Poll Res. 43 (1–2) : 22-26 (2024)

ISSN 0257–8050
DOI No.: http://doi.org/10.53550/PR.2024.v43i01-02.006

INFLUENCE OF INDUSTRIAL WASTEWATER ON MORPHOLOGICAL AND CHLOROPHYLL CONTENT OF GROUNDNUT (*ARACHIS HYPOGAEA* L.)

V. SUDHAKAR, JYOTHI MANOHAR CH, K. ABRAHAM AND T. DAMODHARAM

Department of Environmental Sciences, S.V. University, Tirupati 517 502, A.P, India

(Received 27 September, 2023; Accepted 14 November, 2023)

ABSTRACT

The objective of the present study is to find out the influence of industrial wastewater on morphological and chlorophyll content of groundnut (*Arachis hypogaea* L.). Pot culture experiments were conducted on groundnut plants under natural conditions by day and night light in the Department. Seeds were grown in pots for a period of 30 days where the soil was treated with various wastewater concentrations (25, 50, 75 and 100%) collected nearby industrial area and a control was carried out. The heavy metals comprise in experimental crops were determined and observed in experimental days i.e., 10, 20 and 30th day. The metals such as Cr, Cu, Mn, Fe, Ni, Pb, Cd and Zn were estimated in plants by AAS. The germination percentage of seed, seedling growth and chlorophyll content showed a gradual decline with increase in wastewater concentrations. The results have been observed at 25% concentration, there was growth rate in root length, an increase in shoot length and total chlorophyll content up to 20th day. At 30th day, decrease was observed in all the parameters. However, at higher concentrations of the effluent, toxic effects were observed from 20th day onwards.

KEY WORDS : Wastewater, heavy metals, Germination, Cholorophyll, A*rachis hypogaea* L.,

INTRODUCTION

Water and soil pollution has become a global problem due to population growth and industrialization. Wastewater is polluted water which is discharged by human usage and it is unfavorable for any particular purposes like drinking, commercial, agriculture and industrial use.

High concentration of BOD, COD, TDS, AND, Cr etc. in tannery and textile industrial effluents adversely affects soil and water bodies as well as plant growth (Chhonkar *et*, *al.,* 2000). Especially the waste water released from the industrial zones is constantly adding toxic substances to the groundwater aquifer. Humans in many parts of the world depend heavily on groundwater for their needs (Babiker *et al.,* 2004; Nair *et al.,* 2006). There are numerous chemical species present in water with concentrations vary from a few mg/l to a few g/l. They are referred as micro-pollutants, which even in small quantities are dangerous to man's health (Ngah WSW *et al.* 2011 and Holzer *et al.,* 2010). The industrial effluents have showed an adverse affect on morphological parameters and chlorophyll content of green gram (*Phaseolus aureus*). Unsanitary activities and use of waste water for irrigation create serious pollution and adverse effects on soil and crops. Because of the harmful effects of public, hospital, and industrial wastewater on soil, air, water, as well as agricultural product, wastewater treatments and the proper sludge disposal are needed for environmental protection (Dushyanth *et al.,* 2019). Untreated discharge of industrial effluents are responsible for serious water (Otokunefor and Obiukwu, 2005) and soil pollution (Konwar and Jha, 2019), which is considered as one of the major factors responsible for low productivity of crops. Similar findings were revealed on the effect of various industrial effluents on different crops

(Cabral *et al.*, 2010).

The toxic levels of mineral elements like NH4+, NO_3-, PO_4^{3-}, and SO_4^{2-}, and Mg, Ca, K, Na, Cu, Zn, Fe, M, and Ni in the wastewater resulted in a significant decline in the K, P, Si, and Zn content of plant leaves.

MATERIALS AND METHODS

Wastewater sample was collected in the month of June, 2023 (peak hours) from outlets of industrial area situated at Gajulamanyam Industrial Estate, near by Tirupati air port, Tiruapti district, Andhra Pradesh. Wastewater sample was collected in well cleaned polythene containers; each bottle was washed with fresh water before collection of the sample. Finally bottle was tightly closed. After filtering, pH, electrical conductivity (EC) of the sample was immediately measured in the laboratory and afterwards the samples were stored at 4 °C for physico-chemical analysis (APHA, 2005).

