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Effect of *Rhizobium* Inoculation Under Bio- And Mineral Fertilization and Their Interaction on Quality and Quantity of Soybean (Glycine Max L.)

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ABSTRACT

Two field experiments were conducted at Sids Agricultural Research Station, A.R.C., Beni Swif Governorate to study the response of soybean variety Giza.111 to rhizobium inoculation combined with bio-fertilizer under mineral fertilization of nitrogen, phosphorus and molybdenum and their interactions on growth (plant height and dry weight/plant) , yields (seed and straw) , nutrients concentration and uptake and protein and oil percentages and yields. Four replicates in randomized complete block design were used in both experiments with the four factors of study. Results showed that plant height, dry weight/plant , seeds and straw yields and concentrations of nitrogen, phosphorus and molybdenum and uptake in seeds and straw as well as protein percentage and protein and oil yields were positively affected by rhizobium inoculation and 60, 13.1and 5kg/fed nitrogen , phosphorus and molybdate sodium except N and K % in seeds and straw , P % in seeds and Mo% in straw not affected by nitrogen , bio- and molybdenum fertilization . Moreover , oil percentage in seeds did not respond to the studied factors . The dual inoculation surpassed the single inoculation . As for the interaction, the statistical analysis showed that the high level of nitrogen had a antagonistic action on the effective effect of bacterial inoculation . On the other hand , added phosphorus had a synergistic effect on enhancing the positive effects of both bacterial inoculation and molybdenum on soybean growth and yields . In general , the treatment of rhizobium +bio- inoculation + 30 + 13.1 + 5 kg/fed nitrogen , phosphorus and molybdate sodium gave the highest quality and quantity of soybean .

Keywords: Soybean, nitrogen, phosphorus, molybdenum, rhizobium, bio- fertilizer, growth, yield, nutrient contents, protein % and Oil %.

INTRODUCTION

Soybean (*Glycine max L.*) is the most important grain legume crop in the world in terms of total production and international trade . Soybean accounts for 30% of the worlds processed vegetable oil and also has been employed as a source for bio-diesel fuels (Graham and Vance , 2003) . Soybean seeds contain about 20% oil and 40% good quality protein (Hymowitz *et al* , 1998) . It also rich in certain essential amino acids , fat soluble vitamins as well as priced product like lecithin . Also , it contains 20.5% starch and rich in calcium , iron and vitamin B . In addition to its nutritional value , soybean is also used as an important dinitrogen (N_2) – fixing crop throughout the world .

The co-inoculation of Rhizobium with other plant-promoting bacteria has received a great attention in legume growth promotion for a long time (Anandham *et al* 2007) . The co-inoculation of Rhizobium and other bio-fertilizer is one of these important dual inoculations , which has proved its effect on many legumes . These dual inoculation can stimulate or inhibit nodule formation and growth , depending on the concentration and timing of inoculation (Yahalom *et al* , 1991) . The increase in plant dry matter and nitrogen content , as a result of co-inoculation of Rhizobium and other bio-fertilizer , may be related to early nodulation , higher N-fixation and improvement of root development (Burdman *et al* , 1997) . According to Iruthayathas *et al* (1983) , the shoot yield of soybean increased as a result of dual inoculation of R. japonicum and A. brasilense , compared with Rhizobium alone . Molla *et al* (2001) observed a significant root growth , nodulation stimulated and dry matter during co-inoculation with Bradryrhizobium and Azospirillum . Groppa *et al* (1998) and Abdul Jabbar and Saud (2012) found a significant increasing in soybean yield and its components due to dual inoculation .

Many authors stated that legume yields could be increased by seed inoculation compared to nitrogen fertilizer variants (Dobereriner *et al* , 1995 and Brick *et al* , 2004) . It was found that low dose of nitrogen had favorable effects on nodulation and nitrogen fixation , whereas higher doses of mineral nitrogen resulted in nodule mass reduction . This directly affected the value reduction of all yield elements (Waterer *et al* , 1992 and Milakovic *et al* , 2000) . El Behidi (1985) reported that high rates of available soil nitrogen reduced nodulation and biological nitrogen fixation since plants did not require symbiosis with nodule bacteria .

Among essential nutrients , phosphors (P) plays an important role in biological nitrogen fixation (BNF) in legumes . Symbiotic nitrogen fixation has a high P demand because the process consumes large amounts of energy (Schulze *et al* , 2006) . Without proper fertilization by phosphorus , Rhizobium activities and nitrogen fixation is depressed because promotes root formation and formation of lateral , fibrous and healthy roots . It is supposed that phosphorus is effectively translocated into grain at high rates , since P is necessary for the production of protein , phospholipids and phytin (Trung and Yoshida , 1982) . Shahid *et al* (2009) reported that in all phosphorus levels oil content in soybean seed were found non significant , while in case of plant height and number of pod bearing branches/plant , the two higher phosphorus levels gave significantly better results . Also, Qureshi *et al* (1986) and Malik *et al* (2006) added that plant height of soybean was significantly increased caused by inoculation and phosphorus application , which may be due to the fact that inoculation started the nitrogen fixation during early growth stages of plant and similarly phosphorus application played a vital role in early root proliferation . P addition resulted in high P uptake and growth of soybean plant (Kumange and Ofori 2004) .

Molybdenum is a trace element found in the soil and is required for growth of most biological organisms including plants (Franco and Munns,1981 and Graham and Stangoulis, 2005) . Similar to other metals required for plant growth , molybdenum has been utilized by specific plant enzymes as co-factor that participate in reduction and oxidative reactions in plants (Mendel and Hansch, 2002 and Williums and Da Silva , 2002) . Furthmore , Hageman and Burris (1978) reported that the enzyme nitrogenase contained two proteins ; Mo-Fe protein (component containing iron and protein) and Fe protein (component containing iron and protein) . Jongruaysup *et al* (1993) stated that crops developing symbiosis with Rhizobium bacteria had increased molybdenum requirements . Deficiency of this element causes a reduction of nodule dry weight . In this concern , Ranaweera (1992) reported that nitrogen and molybdenum application had a significant effect on increasing nitrogen percent and uptake at different growth stages as well as protein percentage and yield in soybean seeds . Also , Liu *et al* (2005) reported that molybdenum significantly prompted accumulation of root and a aboveground biomass of soybean .

The present study was undertaken to find out the influence of the dual seed inoculation with Rhizobium and bio -fertilizer (Biogen) inoculants as well as nitrogen , phosphorus and molybdenum fertilization and their interactions on productivity and quality of soybean

MATERIALS AND METHODS

The present study was conducted at Sids Agricultural Research Station Farm , ARC , Beni Swief Governorate , Egypt during summer seasons of 2013 and 2014 to assess the effect of dual inoculation of soybean seeds with Rhizobium and bio-fertilizer (Biogen) under nitrogen , phosphorus and molybdenum fertilization on growth , yield in.grains and straw, nutrient uptake as well as protein and oil concentration

The soil of the two experimental locations is clay loam in texture , had 8.0 and 8.1 pH , 0.43 and 0.46 EC (mmohs/cm) , 1.83 and 1.76% organic matter and 19 and 21 ppm for available N ; 14 and 12 for available P and 186 and 175 ppm for available K in the two seasons , respectively (according to Jakson , 1973) . The previous crop was wheat in both seasons .

The experiment was laid out in a factorial (four factors) design in complete randomized blocks with four replications . The studied factors were :

- Nitrogen fertilization at 30 and 60 kg N /fed as ammonium nitrate (33.5 % N).
- Phosphorus fertilization (0 and 13.1 kg P/fed as calcium super phosphate (15.5 % P_2O_5)
- Molybdenum fertilization (0 and 5kg sodium molybdate ($Na_2MoO_4.2H_2O$, 39%Mo)
- Inoculation (without inoculation , inoculation with *Rhizobium Japonicum* alone, and inoculation with *Rhizobium Japonicum* plus Biogen (Biogen is a commercial biofertilier contain N fixing bacteria of Azotobacter) . It is produced by General Organization of Equalization Fund .

Soybean seeds of the variety Giza 111 were inoculated with specific *Rhizobium Japoncum* strain alone or combined with Biogen as bio-fertilizer before sowing at rate of one bag/fed for each Rhizobium (supplied by department of Microbiology , Soil , Water and Environment Research Institute , ARC) . The most respective bacterial number of Biogen is Azotobacter . The inoculation was done by using Arabic gum as an adhesive material and 1% glucose (W/V) for activating the product candidates . Soybean seeds were coated by bacterial – peat mixture and sown in 15 and 20 June in the two seasons, respectively . Seeds were sown in hills 5 cm apart on ridge 60 cm width . The plot size was 10.5 m^2 (3 x 3.5 m) . Plants were thinned to one plant per hill 21 days after sowing . The normal cultural practices of soybean were followed .

Nitrogen treatments were applied at two equal doses , before sowing as an activator and before first irrigation . Whereas phosphorus and molybdenum treatments were added before sowing during the land preparation .

At maturity random sample of 10 plants were taken from the middle two ridges of every plot . Growth characters , i.e. plant height (cm) and dry weight/plant (g) were recorded ,seed (ardab/fed) and straw (t/fed) yields were measured samples of seeds and straw were collected to determine N,P,K and Mo content in grains and straw according to Chapman and Pratt (1978) . Also, seeds oil content was measured according to A.O.A.C. (1975) . Total N,P,K and Mo,uptake and protein and Oil % as well as protein and oil yield were calculated as multiplying protein or oil content by seed yield .

All data were subjected to the proper statistical analysis according to Sendecor and Cochran (1980) . Treatment means were compared by least significant difference (L.S.D.).

RESULTS

Growth parameters

The effects of N , P and Mo as well microbial inoculation on the studied growth parameters of soybean expressed as plant height and dry weight/plant are given in Table (1) . The results show that both plant height and dry weight/plant were significantly affected by nitrogen , phosphorus and microbial inoculation . The tallest and heaviest plants were obtained under 60 kg N/fed ,13.1 kg P/fed and dual inoculation of bio-fertilizer and rhizobium , while molybdenum application did not alter these growth parameters . The relative increases of plant height due to 60 kg N/fed ,13.1 kg P/fed and dual microbial inoculation reached 4.2 , 5.3 and 4.2 % over 30 kg N/fed , 13.1 kg P/fed and without microbial inoculation, respectively in the first season . The corresponding values for the dry weight/plant were 9.6 , 31.9 and 9.6% in the abovementioned order . The same trends were obtained in the second seasons . Obviously, dual inoculation surpassed single inoculation in its effects on plant height and dry weight by about 1.4 and 4.4 % in the first season and 1.7 and 2.7 % in the second season .

With respect to the interaction between any two of the four studied factors or among them , the results indicate that both plant height and dry weight/plant were affected by the interaction between nitrogen and molybdenum (A×D) ; nitrogen , phosphorus and molybdenum (A×B×D) ; nitrogen , micro bacterial inoculation and molybdenum (A×C×D) ; phosphorus , micro bacterial inoculation and molybdenum (B×C×D) and among the four factors (A×B×C×D) . These results of the interaction reveal that the effect of Mo is more pronounced in the presence of 13.1 kg P/fed and the low level of nitrogen (30 kg N/fed) . In general , the highest values of plant height or dry weight/plant were recorded for soybean plants inoculated with rhizobium + bio fertilizer and received 30 kg N/fed + 13.1 kg P/fed and 5 kg sodium molybdate /fed

