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Influence of lead acetate on the seed germination and growth of tomato

Y. Chandrakala[1]

Assistant professor

Department of Science and Technology

Faculty of Education and Methodology

[1]Jayoti Vidyapeeth Women's University, Vedant Gyan Valley, Jharna, Jaipur Rajasthan 303122,

Abstract

The experiment was performed to find the seed germination indices of Tomato (*Lycopersicon esculentum Mill*.) under lead acetate. A study was conducted to determine the effect of different concentrations of lead acetate on seed germination indices of Tomato (*Lycopersicon esculentum Mill*.) under lead acetate. The present study the experiments were conducted to find out the effect of Lead acetate on the germination indices of Tomato (*Lycopersicon esculentum Mill.)* , *a* significant decrease in germination percentage (GP%) and germination rate (GR) were proportionate to lead acetate on 15th DAS. Decline in germination index (GI), and coefficient of velocity of germination (CVG) were noted with increasing concentration of lead acetate in irrigation water.

Keywords

Germination (%), Seed vigour index, seedling tolerance index, germination index (GI), coefficient of velocity of germination (CVG) (*Lycopersicon esculentum Mill*.).

Introduction

Lead is one of the heavy metals that easily accumulates in soils and sediments. Lead levels in the environment are currently a major concern. Plants absorb lead even though it is not a necessary component. It is well known that lead has many harmful effects on living beings.

This metal hinders plant growth, root elongation, germination and seed development, transpiration, lamellar organization of chloroplasts and cell division. the extent of plant stress, the stage of plant development and the specific organs. There is often a correlation between the amount of lead present in the environment and the amount found in plants. Pesticide residues can be found in soil and surface water in agricultural settings. (Y.Chandrakala and P.K. Mohapatra, 2012).

MATERIAL AND METHODS

The present investigation entitled "Seed Germination Indices of Tomato (Lycopersicon esculentum Mill.) under lead acetate.)" was carried out in the DST, FEM, Jayoti Vidyapeeth Women's University,Jaipur. An experiment was conducted with Tomato (*Lycopersicon esculentum Mill*.) using a completely randomized design of five replications. The Tomato (*Lycopersicon esculentum Mill*.) seeds were superficially sterilized with 0.1% mercury chloride solution to prevent surface contamination, and then the seeds were rinse with distilled water. The seeds were tested for standard germination test in a seed germinator at at 22±2°C. Using paper towel. Each set was uniformly treated with different treatments 10, 25, 50,100 mg/l of lead acetate. Control seeds were treated with distilled water. Each treatment, including the control, was repeated five times. Germination was recorded every 24 hours and on day 15th of each treatment, five seedlings were randomly selected to record seedling growth.

1. Germination percentage (GP %) = (number of germinated seeds/total number of seeds) x 100 (till 10 days).

2. Germination Rate (GR) = $\frac{\text{Number of germinated seeds}}{days}$

3. Germination index (GI) = Σ (Gt / Dt), (AOSA, 1983). Where Gt is the number of germinated seed on day t, and Dt is the total number of days (3-10 days in this experiment).

4. Coefficient of velocity of germination (CVG) was evaluated according to Maguire (1962) as follows: CVG= $\frac{G1+G2+\cdots Gn)}{1\times G1+2XG2+\cdots\ldots n\times Gn}$

Where, G is the number of germinated seeds per day (in this experiment 3 to 9 days), and n is the last day of germination (9th day).

5. Means germination time (MGT) is calculated according to Ellis and Roberts (1981) as given below, MGT =$\frac{\sum(nd)}{\sum n}$

Where 'n' is the number of germinated seeds in day d, Σn is the total germinated seeds during experimental period.

RESULTS AND DISCUSSION

Abiotic stress and its effects on plants. They may affect the basic metabolisms of plants or any other living thing, including those susceptible to UV-B radiation, heavy metals, salt stress, cold, or drought, because of their direct or indirect presence. The effect of different concentration of lead acetate on germination parameters are summarized in Table1.

Table 1: The results regarding the effect of seed germination of Tomato (*Lycopersicon esculentum Mill.)* at 15th DAS. Germination percentage (GP %), Total Seedling Length in cm (SL), Germination Index (GI),

Germination Rate (GR),and Coefficient of velocity of germination (CVG) under concentration of lead acetate.

Treatment lead acetate (mg/l)	GP %	SL	GI	GR	CVG
0	100	5.7	35.5	5.4	1.56
10	98	7..0	32.6	5.4	0.94
25	83	5.9	30.1	4.8	0.97
50	71	5.5	22.2	4.1	0.58
100	52	3.8	9.1	2.8	0.37

The plants under stress condition are most likely to be adversely affected by high concentrations of pollutants. Lead is considered a toxic and dangerous heavy metal. The lead treatment at 150 mM showed significant physiological, photosynthetic and ultrastructural changes in seedlings of Vigna unguiculata. GP decreased with increased in concentration. The effect of lead in the polluted soil has an effect on germination. The similar trends s was observed by Al-Yemini and Al-Hetal, (2001) in *Vigna ambacensis*. The lead treatment up to 10 mg/l of lead acetate was found to increase the germination percentage over control. Root and shoot length of Tomato (*Lycopersicon esculentum Mill.*)seedling increased 10 mg/l decreased with an increase in lead acetate concentration. Root and shoot length were found to be higher at 10 mg/l of lead acetate at high levels may inhibit the root growth directly by inhibition of cell division or cell elongation. Pb mostly movements into the root apoplast, then spreads out radially throughout the cortex, accumulating close to the endodermis. The endodermis act as a barrier to the movement of Pb in the roots compared to shoots (Verma and Dubey, 2003). It alters the mineral nutrition and water balance, modifies hormonal levels and affects the structure and permeability of the plasma membrane (Romerio *et al.,* 2006). Seedling length of Tomato (Lycopersicon esculentum Mill.)seedling increased at 10 mg/l, increase in seedling length might be the result of higher embryo-cell wall extensibility. Increased seedling length and its growth may be due to increase in cell division within the apical meristem of seedling shoots and roots which was responsible for increase in overall seedling growth. But then it decreased with an increase gradually with concentration of lead acetate 100mg/l. These results showed that lead contamination has negatively affected root and shoot development. Seedling length is an key factor as it decides the vigour of seed. By overproducing ROS, lead poisoning results in the suppression of ATP synthesis, lipid peroxidation, and DNA damage. Lead significantly reduces water and protein content, transpiration, chlorophyll production, seed germination, seedling development, and seedling growth. Percent Germination showed decrease in percent germination proportionate to the increasing concentration of lead in solution. It has been observed that the highest germination rate (GR) at 10 mg/l lead acetate of treatment and in all the concentration the emergence of radical was observed the proportional decrease in GR was observes with increasing concentration up to 100 mg/l. along with exposure time up to 15 days. Delaying in % germination is caused by a slow germination rate. According to Jamil *et al.*, (2005) decrease in the germination rate of canola, cabbage, and cauliflower when compared to the control under high salt concentrations. The germination indices decreased with increasing stress. Khan *et al.,* (2009), reported reduction in germination index in hot

pepper, Coefficient of velocity of germination (CVG) decreased with increase in the concentrationof lead acetate.

CONCLUSION - Up to 10 mg/l, lead acetate in soil improves germination indicators such as seedling length, CVG and GR establishment, but after that, it negatively affects tomato (*Lycopersicon esculentum Mill*.) seed germination. The higher the concentration of lead acetate, the lower the GP% and GI.

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