Print & Online, Open Access, Research Journal Available on http://jbsd.in
ISSN: 2229-3469 (Print); ISSN: 2231-024X (Online)

Research Article

Impact of dyeing industrial effluent on *Dolichos lablab* L.in pot culture

Jairajpuri Mariya[1], Patel Kailash[2], Jadav Rajendra[3] and Reddy M.N.[4]

[1, 2, 4] Veer Narmad South Gujarat University, Surat, Gujarat, India
[3] Bhavan's Sheth R.A. College of Science, Khanpur, Ahemdabad, Gujarat, India
[*]mariyajairajpuri@gmail.com

Article Info

Received: 02-10-2017,
Revised: 05-12-2017,
Accepted: 11-12-2017

Keywords:
Chlorophyll, Antioxidant enzymes, Dyeing effluent, *Dolichos lablab* L., oxidative stress.

Abstract

Insufficient quality of fresh water for agriculture has made application of wastewater a popular option. The present study was designed to study the morphological characteristics, chlorophyll content and antioxidant responses in roots, shoot, leaves and fruit of *Dolichos lablab* grown under dyeing industrial effluent. The diluted (10, 20, 50 and 80%), and undiluted (100%) effluent was used to irrigate *Dolichos lablab* plants in loamy sandy soil. The plants was harvested after maturation and was checked for number of branches, number of leaves, number of fruits, weight of fruits, number of pods and chlorophyll content of the leaves. Oxidative stress was also checked by the analysis of 3 key antioxidant enzymes such as Superoxide Dismutase (SOD), Guaiacol Peroxidase (POD) and Catalase (CAT) activity. The study indicates that plants growing at diluted concentration (10%) in dyeing wastewater have developed a condition of defense strategy.

INTRODUCTION

Increasing demand of irrigation water due to increasing urbanization and scarcity of water has moved our steps towards the reuse of industrial waste water for irrigation purposes in developing countries including India; hence representing an agronomic option for such regions (Meli *et al.*, 2002; FAO, 2011).Disposal of industrial effluent is causing tremendous pollution, but it can be alternatively used for irrigating the crop plants. This treated wastewater also offers the opportunity to recycle plant nutrients (Chen *et al.*, 2008).

Continuous application of this wastewater leads to enrichment of soil with essential macro and micro nutrients (Dass and Kaul, 1992; Kanan *et al.*, 2005); although periodic monitoring of the physical properties of soil needs to be done to avoid any imbalance in nutrient supplies causing uneven growth of the plant such as excessive vegetative growth, uneven maturity, weight and reduced yield (Pedrero *et al.*, 2010).

Plants generate reactive oxygen species (ROS) when they experience any sort of environmental stress (Shah *et al.*, 2001). In order to survive under the stress condition, plants have enzymatic and non-enzymatic antioxidants to scavenge free radicals (RS^*, H_2O_2) and reactive oxygen species (O^- , O_2^*, OH^*). (Gratao *et al.*, 2005) concluded that antioxidants can be considered as a stress markers to assess stress response in plant system. This oxidative damage can be mitigated by plants defense system composed of antioxidant enzymes such as SOD, CAT and POX. *D.lablab* is an important pulse crop in South East Asia and Eastern Africa. It is used as an intercrop in India and Australia, as a weed suppressor and soil erosion retardant. It is also an excellent nitrogen fixer, and grown as a cover crop or for livestock fodder (D'souza MR and Devaraj VR, 2011).

The aim of the present study was to determine the effects of treated dyeing industrial effluent on the performance of *Dolichos lablab.*

In particular, the objectives of the study were; (1) to evaluate the effects of industrial effluent the morphology and chlorophyll content of the bean plants. (2) To check the antioxidative potential of the plants towards the dyeing effluent.

MATERIALS AND METHODS

Experimental design

The experiment was carried out in black polyethylene bags of 33 × 24 cm. 3 replicates per treatment was used, thus making a total of 18 pots.

Test organism

Seeds of *Dolichos lablab* were purchased from Agriculture Produce Market Committee, Surat – Gujarat. Seeds with uniform size, weight and colour were chosen to run the experiment

Test agent

Dyeing industrial wastewater samples were collected from the drain of common effluent treatment plant (CETP) located in Pandesera region of Surat, Gujarat, India. Six irrigation treatments of the effluent (0, 10, 20, 50, 80 and 100%) were made and supplied every 2 days to each pots. Tap water was used as a control.