Table 1. Mean and significant of plant height and dry weight/plant as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			Plant height (cm)						Dry weight/plant (g)					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
30	0	-	70.1	70.4	70.3	80.2	80.3	80.3	18.5	18.4	18.5	20.5	20.4	20.5
		single	74.6	74.5	74.6	82.8	82.7	82.8	20.3	20.4	20.4	22.1	22.3	22.2
		dual	76.9	76.8	76.9	85.1	85.3	85.2	22.8	22.8	22.8	23.9	23.9	23.9
	mean		73.9	73.9	73.9	82.7	82.8	82.8	20.5	205	20.5	22.2	22.2	22.2
	13.1	-	74.4	74.5	74.5	84.7	84.2	84.5	24.6	24.6	24.6	25.7	25.9	25.8
		single	77.2	79.3	78.3	86.9	89.2	88.1	26.9	28.3	27.6	27.2	29.4	28.3
		dual	79.9	81.8	80.9	88.5	90.4	89.5	28.7	29.8	29.3	29.0	30.9	30.0
	mean		77.2	78.5	77.9	86.7	87.9	87.3	26.7	27.6	27.2	27.3	28.7	28.0
mean			75.5	76.2	75.9	84.7	85.4	85.1	23.6	24.1	23.9	24.7	25.5	25.1
60	0	-	76.3	76.4	76.4	85.5	85.4	85.5	22.6	22.6	22.6	22.7	22.9	22.8
		single	76.5	76.5	76.5	86.9	89.2	88.1	22.5	22.7	22.6	22.8	23.0	22.9
		dual	76.4	76.4	76.4	89.0	91.8	90.4	22.7	22.6	22.7	22.3	22.7	22.7
	mean		76.6	76.7	76.7	87.1	88.8	88.0	22.6	22.6	22.6	22.6	22.9	22.8
	13.1	-	81.8	81.8	81.8	91.7	91.9	91.8	29.7	29.8	29.8	30.9	30.8	30.9
		single	81.9	81.9	81.9	91.6	91.7	91.7	29.8	29.7	29.8	30.7	30.7	30.7
		dual	81.8	81.8	81.8	91.6	91.8	91.7	29.7	29.6	29.8	30.7	30.7	30.7
	mean		81.8	81.8	81.8	89.4	90.4	89.9	29.8	29.8	29.8	30.8	30.7	30.8
mean			79.2	79.3	79.3	88.3	89.8	89.0	26.2	26.2	26.2	26.8	26.8	26.8
D			77.4	77.7	77.6	87.1	87.8	87.5	24.9	25.2	25.1	25.7	26.2	26.0
Interactions														
B × D	0		75.3	75.3	75.3	88.9	86.2	85.6	21.6	21.6	21.6	22.4	22.6	22.5
	13.1		79.5	79.0	79.3	88.6	89.2	88.9	28.3	28.7	28.5	29.1	29.7	29.4
C ×D		-	75.7	75.8	75.8	85.5	85.5	85.5	23.9	23.9	23.9	25.0	25.0	25.0
		single	77.6	78.1	77.9	87.1	88.2	87.7	24.9	25.3	25.1	25.7	26.4	26.1
		dual	78.8	79.2	79.0	88.6	89.8	89.2	26.0	26.3	26.2	26.5	27.1	26.8
A×C×D	30	-	72.3	72.2	72.4	82.5	82.3	82.4	21.6	21.5	21.6	23.1	23.2	23.2
		single	75.9	76.9	76.4	84.9	86.0	85.5	23.6	2.4	24.0	24.7	25.9	25.3
		dual	78.2	79.2	78.7	86.8	87.9	87.4	25.8	26.3	26.1	26.5	27.4	27.0
	60	-	79.1	79.1	79.1	88.6	88.7	88.7	26.2	26.2	26.2	26.8	26.9	26.9
		single	79.2	79.2	79.2	89.3	90.5	89.9	26.2	26.2	26.2	26.8	26.9	26.9
		dual	79.1	79.2	79.3	90.3	91.8	91.1	26.2	26.2	26.2	26.5	26.7	26.6
B×C×D	0	-	73.2	73.4	79.3	82.9	82.9	82.9	20.6	20.5	20.6	21.6	21.7	21.7
		single	75.6	75.5	75.6	84.9	86.0	85.5	21.5	21.6	21.6	22.5	22.7	22.6
		dual	76.7	76.6	76.7	87.1	88.6	87.9	22.7	22.7	22.7	23.0	23.3	23.2
	13.1	-	78.1	78.1	78.1	88.2	88.1	88.2	27.2	27.2	27.2	28.3	28.4	28.4
		single	79.6	80.6	80.1	88.2	90.5	89.4	28.4	25.5	27.0	29.0	30.1	29.6
		dual	80.9	81.8	81.4	90.1	91.1	90.6	29.2	29.8	29.5	29.9	30.8	30.4
L.S.D.	at 0.05													
A	B	C	0.8 , 0.7 , 0.6			0.7 , 0.6 , 0.05			0.30 , 0.2 , 0.4			0.5 , 0.4 , 0.4		
D	AB	AC	0.03 , NS , NS			0.03 , NS , NS			0.03 , NS , NS			0.04 , NS , NS		
AD	BC	BD	1.1 , NS , NS			0.8 , NS , NS			0.3 , NS , NS			0.5, NS , NS		
CD	ABC	ABD	NS , NS , 1.2			NS , NS , 0.8			NS , NS , 0.4			NS , NS , 0.5		
ACD	BCD	ABCD	1.0 , 0.9 , 1.5			0.9 , 0.9 , 1.3			0.4 , 0.5 , 1.1			0.6 , 0.7 , 0.9		

-Without molybdenum + With molybdenum

Seed and straw yields

Data in Table (2) present the seed and straw yields of soybean plants as affected by nitrogen, phosphorus and molybdenum application as well as microbial inoculation. The main effect show that both seed and straw yields were significantly and positively affected by the four studies factors. Taking average values into consideration, the percentage increases of seed yield due to 60 kg N/fed as well as P, Mo and dual inoculation application were 26.5, 46.5, 2.8 and 23.4 % as compared with 30 kg N/fed and without P, Mo ,or inoculation, respectively in the first season . The corresponding values for the straw yield were 26.7, 35.2, 2.2 and 19.4 % in the first season as the above mentioned order .

Similar trends were observed in the second season whether for seed or straw yields . It is obvious to notice that dual inoculation with Rhizobium plus Biogen (bio-fertilizer) yielded seed and straw yields surpassed that due to single inoculation by Rhizobium only by about 7.8 and 5.1 % , respectively in the first season . The corresponding values in the second season were 6.9 and 6.0 % . Also, it could be notice that the plants inoculated with Rhizobium only produce higher seed or straw yields than that without bacterial inoculation in the both seasons .

Regarding the interactions between treatments , the data reveal that response of both seed and straw yields to microbial inoculation were affected by N, P and or Mo, where application of 60 kg N/fed decreased the effect of bacterial inoculation on soybean yield . On the other hand, application of P or Mo enhanced the effect of bacterial inoculation in both seasons . Moreover , added Mo to soybean plants was not affected seed and straw yields under the high level of nitrogen (60 kg/fed) . In general, the plants supplied with 30 kg N/fed + 13.1 kg P/fed + 5 kg molybdate sodium/fed + Rhizobium and Biogen inoculation gave the significantly highest seed and straw yields .

Table 2. Mean and significant of seed yield (t/fed) and straw yield (t/fed) of soybean as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)															
			seed yield (t/fed)						straw yield (t/fed)					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
30	0	-	0.713	0.715	0.714	0.861	0.860	0.861	0.913	0.919	0.916	10.012	1.066	1.039
		single	0.972	0.966	0.969	1.162	1.167	1.165	1.301	1.312	1.307	1.395	1.387	1.391
		dual	1.137	1.139	1.138	1.356	1.350	1.353	1.486	1.479	1.483	1.513	1.516	1.515
	mean		0.941	0.940	0.941	1.126	1.126	1.126	1.233	1.237	1.235	1.307	1.323	1.315
	13.1	-	0.956	0.958	0.957	1.139	1.332	1.236	1.331	1.336	1.334	1.389	1.392	1.391
		single	1.211	1.416	1.314	1.458	1.678	1.568	1.639	1.821	1.730	1.672	1.901	1.787
		dual	1.406	1.608	1.507	1.673	1.913	1.793	1.911	1.995	1.903	1.935	2.134	2.035
	mean		1.191	1.327	1.259	1.423	1.643	1.533	1.594	1.717	1.656	1.665	1.809	1.737
	mean		1.066	1.134	1.100	1.275	1.385	1.330	1.414	1.477	1.446	1.486	1.566	1.526
60	0	-	1.141	1.143	1.142	1.377	1.369	1.373	1.539	1.550	1.545	1.677	1.692	1.685
		single	1.136	1.140	1.138	1.376	1.375	1.376	1.560	1.561	1.561	1.682	1.673	1.678
		dual	1.147	1.146	1.147	1.381	1.380	1.381	1.542	1.566	1.554	1.687	1.669	1.678
	mean		1.141	1.143	1.142	1.378	1.375	1.377	1.547	1.559	1.553	1.682	1.678	1.680
	13.1	-	1.621	1.609	1.615	1.901	1.896	1.899	2.108	2.115	2.112	2.211	2.216	2.214
		single	1.636	1.656	1.646	1.897	1.903	1.900	2.113	2.108	2.111	2.219	2.235	2.227
		dual	1.672	1.668	1.670	1.899	1.896	1.898	2.107	2.113	2.110	2.220	2.339	2.280
	mean		1.643	1.644	1.644	1.899	1.898	1.899	2.109	2.112	2.111	2.217	2.263	2.240
mean			1.388	1.394	1.391	1.639	1.637	1.638	1.828	1.836	1.832	1.350	1.971	1.961
D			1.229	1.264	1.247	1.457	1.510	1.484	1.620	1.656	1.639	1.718	1.769	1.743
Interactions														
B × D	0		1.041	1.042	1.042	1.252	1.251	1.252	1.390	1.398	1.394	1.495	1.501	1.498
	13.1		1.417	1.636	1.527	1.661	1.771	1.716	1.852	1.915	1.884	1.941	2.036	1.989
C× D		-	1.108	1.106	1.107	1.320	1.364	1.342	1.473	1.480	1.477	1.572	1.592	1.582
		single	1.239	1.295	1.267	1.473	1.531	1.502	1.653	1.701	1.677	1.742	1.799	1.771
		dual	1.341	1.391	1.366	1.577	1.635	1.606	1.734	1.788	1.763	1.839	1.915	1.877
A×C×D AXCXD	30	-	0.835	0.837	0.836	1.000	1.096	1.048	1.122	1.28	1.25	1.201	1.229	1.215
		single	1.092	1.191	1.142	1.310	1.423	1.367	1.470	1.567	1.519	1.534	1.644	1.589
		dual	1.272	1.374	1.323	1.515	1.635	1.575	1.649	1.737	1.692	1.724	1.825	1.775
	60	-	1.381	1.376	1.379	1.639	1.633	1.636	1.824	1.833	1.829	1.944	1.954	1.950
		single	1.386	1.398	1.392	1.637	1.639	1.638	1.837	1.835	1.836	1.951	1.954	1.953
		dual	1.410	1.407	1.409	1.640	1.638	1.639	1.825	1.840	1.832	1.954	2.004	1.979
B×C×D	0	-	0.927	0.929	0.928	1.119	1.115	1.117	1.226	1.235	1.231	1.345	1.379	1.362
		single	1.054	1.053	1.054	1.269	1.271	1.270	1.431	1.437	1.434	1.539	1.530	1.535
		dual	1.142	1.143	1.143	1.369	1.365	1.367	1.523	1.523	1.519	1.600	1.593	1.597
	13.1	-	1.289	1.284	1.287	1.520	1.614	1.567	1.720	1.726	1.723	1.800	1.804	1.802
		single	1.424	1.536	1.480	1.678	1.791	1.735	1.876	1.965	1.921	1.946	2.068	2.007
		dual	1.539	1.638	1.589	1.786	1.908	1.844	1.959	2.054	2.007	2.078	2.237	2.158
L.S.D.at 0.05														
A	B	C	0.005 , 0.004 , 0.004			0.004 , 0.005, 0.004			0.005, 0.005 , 0.004			0.004 , 0.003 , 0.004		
D	AB	AC	0.006 , NS , 0.006			0.003 , NS , 0.005			0.003 , NS , 0.006			0.004 , NS, 0.006		
AD	BC	BD	0.037 , NS , 0.071			0.045 , NS ,0.092			0.019 , NS ,0.069			0.018 , NS ,0.046		
CD	ABC	ABD	0.034 , 0.125 , 0.118			0.029 , 0.136 , 0.142			0.033 , 0.112 , 0.100			0.026 , 0.119 , 0.102		
ACD	BCD	ABCD	0.082 , 0.911 , 0.152			0.095 , 0.096 , 0.142			0.083 , 0.079 , 0.164			0.085 , 0.096 , 0.153		

-Without molybdenum + With molybdenum

While, the lowest grain and straw yields were obtained for plants fertilized with 60 kg N/fed and without P and Mo and without bacterial inoculation .

Nutrients content

The results of N , P, K and Mo concentration in seeds and straw present in Tables (3 , 4 ,5 and 6) . The results reveal that increasing nitrogen level from 30 to 60 kg/fed did not affect N , P , K and Mo concentrations in seeds or straw in both seasons , except molybdenum content in seeds which negatively responded to increasing nitrogen level .

The relative decreasing of molybdenum concentration in seeds due to 60 kg N/fed reached to 7.7 and 4.5 % , less than 30 kg N/fed during the first and second seasons, respectively .

As for phosphorus application , the data show that N , P, K and Mo in seeds and N , P and Mo in straw were significantly affected by phosphorus fertilization , while K in straw was not affected .

Increasing phosphorus levels from no phosphorus to 13.1 kg P/fed increased N , P, K and Mo in grains by about 8.5 , 34.5 , 4.4 and 28.4 %, respectively in the first season . On the other hand the relative increasing of N , P and Mo content in straw in the first season were 3.9 , 23.8 and 16.2 % in the abovementioned order .

