The virtual conference of AQUA≈360: Water for All - Emerging Issues and Innovations
31st August 2021 – 2nd September 2021, University of Exeter, United Kingdom

PHYTOTOXICITY ASSESSMENT OF UNTREATED AND BIOTREATED HOSPITAL WASTEWATER ON CROP PLANTS

Aneeba Rashid[1, 2], Safdar A. Mirza[1], Ciara Keating[3], Sikander Ali[4], Luiza C. Campos[2, *]
[1] Department of Botany, GC University Lahore, 54000, Pakistan
[2] Department of Civil, Environmental and Geomatic Engineering, University College London, United Kingdom
[3] Division of Infrastructure and Environment, James Watt School of Engineering, University of Glasgow, United Kingdom
[4] Institute of Industrial Biotechnology (IIB), GC University Lahore, 54000, Pakistan
* l.campos@ucl.ac.uk

Keywords: Phytotoxicity; biotreatment; hospital wastewaters; edible crops; fodder crop

EXTENDED ABSTRACT

Introduction

The wastewaters containing dyes and harmful chemical compounds are lethal to crop plants [1]. Phytotoxicity studies of several crop plants, *i.e.*, *Triticum aestivum* [2, 3, 4, 5], *Hordeum vulgare* [2], *Lens esculenta* [2], *Lactuca sativa* [6], *Phaseolus mungo* [3], *Brassica nigra* [5, 7] and *Cyamopsis tetragonolobus* [7], using the different concentrations of untreated and treated wastewaters have been examined previously [8]. Bacterial consortia systems are proven to be more beneficial than a single bacterial strain as this involves mechanism of metabolism among the co-existing bacterial strains in the consortia [9]. These biological treatments of wastewaters are capable of improving the growth of plants [10]. The reuse of biotreated wastewaters for crop irrigation would be an attractive option to meet the increasing demand of water. The study allowed testing the biotreated hospital wastewater on the growth of plant species. It was an effort to create a harmony between industrial and agriculture sector for sustainable approach in Pakistan by treatment of wastewaters. The work is hoped to help indirectly the promotion of the Sustainable Development Goals # 6, 11, 14 and 15 that are Clean water and sanitation, Sustainable cities and communities, Life below water and Life on Earth, respectively, to sustain the world as designed by the United Nations.

Methods and Materials

The biotreatment of untreated hospital wastewater (with bacterial consortium: two *Bacillus paramycvoides* spp. and one *Alcaligenes faecalis*) was carried out under optimal conditions [size of inoculum (10 %), temperature (37°C) and time of incubation (48 h)] [11, 12]. Untreated and biotreated hospital wastewaters were diluted with distilled water in 25, 50, 75 and 100 % concentrations. Effect of biotreated hospital wastewater was evaluated on five different crop plant, *i.e.*, *Raphanus sativus* (reddish), *Brassica oleracea* (cauliflower), *Capsicum annuum* (hot pepper), *Triticum aestivum* (wheat), *Solanum lycopersicum* (tomato), *Trifolium alexandrinum* (berseem clover) and *Oryza sativa* (rice). Initially seeds were germinated on Petri plates under aseptic conditions to assess the percentage seed germination, delay index (DI) [8], stress tolerance indexes (STIs) and seedling vigor index (SVI) [13] by measuring lengths (shoot and root) and weights of seedlings (fresh and dry) [7]. Subsequently, the plants were grown in small pots and irrigated with dilutions of untreated and biotreated hospital wastewater separately in comparison with distilled and dechlorinated tap water to assess the potential of biotreatment and phytotoxicity [7].

Results and Discussion

The seedling vigour indexes for seven crops were analysed against untreated and treated hospital water by measuring lengths and weights of seedlings (Figure 1).

