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THE COMBINED EFFECT OF DIFFERENT NITROGENOUS FERTILIZERS AND INOCULAT ION WITH RHIZOBIUM ON FABA BEAN AND ITS QUALITY

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ABSTRACT

A field experiment was carried out in saline sandy clay soil of a private farm at village 7, Gelbana (Sahl El-Tena plain) during two successive winter seasons of 2006-2007 and 2007- 2008, to study the effect of different forms (ammonium nitrate (AN), ammonium sulfate (AS) and urea (U) at different rates (i.e., 70, 45 and 35 kg N/ fed) each alone and /or in combination with bio-fertilizer on faba bean productivity.

Results revealed that the applied fertilization treatments led to increase available macro and micronutrient soil contents. Such favored effect was reflected on plant nutrient contents, protein content, yield and its components and were significantly increased. In this connection, it could be deduced that urea fertilizer was of the highest effect, whereas AN was of least effect, while AS resulted in a moderate effect. Also, bio-fertilizer could partially substitute a considered portion of the mineral nitrogen. Since, bio-fertilization had been proved as an approach quite enough to improve plant quality, reduce the mineral nitrogen cost, as well as they are environmentally safe and eco-friendly.

INTRODUCTION

Due to the importance of fab bean as a food legume for a wide sector of the people in Egypt, high costs of the mineral nitrogenous fertilizers used in its fertilization and their hazardous effect on yield and ground water beside of the potential hazard on human health, bio-fertilizers were suggested as promising substitutes for the mineral ones (El-Ghandour and Galal, 1997, Mohamed and Gomaa, 2005 and Ali, 2007) .

Biological process of nitrogen fixation may occur symbiotically when soil micro-organisms are associated with plant root tissue (Ahmed and El-Abagy, 2007). The best –know example of symbiotic N_2- fixation is the relation between rhizobia and numbers of the legume roots, which carry on atmospheric nitrogen fixation through this relation. However, growing legume not automatically ensure a net addition of nitrogen to the soil. Many things can go wrong, i.e., growth conditions may be unfavorable, or the right strain of rizobium may not be present (Adam, 2004). The right rizobia strains are essential, since the indigenous rizobia are incapable for supporting adequate levels of N_2 (Anyango *et al.*, 1995).

Nitrogen fixation by the legume –*Rhizobium* symbiotic partnership represents an inexpensive alternative to the use of chemical nitrogen fertilizers in the production of food protein and oil, (Brock and Michael, 2003). Cordovilla *et al.* (1995) suggest that an exogenous supply of nitrate-N would improve the vegetative growth of *V. faba* plants by moderating the suppressive effect of salinity. Hamdi (1999) reported the *Rhizobium*-legume symbiosis is suggested to be the ideal solution to the improvement of soil fertility and the rehabilitation of arid lands and is an important direction for future research. The major N_2-fixing systems are the symbiotic systems, which can play a significant role in improving the fertility and productivity of low-N soils. The *Rhizobium*-legume symbioses have received most attention and have been examined extensively. Moawed *et al.* (2004) indicated that the improvement of faba bean production requires selection of effective Rhizobia strains. Rizk and Shafeek (2000) pointed out that rhizobial inoculation had increased total dry matter and N value of faba bean .Tejera *et al.* (2005) showed that the salt dose of 25 mM produced an increase of free amino acids content. Suggesting that these metabolites might be related with a nodule osmotic adjustment response under saline conditions however it cannot be excluded that the increase of amino acids content could be a consequence of protein degradation. Nabil and Talaat (2007) found that the application of bio-fertilizers is an acceptable approach for higher yield with good quality and safe for human consumption. Hanan *et al.* (2008) suggested that application of N- source had an effective and significant role in increasing yield quality, protein, oil, starch and sugars in maize plant. Shaban and Helmy (2006) revealed that soil pH and EC were decreased when nitrogen mineral fertilizer in combination with bio-fertilizer compared the use of both individually. In addition, soil pH and moisture are crucial for ultimate attachment and spread of the microbes (Burr *et al.*, 1978). Concerning the effect of mineral nitrogen fertilizer levels or bio-fertilization on soil salinity and salt distribution, the degrees of soil salinity were slightly affected (El-Fayoumy and Ramdan, 2002). Salama (2006) reported that the application of bio-fertilizers plus inorganic N- fertilizers increased the N, P and K contents (mg/plant) in whole parts of wheat and faba bean plants compared with un inoculated treatments.

