International Research Journal of Plant Science (ISSN: 2141-5447)
Vol. 13(4) pp. 01-5, June, 2022
DOI: http:/dx.doi.org/10.14303/irjps.2022.024
Available online @ https://www.interesjournals.org/plant-science.html

Research Article

Effect of nickel toxicity on the seedling growth of guar (Cyamopsis tetragonoloba L.)

Karishma Prajapati*[1], Bhoomi Shah[2], Archana Parmar[3] and Ruby Patel[4]

Department of Botany, M. N. College, Visnagar, Gujarat, India

E- mail: karishmaprajapati1998@gmail.com

Abstract

Phytoremediation is a strategy to employ plants to recover high quantities of metals in the soil into the harvestable parts, such as shoots and roots. High levels of Ni in the soil cause several stress symptoms in plants, including a decrease in growth, reduced root-shoot growth, and reduced fresh weight. Cyamopsis tetragonoloba L. seeds treated with different concentrations (50 and 500 ppm) of Ni along with control. Maximum reduction in seed germination percentage was observed at 500 ppm concentration. It decreased up to 60% in Ni whereas it was found to be 100% in the control. However, at low levels of Nickel (50 ppm) showed increased germination percentage and increase root length, shoot length than high levels of Nickel (500 ppm). It was observed that heavy metal significantly reduced the fresh weight of seedling of Cyamopsis tetragonoloba L. It concluded that high concentration of heavy metal is very toxic.

Keywords: *Cyamopsis tetragonoloba L.*, Phytoremediation, Stress, Heavy metal, Seedling growth

INTRODUCTION

Organic matter pollution is increasing day by day as a result of the release of untreated chemicals by various industries and anthropogenic sources, resulting in a high concentration of heavy metals, which, when combined with high concentrations of plants, can cause problems in plant metabolism and reduced plant production, as well as into the food chain (Sinha et al., 2012), which can lead to liver and brain disorders in humans.

Pescod (1992), gave the source of pollution, various treatment techniques have been offered to address this global problem.

Heavy metals, through their poisonous compounds, have been proven to hinder many stages of plant growth, including seed and plant growth phases, physiological processes, and biochemical activities, according to research. The different abiotic stresses inherent in water and soil have caused a significant reduction in crop productivity. Heavy metal pollution has increased dramatically in recent decades as a result of increased anthropogenic activities, rapid industrial development, modern agricultural practises such as pesticide use, and the release of toxins that cause damage to organisms (Kavamura & Esposito, 2010).

Several plant species in the Fabaceae family have phytoremediation potential (Ginneken & Gawronski, 2007; Anjum et al., 2014). Legumes are high in phytoremediation and offer more nitrogen compounds to the soil, resulting in increased soil fertility and the ability to support biological growth (Hao et al., 2014). Guar (*Cyamopsis tetragonoloba L.*) is a fast-growing legume that is virtually exclusively planted in dry and semi-arid environments (Meftahizadeha et al., 2019).

Guar has lately gained popularity as a result of the widespread usage of plant-derived polysaccharides in a variety of industrial applications. Guar is a widely used crop with economic values for growing fodder, vegetables (green pods), and gum that is widely used in a variety of industries, including food processing (as a natural novel supplement), paper production, textile and carpet printing, mining exploration, medicine, cosmetics, agrochemistry, and oil and gas exploration, due to its high galactomannans

Received: 01-Jul-2022, Manuscript No. IRJPS-22-68239; **Editor assigned:** 02-Jul-2022, PreQC No. IRJPS-22-68239(PQ); **Reviewed:** 16-Jul-2022, QC No. IRJPS-22-68239; **Revised:** 18-Jul-2022, Manuscript No. IRJPS-22-68239(R); **Published:** 25-Jul-2022

Citation: Prajapati K et al. (2022). Effect of nickel toxicity on the seedling growth of guar (Cyamopsis tetragonoloba L.). IRJPS. 13: 024.

content in its endosperm (Abidi et al., 2015; Gresta et al., 2017; Mudgil et al., 2017; Mudgil et al., 2014). Seed coat (14-17%), endosperm or amber (35- 42%), and virus (43-47%) are all present in guar seeds (Sabah et al., 2008). Guar seed demand and emergence have recently surged over the world.

