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Alteration in germination, growth and biochemical parameters in *Cucumis sativus* L. due to nickel stress

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Abstract
Environmental pollution due to industrial activity, mining, agricultural activity and transportation, leads to production of high amounts of contaminants like heavy metals into surface water and ground water and soils which ultimately leaches to ground water and also affects the biosphere. Seed is the developmental stage that leads to subsequent vegetative developmental processes *Cucumis sativus* L. and it becomes sensitive to external stress. In this study, germination was conducted in cucumber [*Cucumis sativus* L.] in order to find out the changes in germination, different developmental stages in terms of its growth, physiological and biochemical alteration due to nickel stress. The seeds of cucumber were germinated in variable nickel concentrations of ranging from 0-100 mg/L of Nickel as nickel chloride solution. It was found that germination percentage and Seedling vigour indices were reduced with increasing concentration of nickel. In another experiment conducted in pot culture revealed that, different physiological and biochemical parameters like total chlorophyll content and total protein content were decreased whereas free proline content were increased with increase in concentration of Nickel. It was also observed that seeds of cucumber showed better result in terms of different physiological and biochemical parameters in 20 ppm of Nickel at different interval of days like 10th, 20th and 30th days of growth of seedling thereby indicating that Nickel within 20 mg/kg could facilitate the plants growth and it is subsequently affect the seedling when it exceeds from 20 mg/kg of nickel in soil.

Keywords: nickel, *Cucumis sativus* L., germination, growth parameters, biochemical parameters

Introduction
Dispersal of industrial and urban waste generated by human activities is a major environmental concern which causes the contamination of soil. The surface deformation, caused by mining and surface construction damage, is becoming a problem. This is drawing more and more attention to underground mining causing surface deformation [1, 2]. Contamination of agricultural soils due to trace metal in agricultural soil are major environmental problems today [3]. Uptake of metals by plants can have strong adverse impact on both plants as well as animals through the food chain [4]. There are thirty five metals responsible for occupational and residential exposure among which twenty three are heavy metals. Heavy metals can include elements lighter than carbon and can exclude some of the heaviest metals [5].
Nickel is just one of a variety of obiquitous trace metal emitted to the environment from both natural and anthropogenic sources. Sukinda is only indigenous resources of Nickel ore of India which produces the lateritic nickel ore [6]. Nickel is considered as a micronutrient for plants as it is required at very low concentration by plants [7]. According to International Agency for Research on Cancer, Nickel is reported as one of the toxic heavy metals and it is also considered as human carcinogens [8]. As Nickel is one of the heavy metal pollutant, it is of interest to study the effect of nickel on alteration of growth and development along with different physiological and biochemical parameters of *Cucumis sativus* L.

Materials and Methods
Cucumis sativus L. is a popular vegetable plant particularly in tribal rich pockets of the states of Odisha. Seeds of *Cucumis sativus* L. were obtained from Orissa University of Agriculture and Technology, Sambalpur to be used as the experimental material. Seeds of cucumber were surface sterilized with 0.1% mercuric chloride and washed thoroughly with tap water and then with distilled water. Hundred uniform seeds were germinated in petridish with different nickel concentration and it was incubated for five days and then number of germinated seeds were counted and percentage of germination were calculated, Seedlind vigour indices [9] were also calculated. Another experiment had been carried out in pot culture in which seeds were sown in pre-treated soil which was treated with different concentration of nickel ranging from 20 mg/kg to 100 mg/kg with a nickel less soil and different growth and biochemical parameters like total chlorophyll content [10], total protein content [11] and free proline content [12] were estimated in plants at 10, 20 and 30 days after treatment. All the experiments were done in triplicates and the data was statistically analyzed and standard error of mean (SEM) was calculated.

Results and Discussion
Germination percentage were decreased at higher concentration of Nickel. Reduction in germination percentage of *Cucumis sativus* L.at higher concentrations may be attributed to the interference of Nickel ions. Seedling vigour index were increased at lower concentration and decreased at higher concentration, simultaneously the significant decrease in radicle length of *Cucumis sativus* L. seedling suggested that low concentration of Nickel was beneficial for seedling growth. Nickel at higher concentrations suppressed the seedling growth (Table-1). Similarly different physiological and biochemical parameters were also found to be better in 20 mg/kg of soil

and then it was found to be decreased with increasing concentration of nickel (Fig. 1 & 2). Free proline content were found to be increased with increasing concentration of nickel (Fig. 3).

