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NOTE

Effects of Cobalt on Some Physiological Parameters of Common Bean (*Phaselous vulgaris* L.)

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A greenhouse experiment was carried out in an alkaline soil to study effects of cobalt on the nitrogen-reductase activity, total chlorophyll, nitrogen and cobalt contents of bean plant. The results showed that nitrogen-reductase enzyme activity increased at higher cobalt applications comparing to the control. Total chlorophyll content of the plants was affected by cobalt treatments statistically. As cobalt concentrations increased, total chlorophyll content of the plants decreased below the control. Dry weights of plants indicated that growth was increased at low cobalt concentrations, while was decreased as cobalt concentrations increased. Nitrogen content of the plants increased at 0.10 μg g^{1} cobalt treatment and then decreased with the increasing applications.

Key Words: Cobalt, Nitrogen-reductase activity, Chlorophyll, Bean, Nitrogen.

Cobalt is a trace element that is essential in both human and animal nutrition and plant growth although it is required in a very small amount[1,2]. Depending on the concentration and status of cobalt in rhizosphere and soil, cobalt affects growth and metabolism of plants, in different degrees[2,3]. The beneficial effects of cobalt include retardation of senescence of leaf, increase in drought resistance in seeds, regulation of alkaloid accumulation in medicinal plants and inhibition of ethylene biosynthesis[4]. Legumes exhibit nitrogen deficiency symptoms in case of cobalt deficiency due to inhibition of the formation of leghaemoglobin[3,5]. Legumes contain larger amounts of cobalt than grasses and cereals[3]. Phaseolus bean or common bean (*Phaseolus vulgaris* L.) is one of the most widely cultivated legumes in the world. Regarding to consumption, grain legumes are common food throughout the world.

In this study, it is aimed to investigate influence of cobalt on nitrogen-reductase activity, total chlorophyll content and, nitrogen and cobalt contents of bean plant (*Phaselous vulgaris* L.) after cobalt treatment of an alkaline soil.

Bean (*Phaselous vulgaris* L.) plants (*Strike variety*) were grown in pots filled with 1.6 kg loamy soil in a greenhouse under natural lights. Seeds were sown at a rate of three per pot and thinned to two after emergence. A basal dose of N, P, K was mixed

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thoroughly into the soil at 40, 40 and 50 mg kg^{-1}, respectively before sowing. Cobalt was applied to the soil samples at the rates of 0, 0.05, 0.1,0.25, 0.50 and 1.0 µg g^{-1} as a solution of cobalt chloride. Total-nitrogen for soil was performed according to Kjeldahl method[6]. Total cobalt of the plants were determined using by ICP-MS. Chlorophyll content was estimated according to Withan *et al.*[7]. Nitrate reductase activity was determined in plant materials sampled after 28 d transplanting[8]. In the experiment four treatments with 3 replications were compared in a completely randomized factorial design. The obtained data were evaulated statistically using MSTAT computer program.

Both organic matter content (0.93 %) and nitrogen content (0.08 %) of the soil sample was very low. Soil pH (8.30) was alkaline. Alkaline soil is relatively rich in available cobalt comparing to acid soil.Total and soluble cobalt content were 13.4 and 1.14 mg kg^{-1}, respectively. Soils containing less than 5 mg kg^{-1} of total cobalt are considered deficit and cannot supply plants with the quantities of cobalt required to animals[9].

Phenologic observations showed that applied cobalt concentrations had neither injurious nor depressing effect on the growing plants. It has been proposed that phytotoxicity of cobalt results in chlorosis, necrosis and root tip damage are typical of iron deficiency[2]. he effects of all cobalt treatments on the plant parameters, are shown in Table-1. The results showed that nitrogen-reductase enzyme activity increased at higher cobalt applications comparing to the control ($p < 0.05$).The highest value was 0.1670 mmol g^{-1} at 0.1 µg g^{-1} cobalt application. At low concentration of cobalt (0.05 µg g^{-1}) did not cause statistically significant changes in nitrogen-reductase activity. This can be attributed to adsorption of cobalt by soil fractions.

Regarding to total nitrogen content of the plants (Table-1) there were statistically significant ($p < 0.05$) differences among cobalt treatments. Nitrogen content of the plants increased up to 0.1 ug g^{-1} cobalt treatment and then decreased with the increasing

TABLE-1
EFFECTS OF COBALT TREATMENTS ON NITROGEN-REDUCTASE ENZYME ACTIVITY, TOTAL CHLOROPHYLL CONTENT, COBALT CONTENT, NITROGEN CONTENT AND DRY MATTER CONTENT OF PLANTS

Cobalt treatment (µg g^{-1})	Nitrate-reductase (mmol g^{-1}, fresh weight)	Total chlorophyll (mg g^{-1}, fresh weight)	Cobalt content (µg g^{-1}, dry weight)	Total nitrogen (%)	Dry weight (g pot^{-1})
0.00	0.0798 c	0.1952 b	6.60 d	25.23 cd	2.161 d
0.05	0.0697 c	0.2045 a	7.62 c	28.57 b	3.114 b
0.10	0.1670 a	0.1964 b	10.30 a	31.90 a	3.636 a
0.25	0.1662 a	0.1723 c	8.67 b	27.23 bc	3.030 bc
0.50	0.1467 ab	0.1336 d	8.11 b	28.90 b	2.846 c
1.00	0.1332 b	0.0762 e	6.20 d	23.90 d	2.272 d
LSD*	0.0283	0.075	0.497	2.497	0.242
Mean	0.1271	0.1630	7.92	27.62	2.84

LSD* = Least significant difference at $p < 0.05$.

applications. Total chlorophyll content (Table-1) of the plants was effected by cobalt treatments ($p < 0.05$). The highest value (0.2045 mg g^{-1}) was obtained for 0.05 μg g^{-1} cobalt application. Increasing cobalt concentrations decreased total chlorophyll content of the plants below the control.

Dry weights of plants indicated that growth was increased first and than decreased as cobalt concentrations increased (Table-1). The highest yield 3.636 g pot^{-1} was obtained at 0.1 cobalt treatment. The cobalt concentration in the dry weight of plants grown in soil usually lies[10] between 0.02-0.5 mg kg^{-1}.

Although there was no cobalt deficiency in the examined soil, statistically significant effects of cobalt treatments on plant parameters were determined. This effect was more pronounced for plants grown at 0.10 μg g^{-1} cobalt concentration. Cobalt content of the plants increased at 0.10 mg g^{-1} cobalt application with the highest value (10.3 μg g^{-1}) and then decreased to the below control. Since cobalt part of vitamin B_{12}, people who are deficient in vitamin B_{12} would be deficient in cobalt. It is clear that it has to be taken by people although there are no recommended daily intake levels for cobalt. Elinder *et al.*[11] stated that the absorption of cobalt from food is around 30-40 %. However, Yamagata *et al.*[12] stated that foods of vegetable origin represent 88 % of the whole intake of dietary cobalt. It is well known that the deficiency of cobalt may affect anemia and anorexia. All these informations show that cobalt is a valuble micro element both for plant and human nutrition. Therefore, it is important to know the cobalt content of the foods in countries which their nutrition are based on vegetable.

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