Guar produces a lot of biomass and grows rapidly with a high degree of growth. It can also be used for phytoremediation. The oil industry has just began to use guar gum in hydraulic fracturing, a technique for cracking rock using high pressure. The current research was planned to investigate the effect of nickel toxicity on the seedling growth of guar (*Cyamopsis tetragonoloba L.*).

MATERIAL AND METHODS

This experiment was performed at botanical garden of M. N. College, Visnagar. The seeds of *Cyamopsis tetragonoloba L.* were obtained from MG Naturals, Ambattur, Tamilnadu. After a preliminary selection for uniformity criteria (size and colour of seeds), the seed was surface sterilized with 0.1% HgCl2 for 2 minutes then washed with distilled water three times and then transferred within the pot. Nickel chloride was employed in various combinations. The element Ni was used on two different levels (50 and 500 ppm).

Composition of the Soil

The soil texture was sandy loam (pH 6.9) with an organic matter content of 8.0 g kg−1 soil, total nitrogen of 0.03%, available phosphorus (P) of 14 mg−1 kg−1 soil, and available potassium (K) of 227 mg−1 kg−1. After 10 days, heavy metal treatments of Ni were applied.

On the day of termination of experiment germinated were counted, seedling growth parameters viz., shoot length, root length, and fresh weight.

(i) Seed germination percentage: The daily progress in germination was recorded for 10 days. The criterion used for seeds germination was taken as the emergence of stub through the seed coat.

(ii) Shoot length and root length: The root and shoot length of 20-day old seedlings were measured in centimeters using a centimeter scale.

(iii)Fresh weight: For fresh weight determination, five seedlings from each treatment were weighed on an electrical balance. Average values were calculated in g/seeding.

RESULTS AND DISCUSSION

The effect of heavy metals on seed germination percentage, shoot length, root length, and fresh weight of 20 days old seedlings *Cyamopsis tetragonoloba L.* were recorded.

Effect of Metal on Seed Germination

Seed germination was adversely affected by the treatment of heavy metals. On increasing heavy metal concentration it was observed that seed germination decreased. Nickel was discovered to be the harmful heavy metal in germination percentage investigations. A significant reduction occurs in seed germination at 50 and 500 ppm of Ni onwards in comparison to the control. Maximum reduction in seed germination percentage was observed at 500 ppm concentration. It decreased up to 60% in Ni, whereas it was found to be 100% in the control. The statistical analysis of data showed a very highly significant difference between the control and treatment **(Figure 1)**.

Effect of Heavy Metals on Shoot Length

The shoot length of seedling was highly affected by the treatment of heavy metals. All the heavy metals, particularly at higher concentrations, resulted in an adverse effect on shoot length. It was observed after 10 days of treatment that the shoot length of seedling decreased with the increasing concentration of heavy metals. At 500 ppm concentration of the heavy metal, the shoot length was 3.0 cm in Ni which was very less as compared to control where it was 4.0 cm **(Figure 2)**.

Effect of Heavy Metals on Root Length

With increasing concentration of heavy metals, the root length of seedling gradually in *Cyamopsis tetragonoloba* in nickel metal. The highly significant differences in root length were observed between control versus treatment, among concentration, and chemicals. Ni particularly at higher concentrations showed an adverse effect on root length. The root length was 1.33 cm at the highest concentration of 500 ppm of heavy metal and in control; it was 2.52 cm **(Figure 3)**.

Effect of Heavy Metals on Fresh Weight of Seedlings

It was observed that heavy metals significantly reduced the fresh weight of seedlings in 500 ppm in Ni of *Cyamopsis tetragonoloba*. The percentage decreased (0.136 gm at 500 ppm) in the fresh weight of seedling due to heavy metal application as compared to control(0.2438) **(Figure 4)**.

In a study evaluating the effect of cd on tomato seedling growth, Dong et al., (2005) discovered that cd lowered plant height, root length, and root volume when compared to control. Similarly, when Ni was applied to the growth of Guar seedlings, it was discovered that the plant height and root length were lowered when compared to the control (Figure 3). The effect of cadmium toxicity on maize plants was examined by Rascio et al., (2002). The symptoms included root and shoot length loss, leaf bleaching, extreme structural changes in chloroplasts, and a decline in photosynthetic activity.

