Research Article……..

International Journal of Agricultural Invention

(online available at www.agriinventionjournal.com)

***International Journal of Agricultural Invention* 8(2): 268-272: December, 2023**

ISSN: 2456 – 1797 (P)

Impacts of Co and Pb on growth and physiological parameters of *Portulaca oleracea* (Purslane)

***Ruchi Bhatnagar, Dilip Singh Yadav, Sweety Singh**

Department of Botany, Narain College, Shikohabad (Dr. Bhim Rao Ambedkar University, Agra) UP, India

***Corresponding email**: *ruchibhatnagar02@gmail.com*

ARTICLE INFO

Research Article

Received on August 29, 2023

Revised on September 28, 2023

Accepted on October 21, 2023

Published on October 29, 2023

Article Authors

Ruchi Bhatnagar, Dilip Singh Yadav, Sweety Singh

Corresponding Author Email

ruchibhatnagar02@gmail.com

PUBLICATION INFO

International Journal of Agricultural Invention (IJAI)

RNI: UPENG/2016/70091

ISSN: 2456-1797 (P)

Vol.: 8, **Issue:** 2, **Pages:** 268-272

Journal Homepage URL

http://agriinventionjournal.com/

DOI: 10.46492/IJAI/2023.8.2.19

ABSTRACT

Portulaca oleracea has tendency to remove heavy metals from the soil as it has phytoremediation properties. This plant has potential to with stand heavy metal stress without getting impacts on normal plant physiology. The aim of this study was to investigate phytoremediation capacity of *P. oleracea.* Study was carried out by using Co and Pb as heavy metals and their accumulation in plants was analyzed precisely. Impacts of Co and Pb on plant growth parameters i.e., height and biomass was also being studied. Experimental data revealed that Pb had lower negative impact in comparison to Co and Pb had higher level of chlorophyll in comparison to Co.

KEYWORDS

Heavy Metal Stress, *Portulaca oleracea,* Cobalt, Lead, Chlorophyll, Proline

HOW TO CITE THIS ARTICLE

Bhatnagar, R., Yadav, D. S., Singh, S. (2023) Impacts of Co and Pb on growth and physiological parameters of *Portulaca oleracea* (Purslane), *International Journal of Agricultural Invention,* 8(2): 268-272. DOI: 10.46492/IJAI/2023.8.2.19

Heavy metal toxicity means excess or undesired content naturally produced on the earth and concentrated because of human activity, entering plant, animal and human tissue through inhalation, food intake and manual handling, and may bind and interfere with the functioning of vital cellular functions. Heavy metals were major contaminants in the environment; their toxicity is a growing concern for biological, evolutionary, nutritional and environmental reasons (Lenntech, 2004). There are the group of metals and metalloids with an atomic density greater than 4 g/cm^3 or more than 5 times or higher than that of water including Copper (Cu), Manganese (Mn), Lead (Pb), Cadmium (Cd), Cobalt (Co), Iron (Fe), Zinc (Zn), Chromium (Cr), Arsenic (As), Silver (Ag) and platinum (Hawkes, 1997). In developing countries, a major problem is open dumping of solid waste, which causes environmental pollutions as water pollution, land pollution, air pollution and except these problems; it causes unpleasant odour, health issues and vegetation loss (Sharma *et al.*, 2019). In the environment, the abundance of heavy metals in the environment raised significant concerns throughout the world with the development of urbanization and industrialization (Suman *et al.*, 2018, Ashraf *et al.*, 2019).

Due to different types of anthropogenic activities and many natural processes, the accumulation of heavy metals has been increased rapidly in soil. Heavy metals are persisted in throughout the environment and are non-biodegradable. Heavy metals have the potential for entering the food chain and accumulating in the human body. Heavy metals have toxic nature, which cause serious threat to health of human, animals, and ecosystem (Yan *et al.,* 2020).

