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TO FIND OUT THE EFFECT OF SOME CONCENTRATIONS (MG/KG SOIL) OF NICKEL ON SHOOT LENGTH AND ROOT LENGTH OF RAPHANUS SATIVUS VAR. PUSA CHETKI IN POT CULTURE EXPERIMENTS

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Abstract

This study aimed to investigate the effects of nickel on the shoot length and root length of Raphanus sativus var. Pusa chetki through a comprehensive series of pot culture experiments. The experiments were designed to simulate real-world conditions and provide insights into how this heavy metal influences the growth and development of the plant species. To ensure accuracy and consistency, standard-sized pots were utilized, each containing 10 kg of air-dried garden soil with proper drainage. The seeds of Raphanus sativus var. Pusa chetki were sown at equal distances in each pot, and the treatments were replicated three times. The plants were allowed to grow naturally under controlled light and environmental conditions for 45 days, after which shoot length and root length were meticulously recorded. The focus of the study was on nickel, known for its potential impact on plant growth. Nickel sulphate was introduced into the soil at concentrations of 100, 500, 700, and 1000 mg/kg, with thorough mixing to ensure uniform distribution. Additionally, a control group without any heavy metal treatment was maintained for comparison. The results showed that increasing nickel concentrations led to a gradual reduction in both shoot length and root length of Raphanus sativus cv Pusa chetki. Previous research on other heavy metals revealed similar negative effects on essential nutrient uptake and enzyme activity in plants.

Keywords: *Nickel, Shoot length, Root Length, Raphanus sativus, Variety Pusa chetki, Pot culture experiments.*

Introduction

Radish is an economically important crop and an indicator species for studying heavy metal toxicity in terrestrial plants. Consequently, a comprehensive study was undertaken to explore how varying concentrations of nickel affect the growth and development of Raphanus sativus var. Pusa chetki under simulated real-world conditions.

To achieve accurate and reliable results, a series of pot culture experiments were meticulously conducted, ensuring a controlled environment that emulated natural conditions. The experiments involved standard-sized pots filled with carefully measured quantities of air-dried garden soil. The pots were uniformly arranged with proper drainage to prevent any potential interference in the growth process. Moreover, to minimize bias, the seeds of Raphanus sativus var. Pusa chetki were sown at equal distances from each other and replicated three times in each treatment.

During the experiment, meticulous care was taken to maintain consistent light exposure and prevent any potential contamination that might skew the results. After a growth period of 15 days, seedling survival rates were recorded, and healthy plants were selected and retained in each pot to grow naturally for an additional 45 days. At the end of the growth period, shoot length and root length were measured with precision to evaluate the impact of nickel on these essential aspects of plant development.

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Nickel, as the primary focus of this study, was introduced into the soil in the form of its respective salt, nickel sulphate, at varying concentrations of 100, 500, 700, and 1000 mg/kg. Thorough mixing ensured an even distribution of the chemical in the garden soil. A control group without any heavy metal treatment was maintained to provide a baseline for comparison and enable the assessment of nickel's specific effects.

This research aims to contribute valuable insights into the influence of nickel on shoot length and root length in Raphanus sativus var. Pusa chetki, shedding light on the potential ecological implications of heavy metal toxicity on plant growth and development. The findings may have broader implications for understanding the impact of heavy metals on other plant species and provide valuable information for sustainable environmental management and crop cultivation practices.

Objectives

- Investigate the effects of nickel on shoot length and root length in Raphanus sativus var. Pusa chetki.
- Conduct pot culture experiments to simulate real-world environmental conditions.
- Evaluate the influence of varying concentrations of nickel (100, 500, 700, and 1000 mg/kg) on plant growth.
- Replicate each treatment three times to ensure reliability of the results.
- Compare the growth of Raphanus sativus var. Pusa chetki under nickel exposure to a control group without heavy metal treatment.
- Assess the potential ecological implications of nickel toxicity on plant development.
- Contribute to the understanding of heavy metal effects on plant species under natural environmental conditions.

Material and Methods

In order to investigate the influence of nickel on both shoot length and root length of Raphanus sativus var. Pusa chetki, a comprehensive series of pot culture experiments were meticulously conducted. The aim was to understand how this heavy metal affected the growth and development of the plant species under real-world conditions, simulating the natural environment.

To ensure consistency and accuracy in the experiments, standard-sized pots measuring 15 × 15 inches were utilized. Each pot was uniformly filled with 10 kg of air-dried garden soil, and a control drainage hole was incorporated to facilitate proper drainage. To maintain uniformity and minimize any potential bias, 20 seeds of Raphanus sativus var. Pusa chetki were sown in each pot at a depth of 5 cm and equidistantly placed from one another. Moreover, to enhance the credibility of the findings, each treatment was replicated three times. Throughout the experiment, standard cultural practices were diligently adhered to, ensuring optimal growth conditions for the plants.