Table 3. Mean and significant of N and P concentration in seeds as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			N %						P %					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
		-	4.23	4.24	4.24	4.15	4.16	4.16	0.50	0.54	0.52	0.46	0.50	0.48
	0	single	4.40	4.41	4.41	4.36	4.35	4.36	0.52	0.56	0.54	0.48	0.53	0.51
		dual	4.59	4.59	4.59	4.55	4.54	4.55	0.55	0.59	0.57	0.52	0.56	0.54
30	mean		4.41	4.41	4.41	4.35	4.35	4.35	0.52	0.56	0.54	0.49	0.53	0.51
		-	4.62	4.75	4.69	4.60	4.76	4.68	0.62	0.78	0.70	0.58	0.64	0.61
	13.1	single	4.78	4.92	4.85	4.76	4.95	4.81	0.63	0.83	0.73	0.60	0.67	0.64
		dual	5.13	5.51	5.32	4.89	5.33	5.11	0.66	0.89	0.78	0.62	0.69	0.66
	mean		4.84	5.06	4.95	4.75	5.01	4.98	0.64	0.83	0.74	0.60	0.67	0.64
mean			4.63	4.74	4.69	4.55	4.68	4.62	0.58	0.70	0.64	0.54	0.60	0.57
		-	4.42	4.40	4.41	4.41	4.42	4.42	0.51	0.54	0.53	0.46	0.61	0.49
	0	single	4.57	4.58	4.58	4.52	4.46	4.49	0.53	0.56	0.55	0.48	0.54	0.51
		dual	4.72	4.74	4.73	4.63	4.61	4.62	0.65	0.58	0.57	0.51	0.56	0.54
60	mean		4.57	4.57	4.57	4.52	4.50	4.51	0.53	0.56	0.55	0.48	0.53	0.51
		-	4.53	4.63	4.58	4.50	4.60	4.55	0.61	0.77	0.69	0.57	0.64	0.61
	13.1	single	4.77	4.85	4.81	4.72	4.79	4.76	0.64	0.82	0.73	0.59	0.67	0.63
		dual	4.89	4.96	4.93	4.83	4.86	4.85	0.66	0.88	0.77	0.62	0.70	0.66
	mean		4.73	4.81	4.77	4.68	4.75	4.72	0.64	0.82	0.73	0.59	0.67	0.63
mean			4.65	4.69	4.67	4.60	4.62	4.61	0.59	0.69	0.64	0.54	0.60	0.57
D			4.64	4.72	4.68	4.58	4.66	4.62	0.58	0.66	0.62	0.54	0.60	0.57
Interactions														
	0		4.49	4.49	4.49	4.44	4.43	4.44	0.53	0.56	0.55	0.52	0.57	0.55
B× D	13.1		4.79	4.94	4.87	4.72	4.88	4.80	0.64	0.83	0.74	0.60	0.67	0.64
		-	4.45	4.51	4.48	4.42	4.49	4.46	0.56	0.66	0.61	0.52	0.57	0.55
C × D		single	4.63	4.69	4.66	4.59	4.64	4.62	0.58	0.69	0.64	0.53	0.60	0.57
		dual	4.83	4.95	4.89	4.73	4.84	4.79	0.60	0.64	0.62	0.57	0.63	0.60
		-	4.43	4.50	4.47	4.38	4.46	4.42	0.56	0.66	0.58	0.52	0.57	0.55
	30	single	4.59	4.67	4.63	4.56	4.65	4.61	0.58	0.70	0.64	0.54	0.60	0.57
		dual	4.86	5.05	5.00	4.72	4.94	4.83	0.61	0.74	0.68	0.57	0.63	0.60
A× C× D		-	4.48	4.52	4.50	4.46	4.51	4.48	0.56	0.81	0.69	0.52	0.58	0.55
	60	single	4.67	4.72	4.70	4.62	4.63	4.63	0.59	0.70	0.65	0.55	0.62	0.59
		dual	4.81	4.85	4.83	4.73	4.74	4.74	0.61	0.73	0.67	0.57	0.63	0.60
		-	4.33	4.32	4.33	4.28	4.29	4.29	0.51	0.54	0.53	0.46	0.51	0.49
	0	single	4.49	4.50	4.50	4.39	4.41	4.40	0.53	0.56	0.55	0.78	0.54	0.51
		dual	4.66	4.67	4.67	4.59	4.58	4.59	0.56	0.59	0.58	0.52	0.56	0.54
B× C× D		-	4.58	4.69	4.64	4.55	4.68	4.82	0.62	0.78	0.70	0.58	0.64	0.61
	13.1	single	4.78	4.89	4.84	4.64	4.87	4.76	0.64	0.83	0.74	0.60	0.67	0.64
		dual	5.01	5.24	5.13	4.86	5.10	4.98	0.66	0.89	0.78	0.62	0.70	0.66
L.S.D	.at 0.05													
A	B	C	NS , 0.06 , 0.05			NS , 0.05 , 0.06			NS , 0.06 , NS			NS , 0.08 , NS		
D	AB	AC	0.05 , 0.06 , NS			0.03 , 0.07 , NS			0.03 , 0.07 , NS			0.03 , 0.09 , NS		
AD	BC	BD	0.07 , NS , 0.08			0.06 , NS , 0.07			0.05 , NS , 0.06			0.03 , NS , 0.05		
CD	ABC	ABD	NS , NS , 0.07			NS , NS , 0.06			NS , NS , 0.07			NS , NS , 0.05		
ACD	BCD	ABCD	NS , 0.08 , 0.16			NS , 0.09 , 0.15			NS , 0.10 , 0.13			NS , 0.06 , 0.14		

-Without molybdenum + With molybdenum

Similar trends were obtained in the second season . It is obvious to notice that the effect of P fertilization on enhancing nutrient content is more pronounced on P and Mo concentrations in seeds or straw than on N or K content .

Concerning the microbial inoculation , the results indicate that N , P , K and Mo concentration in seeds and straw were significantly affected by microbial inoculation , whether single or dual , except phosphorus concentration in seeds which was not affected . The effect of microbial treatments on improving nutrient content could be arranged in the ascending order as follows : without inoculation < single inoculation with rhizobia < dual inoculation with rhizobia + bio-fertilizer.

Regarding the effectiveness of molybdenum , the data obtained reveal that nitrogen , phosphorus and molybdenum in seeds and phosphorus , potassium and molybdenum in straw were markedly increased due to molybdenum application . The application of Mo enhanced N ,P and Mo in seeds by about 1.7 , 13.8 and 4.9 % , respectively in the first season , and increased P , K and Mo in straw by about 17.4 , 3.7 and 5.7 % , respectively in the first season Similar trends were obtained in the second season .

Table 4. Mean and significant of K and Mo concentration in seeds as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			K (%)						Mo (ppm)					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
30	0	-	1.40	1.41	1.41	1.32	1.33	1.33	2.51	2.73	2.62	2.45	2.70	2.54
		single	1.63	1.62	1.63	1.65	1.55	156	2.76	2.91	2.84	2.68	2.85	2.77
		dual	1.85	1.83	1.84	1.76	1.75	1.76	2.92	3.12	3.02	2.83	3.00	2.92
	mean		1.62	1.62	1.63	1.55	1.55	1.55	2.93	2.92	2.83	2.66	2.85	2.75
	13.1	-	1.41	1.52	1.47	1.34	1.41	1.38	3.63	3.72	3.68	3.58	3.67	3.63
		single	1.62	1.69	1.66	1.55	1.62	1.59	3.85	3.95	3.90	3.81	3.92	3.87
		dual	1.83	1.91	1.87	1.75	1.84	1.80	3.99	4.13	4.06	3.92	4.05	3.99
	mean		1.62	1.07	1.66	1.55	1.63	1.59	3.83	3.93	3.88	3.77	3.88	3.83
mean			1.62	1.66	1.64	1.55	1.58	1.56	3.28	3.43	3.36	3.21	3.37	3.30
60	0	-	1.42	1.41	1.42	1.33	1.31	1.32	2.50	2.72	2.61	2.46	2.71	3.49
		single	1.62	1.69	1.65	1.55	1.63	1.59	2.75	2.90	2.83	2.67	2.88	2.77
		dual	1.82	1.89	1.86	1.74	1.86	1.80	2.90	3.16	3.03	2.81	3.01	2.91
	mean		1.62	1.67	1.65	1.54	1.06	1.58	2.71	2.93	2.83	2.65	2.86	3.06
	13.1	-	1.41	1.52	1.47	1.32	1.43	1.38	3.62	3.74	3.68	3.57	3.67	3.62
		single	1.61	1.70	1.66	1.54	1.61	1.58	3.85	3.94	3.90	3.80	3.91	3.86
		dual	1.81	1.91	1.86	1.76	1.87	1.81	3.98	4.15	4.06	3.92	3.07	3.99
	mean		1.61	1.71	1.66	1.54	1.64	1.59	3.27	3.44	3.36	3.21	3.37	3.25
mean			1.62	1.69	1.66	1.54	1.62	1.58	2.99	3.19	3.10	2.93	3.12	3.15
D			1.62	1.68	1.65	1.55	1.60	1.58	3.27	3.43	3.35	3.13	3.37	3.25
Interactions														
B × D	0		1.62	1.65	1.64	1.55	1.57	1.62	2.72	2.93	2.82	2.66	2.86	2.76
	13.1		1.61	1.68	1.65	1.55	1.64	1.61	3.55	3.69	3.62	3.49	3.37	3.43
C × D		-	1.41	1.47	1.44	1.33	1.47	1.41	3.07	3.23	3.15	2.79	3.19	2.99
		single	1.62	1.68	1.56	1.55	1.60	1.62	3.30	3.43	3.37	3.24	3.39	3.32
		dual	1.83	1.89	1.86	1.75	1.83	1.83	3.45	3.64	3.55	3.37	3.53	3.45
A×C×D	30	-	1.41	1.47	1.44	1.33	1.38	1.41	3.07	3.23	315	3.03	3.19	3.11
		single	1.63	1.66	1.64	1.56	1.59	1.63	3.31	3.43	3.37	3.25	3.39	3.32
		dual	1.84	1.87	1.86	1.76	1.80	1.84	3.46	3.63	3.55	3.38	3.53	3.46
	60	-	1.42	1.47	1.45	1.33	1.37	1.42	3.06	3.23	3.15	3.02	3.19	3.11
		single	1.62	1.70	1.66	1.55	1.62	1.62	3.30	3.42	3.36	3.24	3.39	3.32
		dual	1.82	1.90	1.86	1.75	1.87	1.82	3.43	3.66	3.55	3.37	3.54	3.46
B×C×D	0	-	1.41	1.41	1.41	1.33	1.32	1.41	2.51	2.73	2.62	2.46	2.71	2.59
		single	1.63	1.66	1.65	1.56	1.59	1.63	2.76	2.91	2.84	2.68	2.86	2.77
		dual	1.8	1.86	1.85	1.75	1.81	1.8	2.91	3.14	3.03	2.82	3.01	2.92
	13.1	-	1.41	1.52	1.47	1.33	1.42	1.41	3.63	3.73	3.68	3.58	3.67	3.63
		single	1.62	1.70	1.66	1.55	1.62	1.62	3.85	3.95	3.90	3.81	3.92	3.87
		dual	1.82	1.91	1.87	1.76	1.86	1.82	3.99	4.14	4.07	3.92	4.06	3.99
L.S.D.	at 0.05													
A	B	C	NS , 0.05 , 0.07			NS , 0.08 , 0.09			0.08 , 0.09 , 0.08			0.07 , 0.09 , 0.09		
D	AB	AC	NS , 0.08 , 0.09			NS , 0.09 , 0.08			0.06 , NS , NS			0.07 , NS , NS		
AD	BC	BD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		
CXD	ABC	ABD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		
ACD	BCD	ABCD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		

-Without molybdenum   +With molybdenum

In general , the results of the interaction between treatments reveal that increasing nitrogen level inhibited the effect of molybdenum on improving the nutrient content . Also , under the low level of nitrogen , the added molybdenum enhanced the effect of microbial inoculation on nutrient content , while increasing nitrogen level inhibited these effect . Moreover , the effects of molybdenum on enhancing the role of microbial inoculation on improving nutrient content were more pronounced in the presence of phosphorus .

