EFFECTS OF BRADYRHIZOBUM INOCULATION, NITROGEN FERTILIZER AND FOLIAR APPLICATION WITH MOLYBDENUM ON SEED YIELD AND QUALITY OF LUPIN (*LUPINUS TERMIS*, L)

Mehasen S.A.S. and El-Gizawy N. Kh. B

Agronomy Dept., Fac. Agric. Moshtohor , Zagazig Univ. Egypt

ABSTRACT

Two field experiments were carried out at the Agricultural Research and Experimental Center, Faculty of Agriculture at Moshtohor, Zagazig University, during 2001/ 2002 and 2002 / 2003 seasons to study the effect of Bradyrhizobum inoculation , nitrogen fertilizer rates and foliar application with molybdenum on yield , its components and seed quality of lupin cv. Giza 1. Each experiment included 12 treatments which were the combination between two inoculation treatments (uninoculation and inoculation), three N rates (0 , 15 and 30 kg N/fed) and two spraying treatments with Mo (tap water and 30 ppm). The obtained results of each season and the combined analysis of two seasons revealed that:-

1-Inoculated plants significantly surpassed uninoculated ones in number of nodules/plant , plant height , number of branches and pods / plant , seed yield/plant, 100- seed weight and seed yield/fed . Number of seeds/pod , pods weight/plant , seed N content % and seed protein content % were not affected by inoculation.

2-Adding nitrogen fertilizer to lupin plants caused an increase in all traits studied. Nitrogen fertilization at a rate of 30 kg N/fed increased seed yield/fed over unfertilized plants and that received 15 kg N/fed by 38.8 and 7.7 %, 35.4 and 6.7 % and 37.0 and 7.2 % in the first season, second season and combined , respectively.

3-Molybdenum application effect on all traits studied were significant in the 1st and 2nd seasons as well as combined analysis except plant height and seed yield/fed in the first season and number of seeds/pod in the 2nd season.

4-Inoculation x N rates interaction had significant effect on nodules number/plant, plant height, seed and protein yields/fed and N uptake/fed., while number of nodules/plant and seed yield/plant were significantly affected by the interaction between Mo spraying and N rates.

INTRODUCTION

Lupin is considered one of the legumes with the promising future potential due to its high protein content as well as its adaptation to poor soils and dry climates. It has been used as a green manure, forage and seeds for human usage because of its high protein content. Like other seed legumes, lupin plant is able to fix atmospheric nitrogen in the soil that increase soil fertility with no additional cost or effort particularly in reclaimed soils and, therefore lupin appear to have useful effect in such areas. Inoculation of lupin seeds with rhizobium , foliar application with molybdenum and nitrogen fertilizer are among factors affecting considerably soil coverage. **Ayisi *et al.* (1992)** found that seed yield of inoculated plots increased by an average of 51 % in

1988 and two to five fold in 1989 and 1990 , respectively, compared with non-inoculated control. Yield increase were due to changes in pod number or seed weight, depending upon the year of evaluation. Inoculation resulted in seed protein increase from 28 to 45 % greater than non-inoculated control. Also, **Hob Allah *et al.* (2001**) reported that inoculated plants were taller with more branches and pods / plant , more seeds / pod and higher in seed weight than the non-inoculated plants. On the other hand, **Larson *et al.* (1989**) working with fall-sown white lupin ,found no significant difference in the yield of inoculated or non-inoculated plants by native Bradyrhizonium populations.

Although lupin plant is Legumious crop, low rate of N fertilizer may be needed for early growth and during the entire growing season when symbiotic N_2-fixation by rizobium is inhibited (**Westerman *et al*., 1981 and Eaglesham *et al.* 1983**). In studies reviewed by **Lopez-Bellido and Fuentes (1986),** clear increases in lupin seed yield due to N fertilizer applications occurred only on soils without initial effective bradyrhizobium populations. **Abo-Shetaia(1990**) indicated that increasing nitrogen from 45 to 75 kg N/fed increased yield attributes. However, seed inoculation only and N fertilizer only or both together significantly increased seed yield and its components as compared to the control treatment (**HobAllah and Kandil, 2001**). Increasing nitrogen from 30 to 45 kg N/fed increased yield attributed. Whereas , adding nitrogen fertilization at a rate of 45 kg N/fed increased seed yield/fed over the plants which fertilized by 30 and 60 kg N/fed by 190 and 100 kg seeds/fed, respectively (**Mokhtar, 2002**).