Soil sample was collected near Gajulamandyam industrial zone and used for pot culture studies. The seeds of groundnut were obtained from N.G. Ranga Agriculture College, Tirupati and treated with 0.2 N mercuric chloride for 2 min and washed with running tap water to remove contamination of seed coat, prior to germination studies (Singh *et al.*, 2006). The pot studies were carried out with groundnut as a test crop using various concentrations of industrial wastewater 25%, 50%, 75% and 100% and distilled water was served as control. Each treatment including control was carried out in triplicate using 15 seeds per pot. The number of seeds germinated in each treatment was recorded at 10th, 20th and 30th days of the experiment and the germination percentage was calculated. Growth of the root and shoot length were measured with the help of meter scale and chlorophyll content estimated following the method of Arnon (1949) using UV- UIS spectrophotometer 117 model.

RESULTS AND DISCUSSION

This study deals with the influence of industrial wastewater on The wastewater sample was colourless, alkaline in nature and contained in high levels of heavy metals like Zn, Pb, Cd, Cr and Fe. It contains considerable amount of Ni, Mn and Co. The higher EC alter the chelating properties of receiving water systems, which create conditions for free metal availability to flora and fauna (Jung Eek Son, 2015). The percentage of seed germination on exposure of different concentrations and duration was presented in Fig. 1. The maximum seed germination percentage was recorded at 25% and minimum was at 100% of wastewater concentrations, as compared to control. At 25% of wastewater concentration, increase in root and shoot length is high at 30th day as compared to control Figs. 1 and 2, whereas at 100% of wastewater concentration decrease in length of root and shoot was recorded at 10th, 20thh and 30th days. Inhibition of seed germination may be due to high amounts of

Table 1. Physico-Chemical Characteristics of Industrial Wastewater

S. No.	Parameter	Unit	Observed Values	Standards for portable and irrigation waters ISI (1983)
1	Color	–	Colorless	—
2	Odor	–	Odorless	—
3	Temperature	°C	28.0	—
4	pH	–	8.5 ± 0.34	6.5-8.5
5	EC	µmhos/cm	10.5 ± 0.12	2.25
6	TSS	mg/L	647.33± 3.25	—
7	TDS	mg/L	611 ± 11.79	—
9	BOD	mg/L	48.6 ± 2.3	—
10	COD	mg/L	128.66 ± 0.25	—
11	Ni	mg/L	0.041 ± 0.004	0.05
12	Cu	mg/L	0.014 ± 0.002	0.05
13	Mn	mg/L	0.036 ± 0.002	0.1
14	Cd	mg/L	0.028 ± 0.002	0.01
15	Cr	mg/L	0.071 ± 0.003	0.05
16	Fe	mg/L	0.04 ± 0.001	0.3
17	Zn	mg/L	5.73 ± 0.120	5.0
18	Pb	mg/L	0.104 ± 0.002	0.10

dissolved solids in wastewater, which enrich the salinity and conductivity of the absorbed solute by seed before germination (Gautam *et al.*, 1992; Singh *et al.*, 2006) and Murkumar and Chavan (1987) have reported that the higher concentration of effluent decrease enzyme dehydrogenase activity that is considered as one of the biochemical change which may have disrupt germination and seedling growth. Salt stress affects the seed germination and seedling establishment through osmotic stress, ion toxicity, and oxidative stress (Cuneyt Ucarli, 2020). Chlorophyll content was estimated at various time intervals of exposure and concentrations of wastewater have been represented in Tables 3, 3.1 and 3.2. In the wastewater concentration at 25%, chlorophyll a, b and total chlorophyll contents were increased up to the 20th day and decreased at 30th day in groundnut. Wastewater concentration at 100% overall decrease in chlorophyll content was