Soil and biological materials

Loamy soil was collected from the agriculture field of Saroli region, Surat. It was then sieved (2mm) and was kept for sun drying for 2 days. Pots were filled with 5 kg of soil with 10 seeds per pot. Later, it was thinned to 3 plants per pots and studied up to maturation.

Growth conditions

Plant was grown in pots in natural atmospheric condition and photo radiation from October 2016 to January 2017.

Biochemical analysis

Chlorophyll a, b and total chlorophyll content in fresh leaves of treated and control plant was estimated by MacKinney's method, 1941.

Determination of antioxidant enzyme activities

Superoxide dismutase (SOD) (EC 1.15.1.1) activity was determined by Beauchamp and Fridovich, 1971. The activity of Guaiacol peroxidase was determined spectrophotometrically as described by Chance *et al*., 1955. Activity of catalase was assayed according to the method of Aebi, 1984.

Statistical analysis

Data were expressed as mean ±standard deviation (SD). Results were statistically analysed by independent sample student's t-test using SPSS 17.

RESULTS

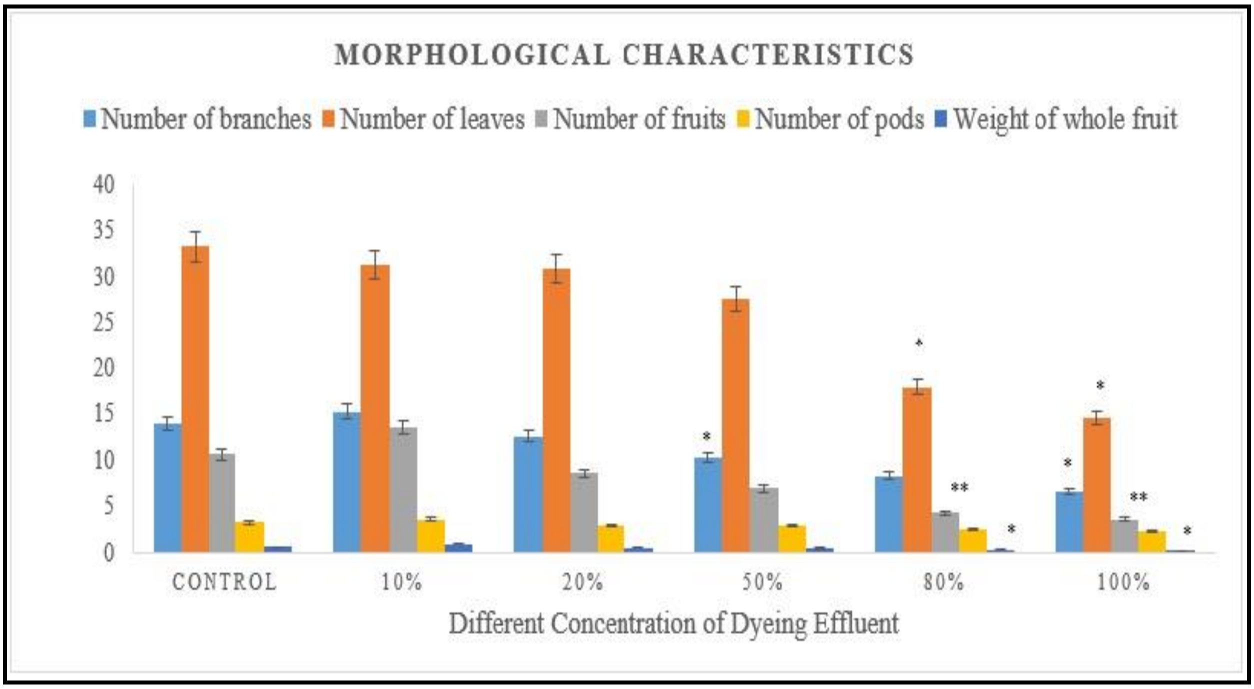

Fig. 1: Morphological characteristics of bean plants exposed to five different levels (0%, 10%, 20%, 50%, 80% and 100%) of dyeing industrial effluent. The data presented are means of means of 3 replicates ± SD. Bars with * and ** show significant difference at $p \leq 0.05$ and $p \leq 0.005$.