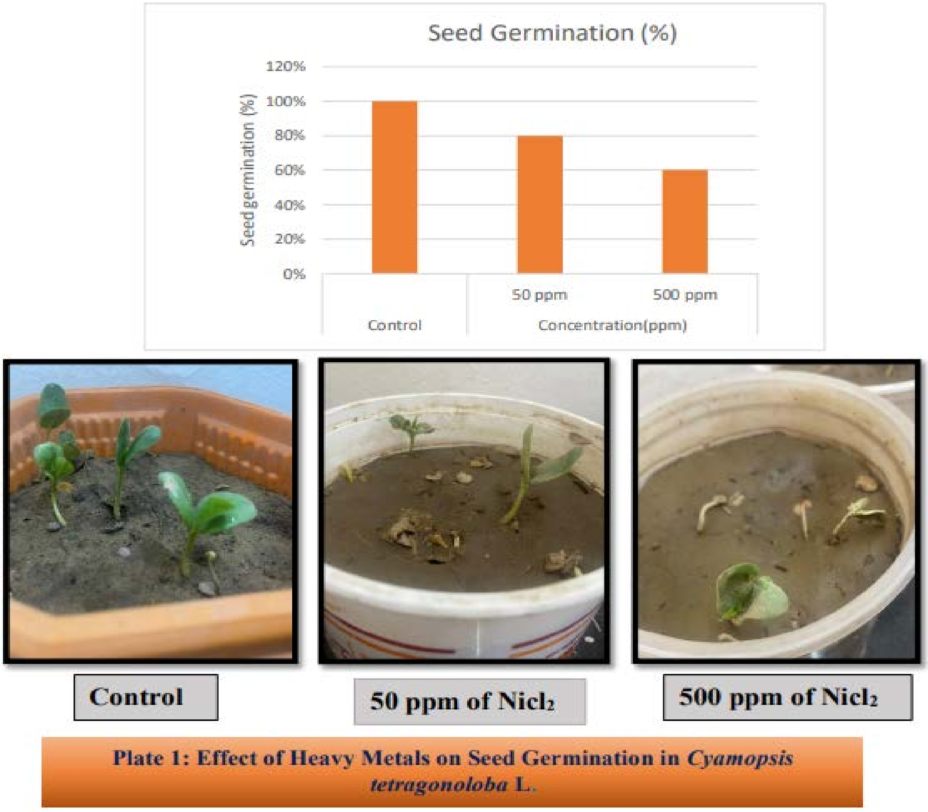

Figure 1. The effect of heavy metals on seed germination (%) in *Cyamopsis tetragonoloba* L.

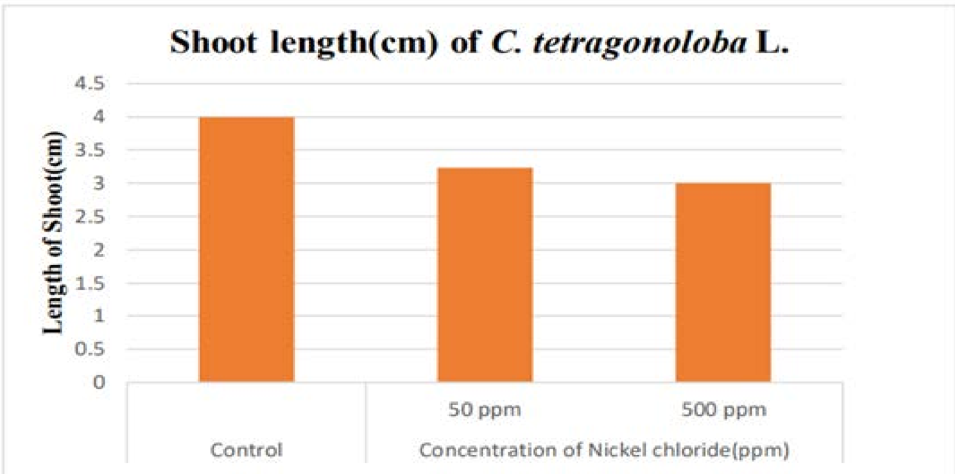

Figure 2. The effect of heavy metals on shoot length (cm) of seedlings in *Cyamopsis tetragonoloba L.*

Tuna et al., (2002) found that high concentrations of heavy metals inhibited plumula and radicles growth (10-200 ppm). Germination percentage, germination index, roots and shoots length and root and shoots dry matter rates are among the other negative consequences. Pb toxicity in Elsholtzia argyi hindered growth, lowered plant height and root length, reduced fresh and dry weight of shoots, discoloured leaves, and folded them, according to Islam et al., (2008). Pb stress at 1000 mg kg 1 reduced root fresh weight (8.15 gm) and shoot fresh weight (21.13 gm) in *C. tetragonoloba* compared to control treatments (Amin et al., 2018). In C. tetragonoloba, Ni stress at 500 ppm reduced shoot and root length as well as fresh weight when compared to control treatments. Mihalescu et al., (2010) reported that increasing the concentration of Cd decreased the length of the maize plant, especially at concentrations of 100 and 200 ppm.

