Comparative Effects of Paracetamol Exposure and Light Regimes on Early Seedling Growth of Rice (Oryza sativa L.) and Green Gram (Vigna radiata L.)

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Abstract*—Light availability and exposure to pharmaceutical residues may influence early crop plant growth and development. This study compared the effects of paracetamol exposure under natural day–night conditions, continuous light, and continuous darkness on early seedling growth in rice (Oryza sativa L.), a monocotyledonous plant, and green gram (Vigna radiata L.), a dicotyledonous plant. Seedlings were maintained under six experimental conditions for each plant species: three light regimes, each with either normal water or paracetamol solution. The experimental observations were recorded over five days, with shoot height and root length measured daily. We used 20 mL of liquid per plant and defined the paracetamol treatment as a solution prepared from a 650 mg tablet. Both plant species showed progressive increases in shoot height and root length during the observation period, although growth varied by light regime and treatment. On day 5, rice seedlings under natural day–night conditions showed a shoot height of 6.8 cm and a root length of 5.0 cm in the normal-water group, compared with 5.6 cm and 3.9 cm, respectively, in the paracetamol-treated group. Similarly, green gram seedlings under natural day–night conditions attained a shoot height of 4.8 cm and a root length of 3.6 cm in the control group, compared with 3.9 cm and 2.8 cm, respectively, following paracetamol treatment. The lowest growth measurements were observed under continuous darkness in both species. Overall, the observations indicate that growth responses differed between plant species and illumination conditions, while paracetamol-treated seedlings consistently had lower shoot heights and root lengths than their controls. These findings provide preliminary descriptive evidence of the potential influence of paracetamol exposure and light availability on early seedling development. Further experiments using defined paracetamol concentrations, biological replicates, and statistical analysis are needed to establish dose-dependent effects and determine whether the observed differences are significant.

***Index Terms*—Paracetamol; seedling growth; rice (Oryza sativa); green gram (Vigna radiata); photoperiod; continuous illumination; continuous darkness; root elongation; shoot development; pharmaceutical contaminants; phytotoxicity.**

I. INTRODUCTION

1.1 Background

Plant growth and development are regulated by complex interactions among environmental conditions, physiological processes, and external chemical exposures. Among these factors, light plays a fundamental role in seed germination, seedling establishment, photosynthetic development, and the regulation of shoot and root morphology. Plant photoreceptors perceive light and initiate signaling pathways that influence gene expression, hormonal regulation, cell differentiation, and organ development (Arsovski et al., 2012; de Wit et al., 2016). Consequently, variations in illumination can substantially affect seedling growth, particularly during early development.

Seedlings grown under natural day–night conditions experience alternating periods of light and dark that broadly reflect their normal environment. Continuous illumination removes the regular dark period, whereas continuous darkness restricts light-dependent developmental responses and photosynthetic establishment. Seedlings developing in darkness may exhibit etiolation, characterized by altered stem elongation, limited leaf expansion, and delayed chlorophyll development. In contrast, light exposure promotes photomorphogenesis, supports the

development of functional photosynthetic structures, and establishes characteristic seedling morphology (Arsovski et al., 2012; von Arnim & Deng, 1996). Comparing these illumination conditions can therefore provide useful insights into how the environment regulates early plant growth.

In addition to light, chemical contaminants present in the surrounding environment may influence plant development. Pharmaceutical residues have attracted increasing attention as emerging environmental contaminants because compounds used in human and veterinary medicine can enter aquatic and terrestrial systems through wastewater discharge, sewage sludge, irrigation, and other waste-management pathways. Their potential effects on non-target organisms, including plants, depend on factors such as exposure concentration, chemical properties, exposure duration, and species-specific physiological responses (aus der Beek et al., 2016). Investigating seedling responses to pharmaceutical exposure is therefore relevant to understanding potential interactions between environmental contamination and crop establishment.

1.2 Paracetamol as an Emerging Environmental Contaminant

Paracetamol, also known as acetaminophen, is a widely used analgesic and antipyretic pharmaceutical. After human consumption, some of the administered compound and its metabolites may enter wastewater systems. Conventional wastewater treatment processes do not always eliminate pharmaceutical residues, creating opportunities for their release into aquatic environments and potential transfer to agricultural soils through wastewater reuse or contaminated irrigation sources (aus der Beek et al., 2016). The environmental occurrence of pharmaceuticals has consequently raised questions about their long-term effects on plants and other non-target organisms.