Table 5. Mean and significant of N and P concentration in straw as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D) N (%) 2013 -	+	mean	N (%) 2014 -	+	mean	P (%) 2013 -	+	mean	P (%) 2014 -	+	mean
30	0	-	2.13	2.13	2.13	2.11	2.12	2.12	0.17	0.20	0.19	0.18	0.21	0.20
		single	2.25	2.24	2.25	2.23	1.23	2.23	0.19	0.23	0.21	0.21	0.24	0.23
		dual	2.36	2.37	2.37	2.35	2.36	2.36	0.21	0.25	0.23	0.23	0.27	0.25
	mean		2.25	2.25	2.25	2.23	2.24	2.24	0.19	0.23	0.21	0.21	0.24	0.23
	13.1	-	2.32	2.31	2.32	2.31	2.29	2.30	0.25	0.29	0.27	0.26	0.30	0.28
		single	2.44	2.45	2.45	2.45	2.40	2.43	0.27	0.32	0.30	0.28	0.33	0.31
		dual	2.56	2.57	2.57	2.57	2.50	2.54	0.29	0.36	0.33	0.30	0.36	0.33
	mean		2.44	2.44	2.44	2.44	2.40	2.42	0.27	0.32	0.30	0.28	0.33	0.31
mean			2.34	2.32	2.33	2.34	2.32	2.33	0.23	0.28	0.26	0.24	0.29	0.27
60	0	-	2.21	2.27	2.24	2.23	2.22	2.23	0.17	0.21	0.19	0.18	0.21	0.20
		single	2.34	2.40	2.37	2.35	2.34	2.35	0.19	0.23	0.21	0.21	0.24	0.23
		dual	2.46	2.49	2.48	2.50	2.47	2.49	0.22	0.26	0.24	0.23	0.27	0.25
	mean		2.34	2.39	2.37	2.36	2.34	2.35	0.19	0.23	0.21	0.21	0.24	0.23
	13.1	-	2.29	2.32	2.31	2.27	2.28	2.28	0.25	0.30	0.28	0.25	0.29	0.27
		single	2.34	2.39	2.37	2.35	2.36	2.36	0.28	0.34	0.31	0.28	0.32	0.30
		dual	2.40	2.43	2.42	2.41	2.40	2.41	0.29	0.37	0.33	0.30	0.37	0.34
	mean		2.34	2.38	2.36	2.35	2.35	2.35	0.23	0.29	0.26	0.24	0.28	0.26
mean			2.34	2.39	2.37	2.36	2.35	2.36	0.21	0.26	0.24	0.23	0.26	0.25
D			2.34	2.37	2.36	2.35	2.33	2.34	0.23	0.27	0.25	0.25	0.28	0.27
Interactions														
B × D	0		2.30	2.32	2.31	2.30	2.29	2.30	0.19	0.23	0.21	0.21	0.24	0.23
	13.1		2.39	2.41	2.40	2.40	2.38	2.39	0.23	0.29	0.26	0.24	0.29	0.27
C × D		-	2.24	2.26	2.25	2.23	2.23	2.23	0.21	0.25	0.23	0.22	0.25	0.24
		single	2.34	2.37	2.36	2.35	2.33	2.34	0.22	0.26	0.24	0.25	0.28	0.27
		dual	2.45	2.47	2.46	2.46	2.43	2.45	0.25	0.31	0.28	0.27	0.32	0.30
A×C×D	30	-	2.32	2.22	2.27	2.21	2.21	2.21	0.21	0.25	0.23	0.22	0.24	0.23
		single	2.35	2.35	2.35	2.34	2.32	2.33	0.23	0.28	0.26	0.25	0.29	0.27
		dual	2.46	2.47	2.47	2.46	2.43	2.45	0.25	0.31	0.28	0.27	0.32	0.30
	60	-	2.25	2.30	2.28	2.25	2.25	2.25	0.21	0.26	0.24	0.22	0.25	0.24
		single	2.34	2.36	2.35	2.35	2.35	2.35	0.24	0.29	0.27	0.25	0.28	0.27
		dual	2.43	2.46	2.45	2.46	2.44	2.45	0.26	0.32	0.29	0.27	0.32	0.30
B×C×D	0	-	2.17	2.20	2.19	2.17	2.17	2.17	0.17	0.21	0.19	0.18	0.21	0.20
		single	2.30	2.32	2.31	2.29	2.29	2.29	0.19	0.23	0.21	0.21	0.24	0.23
		dual	2.41	2.43	2.42	2.43	2.42	2.43	0.22	0.26	0.24	0.23	0.27	0.25
	13.1	-	2.31	2.32	2.32	2.29	2.29	2.29	0.25	0.30	0.28	0.26	0.30	0.28
		single	2.39	2.42	2.41	2.40	2.38	2.39	0.28	0.33	0.31	0.28	0.33	0.31
		dual	2.48	2.50	2.49	2.49	2.45	2.47	0.29	0.37	0.33	0.30	0.37	0.34
L.S.D.	at 0.05													
A	B	C	NS , 0.04 , 0.04			NS , 0.05 , 0.05			NS , 0.03 , 0.04			NS , 0.03 , 0.04		
D	AB	AC	NS , 0.06 , NS			NS , 0.07 , NS			0.03 , NS , NS			0.02 , NS , NS		
AD	BC	BD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		
CD	ABC	ABD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		
ACD	BCD	ABCD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		

-Without molybdenum **+With molybdenum**

Table 6. Mean and significant of K and Mo concentration in straw as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)														
			K (%)						Mo (ppm)								
			2013			2014			2013			2014					
			-	+	mean	-	+	mean	-	+	mean	-	+	mean			
30	0	-	3.20	3.21	3.21	3.27	3.27	3.27	0.52	0.63	0.58	0.50	0.61	0.56			
		single	3.53	3.53	3.53	3.60	3.61	3.61	0.66	0.71	0.69	0.65	0.73	0.69			
		dual	3.73	3.75	3.76	3.97	3.96	3.97	0.81	0.70	0.76	0.80	0.95	0.88			
	mean		3.50	3.68	3.59	3.61	3.62	3.62	0.66	0.68	0.68	0.65	0.76	0.74			
	13.1	-	3.65	3.66	3.66	3.67	3.76	3.72	0.65	0.77	0.71	0.61	0.73	0.67			
		single	3.82	3.80	3.81	3.83	3.93	3.88	0.76	0.83	0.80	0.74	0.80	0.77			
		dual	4.13	4.20	4.17	4.25	4.29	4.27	0.84	0.91	0.88	0.81	0.89	0.85			
	mean		3.87	3.89	3.83	3.92	3.98	3.96	0.75	0.83	0.79	0.72	0.81	0.77			
	mean		3.68	3.69	3.69	3.77	3.80	3.79	0.71	0.79	0.75	0.69	0.79	0.74			
60	0	-	3.55	3.56	3.56	3.61	3.62	3.62	0.53	0.64	0.60	0.50	0.62	0.56			
		single	3.71	3.72	3.72	3.80	3.81	3.81	0.65	0.66	0.66	0.64	0.75	0.70			
		dual	3.83	3.84	3.84	3.93	4.02	3.99	0.80	0.81	0.81	0.80	0.94	0.87			
	mean		3.70	3.71	3.71	3.78	3.82	3.81	0.66	0.71	0.69	0.64	0.77	0.71			
	13.1	-	3.60	3.62	3.61	3.65	3.66	3.66	0.65	0.76	0.71	0.60	0.72	0.66			
		single	3.75	3.76	3.76	3.79	3.78	3.79	0.75	0.84	0.80	0.74	0.80	0.77			
		dual	3.83	3.85	3.84	3.89	3.90	3.90	0.83	0.93	0.88	0.80	0.90	0.85			
	mean		3.72	3.73	3.73	3.78	3.80	3.79	0.74	0.84	0.79	0.72	0.81	0.77			
	mean		3.71	3.72	3.72	3.78	3.81	3.80	0.71	0.77	0.74	0.68	0.79	0.74			
	D		3.70	3.71	3.71	3.77	3.80	3.79	0.70	0.74	0.72	0.68	0.79	0.74			
	Interactions																
B × D	0		3.60	3.69	3.64	3.69	3.72	3.71	0.66	0.69	0.68	0.65	0.77	0.71			
	13.1		3.79	3.81	3.80	3.85	3.89	3.87	0.75	0.84	0.79	0.72	0.81	0.78			
C × D		-	3.50	3.51	3.51	3.55	3.58	3.57	0.58	0.70	0.64	0.55	0.67	0.61			
		single	3.70	3.70	3.70	3.76	3.78	3.77	0.71	0.74	0.73	0.69	0.77	0.73			
		dual	3.89	3.91	3.90	4.01	4.04	4.03	0.81	0.78	0.80	0.80	0.92	0.86			
A×C×D	30	-	3.43	3.44	3.44	3.47	3.52	3.50	0.59	0.70	0.65	0.56	0.67	0.62			
		single	3.43	3.44	3.44	3.47	3.77	3.62	0.71	0.77	0.74	0.70	0.80	0.75			
		dual	3.95	3.98	3.97	4.11	4.13	4.12	0.83	0.91	0.87	0.81	0.92	0.87			
	60	-	3.58	3.59	3.59	3.63	3.64	3.64	0.59	0.70	0.65	0.55	0.67	0.61			
		single	3.73	3.77	3.77	3.75	3.80	3.78	0.70	0.75	0.73	0.69	0.78	0.74			
		dual	3.83	3.85	3.84	3.91	3.96	3.94	0.82	0.87	0.85	0.70	0.92	0.86			
B×C×D	0	-	3.38	3.39	3.39	3.44	3.45	3.45	0.53	0.64	0.59	0.50	0.62	0.56			
		single	3.62	3.63	3.63	3.70	3.71	3.71	0.66	0.69	0.68	0.65	0.74	0.70			
		dual	3.80	3.80	3.80	3.95	3.99	3.97	0.81	0.86	0.84	0.80	0.94	0.87			
	13.1	-	3.63	3.64	3.64	3.66	3.71	3.69	0.65	0.81	0.73	0.61	0.73	0.67			
		single	3.79	3.78	3.79	3.81	3.86	3.84	0.76	0.84	0.80	0.74	0.80	0.77			
		dual	3.98	4.03	4.01	4.07	3.92	4.00	0.84	0.92	0.88	0.81	0.90	0.86			
L.S.D.	at 0.05																
A	B	C		NS , NS , 0.05			NS , NS , 0.06			NS , 0.04 , 0.06			NS , 0.05 , 0.06				
D	AB	AC		0.04 , NS , 0.05			0.03 , NS , 0.06			0.03 , 0.6 , 0.07			0.05 , 0.07 , 0.07				
AD	BC	BD		NS , NS , 0.05			NS , NS , 0.05			NS , NS , NS			NS , NS , NS				
CD	ABC	ABD		NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS				
ACD	BCD	ABCD		NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS				

-Without molybdenum **+With molybdenum**

Nutrients uptake

The results concerning N , P, K and Mo uptake by seeds and /or straw are given in Tables (7 , 8, 9 , 10, 11and 12) . With respect to the main effect, the data obtained clearly indicate that nitrogen , phosphorus and molybdenum fertilization as well as microbial inoculation had positive effects on nutrient uptake by seeds and /or straw of soybean plants . Increasing nitrogen level from 30 to 60 kg /fed increased total N , P , K and Mo by about 27.0 , 27.0 , 24.1 and 25.6 % , respectively in the first season . Similar trends were obtained in the second season . The plants received 13.1 kg P/fed showed increases in total N , P , K and Mo by about 43.2 , 92.4 , 44.9 and 72.4 % over no phosphorus , respectively in the first season . Similar results were obtained in the second season . The plants treated with molybdenum absorbed N , P , K and Mo more than without molybdenum by about 6.2 , 24.1 , 5.9 and 11.0 % , respectively in the first season . The corresponding values for the second season were 4.9 , 13.0 , 5.4 and

9.8 % in the abovementioned order . The effectiveness of microbial treatments on nutrients uptake could be arranged in the descending order as follow : dual inoculation > single inoculation > without microbial treatment.

Considering the interaction between treatments , the results in general reveal that , the effect of rhizobia inoculation and /or bio-fertilizer was enhanced under the presence of P , Mo under the nitrogen level (30kg/fed) . It observed that nutrient uptake of the plants with the dual inoculation under 30 kg N/fed were significantly higher or equal to that treated with 60 kg N/fed .The plants treated with rhizobia + bio-fertilizer + 30 kg N/fed + 13.1 kg P/fed + 5 kg sodium molybdate /fed absorbed greatest nutrients contents in its seeds and straw . On the other hand, the lowest nutrient uptake were recorded for soybean plants without microbial inoculation and fertilized with 30 kg N/fed and without both P and Mo application .

Table 7. Mean and significant of N and P uptake by seeds as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			N (kg/fed)						P (kg/fed)					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
30	0	-	30.2	30.3	30.3	35.7	35.8	35.8	3.17	3.46	3.31	3.94	4.34	4.14
		single	42.8	42.6	42.7	50.7	50.8	50.8	5.07	5.39	5.23	5.60	6.20	5.90
		dual	52.2	52.3	52.3	61.7	61.3	61.5	6.28	6.70	6.49	7.05	7.58	7.32
	mean		41.7	41.7	41.7	49.4	49.3	49.4	4.84	5.18	5.01	5.53	6.04	5.79
	13.1	-	44.2	45.5	44.9	52.4	63.4	57.9	5.93	7.47	6.70	6.61	8.53	7.57
		single	57.9	69.7	63.8	69.4	83.1	76.3	7.63	11.8	9.69	8.75	11.2	10.0
		dual	72.1	88.6	80.4	81.8	102.0	91.9	9.28	14.3	11.8	10.4	13.2	11.8
	mean		58.1	67.9	63.0	67.9	82.8	75.4	7.61	11.2	9.41	8.59	11.0	9.80
mean			49.9	54.8	52.4	58.6	66.1	62.4	6.22	8.19	7.21	7.06	8.52	7.79
60	0	-	50.4	50.3	50.4	60.7	60.8	60.6	5.82	6.17	6.00	6.33	6.98	6.66
		single	51.9	52.2	52.1	62.2	61.3	61.8	6.02	6.83	6.43	6.61	7.42	7.02
		dual	54.1	54.3	54.2	63.9	63.6	63.8	6.42	6.65	6.54	7.01	7.73	7.37
	mean		52.1	52.3	52.2	62.3	61.8	62.1	6.09	6.55	6.32	6.65	7.38	7.02
	13.1	-	73.4	74.5	74.0	85.5	87.2	86.4	9.89	12.4	11.2	10.8	12.1	11.5
		single	78.0	80.3	79.2	89.6	91.2	90.4	10.5	13.6	12.1	11.2	12.8	12.0
		dual	81.8	82.7	82.3	91.7	92.2	92.0	11.0	14.7	12.9	11.8	13.3	12.6
	mean		77.7	79.2	78.5	88.9	90.2	89.6	10.5	13.6	12.1	11.3	12.7	12.0
mean			64.9	65.8	65.4	75.6	76.6	76.2	8.30	10.1	9.21	8.98	10.0	9.51
D			57.5	60.3	58.9	67.1	71.4	69.3	7.25	9.13	8.20	8.01	9.31	8.66
Interactions														
B × D	0		46.9	47.0	47.0	55.8	56.2	54.5	5.47	5.87	5.67	6.09	6.71	6.41
	13.1		67.9	73.6	70.8	78.4	86.5	82.5	9.06	12.4	10.8	9.95	11.9	9.66
C × D		-	49.6	50.2	49.9	58.5	61.8	60.2	6.20	7.38	6.80	6.92	8.00	7.47
		single	57.7	61.2	59.5	67.9	71.6	69.8	7.31	9.41	8.36	8.04	9.42	8.73
		dual	65.1	69.5	67.3	74.8	80.7	77.8	8.25	10.6	9.43	9.07	10.5	9.79
A×C×D	30	-	37.2	37.9	37.6	43.9	49.8	64.9	4.55	5.47	5.01	5.28	6.44	5.86
		single	50.4	56.2	53.3	59.9	67.0	63.5	6.35	8.57	7.46	7.18	8.72	7.95
		dual	62.2	70.5	66.4	71.8	81.7	76.8	7.78	10.5	9.15	8.73	10.4	9.57
	60	-	61.9	62.4	62.2	73.2	73.9	73.6	7.86	9.29	8.58	8.57	9.56	9.07
		single	65.0	66.3	65.7	75.9	76.3	76.1	8.26	10.2	9.23	8.91	10.1	9.51
		dual	68.0	68.5	68.3	77.8	79.7	78.8	8.71	10.7	9.71	9.41	10.5	9.96
B×C×D	0	-	40.3	40.3	40.3	48.1	48.3	48.2	4.50	4.82	4.66	5.14	5.66	5.40
		single	47.4	47.4	47.4	56.3	56.1	56.2	5.55	6.11	5.83	6.11	6.81	6.46
		dual	53.2	53.3	53.3	62.8	64.2	63.5	6.35	6.68	6.52	7.03	7.66	7.35
	13.1	-	58.8	60.0	59.4	69.0	62.0	65.5	7.91	9.94	8.93	8.71	10.3	9.51
		single	68.0	75.0	71.5	79.5	87.2	83.4	9.07	12.7	10.9	9.98	12.0	11.0
		dual	77.0	85.7	81.4	72.9	76.8	74.9	10.1	14.5	12.3	11.1	13.3	12.2

