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A STUDY ON THE PHYTOTOXIC IMPACT OF COPPER ON THE GROWTH PARAMETERS OF FLAT BEANS (*PHASEOLUS VULGARIS*)

Divya J[1], Vasudha Ranjan[2], Abhijna B G

[1]Assistant Professor, Department of Environmental Science, JSSAHER, Mysore, Karnataka, India[2]

[2]Research Scholar, Department of Environmental Science, JSSAHER, Mysore, Karnataka, India[1]

Abstract: Copper is a micronutrient that plays a significant role in the carbon dioxide absorption and ATP generation in plants. Metal accumulation in the soil environment can be caused by anthropogenic, industrial, mining and agricultural activity. In this study, the effect of different concentrations of copper on growth of flat beans (Phaseolus vulgaris) were studied. The germination index, root length, shoot length and number of leaves produced were calculated and recorded for different concentrations. From the experimental results, it was found that, the germination index was found higher at 225 ppm treatment. The root length, shoot length and leaf count were higher at 100 ppm treatment. Since there were no much negative effects on growth parameters, in all the treatments, there was no formation of the flowers. From the study, it was concluded that, even though the flat beans (Phaseolus vulgaris) can tolerate copper levels, its impact on flower formation was observed.

Index Terms **- Copper, Flat beans, Growth parameter, Root length, Shoot length.**

I. INTRODUCTION

Heavy metals are the major environmental pollutants and their toxicity is becoming more of a problem for nutritional and environmental reasons. The toxicity of heavy metals in plants varies depending on the types of species, metal, concentrations and the soil. Metal accumulation in the environment particularly in soils can be caused by anthropogenic, industrial, mining and agricultural activity. Heavy metals like copper, zinc and iron are necessary for plants and animals to survive. The heavy metals at larger concentrations of ions are toxic to both anabolic and catabolic activities. To determine the effects of harmful heavy metals on plants, many studies have been conducted all over the world [1-6]. Heavy metal contamination in the agricultural soil has become a major environmental concern due to the potential for negative ecological consequences. Because of their toxic effects on plants and other organisms these toxic substances are considered as soil pollutants [3].

Copper is a necessary heavy metal for higher plants and algae. Increased industrial and mining operations have contributed to an increase in the presence of copper in the environment. Copper in excess, in the soil is cytotoxic, creates stress and causes harm to the plants [4]. This causes leaf chlorosis and plant growth retardation. Excess copper causes oxidative stress and the production of reactive oxygen species (ROS) in plants. Metabolic pathways are disrupted and macromolecules are damaged because of oxidative stress. When plants are exposed to heavy metals they undergo oxidative stress, which causes cellular damage [5, 6]. Heavy metal tolerance is expected to be found in all plant species. They manage a complex system involving uptake/efflux, transport/sequestration and chelation. In this study, the effect of different concentrations of copper solution on growth of flat beans plant is studied.

II. RESEARCH METHODOLOGY

2.1. Experimental Setup: For the preparation of pots with different concentration of copper, first the soil sample were collected from an agricultural land located at Manchalli village, Gundlupete taluk, Chamrajnagara district. The study area which is suitable for the cultivation of vegetables. Only the organic bio manure is used from many years. During the study period, tomato and chilli were grown in entire agriculture land, different vegetables were grown in accordance to the seasons. The collected soil was grinded and sieved to gain the uniform size. 700 grams of soil was weighed and filled to each pot. The flat beans (Phaseolus vulgaris) seeds were sown in twelve different pots with three copper concentration of 100 ppm, 175 ppm, 225 ppm respectively with three trials of each and control pots were also maintained for the comparison of the results.

2.2 Experimental Section: The soil samples collected were subjected to a various physico-chemical tests. The volumetric flask method was used to determine the bulk density and particle density. Porosity was calculated using the values of bulk density and particle density. The pH was measured using pH meter. The titrimetric analysis was carried out to calculate chloride content. The walky and black method used to calculate total organic carbon present in the soil sample. The titration method used to determine calcium and magnesium. Using spectrophotometer, the phosphate and sulphate were determined. The sodium and potassium concentrations were measured by flame photometer.

After two months, the plants were removed. The different plant parts separated and growth parameters were calculated. The results of physico-chemical tests of soil sample are presented in Table 1. The variations in growth parameters are depicted in Table 2.

2.3. Observations on seed germination and other growth parameters: Seeds started to germinate around five to six days of sowing. On fifteenth day, the total number of seeds germinated were counted. The day seeds were sown considered as the first day. Germination percentage was calculated based on the fifteenth day count. The other parameters were measured after 60th day.