Although paracetamol is designed to exert therapeutic effects in humans, its biological activity in plants may differ by organism, exposure concentration, and environmental conditions. Experimental studies have investigated its potential phytotoxicity using seed germination, root elongation, shoot development, and cellular responses as indicators. For example, Barceló and colleagues' research on pharmaceutical mixtures in Lactuca sativa showed that plant responses to pharmaceuticals vary by compound and by whether they are applied individually or in combination with other substances (Pereira et al., 2019). In addition, an investigation involving lentil (Lens culinaris) and pea (Pisum sativum) reported adverse root-growth and cytogenetic responses following paracetamol exposure, highlighting the importance of evaluating pharmaceutical effects in plant bioassays (Tkachuk et al., 2023). Research on spinach (Spinacia oleracea) has also documented changes in morphological and physiological parameters under experimental paracetamol exposure (Kumar et al., 2022).

These findings suggest that pharmaceutical exposure may influence plant growth, but they also demonstrate why the effects should not be assumed to be uniform across plant species or experimental conditions. When interpreting observed responses, consider active-ingredient concentration, exposure duration, formulation excipients, and the selected plant's sensitivity. In particular, using a tablet-derived solution without a defined final concentration limits the ability to attribute an observed growth response exclusively to paracetamol.

1.3 Comparative Assessment of Rice and Green Gram

Rice (Oryza sativa L.) and green gram (Vigna radiata L.) are agriculturally important crop plants that differ in their taxonomic classification, seedling morphology, and developmental characteristics. Rice is a monocotyledonous cereal, whereas green gram is a dicotyledonous legume. These contrasting growth forms allow comparison of early seedling responses to environmental and chemical treatments.

Shoot height and root length are common morphological indicators in preliminary plant-growth experiments because they are easy to measure and can reveal differences in seedling development over time. Root growth is particularly relevant in phytotoxicity assessment because roots are directly exposed to the surrounding growth medium and may respond rapidly to chemical stress. Shoot development, meanwhile, reflects the combined influence of seed reserves, water availability, light conditions, and seedling development.

1.4 Rationale and Objectives of the Study

Although light-dependent seedling development and pharmaceutical phytotoxicity have been investigated independently, evaluating both factors within a comparative experimental framework can provide useful preliminary information about their combined relevance to early plant growth. A simple, short-duration experiment can establish whether shoot height and root length differ between control and paracetamol-treated seedlings under contrasting illumination regimes.

The present study therefore evaluated early growth in rice and green gram over a five-day observation period under natural day–night conditions, continuous illumination, and continuous darkness. Each light regime included a normal-water control and a paracetamol-treated group, with a nominal application volume of 20 mL per plant.

The specific objectives were:

1. To monitor daily changes in shoot height and root length in rice and green gram under three different light regimes.
2. To compare the growth of normal-water control seedlings with that of seedlings receiving the paracetamol preparation.
3. To examine whether the observed treatment-associated growth patterns differ between a monocotyledonous cereal and a dicotyledonous legume.
4. To identify preliminary patterns that may guide more controlled investigations of pharmaceutical exposure and seedling development.

By integrating morphological observations with comparisons across light conditions and plant species, this study provides a preliminary framework for investigating the potential influence of paracetamol exposure on early crop growth.