L.S.D.	at 0.05		N 2013	N 2014	P 2013	P 2014
A	B	C	2.13 , 2.70 , 2.11	3.45 , 2.25 , 2.06	1.02 , 1.13 , 1.04	1.16 , 1.27 , 0.08
D	AB	AC	1.50 , NS , NS	1.46 , NS , NS	0.61 , NS , NS	0.52 , NS , NS
AD	BC	BD	5.32 , NS , 2.95	3.76 , NS , 4.05	NS , NS , 2.25	NS , NS , 2.49
CD	ABC	ABD	3.14 , 3.45 , 2.11	3.96 , 5.06 , 2.40	NS , 1.83 , 1.16	NS , 1.52 , 1.27
ACD	BCD	ABCD	4.46 , 3.16 NS	7.35 , 2.83 , NS	3.06 , 2.05 , NS	1.15 , 1.76 , NS

-Without molybdenum +With molybdenum

Table 8. Mean and significant of K and Mo uptake by seeds as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			K uptake (kg/fed)						Mo uptake (g/fed)					
			2013			2014			2013			2014		
			-	**+**	**mean**	**-**	**+**	**mean**	**-**	**+**	**mean**	**-**	**+**	**mean**
30	0	-	9.98	10.1	10.0	11.4	11.4	11.4	1.79	1.95	1.87	2.71	2.32	2.52
		single	15.8	15.7	15.8	19.2	18.1	18.7	2.63	2.89	2.74	3.82	3.44	3.63
		dual	21.0	20.9	21.0	23.9	23.6	23.8	3.04	3.91	3.48	4.05	4.61	4.33
	mean		15.6	15.6	15.6	18.1	17.8	18.0	2.49	2.92	2.70	3.53	3.46	3.50
	13.1	-	13.5	14.6	14.1	15.3	17.5	16.4	4.01	3.56	3.79	4.00	4.95	4.48
		single	19.6	23.9	21.8	22.6	27.2	24.9	4.14	5.71	4.93	5.60	6.51	6.01
		dual	25.7	30.7	28.2	29.3	35.2	32.3	5.69	6.23	5.96	6.95	7.70	7.33
	mean		19.6	23.1	21.4	22.4	26.6	24.5	4.62	5.17	4.90	5.52	6.39	5.94
mean			17.6	19.4	18.5	20.3	22.2	21.3	3.56	4.05	3.80	4.53	4.93	4.72
60	0	-	16.2	16.1	16.2	18.3	17.9	18.1	2.97	3.56	3.27	3.86	3.33	3.60
		single	18.4	19.3	18.9	21.3	22.4	21.9	3.95	3.21	3.58	3.43	4.52	3.98
		dual	20.9	21.7	21.3	24.0	25.7	24.9	3.14	4.09	3.62	3.90	4.98	.44
	mean		18.5	18.8	18.7	21.2	22.0	21.6	3.36	3.62	3.49	3.73	4.28	4.01
	13.1	-	22.9	24.5	23.7	25.1	27.1	26.1	5.24	6.31	5.78	6.95	6.73	6.84
		single	26.3	28.0	27.2	29.2	30.6	29.9	6.56	6.39	6.45	7.15	7.85	7.50
		dual	30.3	31.9	31.1	33.4	35.5	34.5	5.83	6.92	6.38	6.21	6.58	6.40
	mean		26.5	28.1	27.3	29.2	31.1	30.2	5.88	6.54	6.21	6.77	7.06	6.92
mean			22.5	23.5	23.0	25.2	26.6	25.9	4.62	5.09	4.85	5.25	5.67	5.47
D			20.1	21.5	20.8	22.8	24.4	23.6	4.09	4.56	4.33	4.89	5.29	5.09
Interactions														
B × D	0		17.1	17.2	17.2	19.7	19.9	19.8	2.93	3.27	3.10	3.63	3.87	3.76
	13.1		23.1	25.6	24.4	25.8	28.9	27.4	5.25	5.86	5.55	6.15	6.73	6.43
C × D		-	15.7	16.3	16.0	17.5	18.5	18.0	3.52	3.85	3.67	4.38	4.33	4.36
		single	20.0	21.7	20.9	23.1	24.6	23.9	4.32	4.55	4.44	5.00	5.58	5.29
		dual	24.5	26.3	25.4	27.7	30.0	28.9	4.43	5.29	4.86	5.28	5.97	5.63
A×C×D	30	-	11.7	12.4	12.1	13.4	14.5	14.0	2.90	2.76	2.83	3.36	3.64	3.50
		single	17.7	19.8	18.8	20.9	22.7	21.8	3.39	4.30	3.85	4.71	4.98	4.85
		dual	23.4	25.8	24.6	26.6	29.4	28.0	4.37	5.07	4.72	5.50	6.16	5.83
	60	-	19.6	20.3	20.0	21.7	22.5	22.1	4.11	4.94	4.53	5.41	5.03	5.22
		single	22.4	23.7	23.1	25.3	26.5	25.9	5.26	4.80	5.03	5.29	6.19	5.74
		dual	25.6	26.8	26.2	28.7	30.6	29.7	4.49	5.51	5.00	5.06	5.78	5.39
B×C×D	0	-	13.1	13.1	13.1	14.9	14.7	14.8	2.38	2.76	2.57	3.29	2.83	3.06
		single	17.1	17.5	17.3	20.3	20.3	20.3	3.29	3.05	3.17	3.63	3.98	3.81
		dual	21.0	21.3	21.2	24.0	24.7	24.4	3.09	4.00	3.55	3.98	4.80	4.39
	13.1	-	18.2	20.0	19.1	20.2	22.3	21.3	4.63	4.94	4.79	5.48	5.84	5.66
		single	23.0	26.0	24.5	25.9	28.9	27.4	5.35	6.05	5.70	6.38	7.18	6.78
		dual	28.0	31.3	29.7	31.4	35.4	33.4	5.76	6.58	6.17	6.58	7.14	6.86
L.S.D.	at 0.05													
A	B	C	1.13 , 2.54 , 1.09			1.85 , 2.70 , 1.12			0.67 , 0.85 , NS			0.78 , 0.76 , NS		
D	AB	AC	1.32 , NS , NS			1.90 , NS , NS			0.31 , NS , 0.72			0.37 , NS , 0.74		
AD	BC	BD	1.12 , NS , 1.4			2.83 , NS , 1.77			NS , NS , NS			NS , NS , NS		
CD	ABC	ABD	NS , NS , 1.05			NS , NS , 1.85			NS , NS , NS			NS , NS , NS		
ACD	BCD	ABCD	2.26 , 2.56 , NS			2.05 , 2.17 , NS			NS , NS , NS			NS , NS , NS		

-Without molybdenum   +With molybdenum

Table 9. Mean and significant of N , and P uptake in straw as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			N (kg/fed)						P (kg/fed)					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
30	0	-	19.5	19.6	19.6	21.4	22.6	22.0	1.55	1.84	1.70	1.82	2.24	2.03
		single	29.3	29.4	29.4	31.1	30.9	31.0	2.47	3.01	2.74	2.93	3.33	3.13
		dual	30.1	35.1	32.6	35.6	35.8	35.7	3.12	3.70	3.41	3.48	4.09	3.79
	mean		26.3	28.0	27.2	29.4	29.8	29.6	2.38	2.85	2.62	2.74	3.22	2.98
	13.1	-	30.9	30.9	30.9	30.8	30.6	30.7	3.33	3.87	3.60	3.61	4.18	3.90
		single	40.0	44.6	42.3	40.0	45.6	42.8	4.43	5.82	5.13	4.68	6.27	5.48
		dual	48.9	51.3	50.0	49.7	53.4	51.6	5.54	7.18	6.36	5.81	7.68	6.75
	mean		39.9	42.3	41.1	40.2	43.2	41.8	4.43	5.62	5.03	4.70	6.04	5.37
mean			33.1	35.2	34.2	34.8	36.5	35.7	3.41	4.24	3.83	3.72	4.63	4.18
60	0	-	34.0	35.2	34.6	37.4	37.6	37.5	2.62	3.26	2.94	3.02	3.55	3.29
		single	36.5	37.5	37.0	39.5	39.1	39.3	2.96	3.59	3.28	3.53	4.02	3.78
		dual	37.9	39.0	38.5	42.2	41.2	41.7	3.39	4.07	3.73	3.88	4.51	4.20
	mean		36.1	37.2	36.7	39.7	39.3	39.5	2.99	3.64	3.32	3.54	4.03	3.79
	13.1	-	48.3	49.1	48.7	50.2	50.5	50.4	5.27	6.35	5.81	5.53	6.43	5.98
		single	49.5	50.4	50.0	52.2	52.8	52.5	5.92	7.17	6.55	6.21	7.15	6.68
		dual	50.6	51.4	51.0	53.5	56.1	54.8	6.11	7.82	6.97	6.66	8.65	7.66
	mean		49.5	50.3	49.9	52.0	53.1	52.6	5.77	7.11	6.44	6.13	7.41	6.77
mean			42.8	43.8	43.3	45.9	46.2	46.1	4.38	5.38	4.88	4.84	5.72	5.28
D			38.0	39.5	38.8	40.3	41.3	40.8	3.89	4.80	4.35	4.27	4.59	4.43
Interactions														
B × D	0		31.2	32.6	31.9	34.6	34.6	34.6	2.69	3.25	2.97	3.14	3.63	3.39
	13.1		44.7	46.3	45.5	46.1	48.2	47.2	5.10	6.37	5.74	5.42	5.74	5.58
C × D		-	33.2	33.7	33.5	35.0	35.3	35.2	3.19	3.83	3.51	3.50	4.10	3.00
		single	38.8	40.5	39.7	40.7	42.1	41.4	3.95	4.88	4.42	4.34	5.19	4.77
		dual	41.9	44.2	43.1	45.3	46.6	46.0	4.54	5.69	5.12	4.96	6.08	5.52
A×C×D	30	-	25.2	25.3	25.3	26.1	26.6	26.4	2.44	2.86	2.65	2.72	3.21	2.97
		single	34.7	37.0	35.6	35.6	38.3	37.0	3.45	4.42	3.94	3.81	4.80	4.31
		dual	39.5	43.2	41.4	42.7	44.6	43.7	4.33	5.44	4.89	4.65	5.89	5.27
	60	-	41.2	42.2	41.7	43.8	44.1	44.0	3.95	4.81	4.38	4.28	4.99	4.64
		single	43.0	44.0	43.5	45.9	46.0	46.0	4.44	5.38	4.91	4.87	5.59	5.23
		dual	44.3	45.2	44.8	47.9	48.7	48.3	4.75	5.95	5.35	5.27	6.58	5.93
B×C×D	0	-	26.8	27.4	27.1	29.4	30.1	29.8	2.09	2.55	2.32	2.42	3.21	2.82
		single	32.9	33.5	33.2	35.3	35.0	35.2	2.72	3.30	3.01	3.23	3.68	3.46
		dual	34.0	37.1	35.6	38.9	38.5	38.7	3.26	3.89	3.58	3.68	4.30	3.99
	13.1	-	39.6	40.0	39.8	40.5	40.6	40.6	4.30	5.11	4.71	4.57	5.31	4.94
		single	44.8	47.5	46.2	46.1	49.2	47.7	5.18	6.50	5.84	5.45	6.71	6.08
		dual	49.8	51.4	50.6	51.6	54.8	53.2	5.83	7.50	6.67	6.24	8.17	7.21

