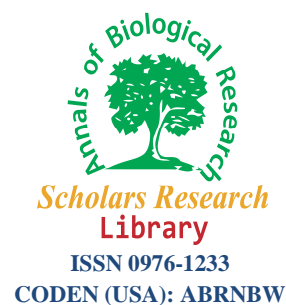




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## Effect of soil inoculation with Azospirillum and Azotobacter bacteria on nitrogen use efficiency and agronomic characteristics of corn

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### ABSTRACT

To reduce nitrogen fertilizer consumption in corn cultivation, a research was done in complete randomized block design as split plot with three replications in 2008 in Al-Ashtar region. Nitrogen Factor was in four levels including the recommended amount based on soil test (control), 25, 50 and 75% recommended amount as the main factor and soil inoculation with bacteria (Azospirillum and Azotobacter) including no inoculation (control) and inoculation with 1, 2 and 3Kg ha bacteria with soil was as the sub-factor. The results showed that application of the treatments has significantly different effect on the performance of corn seed as consuming 2kg ha bacteria produced the highest grain yield of 11.35ton ha . The effect of nitrogen fertilizer on yield was significant and the highest performance was achieved in treatment of total consumption of nitrogen based on soil test (control) of 10.4 ton ha was achieved. In addition, nitrogen application base on soil test and in inoculation of soil with 2 kg ha bacteria produced the highest number of grains per row, total number of grains per corn , the weight to 1000-grain, harvest index is produced that make increase of seed/grain yield.

**Keywords:** Corn; nitrogen fertilizer; yield; bacteria

### INTRODUCTION

Corn is the most powerful cultivation plant and the greatest attraction and storage of free energy in the earth and in terms of energy, it is a good food for live stock and it is full of energy and it is the main food of a great number of people as directly or indirectly via live stock and vegetable products and it has the highest position in comparison with other cereals. Due to this, it is called the lord of cereals [11]. Nitrogen as the most important vital elements of plant in quality and quantity production of cultivation products plays important role. On the other hand, the economical and environmental problems of unduly consumption of chemical nitrogen fertilizers and considering the main aspects of earth creatures and microorganisms caused that one of the most important and applied research fields in update scientific studies are attempts for biofertilizer [2]. Azotobacter and Azospirillum as fixing bacteria of nitrogen can freely fix molecular). nitrogen and be considered as biological fertilizer [15]. nitrogen fertilizers increase the performance of feed and its quality. The high dynamics of nitrogen in soil caused that its application and amount for the success in the performance of seed are of great importance [4]. Thus, achieving this goal is possible via applying good methods of consumption of nitrogen fertilizer during growth perid [14]. Melgar *et al.*, [9] stated that the best time to apply nitrogen fertilizer to maximum corn yield is in planting time and in addition at 25 days after sowing. Nitrogen deficiency in the early stages of growth (plant height 30 to 20 cm) has negatively

affected on the number of seeds per rows, increasing in nitrogen in the other stages cannot reparation this negative effect [5]. In order to achieve maximum 1000 seed weight and seed yield, Albronz *et al.*, [1] method of nitrogen application to a point near the plant offered. Karly [3] showed that these bacteria by synthetic growth hormones such as Indole Acetic Acid (IAA) causes increasing plant growth, seed germination percentage, rooting and root development. Now using of Azospirillum bacteria that can assistance with the roots of many plants of cereals family have been used and their role in nitrogen fixation process in plants has been reported.

Azospirillum is the main microorganism that is responsible for the fixation of molecular nitrogen (N<sub>2</sub>) in collaboration with corn grown in the field, is known [12]. Corn inoculating with Azospirillum may be provide 10 to 20 percent of nitrogen that is used for plant and with attention to the cultivation of this crop, annual will save millions of tons of nitrogen [17].

Considering the economical and environmental problems to achieve the stable agricultural goals, it is necessary to replace a part of nitrogen chemical fertilizers via biological fixation of nitrogen by inoculation of fixing microorganism namely, Azotobacter and Azospirillum and determine the share of nitrogen via chemical fertilizer. Considering the above items, this study was of laid out to investigate the effect of the application of Azotobacter and Azospirillum bacteria on the growth and performance of corn.

