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RESEARCH ARTICLE

EFFECT OF TEXTILE DYE ON SEED GERMINATION OF CHICKPEA

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ABSTRACT

The effect of textile effluent was studied with respect to germination and growth of chickpea (Cicer arietinum L.). In lower concentration the germination ratio and growth are relatively higher than the control, but gradual decrease in the germination of seeds, seedling growth with increase in effluent concentration was observed. The best germination and seedling growth was observed in 25% concentration with growth promoting effect and significantly better than control. Beyond 25% effluent, root and shoot length decreased. Thus the textile mill effluent can be safely used for irrigation purposes with proper treatment and dilution at 25%. Disposal of these effluents through proper treatment might have a positive result from the view of producing a sustainable environment. Consequently, farmers who are adjacent to textile industry areas will benefit by using treated effluent for production of crops that will minimize the use of fresh underground water for dying and other purposes.

INTRODUCTION

India is an agrarian country. Chickpea is one of the most important vegetables in India. Periphery and urban area are used by farmers for cultivation of this vegetable. Now a day, textiles dying effluents are discharging to agriculture crop areas without treatment of water. Treating waste effluents is very much significant for cultivation of crops and environment. Moreover, the economy of India is predominantly based on agriculture but, in the race towards industrialization, industries are taking place in a gradual increasing phase. The important industries are textiles, lather tanning, fertilizer, sugar, chemical pharmaceutical, oil refining and so on. Among these, textile industries are rapidly expanding day by day. There are 1821 small and large knit dyeing industries in India (Adeyinka and Urum, 2004). These industries are major source of effluents due to the nature of their operations which requires high volume of water that eventually results in high wastewater generation. The most common textile wet processing setup consists of desizing, scouring, bleaching, mercerizing, dyeing as well as finishing process. Dyeing is the process of adding color to the fibers, which normally requires a large volume of water.

However, the adverse effects of textile effluents on plants depend on the type of species, types and concentrations of toxic materials in the effluent. This necessitates a detailed scientific study before any specific waste can be used for irrigation for particular crop and environmental conditions. Seed germination is an important and vulnerable stage in the life cycle of terrestrial angiosperms and determines seedling establishment and plant growth. Such types of works have performed in a scattered way in many countries of the world rather those in our country, for instance, Muhammad and Khan found that industrial effluent reduced the germination percentage of kidney bean (Phaseolus aureus) and ladies' fingers (Abelmoschus esculentus). While working with Cicer arietinum Dayama (1987) reported that even highly diluted industrial effluent (5% of industrial effluent) adversely reduced the seed germination. In contrast, 50% diluted textile effluent increased the seed germination, total sugars, starch, reducing sugars and chlorophyll of groundnut seedlings. Similarly, effect of dye factory effluent was studied with respect to germination and growth of Bengal gram Cicer arietinum L. In lower concentration the germination percentage and growth are relatively higher than the control, but gradual decrease in the germination of seeds, seedling growth with increase in effluent concentration was observed (Hedge and Hofreiter, 1962).

The chemicals present in the textile effluent are not only poisonous to humans but also found toxic to the growth of plants and aquatic life. Certain pollutants in textile waste water are more important to target for pollution. Such effluents must be treated before discharging in to the agricultural field. Present investigation has clearly shown that industrial effluents are toxic to seed germination and growth rate. (Susan Verghese and Kumar, 2004).

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An experiment has been completed on the impact of dying effluents on germination and seedlings of country chickpea (Cicer arietinum L.) four types of dyeing effluents have been taken as treatment variables (Adriano, *et al*., 1973). The effect of textile effluent was studied with respect to germination and growth of chickpea (Cicer arietinum L.).

MATERIALS AND METHODS

Collection and storage of sample

The effluent was collected from textile mills at Sachin. The effluent was collected in sterile plastic container and filtered through ordinary filter paper to remove large suspended particles. After collection, immediately the water sample was brought to the laboratory and stored at 4^0C in a refrigerator. The effluent was collected directly from the outlet of the common effluent treatment plant (M. Koorneef., 2000).