Lead

Lead, a chemical element, which symbol is Pb having 82 atomic number. Pb is a heavy metal, which is soft and malleable having low melting point. It is bluish-white in colour, when it cuts freshly and when it exposed to air, it turns to dull grey colour. Pb is stable element: because of having highest atomic number. Lead is present in 14^{th} group and 6^{th} period of p-block in periodic table having $4f^{14}$, $5d^{th}$, $6s^2$, $6p^2$ electronic configuration. Lead is post- transitional metal; solid in nature with 600.61 K (327.46ºC, 621.43ºF) melting point and boiling point is 2022 K (1749ºC, 3180ºF). Its density is 11.34 g/cm^3. At highest level of Lead, the production of Reactive Oxygen Species (ROS) gets fast which cause damage of lipid membrane, which leads to damage of photosynthetic processes and chlorophyll damage and overall plant growth suppresses (Najeeb *et al.,* 2014).

Cobalt

Cobalt is a chemical element. Symbol is Co and atomic number is 27. It is found in the form of combination in crust of earth. It is found in alloys of natural meteoric iron. Reductive smelting and hard, lustrous, silver-grey metal produce it. It is present in period 4 group 9 of d block in periodic table. It is transitional metal having $3d^7$, $4s^2$ electronic configuration and 2, 8, 15, 2 electrons per shell. Cobalt is firstly discovered and isolated by (George Brandtin, 1735). It is metallic grey in colour and solid in nature having 1768 K (1495ºC, 2723ºF) melting point and its boiling point is 3200 K (2927ºC, 5301ºF) and its density is 8.90 g/cm^3. Its toxic concentrations are responsible for reduced shoot weight and inhibition of active ion transport and absorbed by plant's root through active transport.

Co is also promoting plant growth and development resulting in inhibitory plant growth at concentration which is greater than 0.5 mm. Co is also significantly responsible for increasing plant yield (Boureto and Kagawa, 2001, Lisnik and Toma, 2003, Gad and Kandil 2008, 2009 and 2010, Gad *et al.,* 2014).

Portulaca oleracea

Portulaca oleracea (commonly known as purslane, verdolaga, pigweed, small hogweed or parsley and moss rose) is an annual grass weed of the Portulacaceae family. *Portulaca oleracea* is a good source of carbohydrates, proteins, fats, vitamins, tannins, minerals, saponins, sitosterol, urea, alkaloids, oxalate, mono, di, triterpenes, omega-3 fatty acids and phenolic compounds. It has a wide range of medicinal properties including anticancer, antidiabetic, antioxidant, antiulcer, antimicrobial, anti-inflammatory, nephroprotective, hepatoprotective, neuroprotective, hypo cholesteric, uterine bleeding control, wound healing and wormicidal, insecticidal activity (Zhou *et al.,* 2014) and used as folk medicine (Lee *et al.,* 2012).

Although purslane is grown as a vegetable (stems and leaves) in some parts of the world, approximately forty varieties currently are cultivated. Purslane has an extensive distribution, assumed mostly anthropogenic, extending from North Africa and Southern Europe the Middle east and the Indian subcontinent to Malesia and Australia. During summer and spring season, it rapidly producing flowers, fruits and seeds after 40 days of germination and it is easily grown in warm and moist places (Okafor, 2014).

Material and Methods

Cultivation of Plant

- Seeds of test plant were sown in plastic pots of 30 cm X 26 cm with 5 kg of test soil contains $CoCl_2$ and $PbCl_2$ respectively.
- Three replications of each concentration of heavy metal were taken, so as to get the precise and accurate result.
- Cultivation was carried out in a normal native plant condition at 32°C for 120 days.

Experimental Design

Physiological parameters such as chlorophyll and proline and growth parameters such as height and Biomass were investigated in different experiment.

Statistical Analysis

Data were expressed as mean and standard deviation.

