EFFECT OF BIOFERTILIZER AND CHEMICAL FERTILIZERS ON IRON AVAILABILITY AND YIELD OF LENTIL

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ABSTRACT

Field experiment was conducted in the research farm of soil & water sciences department, College of Agriculture and Forestry, to study the effects of biofertilizer (mixture of three rhizobial strains of *R. Leguminosarum* Le_{719}, Le_{726} and Le_{735}), N (0, 40, and 80 kg N/ha) and P(0, 40, and 80 kg P/ha) fertilizers on the availability of Iron in soil (Calciorthid) and on the yield of Lentil (*Lens culinaris)*.

The results showed that rhizobial strains used increased the availability of Iron in soil and seed yield of Lentil.

Introduction

Lentil (Lens culinanis)was known in Turkey, Syria and Iraq before about 8000 years (Cubero, 1981), and became an important crops that contribute to human and animal feed without a deterioration of the environment and soil, which contains a high proportion of protein 26 - 22%, and it is a cheap and alternative source of meat in countries where the meat is not available and the prices are high (Whitehead et al, 1998) Furthermore its remnants are a repository of nitrogen, carbon and other nutritional elements. The agricultural development requires an optimal effectiveness of soil micro-organisms to supply plant with some necessary elements as source of alternative and environmentally safe and cheap compared to chemical fertilizers. Halder, et al (1990) found that some bacterial strains of Rhizobium play an important role in dissolving rock phosphate in soil. Sultan (2005) proved that (Rhizobium leguminosarum) applied to lentil has the ability to dissolve low solubility phosphrous compounds to supply plants with partially requirements of phosphorus. The feasibility of these bacteria in symbiotic nitrogen fixation to

Analysis	Value	Unit	Method	Reference

use of the activity and lentil fulfill needs around

80% of nitrogen (Saxena, 1988). Because of the little informations on the relationships among bacterial inoculation , phosphorus and micro-elements (Fe) this study was conducted to evaluate the interaction		**effects of three new Rhizobium strains (Le_{719} and Le_{726} and Le_{735}) with different levels of N and P on Fe availability in calcareous soil and on grain yield of Lentil plants.**

Material and Methods

Field experiment was conducted at College of Agriculture and Forestry (Calciorthid soil, Table l) in the 2004/2005 growing season to study the application of bio-chemical fertilizers on Iron availability and yield of lentil. The design of experiment was a randomized block design with three replication ,and the plot size was (2 × 1 m). Sowing was in 15/1/2004. The experiment involved three levels of nitrogen fertilizer (0, 40, and 80 kg N/H) added as urea, and five levels of phosphorus [(0, 40, and 80 kg P/H) as super phosphate		**beside two levels of rock phosphate (40 and 80 kg P/H)]. K was added to all treatments at a rate of 10 kg K/H as K_2SO_4. All the combinations of fertilizers above was splitted into inoculated by a mixture of the three rhizobial strains *R.leguminosarum* (Le_{719}, Le_{726}, and Le_{735}), and not inoculated. Two irrigation were applied to the crop depending upon the climatic condition. Samples of soil were taken at three interval times 75, 105, and 134 days after sowing and analyzed for Fe. At harvest time grain yields of Lentil plants were recorded.**

	Calciorthid			
ECe	1.03	$ds.m^{-1}$	EC- meter	Richards 1954
pH	7.8	–	paste saturate PH –meter	Mckeague 1982
CEC	25.1	$C.mole^{-}.kg^{-1}$	Na acetate NH_4^+ acetate	Richards 1954
O.M.	18.2	$gr.kg^{-1}$ soil	Walkley	1974،FAO
$CaCo_3$	345	-	Titration	
Soluble Ions				
Ca^{+2}	3.28	$C.mole^{-}.kg^{-1}$	EDTA	Richards 1954
Mg^{+2}	0.35			
K^+	0.26		Flamephotometer	
Na^+	0.21			
N	13.5	$mg.kg^{-1}$ soil	microkildal KCl	–
P	25.5		Modify Olsin Spectrophotometer	Page,1982
K	80		NH_4^+ acetate Flamephotometer	Black 1965
Fe	8.26	$mg.kg^{-1}$ soil	DTPA	Lindsay1978
texture	Clay Loam			
sand	399	$gr.kg^{-1}$ soil	Pipette	1965 Day
silt	304			
clay	296			
Total bacteria	1.58×10^8	$CFU.gr^{-1}$ soil	Standard plate tech.	1965 Black
Total fungi	2.15×10^4			