Effluent dilution

Two different seeds were taken for germination studies Kabuli and Desi from the family Fabaceae. The seeds were procured from Agricultural University.

Dilution is one of the main processes for reducing the concentration of substances. Dye effluent was diluted to different concentration for experimental purposes (0 %, 4 %, 8 %, 10 %, 12 % and 16 %) Seed sterilization It was washed with tap water then with distilled water. The healthy and uniform sized seeds were selected (Pawar and Pawar, 2011). After it was treated with 0.2% Mercuric chloride for 2 minutes and washed with water to remove contamination of seed coat, prior to germination studies.

Experimental Design

Sterilized Petri plates prepared with filter paper and known volume of different concentration of dye effluent (0 %, 4 %, 8 %, 10 %, 12 % and 16 %) was poured into different Petri plates marked with the concentration. 20 seeds were placed especially in sterilized Petri plate. The effluent (50ml) was irrigated periodically at every 24 hours.

Germination of chickpea

Number of seeds responded for germination was observed on 15th day and growth was observed. The shoot length of the seedlings was recorded at every 48 hours for 15 days. Fresh and Dry mass, shoot and root length of the seedlings were determined after 15 days.

The seedlings were uprooted and washed thoroughly with distilled water and length of shoots and root length were measured. The plants were dried under natural conditions at the open roof top garden for 2 hours. The fresh weight was taken and the plants were then packed in paper envelopes and oven dried for 36 hours at 70˚ C. The dry weight of the seedlings was also recorded. The values were tabulated (Lakhshmi and Sundramoorthy, 2001).

Germination Studies Preparation of dilution

1. The seeds of Kabuli and Desi chickpea were surface sterilized with 0.1 % of mercuric chloride for 2-3 minutes, washed in running tap water for 3 minutes and in distilled water for 2 minutes.
2. Ten seeds of each chickpea were placed in sterilized glass petri plate of size 15 X 100 mm lined with two Whattman filter paper discs.
3. The filter papers were wetted with 5 ml of distilled water (control) and same (5 ml) of various concentration of textile effluent.
4. After seed inoculation the plates were incubated at room temperature, in the laboratory.
5. The preparation was moistened with 5 ml of effluent every 12 hrs and observed for radicle emergence. Triplicates were maintained, the results were averaged.
6. Germination percentage, relative root length, shoot length, dry weight, fresh weight were determined.

Measurement of Shoot, Root length, Fresh weight and Dry weight

The root, shoot length were measured in cm/plant. On the sixth day the germinated seeds were weighed to record the fresh weight using electrical Single Pan Balance. After the fresh weight of germinated seed it was dried at 65o C in hot air oven for 24 hrs and dry weight was recorded.

Protein Estimation

Five ml of phosphate buffer (pH 7.0) was taken in mortar and pestle with 10 number of dried germinated seed. And it was crushed in cold room. From the crushed material 5ml is taken and it was centrifuged at 8000rpm for 20 min. After centrifugation the supernatant is taken for protein estimation under Bradford's method and Folin-lowry's method (Lowry, *et al*., 1951)

RESULTS AND DISCUSSION

Results of Germination study

The germination percentages of treated effluent grown seeds are comparable with control plant. The germination percentage in raw effluent is concentration dependant decreasing with increasing effluent concentration.

Table 1 Effect of different stages of textile dying effluents on seedling growth *C. arietinum*

Length (cm)	Chickpea type	Control	Textile Dye 1	Textile Dye 2	Textile Dye 3	Textile Dye 4
Shoot	Desi	10.1	4.5	6.8	0.5	12.1
	Kabuli	4.5	7.2	0.5	0.9	4.1
Root	Desi	14.1	5.6	4.6	0.5	7.3
	Kabuli	8.5	1.6	1.2	0.3	3.1
Seedling	Desi	24.1	10.1	11.1	1.0	19.4
	Kabuli	13	8.8	1.7	1.2	7.2

Values for various parameter of the effluent are given in Table 1 and Table 2. At higher concentration, the germination percentage was gradually decreased from 4 % – 16 % raw effluent. It may also be due to the disturbance of the osmotic relation of the seed and water, thus reduced the amount of absorbed water and retarded seed germination by enhanced salinity and conductivity of the solutes. Furthermore, the germinated seeds will not get any oxygen due to organic and inorganic chemicals present in the effluent.

