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ORIGINAL ARTICLE

Effect of Different Concentrations of Lead on the Growth Parameters of Foxtail Millet (*Setaria italica* (L.) P. Beauv.)

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Heavy metals in the environment has been drastically increasing with the development of industries in the world. Among the heavy metals, lead (Pb) is the most toxic metal that easily gets accumulated in the soil and sediments. Lead is not an important element for plant growth but it gets easily absorbed and accumulated in different parts of the plant. In this study, *Setaria italica* (Foxtail millet - CO (Te) 7) is treated with different concentrations of lead to evaluate the changes in the morphological growth parameters such as root length, shoot length, rate of percentage of germination, Tolerance Index (TI) and phytotoxicity. The germination percentage is comparatively greater in the control plant and gradually decreases as the concentration of Pb increases. The length of root and shoot, the amount of fresh weight and dry weight also decrease with the increase in the concentration of heavy metals. The root length and shoot length in the control on the 45th day were 20.2±0.16 cm and 48.7±0.24 cm whereas in the maximum concentration of metal (250 mg/kg) it showed a minimum accumulation of 11.1±0.43 cm and 27.3±0.33 cm respectively. The percentage of phytotoxicity increases as the concentration of the metal increases. Tolerance indices decrease as the percentage of phytotoxicity increases.

Key words: Foxtail millet, Germination percentage, Heavy metals, Lead, Morphology and Phytotoxicty

Metals whose atomic number is greater than 20 in the periodic table, except the alkali metal and alkali earth are considered heavy metals. Heavy metals are found in the soil naturally, but their concentration has increased to toxic levels in several places due to mining, smelting of metals, industrialization, increased use of fertilizers and pesticides in agriculture, burning of fossil fuels, sewage sludge and municipal waste. There is a surplus amount of heavy metals released, particularly in areas where human activity is higher. These heavy metals include cadmium, chromium, copper, iron, lead, mercury, nickel, zinc, etc, Raskin *et al.* (1994) reported that the natural biogeochemical cycles have been disturbed due to the increase of heavy metals. Contamination and pollution of ecosystems and the action of toxic metals on plants and animals are one of the foremost problems worldwide. Continuous release of such heavy metals can have serious health problems on human life, soil, air and aquatic biota. Garbisu and Alkotra (2001) stated that these metals cannot be destroyed biologically but are only transformed from one oxidation state or organic complex to another. Singh and Chandra (2005) and Snehlata (2016) reported that heavy metal pollution poses a great potential threat to the environment and human health. In such cases, certain plants and microbes can be used as agents in the conversion of these toxic into non-toxic forms or for bioaccumulation.

Lead is present everywhere and was used as antiknock agents in gasoline until 1989. Sharma and Dubey (2005) reported that among the heavy metals, Pb is a highly toxic and persistent environmental pollutant derived from various sources. The biodegradable nature of the metals is the primary reason for their delayed presence in the environment. Flora *et al*. (2012) reported that human exposure to lead occurs through different sources which mainly includes leaded gasoline, industrial processes which involves Pb such as smelting, combustion and lead-based products like paints, pipes or solder in water supply systems. Pourrut *et al*. (2011) highlighted that accumulation of lead in plant tissue in higher concentration disturbs various biochemical, morphological and physiological and functions in plants, either directly or indirectly and induces a wide range of lethal effects.

Cereals such as wheat, maize, rice, barley, sorghum and other millets are the staple food sources of the world (Vigouroux *et al.,* 2011). Gupta *et al*. (2012) and Amadou *et al*. (2013) also found that human diet depends mainly on wheat and rice, but with an explosion of population and due to higher nutritional value millets and oats are now getting great response from scientists, technologists and nutritionists in terms of food security and other health benefits. Foxtail millet (*Setaria italica* (L.) Beauv. is also known as Italian millet and German millet. It belongs to the family Poaceae. *Foxtail millet is a drought resistant crop.* Foxtail millet is used as a medicinal food in Chinese medicine, the beneficial effects being partly attributable to its high nutritional quality. The grain is also used as fodder for animal and straw as forage. Foxtail millet helps in the stable release of glucose without disturbing the metabolism of the body. When people consume foxtail millet, the occurrence of diabetes is reduced and it is also known as hale and healthy food due to its good source of magnesium (Reddy, 2017). The present study aimed to provide comparative data on the effect of excessive lead on germination of seed and other morphological growth responses in foxtail millet.