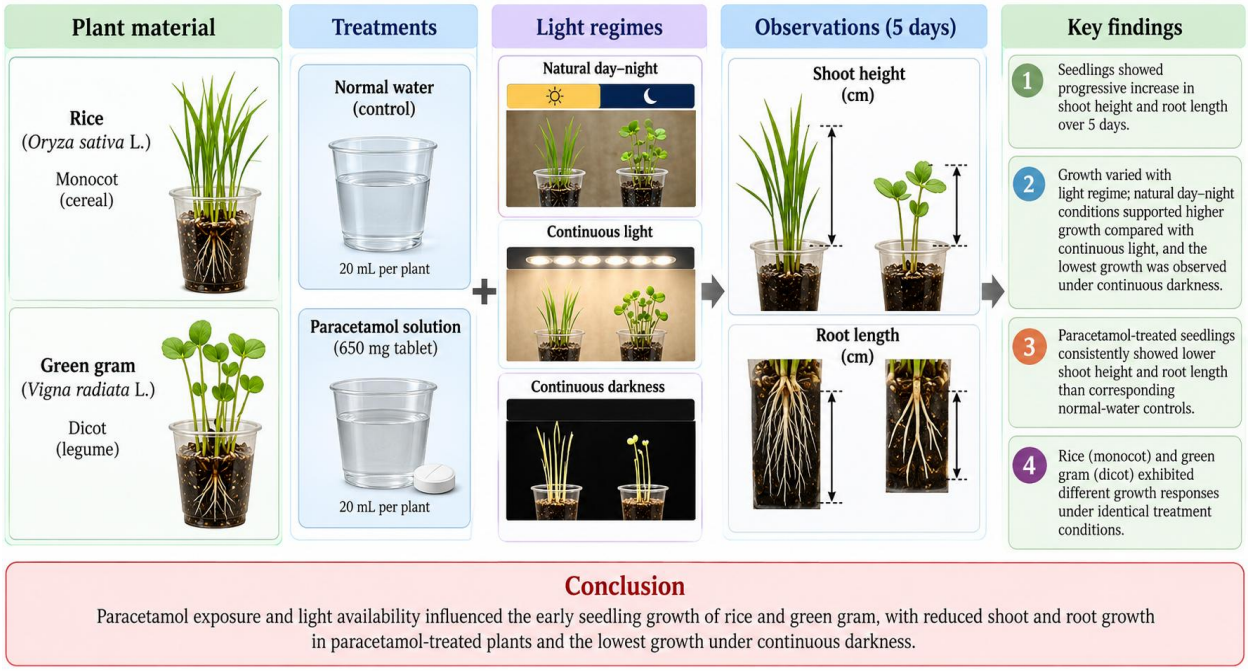


Figure 1: Graphical Abstract of the study.

II. MATERIALS AND METHODS

This section is structured as a short research paper, with tables and figure-generation prompts placed at the relevant points. It is based on the supplied observation table and experimental photographs. Details that were not documented in the attachments, such as the number of replicates, exact paracetamol concentration, seed sterilization procedure, and environmental conditions, are identified for confirmation rather than assumed.

2.1 Experimental Design

The study used a comparative, five-day seedling-growth experiment to investigate the effects of paracetamol exposure under different illumination conditions. Two plant species, rice (Oryza sativa L.) and green gram (Vigna radiata L.), were examined to compare the responses of a monocotyledonous cereal and a dicotyledonous legume.

Three light regimes were included: natural day–night conditions, continuous light, and continuous darkness. Within each light regime, two treatment groups were maintained: a normal-water control and a paracetamol-treated group. This resulted in six experimental treatment combinations per species and twelve species–treatment combinations overall.

Shoot height and root length were recorded daily from day 1 to day 5. A liquid application volume of 20 mL per plant was specified for all groups in the experimental record.

The design enabled descriptive comparisons of growth between control and paracetamol-treated seedlings within each species and light regime. Because illumination can influence plant morphology and development, maintaining distinct light conditions was important for interpreting the observed growth patterns (Arsovski et al., 2012; von Arnim & Deng, 1996).

2.2 Plant Materials and Experimental Units

Rice (Oryza sativa L.) and green gram (Vigna radiata L.) were selected as representative monocotyledonous and dicotyledonous crop plants, respectively. The experimental photographs show seedlings growing in individual transparent plastic cups containing a dark, particulate growth medium. A ruler was placed next to the seedlings to facilitate measuring plant growth.

Table 1. Plant materials and experimental setup.

Parameter	Rice	Green gram
Scientific name	Oryza sativa L.	Vigna radiata L.
Plant group	Monocotyledon	Dicotyledon
Plant type	Cereal	Legume
Experimental container	Individual plastic cup, as shown in photographs	Individual plastic cup, as shown in photographs
Growth medium	Dark particulate medium	Dark particulate medium
Observation period	5 days	5 days
Growth parameters	Shoot height and root length	Shoot height and root length

2.3 Preparation of the Control and Paracetamol Treatments

Two liquid treatments were included in each light regime.

1. Normal-water control: Water was supplied at a nominal volume of 20 mL per plant.
2. Paracetamol treatment: A paracetamol preparation associated with a 650 mg tablet was supplied at a nominal volume of 20 mL per plant.

The experimental key identifies the pharmaceutical treatment as a paracetamol solution prepared using a 650 mg tablet. However, the final solution volume, tablet dissolution procedure, active ingredient concentration, and whether the solution was filtered or otherwise clarified were not documented in the supplied materials.