The aim of the current work is to study the effect of bio-fertilizer in combination with different forms and rates of mineral nitrogen on the soil available N, P, K, Fe, Mn, Zn and Cu as well as their consequent concentrations in straw and seed of faba bean plants and their dry matter yields.

MATERIALS AND METHODS

A field experiment was carried out in asaline sandy clay soil of a private farm at village 7, Gelbana (Sahl El-Tena plain) during two successive winter seasons of 2006- 2007 and 2007- 2008, to study the effect of different forms and rates of mineral nitrogen sources in combination with bio-fertilizer on faba bean productivity grown on a saline sandy clay soil. The main physical and chemical properties of the studied soil are presented in Table (1)

The experiments included 9 treatments and laid out in spilt split plot design with three replicates for each treatment. The sources of N represented the main plots, while the rates of N application represented the sub plots and the two seasons represented sub sub plot. The three N mineral fertilizer sources were: Ammonium nitrate (33.5 % N); ammonium sulfate (20.5 % N) and urea (46 %). The corresponding nitrogen rates were 70, 45 and 35 kg N /fed. Application of nitrogen fertilizers was after 25, 40 and 55 days from sowing. The inoculation of faba bean seeds (*Vicia faba*, L.) was conducted at sowing by using an inoculums of the symbiotic N_2 – fixing salt tolerant *Rhizobium leguminosarum* strain (Biofertilizer Unit, Soils, Water and Environ. Res. Inst. (ARC), Giza, Egypt) through seed coating process using the Arabic gum solution as sticking agent. Plots with inoculated faba bean seeds were also, received the *Rhizobium* inoculum in the form of liquid culture three times at the periods of 30, 45 and 65 days from sowing. This process was conducted by dripping the liquid inoculums in adjacent to faba bean plants in rows as described by Shaban and Omer (2006). The experiment included the following treatments:

Table (1): Physical and chemical properties in of the experimental soil

Location	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Soil texture		OM (%)		CaCO$_3$ (%)
Village 7	10.58	66.37	7.44	15.61	Sandy Clay		0.59		12.73
	pH (1:2:5)	**EC (dS/m)**	**Cations (meq/l)**				**Anions (meq/l)**		
			Ca^{++}	**Mg^{++}**	**Na^{+}**	**K^{+}**	**HCO_3^{-}**	**Cl^{-}**	**SO_4^{--}**
	8.21	15.32	9.82	14.52	128	1.03	8.29	115	30.08
	Macronutrients (mg/kg)			**Micronutrients (mg/kg)**					
	N	**P**	**K**	**Fe**	**Mn**	**Zn**	**Cu**		
	45	5.80	176	3.47	2.90	1.08	0.16		

AN: Ammonium nitrate at a rate of 70 kg N/fed, AS: Ammonium sulfate at a rate of 70 kg N/fed and Urea: at a rate of 70kg N/fed.

AN: Ammonium nitrate at a rate of 45 kg N/fed in combination with *Rhizobium* inoculation; AS: Ammonium sulfate at a rate of 45 kg N/fed in combination with *Rhizobium* inoculation and Urea: at a rate of 45 kg N/fed in combination with *Rhizobium* inoculation. AN: Ammonium nitrate at a rate of 35 kg N/fed in combination with *Rhizobium* inoculation; AS: Ammonium sulfate at a rate of 35 kg N/fed in combination with *Rhizobium* inoculation and Urea: at a rate of 35 kg N/fed in combination with *Rhizobium* inoculation.

At harvest (95 days) , faba bean seeds and plants were sampled to determine seed and straw yields, 100-seed weight , plant macro and micronutrient contents (Chapman and Pratt, 1961 and Soltanpour, 1985).The remained soil after faba bean harvesting was sampled , pulverized , oven dried (105 ^oC), sieved at 2 ml size and then subjected to determine particle size distribution (Piper, 1950) , organic matter content and $CaCO_3$ (Black , 1965) , soil reaction (pH) suspension (1:2.5) and EC in soil paste (Jackson , 1967), Available phosphorous, Fe , Mn, Zn and Cu (Soltanpour, 1985), available potassium (Soltanpour and Schwab, 1977). Protein percentage in faba bean seeds was calculated by multiplying the nitrogen percentage by the converting factor 6.25 (Hymowizer *et al.*, (1972). The obtained data were statically analyzed according to Snedcore and Cochran (1979).

