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Study Of Copper And Nickel Elements Effects On Seed Germination And Seedling Growth Of Pusa Rashmi Variety Of Raphanus Sativus L., In the District Of Damoh (MP), India

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Abstract –

The presence of metallic elements in the environment poses a significant risk to both ecosystems and human communities. These elements, including copper (Cu), cadmium (Cd), lead (Pb), nickel (Ni), magnesium (Mg), manganese (Mn), molybdenum (Mo) and zinc (Zn), manganese (Mn), are common pollutants that can infiltrate the soil through various human activities such as industrial processes, mining, and agriculture. The role of Environment in seed germination is a big chaser but soil and mineral elements are playing a big role in germination also. The hazardous effect of Copper and Nickel individually assessed on seed germination and seedling growth of Raphanus sativus variety Pusa Rashmi. It was noticed that both the heavy metals badly affected the seed germination and seedling growth at higher concentrations near about 200 PPM and 500 PPM. Copper was more toxic than Nickel to both seed germination and seedling growth. All the concentrations of Copper and Nickel used except 10 PPM onward showed a gradual decline in seed germination and seedling growth of Raphanus sativus L. variety Pusa rashmi.

Keywords –

Effect of Copper and Nickel, Seed germination, Pusa Rashmi variety of **Raphanus sativus** L., Hazardous effects

Introduction –

Damoh is a district of Madhya Pradesh located in central India. Damoh is a part of Bundelkhand region, it is situated between 23.50˚ north latitude and 79.33˚ east longitude. Its total geographical area is 7306 sq. KM. The district is surrounded by Sagar, Narsinghpur, Jabalpur, Newari, Panna and Katani districts. There are mainly seven blocks in Damoh. The names of the blocks are Batiyagarh, Damoh, Hatta, Patera, Tendukheda, Pathariya and Jabera. 5-5 Formers selected in each block were given Pusa Rashmi verity seeds for the sowing. After sowing, the seeds received regular irrigation using water to monitor their growth. The visual emergence of radicals was taken as criteria for germination. Production of radish, roots length, and shoots length were examined based on the sustainability of the environment and the amount of micronutrients present in the soil. The fresh weight of seedlings was measured using an electric balance and expressed in grams per seedling. The weight of seedlings, percentage of germination, average root and shoot length were recorded and statistically analysed. They are mentioned in table no. 01 along with block wise observation.

Observation table (01) –: Block wise analysis along with average perspiration in field area.

District	Names of blocks	No. of seeds	Average of Preparation in area (10x10 feet)			
			Weight of Seedling (gm.)	Percentage of Germination (%)	Root Length (cm)	Shoot Length (cm)
Damoh	Batiyagarh	50	27	86	8.8	8.6
	Damoh,	50	28	88	9.3	9.0
	Hatta	50	25	88	9.0	8.9
	Jabera	50	26	84	8.9	7.8
	Patera	50	24	87	8.5	8.3
	Pathariya	50	25	85	8.4	7.9
	Tendukheda	50	26	87	9.3	8.9