Number of branches, number of fruits, pods of fruits and weight of whole fruit was higher at 10% concentration of irrigated effluent than the control except for the number of leaves which was higher in control plants irrigated with tap water. While for other concentration, a decreasing trend in number of branches, number of fruits number of leaves and weight of fruits was observed which confirms the toxic effect of this effluent to *Dolichos lablab*. Though the number of pods in plants irrigated with 20% and 50% were same, it differed in their weight.

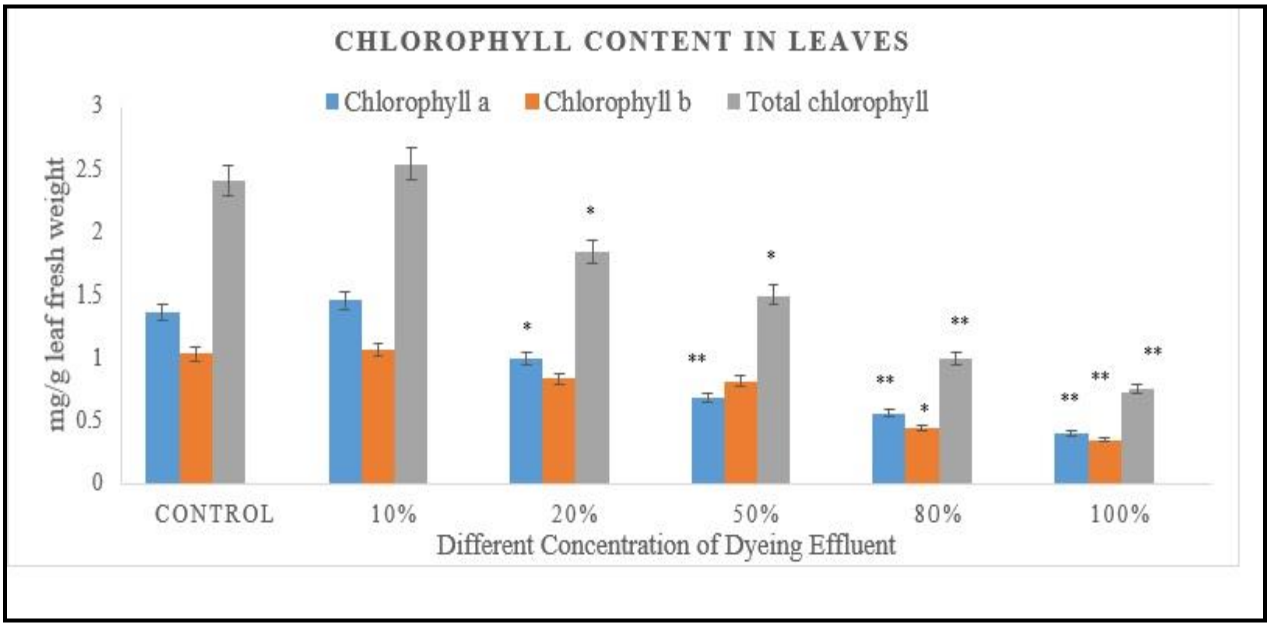

Fig. 2: Pigment content of leaves of bean plants exposed to five different levels (0%, 10%, 20%, 50%, 80% and 00%) of dyeing industrial effluent. The data presented are means of means of 3 replicates ± SD. Bars with * and ** show significant difference at $p \leq 0.05$ and $p \leq 0.005$.