El-Karamity and Hammad (1992) stated that Mo , Bo and Zn significantly increased number and dry weight of root nodules as well as N- content of soybean plants**. Hanna and Eisa (1998**) demonstrated that molybdenum application to soybean increased seed yield , number of pods/plant and nitrogen in seeds. **Abdel-Aziz and Anton (1999**) found that when Mo was added alone at the rate of 30 ppm, faba bean growth was found to be more as compared with the first mixture (Fe + Zn + Mn) but less than the mixture of the four elements (Fe + Zn + Mn + Mo). Furthermore**, Mehasen and El-Ghozoli (2003)** reported that spraying with Fe or Mo statistically increased number of pods / plant , weight of pods and seeds/plant, seed and protein yields/fed of soybean during the two growing seasons. This study was raised to determine the influence of inoculation with *Bradyrhizobium lupinus*, nitrogen fertilizer and foliar application with molybdenum on yield, yield components and quality of lupin.

MATERIALS AND METHODS

Two field experiments were carried out at the Agric. Res. and Exper. Cent .of the Fac.of Agric., Moshtohor, Zagazig Univ., Egypt during 2001 / 2002 and 2002 / 2003 seasons to study the effect of inoculation with *Bradyrhizobium lupinus*, nitrogen fertilizer rates and spraying with molybdenum on yield , yield components and seed quality of lupin plants cv. Giza 1 .

Each experiment included 12 treatments which were the combination of two inoculation treatments (uninoculated – inoculated), three levels of nitrogen fertilizer (zero , 15 and 30 kg N / fed) and two spraying treatments with molybdenum (Tap water – 30 ppm as ammonium molybdate). The soil of the experiment was clay loame in texture with pH of 8.01 and contained 0.12 % total N, 2.0 % organic matter, 3.80 %

$CaCO_3$ and 0.23 ppm available Mo average of both seasons. The preceding crop was maize in both seasons. The split plot design in four replication was applied where inoculation treatments occupied the main plots. Every main plot was subdivided into six subplots to take all combinations (3x2) of the N levels and spraying with molybdenum. The area of sub-plot was 10.5 m^2 consisting of 5 ridges 60 cm intra ridge spacing and 3.5 meters length , 30 cm between hills and planting seeds on both sides of ridges. Calcium super phosphate (15.5 % P_2O_5) at rate of 150 kg / fed was added at seed bed preparation. Seeds were inoculated just before planting with *Bradyrhizobium lupinu*, which was provide by Soil Microbiology Department, ARC, Giza. The sowing dates were Nov. 19th and 11th in the first and second seasons, respectively. Nitrogen , as ammonium nitrate (33.5%) applied at two equal doses at sowing and before the first irrigation. Thinning was done three weeks after emergence to 2 plants/hill. Lupin plants were sprayed once with the aqueous solution of this molybdenum 40th day after sowing. The volume of the sprayed aqueous solution of this molybdenum was 400 L / fed.(*using hand sprayer 1 L.*) Before spraying Mo solution tested on a few plants first. The normal cultural practices for growing lupin were used

At age of 50 days, five plants were chosen at random from each sub-plot and carefully uprooted. The root nodules were counted and expressed as number of nodules / plant. At harvest ,ten guarded plants were randomly taken from the middle ridges of each sub-plot to measure plant height (cm), number of branches and pods / plant , number of seeds / pod, 100- seed weight (g), pods weight/plant (g) and seed yield / plant (g). Seed yield / fed was estimated from the whole sub-plot. Total N content of seed was determined according to **A.O.A.C. (1990**). Protein content was calculated by multiplying percent of N by 6.25, protein yield kg/fed was calculated by multiplying protein % in seeds by seed yield/fed. and N uptake kg/fed was calculated by multiplying N % in seeds by seed yield/fed .

