The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 2 | Issue 5 | May 2024
ISSN: 2583-973X (Online)
Website: www.theacademic.in

The effects of textile waste water on Chickpea (*Cicer arietinumL.)* seed germination and seedling growth are hazardous to plants. Jaipur, Rajasthan

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ARTICLE DETAILS

Research Paper

Keywords:
Chickpea (Cicer arietinum L.) Textile waste water, Seed germination, Growth, Seedling.

ABSTRACT

This study delved into how textile wastewater affects the germination and early growth of Chickpea (Cicer arietinum L.) seedlings in a lab setting. Researchers compared the impacts of varying concentrations of textile wastewater to a control group using distilled water. Wastewater concentrations tested were 0%, 25%, 50%, 75%, and 100%. The findings revealed that the 25% concentration had the least toxicity, with toxicity levels rising alongside higher wastewater concentrations. As the wastewater concentration increased, fewer seeds managed to germinate, indicating greater toxicity. The study concluded that diluting textile wastewater to 25% can improve the germination rates of Chickpea seeds.

INTRODUCTION:

While industrialization and urbanization meet our basic needs, they also cause significant pollution of air, water, and soil, altering their natural conditions. Industrial processes generate large volumes of effluent daily. If textile wastewater is not properly treated, it can harm local ecosystems where it is discharged. This untreated wastewater often contaminates nearby water bodies or land, reducing soil fertility. When released into the environment without treatment, it disrupts ecological habitats and can impede photosynthesis in plants. In India, only 30% of wastewater is treated before discharge. Consequently, untreated industrial effluent frequently pollutes rivers, lakes, groundwater, and coastal areas, leading to serious water pollution issues (Thapliyal et al., 2011).

India is home to a vast and diverse network of textile industries with a range of capacities. According to the Ministry of Environment and Forests, these industries rank among the most polluting sectors. Initially centered in major cities like Ahmedabad, Mumbai, Chennai, Coimbatore, Bangalore, and Kanpur, the textile industry has now expanded to include many small processing units scattered across the country. These units perform wet processes such as bleaching, dyeing, and screen printing, which consume large quantities of fresh water. The wastewater output from Indian textile mills varies, ranging from 86 to 247 liters per kilogram of fabric, with an average of 172 liters. This contributes significantly to India's industrial effluents. On an industrial scale, wastewater from dyeing and printing in textile mills is typically treated through primary or secondary processes.

Textile industries are vital to India's economy, generating roughly one-third of the nation's export earnings and employing about 25% of its workforce (Paul, 1997). Notably, Pali, Balothra, Bagru, and Sanganer in Rajasthan stand out as global leaders in traditional textile printing.

The textile printing and dyeing industry consumes large quantities of fresh water throughout its processes. Frequently, untreated effluents are released into nearby drains and ponds (Bharadwaj, 1999, at Sanganer, Jaipur). These effluents are laden with bleaching agents, salts, acids, alkalis, heavy metals like copper, chromium, iron, and cadmium, as well as azo dyes, often surpassing the limits established by the CPCB (1989).

Managing wastewater disposal is a significant challenge for municipalities, particularly in large cities where space for land-based treatment is limited. However, wastewater offers potential benefits as it contains nutrients that can be used in agriculture, making it both a valuable resource and a pressing issue. Effluents from textile industries, whether released directly or indirectly, pose serious environmental and health hazards. These effluents can harm plants, animals, and humans, highlighting the urgent need for safe disposal methods. They negatively impact soil and vegetation, and in many instances, textile industry effluents are stored in ditches. Unaware of the risks, farmers may pump this low-quality wastewater into wells and use it to irrigate crops after dilution.

While some effluents contain beneficial nutrients for plants, ensuring their safe use is crucial. Various studies have examined the effects of using effluent discharge from different sources on crop performance (Pathak et al., 1998; Pathak et al., 1999; Lubello et al., 2004; Nath et al., 2009; Pramanik et al., 2022; Patil et al., 2020). Recently, using industrial effluents for irrigation has gained attention as a method of wastewater utilization, offering both benefits and drawbacks (Gautam et al., 2021; Kaur et al., 2019; Snehlata et al., 2018; Rana and Kumar, 2017; Sinha and Paul, 2013; Dush, 2012; Panaskar and Pawar, 2011; Verma and Sharma, 2012; Lata, 1983; Sisodia and Bedi, 1985; Sharma, 2004; Dixit et al., 1986).

This study aims to characterize untreated textile industry effluent and explore its impact on the germination and seedling growth of Chickpea (Cicer arietinum L.) at different concentrations.

MATERIAL AND METHODS:

Wastewater samples were collected from a textile mill in Jaipur (Sanganer) and stored in polyethylene containers in a dark environment. The samples were analyzed for various physico-chemical characteristics using standard APHA (1998) methods. To preserve their properties, the effluents were refrigerated at 4ºC. The effluents had a dark color and a strong odor. Detailed properties are listed in Table 1. For the bioassays, the effluents were diluted to concentrations of 25%, 50%, 75%, and 100%.