Result and Discussion

Result of experiment revealed that with comparison of Biomass of control plant with $CoCl_2$ and $PbCl_2$ treated sample of plants and the result of experiment revealed that accumulation of heavy metal in *Portulaca oleracea* (purslane) had significant impacts on height and biomass of the plant. During the phase of cultivation, the height of $PbCl_2$ treated plant was seems to be increased at all concentration as 16.2 inch ($PbCl_2$ 50 µM), 16.8 inch ($PbCl_2$ 100 µM) and 16.9 inch ($PbCl_2$ 150 µM).

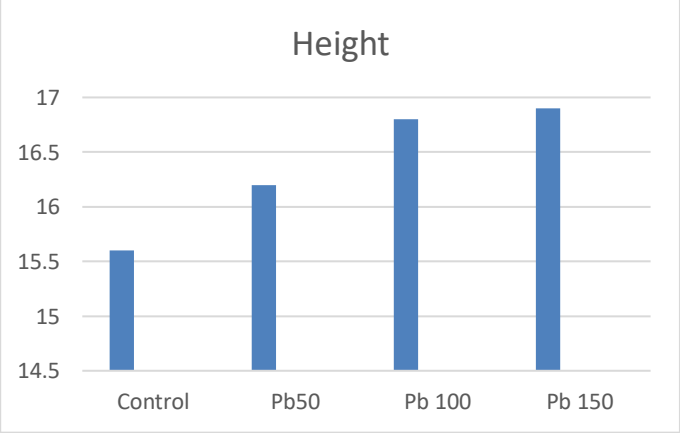

Fig 1. Effect of $PbCl_2$ on Plant height

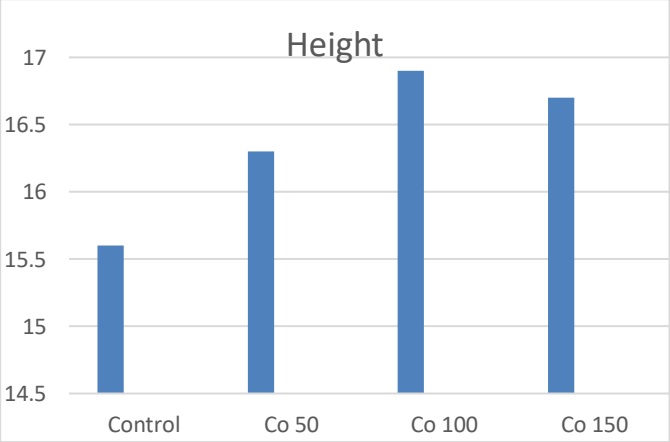

Fig 2. Effect of $CoCl_2$ on Plant height

On the other hand, $CoCl_2$ treated plant had height 16.3 inch ($CoCl_2$ 50 µM), 16.9 inch ($CoCl_2$ 100 µM), 16.7 inch ($CoCl_2$ 150 µM). While comparing the height of $CoCl_2$ and $PbCl_2$ treated plant with control, study suggested that height of $PbCl_2$ treated plant were greater followed by $CoCl_2$ and control. Total biomass of *Portulaca oleracea* using $CoCl_2$ and $PbCl_2$ treatment was slightly increased as a result of increasing level of heavy metal in plants. However in some cases it was found that Co and Pb treated samples had no or negligeble increament in plant biomass. Thus, the data revealed that increasing concentration of heavy metal had negligible effect on plant's growth parameters. *Portulaca oleracea* has some tendency to with stand against heavy metal stress.

