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EFFECTS IN THE GROWTH AND BIO CHEMICAL CONTENTS OF GROUND NUT (*Arachis hypogaea*) AGAINST HEAVY METAL COMPOUND LEAD CHLORIDE ($PbCl_2$).

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Abstract: Lead (Pb) - toxicity causes inhibition of growth in plants, causes adverse effects to live stocks and finally reaches to humans through the process of biomagnification. The adverse effects of lead contamination include damage to kidneys and nervous system etc. In this experiment effects of lead contamination studied on Arachis hypogaea plant. The seeds (consist of several active components alkaloids, flavonoids, phytosterols etc) were sown on soil irrigated with 0 ppm, 10 ppm, 20 ppm, 30 ppm and 40 ppm lead concentrations. Growth productivity indices were recorded 8 – 9 weeks. The data generated is subjected to one – way of analysis of variants. The results showed that increase in lead concentration resulted in toxic effects in various growth indices and productivity of the plant. The filling potentials of the plant were greatly reduced with increase in concentrations of lead. The seeds produced accumulated more lead with increase in their concentrations. This study has been used to show the risks of consumption of ground nuts that are irrigated with contaminated effluents or waste water.

Index Terms: **Lead chloride, *Arachis hypogaea*, Bio – accumulation, Growth indices, Filling potential, Germination, Inhibition.**

1. INTRODUCTION:

In the environment, lead is the most potential hazardous heavy metal. Its usage dates back to ancient times because of its significant physico-chemical characteristics. It is a widespread environmental chemical throughout the world (Madhu PM et al., 2020; Mahaffay et al., 1990; Prasad MNV et al.,1999). Lead is used in the construction of boats, bearings, buildings, paints, lead batteries, vehicles, fuel, pipelines, ceramics, plastics, as well as smelting, mining operations, and the armaments industry. Lead poisoning affects in humans by, skin contact and inhalation contribute to indirect lead intake; ingestion of Pb-contaminated food and drink is a direct cause of accumulation. Acute Pb exposure causes renal, reproductive, and brain problems, whereas chronic Pb toxicity affects the CNS and PNS. (William O et al., 1999; Ara and Usmani et al., 2015). Lead also impairs haemoglobin production. Pregnant women who have low calcium, iron, or zinc levels are especially vulnerable to the consequences of lead buildup. Changes in behaviour, reduced IQ, sluggish learning in youngsters, diarrhoea, anaemia, skin allergies, chronic renal malfunctioning, and many other symptoms (Cerazy and Cottingham et al., 2010; Larbi A et al 2002; Kwong et al., 2004; Barbier et al., 2005).Lead reduces plant absorption of key minerals including magnesium and iron, which hinders chlorophyll production. It damages the photosynthetic machinery due to its affinity for protein N- and S-ligands. Increased chlorophyllase activity promotes chlorophyll breakdown in lead-treated plants. Lead treatment is said to have a greater impact on chlorophyll b than on chlorophyll a. Lead effects have been documented for both donor and acceptor sites of photosynthesis-2 (PS II), the cytochrome b/f complex, and photosynthesis-1 (PS I) (Shu X et al., 2012; Stefanov K, Seizova K et al.,1995; Rebechini HM, Hanzely L. et al.,1974; Ahmed A, Tajmir–Riahi HA. et al.,1993; Oncel, I et al., 2000). phytoremediation is a novel, cost-effective, and environmentally friendly metal cleanup approach by using plants from contaminated soil and water with minimal environmental degradation. (Koźmińska et al., 2018; Afonso et al., 2019; Abou-Shanab, 2011; Sharma et al., 2015; Ogundola et al., 2022).

