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Research Article

EFFECT OF NICKEL TOXICITY ON THE GROWTH OF *RAPHANUS SATIVUS* (L.)

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ABSTRACT

The Study was conducted to find out the effect of Nickel on the Radish plants. Radish plants were raised in pots containing the soil amended with various levels of nickel (control, 0, 6, 9, 12 ppm). Three replicates were maintained for each level. Morphological parameters like root and shoot length, total leaf area and dry weight of root and shoot of radish plants were recorded at an interval of following days (2days, 4days, 6 days). Nickel treatment at all levels tested (except control). The results showed decrease in the various growth and yield parameters such as length of the root and shoot, area of leaves and dry weight of root and shoot and biochemical constituents of radish plants.

Keywords: *Nickel, Raphanus sativus* L., *Developmental Stages, Root, Shoot, Growth, Yield, Dry Weight, Biochemical Constituents*

INTRODUCTION

Heavy metal contamination of soils is one of the major environmental stresses for higher plants and there is increased interest in the use of plants to decontaminate soils polluted by heavy metals. Among the heavy metals, nickel is an important element for both plants and animals. It plays an important role in several plant metabolic processes.

It activates enzymes and is involved in protein synthesis and in carbohydrate, nucleic acid and lipid metabolism. It forms complexes with DNA and RNA and affects the stability of these compounds (Collins, 1981; Pahlsson, 1989). But in excess levels nickel stress causes multiple direct and indirect effects on growth and development of plants. Metals play an integral role in the life processes of microorganisms.

Some metals, such as calcium, cobalt, chromium, copper, iron, potassium, magnesium, manganese, sodium, nickel and zinc, are essential, serve as micronutrients and are used for redox-processes; to stabilize molecules through electrostatic interactions; as components of various enzymes; and for regulation of osmotic pressure (Aery and Sarkar, 1991; Alan, 1981; Ambler *et al.*, 1970). Many other metals have no biological role (e.g. silver, aluminium, cadmium, gold, lead and mercury), and are nonessential and potentially toxic to microorganisms. Toxicity of nonessential metals occurs through the displacement of essential metals from their native binding sites or through ligand interactions (Anita *et al*., 1990).

In addition, at high levels, both essential and nonessential metals can damage cell membranes; alter enzyme specificity; disrupt cellular functions; and damage the structure of DNA (Aery and Sarkar, 1991; Alan, 1981; Ambler *et al.*, 1970).

Radish (*Raphanus sativus* L.) belonging to the family Cruciferae (Brassicaceae) is one of the important vegetables of the world. The leaves and tubers of radish are used to prepare salad and also cooked as vegetables. It is used as a medicine in curing liver disorders and jaundice. The present investigation has been carried out to find out the effect of nickel on growth and biochemical constituents of radish (*Raphanus sativus* L.)

MATERIALS AND METHODS

Seed Material

The experimental plant, the radish belongs to the family Cruciferae (Brassicaceae) is one of the important vegetables of the world. Certified seeds were obtained from the market. Seeds with uniform size and weight were chosen for experimental purpose.

Pot Culture Experiments

Radish plants were grown in pots in untreated soil (control) and in soil to which nickel had been applied (0, 6, 9, and 12 ppm). The inner surfaces of pots were lined with a polythene sheet. Each pot contained 6 kg of air dried soil. The nickel as in solution form was applied to the surface soil and thoroughly mixed with the soil. Nine seeds were sown in each pot. All pots were watered to field capacity daily. Plants were thinned to a maximum of five per pot, after a week of germination. Each treatment including the control was replicated three times. Carefully cultivate plants into the pots. Filling the pots with soil and planted seeds in then. Give water to the pots every day after 4 to 5 days plants come out of soil. Metals are not applied to the plant because they were too small that they cannot bear the effect of metal. After one month the plants will fully developed.

Sample Collection

The plant samples were collected at two days intervals for the measurement of various morphological growth parameters. Three plants from each replicate of a pot was analyzed for its various parameters and the average was calculated. These mean values were used for statistical analysis. All the parameters are taken all different concentration of nickel 6ppm, 9ppm &12 ppm.

Morphological Parameters

The various morphological parameters such as root length shoot length, total leaf area and dry weight of root and shoot per plant, wet weight of root and shoot were determined for every sample. The total leaf area was also measured.