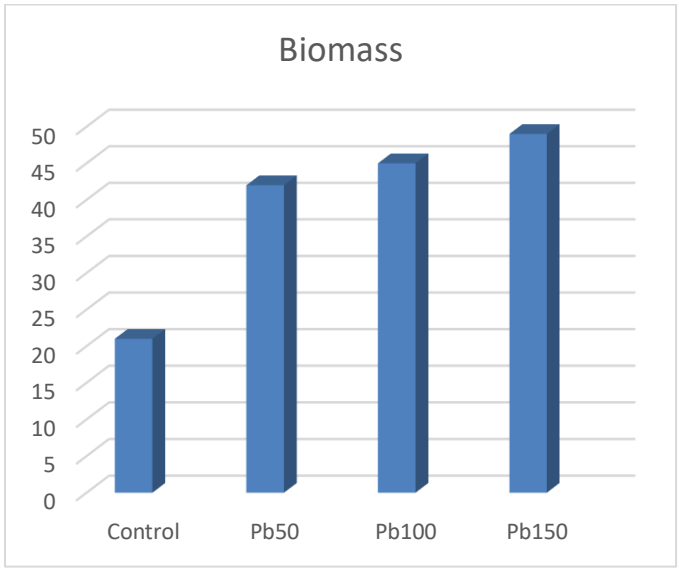

Fig 3. Effect of $PbCl_2$ on Biomass

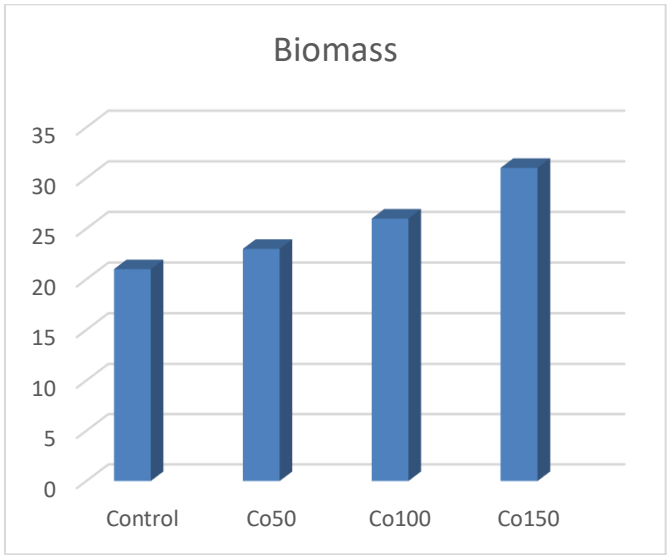

Fig 4. Effect of $CoCl_2$ on Biomass

Estimation of Chlorophyll and Proline

Research data revealed that chlorophyll content *Portulaca oleracea* species among different heavy metal concentration as follows: At lower concentration of $PbCl_2$ 50 µM, Chlorophyll was 0.99-1.144 mg g^{-1}, at $PbCl_2$ 100 µM, Chlorophyll content was 0.88-0.921 mg g^{-1} and at $PbCl_2$ 150 µM, concentration of Chlorophyll was 0.614-0.601 mg g^{-1}. This clearly stated that with increasing in heavy metal concentration the level of chlorophyll decreases but it was higher than that of control, which was 0.52-0.54 mg g^{-1}. $CoCl_2$ had 0.630-0.664 mg g^{-1}, 0.604-0.642 mg g^{-1}, 0.638-0.641 mg g^{-1} of chlorophyll content at $CoCl_2$ 50 µM, $CoCl_2$ 100 µM and $CoCl_2$ 150 µM respectively. This data depicts that increasing in level of heavy metal had negligible effect on plant *Portulaca oleracea* but the data of control such as 0.511-0.543 mg g^{-1}, suggested that it had lower chlorophyll content than heavy metal treated plant samples.