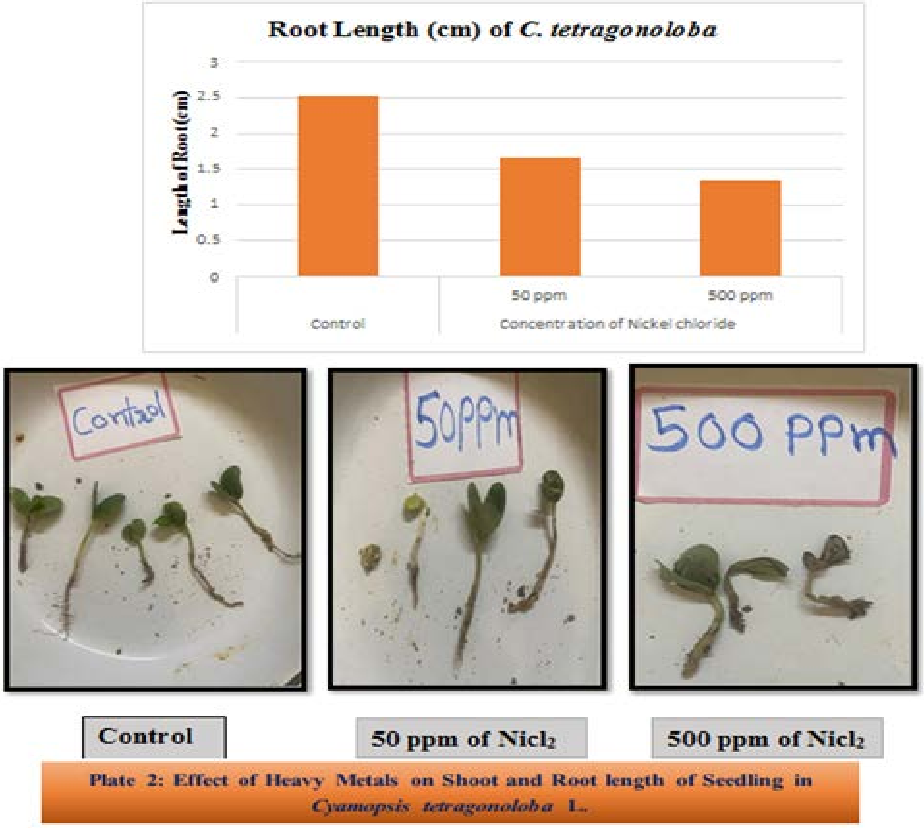

Figure 3. The effect of heavy metals on root length (cm) of seedlings in Cyamopsis tetragonoloba L.

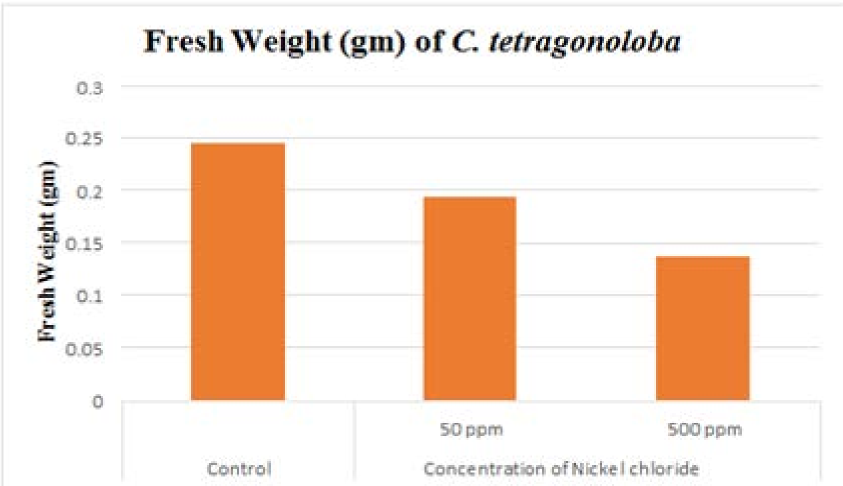

Figure 4. The effect of heavy metals on fresh weight (g) of seedlings in *Cyamopsis tetragonoloba L.*