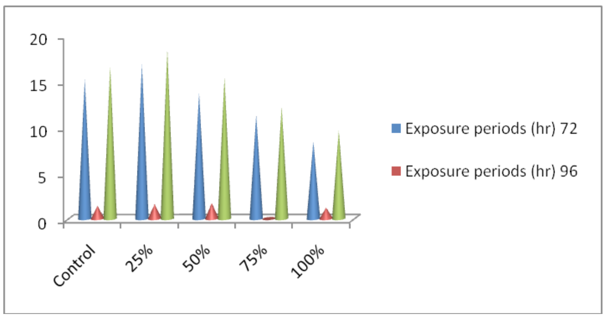

Fig. 1. Germination percentage of groundnut in control and industrial effluent at different time intervals

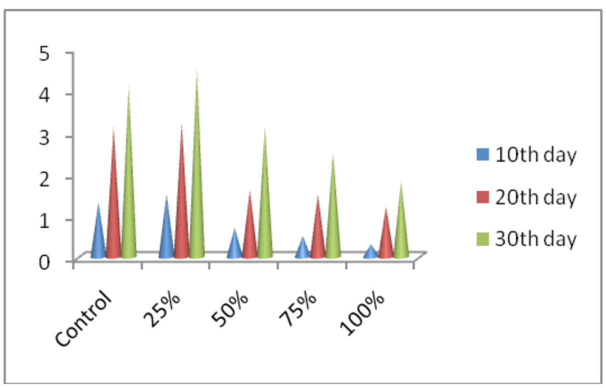

Fig. 2. Influence of industrial wastewater on root length of *Arachis hypogaea* L. (cm seedling^{-1})

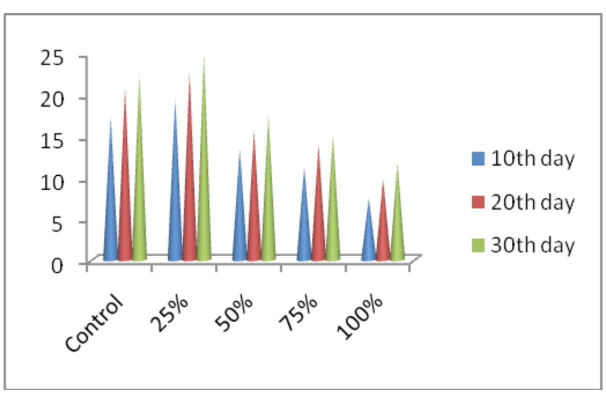

Fig. 3. Influence of industrial wastewater on shoot length of *Arachis hypogaea* L. (cm seedling^{-1})

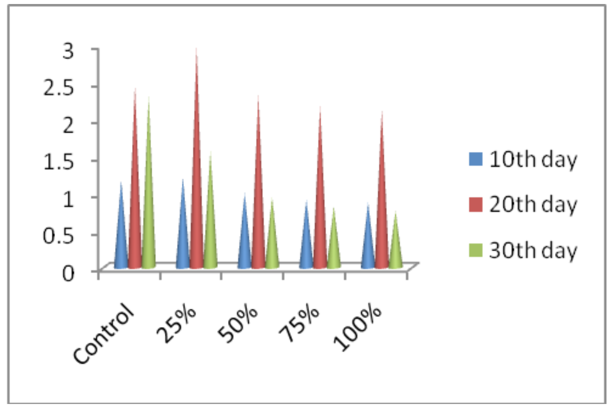

Fig 4. Influence of industrial wastewater on chlorophyll a content of *Arachis hypogaea* L. (mg/g.fr.wt)

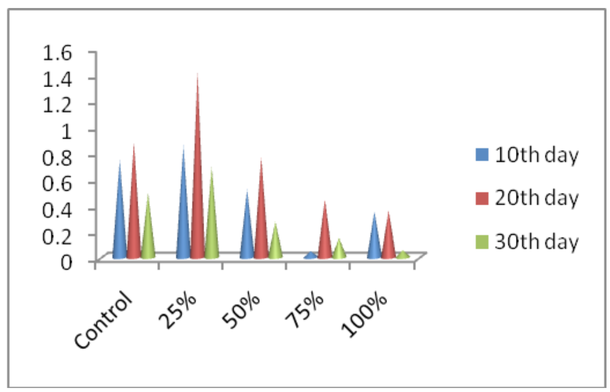

Fig. 5. Influence of industrial wastewater on chlorophyll b content of *Arachis hypogaea* L. (mg/g.fr.wt)

