INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 16, No. 3, p. 65-69, 2020
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

A study on physiological, anatomical characterization of selected radish plant

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Article published on March 30, 2020

Key words: Chlorophyll *a* and Chlorophyll *b,* Carotenoids, Nickel sulphate

Abstract

A pot experiment was conducted in the old Botanical Garden at University of Agriculture, Faisalabad to analyze and check the impact of nickel sulphate effect by on radish plant. One variety of radish (*Raphanus sativus*) Mooli Day-40 was grown under nickel sulphate solution. Varying concentration of nickel sulphate (10, 20, 30mM) was applied. All the morphological parameters were studied e.g. chlorophyll a, b, and carotenoids. Ni effect significantly reduced the growth attributes. Results were described after data recording and statistical analysis by using latest computer software packages. A marked drop in all morpho-physiological attributes in relation to biochemical attributes chlorophyll *a* and chlorophyll *b* were reduced while a subsequent elevation was observed in carotenoid.

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Introduction

In Unani, Greeko-Arab, and Indian folk medicine, radish is used as a household remedy for the treatment of many diseases such as jaundice, gallstone, liver diseases, rectal prolapse, indigestion, and other gastric pains (Ahmad *et al.*, 2007). In general, radish contains carbohydrates, sugars, dietary fibers, protein, and even some fat and fluoride. In addition, it mcontains various water-soluble vitamins B1, B2, B3, B5, B6,B9, and C and minerals such as calcium, iron, magnesium, manganese zinc, potassium, and phosphorous.

Radish is useful in liver and gall Bladder troubles. In homoeopathy, they are used for neuralgic headache, sleeplessness and Chronic diarrhea. Roots, leaves, flower and Pod are quite effective against gram positive Bacteria. The roots are said to be useful in Urinary complaints, piles and in gastrodynia. A Salt extracted from roots, dried and burnt to White ash is said to be used as diuretic and Laxative. Heavy metal contamination of the environment is currently a global problem threatening vegetation, wildlife and human (Alexander *et al.*, 2007).

Nickel is an essential micronutrient for plant growth so it is readily absorbed through plant roots But there are negative consequences when it is present in toxic concentrations. Excess Ni often Competes with other necessary micronutrients for uptake into plant tissues from soil. As a result, Nutrient deficiencies may arise within seeds (Naeem *et al.*, 2019). These nutrients are important cofactors and enzyme Activators involved in the metabolic processes/events needed to ensure successful germination And seedling growth. Nutrient deficiencies result in imbalances and suppression of those Metabolic processes, thus inhibiting plant growth (Antoniadis *et al.*, 2008).

The effect of various concentrations of nickel (100, 200, 500 and 1000µM) and recovery treatments of boron (50 and 100µM) and copper (15 and 75µM) each with 200µM and 500µM of nickel on germination, growth, biomass, chlorophyll, carotenoids, pheophytin, amylase, protein, sugar as well as activity of catalase and peroxidase were studied in radish (Raphanus sativus cv. Early menu) seedlings. Nickel treatments caused a considerable reduction in germination percentage, growth and biomass. The different pigments were also decreased with nickel treatments. The combination of nickel with boron resulted into increased protein contents. This combination also reduced the catalase and peroxidase activity (Ashraf *et al.*, 2011).

Researched on water lettuce plants which were exposed to variousconcentrations (0, 0.01, 0.1, 1.0 and 10.0ppm) of nickel as Nickel sulphate in nutrient medium. The effect of graded nickel (Ni+2) concentrations on visible symptoms of Toxicity, pigments (chlorophyll a, b and total) and antioxidative attributes were evaluated. Plants exposed to High nickel (1.0 and 10.0ppm) showed visible toxicity symptoms, such as wilting, chlorosis in young leaves, Browning of root tips and broken off roots, observed at 6 days after treatment. Nickel was accumulated more In root (863.3µg g-1 dry weight) than leaves (116.2µg g-1 dry weight) at 6 days of treatment. Nickel exposure Decreased chlorophyll a, b and total chlorophyll contents (Assunçao *et al.*, 2003).

The aims of this study included the study of anatomy and biochemical characterization of radish plant under stress conditions. Ni has negative effect on photosynthesis and respiration. High uptake of Ni induces a decline in water content of dicot and monocot plant species (Baenas *et al.*, 2016).

The decrease in water can act as an indicator for Ni toxicity in plants. Ni is associated with proteins inhibition germination and chlorophyll synthesis (Alexander *et al.*, 2007). Nickel received very little attention due to its dual character and complicated electronic chemistry which acts as barrier to reveal the toxicity mechanism in plants. The objective of this review paper is to summarize the overview of the sources, essentiality, uptake Ni toxicity in plants. Nickel pollution is a serious environmental concern which led to research on phytoremediation (Choudhari *et al.*, 1997).