RESULTS AND DISUSSION

Effect of different used fertilization treatments on some properties of investigated soil:

Data presented in Table (2) revealed that soil pH values were insignificantly decreased due to the tested fertilization treatments. According to the effect of the applied nitrogen fertilizers on reducing soil pH, the following descending order could be noticed:

Urea > AS> AN. Such an order were occurred regardless applied rates of nitrogen fertilizers, yet it is worth to indicate that the application of bio-fertilizer in combination with nitrogen enhanced the reduction of soil pH values especially upon application of the combination of bio-fertilizer with 45 kg N/fed. Moreover, the applied treatments led to obviously a slight reduction of soil pH but in insignificant trend in both seasons.

The superior effect of urea on reducing soil pH is probably because of it hydrolyzes upon application of irrigation water and hence ammonia releases as shown by the following equation:

$$(NH_2)_2 CO + H_2O \text{ ------}\rightarrow 2NH_3 + CO_3$$

Carbon dioxide that dissolved in H_2O forming the carbonic acid, which causes soil pH to be reduced. However, upon the application of ammonium sulfate and/or ammonium nitrate, the reduction of soil pH can be attributed to the effect of nitrification process on changing the nitrogen from a basic (ammonium) form to an acidic (nitrate) form through the activity of the nitrifying bacteria in soil. Accordingly, the application of any of the studied nitrogenous forms resulted in acidifying effect and caused soil pH to be lower.

Also, significant differences could be detected among the studied fertilization treatments, which could be arranged in this concern similar to that stated of soil pH, i.e., urea > AS > AN. These results are agreement by Burr *et al.* (1978), El-Fayoumy and Ramdan (2002) and Shaban and Helmy (2006).

Data in Table (2) revealed that the soil electrical conductivity (EC) values were reduced as compared with the corresponding initial soil before cultivation. Increasing the rate of nitrogen was associated with significant reduction in EC values. EC values of the soil plots were significantly lower in second season than in first season. On the other hand the reduction in EC values is probably due to both the irrigation practice of faba bean plant, which resulted in leaching of readily soluble salts throughout successive irrigations. The application of mineral nitrogen sources may account for the most superior effect of urea on reducing EC than ammonium nitrate (AN) or ammonium salphate (AS) do. These results are in agreement with those stated by Shaban and Helmy (2006) and Nasf *et al.* (2004) who found that the application of N at different levels in combination with bio-fertilizer led to an increase in total porosity, improves soil aggregation and possible moving salt soil under irrigation water.

Data in Table (2) presented that due to the different fertilization treatments, all soil available macro-nutritive elements, i.e., N, P and K as well as the micro- ones, i.e., Fe, Mn, Zn, and Cu had increased as compared with their corresponding concentrations of initial soil samples before cultivation. There were insignificant differences among the effect of types and /or rates of the applied nitrogen fertilizer on N and Mn concentrations; however, significant effects could de noticed on the other studied nutritive elements. The increases in soil contents of the different nutrients are the final product of providing more favorable nutrients, i.e., reducing soil pH on one hand and decreasing soil salinity on the other. Season of cultivation affected significantly soil concentration of some studied nutritive elements except for N and Mn.

These results are in agreement with El-Fayoumy and Ramdan (2002) and Shaban and Helmy (2006).

Table (2): Soil reaction (pH), electric conductivity (EC), Macro and micronutrients content in soil after faba bean harvest in two seasons