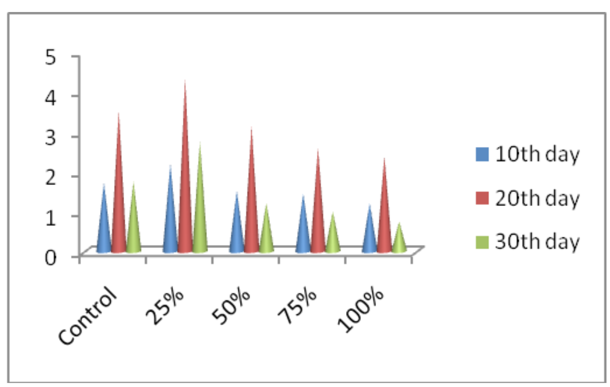

Fig. 6. Influence of industrial wastewater on total chlorophyll content of *Arachis hypogaea* L. (mg/g.fr.wt)

recorded during all the experimental days as compared to control. Changes in total chlorophyll concentration indicate that the chlorophyll synthesizing capacity of the crop has diminished affecting the overall photosynthetic process. Similar findings and observations were reported in earlier investigations (Krupa *et al.,* 1993 and Shokoofeh Hajihashemi *et al.,* 2020). According to the findings of Klimentina Demerivska – Kepova *et al.* (2006), Cd has reduced plant length, biomass and leaf pigments and inhibiting the fixation of carbon and decreasing chlorophyll content and photosynthetic activity (Gallego *et al.,* 1996).

Seed germination percentage was reduced at higher concentration of wastewater may be due to the high levels of solids present in the wastewater, which causes changes in the osmotic relationship of the seed and water. Hence the amount of water absorption decreases, resulting in retardation of seed germination due to increasing salinity. Increased salt stress reduces the seed's ability to absorb water (osmotic stress) and causes an ion imbalance in the seed (ionic stress), ultimately inhibiting seed germination and crop production. Therefore, salt water intrusion in growing standard crops can be risk to crop failure (Elizabeth de la Reguera, *et al.,* 2020). Saxena *et al.* (1986) has mentioned that higher concentration of solid in the wastewaters result in a low amount of oxygen in dissolved form, which reduces the energy supply through anaerobic respiration and resulting in limitation of seedling growth and development.

CONCLUSION

This investigation was conducted on the influence of wastewater in morphology and chlorophyll content of groundnut, at higher concentrations of wastewater has clearly showed deleterious effects. Plants growing in such type of polluted waters may accumulate chemical substance at high levels in such plants, if consumed may have similar effects on live-stock and human beings. Hence it may be suggested that nutrients available in 25% in wastewater discharged by industries and it may be used as a suitable liquid fertilizer. It reduces the amount of water required for irrigation and helps conserve water and provides nutrients to the field and plants. Proper precautions should be taken before discharge industrial wastewater to avoid water and land pollution.

Conflict of Interest : None

REFERENCES

Arnon, D.I. 1949. Copper enzyme in isolated chloroplasts, polyphnenol oxidase in *Beta vulgaris*. *Plant Physiol*. 24: 1-15.

APHA. 2005. *Standard Methods for Water and Wastewater Analysis*. APHA, USA.

Babiker, I.S., M.A.A. Mohamed, H. Terao, K. Kato and K. Ohta, 2004. Assessment of groundwater contamination by nitrate leaching from intensive vegetable cultivation using geographical information system. *Environ. Int*. 29: 1009-1017.

Cabral, J.R., Freitas, P.S.L., Bertonha, A. and Muniz, A.S. 2010. Effects of wastewater from a cassava industry on soil chemistry and crop yield of lopsided oats (*Avena strigosa* Schreb.). *Brazilian Archives of Biology and Technology*. 53:19-26.

Cuneyt Ucarl, 2020. Effects of Salinity on Seed Germination and Early Seedling Stage, *Abiotic Stress in Plant*. Pp. 1-10.

Dushyanth, 2019. A Brief Review on Wastewater Treatment. *Journal of Emerging Technologies and Innovative Research*. pp. 15-22.

