Enhancement of groundnut yield by soil amendments

J. Rameshkumar, L. Baskaran, R. Rajendran and G. Thiyagarajan*

Department of Botany, Annamalai University, Annamalainagar 608 002, Tamilnadu, India.

*G. Thiyagarajan
Assistant Professor, Department of Botany-DDE, Annamalai University, Annamalainagar 608 002, Tamilnadu, India.
E-mail: gthiyagubot@gmail.com

Received 17 November 2013; accepted 28 November 2013

Abstract

Pot culture experiment was conducted to find out the suitable amelioration for lead toxicity by growing groundnut on leaded soil amended with cow dung and vermicompost and all morphological, growth and yield characters were analysed on 120th DAS to find out the comparative effect between leaded soil and leaded soil with soil amendments. The germination percentage, seedling growth and dry weight of groundnut seedlings were high at amended soil when compared to leaded polluted soil and it might be due to the presence of optimum level of nutrients. Whereas, in higher concentrations of lead acetate, all the parameters showed negative results and it might be due to the high toxicity level present in the polluted soil.

1. Introduction

Pollution is an undesirable changes in the physical, chemical or biological characteristics of an air, land and water that will harmfully affect the human life and the desirable species or that may waste or deteriorate the raw material resources. An important factor influencing the productivity of the planet’s various ecosystems is the nature of soil. 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 soil (Hamid et al., 2010). Soil characteristics like low pH, low density of phosphorus (P) and abundance of organic ligands can increase Pb absorption level by plants (Kabata-Pendias and Pendias, 2000). The most significant factors which can distribute lead as a pollutant in the environment are burning of fossil fuels, agricultural manufacturing, mining, pesticides and fertilizers (Ross, 1994; According to Oliver and Naidu (2003) plants show different reactions against Pb toxicity. Some of them are sensitive and the others have more tolerance. The anthropogenic emission of Pb is at least 100 times higher than natural emissions. Soil and dust are significant sources of Pb exposure. Lead is generally immobile in soil and accumulates in the upper layers. Sources of Pb pollution may be divided into two major categories, industrial and domestic. The industrial Pb exposures are mainly due to the particulates generated by coal burning and roasting of minerals i.e. iron pyrite, dolomite, alumina, etc. The domestic Pb exposure comes mainly from the burning of solid fuels (i.e. coal, biomass, agricultural waste, etc.), paints, ceramic glazes and cosmetic. The present investigation was aimed to study the effect of lead toxicity and soil amendments mixed soil on seed germination, growth, yield of groundnut

2. Materials and methods

2.1. Pot culture experiment

Pot culture experiments were conducted with groundnut to find out the suitability of various soil amendments for getting higher yield of crop grown under lead acetate polluted soil. Five kg of polluted soil was taken in an earthen pot. The polluted soil mixed with some soil amendments such as farmyard manure and vermicompost. The following soil amendments were given to the polluted soil in pot culture experiments.

T1 – Polluted soil (Control)
T2 – Polluted soil + Farmyard manure (0.50 kg/pot).
T3 – Polluted soil + Vermicompost (0.50 kg/pot)

The seeds of groundnut were sown in earthen pots. The pots were irrigated with well water once in a week. Three replicates were maintained for this experiment. Five plant samples were randomly selected from each and every treatment and they were used for recording the morphological growth parameters (plant height, total leaf area and dry weight) and the yield parameters also at the time of harvest (105 DAS).
2.2. Seed and plant materials
Groundnut (*Arachis hypogaea* L.) was obtained from Oil Seeds Research Station, Regional Research Station of Tamil Nadu Agricultural University located at Vinudhachalam, Tamil Nadu, India. The healthy seeds were chosen and used for both laboratory and field experiments. The vermicompost was collected from department of zoology annamalai university and the farmyard manure (FYM) was obtained from local farmers. These soil amendments were used for remediation of lead acetate polluted soil.

2.3. Morphological parameters
Plant samples were collected randomly at various stages (30, 60 and 105 DAS) of its growth and used for recording morphometrical observation like shoot length, root length, total leaf area, fresh weight, dry weight and yield of crop plants. Five plants were selected from each concentration including control for recording the various morphological parameters.

2.4. Shoot length and root length
Five plants samples were collected at 30, 60 and 105 DAS. Their heights were measured by using cm scale and recorded. In another experiment shoot length and root length were measured and recorded.

2.5. Total leaf area
The leaf area was calculated by measuring the length and width of the leaf as described by Yoshida et al. (1972).

Leaf area (cm²) = K × length × breadth

Where = Kemp’s constant (for dicot leaves 0.66)

2.6. Dry matter production
The plant samples taken for morphometric studies were used for determination of fresh weight and dry weight. They were dried in a hot air oven at 80 °C for 24 hrs and their dry weight was determined by using electrical single pan balance.