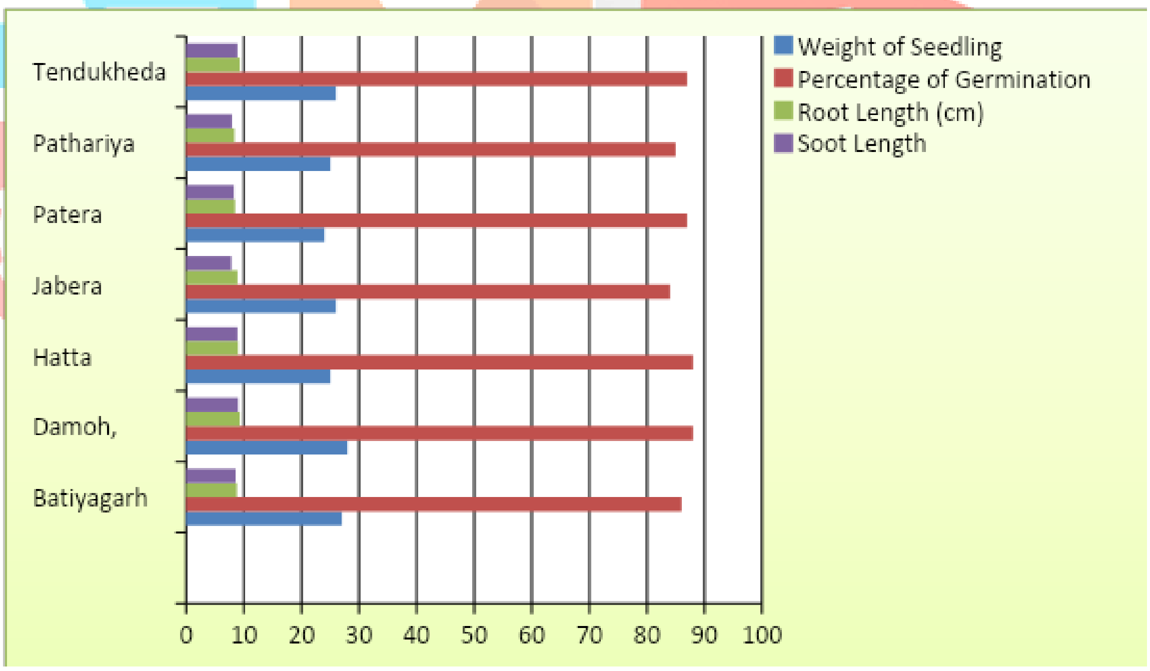

Figure (01) -: Block wise analysis in field area.

The toxic effect of heavy metals on plants is a well-known fact. Many waste and effluents contain heavy metals in an amount sufficient enough to cause toxicity to crop plants. The accumulation of heavy metals like Nickel, Copper, Cobalt, etc. in soil originates from metal mining and processing and other technological activities have been reported extensively. Hazardous levels of heavy metals change biological equilibrium in soil which in turn unfavourably influences soil fertility, plant development and yield.

The findings of this study contribute to expanding our understanding of the effects of heavy metal contamination on the growth and development of Raphanus sativus seedlings. Furthermore, by establishing connections with previous research conducted on other plant species, these results will enhance our comprehension of the broader implications of heavy metal toxicity on plant physiology and environmental sustainability. Ultimately, this research will aid in the development of effective strategies to mitigate the harmful impacts of heavy metal pollution on plant systems and consequently human health.

Objectives –

1. Investigate the inhibitory effects of specific metallic elements (copper and nickel) on the overall development of Pusa rashmi cultivar seedlings from Raphanus sativus.
2. Appraise the relative toxicity of diverse metallic elements on the fresh weight of seedlings, with specific emphasis on copper & Nickel.
3. Correlate the rise in heavy metal concentrations with a decline in the fresh weight of seedlings.
4. Contrast the fresh weight of seedlings exposed to different levels of metallic elements (10 ppm and 500 ppm) with the control group.
5. Evaluate the statistical significance of disparities between the control group and the treatment groups, as well as among the various metallic element treatments.
6. Investigate the potential mechanisms underlying the decrease in seedling fresh weight, including effects on cell count, elongation of roots and shoots, and thickening of cell walls.
7. Establish a connection between the findings of this study and prior investigations involving other plant species (Vigna radiata, Pigeon pea, Soybean and Sorghum bicolour) that have documented reductions in seedling fresh weight resulting from exposure to metallic elements.

Review of Literature –

A study of literature indicates that effects of heavy metals on crop plants have received little attention. The information on the toxic effect of Copper and Nickel in radish (**Raphanus sativus L**.), an important vegetable crop, is very scanty. Therefore it was of interest that I undertook to study dealing with the effect of heavy metals particularly Copper and Nickel on various phases of seedling establishment of Pusa rashmi variety of radish (**Raphanus sativus L.**). The literature on Copper and Nickel as a heavy metal has been extensively reviewed.

The quantity of copper in sewage waste water–fed soils was in toxic range (> 22-30 PPM). Nickel was present in polluted soils. The amount of copper in soil near a nickel refinery has been regarded as high as 2000 PPM. In this paper the toxic and critical levels of Copper and Nickel for radish has been investigated.

Methods and Materials –

Preliminary selection for uniformity (criteria being the size and colour of seeds), the seeds were surface sterilized with 0.1% $HgCl_2$ for 2 minutes and repeatedly washed with distilled water. Solutions of 10, 50, 100, 200 and 500 PPM concentrations of Copper sulphate ($CuSO_4$) and Nickel sulphate ($NiSO_4$) individually were prepared in distilled water. The 60-60 seeds were soaked in these different solutions for 02 hours. A control with distilled water was also being run simultaneously. Each treatment was replicated thrice. Then, seeds were washed thoroughly and then transferred into petri plates over wet (with distilled water), filter paper for germination and seedling growth. From National seed Corporation, New Delhi the certified seeds of **Raphanus sativas L.** variety Pusa rashmi were procured, then stored in glass stopper bottles.

The laboratory experiment spanned a period of 10 days and was conducted under controlled conditions with a temperature of 25±2 °C and diffused light. The seeds received regular irrigation using distilled water to monitor their growth. The visual emergence of radicals was taken as criteria for germination. The fresh weight of seedlings was measured using an electric balance and expressed in grams per seedling. The weight of seedlings, percentage of germination, average root and shoot length were recorded and statistically analysed.