L.S.D.	at 0.05					
A	B	C	2.15 , 3.07 , 2.34	2.63 , 1.98 , NS	0.82 , 0.69 , 0.44	0.76 , 0.63 , 0.46
D	AB	AC	0.36 , NS , 3.81	0.57 , NS , 4.99	0.46 , NS , 1.45	0.37 , NS , 1.89
AD	BC	BD	1.92 , NS , 1.6	1.2 , NS , 1.05	NS , 0.73 , NS	NS , 1.40 , NS
CD	ABC	ABD	1.04 , 3.0 , 1.52	0.96 , 3.1 , 1.25	0.82 , 0.85 , 0.66	0.66 , 0.63 , 0.71
ACD	BCD	ABCD	1.52 , 1.05 , NS	1.43 , 1.23 , NS	0.73 , 0.92 NS	0.83 , 0.94 , NS

-Without molybdenum +With molybdenum

Table 10. Mean and significant of K and Mo uptake in straw as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			K uptake (kg/fed)						**Mo uptake (g/fed)**					
			2013			**2014**			**2013**			**2014**		
			-	**+**	**mean**	**-**	**+**	**mean**	**-**	**+**	**mean**	**-**	**+**	**mean**
30	0	-	22.8	23.0	22.9	28.2	28.1	28.2	0.45	0.60	0.53	0.55	0.61	0.58
		single	34.3	34.1	34.2	41.8	42.1	42.0	0.90	0.95	0.93	0.89	1.04	0.97
		dual	42.4	42.7	42.6	53.8	53.5	53.7	1.25	1.30	1.28	1.31	1.40	1.36
	mean		33.2	33.3	33.3	41.3	41.2	41.3	0.87	0.95	0.91	0.92	1.02	0.97
	13.1	-	34.9	35.1	35.0	41.8	50.1	46.0	0.85	1.05	0.95	0.90	1.00	0.95
		single	46.3	53.8	50.1	55.8	66.0	60.9	1.27	1.49	1.38	1.27	1.50	1.39
		dual	58.1	67.5	62.8	71.1	82.1	76.6	1.59	1.84	1.72	1.53	1.92	1.73
	mean		46.4	52.1	49.3	56.2	66.1	61.2	1.24	1.46	1.35	1.23	1.47	1.35
mean			39.8	42.7	41.3	48.8	53.7	51.3	1.06	1.26	1.16	1.08	1.47	1.28
60	0	-	40.5	40.7	40.6	49.7	49.6	49.7	0.84	1.01	0.93	0.87	1.02	0.95
		single	42.2	42.4	42.3	52.3	52.4	52.4	1.06	1.01	1.04	1.02	1.29	1.16
		dual	43.9	44.0	44.0	54.3	55.5	54.9	1.33	1.20	1.17	1.37	1.60	1.49
	mean		42.2	42.4	42.3	52.1	52.5	52.3	1.08	1.07	1.06	1.09	1.30	1.20
	13.1	-	58.4	58.3	58.4	69.4	69.4	69.4	1.40	1.59	1.50	1.37	1.62	1.15
		single	61.4	62.3	61.9	71.9	71.9	71.9	1.55	1.81	1.68	1.61	1.81	1.71
		dual	64.0	64.2	64.1	73.9	74.0	74.0	1.78	1.93	1.86	1.80	2.14	1.96
	mean		61.3	61.6	61.5	71.7	71.8	71.8	1.58	1.78	1.68	1.59	1.87	1.73
mean			51.8	52.0	51.9	61.9	62.2	62.1	1.33	1.43	1.38	1.34	1.58	1.46
D			45.8	47.4	46.6	55.4	58.0	56.7	1.19	1.30	1.25	1.21	1.41	1.31
Interactions														
B × D	0		37.7	37.9	37.8	46.7	46.9	46.8	0.56.99	1.01	1.00	1.01	1.16	1.09
	13.1		53.9	56.9	55.4	65.1	69.0	67.1	1.4148.	1.63	1.52	1.41	1.67	1.54
C × D		-	39.2	39.3	39.3	47.3	49.3	48.3	0.89	1.06	0.98	0.92	1.06	0.99
		single	46.1	48.2	47.2	55.5	58.1	56.8	1.20	1.26	1.23	1.20	1.41	1.31
		dual	52.1	54.6	53.4	63.3	66.3	64.8	1.49	1.57	1.53	1.50	1.77	1.64
A×C×D	30	-	28.9	29.1	29.0	35.0	39.1	37.1	0.65	0.83	0.74	0.73	0.81	0.77
		single	40.3	44.0	42.2	48.8	54.1	51.5	1.09	1.22	1.16	1.08	1.27	1.16
		dual	50.3	55.1	52.7	62.5	67.8	65.7	1.42	1.57	1.50	1.42	1.66	1.54
	60	-	49.5	49.5	49.5	59.6	59.5	59.6	1.12	1.30	1.21	1.12	1.32	1.22
		single	51.8	52.4	52.1	62.1	62.2	62.2	1.31	1.41	1.36	1.32	1.55	1.44
		dual	54.0	54.1	54.1	64.1	64.8	64.5	1.56	1.57	1.57	1.59	1.87	1.73
B×C×D	0	-	31.7	31.9	31.8	39.0	38.9	39.0	0.65	0.81	0.73	0.71	0.82	0.77
		single	38.3	38.2	38.3	47.1	47.3	47.2	0.98	0.98	0.98	0.96	1.17	1.07
		dual	43.2	43.4	43.3	54.1	54.5	54.3	1.29	1.25	1.27	1.34	1.50	1.42
	13.1	-	46.7	46.7	46.7	55.6	59.8	57.7	1.13	1.32	1.23	1.14	1.31	1.23
		single	53.9	58.1	56.0	63.9	69.0	66.5	1.41	1.65	1.53	1.44	1.66	1.55
		dual	61.1	65.9	63.5	72.5	78.1	75.1	1.69	1.89	1.79	1.67	2.03	1.35
L.S.D.	at 0.05													
A	B	C	2.16 , 1.54 , 1.21			1.78 , 1.54 , 1.30			0.10 , 0.11 , 0.10			0.12 , 0.14 , 0.13		
D	AB	AC	1.05 , NS , NS			1.11 , NS , NS			0.13 , NS , NS			0.12 , NS , NS		
AD	BC	BD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		
CD	ABC	ABD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		
ACD	BCD	ABCD	NS , NS , NS			NS , NS , NS			NS , NS , NS			NS , NS , NS		

-Without molybdenum + With molybdenum

Table 11. Mean and significant of total N and P uptake as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D) N uptake (kg/fed) 2013 -	+	mean	2014 -	+	mean	P uptake (kg/fed) 2013 -	+	mean	2014 -	+	mean
		-	49.9	50.3	49.9	56.8	58.7	57.8	4.72	5.30	5.01	5.76	6.58	6.17
	0	single	71.9	72.3	72.2	81.5	81.8	81.7	7.54	9.40	7.97	8.53	9.53	9.03
		dual	82.3	87.4	84.9	97.3	97.1	97.2	9.40	10.4	9.90	10.6	11.7	11.1
30	mean		68.0	69.8	69.0	78.6	79.2	78.9	7.22	8.03	7.63	8.27	9.26	8.77
		-	75.1	76.4	75.8	83.2	94.0	88.6	9.26	11.6	10.3	10.2	11.7	11.5
	13.1	single	97.9	114.3	105.8	109.4	128.6	119.1	12.1	17.6	14.8	13.4	17.5	15.5
		dual	121.0	139.9	130.4	131.5	155.9	143.7	14.9	21.5	18.2	16.5	20.9	18.6
	mean		98.0	110.2	104.1	108.1	126.0	117.2	12.1	16.8	14.5	13.3	17.1	15.2
mean			83.0	90.1	86.6	93.4	102.6	98.1	10.2	12.4	11.1	10.8	13.2	12.0
		-	84.4	85.5	85.0	98.4	98.1	98.1	8.44	9.40	8.94	9.35	10.5	9.95
	0	single	88.4	113.4	100.9	101.7	100.4	101.1	8.98	10.4	9.71	10.2	11.5	10.8
		dual	90.5	93.3	92.0	106.1	108.3	147.2	14.8	10.7	10.3	10.9	12.3	11.6
60	mean		87.7	97.4	92.6	102.0	102.3	102.2	9.08	10.2	9.70	10.2	11.4	11.8
		-	121.7	119.9	120.8	135.8	137.7	136.8	15.2	18.8	17.0	16.4	18.6	17.5
	13.1	single	127.5	130.7	129.2	141.7	143.5	142.9	16.4	20.8	18.6	17.4	20.0	18.7
		dual	132.4	131.2	132.0	155.2	148.3	151.8	17.1	21.5	19.9	18.5	22.0	20.3
	mean		127.2	127.3	127.3	140.9	143.3	142.2	16.3	20.7	18.6	17.4	20.1	18.8
mean			107.5	112.4	110.0	121.5	122.3	122.3	12.7	15.5	14.1	13.8	15.7	15.0
D			95.3	101.2	98.3	107.4	112.7	109.5	11.2	13.9	12.6	12.3	13.9	13.1
Interactions														
	0		77.9	83.6	80.8	90.4	90.8	89.1	8.16	9.12	8.64	9.23	10.3	9.80
B × D	13.1		112.6	118.8	115.7	124.5	134.7	129.7	14.2	18.8	16.6	15.4	17.6	15.3
		-	82.8	82.9	82.9	93.5	97.1	95.4	9.39	11.2	10.3	10.4	10.5	10.5
C × D		single	96.4	107.7	102.1	108.6	113.7	111.2	11.3	14.3	12.8	12.4	14.6	13.5
		dual	106.6	113.0	109.9	120.1	127.3	123.8	12.8	16.3	14.6	14.1	16.6	15.3
		-	62.5	63.1	62.9	99.0	97.1	73.3	6.99	7.30	7.66	8.00	9.65	8.80
	30	single	85.0	93.3	88.9	95.5	105.3	100.5	9.80	13.0	11.4	11.0	13.5	12.1
A×C×D		dual	101.7	113.7	107.8	114.5	126.3	120.5	12.2	15.9	14.1	13.4	16.3	15.9
		-	103.1	102.8	103.0	117.0	118.0	117.6	11.8	14.1	13.0	13.0	14.6	13.7
	60	single	108.0	122.1	115.1	121.8	122.3	122.1	12.7	15.6	14.2	13.8	15.7	14.7
		dual	111.5	112.3	109.0	125.2	128.4	127.1	12.5	16.7	15.1	14.7	17.5	15.4
		-	67.2	67.6	67.4	77.5	78.4	78.0	6.59	7.37	6.98	7.60	8.87	8.22
	0	single	80.2	92.9	86.6	91.6	91.1	91.4	8.27	9.41	8.84	9.40	10.5	9.92
B×C×D		dual	86.4	90.4	88.5	101.7	101.7	102.2	9.61	10.6	10.1	10.7	12.0	11.4
		-	98.4	98.2	92.3	109.5	102.6	106.1	12.2	15.1	13.7	13.3	15.6	14.5
	13.1	single	112.8	122.5	117.7	125.6	136.4	132.1	14.3	19.2	16.8	15.4	18.7	17.1
		dual	126.8	135.6	131.2	124.5	131.6	128.1	15.9	22.0	18.9	17.4	21.5	19.4
L.S.D.	at 0.05													
A	B	C		3.36 , 4.78 , 2.75			4.09 , 5.19 , 2.86			1.05 , 1.54 , 1.07			1.17 , 1.36 , 1.13	
D	AB	AC		2.24 , NS , NS			3.09 , NS , NS			0.85 , NS , NS			0.71 , NS , NS	
AD	BC	BD		NS , NS , 5.71			NS , NS , 4.11			NS , NS , 1.35			NS , NS , 1.76	
CXD	ABC	ABD		3.6 , NS , 4.11			4.5 , NS , 5.35			3.36 , NS , 1.42			2.45 , NS , 1.34	
ACD	BCD	ABCD		3.72 , 2.85 , NS			3.86 , 2.25 , NS			2.95 , 2.06 , NS			2.16 , 2.18 , NS	

-Without molybdenum +With molybdenum

Table 12. Mean and significant of total K and Mo uptake as affected by N , P , Mo and dual inoculation as well as their interactions .

