANUS SATIVUS VARIETY PUSA CHETKI

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ABSTRACT

Calcium (Ca) is a secondary essential element among the mineral elements, and it plays a crucial role in plant nutrition. Plants have the ability to absorb calcium, and it is necessary for their growth and development. In particular, calcium exists in the form of calcium pectate, which is an essential component of the middle lamella of the cell wall. This middle lamella is responsible for holding adjacent plant cells together, providing structural support and stability. Furthermore, soils rich in lime tend to exhibit a neutral or alkaline reaction. The high calcium content contributes to the soil's pH, making it less acidic. This can have implications for the types of plants that can grow in the soil, as different plant species have varying pH preferences. Additionally, the alkaline conditions created by lime can affect nutrient availability in the soil, influencing the availability of certain essential elements for plants. Regarding a statistical analysis conducted on the effects of lime-dressing, the results showed that there were no significant differences observed between the control group (without lime treatment) and the treatment groups (with lime application). This suggests that in the specific context of the study, the addition of lime did not have a substantial impact on shoot and root length of the plants under investigation.

Keywords: *Shoot Length, Root Length, Lime, Calcium Oxide, Magnesium Carbonate.*

Introduction

Lime, as applied in agriculture, refers to the addition of any calcium or magnesium-containing compound to the soil with the ability to reduce acidity. While lime technically refers to calcium oxide (CaO), it is commonly used to encompass other materials such as calcium hydroxide, calcium carbonate, calcium-magnesium carbonate, and calcium silicate slags.

The addition of calcium to the soil, often in the form of lime, plays a significant role in the absorption of other minerals by plants. It acts to neutralize acidity that could hinder the proper uptake of minerals. Furthermore, calcium has an anti-toxic effect on various harmful substances present in the soil, thus protecting plants from their detrimental effects.

In the process of absorption, calcium influences the entry of other minerals into plant roots. By forming calcium soaps and proteinates, it contributes to maintaining the semi-permeability of plant cell membranes. When calcium is absent, not only does the plant struggle to acquire essential minerals, but it also allows many of these substances to escape from the root hairs.

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Another notable effect of calcium in the soil is its impact on the coagulation and aggregation of soil particles. Lime, which contains calcium compounds, can influence the soil's chloride content, resulting in the development of a coarse, crumbly soil structure. This type of soil structure is advantageous as it enhances water conduction, facilitating the movement of water throughout the soil. Additionally, the presence of lime in the soil positively affects temperature regulation and aeration. Lime creates a favorable environment for soil microorganisms and plant roots to thrive.

However, it is important to note that the specific effects of lime-dressing on plant growth may vary and require further investigation. Although lime has the potential to influence soil properties and plant development, the results of a statistical analysis conducted in a particular study did not demonstrate significant differences in shoot and root length between the control group (without lime treatment) and the treatment groups (with lime application). Therefore, additional research is necessary to explore the factors that may contribute to the varying responses of plants to lime-dressing, as well as to evaluate its potential effects on other aspects of plant growth and overall plant health.

Objectives

- Investigate the role of calcium as a secondary essential element in plant nutrition.
- Explore the absorption process of calcium by plants and its incorporation into the cell wall as calcium pectate.
- Examine the influence of lime, containing calcium compounds, on soil properties such as coagulation, aggregation, and soil structure.
- Assess the impact of lime on water conduction in the soil and its effect on the movement of water through the soil.
- Investigate the relationship between lime presence in soil and its contribution to temperature regulation and aeration.
- Conduct further research to determine the specific effects of lime-dressing on plant growth, considering shoot and root length as parameters.
- Explore other potential effects of lime application on plant development and overall plant health.

Material and Methods

To study the effect of lime-dressing on root-shoot length, pot culture experiments were performed with the seeds of Raphanus sativus variety Pusa chetki, a specific cultivar of radish. The experiments were conducted under natural environmental conditions to mimic real-world growth conditions.

The experimental setup involved using pots of a specific size, measuring 15 × 15 inches, which were filled with 10 kg of air-dried garden soil. Each pot was equipped with a drainage hole to ensure proper water flow. A total of 20 seeds of Raphanus sativus variety Pusa chetki were sown in each pot, placed at a depth of 5 cm, and were evenly spaced. To ensure the reliability of the results, each treatment was replicated three times.