Data were statistically analyzed according to **Gomez and Gomez (1983**) using the MSTAT-C Statistical Software package (**Michigan State University, 1983**). Test of homogeneity of the data was applied, then combined analysis of variance was performed over the first and second seasons. For comparison between means Duncan's multiple range test was used **(1955).**

RESULTS AND DISCUSSION

I- Effect of growing seasons.

Data in Table 1. show that non significant seasonal effects existed for all characters studied except number of seeds / pod and 100- seed weight. Higher mean values for both traits were detected in the second season. This result indicates that characters studied were constant from one season to another.

Table 1. Mean values of seasonal effect.

Traits	Growing seasons		F test
	2001 /2002	2002 / 2003	
Number of nodules /plant	7.25	8.22	n.s
Plant height (cm)	76.25	77.88	n.s
Number of branches/plant	3.78	3.68	n.s
Number of pods / plant	10.86	11.08	n.s
Number of seeds / pod	4.02	3.80	**
Pods weight / plant (g)	19.66	19.53	n.s
Seed yield / plant (g)	13.00	13.18	n.s
100-seed weight (g)	37.58	37.05	*
Seed yield / fed. (kg)	712.52	719.27	n.s
Seed nitrogen content %	5.86	6.08	n.s
Seed protein content %	36.64	38.02	n.s
Protein yield / fed. (kg)	262.87	274.79	n.s
N uptake /fed (kg)	42.06	44.12	n.s

*,** indicates significant at $P<0.05$ and 0.01, respectively ; n.s = non significant

B- Effect of inoculation , N fertilizer and spraying with molybdenum:

1- yield and its components:

Data presented in Table (2) showed the effect of seed inoculation, nitrogen fertilizer levels and foliar spraying with molybdenum on yield and yield attributes of lupin in the two seasons and their combined analysis.

Inoculated plants significantly affected number of nodules / plant , plant height , number of branches and pods / plant , seed yield / plant, 100- seed weight and seed yield / fed in the combined analysis , plant height , numbers of branches and pods / plant and seed yield / fed in the second season and number of branches and seed yield / plant in the 1st season. The increase in the traits is expected since inoculation led to a successful nodulation and consequently an active N fixation in lupin. Similar conclusion was reported by **Larson *et al* . (1989); Ayisi *et al.* (1992) and Hoballah *et al.* (2001).**

Adding nitrogen fertilizer to lupin plants caused an increase in all studied traits. The data showed that increasing nitrogen from 0 to 30 kg N / fed increased the nodules / plant by 61.2,45.5 and 52.7 % in the first and second seasons as well as combined analysis. These results may be due to that lupin is a leguminous crop that needs small amount of nitrogen at the first period of growth. Increasing nitrogen up to 30 kg N / fed increased plant height by 15.7, 16.0 and 15.8 % in the frist , second seasons and combined analysis, respectively compared with the control treatment (zero N). This might be attributed to the increase in number and/or length of internodes merestimatic activity of plants. The results demonstrate that there was a progressive and consistent increase in different components of the yield i.e. number of branches and pods/ plant, number of seed / pod, pods weight / plant , seed yield / plant and 100-seed weight with increasing rate of nitrogen from 0 to 30 kg N / fed . This in turn might contribute much to the increase in number of branches / plant with adding nitrogen fertilizer. The increase of the number of pods / plant may be due to nitrogen favorable effect on pod