MATERIALS AND METHODS

Seed collection

A popular cultivar, CO (Te) 7 of *Setaria italica* (L.) P. Beauv., seeds were collected from "Centre for Excellence in Millets", Tamil Nadu Agricultural University, Athiyandal, Thiruvannamalai District, Tamil Nau, India.. The species was authenticated in the Centre for Floristic Research and Herbarium, Department of Botany, Madras Christian College, Tambaram, Tamil Nadu.

Screening test (Paper cup assay)

A preliminary screening test is performed to finalise the minimum and maximum concentrations of the metal in which the crop can grow. A wide range of concentrations varying from 25 to 1000 mg/kg of lead sulphate was selected. Paper cups with varying concentration of lead (25 mg, 50 mg, 75 mg – 1000 mg) were added and 20 seeds were sown in each cup. Spray irrigation was done and monitored daily to note its morphological parameters. The plants were absorbed for 15 days of growth and their germination percentage was calculated. Based on the plant height, length of the shoot and the roots in comparison to the control plant, varying concentrations of lead ranging from 50 to 250 mg/kg was chosen for further studies.

Soil preparation

The soil was air-dried and sieved through 2 mm sieve to remove the non-soil particles. Earthen pots of 20 cm diameter were used for growing the plants. The pots are filled with nearly 5 kg of air-dried soil. Lead in the form of lead sulphate was used as a source of heavy metal. The following concentrations of lead sulphate was prepared and mixed with the soil. (i) 50 mg/kg (ii) 100 mg/kg (iii) 150 mg/kg (iv) 200 mg/kg and (v) 250 mg/kg. Seeds were surface sterilized with 0.1% mercuric chloride for 2 minutes and thoroughly washed with water several times and these sterilized seeds were sown in each pot. All the pots were watered to pot capacity daily.

Sample collection

The plant samples were collected at 15-day intervals viz: 15, 30 and 45 days. The plants were first uprooted and the entire plant with roots and shoots were put under a constant flow of water to remove the soil particles and exogenous contaminants adhered to the plants. The water droplets were dried with blotting paper.. Sampling was done in the early hours for the measurement of various morphological and growth parameters. Three replicates were maintained for each treatment.

Germination percentage

The number of seeds germinated in each treatment was recorded on the 15th day after sowing. The sum of germination was calculated by using the following formula.

Germination percentage =

$$\frac{Total\ number\ of\ seeds\ sown}{Total\ number\ of\ seeds\ germinated} \times 100$$

Root and shoot length

The seedlings were divided into roots and shoots after sampling and the length of each part was measured using a metre scale.. Shoot height was measured from the transition zone of the root to the tip of the tallest leaf.

Percentage of phytotoxicity

It was calculated using the formula of Chou and Lin (1976).

Percentage of Phytotoxicity =

$$\frac{Radical\ length\ of\ control - Radical\ length\ of\ the\ test}{Radical\ length\ of\ control} \times 100$$

Tolerance indices (TI)

TI of the mean root length and shoot length against each concentration was calculated following Baker *et al*. (1994).

TI (%) =

$$\frac{Mean\ length\ of\ root\ or\ shoot\ for\ metal\ solution}{Mean\ length\ of\ root\ or\ shoot\ for\ control\ solution} \times 100$$

Fresh weight and dry weight

Ten seedlings of both treated and control were collected at each sampling stage and their fresh weight was recorded immediately. The same seedlings were kept in a hot air oven at 80°C for 24 h. To dry the samples, they were kept in desiccators and their dry weight was calculated using an electronic weighing balance. The mean value was expressed in the g^{-1} seedling.

Relative Growth Index (%) (RGI)

According to the method of Paliouris and Hutchinson (1991), the relative growth index of each concentration was calculated as indicated below for both the roots and shoots.