CONCLUSION

It can be conclude that Seed germination in *C. tetragonoloba* was shown to be lower when heavy metal concentrations were increased compared to controls. When Ni was applied to the growth of Guar seedlings, it was revealed that at 500 ppm, plant height, root and shoot length, and fresh weight were all reduced compared to the control. As a result, excessive levels of heavy metal are extremely poisonous and have an adverse effect on plant growth.

REFERENCES

Abidi N, Liyanage S, Auld D, Norman L, Grover K et al (2015). Challenges and opportunities for increasing guar production in the United States to support unconventional oil and gas production. CRC Press: 207-225.

Amin H, Arain BA, Jahangir TM, Abbasi MS, Amin F (2018). Accumulation and distribution of lead (Pb) in plant tissues of guar (Cyamopsis tetragonoloba L.) and sesame (Sesamum indicum L.): profitable phytoremediation with biofuel crops. Geol Ecol Landsc. 2: 51-60.

Anjum NA, Umar S, Iqbal M (2014). Assessment of cadmium accumulation, toxicity, and tolerance in Brassicaceae and Fabaceae plants- implications for phytoremediation. Environ Sci Pollut Res. 21: 10286–10293.

Dong J, Hlu FB, Zhang GP (2009). Effect of cadmium on growth and photosynthesis of tomato seedlings. J Zhejiang Univ Sci. 6: 974-80.

Ginneken LV, Meers E, Guisson R, Ruttens A, Elst K et al (2007). Phytoremediation for heavy metal contaminated soils combined with bioenergy production. J Environ Eng Landsc Manag. 15: 227-236.

Gresta F, Wink M, Prins U, Abberton M, Capraro J et al (2017). Lupins in European cropping systems. CABI Publishing: 88–108.

Hao X, Taghavi S, Xie P, Orbach MJ, Alwathnani HA et al (2014). Phytoremediation of heavy and transition metals aided by legume-rhizobia symbiosis. Int J Phytoremediation. 16: 179-202.

Islam E, Liu D, Li T, Yang X, Jin X (2008). Effect of Pb toxicity on leaf growth, physiology and ultrastructure in the two ecotypes of Elsholtzia argyi. J Hazard Mater. 154: 914-926.

Kavamura VN, Esposito E (2010). Biotechnological strategies applied to the decontamination of soils polluted with heavy metals. Biotechnol Adv. 28: 61-69.

Mihalescu L, Mare-Rosca O, Marian M, Bildar C (2010). Research on the growth intensity of the Zea mays L. plantlets aerial parts under cadmium treatment. Analele Univ din Oradea, Fasc. 7: 147-151.

Meftahizadeha H, Ghorbanpourb M, Asareh MH (2019). Changes in phenological attributes, yield and phytochemical compositions of guar (Cyamopsis tetragonoloba L.) landaraces under various irrigation regimes and planting dates. Sci Hortic Sci. 256: 108577.

Mudgil D, Barak S, Khatkar BS (2014). Guar gum: processing, properties and food applications-a review. J Food Sci Technol. 51: 409-418.

Pescod, MB (1992). Wastewater treatment and use in agriculture-FAO irrigation and drainage paper 47. Food Agricul Org United Nations, Rome.

Rascio N, Vecchia FD, Ferretti M, Merlo L et al (1993). Some effects of cadmium on maize plants. Arch Environ Contam Toxicol. 25: 244-249.

Sabah E, Khir MK, Ishag KEA, Yagoub ABA (2008). Chemical composition and oil characteristics of sesame seed cultivars grown in Sudan. J Agric Boil Sci. 4: 761-766.

Sinha R, Singh SN, Gupta AK (2012). Impact of bimetallic combinations of Cu and Ni on percentage germination and early seedling growth of Vigna mungo L. Cultivars. Plant Arch. 12: 383-386.

Tuna AL, Burun B, Yokas İ, Coban E (2002). The effects of heavy metals on pollen germination and pollen tube length in the tobacco plant. Turk J Biol. 26: 109-113.