set. However, the increase of the number of seeds / pod might own much to the increase in rate photosynthesis due to increased the amount of metabolites synthesized by plant and this in true might furnished enough food to face the requirements of greater number of seed / pod. Weight of pods and seeds / plant were increased by increased nitrogen rate from 0 to 30 kg N / fed. However, adding nitrogen fertilizer increased the weight of the pod owing to the increase in both number of seeds / pod and/or the average of seed weight. Weight of 100 seeds became great as a result of adding 30 kg N / fed. This may be due to higher dry matter accumulation and partitioned to seeds associated with adding 30 kg N / fed and this results in the increase in seed weight . Adding nitrogen fertilization at a rate of 30 kg N /fed increased seed yield / fed over the unfertilized plants which and 15 kg N/fed by 38.8 and 7.7 %, 35.4 and 6.7 % and 37.0 and 7.2 % in the frist season, second season and combined , respectively. This accounts for the increase in the amount of metabolites synthesized by plants and led to the increase in number of branches and pods / plant, number of seeds / pod, weight of pods / plant, 100- seed weight and seed yield / plant. This is in agreement with the results obtained by **Westerman *et al.* (1981); Eaglesham *et al.* (1983); Lopez-Bellido and Fuentes (1986); Abo-Shetaia (1990); Hob Allah and Kandil (2001) and Mokhtar (2002).**

Molybdenum effect on all traits studied was positive and significant in the 1st and 2nd seasons as well as combined analysis except plant height and seed yield / fed in the first season and number of seeds / pod in the 2nd season. Results showed that number of nodules / plant was increased by spraying with molybdenum. Nodulation is very important to leguminous crops for nitrogen fixation. Such results may prove the importance of Mo in inducing nodulation. Plant height , numbers of branches and pods / plant, pods weight / plant, seed yield / plant, 100-seed weight and seed yield / fed were significantly increased with applying Mo as foliar spray compared to untreated (control) in the combined analysis. Such results may explain the role of Mo in stimulating the metabolic enzymes, especially nitrogenase which is used as a controller in N fixation process, synthesis of carbohydrates, proteins and growth substances in plants , which positively affect the growth and consequently the yield and its components. These results are in a good line with those recorded by **El-Karamity and Hammad (1992); Marschner (1995); Hanna and Eisa (1998); Abdel-Aziz and Anton (1999) and Mehasen and El-Ghozoli (2003).**

2-Seed nitrogen , protein contents, protein yield and N uptake :

Data in Table (3) show the effect of inoculation, nitrogen fertilizer rates and foliar spraying with molybdenum on nitrogen and protein percentage in lupin seed , protein yield / fed and nitrogen uptake / fed in the 1st and 2nd seasons and their combined.

Inoculation treatments did not affect significantly nitrogen and protein percentage in the first and second seasons and their combined, protein yield / fed in the 1st season and N uptake / fed in the 1st and 2nd seasons, whereas it affected significantly protein yield / fed in the second season and the combined and N uptake / fed in their combined only. **Larson *et al.* (1989**) reported small increases in white lupin seed protein due to Bradyrhizobium inoculation. They found increases in seed crude protein of 86 to 106 g /kg in inoculated vs. non- inoculated plants. **Ayisi *et al.* (1992**) indicated that protein yield of non-inoculation plants was never greater than that of inoculated plants.

Table 2.Effect of Bradyrhizobum inoculation, N fertilizer levels and spraying with molybdenum on yield and yield components of lupin in 2001 /02 and 2002 /03 seasons as well as the combined analysis.