RGI =

$$\frac{Average\ dry\ weight\ of\ a\ root\ or\ shoot\ in\ treatment\ solution}{Average\ dry\ weight\ of\ a\ root\ or\ shoot\ in\ control\ solution} \times 100$$

Relative Water Content (RWC)

According to the formula of Liu and Ding (2008),

RWC (%) = [(FM - DM)/(TM - DM)] x 100

Where FM = Fresh mass, DM = dry mass and TM = turgid mass.

The fresh plant was weighed and the plants were then immersed in water overnight, blotted dry and weighed to get turgid mass. These plants were dried at 70˚C in a hot air oven overnight and reweighed to obtain the dry weight.

RESULTS AND DISCUSSION

Foxtail millet continues to have an important place in the world agriculture in southern Europe and in temperate, subtropical and tropical Asia, providing approximately six million tons of food to millions of people. Setaria will grow in altitudes from sea level to 2000 m. It cannot tolerate water logging. Foxtail millet is a drought resistant crop (Fig 1). The present study investigated the toxic effects of lead over a selected range of concentrations (50, 100, 150, 200 and 250 mg/kg of soil) on seedling growth in foxtail millet. Growth inhibition is an ordinary response of plants to heavy metal stress and is also one of the most significant agricultural indices of heavy metal tolerance (Jiang and Liu, 2010). Sharma and Dubey (2005) stated that the effect of Pb on seedling growth seems to be different about plant species, cultivars, organs and metabolic processes. It also causes changes in the ultrastructure, biochemical and at molecular levels occur in the cells and tissues of plants (Gamalero *et al.*, 2009). The plant undergoes many physiological changes in the absorption and accumulation of heavy metal (Liu *et al*., 2009).

Germination percentage

The emergence of the radicle was measured as seed germination. A significant reduction of seed germination was noted in foxtail millet treated with lead. The germination percentage gradually decreased with an increase in concentration. The reduction rate was 100%, 95%, 90%, 85%, 80% and 75% in control, 50, 100, 150,200 and 250 mg/kg respectively (Fig 2). On treatment with this toxic metal, the minimum concentration (50 mg/kg) showed minimum inhibition of seed germination and the maximum concentration (250 mg/kg) showed maximum inhibition of germination. This result was in line with those reported earlier by Raziuddin *et al*. (2011); Aydinalp and Marinova (2009) and Bakiyaraj *et al.* (2014a). They stated that heavy metal stress decreased seed germination, germination index and vigour index of different crops.

Kedarini and Roja (2019) treated two varieties of *Arachis hypogea* (K6 and ICGV-3043) with lead nitrate and found that the germination percentage decreases with an increase in concentration which is mostly similar to our results. Seed germination inhibition by heavy metals has been reported by many other workers (Farooqi *et al.,* 2009; Tantrey and Agnihotri, 2010 and Gubrelay *et al.,* 2013). It has been stated that a decrease in seed germination may be due to the lowering of water potential through ionic imbalance. Further, Shafiq *et al.* (2008) suggested that a decrease in the percentage of seed germination under heavy metal stress could be attributed to the accelerated breakdown of nutrients stored in the seeds and alteration of selection permeability properties of the cell membrane.

Root length

Maximum root length was observed at control; root length was gradually reduced as the concentration is increased. The effect of lead on the root length of *Setaria italica* iis presented in Table 1. The root length of the plants were determined on the 15th, 30th and 45th day of growth. In 15 day old plants, it was observed that Pb treatment caused a linear decrease in root length. The recorded result was 7.2±0.08 cm in the control (15th day) and at 250 mg/kg of Pb treatment which was comparatively lower (4.3±0.20 cm) than the control. It gradually decreases with an increase in the concentration of lead. In 45 day old plants, the control showed 20.2±0.16 cm which gradually decreases and showed the least value of 11.1±0.43 cm in 250 mg/kg. Jagatheeswari and Ranganathan (2012) reported that in green gram under the influence of mercury showed decreased root length and the effect of lead on root length was reported by Hussain *et al.* (2007). In *Leucaena leucocephala,* Shafiq *et al.* (2008) reported the decrease in root length under the effect of lead and cadmium.

