

Effects of Some Heavy Metals on Chlorophyll Accumulation in *Brassica juncea* (L.) Czern plant

¹Karishma Prajapati and ²Ruby Patel

M. N. College, Visnagar, Gujarat, India.

Abstract:

Heavy metals are topmost environmental pollutants and their intensifying toxicity causes risk for ecological and environmental reasons (Nagajyoti et al.,2010). Excessive accumulation of heavy metals like copper, cobalt, chromium, nickel, cadmium, zinc, lead etc. in soil because of mining, processing and other industrial activities of man have been reported (Chaouhan et al.,2010). Arsenic is a matter that can be delivered into the weather by certain agrarian and modern cycles, for example, through volcanic eruptions and rocks enduring (Sodhi et al., 2019), mining, metal purifying, and application of arsenic pesticides and herbicides (Mandal and Suzuki, 2002). Ni concentration is also increasing in certain areas by anthropological activities such as mining works, emission of smelters, burning of coal and fat, sewage, phosphate fertilizers and pesticides (Gimeno-García et al., 1996). The soil is polluted by high nickel absorption lays diverse toxicity symptoms such as chlorosis and necrosis in different plant species (Pandey and Sharma, 2002). To study the effects of heavy metal on chlorophyll and carotenoid content of the Plants. Lowest Ni toxicity was detected in the plants treated with 150 ppm concentration in 60 days and 90 days, where Ch-B content was lowest among all treatments of Cd, which is shadowed by 150 ppm As in 60 days and 90 days. In 60 days and 90 days plants, carotenoid content maximum in control whereas lowest Ni toxicity was observed in 150 ppm. In 60 days and 90 days of As, Highest As carotenoid content was noted in concentration of 50 ppm. In conclusion, Arsenic proved more toxic than Ni at different concentrations. Chlorophyll plays a vital role by taking the sunlight and translating Chlorophyll is essential as it captures sunlight and converts it into nourishment for plants, while also contributing to the richness of various other pigments found in leaves.

Keywords: *Brassica juncea*(L.) Czern, Phytoremediation, Arsenic, Nickel, Chlorophyll, Carotenoid

Introduction:

Heavy metals are chief environmental pollutants and their intensifying toxicity causes threat for ecological and environmental reasons (Nagajyoti et al.,2010). Soil contamination by industrial sewages loaded with toxic heavy metals has raised a new threat to agriculture. These effluents and wastes contain heavy metals in sufficient amount to cause toxicity to crop plants. The primary response of plants due to heavy metals stress is the production of reactive oxygen species (ROS). ROS are the partially reduced forms of atmospheric oxygen and their production

is strongly regulated in ordinary growth conditions. Consequences of heavy metal toxicity cause the oxidative stress in plants (Mithofer et al., 2004). Excessive accumulation of heavy metals like copper, cobalt, chromium, nickel, cadmium, zinc, lead etc. in soil because of mining, processing and other technological activities of man have been reported (Chaouhan et al., 2010). Such heavy metals including Cd, Cr, Cu, Ni, and Zn enter in large amounts in the environment through mining and burning of fossil fuels creating contamination of soil as well as water leading to either leaching of metals into the groundwater or extreme accumulation in the top soil (Qian et al., 1999; Adriano, 1992).

Arsenic is a matter that can be delivered into the climate by certain agrarian and modern cycles, for example, through volcanic eruptions and rocks enduring (Sodhi et al., 2019), mining, metal purifying, and application of arsenic pesticides and herbicides (Mandal and Suzuki, 2002). Ni^{2+} concentration is also increasing in certain areas by anthropological activities such as mining works, emission of smelters, burning of coal and oil, sewage, phosphate fertilizers and pesticides (Gimeno-García et al., 1996). The soil polluted by high nickel absorption lays diverse toxicity symptoms such as chlorosis and necrosis in different plant species (Pandey and Sharma, 2002).