Accordingly, we describe the treatment as a tablet-derived paracetamol preparation rather than a solution of known concentration. The 650 mg tablet strength does not establish the concentration delivered to each plant because the final preparation volume is unknown. Moreover, tablet formulations may contain excipients that could potentially affect the observed plant response.

Previous research shows that paracetamol exposure can influence plant growth and physiological parameters under controlled conditions, although the response depends on the experimental concentration and exposure conditions (Badar et al., 2022; Salazar Mercado et al., 2023). These studies provide a rationale for investigating the compound in a preliminary seedling bioassay but do not establish the concentration or mechanism of action in the present experiment.

Table 2. Experimental treatments and nominal liquid application volume.

Light regime	Control group	Treatment group	Application volume
Natural day–night	Normal water	Paracetamol preparation	20 mL/plant
Continuous light	Normal water	Paracetamol preparation	20 mL/plant

Continuous darkness	Normal water	Paracetamol preparation	20 mL/plant

2.4 Establishment of Light Regimes

Three illumination conditions were used to investigate how light availability affects early seedling development.

- Natural day–night: Seedlings were maintained under a natural cycle of daylight and darkness.
- Continuous light: Seedlings were maintained under continuous illumination.
- Continuous darkness: Seedlings were maintained in complete darkness.

Each illumination condition included both the normal-water control and the paracetamol-treated group for rice and green gram. Light regulates plant development through photoreceptor-mediated signaling and interactions with developmental pathways. The absence of light can alter shoot elongation, leaf expansion, and chloroplast development, while light exposure promotes photomorphogenic development (Arsovski et al., 2012; von Arnim & Deng, 1996). These established physiological responses support including different light regimes in the experimental design.

Table 3. Light-regime characteristics and experimental considerations.

Light regime	Intended condition	Important details to document
Natural day–night	Ambient light and darkness cycle	Photoperiod, location, and approximate light intensity
Continuous light	Illumination throughout the observation period	Light source, intensity, and daily operating duration
Continuous darkness	No intentional light exposure	Method used to exclude light and any temperature differences within the enclosure.

2.5 Monitoring of Seedling Growth

Seedling growth was monitored over five consecutive observation days. The observation table provides daily measurements of shoot height and root length for each species, illumination regime, and treatment group. Water application was recorded as 20 mL per plant across all groups.

Shoot height was recorded in centimeters, and root length was recorded in centimeters. These measurements were used as morphological indicators of early seedling development. Shoot height reflects above-ground elongation, whereas root length indicates below-ground extension. Both are established endpoints in plant-growth and phytotoxicity assessments (OECD, 2006).

Measurements were organized by day, plant species, illumination regime, and treatment. The supplied table contains observations from day 1 through day 5, allowing temporal patterns to be examined within each experimental group.

Table 4. Growth parameters and measurement schedule.

Parameter	Unit	Observation schedule	Purpose
Shoot height	cm	Daily, days 1–5	Assessment of above-ground growth
Root length	cm	Daily, days 1–5	Assessment of root elongation
Water application	mL/plant	As documented in the treatment protocol	Maintenance of a consistent nominal application volume
Visual seedling appearance	Qualitative	Documented photographically	Supporting description of visible growth differences

2.6 Photographic Documentation

Photographs were used to document the visible appearance of rice and green gram seedlings under the different illumination and treatment conditions.

