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J Rameshkumar
Department of Botany, M.R. Govt. Arts College, Mannargudi, Tamil Nadu, India

PS Saravanan
Department of Botany, M.R. Govt. Arts College, Mannargudi, Tamil Nadu, India

Correspondence
J Rameshkumar
Department of Botany, M.R. Govt. Arts College, Mannargudi, Tamil Nadu, India

Effect of enhanced chromium in Groundnut (*Arachis hypogaea* L.) and its treatment

J Rameshkumar and PS Saravanan

Abstract

Chromium is one of the major environmental stresses that affect plant growth and their toxic level in soils are result of heavy traffic, mining, industrials and agricultural activity. Chromium first accumulates in soil to reach the plant through roots. The chromium present at trace level in fertilizers may accumulate in agricultural soils and pose a hazard to plant growth and yield. In this way present study aimed at the effects of chromium accumulation in groundnut with special reference to various morphological and biochemical analysis done. Pot culture experiment were conducted with groundnut crop, growth in the soil mixed various amount of chromium concentrations of chromium, namely 50, 100, 150, 200 and 250 mg kg^{-1}. The inner surface of pots were lined with a polythene sheets. Each pot contained 5kg of ash dried soils. Uniform irrigation was done once in a week for the entire period of experiment. The soil without chromium is treated as control. The morphological parameters like shoot length, root length, fresh and dry weight, total leaf area and biochemical content such as starch, proline, sugar and protin of groundnut plant were analyzed on various sampling days (30,60and 90 days). The biochemical content (except 50mg kg^{-1}) decreased with increase of concentrations of chromium. The present investigation it was concluded that the 50mg kg^{-1} level of chromium in the soil was beneficial for the growth of *G. hypogea* plants.

Keywords: Chromium, groundnut, morphological and biochemical contents

Introduction

Natural resources are essential to the economics of almost all the nations of the world in general and developing countries in particular. Agriculture, fisheries and forestry contribute greatly to the economic development of the developing countries throughout the world. Such resources – dependent industries rely simultaneously on both the use and conservation of natural resources. Similarly, sustained economic growth dependa on sufficient, reliable and environmentaly sound energy sources. This type of natural resources are mainly affected by environmental pollutions. Heavy metals are natural elements that are found at various high background levels at different places throughout the world, due to various concentrations in the bedrock. Heavy metals are persistent and cannot be deleted from the environment. Thus problem arises when their availability is high due to high background levels or due to human activity. An essential trace metal affects a living organism harmfully in two different ways: (1) as a result of deficient supply, and (2) as a result of over supply. Under the deficient supply of an essential metals and organism shows poor yield and growth. With increase in the supply and uptake of the metal, the growth and yield increase, until they reach a maximum value. Further supply of the metal does not change the growth of the organism up to a certain concentration. However, after this, the metal shows toxic effects with a consequent decrease in growth and yield, ultimately become lethal). A heavy metal contaminated atmosphere, geosphere and hydrosphere pose a serious threat to plants literature on the contamination of the environment by heavy metals is enormous (Mason. 1996; Wong, 1996; Nygard *et al.*, 2001; Metcheva, 2006) [3, 8, 6, 4] and the majority of the studies have been associated with various industries and agricultural activities. When taken up by plants, heavy metals can result in a wide variety of the toxic effects. The scale and character of changes observed in plants after heavy metal application was shown to be dose – dependent and it can vary for different plant species even for identical metal treatment depending on individual tolerance.

Materials and method

Seed and plant materials

Groundnut seeds were obtained from Oil Regional Research Station of Tamil Nadu Agricultural University, Virudhachalam, Tamil Nadu, India. Healthy seeds were used for both loboratory and field experiments.

Pot culture experiments

A.*hypogaea* plants were grown in pots in untreated soil (control) and in soil to which chromium had been applied (50, 100, 150, 200 and 250 mg kg^{-1} soil). The inner surface of pots were lined with a polythene sheet. Each pot contained 2kg of air dried soil. The chromium as finely powdered applied to the surface soil and thoroughly mixed with the soil. The seeds were sown in each pot. All pots were watered to field capacity daily. Plants were thinned to a maximum of six per pot, after a week of germination. Each treatment including the control was replicated five times.