Different concentration of nickel affected seed germination in *Cucumis sativus* L. plants. Since, germination is the most crucial stage of plant development, the germination of seeds can be used as an indicator of early response of the plants in adverse environmental condition [13]. During germination Ni inhibits all cellular processes [14] thus, slow down growth of plumules and radicles. Similar inhibition of germination at higher concentrations was observed by [15] with cobalt treatment in *Vigna mungo* (L.) Hepper. But the results obtained from the germination studies indicated that *Cucumis sativus* L. showed higher seedling growth and dry weight at 40 mg/kg nickel level in the soil. The values of growth parameters showed that Nickel had a significant stimulating and nutritional effect at 20mg/kg concentration which is beneficiary for plants growth and above 40 ppm it shows adverse impact on seedling growth. The growth parameters beyond this concentration indicated that a little excess of Nickel above these levels had an adverse effect. From the result of this investigation, it can be concluded that Nickel at lower concentration has a stimulating effect on the germination process and seedling growth of *Cucumis sativus* L. and will inhibit the same at higher concentrations. Similar results were reported on the effect of cadmium on *Triticum aestivum*, [16] chromium on *Salvia sclarea*, [17] and cobalt and zinc on *Pennisetum americanum* L. and nickel stress on *Macrotyloma uniflorum* (Lam.) verdc. [18]. Different physiological and biochemical changes also reported in different studies like impact of Cr^{+6} toxicity in plants [19] and nickel toxicity in *Arachese hypogea* L. [20].

Table 1: Effect of Nickel on Seed Germination, Radicle Length, Seedling Vigour Index, of 5th days of *Cucumis sativus* L.

Treatments	Germination Percentage	Radicle Length (in cm)	Seedling Viguor Index
Control	98±0.344	3.214±0.1043	314.972
20ppm	83 ±1.436	2.42±0.9978	200.86
40ppm	64±1.448	1.96±0.6542	125.44
60ppm	48±2.886	0.98±0.0976	47.04
80ppm	25±6.432	0.42±0.0458	10.5
100ppm	8±5.648	0.12±0.0754	0.96

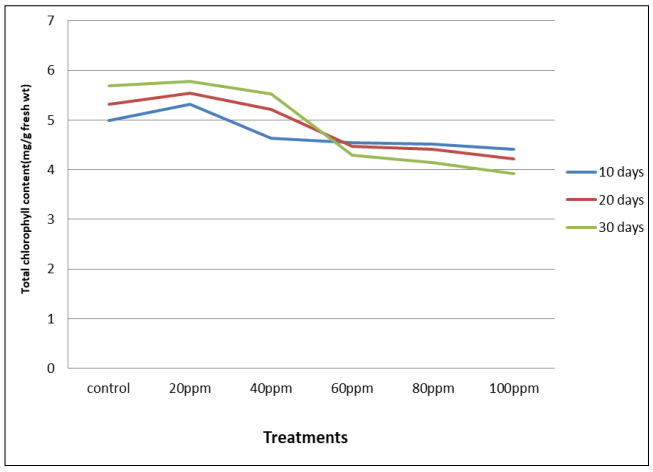

Fig 1: Effect of Nickel ions on total chlorophyll content of *Cucumis sativus* L. Seedlings grown in pot culture experiments.

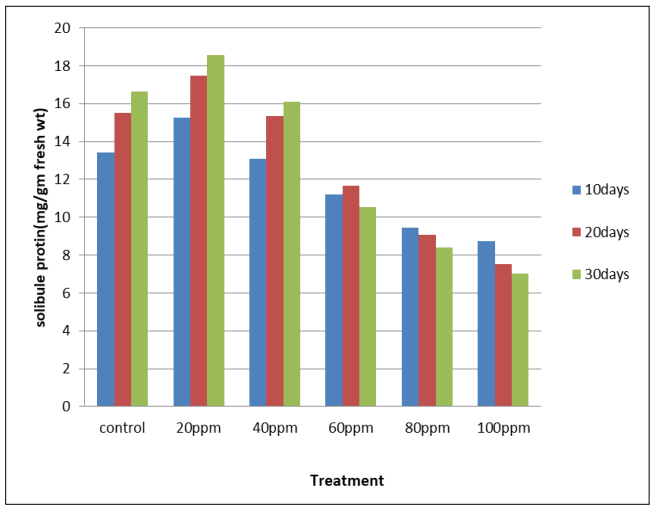

Fig 2: Effect of Nickel ions on soluble protein content of *Cucumis sativus* L.seedlings grown in pot culture experiments.

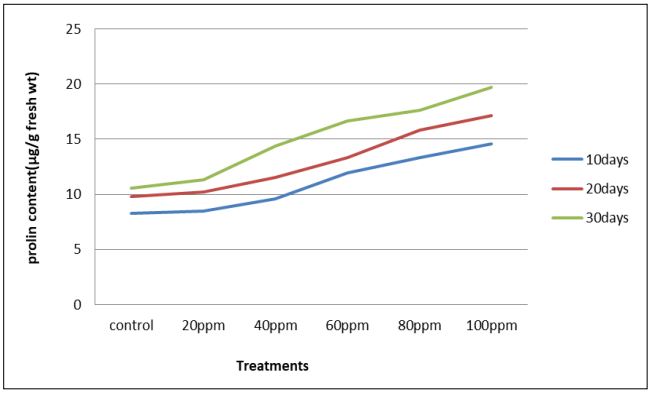

Fig 3: Effect of Nickel ions on free prolin content of *Cucumis sativus* L. seedlings grown in pot culture experiments.