Chickpea (Cicer arietinum L.) seeds were sterilized with a 0.1% w/v aqueous solution of mercuric chloride for 5 minutes to eliminate microbes, then thoroughly rinsed with sterilized double-distilled water. Laboratory experiments were conducted using Petri dishes, each containing 50 sterilized seeds on a double layer of filter paper. The dishes were labeled according to the effluent concentration tested. Untreated effluent concentrations of 25%, 50%, 75%, and 100% were prepared, with distilled water as the control. Germination percentage was observed in each Petri dish from 24 to 120 hours after seeding. Growth parameters such as germination rate, plumule, and radicle length were measured daily from the first to the seventh day after seedling emergence. Throughout the germination period, emergence and growth parameters like germination percentage, root length, and shoot length were recorded.

RESULT AND DISCUSSION:

The germination rate of Chickpea (Cicer arietinum L.) varieties shows a progressive increase with rising concentrations of textile wastewater up to 50%, but beyond this threshold, it declines (refer to Table 2). At higher concentrations, the impact of wastewater on Chickpea germination becomes notably adverse, with inhibition rates ranging from 60% to 80% observed in treatments of 75% to 100% wastewater. Similar observations were made by Khan et al. (2011), who found that higher concentrations of textile wastewater negatively affected seed germination. Dash (2012) also noted decreased germination efficiency at higher concentrations of domestic wastewater, while Varma and Sharma (2012) reported a decrease in wheat plant growth at high concentrations of dairy and textile wastewater. Nagda et al. (2006) observed a decrease in seed germination efficiency at higher concentrations of industrial effluent.

The osmotic pressure of the effluent rises with increasing concentrations of total salts, making inhibition more challenging and impeding germination efficiencies. The ability of seeds to germinate under high osmotic pressure varies depending on variety and species. Lower effluent concentrations support 100% seed germination in kidney bean and millet, whereas higher concentrations associated with sugar factory effluent reduce germination in these crops (Ajmal and Khan, 1983). Treatment with contaminated water also delays seed germination in Chickpea, possibly due to reduced water uptake at higher salinity levels caused by the toxicity of high osmotic pressure in the seedling medium. Khan and Sheikh (1976) reported a significant reduction and delay in the germination of Capsicum annuum seeds with sewage treatment, attributing it to decreased water uptake at higher salinity levels due to high soluble salts.

Moreover, notable decreases in seedling length were observed with textile wastewater treatments at concentrations of 75% to 100%. However, treatments at lower concentrations (25% to 50%) resulted in increased seedling length in Chickpea (refer to Table 3).

CONCLUSION:

The results of this study could have significant implications for agricultural practices, especially concerning the widespread irrigation of diluted effluent. The findings suggest that the best seed germination and seedling growth occur at effluent concentrations between 25% and 50%. Therefore, utilizing treated textile wastewater for irrigation could offer agricultural benefits. Moreover, it is advisable that textile wastewater undergoes thorough treatment before being discharged onto land to reduce pollution and mitigate potential adverse effects on the environment.

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Table 1, Physico-Chemical parameters of Textile waste water Parameter

S.No.	Parameter	Textile waste water
1.	Colour	Blackish
2.	pH	8.5
3.	TDS Mg/L	2340
4.	BOD. Mg/L	285
5.	COD. Mg/L	780
6.	Total Kjeldal Nitrogen	8.5
7.	D.O. Mg/L	2.5
8.	Sodium Mg/L	588
9.	Potassium Mg/L	26
10.	Sulphate Mg/L	402
11.	Magnesium Mg/L	64.4
12.	Chloride Mg/L	410

Table 2, Effect of different concentration of textile waste water on seed germination percentage (%) of Chickpea (*Cicer arietinumL.)*

Textile waste water concentration %	Percentage of germination
25%	94%
50%	88%
75%	80%
100%	68%
Control	95%