In order to eliminate the possibility of contamination and to maintain consistent light exposure, the experimental pots were arranged at appropriate distances from each other. After 15 days of growth, seedling survival rates were carefully recorded. Subsequently, four healthy plants were selected and retained in each pot, allowing them to grow naturally under the prevailing environmental conditions. At the end of a 45-day growth period, the measurements of shoot length and root length were meticulously recorded to evaluate the impact of nickel on these crucial aspects of plant development.

The study particularly focused on nickel, a heavy metal known for its potential to influence plant growth. Nickel was introduced into the soil in the form of its respective salt, nickel sulphate, at four different concentrations: 100, 500, 700, and 1000 mg/kg of soil. Thorough mixing was employed to ensure proper distribution of the chemical in the garden soil. To ensure the robustness of the findings, each concentration was replicated three times, generating reliable and representative data. In parallel, a set of pots without any heavy metal treatment was maintained as the control group for comparison.

Throughout the experiment, daily watering was diligently carried out to maintain appropriate soil moisture levels, allowing the plants to thrive optimally. By observing and measuring the growth of

Raphanus sativus cv Pusa chetki under these controlled conditions and varying concentrations of nickel sulphate, the study aimed to shed light on the impact of this heavy metal on shoot length and root length, contributing to a deeper understanding of its ecological effects.

Result and Discussion

In the conducted pot culture experiments, the heavy metal nickel exhibited a gradual reduction in both shoot length and root length as its concentrations increased, ranging from 100 to 1000 mg/kg of soil.

Previous research conducted by Oberlaender and Roth (1978) observed that the presence of heavy metals such as Cu, Cd, Pb, Ni, Zn, and Hg in the soil led to a decrease in the uptake and distribution of essential nutrients like potassium (K) and phosphorus (P) in young barley plants, negatively impacting shoot and root length.

Moreover, elevated nickel concentrations were found to not only suppress protein synthesis, as noted by Mishra and Samal (1970), but also inhibit the activity of various enzymes while causing competition for iron in the culture medium, as reported by Mengel and Kirkby (1978).

Different crops, including rye grass, French beans, clover, barley, and red beet, displayed varying sensitivities to three heavy metals – zinc (Zn), copper (Cu), and nickel (Ni) – when added to the soil in the form of metal salts. Earlier observations indicated that chickpea growth and biomass were adversely affected at higher concentrations (200 and 400 ppm) of nickel and cobalt (Co).

The obtained data from the current experiments revealed that a concentration of 100 mg/kg of nickel did not inhibit shoot length and root length in Raphanus sativus cv Pusa chetki. Notably, no significant differences were observed between the root lengths of plants exposed to 500 and 700 mg/kg concentrations of nickel, while distinct variations in shoot length were evident between these two concentrations.

In the control group, the shoot length measured 21.1 cm, but at a concentration of 1000 mg/kg of nickel in the soil, it decreased to 15 cm. Similarly, the root length under control conditions measured 19 cm, which reduced to 14.1 cm at a nickel concentration of 1000 mg/kg in the soil. Statistical analysis revealed highly significant differences between the control group and the various treatments in terms of both shoot and root length.

These findings provide valuable insights into the impact of increasing nickel concentrations on shoot length and root length in Raphanus sativus cv Pusa chetki, highlighting the potential ecological consequences of heavy metal toxicity on plant growth and development.

Table 1: Showing the effect of some concentrations of Nickel on shoot length and root length (cm) of Raphanus sativus cv Pusa chetki

S. No.	Chemical	Concentrations (mg/kg soil)									
		Control		100		500		700		1000	
		S.L.	R.L.	S.L.	R.L.	S.L.	R.L.	S.L.	R.L.	S.L.	R.L.
1.	Nickel sulphate	21.1	19	21.1	19	19	17.1	15.4	17.1	15	14.1

(Values represent the mean of three replicates)

Analysis of Variance

F-ratios

For Shoot length and Root length

Control vs Treatment

Shoot length = 45.8715***

Root length = 51.3333***

S.L. = Shoot length

R.L. = Root length

Conclusion

In this study, pot culture experiments were conducted to investigate the effects of nickel on the shoot length and root length of Raphanus sativus var. Pusa chetki under simulated real-world conditions. The results revealed a gradual reduction in both shoot and root length with increasing concentrations of nickel, ranging from 100 to 1000 mg/kg of soil. These findings demonstrate the potential negative impact of nickel on plant growth and development.

The study contributes valuable insights into the ecological consequences of heavy metal toxicity on plant species, shedding light on the potential implications for environmental management and crop cultivation practices. Moreover, the research highlights the importance of understanding heavy metal effects on plant growth under natural environmental conditions.

Overall, this investigation expands our understanding of nickel's influence on plant development, providing essential information for sustainable agriculture and ecosystem management. Further research on the mechanisms underlying heavy metal toxicity and its broader effects on various plant species can pave the way for effective strategies to mitigate heavy metal-induced ecological challenges.

References

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