Main effects	Number of nodules / plant			Plant height(cm)			Number of branches / plant			Number of pods / plant			Number of seeds / pod		
	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.	2001 /02	2002/03	Comb
Rhizobium inoculation															
Non-inoculated	1.00	1.16	1.08	74.8	75.9	75.4	3.56	3.53	3.55	10.3	10.3	10.3	3.98	3.74	3.86
Inoculated	13.50	15.27	14.38	77.6	79.8	78.7	3.96	3.83	3.90	11.3	11.7	11.5	4.05	3.86	3.95
F test	**	**	**	n.s	**	**	**	**	**	n.s	**	*	n.s	n.s	n.s
N fertilizer levels (kg/fed)															
Control	5.58C	6.58C	6.08C	71.3C	72.3C	71.8C	3.24B	3.13C	3.18B	8.7C	8.7C	8.7C	3.50C	3.10C	3.30C
15	7.16B	8.50B	7.83B	74.9B	77.5B	76.2B	3.90A	3.78B	3.84A	10.8B	11.5B	11.1B	4.11B	3.91B	4.01B
30	9.00A	9.58A	9.29A	82.5A	83.9A	83.2A	4.15A	4.13A	4.14A	13.0A	13.0A	13.0A	4.45A	4.38A	4.41A
Molybdenum spraying															
Tap water	6.06	7.05	6.55	75.7	76.9	76.3	3.63	3.53	3.58	10.4	10.6	10.55	3.83	3.72	3.77
Spraying	8.44	9.38	8.91	76.8	78.8	77.8	3.90	3.83	3.86	11.2	11.5	11.38	4.21	3.88	4.04
F test	**	**	**	n.s	*	**	**	**	**	*	*	**	**	n.s	**

Table 2. cont.

Main effects	Pods weight / plant (g)			Seed yield / plant (g)			100-seed weight (g)			Seed yield kg/fed		
	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.
Rhizobium inoculation												
Non-inoculated	19.36	19.63	19.50	12.48	12.54	12.51	27.22	26.88	27.05	705.2	702.6	703.9
Inoculated	19.95	19.43	19.69	13.88	13.65	13.76	27.94	27.22	27.58	719.8	735.8	727.8
F test	n.s	n.s	n.s	**	n.s	*	n.s	n.s	*	n.s	*	*
N fertilizer levels (kg / fed)												
Control	16.91C	16.45C	16.68C	8.77C	8.66C	8.71C	21.08C	20.41C	20.75C	581.4C	595.6C	588.5C
15	20.41B	20.55B	20.48B	13.31B	12.83B	13.07B	28.58B	29.41B	29.00B	749.0B	755.6B	752.3B
30	21.65A	21.60A	21.62A	17.46A	17.79A	17.63A	33.08A	31.33A	32.20A	807.0A	806.5A	806.7A
Molybdenum spraying												
Tap water	19.25	19.02	19.13	12.61	12.10	12.35	26.77	26.38	26.58	707.0	710.7	708.8
Spraying	20.06	20.05	20.05	13.75	14.10	13.92	28.38	27.72	28.05	718.0	727.8	722.9
F test	**	**	**	*	**	**	*	*	**	n.s	**	**

*, ** indicates significant at $P < 0.05$ and 0.01 , respectively; ns = non significant.

Table 3 . .Effect of Bradyrhizobum inoculation, N fertilizer levels and spraying with molybdenum on chemical content in lupin seed in 2001 /02 and 2002 /03 seasons as well as the combined analysis.

Main effects	Seed N content %			Seed protein content %			Protein yield kg/fed			N uptake kg / fed		
	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.	2001/02	2002/03	Comb.
Rhizobium inoculation												
Non-inoculated	5.70	5.92	5.80	35.6	36.9	36.3	252.4	261.3	256.9	40.39	41.82	41.1
Inoculated	6.02	6.25	6.13	37.6	39.0	38.3	273.2	290.1	281.7	43.72	46.43	45.0
F test	n.s	n.s	n.s	n.s	n.s	n.s	n.s	*	*	n.s	n.s	*
N fertilizer levels (kg / fed)												
Control	5.55 B	5.71B	5.62B	34.6 B	35.6B	35.1B	201.6C	212.5C	207.0C	32.26C	34.00C	33.1C
15	5.79 AB	5.92B	5.85B	36.1AB	36.9B	36.5B	271.4B	280.6B	276.0B	43.43B	44.90B	44.1B
30	6.25 A	6.63A	6.43A	39.0A	41.4A	40.2A	315.5A	334.2A	324.8A	50.48A	53.47A	51.9A
Molybdenum spraying												
Tap water	5.64	5.86	5.75	35.2	36.6	35.9	250.2	261.7	256.0	40.04	41.88	40.9
Spraying	6.08	6.30	6.19	38.0	39.4	38.7	275.5	289.8	282.6	44.08	46.37	45.2
F test	*	*	*	*	*	*	*	*	*	*	*	*

*, ** indicates significant at $P < 0.05$ and 0.01 , respectively; ns = non significant.

