



Research Article

IMPACT OF LEAD ON GROWTH, BIO CHEMICAL AND ENZYMATIC CHANGES IN BLACK GRAM.

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Abstract: Lead (Pb) is one of the non essential and toxic heavy metals which can cause oxidative stress in plants. The effects of lead toxicity on growth and some biochemical parameters of black gram were studied under laboratory condition. Different treatments of Pb (0, 5, 10, 25, 50, 100 and 200 mg/l) were used in order to consider changes in germination, seedling growth, dry weight, proline content, Total chlorophyll and enzyme activity (catalase and peroxidase). Compared with the control, Pb treatment caused a significant decrease in root and shoot growth and dry weight and chlorophyll content. In contrast, a significant increase in proline, Catalase and peroxidase activity of leaves was observed in Pb treatments.

Key words: Lead, Black gram, proline,enzymes, Growth, Dry weight

INTRODUCTION

Lead (Pb) is one of the potentially toxic heavy metal pollutants of the environment with no known biological function and its concentrations are rapidly increased in agricultural soil¹. The most significant factors which can distribute lead as a pollutant in the environment are burning of fossil fuels, agricultural manufacturing, mining, pesticides and fertilizers². According to Oliver and Naidu plants show different reactions against Pb toxicity³. Some of them are sensitive and the others have more tolerance. In plants, it has been widely reported that accumulation of Pb may cause many physiological, biochemical and structural changes like decline in photosynthetic rate and essential elements absorption⁴, the roots and shoots growth inhibition, chlorosis and decrease in water potential and plant hormones⁵. Plant cells have a protective system against oxidative stress including enzyme antioxidant system like catalase and guaiacol peroxidase and non-enzyme antioxidant system.⁶ Nowadays, the usage of fertilizers including micronutrients and macronutrients has increased. One of the most toxic heavy metals which may be found in some kind of fertilizers is lead that can be absorbed and accumulated in plants. Then they enter the food chain to form hazard for human health.⁷ Therefore, it is essential to investigate the effects of lead toxicity on some biochemical characteristics of the seedlings in blackgram (*Vigna mungo* (L)Hepper).

MATERIALS AND METHODS

Black gram (*Vigna mungo* (L) Hepper) seeds were obtained from the Regional Rice Research station, Aaduthurai, Tamil Nadu, India. Uniform seeds were selected and surface sterilized with 0.01% HgCl₂ solution for 2 minutes. Petriplates lined with filter paper and 20 black gram seeds were placed in each petriplate. They were treated with different concentrations (control, 5, 10,25,50,75,100 and 200 mg /l) of Lead. Three replicates were maintained. Plant Growth were measured by using

centimeter scale and recorded. The same plant samples were taken for morphological studies were also used for the determination of dry weight by using electrical single pan balance. Their dry weights were determined by keeping the plant materials in a hot air oven at 80 °C for 24 hrs and recorded. Similarly the Proline⁸, Total chlorophyll⁹, Catalase and Peroxidase¹⁰ were also measured.

RESULTS AND DISCUSSION

The common symptoms caused by lead toxicity were yellowing of the leaves and appearance of dark brown pigments, especially in 200 Mg/l, which might be attributed to nutrient imbalance induced by excess lead. Pb treatment dramatically inhibited the germination, seedling growth and accumulation of both shoot and root biomass and consequently, decreased their dry weight. Lead toxicity can induce complex changes in plants at biochemical and physiological aspects. The most obvious symptoms include leaf chlorosis and reduction of plant growth¹¹, Decrease in DNA, RNA and protein synthesis¹², imbalance of chlorophyll metabolism¹³.

Compared to the control, total chlorophyll slightly declined by increase in lead concentrations. Table 2 shows the changes of chlorophyll in different Pb concentrations. The highest level refers to control condition and the lowest level refers to the highest concentration of Pb. In the present study, leaf total chlorophyll significantly decreased by increase in lead amount which coincides with Hamid *et al.*¹. It could be attributed to oxidative stresses and inhibition in chlorophyll synthesis. Lead may prevent enzyme activity like aminolevulinic acid dehydratase¹⁴ or decrease essential elements absorption such as Mg²⁺ and Fe²⁺ to inhibit chlorophyll synthesis.¹⁵ Also, some previous investigations have indicated that chlorophyll decrease can be due to its decomposition by increase in chlorophyllase activity.¹⁶⁻¹⁷

Table 2 illustrates proline changes in blackgram seedlings by increase in Pb. As can be seen, increase in lead results in a rise in proline. High level of proline, especially in roots, can eliminate hydroxyl radicals, maintain osmoregulation, prevent enzyme destruction¹⁸ and decrease toxicity of heavy metals¹⁹.

There was a dramatic rise in catalase and peroxidase activity with the increase in different Pb treatments (Table 2). Increase in catalase and peroxidase activity was significant in all treatments except 200 Mg/l. It has been shown lead can

cause oxidative stress in plants.¹² Plant cells are equipped with a protective system including antioxidant enzymes like catalase and peroxidase which can bridle free radicals.²⁰ Decrease in enzyme synthesis or change in subunits arrangement may be a reason for decline in enzyme activity¹⁷ and increase in peroxidase activity can be due to releasing from cell wall²¹. Most of the previous studies indicated that heavy metals like lead are responsible for catalase activity decrease in rice¹² and peroxidase activity increase in rice and soybean¹² which coincide our results.

Table 1. Effect of Lead on growth parameters of Black gram

	Seed germination	Root length	Shoot length	Dry weight
Control	95	6.56	9.28	0.778
5	89 (-6.31)	5.54 (-15.54)	7.92 (-14.65)	0.722 (-7.19)
10	76 (-20.0)	4.91 (-25.15)	6.84 (-26.29)	0.647 (-16.83)
25	65 (-31.57)	4.16 (-36.58)	5.61 (-39.54)	0.612 (-21.33)
50	54 (-43.15)	3.77 (-42.53)	5.00 (-46.12)	0.493 (-36.63)
75	48 (-70.52)	3.20 (-51.21)	4.31 (-53.55)	0.447 (-42.54)
100	39 (80.0)	2.37 (63.87)	3.60 (61.20)	0.391 (-49.74)
200	28 (84.0)	2.00 (66.50)	3.00 (63.42)	0.312 (-52.54)

Percentage over control is expressed in parentheses

F values are significant at 1 % level.

Table 2. Effect of Lead on Total chlorophyll, Proline content, Catalase and Peroxidase activity of Black gram

	Total chlorophyll	Proline	Catalase	Peroxidase
Control	0.692	0.567	8.38	0.285
5	0.647 (-6.50)	0.614 (+ 8.28)	9.03 (+ 7.75)	0.312 (+ 9.47)
10	0.612 (-11.56)	0.689 (21.51)	9.89 (+ 18.81)	0.339 (+ 18.94)
25	0.563 (-18.64)	0.712 (+25.57)	11.26 (+ 34.36)	0.375 (+ 31.57)
50	0.544 (-21.38)	0.779 (+37.38)	11.76 (+40.33)	0.395 (+38.59)
75	0.502 (-27.45)	0.825 (+45.50)	12.25 (+46.18)	0.414 (+45.26)
100	0.476 (-31.21)	0.860 (+51.67)	12.93 (+54.29)	0.437 (+53.33)
200	0.352 (-37.50)	0.976 (+55.50)	13.38 (+56.18)	0.585 (+55.26)

Percentage over control is expressed in parentheses

F values are significant at 1 % level.

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