			Molybdenum (D)												
			K uptake (kg/fed)						Mo uptake (g/fed)						
N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	2013			2014			2013			2014			
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
		-	32.8	33.1	33.0	39.6	39.5	39.6	2.24	2.60	2.40	3.26	2.93	3.10
	0	single	50.1	49.8	50.0	61.0	60.2	60.6	3.53	3.84	3.67	4.71	4.48	4.60
		dual	63.4	63.6	63.5	77.7	77.1	77.4	4.29	5.21	4.76	5.36	6.01	5.69
30	mean		48.8	48.8	48.4	59.4	58.9	59.2	3.36	3.87	3.61	4.45	4.48	4.47
		-	48.4	49.7	49.1	57.1	67.6	62.4	4.84	4.61	4.74	4.90	5.95	5.43
	13.1	single	65.9	77.1	71.5	78.4	93.2	85.8	5.39	7.20	6.31	6.87	7.01	7.40
		dual	83.8	98.2	91.0	100.4	117.3	108.9	6.28	8.07	7.68	8.48	9.62	9.06
	mean		66.0	75.0	70.1	78.6	92.7	85.7	5.86	6.63	6.25	6.75	7.86	7.29
mean			57.4	61.9	59.7	69.0	75.8	72.4	4.62	5.31	4.96	5.61	6.41	6.00
		-	56.7	56.8	56.8	68.0	67.5	67.8	3.81	4.57	4.20	4.73	3.35	4.55
	0	single	60.6	61.7	61.2	73.6	74.8	47.2	5.11	4.22	4.62	4.45	5.81	5.14
		dual	64.8	65.7	65.3	78.3	81.2	79.8	4.47	5.29	4.79	5.27	6.58	5.93
60	mean		60.7	61.4	61.1	73.3	74.5	73.9	4.44	4.69	4.55	4.81	5.58	5.21
		-	81.3	82.8	82.1	94.5	96.5	95.5	6.64	7.90	7.28	8.32	8.35	8.79
	13.1	single	87.8	90.3	89.1	101.1	102.5	101.8	8.11	8.20	8.13	8.96	9.66	9.21
		dual	94.3	96.1	95.2	107.3	109.5	108.4	7.61	8.85	8.24	8.01	8.72	8.36
	mean		87.8	89.7	88.8	101.0	102.8	101.9	7.46	8.32	7.89	8.36	8.93	8.35
mean			72.6	75.6	74.1	87.2	88.7	88.0	5.95	6.52	6.23	6.59	4.25	6.93
D			65.0	68.8	66.9	78.1	82.3	80.2	5.28	5.86	5.58	6.10	6.70	6.40
Interactions														
	0		54.8	55.1	55.0	66.4	66.7	66.6	2.91	4.28	4.10	4.64	5.03	4.85
B × D	13.1		76.9	82.4	79.7	89.8	97.8	93.8	6.66	7.49	7.07	7.56	8.40	7.97
		-	54.8	55.6	55.2	64.8	67.8	66.3	4.41	4.91	4.65	5.30	5.39	5.35
C × D		single	66.1	69.7	67.9	78.5	82.7	80.6	5.52	5.81	5.67	6.20	7.29	7.60
		dual	76.6	80.9	78.8	90.9	96.3	93.6	5.92	6.86	6.39	6.78	7.74	7.27
A×C×D		-	40.6	41.4	41.0	48.4	53.6	51.0	3.55	3.59	3.57	4.19	4.45	4.27
	30	single	58.0	63.5	60.8	69.7	76.7	73.2	4.48	5.52	5.01	5.79	6.25	6.01
		dual	73.6	80.9	77.3	89.1	97.2	93.2	5.85	6.86	6.36	7.70	7.63	7.17
		-	69.0	69.8	69.4	81.3	82.0	81.7	5.23	6.29	5.47	6.53	6.35	6.44
	60	single	74.2	76.0	75.1	87.4	88.7	88.1	6.57	6.21	6.39	6.61	7.74	7.21
		dual	79.6	80.9	80.3	92.8	95.4	94.1	6.05	7.08	6.57	6.65	7.65	7.22
B×C×D		-	44.8	45.0	44.9	53.8	53.5	53.7	3.03	3.57	3.30	4.00	3.65	3.83
	0	single	55.4	55.8	55.6	67.3	67.5	67.4	4.27	4.03	3.65	4.59	5.15	4.88
		dual	64.1	64.7	64.4	78.0	79.2	78.6	4.38	5.25	4.82	5.32	6.30	6.81
		-	64.9	66.3	65.6	75.8	82.1	79.0	5.76	6.21	6.02	6.62	7.15	6.89
	13.1	single	76.9	83.7	80.3	89.8	97.9	93.9	5.76	7.70	7.23	7.82	8.84	8.33
		dual	89.1	97.2	93.2	103.9	113.4	108.7	7.45	8.47	7.96	8.23	9.17	9.21
L.S.D.	at 0.05													
A	B	C		2.15 , 3.91 , 2.05			2.37 , 4.11 , 2.11			0.86 , 1.03 , 0.77			0.61 , 1.16 , 0.65	
D	AB	AC		3.16 , NS , NS			2.72 , NS , NS			0.54 , NS , NS			0.64 , NS , NS	
AD	BC	BD		NS , NS , 2.85			NS , NS , 2.71			NS , NS , 0.87			NS , NS , 0.96	
CD	ABC	ABD		2.22 , NS , 1.66			4.60 , NS , 2.2			NS , NS , NS			NS , NS , NS	
ACD	BCD	ABCD		NS , 3.78 , NS			NS , 3.19 , NS			0.63 , 0.75 , NS			0.56 , 0.59 , NS	

-Without molybdenum +With molybdenum

Protein and oil percentages and yields .

The data in Tables (13 and 14) present the effect of microbial treatments as well as N , P and Mo fertilization on protein and oil percentages and yields in soybean seeds . The results reveal that protein percentage and yield (kg/fed) were increased due to N , P , Mo and microbial application , except protein % which was not affected by nitrogen treatments . It could be mentioned that the effect of the studied treatments and their interactions on protein % had the same effect as on nitrogen % in seeds (Table, 3) , since protein percentage calculated as nitrogen percentage multiplied by 6.25 . On the other hand, oil % was not affected by the studied treatments and their interactions in both seasons .

The data show that both protein and oil yields were significantly responded to nitrogen , phosphorus , molybdenum and microbial treatments . The addition of 60 kg N , 13.1 kg P , 5 kg molybdate sodium or dual inoculation with rhizobium + bio-fertilizer were improved both protein and oil yields . The data from the interaction among treatments indicated that the highest values of protein or oil yields were recorded for the plants supplied with 30 kg N + 13.1 kg P + 5 kg sodium molybdate /fed and inoculated with rhizobium plus bio-fertilizer . On the other hand, the plants fertilized with 60 kg N/fed without P , Mo or microbial inoculation excreted the lowest protein and oil yields .

Table 13. Mean and significant of protein and oil percentage in seeds as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			Protein (%)						Oil (%)					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
30	0	-	26.4	26.5	26.5	25.9	26.0	26.4	19.1	19.2	19.2	18.5	18.4	18.5
		single	27.5	27.6	27.6	27.3	27.2	27.3	19.1	19.1	19.1	18.5	18.5	18.5
		dual	28.7	28.7	28.7	28.4	28.4	28.4	19.1	19.1	19.2	18.5	18.4	18.5
	mean		27.6	27.6	27.6	27.2	27.2	27.2	19.2	19.2	19.2	18.5	18.4	18.5
	13.1	-	28.9	29.7	29.3	28.8	29.8	29.3	19.2	19.1	19.1	18.4	18.4	18.4
		single	29.9	30.8	30.4	29.8	30.9	30.4	19.1	19.1	19.1	18.5	18.5	18.5
		dual	32.1	34.4	33.3	30.6	33.3	32.0	19.1	19.1	19.1	18.4	18.5	18.5
	mean		30.3	31.6	31.0	29.7	31.3	30.5	19.1	19.1	19.2	18.4	18.5	18.5
mean			29.0	29.6	29.3	28.5	29.3	28.9	19.2	19.2	19.2	18.5	18.5	18.5
60	0	-	27.6	27.5	27.6	27.6	27.6	27.6	19.2	19.1	19.2	18.5	18.4	18.5
		single	28.6	28.6	28.6	28.3	27.9	28.1	19.1	19.2	19.2	18.4	18.5	18.5
		dual	29.5	29.6	29.6	28.9	28.8	28.9	19.2	19.2	19.2	18.5	18.5	18.5
	mean		28.6	28.6	28.6	28.3	28.1	28.2	19.2	19.2	19.2	18.5	18.5	18.5
	13.1	-	28.3	28.9	28.6	28.1	28.8	28.5	19.2	19.1	19.2	18.4	18.5	18.5
		single	29.8	30.3	30.1	29.5	29.9	29.7	19.2	19.2	19.2	18.4	18.4	18.4
		dual	30.6	31.0	30.8	30.2	30.4	30.3	19.1	19.2	19.2	18.5	18.4	18.4
	mean		29.6	30.1	29.9	29.3	29.7	29.5	19.2	19.2	19.2	18.5	18.4	18.4
mean			29.1	29.4	29.3	28.8	28.9	28.9	19.2	19.2	19.2	18.5	18.4	18.4
D			29.0	29.5	29.3	28.6	29.1	28.9	19.2	19.2	19.2	18.5	18.5	18.5
Interactions														
B × D	0		28.1	28.1	28.1	27.8	27.7	27.8	19.2	19.2	19.2	18.5	18.5	18.5
	13.1		30.0	31.3	30.7	29.5	30.5	30.0	19.2	19.2	19.2	18.5	18.5	18.5
C × D		-	27.8	28.2	28.0	27.6	28.1	27.9	19.2	19.2	19.2	18.5	18.5	18.5
		single	29.0	29.3	29.2	28.7	29.0	28.9	19.1	19.2	19.2	18.5	18.5	18.5
		dual	30.2	30.9	30.6	29.5	30.2	29.9	19.2	19.2	19.2	18.5	18.5	18.5
A×C×D	30	-	27.7	28.1	27.9	27.4	27.9	27.7	19.2	19.2	19.2	18.5	18.5	18.5
		single	28.7	29.3	29.0	28.6	29.1	28.9	19.2	19.2	19.2	18.5	18.5	18.5
		dual	30.4	31.6	31.0	29.5	30.9	30.2	19.2	19.2	19.2	18.5	18.5	18.5
	60	-	28.0	28.2	28.1	27.9	28.2	28.1	19.2	19.2	19.2	18.5	18.5	18.5
		single	29.2	29.5	29.4	28.9	28.9	28.9	19.2	19.2	19.2	18.5	18.5	18.5
		dual	30.1	30.3	30.2	29.6	29.6	29.6	19.2	19.2	19.2	18.5	18.5	18.5
B×C×D	0	-	27.0	27.0	27.0	26.8	26.8	26.8	19.2	19.2	19.2	18.5	18.5	18.5
		single	28.1	28.1	28.1	27.8	27.6	27.7	19.2	19.2	19.2	18.5	18.5	18.5
		dual	29.1	29.2	29.2	28.7	28.6	28.7	19.2	19.2	19.2	18.5	18.5	18.5
	13.1	-	28.6	29.3	29.0	28.4	29.3	28.9	19.2	19.2	19.2	18.5	18.5	18.5
		single	29.9	30.6	30.3	29.7	30.4	30.1	19.2	19.2	19.2	18.5	18.5	18.5
		dual	31.4	32.7	32.1	30.4	31.9	31.2	19.2	19.2	19.2	18.5	18.5	18.5

L.S.D.	at 0.05		Protein 2013	Protein 2014	Oil 2013	Oil 2014
A	B	C	NS , 0.32 , 0.30	NS ,0.36 , 0.37	NS , NS , NS	NS , NS , NS
D	AB	AC	0.33 , 0.34 , NS	0.20 , 0.41 , NS	NS , NS , NS	NS , NS , NS
AD	BC	BD	0.47 , NS , 0.51	0.37 , NS , 0.42	NS , NS , NS	NS , NS , NS
CD	ABC	ABD	NS , NS , 0.44	NS , NS , 0.36	NS , NS , NS	NS , NS , NS
ACD	BCD	ABCD	NS , 0.53 , 1.2	NS , 0.56 , 0.93	NS , NS , NS	NS , NS , NS

-Without molybdenum +With molybdenum

Table 14. Mean and significant of protein and oil yields in seeds as affected by N , P , Mo and dual inoculation as well as their interactions .