2. MATERIALS AND METHODS:

2.1. Plant material and growth conditions:

Arachis hypogea seeds that had been authenticated had been bought from the Sri Venkateswara university, Tirupati, India. For the experimentation, the chosen seeds having a consistent size along with no infections were employed. The seeds of A. hypogea are meticulously cleaned using tap water before being sterilised using 80% ethanol over thirty seconds, after which they were changed to a 5% solution consisting of sodium hypochlorite for fifteen minutes and finally washed using de-ionized water. Following sterilisation, seeds were planted in pots (10 cm in height, 8.5 cm in diameter) that contained a compost-based mix of vermiculite & peat (1:4, w/w) combined along with sand (3:1, w/w) for propagation. In the greenhouse situated at Sri Venkateswara University in Tirupati, the pot experiment carried out in pursuant to the following standard growth conditions: temperatures of 28°C/20°C (Day/Light), a 14-hour photoperiod, 410–570 $m^{-2}s^{-1}$ of average per day photosynthetic active radiation, and 75–85% of relative humidity.

2.2. Soil characteristics and Experimental design:

The soil was obtained within the botanical conservatory (1-30 cm depth) at Sri Venkateswara University in Tirupati. The finely crushed soil then sterilised by autoclave allowed to dry for seven days, then pulverised using a mortar and pestle before being put over 2 mm tubes of sieving. Considering the research of Ramesh and Damodharam, (2017) the fundamental characteristics about the soil was determined. Clay (54.2%), silt (10.6%), soil (33.9%), pH (6.8), electrical conductivity (0.39 µMhos/cm), organic matter (6.2 g/kg), available phosphorus (59.26 mg/kg), available potassium (97.45 mg/kg), total nitrogen (55.13 mg/kg), total copper (11 mg/kg), and soil Pb (0.25 mg/kg) had been it's physiochemical attributes. The subsequent full randomised block design was used with five replications, and every single pot received with a comparable amount of soil. For the experiment of the control, water has been provided every day to keep the soil moistened at a level between 75 - 85%. In contrast to the treatment condition, soil had been experimentally supplied with various $PbCl_2$ concentrations (10,20,30,40 ppm).

2.3. Determination of growth and biochemical parameters:

In order to compare the growth rate and physiological responses of being treated and untreated seedlings subjected to varying amounts of $PbCl_2$ stress, offsets of pigeon pea that were 10, 20, and 30 days old were collected.

2.3.1. Root length: The plants were cautiously removed so as not to harm their root system. To get rid of the sandy and clay granules stuck on its root system, everything was washed underneath running water. With a scale to measure, the root length was assessed from the top of the root area to its tip, and the results have been recorded as (cm) centimetres.

2.3.2. Shoot length: The young plants were gently removed so as not to harm the shoot structure. Using a normal scale, each plant's length of shoot was determined by measuring starting at the collar area to the apex of the plant, then the results was recorded as cm.

2.4. Statistical Analysis: The results were expressed as the mean ± standard error of the five determinations.

3. RESULTS:

Table 1. Effect of lead on germination and growth of parameters of *Arachis hypogea*.

Treatment	Seed Germination	No. of Leaves	Height	No. of Pods/Plants	No. of seeds/Plant
Control/ 0 ppm	100	68.1	32.6	2.5	7.2
10 ppm	90	54.3	25.1	2.1	4.6
20 ppm	80	51.7	23.7	1.8	3.4
30 ppm	70	38.2	20.4	1.3	3.2
40 ppm	65	31.0	19.6	1.1	2.3

Table 2. Effect of lead on filling potentials of *Arachis hypogaea*.

NOTE:

$$\text{Filling Potential} = \frac{\text{No. of seed in a pod}}{\text{Length of pod}}$$

Plant	Concentration (ppm)	Filling potentials
Arachis hypogaea	0 ppm	0.88
	10 ppm	0.64
	20 ppm	0.49
	30 ppm	0.41
	40 ppm	0.38