Unlike organic pollutants, these heavy metals cannot be chemically degraded or biodegraded by microbes. The use of plants to remove toxic metals from soils (phytoremediation) is evolving as a probable strategy for cost effective and environment friendly remediation of contaminated soils (Cunningham and Ow 1996). *Brassica juncea* (L.) Czern. have been reported to have high potential to tolerate and accumulate high amounts of toxic trace elements including Arsenic (Blaylock and Huang, 2000), chromium, copper, nickel, manganese, and lead (Chandra et al., 2009).

In the present study, to study the effects of heavy metal on chlorophyll content of the Plant.

Material and methods:

To study the effects of Arsenic (As) and Nickel (Ni) metals on *Brassica juncea* (L.) Czern. plants, a field experiment was conducted in Botanical Garden of M.N. College, Visnagar. Seeds were sown in different blocks. Different treatments of Ni (50 ppm, 100 ppm and 150 ppm) and As (50 ppm, 100 ppm and 150 ppm) metals were given. Plants were harvested after 60 and 90 days of the plants.

Estimation of Chlorophyll:

Chlorophyll content was measured by following the method given by Arnon, 1949. 1 gm fresh plant tissue (leave) was homogenized by using 10 mL of 80% acetone. The homogenized material was subjected to centrifugation using centrifuge for 20 minutes at 1200 rpm at a temperature of 4°C. The supernatant of plant extract was used for the analysis of chlorophyll content. The absorbance of the supernatant was taken at 645 and 663 nm.

Calculations:

Chlorophyll a (mg/gm tissue): $[12.7(A_{663}) - 2.69(A_{645})] * V / 1000 * W$

Chlorophyll b (mg/gm tissue): $[22.9(A_{645}) - 4.68(A_{663})] * V / 1000 * W$

A = Absorbance of specific wavelength;

V = Final volume of Chlorophyll extract in 80%Acetone;

W = Fresh weight of Tissue extract.

Estimation of Carotenoids:

Carotenoid (mg/g): $[A_{480} + (0.114 * A_{663}) - (0.638 * A_{645})] * V / 1000 * W$

A = Absorbance of specific wavelength;

V = Final volume of extract in 80%Acetone;

W = Fresh weight of Tissue extract.

Results and Discussion:**Photosynthetic Pigments:****Chlorophyll content:**

A significant decrease in chlorophyll a and chlorophyll b content were observed in 60 days plants compare to 90 days of the plants (Figure 1).

In 60 days, Chl A content was recorded maximum in control plants whereas 50 ppm and 100 ppm As showed a very slight variation in Chl A level. In 90 days, plants, Chl A content was recorded maximum in control plants whereas 150 ppm Ni and 100 ppm As showed a very slight variation in Chl A level. Lowest Ni toxicity was observed in the plants treated with 150 ppm concentration in 60 days and 90 days, where Chl B content was lowest among all treatments of Cd, which is followed by 150 ppm As in 60 days and 90 days.

Chlorophyll decrease is one of the common symptoms of heavy metal toxicity in plants (Fargasova, 1998). Chlorosis is attributed mainly to poor synthesis in stressful conditions or by the degradation of the pigments (Stobart et al., 1985 and Somashekaraiah et al., 1992).