Materials and methods

A pot experiment was carried out to study the effect of Nickle on radish seedlings. Nickle is applied to the young seedling after 2 week of germination. This Nickle was applied in different concentrations, like 0, 10, 20 and 30mM. This stress was applied in the form of solutions through Foliar application.

Fig.1. A radish Plant with root.

Treatments and Source

Simple water used from the filler plants present in the University of Agriculture, Faisalabad. The nickelsulphate that we want to apply to plants are taken from our Botany Department in a specific amount and make the solution in 1L of water and apply to specific plants.

1- Normal water or *0mM*Nickel solution

2- *10mM* Nickel solution

3- *20mM* Nickelsolution

4-*30mM* Nickel solution

Photosynthetic pigments

The method of Arnon (1949) was used for the determination of chlorophyll a and b and carotenoids contents. Leaf samples (0.10g) were cut and left over-night in 10ml of 80% acetone. The next morning the extracts were centrifuged at 10,000rpm for 5 min and the supernatant's absorbance was recorded at 480, 645 and 663nm using a spectrophotometer (Alexander *et al.*, 2007)

Statistical Analysis

The statistical analysis of data is performed we apply the CO-state and draw the Anova tables. Then data is filled in the tables.

Results and discussions

After conducting experiments chlorophyll a, b and carotenoids in the laboratory final results were obtained that were presented in the form of ANOVA table. F- values and P- values were calculated and results were divided into following sections.

Analysis of Chlorophyll a

Analysis of variance of data for chlorophyll *a* of radish genotype (Mooli Day-40) grown under control and Nickel sulphate stress condition is presented. Application of Nickel effect caused a significant ($P \geq 0.001$) reduction chlorophyll *a*. Maximum increase was observed at control condition whereas maximum reduction at 30m*M* nickel was applied in Foliar medium (Espen *et al.*, 1997) .

Analysis of Chlorophyll b

Analysis of variance of data for chlorophyll *b* of radish genotype (Mooli Day-40) grown under control and Nickel sulphate effect condition is presented. Application of Nickel sulphate effect caused a significant ($P \geq 0.001$) reduction in chlorophyll *b*. Maximum increase was observed at control condition whereas maximum reduction at 30m*M* nickel sulphate was applied in Foliar medium.

Analysis of Carotenoids

Analysis of variance of data for carotenoids of radish genotype (Mooli Day-40) grown under control and nickel sulphate effect condition is presented. We have observed in our results that with application of chemical compound such a nickel sulphate resulted a caused a significant ($P \geq 0.001$) reduction in carotenoids. Maximum increase was observed at control condition whereas maximum reduction at 30m*M* nickel sulphate was applied in Foliar medium.

Table 1. Analysis of Variance of data for chlorophyll a of radish(Moli Day-40).

SOV	Df	SS	MS	F	P
Treatment	3	0.175	0.058	54.874	.735*
Error	8	0.009	0.001		

***, **, * = significant at 0.001, 0.01 and 0.05 probability levels respectively, ns= non- significant.

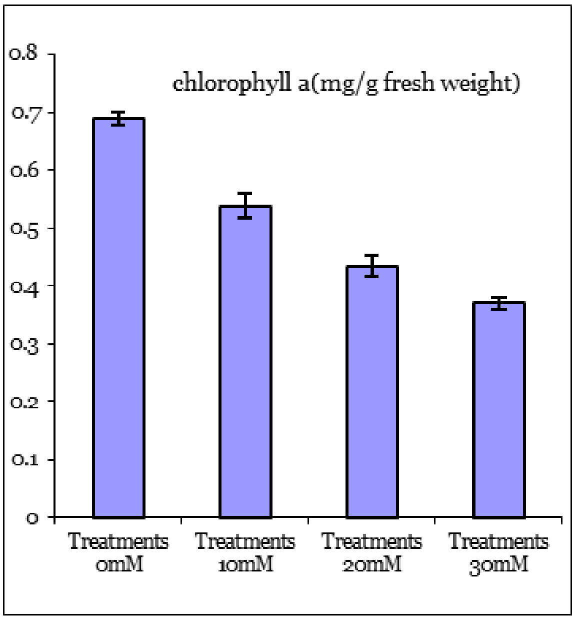

Fig. 2. Analysis of Variance of data for chlorophyll a of radish(Moli Day-40).

Table 2. Analysis of Variance of data for chlorophyll b of radish (Moli Day-40).

