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EFFECT OF IRRIGATION INTERVALS ON SEED GERMINATION OF RAPHANUS SATIVUS VARIETY PUSA CHETKI

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ABSTRACT

Moisture stress is a critical factor that significantly impacts various aspects of plant growth and metabolic processes. Among these, the germination phase holds utmost importance in the overall growth cycle of plants as it directly influences the establishment of plant stands and ultimately affects the final crop yield. The negative effects of moisture stress on plant growth and metabolism are multifaceted. During the germination phase, water availability plays a crucial role in facilitating seed imbibition, triggering metabolic processes such as respiration and activating enzymes necessary for germination. In the absence of adequate moisture, these processes are hindered, leading to delayed or failed germination, compromised seedling vigour, and reduced overall plant growth. Furthermore, moisture stress can disrupt various metabolic pathways, including photosynthesis, respiration, and nutrient assimilation, leading to imbalances in plant metabolism. These disruptions may manifest as reduced chlorophyll content, impaired carbon fixation, altered carbohydrate partitioning, and compromised synthesis of essential biomolecules such as proteins and nucleic acids. These metabolic disturbances collectively contribute to the overall inferior growth and performance observed under moisture stress conditions.

Keywords: *Irrigation Intervals, Pusa Chetki, Crop-Plants, Water-Logged, Experimental Pots.*

Introduction

In the present study, our main objective was to investigate the influence of different irrigation intervals on the seed germination process of the Raphanus sativus variety Pusa chetki. Understanding the impact of irrigation on seed germination is crucial for optimizing crop productivity and yield.

The Raphanus sativus variety Pusa chetki was selected as the focus of our study. This vegetable crop has a somewhat obscure history, with around 8-10 species known to exist. Its stem is reduced and takes the form of a disc, typically exhibiting a glaucous appearance. It is predominantly cultivated throughout the year in the mild climate of the Indian plains.

It was aimed to collect seeds of the Pusa chetki cultivar to ensure uniformity and reliability in our experimentation. By employing different irrigation intervals, we sought to observe the effects of these intervals on the seed germination process. Irrigation plays a crucial role in providing plants with an adequate supply of water, which is essential for various vital activities such as germination, growth, and transpiration.

Soil properties, including water content, aeration, structure, and nutrient availability, significantly influence plant characteristics such as seed germination, growth, and biomass. Moisture stress can adversely impact plant growth and metabolism. Therefore, understanding the relationship between irrigation intervals and seed germination can aid in optimizing crop growth and productivity.

By conducting this study, it was aimed to contribute to the existing knowledge on the impact of irrigation intervals on the seed germination process of the Raphanus sativus variety Pusa chetki. The findings from this research can help inform agricultural practices and provide insights into achieving maximum productivity and yield in crop cultivation.

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Objectives

- To determine the optimal irrigation interval for maximum seed germination of Raphanus sativas variety pusa chetki.
- To develop a model that can predict the effects of irrigation intervals on seed germination.
- To test the effectiveness of different irrigation methods on seed germination.
- To develop recommendations for farmers on how to optimise irrigation intervals for maximum seed germination.

The results of this research could have a significant impact on the agricultural industry. By understanding the effects of irrigation intervals on seed germination, farmers can improve their yields and reduce their costs. Additionally, this research could help to develop new irrigation methods that are more efficient and environmentally friendly.

Material and Methods

To study the effect of irrigation intervals on seed germination, pot culture experiments were performed with the seeds of Raphanus sativus var. Pusa chetki. This cultivar was chosen and grown under natural environmental conditions to simulate real-world conditions as closely as possible.

The experiment involved a series of pots measuring 15 × 15 inches in size. Each pot was filled with 10 kg of air-dried garden soil, and a control drainage hole was present in each pot. The pots were carefully prepared, and 20 seeds of Raphanus sativus variety Pusa chetki were sown at a depth of 5 cm. The seeds were evenly spaced within each pot. This setup was replicated three times for each treatment, ensuring the reliability of the results. Standard cultural practices were followed as required throughout the experiment.

To prevent any potential contamination and provide uniform light conditions, the experimental pots were arranged at appropriate distances from each other. After a period of 10 days from sowing, the pots were examined to assess seed germination under different irrigation interval treatments. The culture medium used in this experiment was garden soil, specifically sandy loam.

The irrigation intervals employed in the study were 24, 48, 72, and 96 hours, in addition to a waterlogged condition. Irrigation was performed by pouring 1 L of tap water into each pot at the specified interval, excluding the waterlogged conditions. The 24-hour irrigation interval served as the control treatment, against which the other treatments were compared.

