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# Impact of Detergents on Chickpea Plant Growth: An Experimental Study

**Siddaraju M N[1], Patil Ravindra Sanganagouda[2]**

[1]Department of Botany, University College Mangalore, Hampankatta, Mangalore, India
Corresponding author Email: *siddumn[at]gmail.com*

[2]Department of Botany, University College Mangalore, Hampankatta, Mangalore, India
Email: *ravindra13patil[at]gmail.com*

**Abstract:** ***This study investigates the effect of detergents on the growth and development of a selected plant Chickpea. Detergents are commonly used in households and industrial settings, and their potential impact on the environment, particularly on plant life, is of growing concern. The experiment employed a controlled laboratory setting to assess the influence of different detergent concentrations on key physiological and morphological parameters of the Chickpea plants. There was a 1.7- and 1.8-fold decreased growth observed in shoot and root respectively after the treatment with the detergent water. Our findings highlight the significant effects of detergents on plant growth, suggesting potential implications for ecosystems and environmental sustainability.***

**Keywords:** Detergents, Plant Growth, Environmental Impact, Physiological Parameters, Morphological Parameters.

## 1. Introduction

Detergents, widely used in households and industries, contain various chemical compounds designed to break down grease and facilitate cleaning. Synthetic detergents emerge as a significant contributor to water pollution, infiltrating lakes and rivers due to industrial activities influenced by climate. Extensive research has documented the detrimental effects of detergent use on aquatic, terrestrial flora and fauna [1, 2, 3]. The discharge of detergent-containing wastewater into the environment raises concerns about its impact on ecosystems, including plant life [4]. Comprising surface-active agents, builders like phosphates, and various additives such as anti-deposition agents, optical brighteners, bluing agents, bleaching agents, foam regulators, organic sequestering agents, and enzymes, synthetic detergents contribute to environmental degradation. Understanding the effects of detergents on plants is crucial for assessing their potential environmental consequences. This study aims to investigate the influence of detergent exposure on the growth and development of selected plant Chickpea.

## 2. Materials and Methods

### 2.1 Plant Selection

The chickpea (Cicer arietinum) seeds were procured from a certified seed center located in Mangalore. Chickpeas were chosen for their brief life cycles and widespread cultivation, being popular tropical legumes in India. The short life cycle of chickpeas allows for efficient research on growth dynamics and responses to environmental factors.

### 2.2 Experimental Design

Sterilized petri plates were prepared by lining them with filter paper, and various concentrations of detergent solutions (0.01%, 0.02%, 0.03%, 0.04%, and 0.05%) were added to different petri plates, each clearly marked with its respective concentration. Each sterilized petri plate was populated with 20 seeds. As a control group, an equivalent number of seeds were germinated and grown in tap water.

After seven days of incubation, the number of seeds that exhibited germination was recorded. These germinated seeds were carefully separated into root and shoot components for further analysis. For each petri plate, 5 grams of shoot material was carefully collected and subsequently crushed. This crushed material was utilized for the estimation of various biochemical parameters, including chlorophyll content [5] protein estimation [6] and starch estimation [7].

### 2.3 Growth Experiments

Soil was obtained from a fallow ground of Krishi Vigyan Kendra, Mangalore to fill the growth trays. Watering was carried out every other day. The growth of the plants was continually monitored and important observations were recorded. Shoot height was measured from the surface of the soil to the tip of the growing point of the shoot apex.

These biochemical estimations provide valuable insights into the physiological responses of the chickpea shoots to different detergent concentrations, shedding light on potential alterations in chlorophyll levels, protein synthesis, and starch accumulation. The results from these estimations contribute to a comprehensive understanding of the impact of detergents on the biochemical composition of the chickpea shoots.

## 3. Results and Discussion

### 3.1 Morphological Parameters

The investigation revealed that the maximum germination was recorded in control group without any detergent and followed by 0.01% detergent (Figure 1). The germination

efficiency was decreased with the increase in detergent concentration. Figure2 and 3 shows the length of the germinated shoot and root respectively. There was 1.7-fold and 1.8-fold decreased growth observed in shoot and root respectively in 0.05% treated plants compared to the control group.