N(kg/fed) (A)	P(kg/fed) (B)	Inoculation (c)	Molybdenum (D)											
			Protein yield (kg/fed)						Oil yield (kg/fed)					
			2013			2014			2013			2014		
			-	+	mean	-	+	mean	-	+	mean	-	+	mean
		-	188.2	189.4	188.8	223.1	223.8	223.5	135.6	138.2	136.9	159.1	158.2	158.7
	0	single	267.5	266.3	266.9	316.9	317.5	317.2	185.2	185.2	185.2	214.6	216.5	215.6
		dual	326.3	326.9	326.6	385.6	383.1	384.4	218.9	217.7	218.1	251.6	248.4	250.0
30	mean		260.7	260.9	260.8	308.8	308.1	308.5	179.9	180.4	180.2	208.4	207.7	208.1
		-	276.3	289.4	282.9	327.1	396.7	361.9	184.3	183.4	183.9	209.8	244.7	227.3
	13.1	single	362.2	435.3	398.8	434.5	519.1	476.9	231.1	271.2	251.2	270.1	310.8	290.5
		dual	451.2	553.2	502.2	511.8	636.8	574.3	268.6	307.5	288.1	307.3	353.4	330.3
	mean		363.2	426.0	394.6	397.2	517.5	457.4	228.0	254.0	241.0	262.4	303.0	282.7
	mean		312.0	343.5	327.8	353.0	412.8	382.9	303.9	217.2	210.6	235.4	255.4	245.4
		-	315.5	314.2	314.9	380.3	380.1	380.2	218.9	217.7	218.3	255.3	252.1	253.7
	0	single	324.6	326.8	325.7	388.8	383.2	386.0	218.9	218.9	218.9	253.9	255.3	254.6
		dual	338.7	339.6	339.2	399.1	397.2	398.2	220.8	220.8	220.8	255.3	255.3	255.3
60	mean		326.3	326.9	326.6	389.4	386.8	388.1	219.5	219.1	219.3	254.8	254.2	254.5
		-	457.4	465.4	461.4	534.9	545.2	540.1	311.0	307.5	306.2	349.6	351.5	350.6
	13.1	single	487.8	501.6	494.7	560.5	570.3	565.4	314.9	318.7	316.8	349.6	351.2	350.4
		dual	511.5	516.5	514.0	574.0	576.8	575.4	319.4	321.3	320.4	351.3	348.9	350.1
	mean		485.6	494.5	490.1	556.5	564.1	560.3	315.1	315.8	315.5	350.2	350.5	350.3
mean			406.0	410.7	408.4	473.0	475.5	474.3	267.3	267.5	267.4	303.0	302.4	302.7
D			358.9	377.1	368.0	419.7	444.2	432.0	235.6	242.3	238.9	296.0	278.9	273.9
Interactions														
	0		293.5	293.9	293.7	349.1	347.5	348.3	199.7	199.8	199.8	231.6	231.0	231.3
B × D	13.1		424.4	460.3	442.4	476.9	540.8	508.9	271.6	284.9	278.3	306.3	326.8	316.6
		-	309.4	314.6	312.0	366.4	386.5	376.5	212.5	211.7	212.1	249.5	251.6	247.6
C × D		single	360.5	382.5	371.5	425.2	447.5	436.4	237.4	248.2	242.8	279.1	283.5	277.8
		dual	406.9	434.1	420.5	467.6	498.5	483.1	256.9	266.8	261.9	291.4	301.5	296.5
A×C×D		-	232.3	239.4	235.9	275.1	310.3	292.7	160.0	160.8	160.4	184.5	201.5	193.0
	30	single	314.9	350.8	332.9	375.7	418.3	397.0	208.2	208.2	208.2	212.2	263.7	237.9
		dual	388.8	440.1	414.5	448.7	510.0	479.4	243.3	262.6	253.2	279.5	309.0	230.2
		-	386.5	389.8	388.2	457.6	462.7	460.2	265.0	262.2	263.7	302.5	301.8	302.2
	60	single	406.2	414.2	410.2	474.7	476.8	471.3	266.9	268.8	267.9	301.8	303.3	302.6
		dual	425.1	428.1	426.6	486.6	487.0	486.8	270.1	271.1	270.6	303.3	302.1	302.7
B×C×D		-	251.9	251.8	251.9	301.7	302.0	301.9	177.3	178.0	177.7	207.2	205.2	206.2
	0	single	296.1	296.6	296.4	352.9	350.4	351.7	208.2	202.1	205.2	234.3	235.9	235.1
		dual	332.5	333.3	332.9	392.4	390.2	391.3	219.9	219.3	219.6	253.3	251.9	252.7
		-	366.9	377.4	372.2	431.0	471.0	451.0	247.7	245.5	246.6	279.7	298.1	288.9
	13.1	single	425.0	468.5	446.8	497.5	544.7	521.1	273.0	295.0	284.0	309.9	331.0	320.5
		dual	481.4	534.9	508.2	542.9	606.8	574.9	294.0	314.4	304.2	329.3	351.2	340.3
L.S.D.	at 0.05													
A	B	C	9.15 , 10.25 , 9.35			11.54 , 10.13 , 9.72			6.09 , 8.61 , 5.56			7.54 , 9.17 , 4.91		
D	AB	AC	5.11 , NS , NS			4.36 , NS , NS			3.36 , NS , NS			3.85 , NS , NS		
AD	BC	BD	NS , NS , 15.91			NS , NS , 17.33			NS , NS , 2.09			NS , NS , 2.28		
CD	ABC	ABD	12.03 , NS ,19.31			19.11 , NS , 18.03			NS , NS , 5.61			NS , NS , 4.87		
ACD	BCD	ABCD	13.31 , 11.35 , NS			14.14 , 13.51 , NS			5.19 , 7.80 , NS			8.09 , 7.92 , NS		

-Without molybdenum +With molybdenum

DISCUSSION

The results of the present investigation revealed that rhizobium and bio-fertilizers, which most of it's respective number is azospirilium had a positively affected soybean growth as plant height and dry weight /plant , seed and straw yields, nutrient content and uptake in seeds and straw and protein percentage and yield comparing with control (without bacterial inoculation). This increments may be related to early nodulation , which encourage root development (Volpin and Kapulnic , 1994) . Tien *et al* (1979) reported that the increase in nodulation and plant growth of soybean attributed to production of growth promoting substances by bacteria . Growth promoting of soybean by inoculation with Bradyrizobium was reported by Rahmani and Saleh (2001) in N-deficient soil . Egamberdiyeva *et al* (2004a) reported that rhizobia inoculation of soybean increased shoot and root dry weight by 7-23% and 5.7 – 78% , respectively . Sobral *et al* (2004) found that isolated Bradyrizobium was able to produce IAA, solubilize phosphate and fix nitrogen which could be used for soybean growth promotion . The increase in mineral uptake (N,P,K and Mo) may be due to the increase in root length rate which was improved after dual inoculation (Dobbeleare and Okon , 2007) . The essential effect of co-inoculation on increasing susceptibility to rhizobia infection may be that due to bio-fertilizer stimulates the formation of large number of epidermal cells that differentiate into infectable root hairs (Yahalom *et al* , 1987) . In a similar manner , Okon and Kapulnik (1986) indicated that the improvement of root proliferation , water status and mineral uptake of plant was due to azospirillum . These results were in line with those obtained by Malike *et al* (2006) and Qureshi *et al* (1986) for growth parameters and Kumage and Ofori (2004) and Abbasi *et al* (2013) for nutrients uptake .Positive effects of increasing N-fertilizer application on plant height and dry weight of soybean have been observed in case of the individual N application , while the nutrients content were not affected . On the other hand , increasing N levels had a negative effect on soybean growth when combined with bacterial inoculation , where 30 kg N/fed + dual bacterial inoculation yielded tallest and heaviest plants . In this concern , Norhayati *et al* (1988) mentioned that the positive effects of nitrogen application on soybean have been observed in the same investigated field , but not in others, Herridege and Brorckwell (1988). Many factors for this variation such as growth conditions , management practice , initail level of soil fertility , native rhizobia population or the timing of N application could be cited (Peopls et al, 1995) . On the other hand , a high rate of chemical N increased nitrate concentration in soybean seeds , hence reduced quality of soybean (Diep *et al* , 2002) . The higher amounts of N seem inhibitory to N_2 – fixation (Yanni,1992) . These results are similar to these obtained by Salvagiotti *et al* (2008) .

There were high increase in soybean growth , i.e. plant height , nutrient concentration and uptake as well as protein and oil percentages and yields after addition of 13.1 kg P/fed . Higher values of these traits due to P application were mainly due to the direct effect of P on the root growth and its development (Srivastava and Ahlawat, 1995) . Abbasi *et al* (2013) mentioned that the P supply in soil had an important role in nitrogen fixation in soybean . This was supported with three lines of evidence . First , increasing in P supply increased the total number of root nodules , second ,P supply increased N concentration in shoots and N uptake by soybean plants, and the third , N in shoots correlated significantly with P concentration in shoot . In addition , Kandil *et al* (2013) reported that growth parameters were significantly increased by application of P fertilizer in the absence or presence of Mo fertilizer . Phosphorus is important for cell divination activity , leading to increase plant height and number of branches and consequently plant dry weight (Thalooth et al, 1981 and Tesfaye *et al* , 2007) . P has a synergistic effect on Mo uptake by plants . A stimulating effect of phosphorus on Mo availability is apparently due to the formation of highly soluble phospho molybdate complex. These results are in line with those obtained by Kumaga and Ofori (2004) and Abassi *et al* (2013) .

Results obtained in the present study have indicated a positive effect of Mo application on phosphorus and molybdenum concentration and uptake . Also, Mo application improved growth and yields of soybean and nitrogen content in seeds and straw only under 30 kg N/fed , while increasing N levels to 60 kg/fed inhibited the positive effect of Mo on plant height and dry weight as well as seed and straw yields and N content . In this concern , Yanni (1992) mentioned that the relative enhancement of nodule development due to Mo decreased with increasing the rate of N , consequently inhibited growth, yields and nutrient uptake . Kandil *et al* (2013) pointed out that there were a synergistic effects on growth parameters and yields between Mo and P fertilizers which added P enhance the beneficial effect of Mo of common bean varieties . The positive effect of Mo on soybean growth is mainly due to , Mo is directly involved in nitrogen fixing enzymes nitrogenase and nitrogen reduction enzyme , nitrate reductase especially for legumes forming root nodules . Its application can play a vital role in increasing growth of legumes through its effect on plant itself and also on the nitrogen fixation process by rhizobium . Sharm *et al* (1988) observed that molybdenum was responsible for the formation of nodule tissue and in increase nitrogen fixation and without adequate quantities of Mo nitrogen fixation could not occur and microbial activity was depressed . These results are in accordance with those obtained by Liu *et al* (2005) and Khan *et al* (2014) .

As for the interactions among treatments the results reveal that increasing nitrogen level from 30 to 60 kg/fed significantly decreased the effect of microorganisms inoculation or molybdenum on soybean growth , yields and nutrient content . Where , 5 kg sodium molybdate increased plant height and dry weight and seed and straw yields (A× C×D) along with dual inoculation by about 1.3 ,8.2 , 1.9 and 5.3 % under 30 kg N/fed when compare with no Mo in the first season , respectively . The corresponding values for the second season were 1.3 ,7.9 , 3.4 and 5.9 % in the same respect . Meanwhile , Mo application did not significantly affect soybean growth and yields along with microbial inoculation for the plants received 60 kg N/fed . Similar results were obtained by Yanni (1992) . On the other hand, P had a synergistic effect on the improving soybean growth and yields cauld be Mo . Moreover , Mo application did not affect soybean growth under zero phosphorus . Mixed bio-fertilizer with rhizobia enhanced the growth parameters than single rhizobia inoculation treatment . The results of the interaction among the four factors revealed that , in general , the highest growth , yields and nutrient content were recorded under the treatment of 30 kg

N/fed + 13.1 kg P/fed + dual inoculation with rhizobia and bio-fertilizer + 5 kg sodium molybdate / fed . Many authors stated the beneficial effect of the combined dual inoculation with bio-fertilizer plus low nitrogen level and P and Mo application to improve growth and yields of soybean plants and quality of its seeds such as Yanni (1992) for rhizobia + Mo on chickpea ; Ranaweara (1992) for N and Mo on soybean , Bhuiyan *et al* (2008) for P, Mo and rhizobia inoculation on mungbean and Abdul Jabbar and Saud (2012) for Mo and rhizobia + azospirillum on soybean .

CONCLUSION

It could be concluded that inoculated soybean plants with rhizobia combined with bio fertilizer(biogen) and fertilized with 30 kg N /fed +5 kg molybdate sodium/fed enhanced soybean growth, yields and protein and oil percentages and yields under the Middle Egypt conditions .

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تاثير التلقيح البكتيرى تحت ظروف التسميد الحيوى والكيماوى وتداخلاتهم على فول الصويا كما ونوعا

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فى محطة بحوث سدس (مركز البحوث الزراعيه) بمحافظة بنى سويف أجريت تجربتان حقليتان فى أربع عوامل و أربع مكررات وكان التصميم المستخدم قطاعات كاملة العشوائيه لدراسة تأثير التلقيح بالريزوبيوم فى وجود أو عدم وجود السماد الحيوى (بيوجين) واضافة النتروجين والفوسفور والموليبدنم على النمو (طول النبات ، الوزن الجاف) – ومحصول الحبوب والقش لنبات فول الصويا ، وتركيز وامتصاص النتروجين (ن) والفوسفور (فو) والموليبدنم (مو) فى الحبوب والقش وكذلك نسبة ومحصول البروتين والزيت فى الحبوب.وكانت أهم النتائج كما يلى :- أثر التلقيح الميكروبى سواء التلقيح بالريزوبيم أو السماد الحيوى أو الأثنين معا تأثيرا ايجابيا على طول النبات – الوزن الجاف - محصول الحبوب والقش – امتصاص النتروجين والفوسفور والبوتاسيوم – نسبة البروتين .سجلت أعلى قيم لصفات النمو والمحصول وتركيز النتروجين وأمتصاص المغذيات عند التسميد 60 كجم ن/فدان بدون تلقيح بكتيرى او عند التسميد بمعدل 30 كجم ن/فدان مع التلقيح البكتيرى .اضافة الفوسفور بمعدل 13.1 كجم فو/فدان أدت الى زيادة طول النبات والوزن الجاف والمحصول وتركيز الفوسفور فى الحبوب والقش وأمتصاص ن ، فو ، البوتايسوم (بو) وكذلك نسبة البروتين والزيت .اضافة الموليبدنم فى صوره أرضيه أدى الى زيادة معنويه فى صفات النمو والمحصول وتركيز النتروجين وايضا امتصاص كل من النتروجين والبوتاسيوم بينما انخفض تركيز الفوسفور وامتصاصه فى الحبوب والقش وكذلك نسبة الزيت . ومن نتائج البحث يمكن التوصيه بالتلقيح المزدوج بالريزوبيا والاسمده الحيويه وكذلك أضافة 30 كجم نتروجين/فدان + 13.1 كم فوسفور /فدان + 5 كم موليبدات صوديوم/فدان وذلك لتحسين نمو ومحصول وامتصاص العناصر ومحصول البروتين والزيت لمحصول فول الصويا تحت ظروف منطقة مصر الوسطى .