Table (1) Chemical and physical analysis of the field studied soil

Results and Discussion

1- Effect of the bacterial inoculation and chemical fertilizer on iron availability after 65 days of planting

The results in table (2) showed that the bacterial inoculation had no significant effect on Fe availability in soil after 65 days from planting date which gave a weak correlation (0.43) between inoculated and non-inoculated. A weak reducing in iron availability has been found, The reason for that could be related to the possibility of its consumption by the bacteria which is needed in nitrogen fixation leads iron to enter in the installation of Fe-protein enzyme and in the form of ferrodoxin or precipitated as un soluble ferric salts especially when bacteria attacking organic matter .		**Also we found addition of phosphorus led to a decline in iron availability. This decline might be relate to P which is an essential element in terms of energy-saving dose that needed for the revitalization of electrons transferred to the protein of bacteria. Highest concentration of iron was found in treatment (un-inoculation + 0 kg P/ha) and the lowest one was in treatment (un-inoculation +40 kg P/ha Addition of nitrogen caused an increase in iron availability, While the inoculated bacteria with nitrogen decreased the availability of Fe. Best treatment in Fe availability was (0P+80kg N.ha^{-1})**

Table (2) Effect of bacterial l Inoculation and Chemical Fertilizers on Availability of Iron (ppm Fe- 65 days) in Soil

	Nitrogen	phosphorous			N*Ino	Ino	N
		0	40	80			
Un Inoculation	0	8.27 ABC	8.40 ABC	8.93 A	8.53 A		
	40	7.60 ABC	7.87 ABC	8.00 ABC	7.82 AB		
	80	6.93 C	8.13 ABC	7.87 ABC	7.64 AB		
Inoculation	0	8.27 ABC	8.13 ABC	8.67 AB	8.36 AB		
	40	7.33 ABC	7.20 BC	8.13 ABC	7.56 B		
	80	7.87 ABC	7.60 ABC	8.27 ABC	7.9 AB		
P * Ino.	UnInoculation	7.60 A	8.13 A	8.27 A		8.00 A	
	Inoculation	7.82 A	7.64 A	8.35 A		7.94 A	
P * N	0	8.26 AB	8.27 AB	8.80 A			8.44 A
	40	7.47 B	7.53 B	8.07 AB			7.69 B
	80	7.40 B	7.87 AB	8.07 AB			7.78 B
P		7.70 A	7.89 A	8.31 A			

2- Effect of the bacterial inoculation and chemical fertilizer on iron availability after 135 days of planting

The inoculated treatments led to17.7% increase in the iron availability after 135 days of planting table (3). This increase indicates the ability of R eguminosarum in increasing iron availability, or to their iron absorption which lead to increased iron in the soil after damaging the bacteriods. No significant effects were noted in the iron availability in soil when phosphorus or nitrogen add without inoculation while with inoculation + 80 kgN.ha^{-1} treatment and + 80 kg P.ha^{-1} treatment led to significant increase in iron availability.