Lerda (1992) emphasized that a drop in root length under heavy metal stress could be due to a reduction in mitotic cell division in the meristematic region of roots. A gradual decrease in root and shoot elongation rate was observed with an increase in the concentration of cadmium in soybean by many workers (Balestrasse *et* *al*., 2003; Chen *et al.,* 2003b). The decline in root growth may be due to their direct contact with the metal causes a crumple and successive inability of the roots to absorb water from the soil. According to Patra and Sharma (2000) and Zhou *et al*. (2009), the reduced growth could be a result of the blocking of cell division or elongation.

Shoot length

The shoot length of the plants was determined on the 15th, 30th and 45th day of plant growth. A significant decrease in the shoot length was observed with an increase in lead concentration at all stages of plant growth (Table 2). In 15 day old plants, it was observed that Pb treatment caused a linear decrease in shoot length. The recorded decrease at 15-day old plants was 5.0±0.12 cm at 50 mg/kg of lead treatment whereas at 250 mg/kg the decrease was 2.8±0.12 cm. In 30 day old plants the height of the shoot was 26.2±0.42 cm at 50 mg/kg which was decreased to 15.9±0.16 cm at 250 mg/kg of Pb treatment. In 45 day old plants the percentage reduction was 44.2±0.29 cm at 50 mg/kg and the decrease was maximum (27.3±0.33 cm) at 250 mg/kg of Pb. In general, the decrease in root length was more as compared to the shoots.

Similar results of reduction in the root, shoot and seedling length and dry weight was noticed in *Albizia lebbeck* and *Leucaena leucocephala* on application with different concentration of lead and cadmium (Iqbal and Shazia, 2004). Similar findings have been observed in green gram by Bhardwaj *et al.* (2009). Studies on maize seedlings reported that the exposure of maize seedlings to 100 g of $CuSO_4$, resulted in inhibition of shoot growth (Chaffai *et al*., 2005).

Percentage of Phytotoxicity

The phytotoxicity of the heavy metal lead tested on the root length of *Setaria italica* is presented in Fig 3. The percentage of phytotoxicity was progressively increased with the increase in the concentration of lead. More phytotoxicity was seen in the later stages of growth than in the early days. The percentage phytotoxicity was determined at different stages of plant growth (15, 30 and 45 days) and was observed to be highly significant with an increase in externally applied lead in the soil. In 15 day old plants, a linear increase in percentage phytotoxicity was observed which showed 8.33% at 50 mg/kg and 250 mg/kg, the increase was significant with 40.27%. In 30 day old plants, 9.67% phytotoxicity was recorded at 50 mg/kg and 250 mg/kg of lead treatment it increased to 41.29%. This shows that there is an increase in the percentage of phytotoxicity as the concentration of the metal increases from 50 to 250 mg/kg. Maximum toxicity is noted in 250 mg/kg in 45th day of growth comparatively. Foy *et al*. (1978) reported that metal phytotoxicity is caused as an outcome of the movement of metal from the soil to root system.

Saritha *et al*. (2016) also reported similar results in percentage phytotoxicity due to the aluminium stress on wheat seedlings. Revathi and Subhashree (2014) experimented on *Sesbania grandiflora L.* and found that the invitro percentage phytotoxicity was great in the maximum concentration of chromium with EDTA. Phytotoxicity percentage was progressively increased with the addition of lead nitrate for both the varieties viz., K6 and ICGV-3043 of *Arachis hypogea*. However, phytotoxicity is more in ICGV-3043 as compared to K6 (Kedarini and Roja, 2019).

Tolerance Index (TI)

The characterization of the concentration of metals and tolerance indices of plant species could help overcome certain problems associated with metal pollution in any area (Kabir *et al.,* 2008). The effect of lead on the tolerance index of roots in *Setaria italica* is depicted in Fig 4. The tolerance index of the plants was determined on the 15th day, 30th day and 45thday of plant growth. The root tolerance index was significant at different growth period. In 15 day old plants, the tolerance index of the roots decreased consistently with an increase in lead treatment. The tolerance index recorded at 50 mg/kg was 91.66% and decreased to 59.72% at 250 mg/kg of Pb (15th day). In 30 day old plants, the tolerance Index at 50 mg/kg of Pb treatment was 90.32% and it reduced to 58.7% at 250 mg/kg. In 45 day-old plants maximum tolerance of 89.6% was recorded at 50 mg/kg and it reduced to 54.95% at 250 mg/kg of Pb.