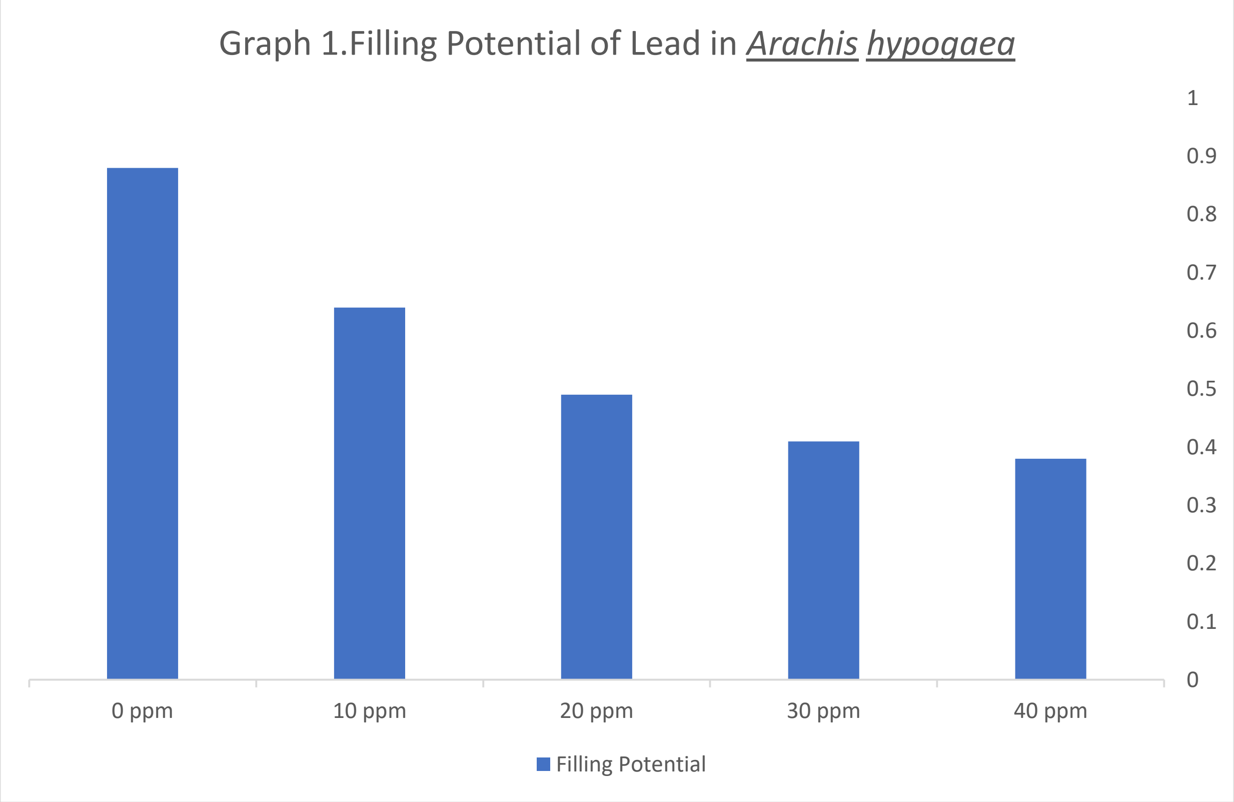
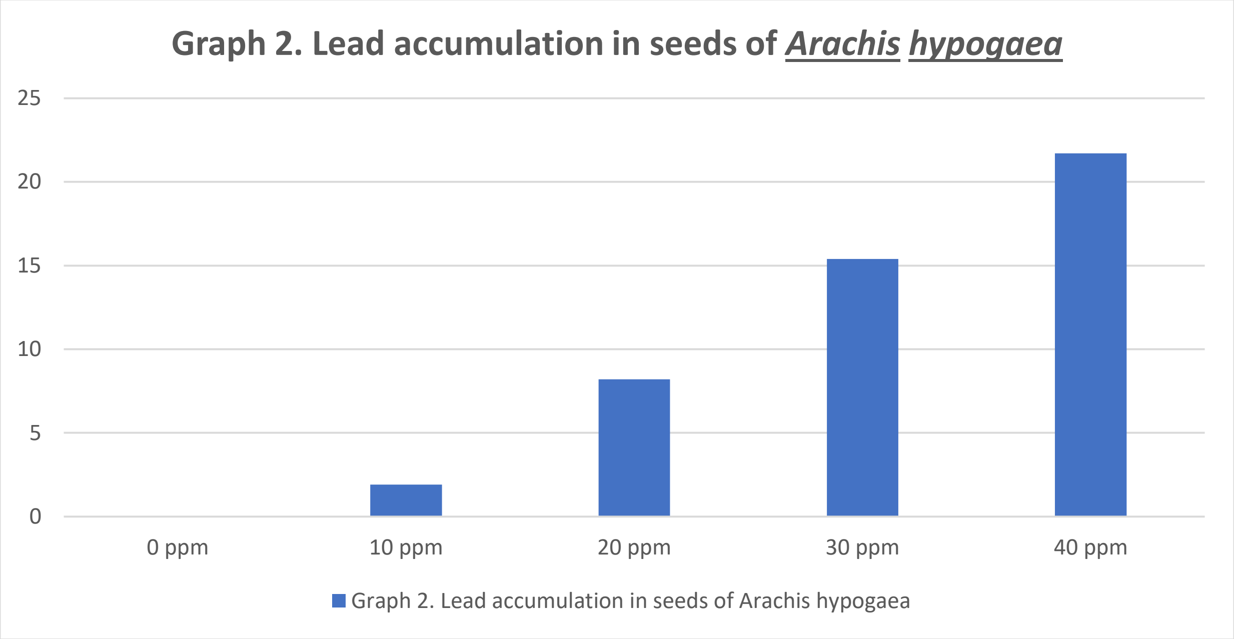