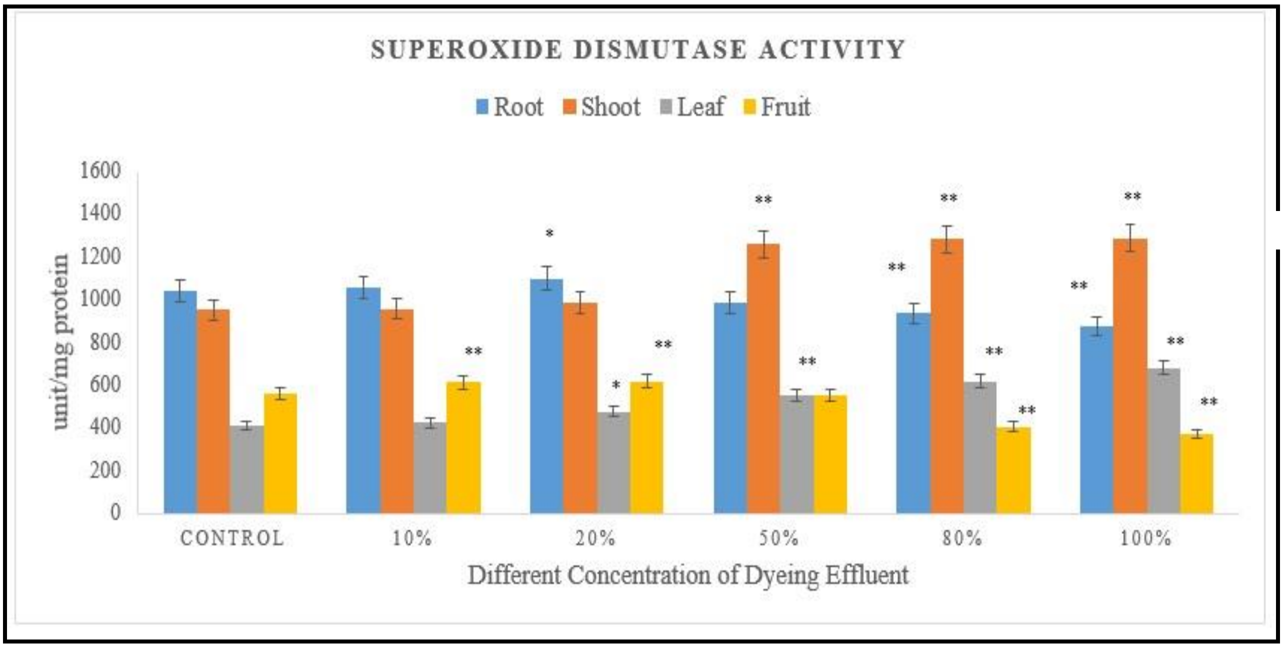

Fig. 3

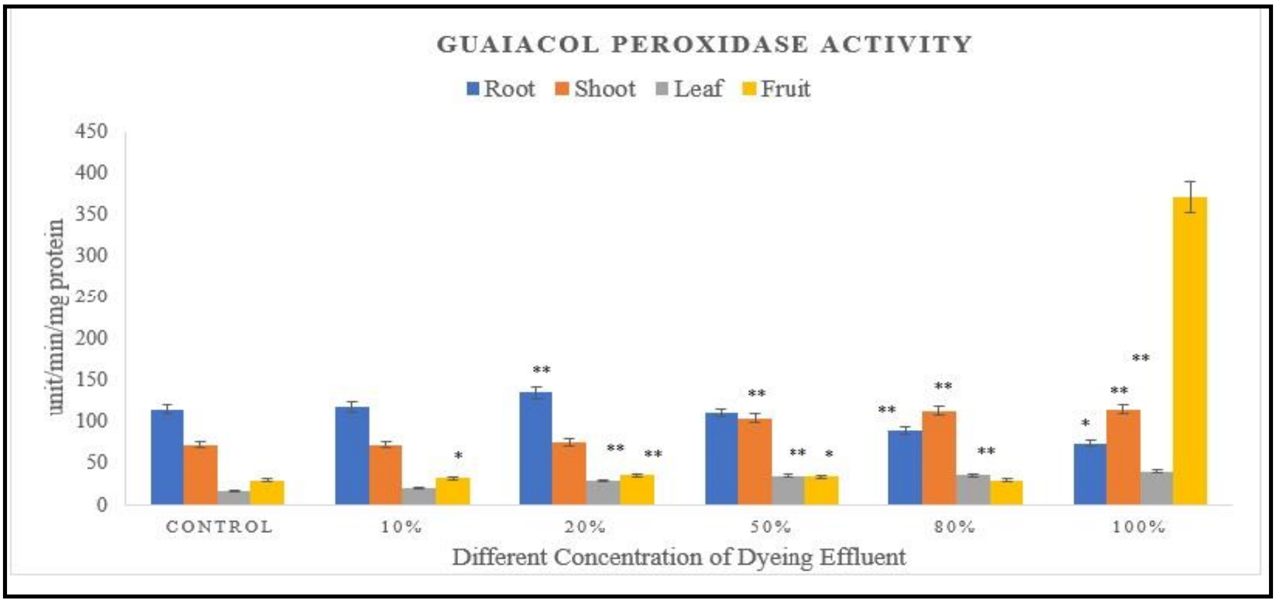

Fig. 4

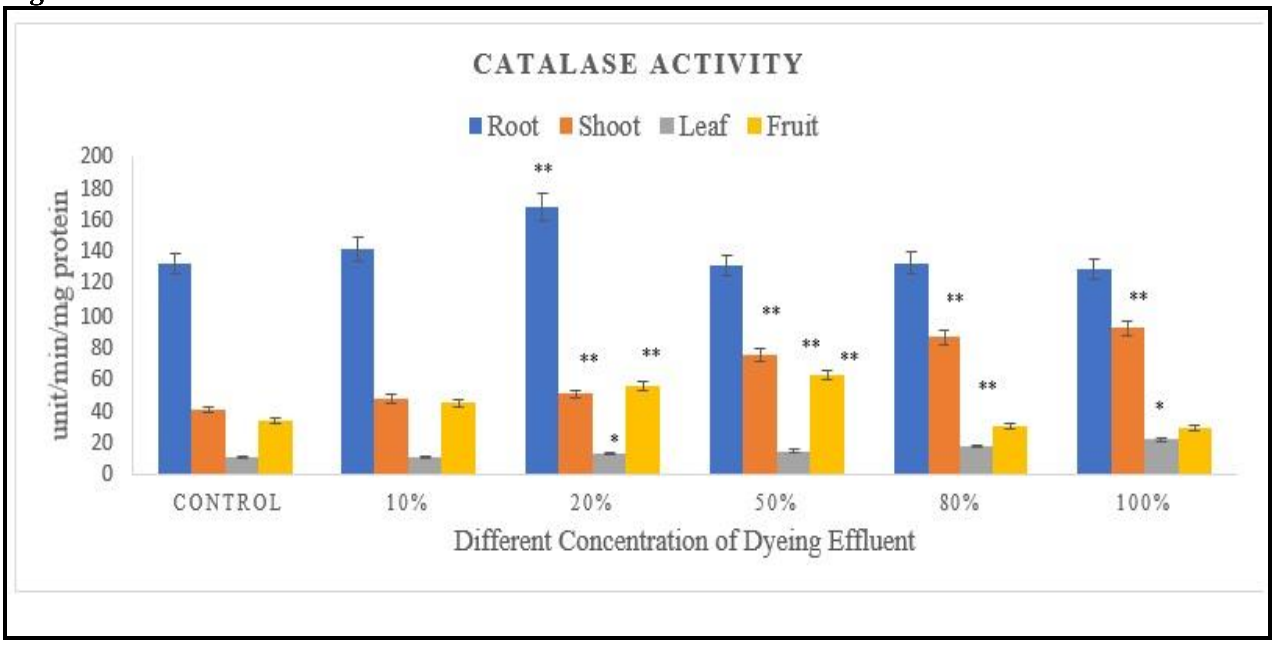

Fig. 5

Fig. 3, 4 and 5: Antioxidant enzymes level of bean plants exposed to five different levels (0%, 10%, 20%, 50%, 80% and 100%) of dyeing industrial effluent. The data presented are means of 3 replicates ± SD. Bars with * and ** show significant difference at $p \leq 0.05$ and $p \leq 0.005$ respectively.

Antioxidant enzyme activities such as SOD, POX and CAT differed in root, shoot, leaves and fruits of the plants.

Chlorophyll a, chlorophyll b and total chlorophyll content was higher at 10% concentration of dyeing industrial effluent than the control plant. Further the values decreased with the gradual increase in the effluent as shown in the figure 2

Figure 3 shows changes in Superoxide dismutase activity in root, shoot, leaf and fruit of *Dolichos lablab* L. grown under different concentration of dyeing effluent. An effective increase in the SOD activity in shoot and leaves of the plant is observed with the increase in dyeing effluent concentration, whereas the SOD activity in root and fruit of a plant increased upto 20 % concentration thereby causing a gradual decline at 50, 80 and 100% concentration.