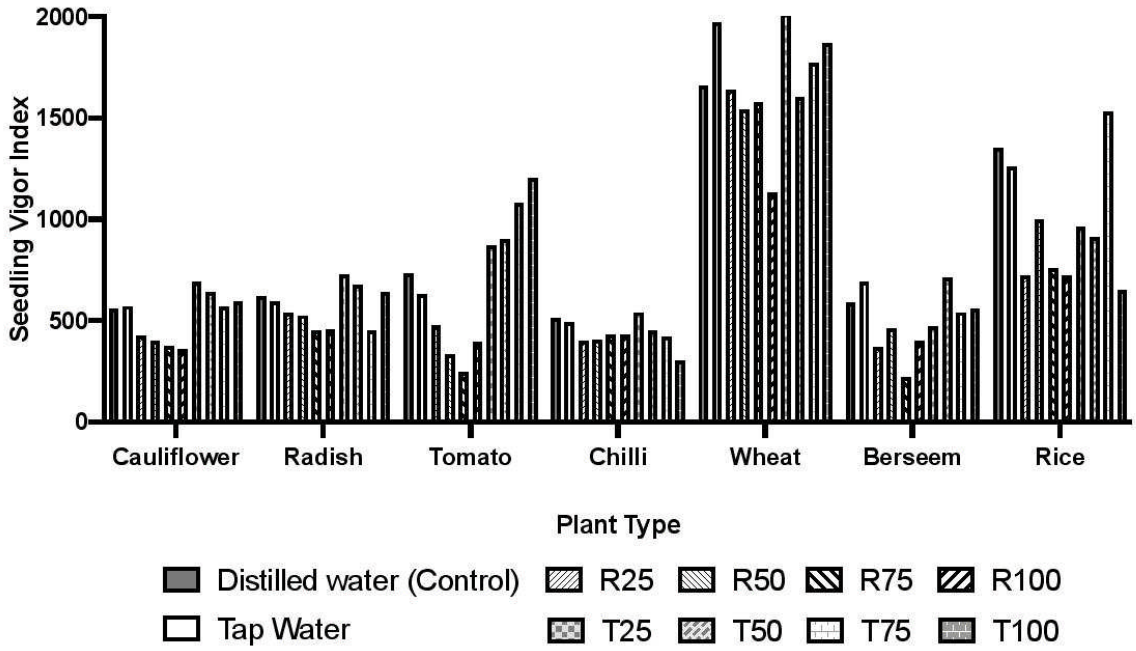

Figure 1. Percentage seed germination of seven plant crops

Conclusions

The biotreatment of hospital wastewater with the help of bacterial consortium (*Bacillus paramycoides* spp. and *Alcaligenes faecalis*) has proven efficient for the growth of different vegetables, fodder and crop plants such as *Raphanus sativus* (reddish), *Brassica oleracea* (cauliflower), *Solanum lycopersicum* (tomato), *Capsicum annuum* (hot pepper), *Triticum aestivum* (wheat), *Trifolium alexandrinum* (berseem clover) and *Oryza sativa* (rice).

REFERENCES

[1] P. Dwivedi and R. S. Tomar, 'Bioremediation of textile effluent for degradation and decolorization of synthetic dyes: a review', *International Journal of Current Research in Life Sciences*, vol. 7, no. 4, pp. 1948-1951, Dec. 2018, doi: 10.1556/1886.2019.00018.

[2] C. J. Ogugbue and T. Sawidis, 'Bioremediation and detoxification of synthetic wastewater containing triarylmethane dyes by *Aeromonas hydrophila* isolated from industrial effluent', *Biotechnology Research International*, vol. 2011, no. 1, pp. 1-11, Jul. 2011, doi: 10.4061/2011/967925.

[3] J. P. Jadhav, D. C. Kalyani, A. A. Telke, S. S. Phugare and S. P. Govindwar, 'Evaluation of the efficacy of a bacterial consortium for the removal of color reduction of heavy metals, and toxicity from textile dye effluent', *Bioresource Technology*, vol. 101, no. 1, pp. 165–173, Jan. 2010, doi: 10.1016/j.biortech.2009.08.027.

[4] H. B. Mansour, F. Salem, N. Afef and H. B. Ouada, 'Reuse of textile wastewater after treatment with isolated bacteria from Oued Hamdoun River', *Bioremediation Journal*, vol. 19, no. 4, pp. 296-302, Oct. 2015, doi: 10.1080/10889868.2015.1066304.

[5] R. Chandra, R. N. Bharagava, S. Yadav and D. Mohan, 'Accumulation and distribution of toxic metals in wheat (*Triticum aestivum* L.) and Indian mustard (*Brassica campestris* L.) irrigated with distillery and tannery effluents', *Journal of Hazardous Materials*, vol. 162, no. 1, pp. 1514–1521, Mar. 2009, doi: 10.1016/j.jhazmat.2008.06.040.

[6] M. B. Ceretta, I. Durruty, A. M. F. Orozco, J. F. González and E. A. Wolski, 'Biodegradation of textile wastewater: enhancement of biodegradability via the addition of co-substrates followed by phytotoxicity analysis of the effluent' *Water Science and Technology*, vol. 77, no. 9, pp. 1-11, May, 2018, doi: 10.2166/wst.2018.179.

[7] S. S. Kumar and M. Jaabir, 'Biological treatment of textile wastewater and its re-use in irrigation: encouraging water efficiency and sustainable development', *Journal of Water Resources and Ocean Science*, vol. 2, no. 5, pp. 133-140, Oct. 2013, doi: 10.11648/j.wros.20130205.21.

[8] P. Kaushik, V. K. Garg and B. Singh, 'Effect of textile effluents on growth performance of wheat cultivars', *Bioresource Technology*, vol. 96, no. 1, pp. 1189–1193, Jul. 2005, doi: 10.1016/j.biortech.2004.09.020.

[9] M. A. Kumar, P. Baskaralingam, A. R. S. Aathika and S. Sivanesan, *Role of bacterial consortia in bioremediation of textile recalcitrant compounds*, *In*: Varjani, S., E. Gnansounou, B. Gurunathan, D. Pant and Z. Zakaria (Eds). Waste Bioremediation, 1st Edition. Springer, 2017.

[10] K. Velayutham, A. K. Madhava, M. Pushparaj, A. Thanarasu, T. Devaraj, K. Periyasamy and S. Subramanian, 'Biodegradation of Remazol Brilliant Blue R using isolated bacterial culture (*Staphylococcus* sp. K2204)', *Environmental Technology*, vol. 3, no. 1, pp. 1-8, Nov. 2017, doi: 10.1080/09593330.2017.1369579.

[11] A. Rashid, S.A. Mirza, C. Keating, S. Ali and L.C. Campos. 2020. Indigenous Bacillus *paramycoides* spp. and *Alcaligenes faecalis*: sustainable solution for bioremediation of hospital wastewater. *Environmental Technology*, doi: 10.1080/09593330.2020.1858180.

[12] A. Rashid, S.A. Mirza, C. Keating, S. Ali and L.C. Campos. 2021. Hospital wastewater treated with a novel bacterial consortium (*Alcaligenes faecalis* and *Bacillus paramycoides* spp.) for phytotoxicity reduction in Berseem clover and tomato crops. *Water Science & Technology*, doi: 10.2166/wst.2021.079.

[13] H. Amin, B. A. Arain, F. Amin and M. A. Surhio, 'Phytotoxicity of Chromium on Germination, Growth and Biochemical Attributes of *Hibiscus esculentus* L.', *American Journal of Plant Sciences*, vol. 4, no. 2013, pp. 2431–2439, doi: 10.4236/ajps.2013.412302.