Treatments	Rate of N kg/fed	pH (1:2.5)	EC (dS/m)	Macronutrient (mg/kg)			Micronutrient (mg/kg)			
				N	P	K	Fe	Mn	Zn	Cu
2007										
AN	70	8.10	12.57	61	6.74	189	4.59	3.69	1.14	0.28
AS		8.04	12.44	63	6.79	196	4.63	3.72	1.18	0.36
Urea		8.06	12.48	66	6.77	199	4.66	3.77	1.19	0.39
AN +Bio	35	8.07	11.86	67	7.83	201	5.04	3.85	1.17	0.32
AS+ Bio		8.02	11.74	72	7.89	208	5.09	3.88	1.20	0.39
Urea+ Bio		8.03	11.76	76	7.93	210	5.12	3.90	1.25	0.42
AN +Bio	45	7.98	11.32	69	7.88	209	5.07	3.94	1.22	0.33
AS+ Bio		7.92	11.20	75	7.92	214	5.11	3.96	1.28	0.42
Urea+ Bio		7.89	11.24	80	7.96	216	5.14	3.97	1.30	0.47
2008										
AN	70	8.05	11.74	68	6.89	200	4.66	3.74	1.18	0.35
AS		8.01	11.53	75	6.96	208	4.68	3.79	1.24	0.38
Urea		7.96	11.57	79	6.98	213	4.75	3.82	1.27	0.43
AN +Bio*	35	8.02	10.85	82	7.91	214	5.13	3.78	1.23	0.39
AS+ Bio		8.00	10.62	87	7.93	218	5.18	3.83	1.28	0.45
Urea+ Bio		7.98	10.73	90	7.98	217	5.21	3.86	1.32	0.48
AN +Bio	45	7.99	10.79	85	7.93	214	5.17	3.84	1.25	0.41
AS+ Bio		7.92	10.51	87	7.98	218	5.23	3.88	1.31	0.46
Urea+ Bio		7.89	10.47	93	7.99	220	5.26	3.93	1.34	0.49
LSD%5 Fertilizer		ns	0.19	ns	0.32	1.39	0.58	ns	0.09	0.015
LSD%5 N –Rate		2.59	0.21	ns	0.36	3.57	1.30	ns	0.10	0.018
LSD%5 Seasons		ns	0.42	ns	0.55	11.87	1.11	ns	0.16	0.036

*** Rhizobium inoculation.***

Effect of the different applied fertilization treatments on concentration of some nutritive elements in faba bean plant:

Data presented in Table (3) revealed that the concentration of the studied macro and micro-nutritive elements in faba bean straw and seed were positively due to the form of applied nitrogenous fertilizers, rate of their application and season of cultivation.

Generally the values of N, P, K, Fe, Mn, Zn and Cu concentrations of faba bean straw and seeds were significantly increased as affected by sources and rates of N combined with bio-fertilizer. Higher values of N, P , K, Fe , Mn , Zn and Cu concentrations for faba bean straw and seeds were achieved with the application of urea than the other forms of N. However, urea fertilizer resulted in the highest concentrations of the studied nutritive elements in straw and seeds of faba bean plant followed by those recorded due to AS and finally AN. Increasing rate of the applied N- fertilizers enhanced their effect on the studied elements. Likewise, the inoculation with *Rhizobium* as an additional led to a favorite effect on concentrations of these elements in straw and seeds of faba bean. Moreover, the effect of the nitrogenous fertilizers at a rate of only 45 kg N fed^{-1} combined with the bio-fertilizer surpassed the corresponding effect of the nitrogenous fertilizers at a rate of 70 kg N fed^{-1}. This means that the applied bio-fertilizer could compensate the decrease in rate of the applied nitrogenous fertilizers. In other words, application of the bio-fertilizer together with the mineral fertilizer at a rate of 45 kg N fed^{-1} is of a desired effect on increasing protein in seed as well as the nutritive elements in straw and seeds of faba bean and at the same time would be less expensive than application of mineral fertilizers solely at a rate of 70 kg N fed^{-1} . This is because at the highest rate of N 70 kg N fed^{-1} or other words when there is a sufficient content of readily available nitrogen in soil, *Rhizobium* will not fix much nitrogen. These results are in agreement with those of Salama (2006), Brock and Michael (2003) and Ali (2007). Accordingly, it can be deduced that bio-fertilizations together with mineral fertilizers (especially urea) would be of a positive significant effect on plant quality and cost of crop production. Also, such an approach will be important from the environmental point of view due to decreasing rate of the applied N, which may take its way to ground water and hence harm the human health.

Effect of the different applied fertilization treatments on faba bean yield and its components of faba bean:

Data presented in Table (4) revealed that the yield and yield components were significantly affected by bio-fertilization, form of the applied N fertilizers, their rate of application and season of cultivation. In this connection , weights of straw and seed per plant , weights of straw and seeds per fed and weight of 100- seed had positively responded to the aforementioned treatments in a positive significant trend . These results are in agreement with those of Carter *et al.* (1994) who pointed out that inoculation with *Rhizobium* as bio-fertilizer increased plant dry weight and N content in faba bean. The applied nitrogen fertilizers can be arranged according to their effect on faba bean yield and its components in the following descending order: urea > AS > AN. Also, bio-fertilization enhanced the effect of the studied nitrogen fertilizers at a rate of 45 Kg N fed^{-1} and could realize a higher seed yield and higher 100- seed weight than those achieved due to the sole application of the nitrogen fertilizers at the highest N rate, i.e., 70 kg N fed^{-1}. Similar results were reported by Nabil and Talaat (2007) and El-Wakeil and El-Sebai (2007) who stated that the application of bio-fertilizer is an acceptable approach for higher yield with good quality and higher safety for human consumption.