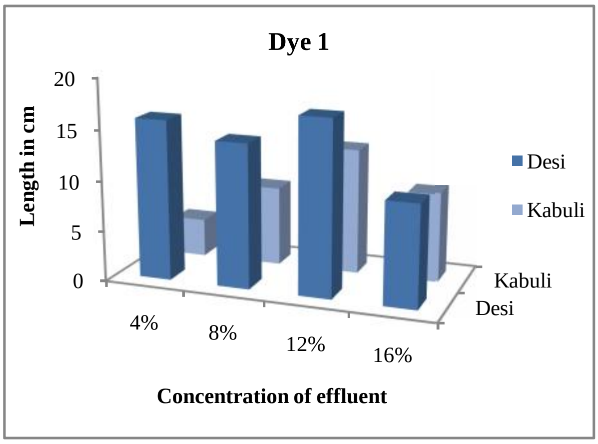

Figure 1 Effect of textile mill effluent on Seed Germination of *C. arietinum*

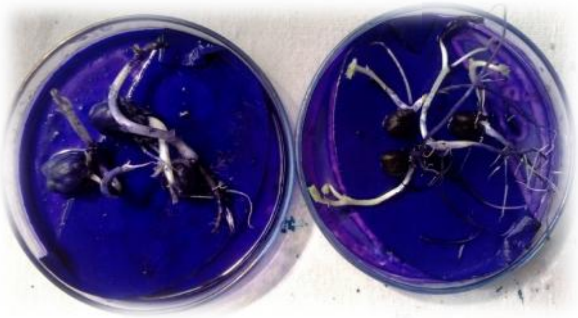

Figure 2 The root and shoot length of *Cicer arietinum L.*

The decrease in germination percentage might be due to the reduction in level of toxic metabolites by dilution and better utilization of nutrients present in the effluent. The reduction in germination percentage at higher concentration may also be due to the excess amount of minerals and nutrients present in the effluent.

Reduction in seed germination percentage at higher amounts of solids present in the osmotic relationship of the seed and water. The reduction in the amount of water absorption takes place with results in to reduction of seed germination due to enhance effluent salinity.

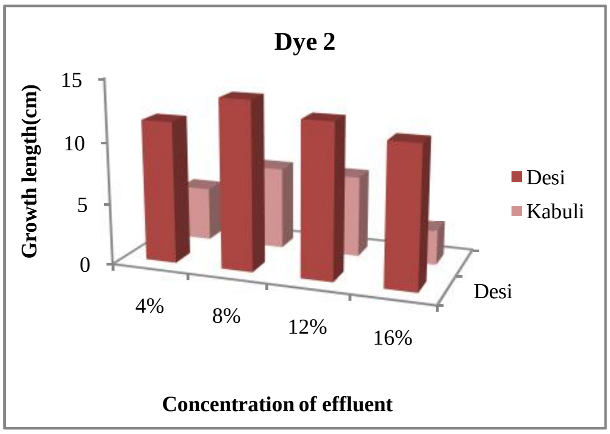

Figure 3 Effect of textile mill effluent on Seed Germination of *C. arietinum*

Figure 4 The root and shoot length of *Cicer arietinum* L

Industrial effluent rich in organic matter and plant nutrients are finding agricultural use as cheaper way of disposal. The evolution of toxicity of these wastes by biological testing is therefore extremely important for screening the suitability of waste for land application. For environmental testing, bioassays provide an integrated picture of overall toxicity of an effluent, reacting in a predictable way to various types of environmental contaminants.

The effluent directly released from the industry affect the germination of seeds and completely destroys the agriculture. In order to prevent this effluent was diluted to different concentration and seeds were allowed to grown germination was observed in seeds cultivated in low concentration of effluent. The concentration of macro molecules such as carbohydrates, protein was also increased. The enzyme activity of amylase, protease and catalase in effluent treated seeds were also comparable with that of seeds germinated in tap water. The concentration of some other important compounds was increased in the effluent treated seeds.

