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Mineral Constituent Variations under Cobalt Treatment in *Vigna mungo* (L.) Hepper

[1]*Kaliyamoorthy Jayakumar,* [1,2]*Cheruth Abdul Jaleel and* [3,4]*M.M. Azooz*

[1]Stress Physiology Lab, Department of Botany, Annamalai University,
Annamalainagar 608 002, Tamilnadu, India
[2]DMJM International (AECOM Middle East Ltd.), Consultant of Gardens Sector Projects,
Alain Municipality and Eastern Emirates, P.O. Box 1419, Al-Ain, Abu Dhabi, United Arab Emirates
[3]Department of Botany, Faculty of Science, South Valley University, 83523 Qena, Egypt
[4]Department of Biology, Faculty of Science, King Faisal University,
P.O. Box: 380, Al-Hassa 31982, Saudi Arabia

Abstract: A study was carried out to understand the mineral constituent variations under cobalt treatment in *Vigna mungo* (L.) Hepper. The experiments were conducted in earthen pots and lined the inner surface with polythene sheet. Each pot contains 3 kg of air dried soil. Blackgram plants were raised in these pots containing soils amended with different concentrations of cobalt (0, 50, 100, 150, 200 and 250 mg/kg). Plants were watered to field capacity daily. Plants were thinned to a maximum of six per pot. The various mineral contents were estimated on 30th days after sowing (DAS). Mineral contents such as nitrogen, phosphorus, potassium, copper, manganese, iron and zinc contents were analysed in both control and treatments. All the mineral contents were increased at 50 mg/kg cobalt level in the soil, when compared with control. Further increase in the cobalt level (100-250 mg/kg) in the soil decreased all the mineral content of blackgram plants.

Key words: Cobalt, Blackgram, Mineral

INTRODUCTION

The pollution of terrestrial environment has become a serious problem with increasing industrial and agricultural operations. The environmental pollutants are likely to affect biological systems in different ways according to their chemical properties [1]. The sum of physiological changes created by particular pollutant is likely to be characteristic of that pollutant. Thus by observing the effects of pollutants on a set of physiological parameters, it might be possible to establish specific responses of that pollutant and may make it possible to identify a pollutant on the basis of its physiological effect pattern [2].

The information on cobalt as a heavy metal pollutant has been studied by Wallace *et al.* [3]. The present investigation was carried out to evaluate the hazardous effects of this heavy metal cobalt on the mineral content of *Vigna mungo* (L.) Hepper.

MATERIALS AND METHODS

The seeds of blackgram (*Vigna mungo* (L.) Hepper var. ADT-3) were obtained from Pulses Division, Tamil Nadu Rice Research Institute, Tamil Nadu Agricultural University, Tamil Nadu. The seeds with uniform size, colour and weight were chosen for experimental purpose and sown in pots containing 3 kg air dried soil each. The inner surface of pots were lined with a polythene sheet. The experiment was conducted in completely randomized block design (CRBD) method in pots. Plants were grown in untreated soil (control) and in soil to which cobalt had been applied (50, 100, 150, 200 and 250 mg/kg soil). The cobalt as finely powdered cobalt chloride ($CoCl_2$) was applied to the surface soil and thoroughly mixed with soil. Ten seeds were sown in each pot. All the 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.

Corresponding Author: Dr. C.A. Jaleel, DMJM International (AECOM Middle East Ltd.), Consultant of Gardens Sector Projects, Alain Municipality and Eastern Emirates, P.O Box 1419, Al-Ain, Abu Dhabi, United Arab Emirates

Table 1: Effect of cobalt on mineral content of *Vigna mungo* (L.) Hepper (30 DAS)