- Germination index % = number of seeds germinated/total number of seeds sowed x 100.
- Measurement of length of shoot: The shoot length was measured from base to the tip of the shoot using centimeter scale. The average shoot length was measured by considering the mean in each culture pots.
- Measurement of length of root: The length of root from the tip to the root collar region were measured by using centimeter scale. The average root lengths were considered by calculating the mean values.
- Number of leaves: The total number of leaves in plant were counted, the average value was calculated by taking mean and it was recorded.

III. RESULTS AND DISCUSSIONS

Table 3.1: The experimental results of the control soil.

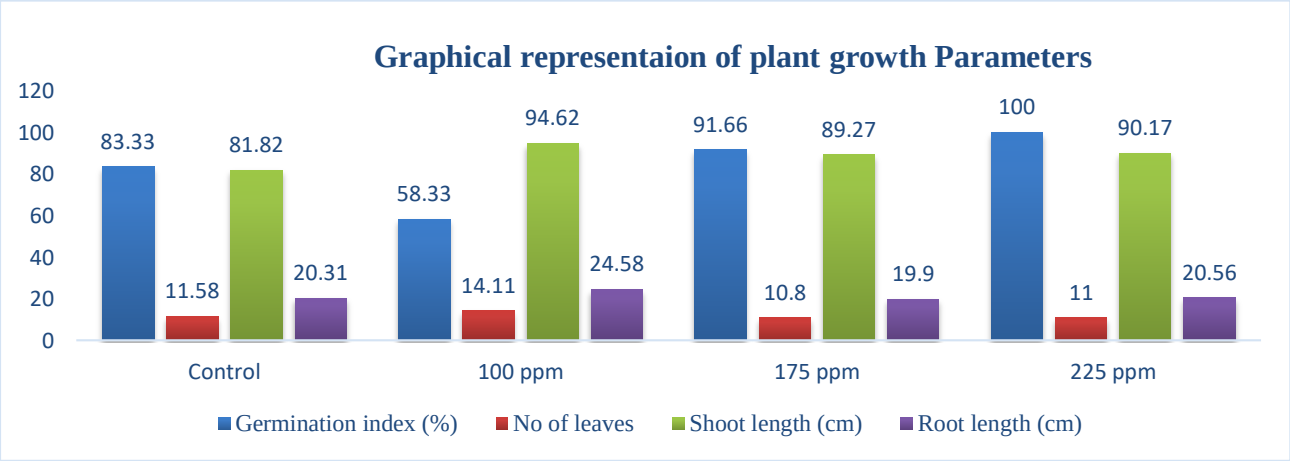
Parameters	Units	Value	Soil Quality Standards
Texture		Sandy clay loamy	
Soil colour		Brown	
Moisture content	%	39.7	-
Bulk density	mg/m^3	1.390	1-1.65
Particle density	mg/m^3	2.4644	2-2.65
Porosity	%	56.403	30-55
pH		6.03	6.5-7.5
Electrical conductivity	ds/m	0.88	0-2
Chloride	%	0.01988	-
Organic carbon	%	0.51	0.50-0.75
Calcium	Meq/L	0.7	10-30
Magnesium	Meq/L	0.4	5-10
Sulphate	kg/ha	31.34	-
Phosphate	kg/ha	6.94	5-10
Potassium	kg/ha	98.56	50-125
Sodium	kg/ha	163.52	-

The analysis of control soil sample has been carried out and the results were presented in Table-1. The texture of soil sample was determined by feel method, the soil used in the experiment is sandy clay loam. The moisture content of the soil sample was found to be 39.7 %. The bulk density value was found to be 1.39 mg/m^3. The particle density calculated by dividing mass by volume, the value was found to be 2.46 mg/m^3. Using the values of bulk density and particle density the porosity was calculated. Porosity is always expressed in terms of percentage. The porosity of soil sample was 56.40 %.

The pH was measured by using the pH meter, the soil sample was little acidic in nature, with pH value of 6.03. The electrical conductivity was found to be 0.88 ds/m. The chloride content in soil was found to be 0.0198 %. The organic carbon content of soil was found to be 0.51 %. The calcium and magnesium ions was found to be 0.7 Meq/L and 0.4 Meq/L respectively. The sulphate present in soil was found to be 31.34 kg/ha and phosphate was found to be 6.94 kg/ha. Flame photometry was used to determine the amount of potassium and sodium existing in the soil and the values were found to be 98.56 kg/ha and 163.52 kg/ha respectively.

Table-2. Results of plant growth parameters.

