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Research Article

TOXIC EFFECT OF LEAD ON GERMINATION AND SEEDLING GROWTH OF (*BRASSICA CAMPESTRIS. L*)

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ABSTRACT
Lead (Pb) is a toxic heavy metal released into the natural environment and known to cause oxidative damage and alter antioxidant mechanism in plants. Lead (Pb) is one of the most important heavy metals frequently available in the environment and its most common sources are vehicles and automobiles. However, not much is known about the interference of Pb with the biochemical processes and carbohydrate metabolism during seed germination. We therefore, investigated the effect of different levels of Pb (6ppm, 9ppm, 12ppm) on growth and biomass production of *Brassica campestris* L. The study revealed that Pb exposure of different concentrations of lead inhibited growth as well as biomass production of Brassica compestris and lead exerted deleterious effect on the growth specially root length, shoot length, leaf area, root fresh weight, root dry weight, shoot fresh weight, shoot dry weight and chlorophyll contents.

Keywords: *Brassica Campestris, Lead (pb), Growth, Germination, Lead Toxicity, Chlorophyll*

INTRODUCTION
The major causes of accumulation of high levels of heavy metals in soils are a variety of anthropogenic activities including manufacturing, agricultural, mining, and waste removal practices (Salgare, 1991; Birke and Rauch, 2000; Hussain *et al.*, 2006; Uwah *et al.*, 2009), they are also brought in due to the use of metal enriched fertilizers and pesticides (Shaukat *et al.*, 1999; Anjana *et al.*, 2006; Nouri *et al.*, 2008; Uwah *et al.*, 2009).
These metal ions dissolved in irrigation water contaminate the cultivated soils and can have toxic impact on living system. Elemental pollution of the environment is a major problem today. It causes health problems in livestock and human beings. Some microelements like zinc, copper, and manganese enter into the environment through air, water and soil and finally reach the food chain through contaminated water, edibles and other food stuffs.
Brassica species is considered to be good hyper accumulator and is effective in the removal of Cd, Pb, Cr, Ni etc, from soil (Kumar *et al.*, 1995). Besides human beings can be directly exposed through occupational and environmental exposures. The family Brassicaceae consists of 350 genera and about 3500 species and includes several genera.
Lead toxicity alters the normal metabolic pathways in plants including Photosynthesis, respiration, and other such key metabolic processes by disrupting specific cellular enzymes. The family Brassicaceae comprises a variety of species, which are known for their widespread uses.
Pb has also been reported to be present in most of the cosmetic samples (Chauhan and Bhadauaria, 2004). The brassicas are widely grown throughout the world for food, medicinal and industrial purposes. The most common Brassica seed crops grown for industrial purposes are oil-seed rape and mustard. Rapeseed stands third as an imperative source of vegetable oil after soybean and palm oil.
The Lead elements selected for this study are essential for various physiological processes, over accumulation of which can lead to deleterious effects.
The increasing influx of heavy metals into water bodies from industrial, agricultural, and domestic activities is of global concern because of their well documented negative effects on human and ecosystem.
The aim of the present research was to investigate the effects of lead on seed germination and seedling growth of *Brassica campestris*.

So, the present study was carried out to evaluate the adverse effects of lead application on overall growth of *B. campestris.*

MATERIALS AND METHODS

The experiment was conducted initially with the temperature 28 ± 2ºC with relative humidity (RH) of 16 to 19% being recorded. The seeds of *Brassica* were allowed to germinate for 4 weeks in pots. These plants were provided appropriate environmental conditions. The germinated seedlings were split into 4 sets including control (T0), T1 (6ppm), T2 (9ppm), T3 (12ppm) Pb was added in to the soil thus, contaminating the soil conditions for further growth of plants. The data was recorded after 1st, 2nd, 3rd and 4th weeks of treatment application of lead metal. The growth attributes including root and shoot dry weight, root and shoot fresh weight, chlorophyll, root length, shoot length, leaf area, and, specific leaf area (SLA) and leaf weight ratio. Then, both shoot and root samples were washed with distilled water and placed in a forced air oven for drying at $^{70\ oC}$ for 72 hr. The fresh and dry biomass of both roots and shoots was recorded to assess the effect of Pb on plant biomass production (Sezgin *et al.*, 2003).

Statistical Analysis

The experiment was performed in completely randomized block design involving four treatments with three replicates. Then, values were calculated and sum of their mean was taken by the following formula.

$$\bar{X} = \frac{\Sigma X}{N}$$

RESULTS AND DISCUSSION

Due to the application of Pb, shoot and root biomass was significantly reduced in all the 3 treatments. However, the most severe effect was noted on roots and shoots of plants growing under the highest level of Pb(Singh and Sinha, 2005).

The effect of Pb toxicity was more severe on roots than on shoots in all the three sets. Seed germination, root, shoot and seedling length, root shoot ratio and dry biomass were highly decreased with the increasing concentration of Pb (Pallavi and Rama, 2005).

Analysis of data regarding root growth showed that lead poisoning caused significant reduction in root length, so that when lead concentration was increased, the root length was significantly decreased. The application of highest dose of the metal significantly decreased the growth of the plants as compared to control.

The results revealed that increasing lead concentration reduced root and shoot length, leaf area, and root and shoot dry weight, root and shoot fresh weight, specific leaf area (SLA) and leaf weight ratio (LWR) (Pendergrass and Butcher, 2006).

