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Nickel and Cobalt Effects on Mize Grmination

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Abstract. This research was conducted to determine the effects of excess nickel and cobalt on germination in maize genotypes. For this aim, concentrations were selected as 0(control), 80, 160 mg/L Ni and 0 (control), 125, 250 mg/L Co in the germination stage. It has found that cobalt and nickel have significant effects on germination.
The germination was found increased significantly under low level of cobalt and nickel with decreased in germination. However, the germination percentage of maize seeds showed a significant difference with cobalt and nickel treatment.

Keywords: germination, maize, nickel, cobalt, effects.

1. Introduction

Heavy metals are naturally present in the environment. Their existence, however, has gradually been increasing with the increase of industrialization. Cobalt (Co), Nickel (Ni), cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) are among the most abundant heavy metals in the agricultural soils [1]. Actually, plants may suffer from excess nickel in the agricultural soil and we can observe toxicity symptomps on vegatative tissues [2]. However in the modern world, numerous soil pollutants restrict the growth of plants. With the ongoing technological advancements in industrialization and urbanization process, release of toxic contaminants like heavy metals in the natural resources has become serious problem worldwide [3]. Metal toxicity affects growth of plant. Metals and chemicals in higher concentration hamper the plant germination, growth and production mainly associated with the physiological and genetic elements of the plants system [3]. The major effects of heavy metals on seeds are manifested by overall abnormalities and decrease in germination, reducer root and shoot elongation, dry weight . Low levels of Ni can contribute to growth of some plants species but its reason is not known. Possible beneficial effects of Ni on plant growth are poorly defined and not understood [4].Some researchers have determined that the nickel is essential for activation of urease, an enzyme involved with nitrogen metabolism that is required to process urea. Possibly urease and, therefore, Ni might be required for the mobilization of stored seed-nitrogen through ureides or arginin during early stage of seedling growth [5; 6].

Co is an essential transition element and it has been also shown to affect growth and metabolism of plants [7]. Cobalt is probably beneficial for plants meaning that the adequate supply might be necessary to maintain a high production [8]. In this research we have investigated to the effect of different concentrations of Nickel and cobalt on maize seeds germination.

2. Material and Method

Firstly, maize seeds were sterilized in %5 sodium hypoclorid solution. Then, they are washed 3 times with distilled water. For germination, maize seeds were put into both folded paper towels in 9 cm diameters petri dishes.

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The effects of nickel on the germination of maize seeds were investigated using three different concentrations for Ni and cobalt metals. In this study, nickel solutions were prepared with distile water that contains 80 and 160 mg/L Ni (NiCl2,6H20) and also Co solutions were prepared with distill water that contains 125 and 250 mg/L.5 ml of these solutions was poured on the seeds twice every day. As explained above, maize seeds were treated with nickel solutions in the following concentrations: 0 (control) mg/l, 80 mg/l, 160 mg/l for Nickel(Ni) , 0 (control) mg/l, 125 mg/l, 250 mg/l for Cobalt (Co) groups were treated with 5 ml distilated water. After the treatments, germination were measured. All treatments were made in three replications. All seeds were germinated in incubator at 20 ℃ temperature and in the dark . 3 maize genotypes (Zea mays L. Pol 710,31Y43 and Cadız) were selected for the study because it is among the most important crop for humans and animal consumption in Turkey. The numbers of germinated seeds were counted after 14 days of treatment. Collected data was analysed by using analysis of variance (ANOVA) procedure and the significant means were separated with the Duncan's multiple range tests using SAS [9].

3. Results and Discussions

3.1. Ni Treatment

The effects of the concentrations of Nickel (Ni) on seed germination index of maize genotypes were presented in Table 1 and Fig. 1. Results showed significant differences for this trait among the genotypes.

When we take a look on its (for 80 mg/l) effect on the germination index, we observe a positive result. Furthermore, the treatment of 160 mg/l Nickel leads to positive effects on the germination index just for Cadiz genotype. But in the treatment of 160 mg\l Nickel lead to negative effects on the germination index for the other genotypes. Based on the results of the analysis with increasing concentration of Ni from 80 to 160 mg\ l was declined. It have been reported that germination reduced in the presence of nickel and cobalt [10,11].

Table 1: According to genotype germination index findings for different concentrations Ni and Co.