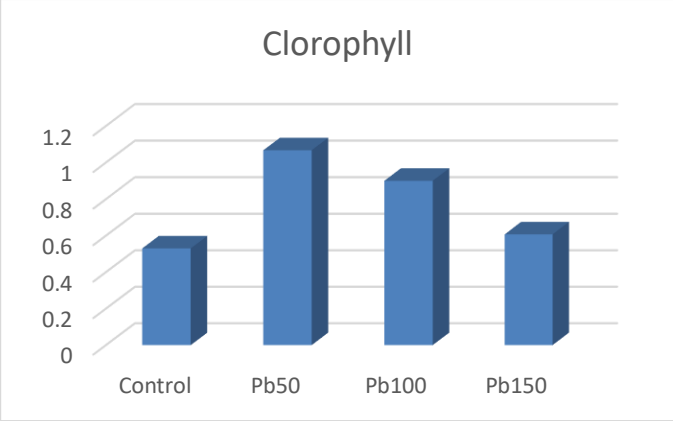

Fig 5. Effect of $PbCl_2$ on chlorophyll

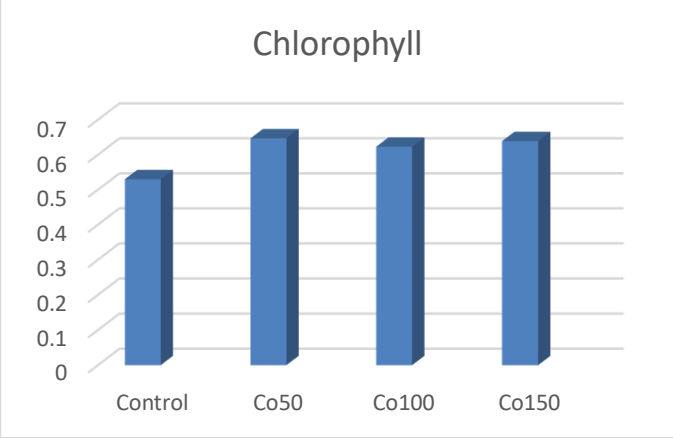

Fig 6. Effect of $CoCl_2$ on chlorophyll

Proline content in plant have a direct resulting to stress physiology of plant.

That means when heavy metal stress induced in plant than proline level will also be increased. Likewise in control plant, proline content was 0.150 mg g^{-1} and at $CoCl_2$ 50 µM concentration, proline content was 0.159 mg g^{-1} and $PbCl_2$ had 0.176 mg g^{-1}. It simply suggested that Pb showed high heavy metal stress followed by Co and Control. Therefore, Pb has higher proline content than Co and Control.

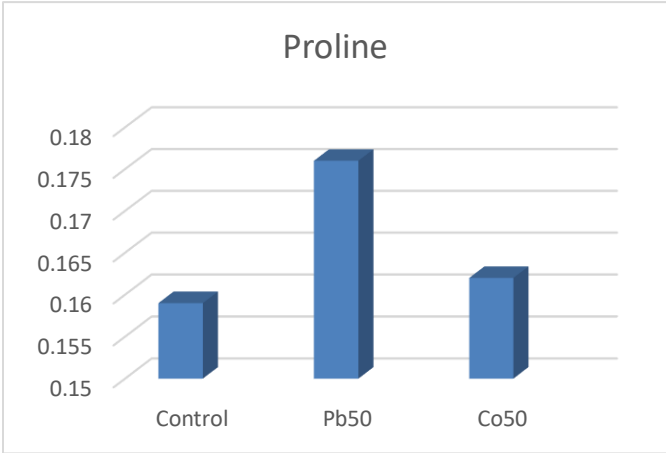

Fig 7. Effect of $PbCl_2$ and $CoCl_2$ on Proline

Conclusion

The research was conducted to determine the effects of different concentrations of Co and Pb on different physiological parameters such as height and biomass and biochemical parameters i.e., chlorophyll and proline in *Portulaca oleracea*. The study revealed that imposition of both heavy metals Co and Pb showed negligible effect in all parameters studied in *Portulaca oleracea*. The findings are that accumulation of heavy metal in *Portulaca oleracea* (purslane) had significant impacts on height and biomass of the plant. The study was also stated that with increasing in concentration of $PbCl_2$ the level of chlorophyll decreases but it was higher than that of control. This data depicts that increasing in level of $CoCl_2$ had negligible effect. It was suggested that it had lower chlorophyll content than heavy metal treated plant samples. This research also revealed that Pb showed high heavy metal stress followed by Co and Control. Therefore, Pb has higher proline content than Co and Control.

Acknowledgement

The author acknowledged for the help and support from Prof. Vijay kumar Singh, Principal, Narain College, Shikohabad.