Throughout the experiment, standard cultural practices were followed as necessary to maintain optimal growing conditions for the plants. Care was taken to arrange the pots at appropriate distances to minimize any potential contamination and to provide uniform light exposure for all the plants. After 10 days of sowing the seeds, the pots were examined to record the rate of seed germination. Following 15 days of growth, the survival rate of the seedlings was noted. In each pot, four healthy plants were retained to ensure consistency and eliminate any outliers.

The critical parameter of interest, root-shoot length, was recorded 45 days after sowing the seeds. To introduce lime into the soil, calcium oxide (lime) was used and added at various concentrations: 0.1% (10 g), 0.3% (30 g), 0.5% (50 g), and 1% (100 g) on a weight basis. Daily watering was carried out to maintain adequate soil moisture throughout the experiment. The experiment included three replicates for each lime concentration, and a control group without lime treatment was also included.

By implementing this experimental design, the objective was to evaluate the influence of different concentrations of lime on the root-shoot length of Raphanus sativus variety Pusa chetki. This approach allowed for the observation of how the application of lime affected the growth and development of the radish plants under natural conditions.

Results & Discussions

After a growth period of 45 days, the data regarding root-shoot length were recorded. The data were statistically analysed as per the method of Bishop (1966) and Peterson (1939). The data regarding the effect of lime concentration on root-shoot length are recorded in table 1.

Table 1: Shows the effect of lime Dressing on Root-Shoot Length (cm) of Raphanus Sativus variety Pusa Chetki

Sr. No.	Lime Dressing	Root Length	Shoot Length
1	Control	18.9	21
2	0.1 %	18.9	20.9
3	0.3 %	18.8	20.8
4	0.5 %	18.7	20.8
5	1 %`	18.6	20.6

Values represent the mean of three replicates.
F ratios- control vs treatment
(i) Root Length = 0.8863
(ii) Shoot Length = 1.5

The statistical analysis for the effect of lime dressing on shoot and root length, showed that the differences between control and treatment were not significant. However, a gradual decrease was observed both in shoot and root length with an increase in the concentrations of lime. In the control condition the shoot length was 21 cm and root length was 18.9 cm /plant, which at 0.1 % level of lime decreased slightly to 20.9 cm and 18.8 cm, respectively. Similarly at 0.3 %, 0.5 % and 1 % concentration of lime, there was a slight decrease in shoot and root length of Raphanus sativus variety Pusa chetki.

Mineral elements such as calcium, magnesium, sulphur are the secondary essential elements for plants and have moisture retention capacity and maintain optimum soil air moisture relationships for optimum growth of crops, Albrecht and Davis (1929), Iljin (1925), Hewitt (1983), Kuiper et al. (1974), Sinha (1998). Radish plants prefer slightly acidic to neutral soil (pH = 6.5 - 7.0) and lime increases the alkalinity of soil.

In the present investigation the vegetative growth of radish plants decreased at 1 % level of calcium. This decrease may be due to the increase in alkalinity of soil, due to high Ca level (Dahiya and Singh (1980)).

It can be concluded that 0.1 %, 0.3 %, 0.5 % and 1 % concentrations of lime can be tolerated.

Conclusion

In summary, calcium serves as a secondary essential element in plant nutrition, playing a crucial role in various aspects of plant growth and development. It is absorbed by plants and then incorporated into the cell wall in the form of calcium pectate. This incorporation is vital as calcium pectate acts as a key component of the middle lamella, which is responsible for the adhesion and structural integrity of adjacent plant cells.

Lime, which is rich in calcium compounds, possesses the ability to significantly impact several important soil properties. One such effect is its influence on the coagulation and aggregation of soil particles. Lime can promote the formation of a desirable soil structure characterized by a coarse, crumb-like texture. This advantageous soil structure enhances water conduction, facilitating the movement of water through the soil profile. As a result, plant roots can access water more efficiently, contributing to their overall hydration and nutrient uptake.

Furthermore, the presence of lime in the soil has additional benefits for plant growth. Lime helps regulate soil temperature by creating an environment that promotes optimal heat distribution. It also enhances soil aeration, allowing for the exchange of gases between the soil and the atmosphere. Adequate soil aeration is crucial for the respiration of soil microorganisms and plant roots, ensuring their healthy functioning.

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