For Ni			For Co	
Genotype	Amount mg\l	Germination Index(%)	Amount mg\l	Germination Index
Cadız	0	6.263	0	6.260
31y43	0	4.353	0	4.352
pol710	0	5.400	0	5.410
Cadız	80	7.370	125	3.96
31y43	80	5.400	125	4.14
pol710	80	6.860	125	4.257
Cadız	160	28.210	250	3.56
31y43	160	3.780	250	5.49
pol710	160	4.380	250	4.12

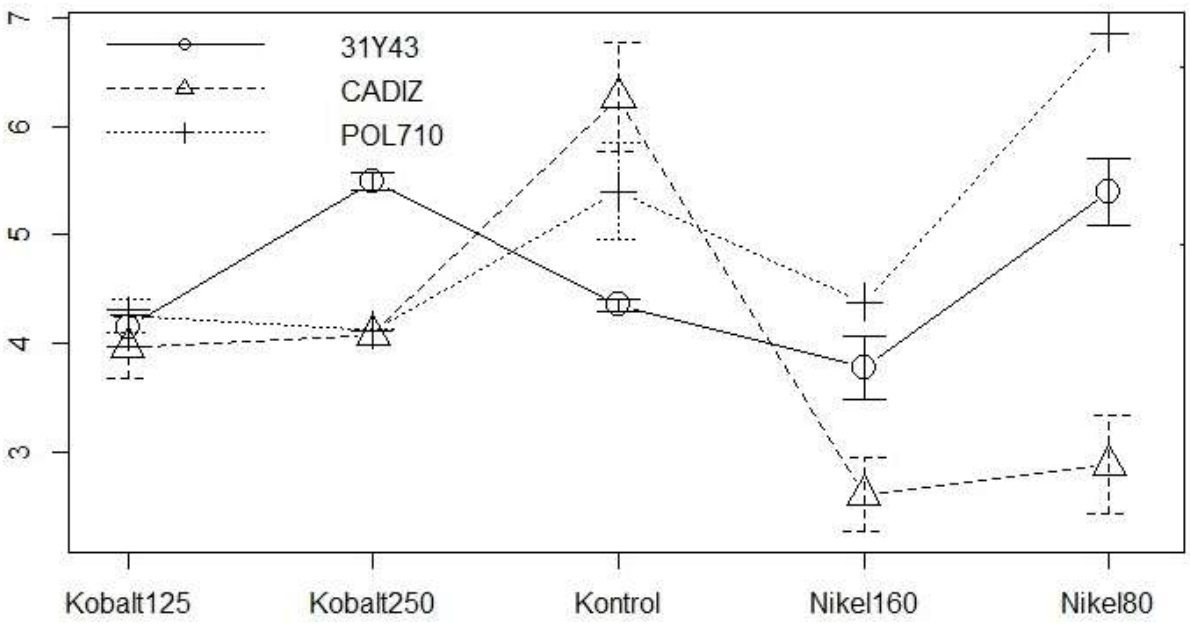

Fig. 1: The influence of Ni and Co ,in different concentrations on maize seeds germination.

3.2. Co treatment

The effects of the concentrations of Cobalt (Co) on seed germination index of maize genotypes were presented in Table 1 and Fig. 1. Results showed significant differences for this trait among the genotypes.

The effects of the concentrations of cobalt on germination index are also negative. When we take a look on its effect on the germination index, we observe a negative effect for 2 types (Cadiz and Pol710). However it leads to a very high increase in the germination index of the 31y43.

Some researchers observed a decrease of seed germination of cultivated plants, as result of heavy metals presence in rain water [10,11]. We have observed similar observations as compared with control in our research. Results of the findings can be useful indicator of Nickel and cobalt tolerance to some extend for plantation of this species in metal contaminated area.

4. Conclusion

The decrease in seed germination of maize (Zea mays L.) can be attributed to the accelerated breakdown of stored food material in seed by the application of Nickel [6; 12].

Similar observations in crops had been observed by Barcel ó and Poschenrieder [13].

Our results can be useful indicator of metal tolerance to some extent for plantation of this species in metal contaminated area.

How fairly low amounts of Nickel and Cobalt absorbed over many years could lead to extinction of such an important maize species is unknown.

5. References

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