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# EFFECT OF CHROMIUM ON SEED GERMINATION AND SEEDLING GROWTH OF *Lens culinaris*

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## Abstract

The present study has revealed the effect of heavy metal chromium on seed germination and seedling growth of *Lens culinaris* . The seed germination was recorded maximum for control, while germination percentage decreased with increasing concentrations of Chromium. The study showed that survival and growth of seedlings were negatively affected by elevated chromium concentration. It was noticed that the lowest concentration of Chromium promotes seed germination and seedling growth.

**Keywords:** *Lens culinaris* , Chromium Nitrate , Heavy metals, Radicle.

## Introduction:

Heavy metals are natural constituents of the lithosphere, whose geochemical cycles and biochemical balances have been drastically altered by human activity. Generally industrial wastes include heavy metals are one of the major threats for agriculture practices because above critical levels they may turn into toxins and cause inhibition of growth and development for the most of the plant species and at times leads to death also (Weiqiang L., et al., 2005). Chromium is used extensively worldwide in various industrial activities (electroplating, alloying, textile dyes , mordants, pigments, ceramic glazes , stainless steel and leather industry) is therefore considered a serious environmental pollutant and poses a threat to human health. Chromium may reach human beings either through polluted drinking water sources or through the food chain or both and its accumulation in higher concentration may lead to cancer and associated health hazards. Its presence in agricultural soils can be attributed to the use of organic wastes as fertilizer and the use of waste water for irrigation (Pillay, A. E., et al., 2003). Chromium like others heavy metals do not degrade biologically, it remains stable for several months in the soil without changing its oxidation state. Toxic effects of Chromium on plant growth and development include alterations in the germination process as well as in the growth of roots, stems and leaves, which may affect total dry matter production and yield (Shanker A. K., et al., 2005).Chromium toxicity affects the length of primary roots and promotes changes in the architecture of the entire root system (Liu J., et al. 1992).

The lentil (*Lens culinaris* or *Lens esculenta*) is an edible legume (family-Fabaceae) . It is an annual plant known for its lens-shaped seeds. It is about 40 cm tall, and the seeds grow in pods, usually with two seeds in each. Lentils are a rich source of numerous essential nutrients including vitamin $B_6$ , folate , iron , manganese , phosphorus , thiamine , pantothenic acid , copper, magnesium and zinc .

The present study is an attempt to reveal the impacts of heavy metal chromium on leguminous plant, *Lens culinaris* .

## Materials and Methods:

Lentil (*Lens culinaris* cv. IPL- 81) seeds were used for experiments. Seeds of test plants were selected on the basis of uniformity in size, shape, colour & weight. Seeds were surface sterilized with 0.1% $HgCl_2$ solution and thoroughly washed with distilled water .The different concentrations of Chromium nitrate (0.05 ppm, 5 ppm and 10 ppm) were prepared for experiment.

For seed germination, sterilized seeds were soaked in different concentrations of chromium nitrate solution for their whole imbibition period. Seeds soaked simultaneously in distilled water constituted the control set. Thereafter, seeds were washed thoroughly with distilled water and transferred to petridishes lined with moist filter paper and kept in dark for germination. The experiment was performed in triplicate. Percentage of seed germination in selected concentration was recorded after observing radicle emergence .The percentage of germination was calculated from the number of seeds showing radicle emergence out of total number of seeds kept in petridishes. The growth parameters like plumule and radicle length were observed on $7^{th}$ day after radicle emergence. The data observed in the experiment, were statistically analyzed for the calculation of standard error. For mitotic studies root tips of germinating seeds were fixed in acetic alcohol (1:3) and squashed in 2% of acetocarmine. Number of normal and abnormal cells and types of chromosomal abnormalities were noted in all concentrations. A control set in identical condition was also managed.

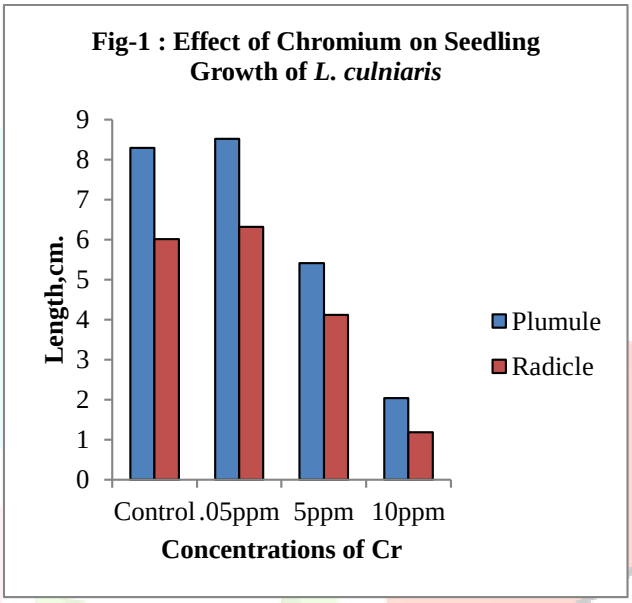
## Result and Discussion:

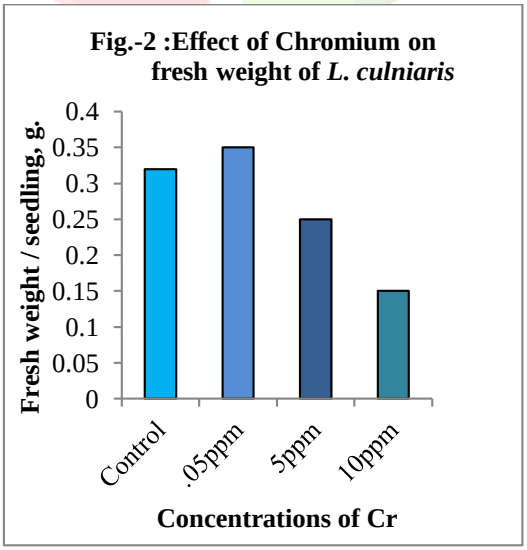
The Results obtained in the experiments are shown in table-1and fig.:1-3.