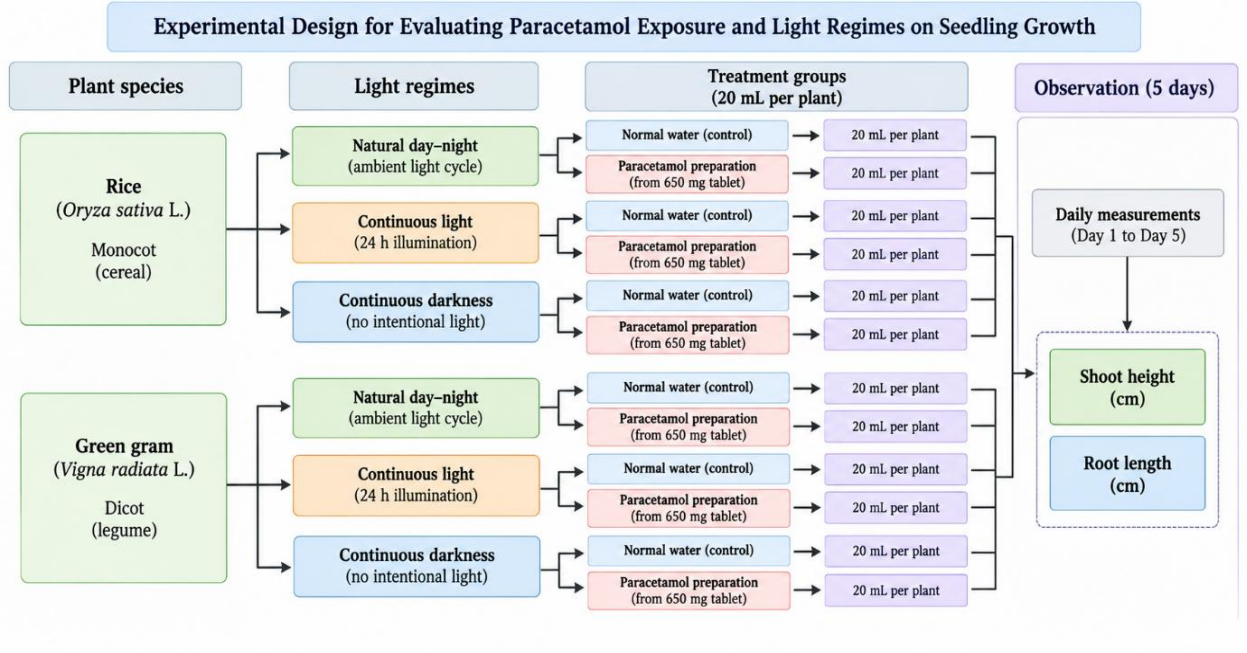


Figure 2: Experimental arrangement and treatment groups.

2.7 Data Recording and Statistical Analysis

Daily observations were organized by plant species, light regime, treatment, observation day, shoot height, and root length. The recorded values were used to describe growth trajectories over the five days and to compare the corresponding normal-water and paracetamol-treated groups.

For a quantitative comparison, the percentage difference in a growth parameter between a treated group and its corresponding control can be calculated as:

$$\text{Growth Reduction } (\%) = \frac{C-T}{C} \times 100$$

where:

- C = growth measurement in the corresponding normal-water control.
- T = growth measurement in the paracetamol-treated group under the same light regime.

A positive value indicates a lower measurement in the treated group, zero indicates equal measurements, and a negative value indicates a higher measurement in the treated group.

The supplied dataset contains one value per species–treatment combination for each observation day, with no information on biological replicates or variability. Therefore, the available observations support descriptive comparisons but do not, on their own, establish statistical significance. Inferential analyses, such as analysis of variance, should be undertaken only if replicate-level data are available and the assumptions of the selected statistical model can be evaluated. This distinction aligns with established plant-test guidance, which recommends appropriate statistical analysis when evaluating treatment-related effects (OECD, 2006).

Table 5. Proposed data-analysis framework.

Analysis	Variables	Purpose
Daily growth trajectory	Shoot height and root length across days 1–5	Describe changes over time
Control–treatment comparison	Normal water versus paracetamol within each species and light regime	Quantify observed differences
Percentage growth reduction	Control and treated measurements	Express treatment-associated differences relative to controls
Cross-species comparison	Rice and green gram under corresponding conditions	Describe differences in growth patterns
Inferential statistics	Replicate-level measurements, if available	Test whether observed differences exceed expected experimental variability

III. RESULTS AND DISCUSSION

3.1 Overall Growth Trends During the Five-Day Observation Period

Growth observations showed progressive increases in shoot height and root length in both rice (Oryza sativa L.) and green gram (Vigna radiata L.) over the five-day experimental period. However, growth magnitude differed among illumination regimes and between the normal-water and paracetamol-treated groups.

For both plant species, seedlings maintained under natural day–night conditions generally exhibited the greatest shoot height and root length by Day 5, followed by those maintained under continuous light. The lowest values were recorded under continuous darkness. Within each illumination regime, paracetamol-treated seedlings generally had lower shoot heights and root lengths than their controls.

3.2 Comparative Growth of Rice and Green Gram on Day 5

Day 5 was selected for the principal endpoint comparison.

Table 6: Shoot height and root length of rice and green gram under different light regimes on Day 5.