Changes in Guaiacol peroxidase activity in root, shoot, leaf and fruit of *Dolichos lablab* L. grown under the effect of different concentration of dyeing effluent is shown in figure 4. There was a uniform increase in Guaiacol peroxidase activity in shoot and leaves treated under all concentration. Whereas the POX activity in root showed an increase uptill 20 % concentration thereby causing a gradual decrease at 50, 80 and 100% concentration. The POD activity in fruit showed an increasing effect uptill 50 %, which decreased at 80 and 100% when compared to control.

Figure 5 shows effect of dyeing effluent in Catalase activity in root, shoot, leaf and fruit of *Dolichos lablab* L. Catalase activity increased with the increasing concentration of dyeing effluent in shoot and leaves of the plant. Catalase activity in root showed an increment up till 20% concentration while at 50%, 80% and 100% showed a profound decrease. The catalase activity in fruit showed an increase in the activity till 50 % concentration. At 80% and 100% decrease in the activity was recorded.

DISCUSSION

In the present study, number of branches, number of leaves, number of fruits, size of fruits, chlorophyll content of leaves increased at lower concentration (10%) of the effluent which decreased as the concentration increased. This is because the lower concentration of the dyeing effluent contained optimum levels of micro and macro nutrients that may have served as a potential fertiliser **(Singh *et al*., 2002)** which might have increased the growth attributes of plants. While at higher effluent concentration, nutrients were raised too high to become toxic resulting in retarded growth.

The plants irrigated with diluted dyeing wastewater grew well upto 10% concentration. However as the concentration of the effluent was increased symptoms like chlorosis, necrosis, drying and wilting of leaves and stunted growth in fruits were observed. The similar results was recorded by **(Naaz S and Pandey SN, 2010).**

Dyeing effluent treatment of the *Dolichos lablab* in this study resulted in increase in the activities of SOD, POX and CAT at all the effluent concentrations in shoot and leaves. In root and fruit, the effluent caused an increase in the antioxidant enzymic activities at lower concentration while higher concentrations led to enzyme inhibition. (**Olorunfemi DI and Lolodi O, 2011)** concluded similar results while working with onion bulbs treated with cassava effluent.

Textile mill effluent diluted upto 25% enhances the growth of black gram **(Wins JA and Murugan M, 2010)**. **(Mohammad A and Khan AU, 1985)** also found no adverse effect of textile industry effluent at lower concentration (< 50% effluent concentration) which is in conformity with the present results (effective concentration 10% effluent). Reduction in chlorophyll content was noted when plant was exposed to effluent concentrations higher than 50% which is supposed to be due to inhibitory effects of toxicants on synthesis of chlorophylls. **(Mistry et al., 2017)** also reported chlorosis in the leaves of radish at higher concentration of thermal treated effluent. Induced inhibition of ETS IN PS II may be another reason for decline in chlorophyll content (**Izawa, S. 1997).**

Conclusion

From the present study, it can be concluded that the higher concentration of treated textile dyeing effluent inhibits the plant growth but could be used for irrigation purpose after dilutions as evident from the above results. However for successful, safe and long term use of waste water for irrigation requires periodic monitoring of physical properties of soil, plants and ground water.

Acknolwdgement

The authors are grateful to Department of Bioscience, Veer Narmad South Gujarat University, Surat, Gujarat for providing laboratory facilities. The authors are also thankful to UGC as this work was supported by funding from Maulana Azad National Fellowship F1-17.1/2015-16/MANF-2015-17-GUJ-57399/ (SA-III/ Website) - UGC, Bahadurshah Zafar Marg, New- Delhi.

REFERENCES

Aebi H, 1984. Catalase *in Vitro*. *Methods in Enzymology*, **105**: 121-126.

Beauchamp C and Fridovich I, 1971. Superoxide dismutase: improved assays and an assay applicable to acrylamide gel. *Anal. Biochem*, **44**: 276-287.

Chance B. and Maehly AC, 1955. Assays of Catalases and Peroxidases. *Methods in Enzymology*, **2**:764-775.