Shoot length and root length

Five seedlings were collected at 30, 60 and 90 DAS. Their heights were measured by using cm scale and recorded. In another experiment, shoot length and root length were measured and recorded.

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 70° c for 24hrs and their dry weight was determined by using electrical single pan balance.

Chlorophyll (Arnon 1949) [1]

Hundred milligram of fresh leaf was ground in a Mortar and pestle with 20ml of 80 per cent acetone. The homogenate was centrifuged at3000rpm for 15 min. the supernatant was saved. The pellet was re-extracted with 5ml of 80 per cent acetone each time, until it become colourless. All the supernatants were pooled and utilized for chlorophyll determination. Absorbance was measured at 645 and 663nm in spectrophotometer. The Chlorophyll 'a', chlorophyll 'b' contents were estimated and expressed in mg/g on fresh weight basis.

Carotenoid (Kirk and Allen, 1965) [2]

The same extract was used for chlorophyll and carotenoid estimation. The acetone extract was read at 480 nm in a UV-Spectrophotometer.

Table 1: Effect of chromium on the shoot length, root length, and total leaf area of *A.hypogaea*

Chromium added in the soil (mg kg^{-1})	Shoot length (cm)	Root length (cm)	Total leaf area (cm^2 $plant^{-1}$)
	90 DAS	90DAS	90DAS
Control	73.80	17.60	725.07
50	84.33	27.26	856.22
100	81.36	16.30	673.55
150	66.56	15.43	633.85
200	63.30	14.60	421.00
250	56.33	12.28	374.20

Table 2: Effect of chromium on the shoot and root dry weight of *A.hypogaea*

Chromium added in the soil (mg kg^{-1})	Chlorophyll 'a' (mg/g fr.wt.)	Chlorophyll 'b' (mg/g fr.wt.)	Carotene content (mg/g fr.wt.)
	90 DAS	90 DAS	90 DAS
Control	0.796	0.746	0.569
50	0.860	0.830	0.645
100	0.824	0.791	0.593
150	0.778	0.729	0.532
200	0.728	0.634	0.456
250	0.684	0.608	0.411

Table 3: Effect of chromium on the Chlorophyll 'a' Chlorophyll 'b' and Carotene content of *A.hypogaea*

Chromium added in the soil (mg kg^{-1})	Chlorophyll 'a' (mg/g fr.wt.)	Chlorophyll 'b' (mg/g fr.wt.)	Carotene content (mg/g fr.wt.)
	90 DAS	90DAS	90DAS
Control	0.796	0.746	0.569
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150	0.778	0.729	0.532
200	0.728	0.634	0.456
250	0.684	0.608	0.411

DAS- Days after sowing

The present investigation deals with the chromium induced changes on growth, biochemicals, content of *A.hypogaea* plants.

A.hypogaea plants were raised in pots containing the soil amended with various levels of chromium (control, 50, 100, 150, 200, and 250 mg kg^{-1} soil). Six replicates were maintained for each level. Morphological parameters like root and shoot length, total leaf area, and dry weight of root and shoot of (Medda and Montal, 2017) [5] *A.hypogaea* were recorded on 90^{th} day. Biochemical constituents (Chlorophyll 'a', chlorophyll 'b', carotenoid were analysed on 90^{th} days Chromium treatment at all levels tested (except 50 mg kg^{-1}) decreased the various growth parameters such as length of the root, shoot and area of leaves and dry weight of root and shoot; biochemical constituents pigments, like chlorophyll 'a', chlorophyll 'b' and carotenoid (Sundaramoorthy *et al.*) [7] of groundnut plants. Increased except 50 mg kg^{-1} with increase in chromium level in the soil. The uptake and accumulation of chromium in *A.hypogaea* plants increased with increase in chromium level in the soil.

From the present investigation it was concluded that the 50 mg kg^{-1} level of chromium in the soil was beneficial for the growth of *A,hypogaea* plants. The level of chromium in the soil above 50 mg kg^{-1} proved to be toxic. The results indicated that the 50 mg kg^{-1} chromium level can be applied for increasing the growth and yield of *A.hypogaea* plants.

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