The Effect of Bacterial Inoculation and Chemical Fertilizers on Zinc Availability

Mowaffaq Yonis Sultan

Dept. of Soil & Water Sciences, College of Agriculture and Forestry, University of Mosul, Mosul, IRAQ

ABSTRACT

An experiment was conducted on a field of the Department of Soil & Water Sciences at the College of Agriculture and Forestry (Calciorthid) to study the effect of biofertilizer, N and P fertilizers, and to determine the effect of *Rhizobium leguminosarum* (mixture of three rhizobial strains: Le_{719}, Le_{726} and Le_{735}) on Zn availability.

The experiment was conducted using a randomized complete block design (RCBD) that included three P levels (0, 40, 80 kg P/H) as superphosphate, three N fertilizer levels (0, 40, 80 kg N/H) added as urea (46%N) and two levels of inoculation (inoculated with rhizobial bacteria and not inoculated). Potassium was added to all treatments at a rate of 10 kg K/H. The total number of experimental units was 54.

Soil and plant samples were taken at three interval times: 75, 105, and 134 days after seeding for determining Zn and its uptake by lentil plants.

The results showed the ability of the studied rhizobial strains to increase Zn availability and Zn uptake by lentil plants.

INTRODUCTION

A way to increase food production without damaging the environment is to grow legumes. One of them is lentil, which is a cheap source of high-quality protein. It provides carbohydrates, B vitamins and fiber, and is useful for gluten-free or diabetic diets. Information regarding the requirements of lentils for primary nutrients is abundant, but research on micronutrients is scarce. Zinc availability as affected by bacterial inoculation and N, P, K levels and the interaction among them. Zinc availability can influence lentil production on a calcareous soil with marginal yields.

Zinc availability in calcareous soils is limited due to high pH (>7.0), high free calcium carbonate and low organic matter content, and the interrelationships with other elements (Steven and Mesbah 2004). Excess P additions induce Zinc deficiency. Foliar applications are recommended sometimes to improve the efficiency of Zn assimilation (Stevens et al. 2004). The objective of our research was to highlight the effect of different P levels and bacterial inoculation on Zn availability.

METHODS

The experiment was conducted in Mosul city, Iraq on a silty loam using a RCBD that combined the inoculation with *R. leguminosarum* with and without N-P-K fertilizer application including three P levels (0, 40, 80 kg P/H) as superphosphate, three N fertilizer levels (0, 40, 80 kg N/H) added as urea (46%N) and two levels of inoculation (inoculated with rhizobial bacteria and not inoculated). Potassium was added to all treatments at a rate of 10 kg K/H. The total number of experimental units was 54. Soil and plant samples were taken at three interval times 75, 105, and 134 days after seeding for determining Zn and lentil yield.

RESULTS AND DISCUSSION

Rhizobial bacteria significantly affected Zn availability and its uptake by lentil compared to the un-inoculated control. The inoculation effects were more pronounced in the presence of fertilizers. The N application decreased Zn availability while P treatments increased it. The treatment $B_1N_2P_2$ gave the highest available Zn concentrations.

Table 1. The effect of *R. leguminosarum*, N and P fertilizers and interval times on Zn availability.

Treat.	(Zn ppm) in soil			(Zn ppm) in plant		
	75 days	105 days	134 days	75 days	105 days	134 days
	Mean	Mean	Mean	Mean	Mean	Mean
$B_0N_O P_0$	1.25	1.13	1.12	67.9	242.7	100.8
$B_0N_0 P_1$	1.32	1.16	1.17	73.9	283.6	124.6
$B_0N_0 P_2$	1.34	1.27	1.20	72.3	238.0	142.9
$B_0N_1 P_0$	1.11	1.01	1.13	74.0	270.9	125.7
$B_0N_1 P_1$	1.33	1.16	1.13	84.2	238.9	142.2
$B_0N_1 P_2$	1.39	1.12	1.17	100.6	200.0	118.4
$B_0N_2 P_0$	1.01	1.01	1.08	69.3	235.0	137.3
$B_0N_2 P_1$	1.24	1.00	1.09	75.6	326.7	120.2
$B_0N_2 P_2$	1.31	1.12	1.28	124.3	218.7	143.6
$B_1N_O P_0$	1.45	1.24	1.24	88.7	145.3	107.3
$B_1N_O P_1$	1.67	1.47	1.45	100.0	175.4	123.4
$B_1N_O P_2$	1.72	1.50	1.48	89.5	166.8	125.1
$B_1N_1 P_0$	1.71	1.29	1.59	90.7	182.1	115.4
$B_1N_1 P_1$	1.67	1.10	1.39	94.7	173.9	121.0
$B_1N_1 P_2$	1.47	1.12	1.63	107.2	164.1	122.5
$B_1N_2 P_0$	1.32	1.20	1.27	79.8	159.5	110.0
$B_1N_2 P_1$	1.16	1.28	1.52	103.1	168.7	86.7
$B_1N_2 P_2$	1.28	1.37	1.87	105.8	179.8	125.0

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