The tolerance index of shoots showed a significant decrease with an increase in lead treatment and growth period (age of the plants). Comparatively, the tolerance index of the roots was more. In 15 day old plant, the tolerance index was maximum, 89.98% at 50 mg/kg and decreased to 50.0% at 250 mg/kg respectively (Fig 5). Similar results in Zinc and differential zinc tolerance in various plants were stated (Ambler *et al.,* 1970 and Shafiq *et al.,* 2008), reported reduced tolerance % in *Leucaena leucocephala* under elevated levels of lead and cadmium.

Fresh and dry weight

The effect of Pb on the fresh weight of roots and shoots in foxtail millet is shown in Table 3. In In 15 day old plants, it was observed that Pb treatment caused a gradual decrease in root fresh weight. The recorded decrease was 0.029±0.002 g at 50 mg/kg and at 250 mg/kg the decrease was 0.020±0.001 g. In 45 day old plants, the maximum reduction was noted in 250 mg/kg which was 0.291±0.006 g. The fresh weight of shoots is also decreased which was very significant with an increase in lead treatment at all sampling days. In 30 day old plants, the shoots fresh weight at 250 mg/kg was 0.192±0.002 g, whereas in the control which shows a comparatively greater value of 0.472±0.003 g respectively.

The result of Pb on the dry weight of roots and shoots in *Setaria* is represented in Table 4. The dry weight of roots and shoots was determined on the 15th, 30th and 45th day of plant growth. In all three sampling days, the biomass decrease as the concentration of lead increases. In 15 days of plant growth, the dry weight of roots at 50 mg/kg was 0.0096±0.001 g and at 250 mg/kg, it showed a reduced value of 0.0079±0.004 g. In thirty day old plants, the recorded value was 0.069±0.003 g (control) and the minimum weight was noticed in 250 mg/kg (0.028±0.002 g). The results clearly show a significant drop in the biomass as the concentration of Pb increases. In the forty-fifth days of plant growth, the recorded biomass of the shoots at 50 mg/kg was 0.123±0.001 g and was 0.062±0.002 g at the maximum concentration of the metal (250 mg/kg).

Similar findings were obtained by several authors in dry matter, fresh weight of plant (Bakiyaraj *et al.,* 2014a) in *Sesbania* plant, Simon *et al*. (1996) in chicory plant. A decrease in biomass production in several other crops was observed by Singh *et al*. (2013) and Farooqi (2009). They reported that reduction in biomass production under the influence of heavy metals (Cd and Cr) may be due to the impairment of uptake and translocation of nutrients and water in aerial parts of plants. Reduction in plant fresh weight under cadmium treatment was also noted in *Vigna radiata* (Kumari *et al*., 2011). Shafiq *et al.* (2008) reported that *L. leucocephala* seedlings showed a gradual decrease in dry weight with an increase in the concentration of cadmium, which was evident in the poor growth of roots and aerial parts. Similar retardation in fresh weight under the influence of some other heavy metal salts has been reported by Patel *et al*. (1976), Jain *et al*. (2000) and Rani (2001).

Relative Growth Index (RGI)

Growth parameter in terms of relative growth index (RGI) was noticeably affected at higher levels of lead treatments and the decrease in shoot RGI was more than the RGI of the roots. Lead treatment had a negative influence on RGI compared to control at all sampling stages. The RGI of roots and shoots decreased with an increase in Pb treatment. The effect of lead on the RGI of roots in *Setaria italica* is represented in Fig 6. At 50 mg/kg, the RGI of the roots was 97.95% whereas, at 250 mg/kg, it was only 80.61% (15^{th} day). At 45th day, the recorded reduction was 42.46% (250 mg/kg) and 83.56% at 50 mg/kg. RGI of the shoots also follows the same pattern as the roots. At 15 days of plant growth, RGI of the shoots was 95.83% at 50 mg/kg and at 250 mg/kg the recorded value was 33.33% respectively (Fig 7). Similar results were reported by Sresty and Madhava Rao (2000), decreased RGI at increasing concentration of zinc and nickel in pigeon pea. The reduction of biomass by metal toxicity could be the direct consequence of the inhibition of chlorophyll biosynthesis (Mirshekali *et al.,* 2012). Radic *et al.* (2009) stated that the down beat influence of Zn on relative growth rate in *Lemna minor* after fifteen days of treatment.