The level of chlorophyll “a” and chlorophyll “b” in control plants were found to be maximum at the flowering stage i.e. 28 days in *B. campestris*. At maturity stage the chlorophyll “a” and “b” were decreased on the concentration of 6ppm, 9ppm and 12ppm of lead (Pb) Chl “a” get more affected by heavy metals as compared to Chl “b” Visual symptoms of plant illness can be observed due to change in chlorophyll content and it also caused decrease of photosynthetic productivity (Parekh *et al.*, 1990). Researchers have reported decreased chlorophyll in several plant species under the impact of heavy metals (Rohn *et al.,* 2009).

With increasing concentration of lead, leaf area was increased significantly compared with the control group. It caused such problems as reduction in growth and production levels, yellowing of young leaves, reduction in absorption of essential elements such as iron and reduction in the rate of photosynthesis. Two concentrations of lead with 5 and 10 μM significantly increased surface of leaf area as compared with lead treatments.

The fresh weight of all the three sets was taken individually. 1st set was 2.2mg, 2nd set was 2.4 mg, and 3rd set was 2.9 mg. After the fresh mass calculation, we dried those three sets of samples in oven for 70 to 72 hours. Then, we calculated their dry weight which were 1.9mg and 2.1mg and 2.5mg respectively. Similar, results were found earlier by Indian Scientists (Gupta and Sinha, 2007).

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Table 1: Effect of Lead (Pb) Toxicity on the Growth and Biomass of Brassica Campestris after One Week of Metal Application

Treatment	Root Length (cm)	Shoot Length (cm)	Shoot Fresh Weight (g)	Shoot Dry Weight (g)	Leaf Area	No of Leaves	No of Branches	Root Fresh Weight	Root Dry Weight	Chlorophyll (mg g-1)
T_0	2.63	3.70	1.7	1	1.71	5.1	4.86	1.3	0.92	0.75± 0.009
$T_{1(6ppm)}$	2.63	3.38	1.00	0.50	1.64	5.1	4.86	2.04	0.94	0.65± 0.017
$T_{2(9ppm)}$	2.01	2.35	1.05	0.35	1.08	3.33	3.11	1.46	0.46	0.55± 0.015
$T_{3(12ppm)}$	1.5	1.19	1.09	0.40	1.05	3.55	3.77	1.01	0.40	0.49± 0.013

Table 2: Effect of Lead (Pb) Toxicity on the Growth and Biomass of Brassica Campestris after Two Weeks of Metal Application

Treatment	Root Length (cm)	Shoot Length (cm)	Shoot Fresh Weight (g)	Shoot Dry Weight (g)	Leaf Area	No of Leaves	No of Branches	Root Fresh Weight	Root Dry Weight	Chlorophyll (mg g-1)
T_0	3.02	3.90	2.00	1.00	1.77	5.5	4.90	1.10	0.62	1.00± 0.011
$T_{1(6ppm)}$	2.01	3.20	0.95	0.47	1.55	5.00	4.80	1.04	0.68	0.63± 0.015
$T_{2(9ppm)}$	1.80	2.00	1.03	0.31	1.00	3.30	3.01	1.38	0.40	0.60± 0.011
$T_{3(12ppm)}$	1.00	1.03	1.05	0.38	1.00	3.45	3.60	1.00	0.38	0.57± 0.009

Table 3: Effect of Lead (Pb) Toxicity on the Growth and Biomass of Brassica Compestris after Three Weeks of Metal Application

Treatment	Root Length (cm)	Shoot Length (cm)	Shoot Fresh Weight (g)	Shoot Dry Weight (g)	Leaf Area	No of Leaves	No of Branches	Root Fresh Weight	Root Dry Weight	Chlorophyll (mg g-1)
T_0	3.07	4.00	2.00	1.00	1.80	6.00	5.00	1.35	0.65	1.15± 0.013
$T_{1(6ppm)}$	2.00	3.05	0.90	0.42	1.50	5.00	4.80	1.01	0.60	0.59± 0.014
$T_{2(9ppm)}$	1.69	1.93	1.00	0.27	0.95	3.23	3.00	1.30	0.38	0.55± 0.010
$T_{3(12ppm)}$	0.92	1.00	0.98	0.32	0.80	3.32	3.00	0.70	0.25	0.53± 0.008

Table 4: Effect of Lead (Pb) Toxicity on the Growth and Biomass of Brassica Compestris after Four Weeks of Metal Application

Treatment	Root Length (cm)	Shoot Length (cm)	Shoot Fresh Weight (g)	Shoot Dry Weight (g)	Leaf Area	No of Leaves	No of Branches	Root Fresh Weight	Root Dry Weight	Chlorophyll (mg g-1)
T_0	3.50	4.47	2.25	1.35	1.95	7.00	6.00	1.90	0.70	1.46± 0.015
$T_{1(6ppm)}$	1.85	2.72	0.78	0.35	1.39	4.00	4.00	1.00	0.48	0.55± 0.012
$T_{2(9ppm)}$	1.00	1.02	0.85	0.20	0.80	3.00	2.75	1.00	0.25	0.51± 0.009
$T_{3(12ppm)}$	0.70	0.75	0.76	0.20	0.60	2.92	2.00	0.50	0.20	0.46± 0.007

Conclusion

So, from this experiment it is obvious that lead is a toxic metal element that contaminates the brassica and minimum growth was found in plants treated with 12 ppm dose**.** The flowering time and pod formation took at almost similar time in control, 6 ppm dose, but as the Pb dose increased to 12ppm, it delayed flowering time and pod formation.

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