Evaluation of above and below Ground Biomass of Raphanus Sativus L. Variety Pusa Chetki After applying different Concentrations of Heavy Metal Copper in Pot Culture Experiments

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Abstract:

High levels of heavy metals in soils may affect the natural population of soil microorganisms and other characteristics of soil including the inhibition of the uptake of mineral nutrient resulting in the disturbance of soil fertility and may result in the reduced growth of crops grown in that soil.

This research work was coined to understand the effect of heavy metal copper on above and below ground biomass of Raphanus sativus cultivar Pusa chetki in pot culture experiments.

Closer examination of data showed that above and below ground biomass decreased to 50% and 56% respectively in comparison to control due to the application of copper in the soil in pot culture experiments. This may be attributed with the fact that heavy metal copper might inhibit the growth of beneficial microorganisms of soil which may deteriorate the soil fertility, or due to the low uptake of mineral elements from soil.

Keywords: Heavy metal copper, Raphanus sativus variety pusa chetki, above and below ground biomass, Pot culture experiments.

Introduction:

Metal mining processes as well as numerous other industrial, urban and agricultural activities arise from copper, which is a common environmental pollutant. Pollutant copper is frequently accompanied by other elements such as zinc, lead, arsenic and nickel in toxic concentrations. These associated elements can influence the biological effectiveness of added copper and complicate the assessment of hazard by both soil and plant analysis. The absorbed copper is slowly soluble and this makes it less toxic to plants.

The Indian Environmental Protection Act (1986) defines pollutant as any solid, liquid or gaseous substance present in such concentrations as may be or tend to be injurious to the environment.

There are comparatively very few reports on the toxic effect of heavy metal copper on above and below ground biomas of radish (Raphanus sativus variety Pusa chetki) and since radish is an important crop and is the most quickly and easily grown vegetable I evaluated the effect of heavy metal copper on the above and below ground biomass of Pusa chetki, a variety of Raphanus sativus L.

I used four concentrations of heavy metal copper in the present investigation determining the toxicity of copper on above and below ground biomass of Raphanus sativus variety Pusa chetki.

The study has ecological implications as the occurrence of copper is common in contaminated soils.

Material and methods:

The experimental material for the present investigation was Raphanus sativus variety Pusa chetki. It is commonly known as muli. It is an important vegetable crop and is cultivated all over the world. It is grown for its fleshy edible roots.

Although it grows mainly in winter, it is raised almost round the year in certain areas to cater to the needs of urban population. Radish is grown mostly in kitchen gardens and even raised as a potted plant, particularly in winter.

To study the effect of heavy metal copper on above and below ground biomass of Raphanus sativus variety Pusa chetki , pot culture experiments were performed with the seeds of Raphanus sativus variety Pusa chetki. Twenty seeds were sown at the depth of five cm in 10 kg air dried garden soil. The size of pots was 15×15 inches , each pot had a control drainage hole.

In the soil heavy metal copper was added and mixed in the form of its salt viz., copper sulphate with four concentrations i.e. 100,500,700 and 1000 mg/kg. There was also a control treatment where a set of pots without heavy metal copper was used. There were three repetitions for every treatment. Everyday watering was performed. The experiments were conducted in natural environmental conditions with normal culture practices. To avoid contamination and to provide as far as uniform light, experimental pots were arranged at proper distances.

Four plants remained in each pot after fifteen days of growth in the natural environment. Parameters above and below ground biomass were examined and recorded after 45 days of growth.

Result and Discussion:

The data regarding above and below ground biomass of Raphanus sativus variety Pusa chetki after applying different concentrations of heavy metal copper in soil in pot culture experiments were arranged in tabulated form.

It is apparent from the table (given below) that even at 100 mg/kg concentration, copper reduced the above (170 g/plant) and below ground biomass (180g/plant) in comparison to control where above and below ground biomass was noticed to be 180-190g/plant and 190-195 g/plant. It was also noticed that 500-1000 mg/kg concentration of copper in the soil was most hazardous to below ground biomass of Raphanus sativus variety Pusa chetki.

Table 1 - Showing the effect of heavy metal copper on above and below ground biomass (g/plant) of Raphanus sativus cv. Pusa chetki.

S. No	Name of the Chemical	Concentrations (mg/kg soil)									
		Control		100		500		700		1000	
		A.G.B	B.G.B	A.G.B	B.G.B.	A.G.B	B.G.B	A.G.B	B.G.B	A.G.B	B.G.B
1.	Copper sulphate	190	195	170	180	145	160	115	135	95	110

(There were three repetitions of each treatment)

Statistical analysis:-

F-ratios:

	A.G.B.	B.G.B.
(i) Among concentrations =	37.2920***	13.1627***
(ii) Control Vs Treatment =	150.6946***	46.1661***

*** = highly significant

A.G.B = Above ground biomass

B.G.B. = Below ground biomass

But all the concentrations of copper were observed to be toxic for above ground biomass of Raphanus sativus variety Pusa chetki.

Increasing copper supply may depress plant growth by interferring with the uptate of other nutrients, e.g. iron [7]. On a dry weight basis the majority of plants contain less than 10 ppm copper, when it exceeds 30 ppm ,copper toxicity is manifested [1].

It was reported [8]that large areas around a copper refinery were denuded of vegetation by high levels (2000 microgram per gram) of copper pollution in soil.

Decreased growth of lettuce shoots and roots was noticed [4]when cadmium, copper , lead or nickel solutions were applied individually.

It was found[2] that the effect of heavy metal copper in solution at higher concentrations was toxic to the plant growth of cabbage.

Seed germination, plant growth and productivity were adversely affected in lentil plants treated with higher concentrations of copper[3].

Reduction in the uptake and distribution of potassium and phosphorus from the soil into roots and shoots of young Barley plants due to heavy metals like copper, cadmium , lead , nickel ,zinc and mercury toxicity was also observed [5].

Safflowers (Carthamus tinctorius L. cv. T-65) in sand culture experiments exhibited growth

depression both at low (< 1 micro ml -1) and excess (2 and 10 micro ml- 1)copper supply[6].

When data were analysed statistically l came to know that there were highly significant differences between control and treatment of heavy metal copper for both the above and below ground biomass.

Conclusion:

Domestic and industrial effluents , sewage sludge, residues of pesticides, fertilizers and detergents invariably result in enhanced contents of heavy metals in soil . The presence of heavy metals in soils can adversely affect the soil respiration and litter decomposition rates. Heavy metals in the soil reduce plant growth. This effect of heavy metals will vary, depending on a number of factors such as type of crop grown, ph and organic matter content of soil.

The form in which the metal is present ,rooting volume and the growing environment are all factors which can affect the metal toxicity to the crop.

This research concludes that cultivation of Raphanus sativus variety Pusa chetki in polluted soils should be checked or suitable control treatments be accepted to control the heavy metal content of soil reaching through industrial effluents.

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