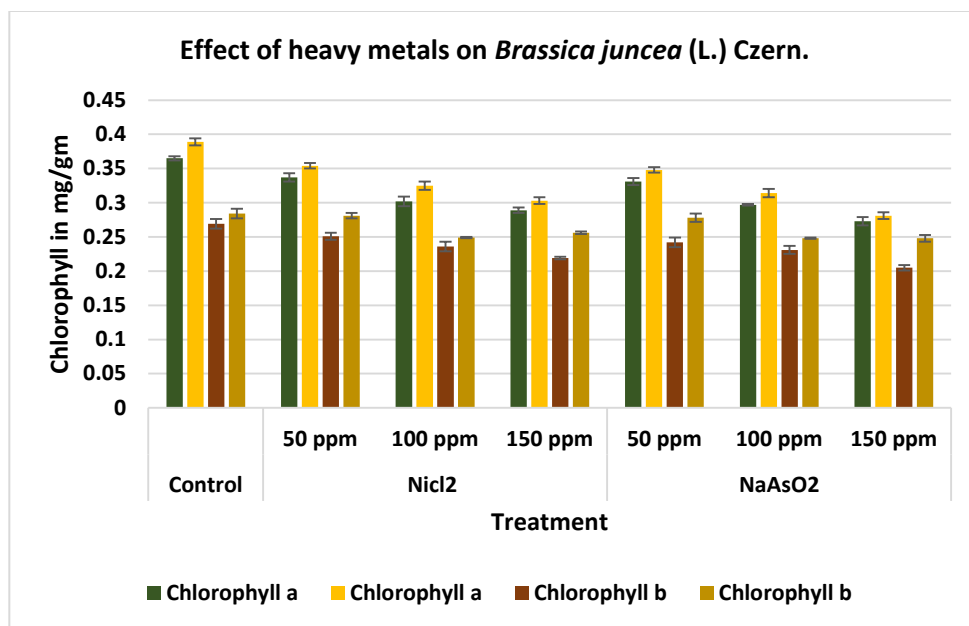


Figure 1: Ni and As metals effect on Chl A, Chl B content of 60 days and 90 days old *Brassica juncea* (L.) Czern. Plants

The reduced chlorophyll accumulation during heavy metal treatment is due to the interference of different chlorophyll biosynthesis stages. In *Brassica juncea* (L.) Czern. (Mustard) we have also observed a significant decrease in the chlorophyll content under metal stress conditions.

Carotenoid content:

A significant decrease in carotenoid content was observed in 60-days and 90 days plants. In 60 days and 90 days plants, carotenoid content maximum in control whereas lowest Ni toxicity was observed in 150 ppm. In 60 days and 90 days of As, Highest As carotenoid content was noticed in concentration of 50 ppm.

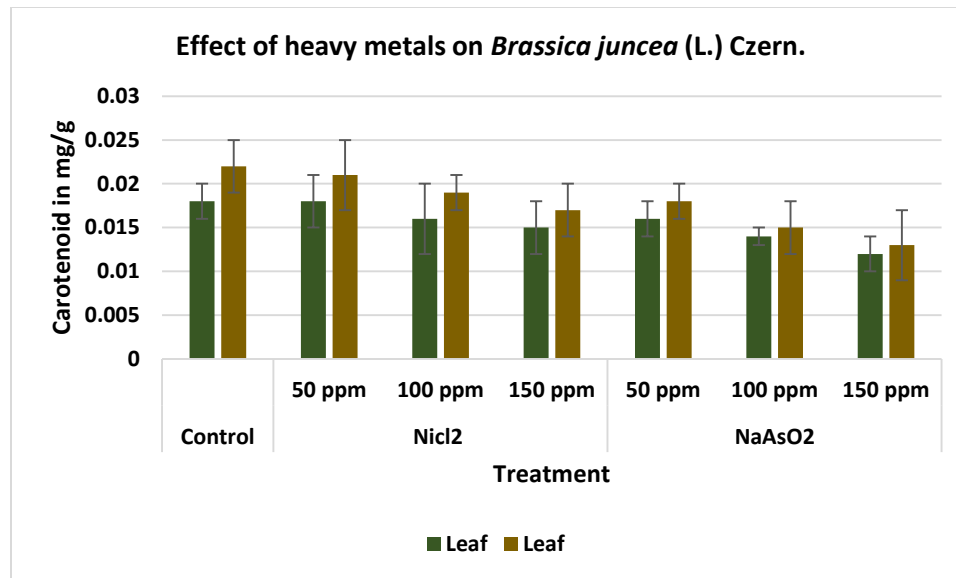


Figure 2: Ni and As metals effect on Carotenoid content of 60 days and 90 days old *Brassica juncea* (L.) Czern. Plants

Conclusion:

Chlorophyll plays a vital role by taking the sunlight and converting it into plant food and rank higher in other leaf pigments. Based on the results, we conclude that Chlorophyll and carotenoid is seriously affected by heavy metals. Chlorophyll 'b' was reduced more as compared to Chlorophyll 'a'. Arsenic proved more toxic than Ni at different concentrations.

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