Plant species	Light regime	Shoot height, control (cm)	Shoot height, paracetamol (cm)	Root length, control (cm)	Root length, paracetamol (cm)
Rice	Natural day–night	6.8	5.6	5.0	3.9
Rice	Continuous light	6.2	4.8	4.2	3.0
Rice	Continuous darkness	3.7	2.8	2.1	1.4
Green gram	Natural day–night	4.8	3.9	3.6	2.8
Green gram	Continuous light	3.7	2.8	2.5	1.8
Green gram	Continuous darkness	1.9	1.2	1.2	0.7

3.2.1 Growth response of rice

Rice seedlings exhibited their greatest observed growth under natural day–night conditions. On Day 5, the control group reached a shoot height of 6.8 cm and a root length of 5.0 cm, while the corresponding paracetamol-treated group reached 5.6 cm and 3.9 cm, respectively.

Under continuous light, the control seedlings reached a shoot height of 6.2 cm and a root length of 4.2 cm. The paracetamol-treated group showed corresponding measurements of 4.8 cm and 3.0 cm. These values were lower than those recorded under natural day–night conditions.

The lowest measurements were recorded under continuous darkness. Rice control seedlings reached a shoot height of 3.7 cm and a root length of 2.1 cm, whereas the treated seedlings reached 2.8 cm and 1.4 cm, respectively.

The results therefore show that shoot and root growth in rice varied with illumination conditions. They also show lower final growth measurements in the paracetamol-treated group within each illumination regime.

3.2.2 Growth response of green gram

Green gram exhibited a similar overall pattern, although its absolute growth measurements were lower than those recorded for rice under the corresponding experimental conditions.

Under natural day–night conditions, control seedlings attained a shoot height of 4.8 cm and a root length of 3.6 cm on Day 5. The corresponding paracetamol-treated seedlings attained 3.9 cm and 2.8 cm, respectively.

Under continuous light, shoot height and root length reached 3.7 cm and 2.5 cm in the control group, compared with 2.8 cm and 1.8 cm in the treated group. Under continuous darkness, the corresponding measurements decreased to 1.9 cm and 1.2 cm in controls and 1.2 cm and 0.7 cm in paracetamol-treated seedlings.

These results suggest that green gram growth was particularly limited under continuous darkness. Differences between the control and treated groups were also evident under all three illumination conditions.

The absolute measurements should not, however, be interpreted as a direct ranking of inherent tolerance between rice and green gram. The two species differ in their developmental characteristics, and this experiment does not explain those differences.

3.3 Relative Differences Between Control and Paracetamol-Treated Seedlings

To facilitate comparisons across species and illumination regimes, the relative Reduction in each growth measurement was calculated using the corresponding normal-water control as the reference.

$$\text{Relative Reduction (\%)} = \frac{\text{Control} - \text{Treated}}{\text{Control}} \times 100$$

Table 7. Relative Reduction in shoot height and root length associated with paracetamol treatment on Day 5.

Plant species	Light regime	Shoot-height Reduction (%)	Root-length Reduction (%)
Rice	Natural day–night	17.6	22.0
Rice	Continuous light	22.6	28.6
Rice	Continuous darkness	24.3	33.3
Green gram	Natural day–night	18.8	22.2
Green gram	Continuous light	24.3	28.0
Green gram	Continuous darkness	36.8	41.7

For rice, the relative Reduction in shoot height increased from 17.6% under natural day–night conditions to 24.3% under continuous darkness. The corresponding Reduction in root length increased from 22.0% to 33.3%. Therefore, the largest relative differences between the rice control and treated group were observed under continuous darkness.

Green gram showed more pronounced differences across illumination conditions. Under natural day–night conditions, shoot height and root length were lower by 18.8% and 22.2%, respectively, in the treated group. Under continuous darkness, the corresponding reductions reached 36.8% and 41.7%.

Root length exhibited a greater relative reduction than shoot height in all six species–light combinations. This pattern suggests that root elongation was more strongly affected than shoot height in the Day 5 observations listed.

3.4 Influence of Light Regimes on Seedling Development

The comparison of illumination conditions revealed a consistent descriptive pattern across both plant species: natural day–night conditions were associated with the greatest Day 5 shoot height and root length, continuous light produced intermediate values, and continuous darkness was associated with the lowest values.

For rice controls, shoot height under continuous darkness was 45.6% lower than under natural day–night conditions, while root length was 58.0% lower. In green gram controls, shoot height was 60.4% lower and root length was 66.7% lower under continuous darkness than under natural day–night conditions. These percentages reflect differences in observed endpoint values, not experimentally established causal effects.