Elizabeth de la Reguera, Jacquelyn Veatch , Keryn Gedan, Katherine L. Tully. 2020. The effects of saltwater intrusion on germination success of standard and alternative crops. *Environmental and Experimental Botany*. 180: 1-6.

Gallego, S.M. Gallego, Benavides, M.P. and Tomaro, M.L. 1996. Effect of heavy metal ion excess on sunflower leaves: evidence for involvement of oxidative stress. *Plant Sci.* 121: 151-159.

Gautam, D.D., Kumar, K. and Bishnoi, S. 1992. Effect of dairy effluent in seed germination of rabi and kharif crop plants. *J. Environ. Biol.* 13: 7-12.

Holzer, L., Münch B., Rizzi, M., Wepf, R. and Marschall, P. 2010. 3D-microstructure analysis of hydrated bentonite with cryo-stabilized pore water. *Applied Clay Science, Elsevier*. 47(3-4): 330-342.

Jong Hwa Shin and Jung Eek Son, 2015. Changes in electrical conductivity and moisture content of substrate and their subsequent effects on transpiration rate, water use efficiency, and plant growth in the soilless culture of paprika (*Capsicum annuum* L.), *Horticulture, Environment, and Biotechnolog.,* volume 56, pages178-18.

Klimentina Demirevska-Kepova, Lyudmlia Simova-Stoilova, Zlatimera Petrova Stoyanova and Urs Feller, 2006. Cadmium stress in barley growth leaf pigment and protein composition and detoxification of reactive oxygen species. *J. Plant Nutr.* 29: 451-468.

Konwar, D. and Jha, D.K. 2019. Response of Rice (*Oryza sativa* L.) to Contamination of Soil with Refinery Effluents under Natural Conditions. *Biological and Environmental Sciences*. 5(1):14-22.

Krupa, Z., Oqist, G. and Huner, N. 1993. The effect of cadmium on photosynthesis of *Phaseolus vulgaris* – A fluorescence analysis. *Physiol. Plantarum.* 88: 626-630.

MurKumar, C.V. and Chavan, P.D. 1987. Influence of water pollution on germination of gram (*Cicer arietinum* L.). In: *Current Pollution Research in India* (Eds.: R.K. Trivedy and P.K. Goel). *Environmental Publications*, Karad, India. pp. 233-238.

Nair, G. Achuthan, Jalal Ahmed Bohjuari, Muftah A. Al-Mariami, Fathi Ali Attia and Fatma F. El-Toumi, 2006. Groundwater quality of north-east Libya. *J. Environ. Biol.* 27: 695-700.

Otokunefor, T.V. and Obiukwu, C. 2005. Impact of refinery effluent on the physico-chemical properties of a water body in the niger delta. *Applied Ecology and Environmental, Research*. 3(1): 61-72.

Nagajyothi, P.C., Dinakar, N., Suresh, S., Udaykiran, Y. Suresh, C. and Damodharam, T. 2008. Effect of industrial effluent on the morphological parameters and chlorophyll content of green gram (*Phaseolus aureus* Roxb). *J. Environ. Biol.* 30(2/3): 1-5

Chhonkar, P.K., Datta, S.P., Joshi, H.C. and Pathak, H. 2000. Impact of industrial effluents on soil health and agriculture- Indian Experience, Part II- Tannery and Textile industrial effluents. *Journal of Scientific and Industrial Research*. 59: 446-445.

Saxena, R.M., Kewa, P.F., Yadav, R.S. and Bhatanagar, A.K. 1986. Impact of tannery effluent on some pulse crop. *Ind. J. Environ. Hlth*. 28: 345-348.

Shokoofeh Hajihashemi, Sonia Mbarki, Milan Skalicky, Fariba Noedoost, Marzieh Raeisi and Marian Brestic, 2020. Effect of Wastewater Irrigation on Photosynthesis, Growth, and Anatomical Features of Two Wheat Cultivars (*Triticum aestivum* L.). *Water.* 12, 607, pp. 1-16.

Singh, P.P., Manish, M. and Singh, J. 2006. Impact of fertilizer factory effluent on seed germination, seedling growth and chlorophyll content of gram (*Cicer aeritenum*). *J. Environ. Biol*. 27: 153-156.