Table (3) Effect of the bacterial Inoculation and Chemical Fertilizers on Availability of Iron (ppm Fe -135 days) in Soil

	Nitrogen	phosphorous			N*Ino	Ino.	N
		0	40	80			
Un Inoculation	0	6.67 B	7.20 AB	6.67 B	6.84 C		
	40	6.93 B	7.60 AB	7.60 AB	7.38 BC		
	80	7.60 AB	6.80 B	7.47 AB	7.29 BC		
Inoculation	0	7.60 AB	7.40 AB	9.07 AB	8.36 AB		
	40	8.00 AB	8.10 AB	8.67 AB	8.27 AB		
	80	9.47 A	8.40 AB	8.27 AB	8.71 A		
P * Ino.	Un Inoculation	7.07 B	7.20 B	7.24 B		7.17 B	
	Inoculation	8.35 AB	8.31 AB	8.67 A		8.44 A	
P * N	0	7.13 A	7.80 A	7.87 A			7.60 A
	40	7.47 A	7.87 A	8.13 A			7.82 A
	80	8.53 A	7.60 A	7.87 A			8.00 A
P.		7.71 A	7.76 A	7.96 A			

3-Effect of the bacterial inoculation and chemical fertilizer on the grain yield

The bacterial inoculation had a significant effect at on grain yields (table 4). The inoculation treatment obtain 1270 kg.ha^{-1} while the un inoculation recorded 1187 kg.ha^{-1} that indicates the ability of bacteria in increasing the production of grain., application of nitrogen increase grain yields which were recorded

1248, 1351kg.ha^{-1} from 40 ,80 kgN.ha^{-1} respectively. also phosphorus application had a significant effect on grain yields. The best treatment (1515 kgN.ha^{-1}) was obtained from the interaction (inoculated with rhizobia + 80 kg P/H + 80 kg N/H+ 10 kg K/H) . A similar result and explanation has been reported by (sultan,2005).

Table (4) Effect of bacterial inoculation and chemical fertilizers on Lentil yield kg.ha^{-1}

	Nitrogen	phosphorous			N*ino.	Ino.	N
		0	40	80			
Uninoculation	0	929 d	1081bcd	1141bcd	1050b		
	40	1123b-d	1231a-d	1248a-d	1200bc		
	80	1249a-d	1311abc	1355abc	1305ab		
Inoculation	0	945d	1114bcd	1194bcd	1084cd		
	40	1205a-d	1336abc	1365abc	1302 ab		
	80	1300abc	1381a	1515a	1398a		
P*Ino.	Unino.	1100c	1207abc	1254abc		1187b	
	Ino.	1150bc	1277ab	1358a		1270a	
P*N	0	934d	1097cd	1172bc			1068b
	40	1164bc	1283abc	1306abc			1248a
	80	1274abc	1346ab	1434a			1351a
p		1125c	1242ab	1305a			

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تأثير التسميد الحيوي والكيماوي في جاهزية الحديد وحاصل العدس

الخلاصة

نفذت تجربة حقلية عامليه بالتصميم العشوائي الكامل (RCBD) في حقول كلية الزراعة والغابات /جامعة الموصل (Calciothid) . لمعرفة قدرة ثلاث سلالات (Le_{719} وLe_{726} وLe_{735}) من بكتريا الرايزوبيا *Rhizobium Leguminosarum* مع التسميد الكيميائي في جاهزية الحديد وحاصل العدس (*Lens culinaris*) .عليه فقد تضمنت التجربة ثلاثة مستويات من الفسفور (صفر، 40، و80 كيلوغرام P / هكتار) من سماد السوبر فوسفات وثلاثة مستويات من النيتروجين (صفر، 40، و80 كيلوغرام N / هكتار) من اليوريا ومستويان من التلقيحِ البكتيري(نصف المعاملات ملقحة بخليط من السلالات السابقة وترك النصف الأخر بدون تلقيح) وبثلاثة مكررات لكل وحدة تجريبية. وقد أضيف البوتاسيوم بمعدل 10كغم/هكتار من كبريتات البوتاسيوم لجميع الوحدات التجريبية وبهذا أصبح عدد الوحدات التجريبية 54 وحدة . أظهرت النتائج قدرة هذه البكترية في زيادة جاهزية الحديد وحاصل العدس وأدى التسميد بالفسفور والنتروجين إلى زيادة معنوية في الحاصل وتم التوصل إلى حاصل أفضل في المعاملة (ملقحة بالرايزوبيا + 80كغم نتروجين + 80 فسفور/هكتار).