Cobalt added in the soil (mg kg^{-1})	N	P	K	Cu	Fe	Mn	Zn
	mg g^{-1} dry weight			µg g^{-1} dry weight			
Control	46	36	22	19	185	55	33
50	48 (+ 4.347)	3.7 (+ 2.777)	23.5 (+ 6.818)	21 (+ 10.52)	200 (+ 8.108)	60 (+ 9.090)	35 (+ 6.060)
100	45.1 (-1.956)	3.5 (-2.779)	21 (-4.545)	18 (-5.263)	182 (-1.621)	54 (-1.818)	32 (-3.030)
150	41.6 (-9.565)	3.1 (-13.88)	19.7 (-10.45)	17 (-10.52)	151 (-18.37)	45 (-18.18)	27 (-18.18)
200	38.2 (-16.95)	2.6 (-27.27)	17.4 (-20.90)	12 (-36.84)	118 (-36.21)	37 (-32.32)	21 (-36.36)
250	35 (-23.91)	2.3 (-36.11)	13.8 (-37.27)	11 (-42.10)	92 (-50.27)	30 (-45.45)	19 (-42.42)

(Per cent over control values are given in parentheses)   Average of five replications

The mineral content such as nitrogen, phosphorus, potassium, copper, iron, manganese and zinc contents of leaves analysed on 30^{th} days after sowing (DAS). The nitrogen content of leaves were estimated by the following method of Peach and Tracey [4], phosphorus [5], quoted by Yoshida *et al.* [6], potassium [7], copper, iron, manganese and zinc [8].

RESULTS AND DISCUSSION

The results of effect of cobalt on mineral contents of the blackgram plants under cobalt stress are given in Table 1. The highest value of mineral content such as nitrogen (48 mg g^{-1} dry wt.), phosphorus (3.7 mg g^{-1} dry wt.), potassium (23.5 mg g^{-1} dry wt.), copper (21 µg g^{-1} dry wt.), iron (200 µg g^{-1} dry wt.), manganese (60 µg g^{-1} dry wt.) and zinc (35 µg g^{-1} dry wt.) content were observed in soil mixed with 50 mg/kg of cobalt.

The increase in cobalt concentration in the soil decreased the mineral content of *V. mungo* over control. Cobalt treatment at 50 mg/kg soil level proved to be favourable for the mineral content of blackgram. Further increase in cobalt concentration in the soil (100-250 mg/kg) decreased the mineral content of *V. mungo* over control.

Our results showed a progressive decline in nitrogen content with increase in cobalt level in blackgram plants. The reduction in nitrogen content under cobalt treatment was comparable with the previous results of Rother *et al.* [9].

The uptake of nitrogen from soil is also inhibited by the presence of heavy metals [10]. Phosphorus content of leaves of blackgram plants decreased with an increase in the cobalt content (except 50 mg/kg) in the soil. This is in accordance with the earlier reports of Walker *et al.* [11] in soybean. The reduce absorption and accumulation of potassium [12]. Potassium is one of the essential macronutrients, absorbed through the roots and generally transported to shoot through the xylem and this transport seems to be controlled by the short growth [13].

Increase in the cobalt content of soil significantly decreased the copper content of leaves of blackgram. Similar decrease in copper content with concomitant increase with heavy metals were also reported by Khan and Frankland [14]. The decrease in the copper content was parallel with the decrease in nitrogen and potassium. The strong binding of copper by nitrogen ligands may be involved in the relationship of copper and nitrogen movement out of the leaves [15].

Iron content of root and shoot of blackgram plants decreased with increase in cobalt content in the soil. These results are in agreement with the results of various metal treatments such as aluminium [16] and cobalt [17] in different plants. Inhibition of manganese is similar to the findings of Moral *et al.* [10] cadmium. Increased cobalt content of the soil (except 50 mg/kg) significantly decreased the cobalt content of blackgram leaves. Similar decrease in zinc content was noticed in various metals by several authors [18] in cadmium, [19] in lead and [2] in nickel.

From the results of this investigation, it can be concluded that, the application of cobalt @ 50 mg kg^{-1} may prove to be a useful tool in increasing the mineral constituent contents in blackgram plants, which in turn might enhance the growth and yield of plants.

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