Conclusion

The alteration in growth and biochemical parameters of the seedling indicated that nickel had a significant stimulating nutritional effect up to 20mg/kg concentration for *Cucumis sativus* L. and all the parameters above these levels had an adverse effect. From the result of this investigation, it can be concluded that nickel at lower concentration had a beneficiary stimulating effect in terms of plants nutrition and growth and devlopment of plant and inhibited the same at higher concentrations. So it can be utilized for plant nutrition as micronutrient with controlling the limit within 20 ppm.

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Reference

1. Zhang LL. A certain mining area of Chongqing the inclined coal-seam mined causes surface movement

deformation mechanism and geological environment problems. Chengdu Univ. Technol,2013:6:1-5.
2. Wang GP. Study on impact and restoration of ecological environment of mining subsidence in Chongqing region, J. Chongqing University,2005:10:3-8.
3. Chand S, Pandey A, Patra DD. Influence of nickel and lead applied in combination with vermicompost on growth and accumulation of heavy metals by MenthaarvensisLinn cv Kosi, Indian J. Nat. Prod. Resour,2012:3:256-261.
4. Sadon FN, Ibrahem AS, Ismail KN. An overview of rice husk applications and modification techniques in wastewater treatment, J. Purity Utility Reaction Environ,2012:1:308-334.
5. Duffus JH. Heavy metals ameaningless term?, (IUPAC Technical Report), Pure and Applied Chemistry,2002:74:793-807. http//dx.doi.org/ 10.1351/ pac 200274040793
6. Sahoo RK. Nickel Ore. In, B.K. Mohanty (Ed)-Geology and Mineral Resources of Orissa. Society of Geoscientists and Allied Technologist, 1998:323-338.
7. Brown PH, Welch RM, Carry E. Nickel is a micronutrient essential for higher plants, Plant Physiology,1987:85:801-803.
8. IARC (International Agency for Research on Cancer), IARC Monograph on the evaluation of carcinogenic risks to humans 49, Lyans, France IARC,1990:318-411.
9. Abdul Baki AA, Anderson JD. Vigour determination in soybean seed by multiple criteria. Crop Science,1973:3:630-633.http://dx.doi.org/10.2135/ cropsci1973.0011183X001300060013x
10. Arnon DI. Copper enzymes in isolated chloroplasts polyphenol oxidase in *Beta vulgaris.* Plant Physiologist,1949:24:1-15. http://dx.doi.org/10.1104/ pp.24.1.1
11. Lowry OH, Rosenbrough NJ, Farr AL, Randall RJ. Protein measurement with Folin-Phenol reagent. Journal of Biological Chemistry,1951:193:265-275.
12. Bates LS, Waldren RP, Teare ID. Rapid determination of free proline for water stress studies. Plant and Soil,1973:39:205-208. http://dx.doi.org/10.1007/BF 00018060
13. Singh BK, Walker A, Wright DJ. Bioremedial potential of fenamiphos and chlorpyriferous degrading isolates: Influence of different environment conditions, Soil Biol.Biochem,2006:38:2682-2693.
14. Hall JL. Cellular mechanisms for heavy metal detoxification and tolerance. Journal of Experimental Botany,2002:53:1-11.
15. Mahalakshmi G, Vijayarengan P. Effects of zinc on germinating seeds of three plant species. Nature Environment and Pollution Technology,2003:2(1):117-119.
16. Kalita MC, Devi P, Bhattacharya I. Effect of cadmium on seed germination, early seedling growth and chlorophyll content of *Triticum aestivum*. Indian Journal of Plant Physiology,1993:36(3):189-190.
17. Corradi MG, Blanchi A, Albasini A. Chromium toxicity in Salvia sclarea. Effects of hexavalent chromium on seed germination and seedling development. Environmental and Experimental Botany,1993:33(3):405-413.http://dx.doi.org/10.1016/ 0098-8472(93)90043-F
18. Arzoo A, Nayak SK, Mohapatra A, Satapathy KB. Impact of nickel on germination, seedling growth and biochemical changes of Macrotyloma uniflorum (Lam) verdc. International journal of Biosciences,2014:5(9):321-331.
19. Pati S, Ghadei A, Arzoo A, Nayak SK, Mohapatra A, Satapathy KB. *et al*. Physiological responses induced by chromium $^{+6}$ toxicity to *Cucumis sativus* L. and Macrotyloma uniflorum Lam. IOSR Journal of Environmental Science, Toxicology and Food Technology,2014:8(12):58-63.
20. Arzoo A, Satapathy KB. Physiological and biochemical responses induced by nickel to *Arachis hypogea* L. International Research Journal of Environmental Science,2015:4(11):19-24.