Light regulates plant development through photoreceptors and interconnected signaling pathways that affect seedling morphology, leaf development, and the transition toward functional photosynthesis (Arsovski et al., 2012; von Arnim & Deng, 1996). Continuous darkness can alter normal developmental patterns, while continuous illumination may produce responses that differ from those under a normal light–dark cycle.

The relatively low measurements observed under continuous darkness are compatible with the importance of light in normal seedling establishment. However, the present experiment did not measure photosynthetic pigments, photosynthetic activity, carbohydrate reserves, or hormonal responses. Consequently, the precise physiological mechanisms underlying the observed differences remain unresolved. The intensity and duration of illumination, temperature, moisture, and other environmental factors would also need to be controlled and documented before causal conclusions could be drawn.

3.5 Potential Effects of Paracetamol Exposure on Seedling Growth

Paracetamol-treated seedlings showed lower shoot height and root length than their corresponding normal-water controls at the final observation point in all six species–light combinations. The magnitude of this difference varied by plant species and illumination regime.

This pattern aligns with broader concerns that pharmaceutical residues may affect plants exposed to contaminated water or growth media. Badar et al. (2022) reported reductions in morphological growth parameters in spinach exposed to defined paracetamol concentrations. Their study also identified changes in photosynthetic parameters and nutrient composition, indicating that exposure responses can extend beyond visible growth changes. Similarly, Salazar Mercado and Vega Galvis (2023) reported root-growth inhibition and cytogenetic effects in lentil and pea bioassays under paracetamol exposure.

These publications provide relevant context for the present observations, but their findings should not be treated as direct validation of the mechanisms operating in rice or green gram. The species, exposure concentrations, cultivation conditions, and experimental methods differ.

3.6 Comparative Sensitivity of Rice and Green Gram

The two species exhibited different patterns of relative growth reduction. Under continuous darkness, green gram showed a 36.8% reduction in shoot height and a 41.7% reduction in root length, compared with 24.3% and 33.3%, respectively, in rice. Under natural day–night conditions, the relative reductions were more similar between the two species.

This observation suggests that the magnitude of the response to the experimental treatment may differ between rice and green gram under particular illumination conditions. However, relative differences should be interpreted in the context of each species' control values. A percentage calculated from a smaller baseline measurement may appear relatively large even when the absolute difference is modest.

For example, the Day 5 shoot-height difference under continuous darkness was 0.7 cm in green gram and 0.9 cm in rice, despite the larger percentage reduction calculated for green gram. Therefore, both absolute and relative differences are necessary for a balanced interpretation.

3.7 Interpretation of the Photographic Observations

The obtained results provide visual context for the numerical measurements. They show differences in apparent shoot development among seedlings maintained under natural day and night conditions, continuous light, and continuous darkness, with separate images for normal-water and paracetamol-treated groups.

The image set broadly supports the descriptive observation that seedling appearance varied across the experimental conditions. Nevertheless, photographic evidence is qualitative unless it is supported by standardized image analysis. Differences in camera position, illumination, background, developmental stage, and the number of seedlings visible in each image may influence visual impressions.