RESULTS AND DISCUSSION

Results

Table 1: Effect of Nickel on Growth of *Raphanus Sativus* after 0 Days of Metal Application

Treatments	Root Length Cm	Shoot Length Cm	No. of Leaves	Leaf Area Cm^2	Root Fresh WT gm	Root Dry WT gm	Shoot Fresh WT gm	Shoot Dry WT gm
T_0 (control)	15.8	0.29	7	19.9	20	11	8.3	6
T_1 (6PPM)	12.6	5.46	7	27.5	21	15.66	6.3	3
T_2 (9PPM)	11.20	4.37	7	14.72	22.33	19.66	5	3
T_3 (12PPM)	6.86	1.77	7	10.81	15	12.33	12.33	4

Table 2: Effect of Nickel on Growth of *Raphanus Sativus* after 1 Days of Metal Application

Treatment	Root Length Cm	Shoot Length Cm	No. of Leaves	Leaf Area Cm^2	Root Fresh WT	Root Dry WT Gm	Shoot FRESH WT Gm	Shoot Dry WT Gm
$T_\circ$(control)	15.2	0.28	8	18.3	18.3	15	4.66	5
T_1 (6PPM)	11.35	4.96	5	25.92	18	13	4.66	1.6
T_2 (9PPM)	10.20	3.67	7	13.69	20	17.3	3.66	2.6
T_3 (12PPM)	6.2	1.69	6	9.81	14	10.6	6	3

Table 3: Effect of Nickel on Growth of *Raphanus Sativus* after 2 Days of Metal Application

No of Treatment	Root Length Cm	Shoot Length Cm	No. of Leaves	Leaf Area Cm^2	Root Fresh WT gm	Root Dry WT Gm	Shoot FRESH WT gm	Shoot Dry WT Gm
T◦	13.46	0.27	5	18.53	17.33	9	7	3
T_1 (6PPM)	10.72	5.02	6	24.73	18.66	6	5	3
T_2 (9PPM)	9.54	4.06	6	9.86	19.6	11	6.33	3.66
T_3(12PPM)	6.4	1.67	5	9.15	13.33	10.6	6	3

Table 4: Effect of Nickel on Growth of *Raphanus Sativus* after 3 Days of Metal Application

Treatment	Root Length Cm	Shoot Length Cm	No. of Leaves	Leaf Area Cm^2	Root Fresh WT gm	Root Dry WT Gm	Shoot FRESH WT gm	Shoot Dry WT Gm
T◦(control)	12.02	1.34	6	17.02	16.63	10	6	3.2
T_1 (6PPM)	11.01	4.02	7	23.03	17.60	7	7	4
T_2 (9PPM)	9.64	5.66	7	10.08	18.05	11	5	3.5
T_3(12ppm)	7.3	2.63	5	9.20	13.02	12	4	2.5

Discussion

The root length of radish plants at different stages of growth under nickel stress. The root length of radish increased in various sampling days and decreased with an increase in the concentration of nickel in the soil. Shoot length of radish at different stages of growth under nickel stress, in higher nickel concentration plants of radish showed the minimum length of shoot. Total leaf area of radish under nickel stress recorded at different stages of growth it increased in the subsequent sampling periods and decreased at high levels (9ppm) of nickel in the soil.

The root dry weight of radish plants raised in various levels of Nickel at different stages of growth when compared to the control nickel at (6ppm) level in the soil increased the dry weight of root and decreased the root dry weight at high levels (9ppm, 12ppm) in all the sampling days. Leaf area of radish decreased with increase in the nickel content of the soil. Similar reduction in total leaf area due to cadmium and manganese (Terry *et al.*, 1975), lead (Khan and Frankland, 1983), nickel (Setia *et al.*, 1988; Vijayarengan, 2004) and chromium (Sharma and Sharma, 1993) was observed. The decrease in leaf area at higher concentration of nickel can be attributed to either a reduction in the number of cells as judged by Nieman (1965) in the leaves of *Phaseolus vulgaris* or due to reduction in cell size (Meiri and Poljakaff-Mayber, 1967).

Dry matter yield in various parts of radish varied according to nickel level. Dry matter of root and shoot was the highest at (6ppm) nickel level, but it showed a gradual decline from (12ppm) level onwards. There is large number of reports that the heavy metals increased the dry matter yield of various plant parts at lower levels (Lal and Maurya, 1981; Shrikrishna and Singh, 1992). The reduction in dry matter yield of plants at higher concentrations of heavy metals was also observed by Jayakumar *et al.*, (2007) in radish due to Nickel.

Conclusion

Root and shoot length of radish plants decreased with an increase in Nickel level in the soil. Nickel at high levels may inhibit the root growth directly by inhibition of cell division or cell elongation or combination of both, resulting in the limited exploration of the soil volume for uptake and translocation of nutrients and water and induced mineral deficiency.

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