References

Ashraf, S., Ali, Q., Zahir, Z. A., Asharf, S. and Asghar, H. N. (2019) Phytoremediation: environmentally sustainable way for reclamation of heavy metal polluted soils, *Ecotox. Environ. Safe*, **174**: 714-727. DOI: 10.1016/j.ecoenv.2019.02.068.

Boureto, A. E. and Kagawa, J. N. (2001) Effect of Co on Sugar beet growth and mineral content, *Revistra Brasileria-Sementes*, **18**: 63.

Gad, N. and Kandil, H. (2008) Response of sweet potato (*Ipomoea batistes* L.) plants to different levels of Co, *Australian Journal of Basic and Applied Science*, 2(**4**): 949-955.

Gad, N. and Kandil, H. (2009) The influence of Co on sugarbeet (*Beta vulgaris* L.) production, *International Journal of Academic Research*, 1(**2**): 52-58.

Gad, N., and Kandil, H. (2010) Influence of Co on phosphorous uptake, growth and yield of tomato, *Agriculture and Biology Journal of North America*, 1(5): 1069-1075. DOI: 10.5251/abjna.2010.1.5.1069.1075

Gad, N., Aziz, E. E. and Kandil, H. (2014) Effect on Co on growth, herb yield and essential and quality in Dill (*Anethum gravealens*), *Middle East Journal of Agriculture Research*, 3(**3**): 536-542.

Gad, N., El-Moez, A., Aziz, E. E., Bekbyeva, L., Attitaalla, I. H. and Suruif, M. (2014) Influence of Co on soybean growth and production under different levels of nitrogen, *International Journal of Pharmacy and Life Sciences*, 5(**3**): 3278-3288.

Hawkes, J. S. (1997) Heavy metals, *J. Chem. Edu*., **74**: 1369-1374.

Lee, A. S., Kim, J. S., Lee, Y. J., Kang, D. G. and Lee, H. S. (2012) Anti-TNF-α Activity of *Portulaca oleracea* in Vascular Endothelial Cells, *International Journal of Molecular Sciences*, 13(**5**): 5628-5644.

Lenntech Water Treatment and Air Purification (2004) Water treatment, Lenntech, Rotterdamseweg, Netherlands,*(http://www.excelwater.com/thp/filters/water-purification.htm).*

Lisnik, S. S. and Toma, S. L. (2003) Regulation of adaptive responses of plant by trace elements, *Akard, Nauk Mold. SSR. Ser. Biol. Khim. Nouk.*, **2**: 19.

Najeeb, U., Ahmad, W., Zia, M. H., Malik, Z. and Zhou, W. (2014) Enhancing the Pb Phyto stabilisation in wetland Plant *Juncus effuses* L. through Soma clonal Manipulation and EDTA Enrichment, *Arab Journal of Chemistry*, http://dx.doi.org/10.1016/j.arabjc.2014.01.009.

Okafor, I. A., Ayalokunrin, M. B. and Orachu, L. A. (2014) A Review on *Portulaca oleracea* (purslane) Plant, Its Nature and Biomedical Benefits, *International Journal of Biomedical Research*, 5(**2**): 75-80.

Sharma, B., Vaish, B., Singh, U. K., Singh, P. and Singh, R. P. (2019) Recycling of organic wastes in agriculture, *International Journal of Environment and Research*, **13**: 409-429.

Suman, J., Uhlik, O., Viktorova, J. and Macek, T. (2018) Phytoextraction of heavy metals: a promising tool for clean-up of polluted environment, *Front Plant Sci.*, **9**: 1476. DOI: 10.3389/fpls.2018.01476.

Yan, A., Wang, Y., Tan, S. N., Yusof, M. L. M., Ghosh, S. and Chen, Z. (2020) Phytoremediation: A promising approach for revegetation of heavy metal-polluted land, *Frontiers in Plant Science*, **11**: 359. DOI: 10.3389/fpls.2020.00359.

Zhou, W. and Qui, B. (2005) Effects of Cd hyper-accumulation on physiological characteristics of Sedum alfredii Hance (Crassulace), *Plant Sciences*, 169(**4**): 737-745.