2.7. Yield and yield components
Five plants were used for recording the various yield parameters like number of pods per plant, number of seeds per plant, 100 seed weight and total yield.

3. Results
Morphological Parameters (Soil Amendment mixed Polluted Soil)

3.1. Shoot length
The effect of different level of lead acetate and soil amendments (cow dung, and vermicompost) mixed soil and morphology parameter shoot length was recorded and presented in Fig. 1. The highest shoot length (67 cm plant) was recorded at 25 ppm lead acetate mixed with cow dung and vermicompost mixed soil. The lowest shoot length (26 cm/plant) was recorded at 200 ppm cow dung + vermicompost mixed soil.

Ecophysiological studies on the effect of lead acetate and amendment mixed polluted soil on shoot length of groundnut

3.2. Root length
The effect of different level of lead acetate and soil amendments (cow dung and vermicompost) mixed soil on morphology parameter root was recorded and presented in Fig. 2. The highest root length (33.71) was recorded at 25 ppm lead acetate mixed with cow dung and vermicompost mixed soil. The lowest shoot length (8.93 cm/plant) was recorded at 200 ppm cow dung + vermicompost mixed soil.

Ecophysiological studies on the effect of lead acetate and amendment of polluted soil on root length of groundnut

3.3. Fresh weight
The effect of different level of lead acetate and soil amendments (cow dung and vermicompost) mixed soil on morphology parameters fresh weight was recorded and presented in Fig. 3. The highest fresh weight (112.0 mg plant⁻¹) was recorded at 25 ppm lead acetate mixed with cow dung and vermicompost mixed soil. The lowest fresh weight soil. The lowest fresh weight (27.35 mg plant⁻¹) was recorded at 200 ppm + cow dung and vermicompost mixed soil.

Ecophysiological studies on the effect of lead acetate and amendment of polluted soil on fresh weight of groundnut
3.4. Dry weight
The effect of different level of lead acetate and soil amendments (cow dung and vermicompost). Mixed soil on morphology parameter dry weight was recorded and presented in Fig. 4. The highest dry weight (34.0 g plant⁻¹) was recorded at 25 ppm lead acetate mixed with cow dung and vermicompost mixed soil. The lowest dry weight (8.77 g plant⁻¹) was recorded at 200 ppm + cow dung and vermicompost mixed soil.

3.5. Total leaf area
The effect of different level of lead acetate and soil amendments (cow dung and vermicompost) mixed soil on morphology parameters of total leaf area (473 plant/cm²) was recorded at 25 ppm lead acetate mixed with cow dung and vermicompost mixed soil. The lowest total leaf area (183 plant/cm²) was recorded at 200 ppm + cow dung and vermicompost mixed soil (Fig. 5).

3.6. Number of flowers
The effect of various concentration of lead acetate and soil amendments (cow dung and vermicompost) mixed soil on yield parameter number of flowers were counted and presented in Fig. 6. The highest flowers (63) was recorded at 10 ppm lead acetate mixed with cow dung and vermicompost mixed soil. The lowest flowers (16) was recorded at 200 ppm lead acetate, cow dung and vermicompost mixed soil.

3.7. Number of pods
The effect of various concentration of lead acetate and soil amendments (cow dung and vermicompost) mixed soil on yield parameter number of pods were counted and presented in Fig. 7. The highest pods (54) were recorded at 10 ppm lead acetate mixed with cow dung and vermicompost mixed soil. The lowest pods (11) were recorded at 200 ppm lead acetate, cow dung and vermicompost mixed soil.

3.8. Number of seeds
The effect of various concentration of lead acetate and soil amendments (cow dung and vermicompost) mixed soil on yield parameter number of seeds were counted and presented in Fig. 8. The highest number of seeds (108) was recorded at 10 ppm, lead acetate mixed with cow dung and vermicompost mixed soil. The lowest number of seeds (20) was recorded at 200 ppm lead acetate, cow dung and vermicompost mixed soil.
Ecophysiological studies on the effect of lead acetate and amendment of polluted soil on Number of seeds of groundnut

3.9. 100 seed weight

The effect of various concentration of lead acetate and soil amendments (cow dung and vermicompost) mixed soil on yield parameters 100 seeds were counted and presented in Fig.9. The maximum seed weight (53.21) was recorded at 10 ppm, lead acetate mixed with cow dung and vermicompost mixed soil. The minimum seed weight (13.21) was recorded at 200 ppm lead acetate, cow dung and vermicompost mixed soil.

4. Discussion

Pot culture experiments were conducted with lead acetate polluted soil and lead polluted soil amended with farmyard manure and vermicompost to study the toxicity effect and ameliorative effect between them on the growth, yield and biochemical aspects of groundnut. The enhancement of growth and yield of groundnut due to the optimum available nutrient present in the amendment mixed lead acetate polluted soil

References


Source of support: Nil; Conflict of interest: None declared