Relative Water Content (RWC)

According to Barrs and Weatherly (1962), Relative water content is the ability of the plant to maintain high water in the leaves under moisture, stress conditions and has been used as an index to determine drought tolerance in crop plants. Flower and Ludlow (1986) stated that RWC was considered a substitute measure of plant water status, reflecting the metabolic activity in tissues and lethal leaf water status. The relative water content decreased with increasing Pb treatments in the leaves of foxtail millet at different stages of plant growth. At 15 days of growth, the RWC was 87.43% at 50 mg/kg and showed a reduced value of 81.14% respectively at 250 mg/kg. At 30 days of plant growth of *Setaria,* RWC showed a reduction percentage of 13.62% at 50 mg/kg (86.38) and at the highest concentration, the reduction was 19.93%.

The decreased value might be attributed to the inhibitory effect of metals on water uptake by roots. These findings are in accord with those obtained by David *et al*. (1995) in Indian mustard and Haroun *et al.* (2003) in *Sorghum* plants under cadmium stress. Similar observations were also reported by Nalini and Chandra (2002) and Valeria *et al.* (2006) on the impact of heavy metals in different plant species. Alsokari and Aldosuquy (2011) reported decreased RWC in the flag leaves at the heading stage of wheat plants treated with Cd. A decrease in RWC was observed in barley plants treated with Cd (Vassilev and Yordanov, 1997) and was also reported in sunflower at different concentrations of nickel treatment (Najafi *et al.,* 2011). The effect of heavy metal on water exchange was the consequent reduction of leaf size which resulted in the reduction of the water potential (Hernandez *et al.,* 1997) and probably was the reason for growth inhibition.

Figure 1. Habit of foxtail millet with panicle.

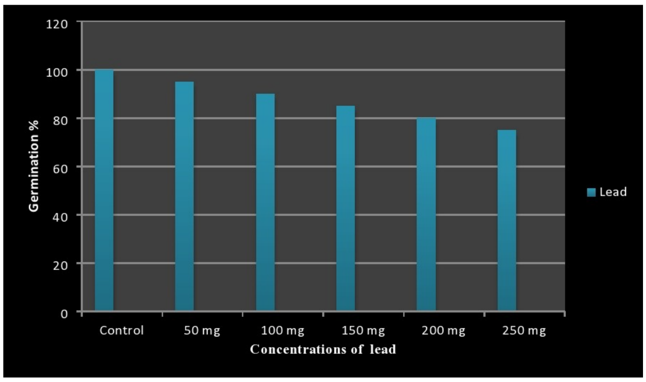

Figure 2. Germination percentage of foxtail millet treated with different concentrations of lead

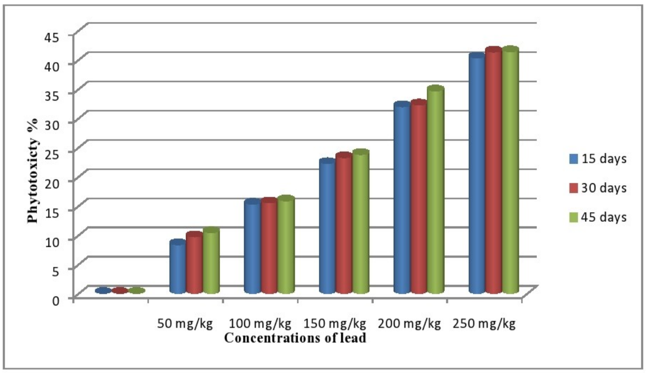

Figure 3. Percentage of phytotoxicity of roots of foxtail millet treated with lead.