SOV	Df	SS	MS	F	P
Treatment	3	1.721	0.573	45.120	.993*
Error	8	0.102	0.012		

***, **, * = significant at 0.001, 0.01 and 0.05 probability levels respectively, ns= non- significant.

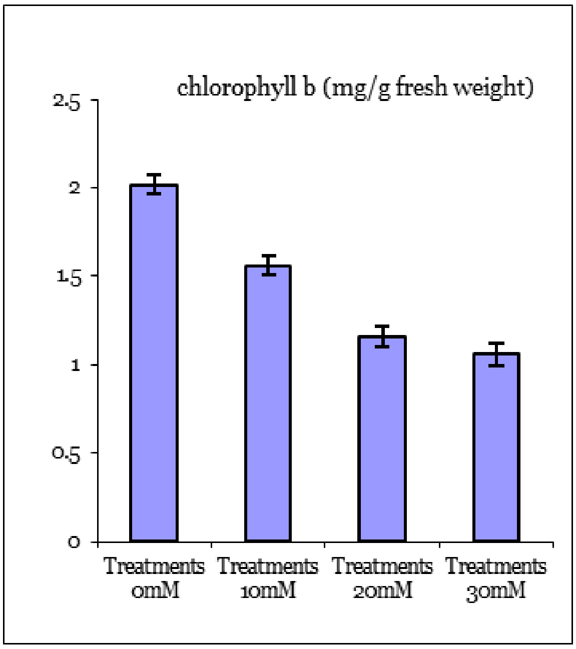

Fig. 3. Analysis of Variance of data for chlorophyll b of radish(Moli Day-40) .

Table 3. Analysis of Variance of data for carotenoid of radish (Moli Day-40).

SOV	Df	SS	MS	F	P
Treatment	3	3.576	1.192	48.133	.487*
Error	8	0.198	0.025		

***, **, * = significant at 0.001, 0.01 and 0.05 probability levels respectively, ns= non-

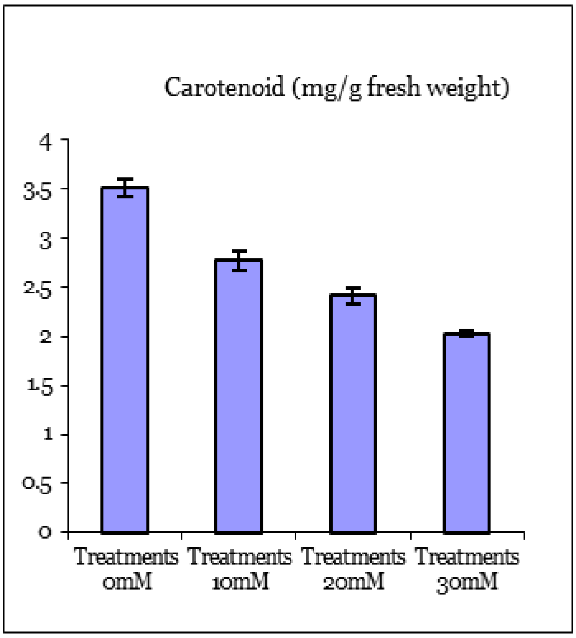

Fig. 4. Carotenoids of radish genotype grown under control.

Chlorophyll a, chlorophyll b and carotenoids showed a significant decrease when the concentrations of nickel sulphate were increased significantly in both cultivars of the radish. This indicates that biosynthesis was inhibited by metals in higher plants (Prasad *et al.*, 1987). The effect of heavy metals on photosynthetic pigments may be due to the heavy metals entering the frond chloroplast with a resulting over-accumulation locally causing oxidative stress and subsequent damage through the peroxidation of the chloroplast membranes (Clemens *et al.*, 2002).

The concentration of both chlorophyll ‘a’ and ‘b’ was reduced in response to nickel supply, The decrease in these plant pigments might be due to the cellular disorganization under nickel toxicity, which cause agglutination of chloroplasts (Pandey *et al.*, 2006).

Conclusion

Types of chlorophyll such as Chlorophyll-a, b and carotenoids studied in this research. This study helpful for the discovery of novel pigments in the field of natural and applied sciences. It might helpful for carrying out bright pigments determination. This study will be helpful for the determination of biochemical parameters measurement as well as for their proper concentration in a discovery of plant sciences.

Acknowledgement

I am thankful to Dr. Muahhmad Irfan , Department of Botany (UAF) that give full devotion towards completion of research and laboratory skills. All authors also contributed in formulating fig.s and scientific citations of this article. I am also thankful for their efforts for publication in this research.

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