Chen, W., Wu, L., Frankenberger Jr., W.T., Chang, A.C., 2008. Soil enzyme activities of long-term reclaimed wastewater-irrigated soils. *J. Environ. Qual*. **37**: 36–42.

D'souza MR and Devaraj VR, 2011. Specific and non-specific responses of Hyacinth bean (*Dolichos lablab*) to drought stress. *Indian Journal of Biotechnology*, **10:** 130-139.

Dass D and Kaul RN, 1992: Greening wasteland through wastewater. National Wastelands Development Board, Ministry of Environment and Forest, New Delhi, India, Pp 33.

FAO, 2011. The State of the World's Land and Water Resources for Food and Agri-culture. The Food and Agriculture Organization of the United Nations And Earth scan, ISBN 978-1-84971-326-9 (hdk).

Gratao LP, Polle A, Lea PJ and Azevedo RA, 2005. Making the life of heavy metal – stressed plants a little easier. *Funct. Plant Biol.*, **3:** 481-494.

Izawa, S. 1997: Photosynthesis (Eds.: A. Trebest and H. Avron). Springer Verlag, Berlin, 256-286.

Kanan, V., R. Ramesh and C. Sasikumar 2005: Study on ground water characteristics and the effects of discharged effluents from textile units at Karur District. *J. Environ. Biol*., **26**: 269-272.

McKinney G, 1941. Absorption of light by chlorophyll solutions. *J. Biol. Chem*. **140**: 315-322.

Medhi, UJ, Talukdar AK and Deka S, 2008. Effect of pulp and paper mill effluent on seed germination and seedling growth of mustard (*Brassica campastris*), Pea (*Pisum sativum*) and rice (*Oryza sativa*) seeds. *Pollution Research*, **27(3):** 437- 442.

Meli S, Porto M, Bellign A, Bufo SA, Mazzatura A, Scopa A, 2002. Influenceof irrigation with lagooned urban wastewater on chimica and microbiologicalsoil parameters in a citrus orchard under Mediterranean condition. *Sci. Total Environ.* **285**: 69–77.

Mistry Brijal, Patel Kailash, Reddy MN, 2017. Impact of Thermal Power Plant Effluent on Changes of Growth and Pigment Content in *Raphanus sativus* L. *Bioscience Discovery*, **8**(4): 707-711.

Mohammad A and Khan AU, 1985: Effect of textile factory effluent on soil and crop plants. *Environ. Pollut*. **37**:131-148.

Naaz S and Pandey SN, 2010. Effects of industrial waste water on heavy metal accumulation, growth and biochemical responses of lettuce *(Lactuca sativa L.*) *Journal of Environmental Biology*, **31**: 273-276.

Olorunfemi DI and Lolodi O, 2011. Effect of Cassava Processing Effluents on Antioxidant Enzyme Activities in *Allium Cepa. Nigerian Society for Experimental Biology*, **23**(2), 49 – 61.

Pedrero F, Kalavrouziotis I, Alarcón JJ, Koukoulakis P, Asano T, 2010. Use of treated municipal wastewater in irrigated agriculture—review of some practicesin Spain and Greece. *Agric. Water Manage*, **97**: 1233–1241.

Shah K, Kumar RG, Verma S, Dubey RS, 2001. Effect of cadmium on lipid peroxidation, superoxide anion generation and activities of antioxidants enzymes in growing rice seedlings. *Plant Sci*, **161**:1135-1144.

Singh A., Aggarwal SB, Rai JPN and Singh P, 2002: Assessment of pulp and paper mill effluent on growth, yield and nutrient quality of wheat (*Triticum aestivum* L.). *J. Environ. Biol*., **23**: 283-288.

Wins JA and Murugan M. 2010. Effect of textile mill effluent on growth and germination of black gram *Vigna mungo* (L.) Hepper. *Int. J. Pharma. BioSci*, **1**: 1-7.

How to cite this article

Jairajpuri Mariya, Patel Kailash, Jadav Rajendra and Reddy M. N., 2018. Impact of dyeing industrial effluent on *Dolichos lablab* L.in pot culture. *Bioscience Discovery*, **9**(1): 188-193**.**