Treatments	Trials	Germination index (%)	No of leaves	Shoot length (cm)	Root length (cm)
Control	Trial-I	100	10.5	88.8	15.47
	Trial-II	100	12.25	89.65	18.47
	Trial-III	50	12	67	27
	Mean value	**83.33**	**11.58**	**81.82**	**20.31**
100 ppm	Trial-I	25	21	119.5	31
	Trial-II	75	11	101.19	21.1
	Trial-III	75	10.33	63.17	21.63
	Mean value	**58.33**	**14.11**	**94.62**	**24.58**
175 ppm	Trial-I	100	10.75	81.77	21.05
	Trial-II	100	10	85.5	17.42
	Trial-III	75	11.66	100.53	21.23
	Mean value	**91.66**	**10.80**	**89.27**	**19.9**
225 ppm	Trial-I	100	11.5	89.85	22.67
	Trial-II	100	10.25	82.22	20.27
	Trial-III	100	11.25	98.45	18.75
	Mean value	**100**	**11**	**90.17**	**20.56**



In control, the plants were grown healthy, with root and shoot development. The average germination index was found to be 83.33 %. The average root length was found to be 20.31 cm. The average shoot length was 81.82 cm. The average leaf count was found to be 11.58. Few flowers and pods were observed during the study.

In 100 ppm treatments, the plants were grown healthy, with root and shoot development. The average germination index was found to be 58.33%. The average root length and shoot length was found to be 24.58 cm and 94.62 cm respectively. The average leaf count was found to be 14.11. No flowers and pods were observed.

In 175 ppm, the average germination index was found to be higher with the value of 91.66 %. The average root length was found to be 19.9 cm. Average shoot length was 89.27 cm. The average leaf count was found to be 10.08. No flowering was seen and no pods were observed.

In 225 ppm, the plants were grown healthy, with root and shoot development. The average germination index was found to be maximum that is 100%. The average root length and shoot length was found to be 20.56 cm and 90.17 cm respectively. The average leaf count was found to be 11. No flowers and pods were observed.

IV SUMMARY AND CONCLUSIONS.

The heavy metals are posing the serious threat to mankind, environment and to all other biotic components of the ecosystem. Due to anthropogenic activities like industrialization, mining etc the heavy metal concentration in soil has been elevated. The increased level of heavy metals in soil causes several negative effects on plants, animals, mankind and the environment. In this study, the effect of different concentrations of copper on plant growth parameters of flat beans (Phaseolus vulgaris) were studied. The germination index, root length, shoot length and number of leaves are all calculated and recorded at every concentration. The germination index is seen higher at 225 ppm concentration treatment. Root length, shoot length and the leaf counts were higher at 100 ppm concentration treatment. No flowering was observed. Since there are no much negative effects on growth parameters, it was concluded that, flat beans (Phaseolus vulgaris) must have certain level of tolerance for copper. But it has negative impact over the formation of flower at higher rate.

References

[1].Sharma RK. 2014. Biological effects of heavy metals : An overview Biological effects of heavy metals : An overview. J Environ Biol,, 26:301–13.
[2]. Ghori NH, Ghori T, Hayat MQ, Imadi SR, Gul A, Altay V, et al. 2019. Heavy metal stress and responses in plants. Int J Environ Sci Technol, 16(3):1807–28.
[3]. Khan A, Khan S, Khan MA, Aamir M, Ullah H, Nawab J, et al. 2019. Heavy metals effects on plant growth and dietary intake of trace metals in vegetables cultivated in contaminated soil. Int J Environ Sci Technol, 16(5):2295–304.
[4].Nagajyoti PC, Lee KD, Sreekanth TVM.2010 Heavy metals, occurrence and toxicity for plants: A review. Environ Chem Lett. 8(3):199–216.
[5]. Mourato MP, Moreira IN, Leitão I, Pinto FR, Sales JR, Martins LL. 2015. Effect of heavy metals in plants of the genus Brassica. Int J Mol Sci.16(8):17975–98.
[6]. Yadav SK. 2010. Heavy metals toxicity in plants: An overview on the role of glutathione and phytochelatins in heavy metal stress tolerance of plants. South African J Bot, 76(2):167–79.
[7.] Singh S, Parihar P, Singh R, Singh VP, Prasad SM.2016. Heavy metal tolerance in plants: Role of transcriptomics, proteomics, metabolomics, and ionomics. Front Plant Sci. 6, 1–36.
[8]. Arif N, Yadav V, Singh S, Singh S, Ahmad P, Mishra RK, et al.2016. Influence of high and low levels of plant-beneficial heavy metal ions on plant growth and development. Front Environ Sci. 4(NOV).
[9]. Nadgórska-Socha A, Gospodarek J. 2014. Effect of soil pollution with heavy metal mixtures on iron content in broad bean (Vicia faba L.). Ecol Chem Eng A. 21(2):461–9.
[10].Hayyat MS, Adnan M, Khan MAB, Abd-Ur-Rahman H, Ahmed R, Fazal-ur-Rehman, et al.2020. Effect of heavy metal (Ni) on plants and soil: A review. Int J Appl Res. 6(7):313–8.
[11]. Bücker-Neto L, Paiva ALS, Machado RD, Arenhart RA, Margis-Pinheiro M.2017. Interactions between plant hormones and heavy metals responses. Genet Mol Biol. 40(1):373–86.