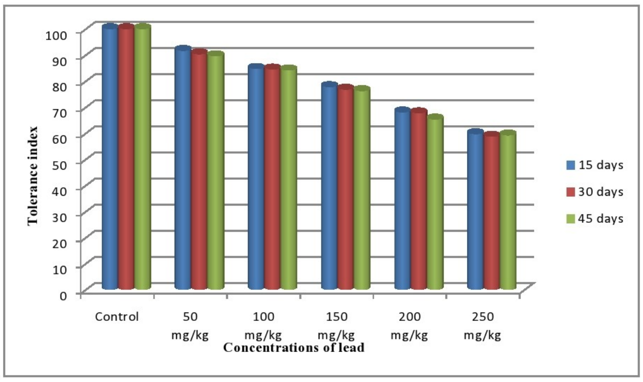

Figure 4. Tolerance index of lead treated roots of foxtail millet

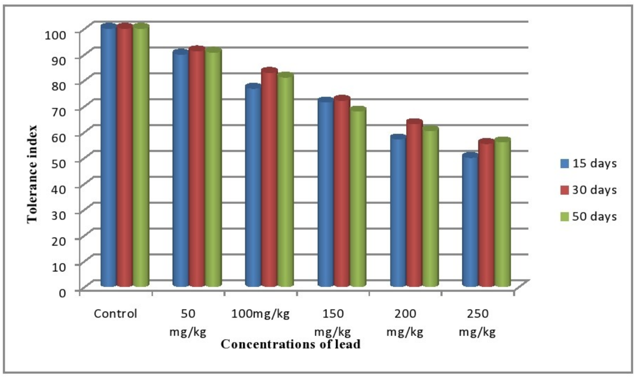

Figure 5. Tolerance index of lead treated shoots of foxtail millet

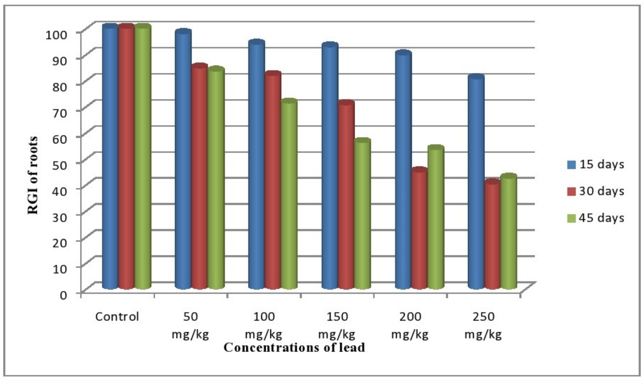

Figure 6. Relative Growth index of lead treated roots of foxtail millet

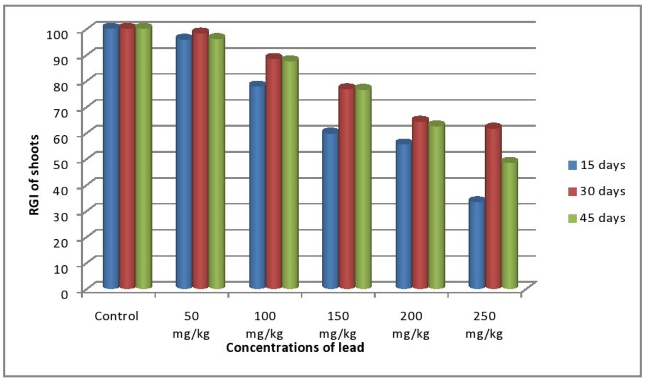

Figure 7. Relative Growth index of lead treated shoots of foxtail millet

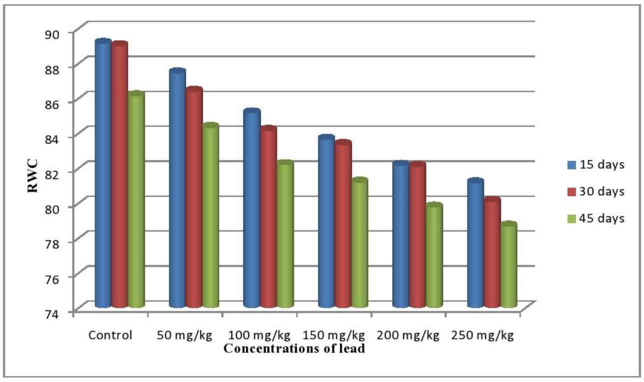

Figure 8. Relative water content in the lead treated leaves of foxtail millet

Table 1 Effect of lead on root length (cm plant $^{-1}$) of foxtail millet at different stages of plant growth.