The industrial effluent can be used for irrigation purpose by the farmers on the basis of the fact that the effluents may serve as a potential source of fertilizer for agricultural use and prevent the wastewater from being a environmental hazard. Use of wastewater in agricultural irrigation is becoming a common and ever increasing practice because of two reasons. Firstly, wastewater represents an extra source of water available for irrigation. Secondly, recycling of the nutrients through the crops and biological degradation of remaining organic matter.

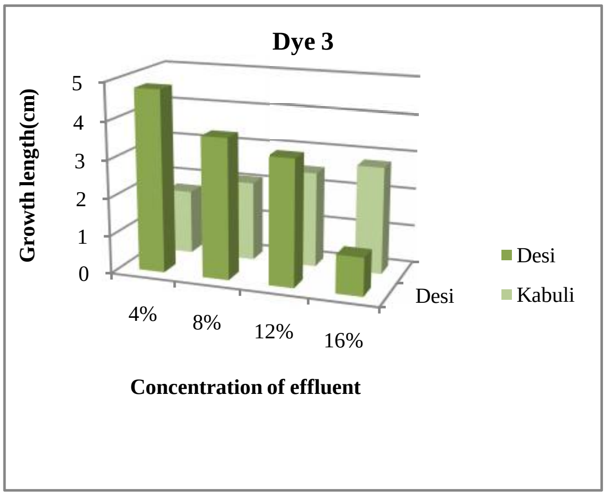

Figure 5 Effect of textile mill effluent on Seed Germination of *C. arietinum*

Figure 6 The root and shoot length of *C. arietinum*

The inhibition of plant growth and crop production by toxic pollutants is a global agricultural problem. Plants adapt to pollution stress by different mechanisms, including changes in morphological and developmental stresses as well as physiological and biochemical processes. Cicer arientum were treated with industrial effluent for 20 days in 4%, 8%, 12%, 16%. pure tap water as control and treated effluent to compare the effect of industrial effluent on seeds. Germination percentage was high in the control and it decreases beyond 4% dilution. At 16% effluent treatment the seed germination was completely inhibited.

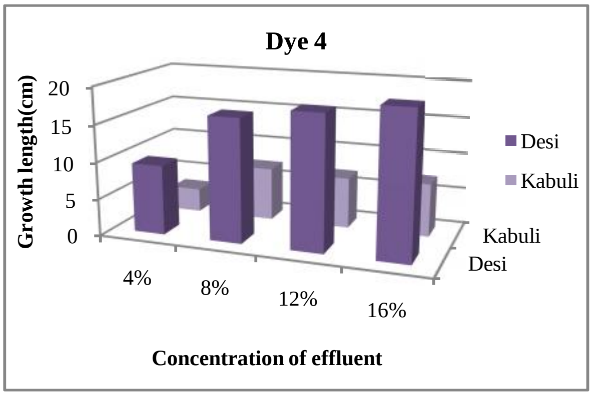

Figure 7 Effect of textile mill effluent on Seed Germination of *C. arietinum*

Figure 8 The root and shoot length of *Cicer arietinum*

Textile industries are major sources of these effluents due to the nature of their operations which requires high volumes of water that eventually result in high waste water generation (Ghoreishi and Haghishi, 2003). Industrial effluents possess various organic and inorganic chemical compounds. The presence of these chemicals will cause detrimental effects on the development of plants, germination process and growth of seedlings. Therefore, neutralization of effluent water should be considered for crop production, reuse and sustainable livelihoods. Therefore, it is necessary to study the impact of effluents on crop systems before being recommended for irrigation (Thamizhiniyan *et al.,* 2009). In this respect, continuous research on the hazards of effluent will play a significant role for sustainable environments.

