The Pot Culture Experiment Investigated The Influence Of Lead On The Germination And Seedling Growth Of Arachis Hypogaea.

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Abstract- The effect of Lead contamination on the germination and seedling growth of arachis hypogaea was evaluated through a pot culture experiment on Arachis hypogaea. L. (Groundnut) under ordinary laboratory conditions with and without Lead treatment. Lead treatment at 3, 4 and 5 mg/L influenced seed germination when compared to the control. Lead concentrations of 2,3,4, and 5 mg/L influenced root and soot length as compared to the control. The greater dose of 5 mg/L had a significant ($p<0.05$) effect on the seedling and physiological changes. With increasing Lead concentrations, there was a significant decrease in seed germination, seedling development, root, and soot length.
Index Terms – Lead Nitrate, Pot culture, seedling, germination, etc.,

I. INTRODUCTION

The presence of heavy metals poses a significant concern due to their toxic nature, which has adverse implications for ecological, evolutionary, and environmental aspects [1]. Lead, symbolized as "Pb" on the periodic table, is an elemental substance that originates from the Latin term "plumbum." With an atomic number of 82, it falls under the category of heavy metals. The toxicity of lead is significantly detrimental to both humans and other living organisms. Exposure to this element can result in a wide array of health complications, particularly impacting the nervous system. It is important to note that even minimal levels of lead exposure can be detrimental, especially for children, as their developing brains and bodies are more vulnerable to its adverse effects. Various sources contribute to lead exposure, including lead-based paint, lead pipes found in outdated plumbing systems, lead-acid batteries, and the previous utilization of lead gasoline. Additionally, industrial processes, soil contamination, and specific consumer products may also play a role in the exposure to lead.

Lead toxicity often results in the hindrance of seed germination and the stunted growth of plants[2,3,4,5,6,7]. Lead pollution is the result of the introduction of lead, a hazardous heavy metal, into the environment. This contamination can have significant and far-reaching implications for both human health and the environment. The accumulation of lead pollution in soil can occur through various means, such as the presence of lead in old gasoline, industrial runoff, and the deterioration of paint. Additionally, the combustion of lead gasoline, although largely phased out in many areas, and industrial emissions can release lead into the atmosphere. The adverse health effects of lead pollution have been extensively documented and can be particularly severe, especially in children. Exposure to lead can result in neurological and developmental issues, as well as other health complications in both children and adults.

The global concern over the influx of heavy metals into water bodies from various sources, including industrial, agricultural, and domestic activities, is due to their well-documented negative impacts on both human health and ecosystems [8]. The effects of lead on the shoot, root lengths, and seedling dry biomass of Lythrum salicaria were found to be highly significant [9]. The concentration of lead in soil and wheat tissues, as well as along roads, was found to decrease with increasing distance from the roads [10]. Lead-induced changes in germination behavior, growth and inhibition of δ-aminolevulinic acid dehydratase activity in Raphanus sativus L [11]. Effects of lead on seed germination and seedling growth of wheat (triticum Aestivum) [12]. The release of harmful exhaust gases and toxic pollutants, such as unburnt and partially burnt hydrocarbons and lead compounds, from dense traffic contributes to the pollution of urban environments. The objective of the current study was to examine the impact of lead on the process of seed germination and subsequent seedling growth of Arachis hypogaea.

II. METHODOLOGY

Seeds of Arachis hypogaea L. were procured in a random manner from Dr. A. G. Ranga Agricultural University in Tirupati, Andhra Pradesh, India. To eliminate any impurities from the seed coat, a treatment of 0.1N Lead Nitrate was administered for a duration of two minutes, followed by five washes with running tap water. The study was conducted on Arachis hypogaea L. using varying concentrations of Lead Nitrate (1, 2, 3, 4, and 5 mg/L), with distilled water serving as the control. Twenty-five seeds were placed in petri dishes, and a daily addition of 10 ml of Lead Nitrate solution was made. Each day, twenty-five seeds were planted in petri dishes on Whatman paper No.42, along with 5 ml of the heavy metal Lead Nitrate solution. The research was carried out in a laboratory setting, both during the day and at night, to evaluate the root, shoot length, and seedling growth of Arachis hypogaea L. through a pot culture experiment. After an incubation period of 5 days, the number of seed germinations was recorded and expressed as a percentage of germination. Following 21 days of seedling growth, the length of the roots and branches was measured using a meter scale.

III. RESULTS

The data on groundnut seed germination, seedling, root, and shoot lengths are presented in Table 1. The application of Lead Nitrate solution at varying concentrations (1,2,3, 4 and 5 mg/L) resulted in a reduction of these parameters as compared to the control. Notably, the Lead treatment at concentrations of 3 mg/L, 4 mg/L, and 5 mg/L had a significant impact on seed germination. Additionally, an increase in Lead Nitrate content by 5 mg/L had a substantial effect on the growth of groundnut seedlings in comparison to the control. However, an increase in the concentration of Lead Nitrate up to 3 mg/L had detrimental effects on root growth and shoot length.

Treatment Lead Nitrate (Pb) mg/ L	**Seed germination (%)**	**Root Length (cm)**	**Shoot Length (cm)**	**Seedling Length (cm)**
Control	90 ± 0.276	6.5 ± 1.006	10 ± 1.062	11 ± 0.186
1mg/ L	86 ± 0.514	4.4 ± 0.112	7.9 ± 0.375	10.7 ± 0.698
2 mg/ L	66 ± 0. 286	2.6 ± 0.128	7.4 ± 0.129	10 ± 0.682
3mg/ L	48 ± 0.012	2.4 ± 0.126	7.1 ± 0.216	5.6 ± 0.445
4 mg/ L	34 ± 0.008	2.0 ± 0.268	5.9 ± 0.238	5.4 ± 0.182
5 mg/ L	22 ±0.216	1.7 ± 0.146	5.1 ± 0.234	5.0 ± 0.292

Values are arithmetic mean ± S. E. of three replicates.

Table 1. Effect of different concentration of Lead Nitrate on seed germination, root, shoot and seedling length of Arachis hypogeae *L.*

Number followed by the identical letter within the corresponding column exhibit no substantial variation at a significance level of $P < 0.005$.

IV. DISCUSSION

Arachis hypogaea L, a member of the Fabaceae family, is a valuable cash crop and rotation crop. The byproducts of groundnut, including shell, haulms, and hay, serve as excellent sources of fodder. Groundnut cake, a nutritious feed for cattle, can also be utilized as manure following oil extraction. Its high dietary fiber content renders it an ideal food for digestion. Trees and plants can directly or indirectly absorb metals through water and soil contamination. Lead, which is detrimental to human health, as well as bacteria, plants, and animals, exhibits a gradual decrease in concentration during the process of seed germination and seedling growth in Arachis hypogaea L. The treatment of Lead significantly inhibits seed germination in comparison to the control group. However, the shoot length and root growth of Arachis hypogaea L show an increase with rising concentrations of Lead when compared to the control group. Ultimately, it has been determined that Lead Nitrate poses a significant hazard to the growth of seedlings in Arachis hypogaea L.

V. CONCLUSION

The necessity for additional investigation into Lead contamination in plants via soil is underscored by the findings of this study on the impact of Lead Nitrate on Arachis hypogaea L. This research holds considerable significance in elucidating the effects of Lead pollution on plants through soil, as it facilitates the exploration of plant physiology by utilizing diverse metal concentrations. Furthermore, it is imperative to conduct further research to comprehensively analyze metal determination in the environment and various plant regions.

VII. REFERENCES

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