Sampling date	15th day	30th day	45th day
Control	7.2±0.08	15.5±0.12	20.±20.16
50 mg/kg	6.6±0.08	14.0±0.16	18.1±0.12
100 mg/kg	6.1±0.12	13.1±0.41	17.0±0.20
150 mg/kg	5.6±0.20	11.9±0.32	15.4±0.16
200 mg/kg	4.9±0.12	10.5±0.26	13.2±0.16
250 mg/kg	4.3±0.20	9.1±0.08	11.1±0.43

Table 2 Effect of lead on shoot length (cm plant $^{-1}$) of foxtail millet at different stages of plant growth.

Sampling date	15th day	30th day	45th day
Control	5.6±0.12	28.7±0.12	48.7±0.24
50 mg/kg	5.0±0.12	26.2±0.20	44.2±0.29
100 mg/kg	4.3±0.30	23.8±0.12	39.5±0.20
150 mg/kg	4.0±0.08	20.7±0.20	33.1±0.40
200 mg/kg	3.2±0.20	18.1±0.20	29.4±0.36
250 mg/kg	2.8±0.12	15.9±0.16	27.3±0.33

Table 3 Effect of lead on fresh weight of root and shoot (gms) of foxtail millet at different stages of plant growth.

Sampling date	15th day		30th day		45th day	
	Root	Shoot	Root	Shoot	Root	Shoot
Control	0.031±0.002	0.098±0.002	0.382±0.001	0.472±0.003	0.561±0.003	0.812±0.001
50 mg/kg	0.029±0.002	0.091±0.001	0.353±0.005	0.413±0.002	0.492±0.008	0.761±0.002
100 mg/kg	0.025±0.001	0.080±0.002	0.331±0.005	0.371±0.002	0.442±0.007	0.542±0.008
150 mg/kg	0.024±0.001	0.073±0.001	0.310±0.004	0.270±0.001	0.391±0.008	0.501±0.004
200 mg/kg	0.021±0.003	0.068±0.002	0.292±0.002	0.201±0.002	0.302±0.003	0.402±0.004
250 mg/kg	0.020±0.001	0.053±0.001	0.261±0.002	0.192±0.002	0.291±0.006	0.391±0.008

Table 4 Effect of lead on dry weight of root and shoot (gms) of foxtail millet at different stages of plant growth.

Sampling date	15th day		30th day		45th day	
	Root	Shoot	Root	Shoot	Root	Shoot
Control	0.0098±0.001	0.072±0.003	0.069±0.003	0.112±0.003	0.073±0.002	0.128±0.002
50 mg/kg	0.0096±0.001	0.069±0.008	0.058±0.001	0.110±0.002	0.061±0.003	0.123±0.001
100 mg/kg	0.0092±0.003	0.056±0.004	0.056±0.001	0.099±0.006	0.052±0.002	0.112±0.002
150 mg/kg	0.0091±0.003	0.043±0.003	0.049±0.001	0.086±0.003	0.041±0.004	0.098±0.002
200 mg/kg	0.0088±0.002	0.040±0.005	0.031±0.002	0.072±0.002	0.039±0.001	0.080±0.008
250 mg/kg	0.0079±0.004	0.024±0.002	0.028±0.002	0.069±0.002	0.031±0.002	0.062±0.002

CONCLUSION

The present investigation revealed the influence of heavy metal lead (Pb) on the germination and growth of *Setaria italica*. Results show that a reduction in the growth with increasing heavy metal stress and thus concluded that heavy metal lead greatly influences the growth parameters of crop plants. Further research is needed to understand the mechanism of heavy metal accumulation in crop plants especially *Setaria italica*. Advancement in plant breeding techniques is required to compete against various plants stress including heavy metal stress.

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CONFLICTS OF INTEREST

Both the authors have declared that they do not have any conflict of interest for publishing this research.

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