By observing the seed germination and growth patterns under different irrigation intervals, this experiment aimed to assess the impact of varying moisture levels on the germination process of Raphanus sativus var. Pusa chetki. The results obtained from this study can contribute to a better understanding of the optimal irrigation practices for this particular cultivar, providing valuable insights for agricultural practices and crop management.

Results and Discussion

The experiment aimed to investigate the effects of different irrigation intervals on the germination of Raphanus sativus (radish) seeds, specifically the Pusa chetki variety. The results showed that the maximum germination rate, reaching 95%, was observed in pots that were watered daily (the control group). On the other hand, the minimum germination rate, only 40%, was found in pots that were waterlogged.

The study further revealed that as the irrigation interval increased, there was a corresponding decrease in seed germination. For instance, at a 48-hour irrigation interval, the germination rate was 90%. However, this rate decreased to 80% and then further dropped to 65% at 72-hour and 96-hour irrigation intervals, respectively.

Under waterlogged conditions, the germination of seeds was significantly hindered, resulting in a germination rate less than half of that observed under the 24-hour irrigation interval. The differences in germination rates between the control group and the various irrigation treatments were highly significant.

Overall, the findings suggest that regular and adequate watering, such as daily irrigation, promotes optimal seed germination in the Raphanus sativus Pusa chetki variety. However, waterlogging and longer irrigation intervals negatively impact the germination process. These results highlight the importance of appropriate irrigation practices for successful seed germination in radish crops.

Table 1: Showing the effect of irrigation intervals on seed germination (%) in Raphanus sativus variety Pusa chetki

S. No.	Irrigation Intervals (Hours)	Seed Germination (%)
1.	Control (24 hrs)	95
2.	48 hrs	90
3.	72 hrs	80
4.	96 hrs	65
5.	Water logging	40

Values represent the mean of 3 replicates.

F-ratios - Control Vs Treatment

Seed germination = 49.25***

*** = highly significant

Furthermore, waterlogging can have detrimental effects on plant growth and development. When plants are exposed to excessive water in the soil, it can lead to oxygen deprivation in the root zone, impeding proper root respiration and nutrient uptake. The accumulation of water around the roots creates an anaerobic environment, which negatively impacts root function.

One of the consequences of waterlogging is the accumulation of auxin in the shoot while inhibiting its basipetal transport, which refers to the downward movement of auxin from the shoot to the root. This disruption in auxin transport can affect various physiological processes in plants, including root growth and development.

In a recent study, it was found that maintaining a daily irrigation interval of 24 hours resulted in the highest germination rate in pots. However, as the irrigation intervals increased beyond the control, the germination rate decreased significantly. This reduction in germination under higher irrigation intervals could be attributed to a moisture deficit in the seeds, where the moisture level fell below the threshold required for successful germination.

The plants that were daily irrigated exhibited the highest values in terms of growth parameters. This can be attributed to the optimal water conditions maintained in these plants, leading to a higher rate of cell division and elongation, increased photosynthesis by the leaves, and enhanced uptake of mineral nutrients from the soil.

Similar observations regarding reduced germination percentage in response to increasing moisture stress have been reported in previous studies. Singh (1992) observed a reduction in germination percentage in lentils, while Singh and Rai (1980) reported similar findings in leguminous crops. Hiron and Wright (1973) found decreased germination in medicago species under moisture stress conditions, and Orchard et al. (1984) observed reduced germination in sorghum and sunflower. Krishnamurthy et al. (1987) reported decreased germination in Cicer arietinum cultivar H-355, and Stanhill (1975) as well as Richard and Wadleight (1952) reported similar observations in their respective studies.

These studies collectively demonstrate the significant influence of soil moisture on plant germination and growth. Adequate moisture levels are essential for successful germination and optimal plant development, while excessive moisture or water logging can negatively impact plant physiology and lead to reduced growth and germination rates. Understanding the effects of soil moisture on plant responses is crucial for effective agricultural practices and ensuring optimal crop productivity.

Conclusions

In conclusion, the irrigation interval profoundly affects every aspect of plant growth and metabolism, with the germination phase holding particular significance. Insufficient moisture availability in submerged or impermeable soil conditions hampers plant growth, leads to poor establishment, and ultimately diminishes crop yield. In the present work it was found that under waterlogged conditions the germination of seeds decreased highly and less than half of that was found under 24 hrs irrigation intervals.

Understanding the effects of irrigation intervals on plants can inform agricultural practices aimed at mitigating its impact, such as implementing appropriate irrigation strategies, developing drought-tolerant crop varieties, and employing soil management techniques to improve water infiltration and retention.

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