Table (02) – Effect of Copper on Seed germination and Seedling growth of Raphanus sativus L. (variety Pusa Rashmi)

S. N.	Treatment (PPM)	Mean Value			
		Germination percentage	Shoot length (cm)	Root length (cm)	Seedling fresh weight (gm.)
01	Control	95	10	9.2	0.26
02	10	95	10	9.2	0.26
03	50	92.8	9.1	8.1	0.23
04	100	85.8	8.7	8	0.22
05	200	73	8.2	7.5	0.17
06	500	65	7	6.2	0.16

Table (03) – Effect of Nickel on Seed germination and Seedling growth of **Raphanus Sativus** L. (variety Pusa Rashmi)

S. N.	Treatment (ppm)	Mean Value			
		Germination percentage	Shoot length (cm)	Root length (cm)	Seedling fresh weight (gm.)
01	Control	95	10	9.1	0.26
02	10	94.6	10	9.1	0.25
03	50	90.8	9.4	8.2	0.22

04	100	86.1	8.5	8	0.20
05	200	82	8.5	7.2	0.19
06	500	72.5	7.1	6.3	0.17

Table (04) – Compared analysis between control V and among treatment from table 01 and 02, (Symbol -: ### highly significant)

F – ratio	Germination percentage	Shoot length (cm)	Root length (cm)	Seedling fresh weight (gm.)
Control V treatment	43.92 ###	66.62 ###	47.94 ###	42.92 ###
Among treatment	21.25 ###	48.79 ###	25.25 ###	16.45 ###

Result and Discussion –

In this preliminary investigation, the treatment of Copper and Nickel on seed germination was severely affected. All the concentrations of Copper and Nickel used except 10 PPM caused a gradual decline in seed germination were clearly shown in the Table (1) and (2). A significant reduction occurred in percentage of germination at 200 and 500 PPM and from 100 PPM of copper onwards; in comparison to control that is 95%. At maximum concentration (that is 500 PPM), the percentage of germination decreased. The present observations agree with the earlier results where inhibition of seed germination was reported with Copper and Nickel in lentils, chickpea and Pisum sativum.

The growth of shoot was moderately affected by the treatment of metals as a significant reduction was recorded at 200 and 500 PPM of Copper and Nickel. Reduction in shoot length at other concentrations of either metal was not significant. Both copper and Nickel particularly at higher concentrations resulted in adverse effects on root growth. The root growth of radish seedlings decreases significantly after treatment with 100, 200 and 500 PPM of Copper and Nickel in comparison to control. Poor root and shoot growth have been earlier reported in copper and nickel treated Acer rubrum, Cornus stolonifera, Lonicera tatarica and Pinus resinosa and tomato in sand culture.

High concentrations of $NiCl_2$ inhibited ear development in wheat plants. The growth of the lentil plant in general was retarded by copper treatment. Fresh weight of radish seedlings was also adversely affected by the treatment of metals. Higher concentrations (200 and 500 PPM) of both the metals were significantly effective in reducing the fresh weight of seedlings. Significant reduction in fresh weight of root and shoot of chickpea treated with 400 PPM of Nickel was earlier observed. Reduction in fresh weight of pigeon pea may be due to high amounts of heavy metals especially copper and zinc which damage the plant cells so that plants cannot grow in high concentrations.

Compared analysis between observation of selected area of field and Lab preparation, the result is clear to Damoh, Hatta and Tendukheda block of Damoh is big changer of Pusa rashmi (variety of Radish) production in Damoh district, than Jabera, Batiyagarh, Patera and Pathariya.

Conclusion –

It is thus evident from the results that inhibition in root length of radish seedlings under the effect of heavy metals was higher than hypocotyl, and also that copper is comparatively more toxic than nickel to plant growth. The results indicate that shoot length is moderately affected by Copper and Nickel treatment. The adverse effects of copper on seedling growth were due to inhibition of root elongation. Copper has been found inhibitory for soil microbes. High concentrations of Nickel besides suppressing protein synthesis and activity of various enzymes also causes iron competition in culture medium. Diminutive effects of copper, nickel and cobalt have been observed on growth characters, biomass, yield, etc. of celery, tomato and lentil plants both in ambient and artificial treatment conditions.

The seedling root length of Raphanus sativus variety Pusa rashmi being more susceptible to the effect of heavy metals (Copper and Nickel) as observed may be used as a bioassay for toxicity and tolerance studies. The findings underscore the importance of implementing effective strategies to mitigate the impact of heavy metal pollution on plant systems, emphasizing the significance of environmental sustainability and the preservation of human health.

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