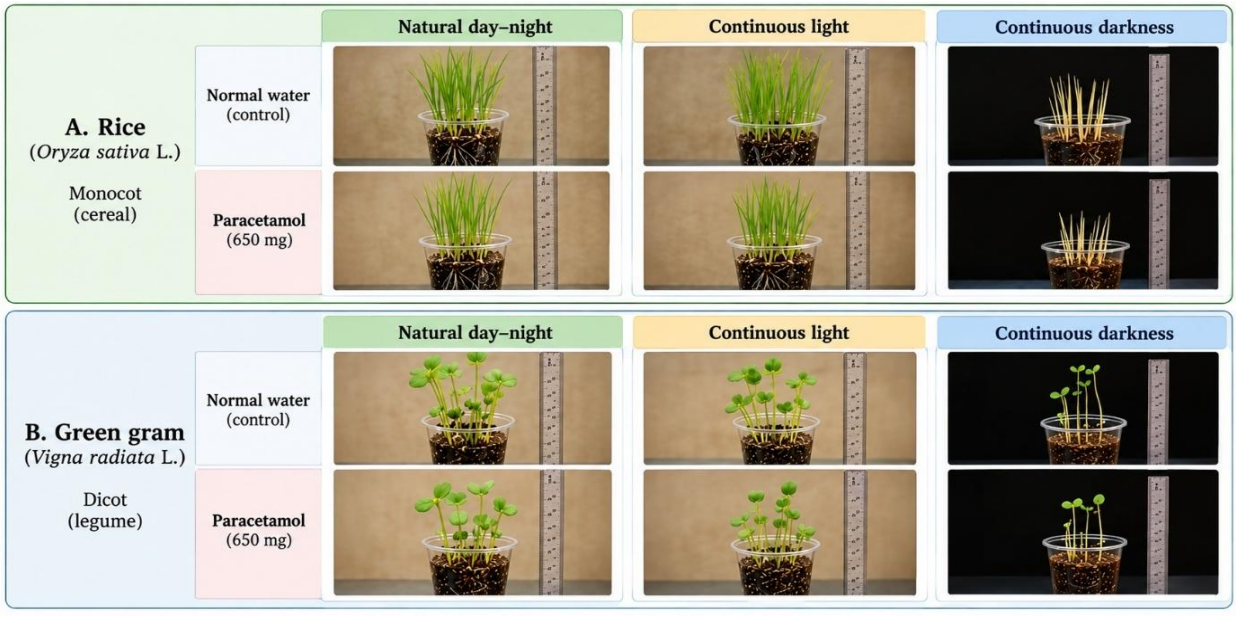


Figure 3: Comparative photographic appearance of rice and green gram seedlings under different light regimes and treatments.

3.8 Integrated Interpretation

Taken together, the recorded observations reveal three principal patterns. First, shoot height and root length increased progressively over the five-day observation period in both rice and green gram. Second, seedlings under natural day–night conditions generally achieved greater final growth measurements than seedlings under continuous light or continuous darkness, with continuous darkness associated with the lowest values. Third, paracetamol-treated seedlings had lower Day 5 shoot heights and root lengths than their corresponding normal-water controls.

The magnitude of the observed differences varied by species, growth parameter, and illumination regime. Green gram displayed the largest relative reductions under continuous darkness, whereas rice exhibited comparatively smaller relative differences under the same condition. Root length showed a greater percentage reduction than shoot height across all six comparisons.

These findings provide preliminary evidence of differing early seedling-growth patterns under the tested experimental conditions. However, they do not establish concentration-dependent paracetamol toxicity, a specific physiological mechanism, or statistically significant interactions between treatment and light regime. Further controlled experiments are required to determine whether the patterns persist under standardized exposure conditions and with adequate biological replication.

IV. SUMMARY

This study investigated early seedling growth responses in rice (Oryza sativa L.), a monocotyledonous cereal, and green gram (Vigna radiata L.), a dicotyledonous legume, under three illumination regimes: natural day–night conditions, continuous light, and continuous darkness. Within each light regime, seedlings were maintained under normal-water control conditions or exposed to a tablet-derived paracetamol preparation. We monitored shoot height and root length over five days, with a nominal liquid application volume of 20 mL per plant.

The recorded observations revealed differences in seedling growth across plant species, illumination regimes, and treatment groups. Both species generally exhibited greater shoot height and root length under natural day–night conditions, whereas continuous darkness was associated with the lowest growth measurements; continuous-light conditions produced intermediate values in the Day 5 observations provided.

Paracetamol-treated seedlings consistently recorded lower shoot heights and root lengths than their corresponding normal-water controls across all six species–light combinations. In rice, relative shoot-height Reduction ranged from 17.6% to 24.3%, while root-length reduction ranged from 22.0% to 33.3%. In green gram, shoot-height Reduction ranged from 18.8% to 36.8%, while root-length Reduction ranged from 22.2% to 41.7%. The greatest relative reductions for both growth parameters were observed in green gram under continuous darkness. Across all treatment combinations, root length exhibited a greater relative reduction than shoot height.

These comparative observations suggest that early seedling growth patterns were associated with both illumination conditions and the applied paracetamol preparation. The differences between rice and green gram further indicate that species-specific characteristics should be considered when evaluating plant responses to environmental chemical exposure. However, these findings describe patterns in the supplied dataset and do not establish a statistically significant treatment effect or a specific toxicity mechanism.

Overall, the study provides preliminary comparative observations of rice and green gram seedling development under different light regimes and treatment conditions. The findings support further investigation into how light availability and pharmaceutical exposure interact during early plant growth, while highlighting the importance of controlled experimental design and quantitative validation.

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