### MATERIALS AND METHODS

This experiment was done in Alshatr region of Lorestan in summer 2008 with 1580m altitude and about 33° N longitude and 48°, 17' E latitude. The annual precipitation is 525 mm and with the maximum temperature of 40<sup>0c</sup>. and minimum of -15 . This test was done as split plot in randomized complete block design in 3 replications. The size of each sub-plot was 18square meter including 4 rows with the distance of 75 cm and the length of 6m. The main factor of the consumption of nitrogen fertilizer based on the soil test: was included the recommended amount (control) and 25, 50, 75 % the recommended amount and sub-factor of soil inoculation with bacteria were included: without inoculation (control) and soil inoculation with 1, 2, 3 kg bacteria per hectare. After preparing the soil for plantation, the seeds were mixed with Azotobacter and Azospirillum bacteria At harvesting time, rows/ear, seeds/ear and 1000-seed weight were measured on 10 randomly selected ears of each subplot and seed yield base on 14 % humidity was measured in 7 square meter area in the middle of each sub plot to avoid border effects. Data was analyzed by MSTATC software and by Duncan test, the averages were compared.

**Table1: Soil characteristics of the experimental site**

Sand %	Silt %	Clay %	K (AV) p.p.m	P(AV) p.p.m	Total .N%	OC%	T.N.V%	PH of Paste
10	54	36						
Si. CL. L			370	7.8	0.85	0.93	35	7.8
Micro element (mg/kg)								
EC	Depth (CM)	B	Cu	Mn	Zn	Fe		
0.78	0-30	0.1	1.87	7.5	1.35	8		

### RESULTS AND DISSCUSSION

The results of variance analysis showed that the effect of nitrogen fertilizer and bacteria on all measured traits including the number of grains per row, total number of grains per corn, the weight of 1000-grain , grain yield and harvest index is significant. The highest number of grains per row (31.6) , grains per corn (461.2), 1000-grain weight (257.2 gr) grain yield (10.4 t/ha) and harvest index (36.158 %) were achieved in the recommended consumption treatment of nitrogen fertilizer based on soil test (control) the lowest number of grains per row (25.4), grains per corn (398.8), 1000-grain weight (226.3 gr), grain yield (7.750 t/ha) and harvest index(30.537 %) were related to the treatment of consuming 25% of nitrogen fertilizer recommended on soil test. The results is agreed with Donald (1998) , Liang (1996), Melgar (1997), Stevensun (1969) and Jokla (1989) findings. Also in treatment of soil inoculation with bacteria, the highest number of seeds per row (33.9), grains per ear (474.6), 1000-grain weight (268.4gr), grain yield (11.350 t/ha) and harvest index(37.885 %) were related to the soil inoculation treatment with 2kg per hectare bacteria and the lowest grains per row (30.9), grains per corn (455.4), 1000-grain weight (255.5 gr), grain yield (10.350 t/ha) and harvest index (34.811 %) was achieved in to control treatment (non-inoculation of soil with bacteria). Nitrogen as a microelement is from necessary needed elements for growing plants which lack of it make decrease of plants growing and also make some damages to yield elements and grain yield. consumption of

nitrogen by using of soil style base on soil test [14, 2, 5,1] and maybe by bacteria with plant root [18,8, 12, 3,15,13,10] improve the lack of this element and by increasing of corn growing and transpassing of photosynthesis materials from growing organs to produce ones (increasing of harvest index) improved the grain yield. The results of this experiment showed that the advantages of Azospirillum and Azotobacter inoculation to reduce nitrogen fertilizer are subsistence of production, increase in production, high income of farmers and less costs of consumption of nitrogen fertilizers.

Table2: mean square comparison results of nitrogen fertilizer and bacteria on some traits

Harvest index	Mean Square				treatment
	Grain yield(ton/ha)	1000-grain weight(g)	Grains/corn	grains/ row	
					<b>Nitrogen</b>
36.158a	10.400a	257.2a	461.2a	.31.64a	<b>N1</b>
35.668a	9.650b	248.3a	449.8b	30.21a	<b>N2</b>
32.427b	8.700c	234.6b	430.5c	28.11b	<b>N3</b>
30.537c	7.750d	226.3b	398.8d	25.46c	<b>N4</b>
					<b>Bacteria</b>
34.811b	10.350c	255.5b	455.4c	30.98b	<b>B1</b>
35.735b	10.800b	259.8b	461.7c	31.23a	<b>B2</b>
37.885a	11.350a	268.4a	474.6a	33.92a	<b>B3</b>
37.145a	10.150a	263.9a	470.9a	32.54a	<b>B4</b>

N: Nitrogen fertilizer consumption; N1: the recommended amount (control), N2: 75% the recommended amount, N3: 50% the recommended amount and N4: 25% the recommended amount. B: Bacteria; B1: non-inoculation (control), B2 to B4: 1, 2, and 3 kg bacteria per hectare, respectively.

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