Table 3. Accumulation of Lead in the seeds of *Arachis hypogaea*.

Plant	Concentration (ppm)	Heavy metal Lead (Pb) accumulation - ppm
Arachis hypogaea	0 ppm	0.0
	10 ppm	1.9
	20 ppm	8.2
	30 ppm	15.4
	40 ppm	21.7



4. DISCUSSION:

Food quality and safety, atmospheric heavy metal pollutants, and the well-being of humans are all interconnected. According to (El-Kady and Abdel-Wahhab et al., 2018; Aprile A et al 2019;I. E. Akinci, S et al., 2010; T. C. Broyer et al., 1972), the quantity about heavy metals within the natural environment has dramatically grown in recent times. Within developing as well as advanced nations, there are different ways to accumulate heavy metals found in food crops, such as atmospheric release, manure from livestock, the cultivation of crops through waste water and/or water that has been contaminated with metallopesticides or herbicides in particular phosphate-based fertilisers, as well as sewage sludge-based supplements (Prabhat et al., 2019; Fasih et al., 2021). Because of their confined nature and reliance upon soil, crops are often subject to the adverse consequences of these contaminants (P. Wang et al., 2012; Ali et al., 2020). As a result, a variety of contaminants containing heavy metals which differ in quantity, variation, and severity frequently attack crops. Whenever agricultural crops are grown in locations where levels of heavy metals stand over regulatory boundaries, such heavy metals eventually enter into the food chain (Ashfaq et al., 2022). For common culinary legume plant grown throughout the tropics

The range of Pb available in the surface soil around the world is 9.0 - 84 mg kg−1 (A. Fargasova et al.,2001; Kabata-Pendias, 2011). Drinking water is one of the most common routes of intake of Pb in humans. Pb guidelines for air and drinking water are 0.5 µgm−3 and 10 µg l−1 (WHO, 2001, 2008). Excessive Pb concentration also causes a significant hazard to plants, animals and human beings (Shevyakova et al., 2008;A.Kumar et al.,2012). It is getting attention because of the public interest for a green technology is preferred over conventional approaches. In addition, physical and chemical methods are costly and often alter the soil properties which are not suitable for agricultural purpose.

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Furthermore, metal stress conditions reduced chlorophyll and protein contents (Bechaieb R et al., 2012; Chettri et al.,1998; Supratin et al.,2004;P. Chauhan & J. Mathur., 2018;2020) A higher amount of accumulated Pb gets restrict within the roots whereas only a small fraction of Pb transport to aerial parts of the plants (Zhou et al., 2016; Kiran et al., 2017). The activity of different enzymes inactivates when Pb binds to their SH-groups sites and increases the process of reactive oxygen species (ROS) production which leads to oxidative stress in the plants (Fahr et al., 2013;2018; Nas and Ali, 2018).

From the current study, carried out using lead concentrations of A.*hypogaea* 10 ppm, 20 ppm, 30 ppm and 40 ppm the results were analysed after 8th week. As the concentration increases the filling potentials decreased gradually (0.88 to 0.38). The accumulation of lead in seeds were increased gradually from 0 ppm to 21.7 ppm.

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