In conclusion, the present study is going to say that the use of biofertilizer with reduced nitrogen dose I faba bean cultivated in saline soil may enable faba bean to withstand the stress effect salt in soil. However, more studies should be conducted to understand and establish this phenomenon.

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التأثير المشترك للأسمدة النتروجنية المختلفة والتلقيح بالريزوبيا على محصول الفول البلدي وجودته

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اجري هذا البحث لدراسة إمكانية إحلال التسميد الحيوي جزئيا للأسمدة المعدنية والتحقيق هذا الهدف تم دراسة استجابة نبات الفول البلدي لإضافة ثلاث مصادر من الأسمدة النتروجنية وهى نترات الامونيوم وسلفات الامونيوم واليوريا بمعدلات مختلفة (٧٠، ٤٥ ، ٣٥ كجم نتروجين /فدان) سواء بمفردها أو مقترنة بالتسميد الحيوي (الريزوبيا) بتغطية البذور عند الزراعة بالإضافة إلى الصورة السائلة ثلاث مرات خلال موسمي النمو (٢٠٠٦/٢٠٠٧ و ٢٠٠٧/ ٢٠٠٨) . تم تلقيح بذور الفول البلدي بالريزوبيا وزراعتها بتربة رملية طينية القوام بقرية جلبانة ٧ (منطقة سهل الطينة) شمال سيناء فى تصميم Split Split Plot .

أوضحت نتائج الدراسة أنة باستخدام التسميد الحيوي إلى جانب عمليات الخدمة المناسبة انخفضت قيم pH التربة وملوحتها إلى جانب زيادة تيسر العناصر الكبرى والصغرى بصفة عامة. هذه التأثيرات المفضلة انعكست على التركيز الممتص من هذه العناصر الغذائية بالنبات.

أظهرت النتائج أيضا وجود زيادة معنوية في محصول الفول البلدي ومحتواة من العناصر الغذائية وبنسبة البروتين. وقد كان التسميد مع اليوريا أكثر تأثيرا مقارنة بكل من سلفات الامونيوم ونترات الامونيوم ، على الترتيب .

أثبتت هذه الدراسة أهمية إضافة التسميد الحيوي جزئيا بدلا من التسميد المعدني لما له من كفاءة في تحسين نوعية وإنتاجية المحصول وخفض تكاليف شراء الأسمدة المعدنية إلى جانب توافر الظروف البيئية الآمنة.

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Table (3): Macro- Micronutrients concentration in straw and seed in faba bean cultivated in 2006/ 2007 and 2007/ 2008 seasons as affected with different nitrogen fertilizer sources and *Rhizobium* inoculation