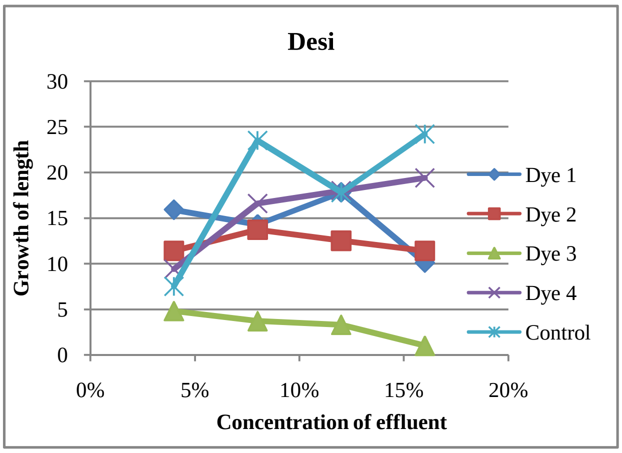

Figure 9 Shows the overall length of germination in effluent of Seeds *C. arietinum*

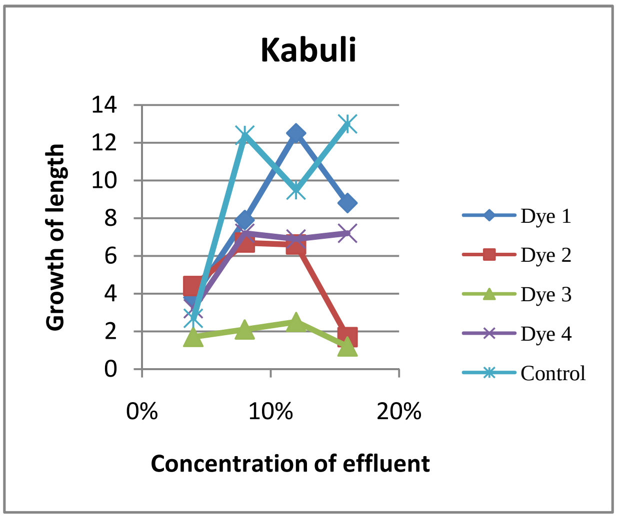

Figure 10 Shows the overall length of germination in effluent of Seeds *C. arietinum*

Figure 11 The seedling growth of *Cicer arietinum*

Germination percentages of seeds were counted daily in specific time. At that time, those seeds were considered germinated when their radical length was more than 3 mm. Counting continued to count more germinated seeds and the results of different days of observation were converted into percentage and shown in figure 5. From this figure it has been revealed that, the highest percentage of germination was observed in Dye 1 and 2 treatment at three days after sowing and the lowest was in Dye 3 treatment which was identical. On the other hand, after four days sowing, the highest result was also found in case of Dye 2 treatment which was similar with Dye 1. Treatment Dye 3 showed the lowest result. Moreover, after five days sowing the highest germination percentage was found in Dye 1 and treatment Dye 3 performed as the lowest. The similar trend of results was also observed after 20 days of observation.

Fresh Weight and Dry Weight

The fresh weight (FW) and dry weight (DW) of plant samples grown in various concentration of effluent were presented in Table: 3. FW and DW were also increased at lower concentration and decreased at the higher concentration of dye effluent. The presence of optimum level of nutrients in the lower concentration of dye effluent might have increased the FW and DW of crop plant. The reduction in dry weight of plant material may be due to the poor growth under effluent irrigation (Balashouri and Prameela Devi., 1994).

The high yield of plant at lower concentration might depend on the enhanced low concentration of pigments, sugar and protein (Pragasam and Kannabiran, 2001).

The decreased in shoot length, root length, fresh weight and dry weight were recorded. It may be due to the presence of toxic pollutants in the effluent. The same result affects the respiration of the root (Singh et al., 1994).