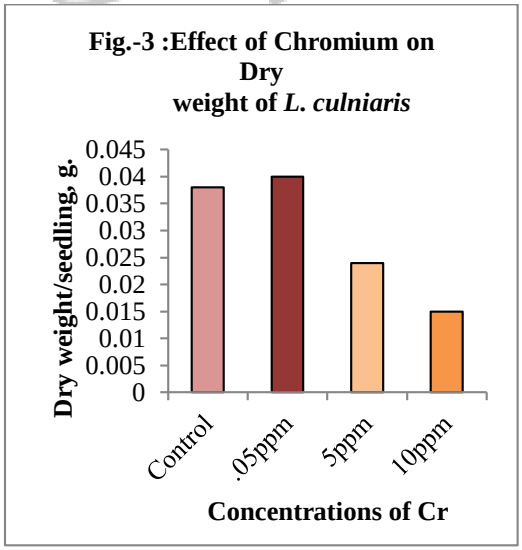
**Table-1: Effect of Chromium on Seed germination and Seedling growth of *Lens culinaris***

| Parameters | Concentrations of Chromium | | | |
|---|---|---|---|---|
| | Control | 0.05 ppm | 5 ppm | 10 ppm |
| % of Seed germination | 100% | 100% | 71% | 45% |
| Hours taken into germination | 48 -50 | 48 -50 | 75-85 | 90-130 |
| % of Survival of Seedlings | 99% | 99% | 70% | 51% |
| RadicleLength (cm) | 6.01 ± 0.33 | 6.32 ± 0.22 | 4.12 ± 0.25 | 1.18 ± 0.22 |
| Plumule Length (cm) | 8.29 ± 0.22 | 8.51 ± 0.25 | 5.41 ± 0.33 | 2.04 ± 0.24 |
| Fresh weight (g) | 0.32± 0.25 | 0.35± 0.21 | 0.25± 0.25 | 0.15± 0.21 |
| Dry weight (g) | 0.038± 0.25 | 0.04± 0.22 | 0.024 ± 0.22 | 0.015± 0.24 |

The average of three triplicates ± S.E




The seed germination was recorded maximum for control and germination percentage decreased with increasing concentrations of chromium. It was found that the lowest concentration of 0.05 ppm promoted seed germination. Increase of concentrations gradually lowered the percentage of seed germination from 100% to 45%. The primary effect of Chromium on seed germination showed a tendency of delay in germination in contrast to control. The survival of seedlings also followed the same trend as revealed from table where survival of seedling decreased from 99 % (at lowest concentration) to 51% (at highest concentration). Similar trend of decrease in percentage of seed germination and survival of seedlings with increasing concentrations of Chromium have also been reported by Jha P.L.,et.al., (1998) , Rasmussen A., et.al. (1975) and Sheeja P, et.al. (2014) . Decrease in percentage of seed germination and delayed

emergence of seedling with increasing concentrations may be attributed to the presence of certain inhibitory or toxic substances which might disturb the metabolic activity (Singh D., et.al., (2017), hence delayed emergence of seedlings. Decline in percentage of seed germination with increasing concentration clearly indicates the presence of more toxic substances in higher concentrations than that of lower concentration. In the present study in each plant radicle and plumule length decreased with increasing concentration of Chromium. The radicle length of different concentrations of Chromium such as 0.05 ppm, 5 ppm and 10 ppm were 6.32 cm., 4.12 cm. and 1.18 cm. respectively. The plumule length was 8.51cm., 5.41cm. and 2.04 cm. for 0.05 ppm, 5 ppm and 10 ppm respectively. Fresh weight and dry weight also showed decreasing trends with increase in Chromium concentration. But the very low concentration of 0.05ppm has promoted the growth than the control. An initial stimulation on germination at lower concentration was also explained by many researchers (Maury A. N., et.al. 1997, Sharma, S, S. 1982 and Sharma A.,1983). Some heavy metals at low doses are essential micronutrients for plants, but in higher doses they may cause inhibition of germination, growth and metabolic disorder etc. (Fernandes J.C., et.al., 1991). Both seed germination and seedling growth were affected at high concentrations of Chromium in lentil. Inhibitory effect of Cr, Cu and Zn on germination and growth of plants, especially at higher concentrations was reported (Aery N.C., et.al, 1991, Mishra J., et al. 1994). In this study the elevated concentration of Chromium showed inhibition of seed germination and seedling growth in lentil.

The most remarkable response of Chromium nitrate on cell division is steep decrease in mitotic activity with gradual increase in concentration which was quite normal in control. Chance in the proportion of nuclei undergoing division is partial index of the degree and kind of effect of the given treatment. Significant decrease in metaphase and anaphase at 5ppm and complete inhibition of cell division in 10ppm concentration indicate that lower concentration prevents cell cycle and breaks the spindle fibers while higher concentration prevent the entry of cell into mitosis. Similar effects have been reported by Gulfishan M., et. al.(2010) and Srivastava S., et.al. (2011)

Thus the present investigation suggests that the Chromium has an adverse effect on plant growth of *L. culniaris* with respect to germination percentages and seedling growth, although very low concncentration was apparently not harmful. However, it needs further research in order to have a better understanding of the mechanism of the effect of Chromium on seed germination and seedling growth *of L. culniaris.*

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