Treatments	N kg/fed	N (%)		P (%)		K (%)		Protein (%)	Fe (mgkg^{-1})		Mn (mgkg^{-1})		Zn (mgkg^{-1})		Cu (mgkg^{-1})	
2006/2007																
		Straw	**Seed**	**Straw**	**Seed**	**Straw**	**Seed**	**----**	**Straw**	**Seed**	**Straw**	**Seed**	**Straw**	**Seed**	**Straw**	**Seed**
AN	70	2.86	3.70	0.29	1.33	2.32	2.64	23.12	125	189	59.68	24.13	54.28	33.78	5.67	1.20
AS		2.88	3.79	0.31	1.38	2.44	2.66	23.69	129	195	60.23	25.01	54.34	39.21	5.80	1.25
Urea		2.93	3.84	0.38	1.42	2.47	2.71	24.00	134	199	60.47	25.07	55.10	40.19	5.87	1.29
AN +Bio*	35	3.07	3.91	0.33	1.38	2.40	2.67	24.44	130	194	60.25	26.12	54.38	40.12	6.43	1.22
AS+ Bio		3.10	3.89	0.39	1.45	2.49	2.70	24.31	136	204	60.75	26.33	55.06	40.23	6.49	1.28
Urea+ Bio		3.15	3.92	0.40	1.49	2.53	2.75	24.5	139	212	61.00	26.41	55.10	40.46	6.53	1.30
AN +Bio	45	3.12	3.94	0.42	1.47	2.44	2.72	24.62	134	1.99	60.84	26.77	54.97	40.19	5.89	1.25
AS+ Bio		3.17	3.97	0.44	1.52	2.49	2.76	24.81	139	214	61.15	27.00	55.14	40.33	6.55	1.29
Urea+ Bio		3.21	3.99	0.46	1.55	2.54	2.77	24.94	140	218	61.19	27.05	55.20	40.50	6.60	1.32
2007/2008																
AN	70	2.94	3.88	0.31	1.35	2.37	2.67	24.25	129	193	60.41	24.20	54.36	36.41	5.72	1.24
AS		2.98	3.92	0.34	1.41	2.48	2.69	24.50	132	198	60.52	25.14	54.40	41.03	5.88	1.29
Urea		3.04	3.94	0.40	1.45	2.50	2.74	24.56	137	205	60.55	25.23	55.14	41.15	6.48	1.33
AN +Bio	35	3.11	3.95	0.35	1.43	2.44	2.70	24.69	133	196	61.05	26.38	54.47	41.23	6.51	1.29
AS+ Bio		3.17	3.98	0.41	1.48	2.54	2.74	24.78	139	209	61.15	26.47	56.10	41.35	6.58	1.34
Urea+ Bio		3.19	4.02	0.44	1.53	2.55	2.81	25.13	141	204	61.10	26.79	56.12	41.39	6.05	1.37
AN +Bio	45	3.18	4.05	0.43	1.49	2.48	2.76	25.31	144	218	61.00	27.03	56.00	41.38	6.59	1.30
AS+ Bio		3.22	4.07	0.45	1.55	2.56	2.80	25.44	146	222	61.22	27.10	56.18	41.45	6.63	1.38
Urea+ Bio		3.26	4.09	0.47	1.58	2.58	2.82	25.56	150	227	61.26	27.14	56.22	41.49	6.66	1.40
LSD%5 Fertilizer		0.32	0.002	ns	ns	0.19	0.016	0.16	0.094	1.75	1.46	3.79	7.57	1.19	0.009	3.35
LSD% 5 N Rates		0.36	0.0021	ns	6.48	0.24	0.018	0.010	0.105	5.04	1.63	1.04	ns	1.33	0.010	ns
LSD%5 Season		0.55	0.0032	3.59	ns	0.16	0.028	0.016	0.160	0.83	2.50	ns	4.46	ns	0.016	ns

*** Bio : *Rhizobium* inoculation.**

Table (4): Yield and its components of Faba bean cultivated in 2006/ 2007 and 2007 /2008 seasons as affected by different nitrogen fertilizer sources and *Rhizobium* inoculation

Treatments	N kg/fed	Weight straw /plant (g)		Weight seed(g)/plant		Weight Straw (ton/fed)		Weight seed (ton /fed)		Weight 100seed (g)	
		Seasons									
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
AN	70	12.78	13.42	31.40	31.53	1.486	1.495	0.782	0.789	58	64
AS		15.17	16.04	37.12	40.27	1.570	1.588	0.794	0.798	66	72
Urea		15.37	16.10	41.20	41.32	1.589	1.597	0.804	0.809	73	78
AN +Bio*	35	14.38	15.22	36.18	40.42	1.649	1.660	0.794	0.801	62	69
AS+ Bio		15.47	16.19	40.23	40.43	1.942	1.955	0.802	0.809	77	83
Urea+ Bio		16.04	17.00	44.33	44.55	2.032	2.049	0.813	0.817	85	92
AN +Bio	45	14.41	15.66	43.29	43.47	1.734	1.748	0.799	0.803	76	89
AS+ Bio		15.50	16.24	44.17	44.22	1.975	1.987	0.812	0.819	88	97
Urea+ Bio		15.57	16.32	44.45	44.56	2.103	2.113	0.824	0.831	93	99
LSD%5 Fertilizer		0.32		0.21		0.32		ns		0.093	
LSD% 5 N Rates		0.36		0.23		0.56		ns		0.104	
LSD%5 Season		0.55		0.035		0.001		ns		0.159	

*** Bio : Rhizobium inoculation.**