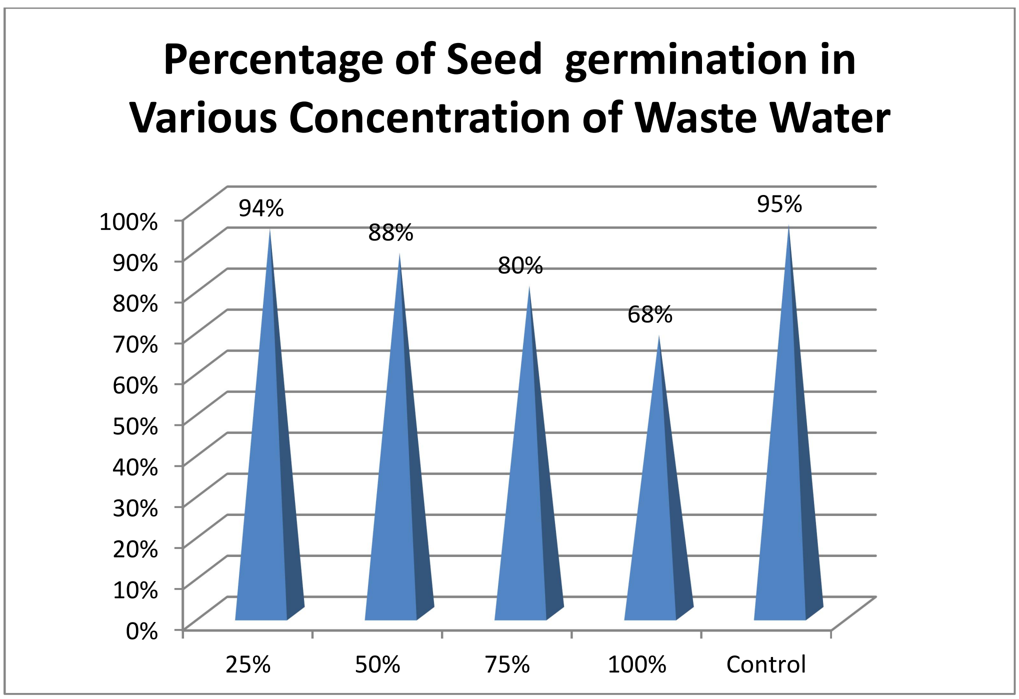
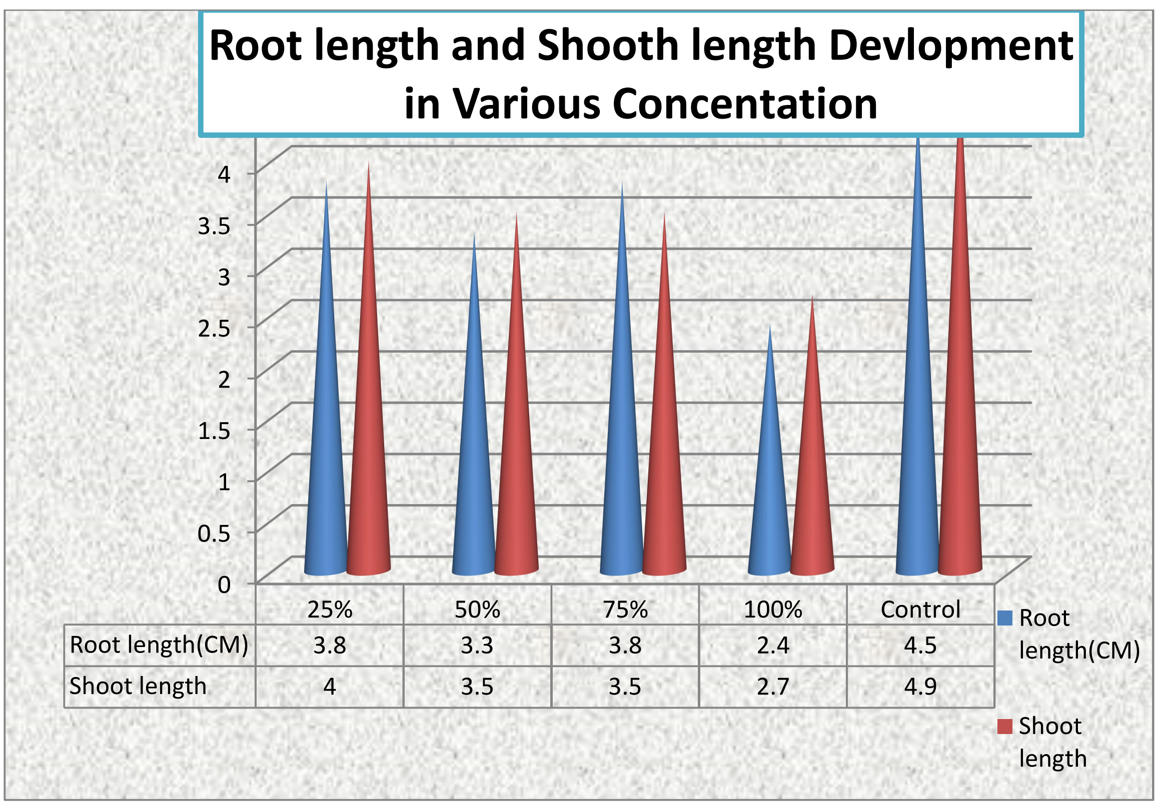


Table 3, Growth of Seedling in Various Concentrations

Concentration % of textile waste water	Root length(CM)	Shoot length(CM)
25%	3.8	4.00
50%	3.3	3.5
75%	3.8	3.5
100%	2.4	2.7
Control	4.5	4.9



(A)

Washing with Chemical and Water (B).Bleaching after Dye

(C) After Washing Dry to sunlight (D) After Dry Collect Cloth for Packing