The dried form of Cicer arietinum L. seed material weighed exactly after 24 hours kept in hot air oven. There was a drastic change in fresh weight and dry weight of different concentration in effluent but it varies between 2 seeds. (Figure 12)

Table 3 Effect of dying effluents on seedling growth of *C. arietinum*

	Effluent Concentration (hr)	Desi	Kabuli
Fresh weight(g)	0	3.735	6.048
Dry weight(g)	24	2.314	2.987
	48	1.431	1.890

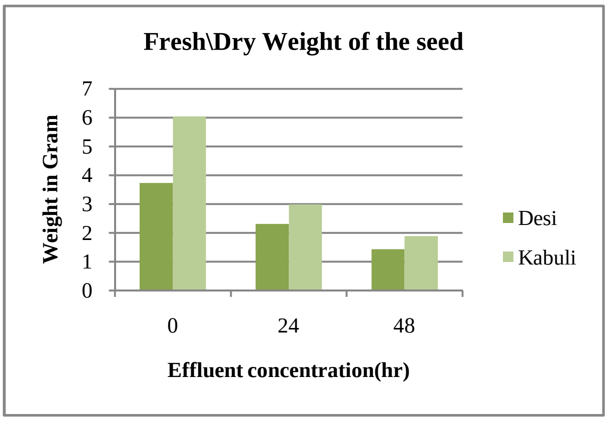

Figure 12 Fresh\Dry weight of the seeds of *Cicer arietinum*

Protein Estimation

There is a significant Increase in protein content of Cicer arietinum L. The maximum protein content of 0.537 mg/mL was observed in Graph. The least concentration of protein was found in concentration. In Kabuli concentration shows the very least amount of protein (Figure13) and Bradford's method protein level is positive

Table 4 Protein Estimation of Different seeds of *C. arietinum*

	Standard	Desi	Kabuli
Blanck	–	–	–
0.5	1.12	0.30	0.26
1.0	1.38	0.63	0.50

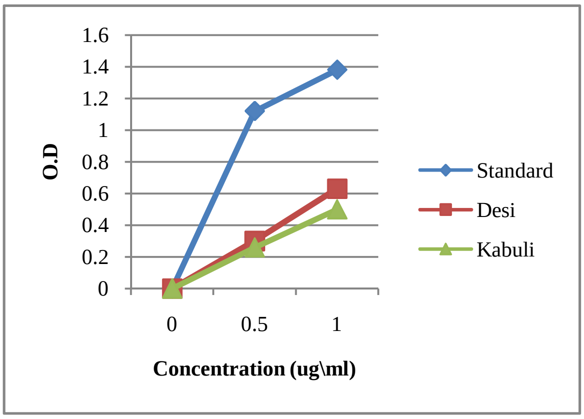

Figure 13 Estimation of Protein of Cicer arietinum.

CONCLUSION

It is concluded that Effect of Dye on seed germination on Chickpea of the effluents that's were exceeded the standard limit has negative impact on germination.

The large number of extensive and intense research proves the potential toxicity of textile effluent over soil and aquatic biodiversity, mainly a pre-treatment stage is very essential for wastewater remediation. In recent years, many authors have also developed combined chemical, physical and biological systems for the treatment of a diversity of wastewater and industrial pollutants and evaluating toxicity during and after the degradation process. Since the textile effluents are highly polluted, it is not directly used in agriculture purposes.

The plumule and radicle lengths also decreased in case of untreated effluent and the simulated dye mixture samples. Whereas the treated samples were less toxic and showed lower inhibition percentages as compared to their untreated forms. The exposure of the untreated effluent and dye mixture was highly toxic to the plantlets as the root and shoot lengths [Dye 3>Dye 2>Dye 4>Dye 1 in Desi and Dye 3>Dye 2>Dye 1>Dye 4 in Kabuli] were also inhibited when compared to treated effluent and dye mixture samples by different sets of reactors.

Disposal of these effluents through proper treatment might have a positive result from the view of producing a sustainable environment. Consequently, farmers who are adjacent to textile industry areas will benefit by using treated effluent for production of crops that will minimize the use of fresh underground water for dying and other purposes.

In India, the abundance of soils with low organic matter content, favors the use of industrial wastewaters containing organic matter as an organic amendment and nutrient supply to soil. Although the benefits of waste water use in irrigation are numerous but precautions should be taken to avoid short and long-term environmental risks related). So it is essential to treat the dyeing industrial effluents before their use in agricultural fields.

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