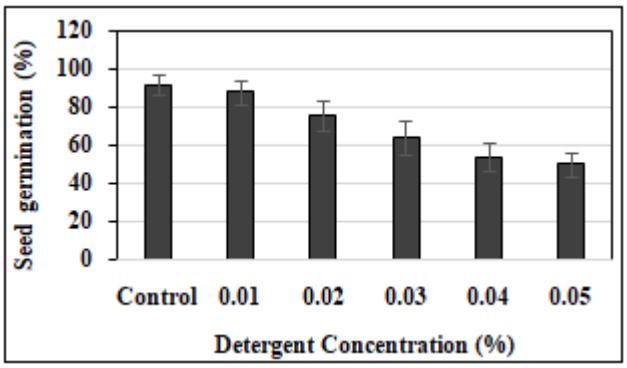


**Figure 1:** Percentage of seed germination

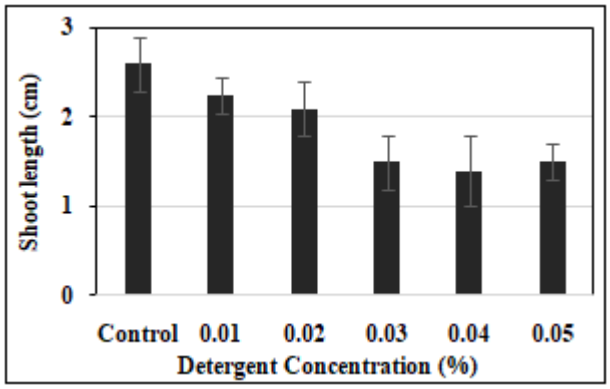


**Figure 2:** Germinated shoot length in treated groups

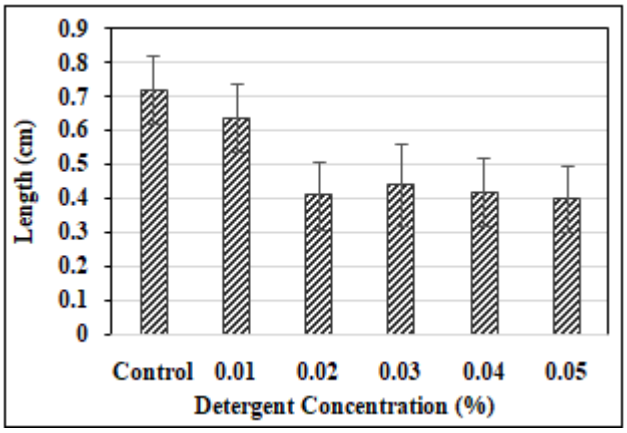


**Figure 3:** Germinated root length in treated groups

This result aligns with a prior study by Vijayakumari (2003) [8], which examined the effects of detergents on various parameters in pearl millet. The study on pearl millet indicated that soap factory effluent, initially toxic to seed germination and seedling growth, demonstrated improved outcomes when diluted to concentrations ranging from 2.5% to 5%. This suggests a nuanced relationship between detergent concentration and seedling development. Additionally, insights from Nagada et al. (2006) [9] proposed that the inhibition observed at higher concentrations of soap factory effluent may be attributed to the osmotic pressure generated by increased total salt levels in the effluent. The findings collectively underscore the importance of considering specific concentrations and their impact on seed germination and seedling growth, offering valuable insights for both research and potential applications in agricultural practices.

### 3.2 The biochemical parameters

The biochemical parameters including chlorophyll, starch, and protein content, exhibited a decreasing trend with the increase in the concentration of the detergent. The increased concentration of detergent appears to induce a reduction in the pigment content of chickpea, specifically leading to a significant decrease in chlorophyll levels. This pronounced decline in chlorophyll content under the influence of higher detergent concentrations is likely attributed to the inhibitory effects of toxicants on the synthesis of chlorophyll in plants (Figure 4).

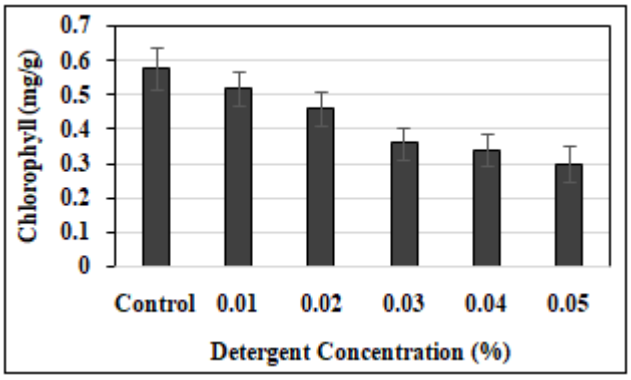


**Figure 4:** Chlorophyll content in treated groups

The highest amount of starch 18.6±1.1 mg/g was observed at 0.01% compared to 7.8±0.8 mg/g in 0.05% group. Similarly, there was a gradual reduction in protein content as the detergent concentration was increased (Figure5).

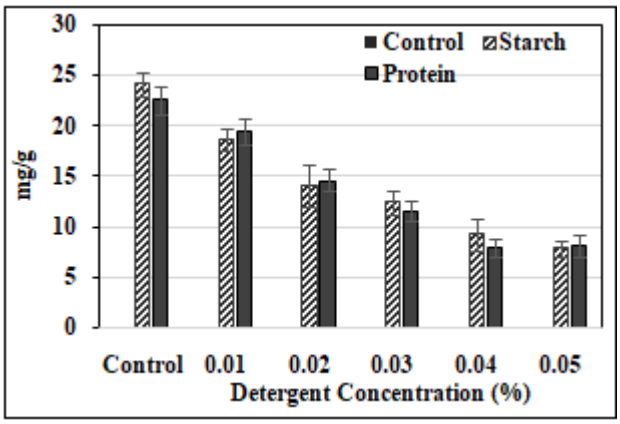


**Figure 5:** Starch and protein content in treated groups

The results showed 35% reduced protein content in 0.05% group compared to the control group. This result aligns with findings by Kumar and Kumar (1990) [10], who observed a decrease in seed germination percentage with increasing detergent concentration. The decline in protein and starch content at higher concentrations could be attributed to the elevated presence of toxic chemicals. Sahai et al. (1983) [11] reported similar observations in certain crop varieties. These findings collectively highlight the intricate relationship

between detergent concentration and biochemical parameters, emphasizing the need for nuanced considerations in agricultural practices.

## 4. Conclusions

Various concentrations of synthetic detergents were found to significantly impede the growth of chickpea. A gradual decline in all growth parameters was observed with increasing detergent concentration. The results suggest that higher detergent concentrations exert a toxic effect on plant growth. Therefore, it is recommended that detergents intended for irrigation purposes undergo proper treatment to mitigate their potential adverse impact on plant development. This highlights the importance of mindful and regulated detergent use in agricultural practices to ensure the health and productivity of crops.

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