Nitrogen fertilizer levels significantly affected nitrogen and protein percentages in seeds of lupin , protein yield / fed and nitrogen uptake / fed in the first and second seasons and their combined. Protein percentage was increased by 4.3 and 12.7 % in the first season, 3.6 and 16.2 % in the second season and 3.9 and 14.5 % in the combined by adding 15 and 30 kg N / fed, respectively as compared with zero level (control). Increasing protein % as a result of increasing N rates may be due to the increase in the plant tissues. Increasing nitrogen fertilizer levels up to 30 kg N fed increased significantly protein yield / fed and N uptake / fed by 56.9 and56.7 % than that of zero level in the combined analysis , respectively. This result is expected because seed yield and protein % were increased significantly at rate of 30 kg N / fed (Tables 2 and 3). Similar conclusion was reported by **Ayisi *et al.* (1992**) in white lupin.

Nitrogen and protein percentages in lupin seed, protein yield / fed and N uptake were significant at 5% level only by spraying with molybdenum in the 1st , 2nd seasons and combined data. Increasing protein % in seed , protein yield / fed and N uptake / fed were 7.7 , 10.3 and 10.5 % by spraying with molybdenum in the combined analysis , respectively compared with the control. The increment of N and protein contents by Mo treatment may be ascribed to the activation in root nodules which due to Mo application and hence increasing the fixed nitrogen. Results are in harmony with the results obtained by **El-Karamity and Hammad (1992); Hanna and Eisa (1998) and Mehasen and El-Ghozoli (2003).**

3- Interaction effect.

3-1-Effect of bacterial inoculation x nitrogen fertilizer levels interaction.

All the interactions between inoculation and nitrogen levels on measurements of lupin did not reach the 5 % level of significance except Number of nodules/ plant, plant height, seed yield / fed , protein yield / fed and N uptake / fed in the combined analysis (Table 4). Data indicate that the highest plant height and seed yield/fed were obtained when inoculation or uninoculation at a rate 30 kg N/fed. Whereas, the highest protein yield/fed and N uptake / fed were obtained when inoculation at a rate of 30 kg N/fed. Similar results were obtained by **Ayisi *et al.* (1992) and HobAllah *et al.* (2001**).

Table 4.Interaction effect between bacterial inoculation and nitrogen rates on No. of nodules/plant, plant height , seed yield/fed, protein yield/fed and nitrogen uptake/fed(combined analysis).

Traits	Non-inoculation			Inoculation		
	control	15	30	control	15	30
1-Number of nodules/ plant	0.75 D	1.08 D	1.41 D	11.41 C	14.5 B	17.2 A
2-Plant height (cm)	70.50 D	73.0 C	82.50A	73.0 C	79.4 B	83.8 A
3-Seed yield (kg/fed)	592.5 C	713.1B	806.1A	584.5C	791.5A	807.5A
4-Protein yield (kg/fed)	208.9 D	251.1C	310.7B	205.2D	301.0B	338.9A
5-N uptake (kg / fed)	32.20 D	43.4 C	50.40B	34.0 D	44.9 C	53.4 A

3-2-Effect of N x spraying with molybdenum interaction.

Data presented in (Table 5) show that N rates and spraying with Mo interaction were insignificant for all studied traits except seed yield / plant in the combined

analysis. The highest seed yield / plant was obtained by applying nitrogen rate of 30 kg N/fed at spraying with molybdenum or spraying tap water (control).

Table 5.Interaction effect between nitrogen fertilizer rate and spraying with molybdenum on seed yield / plant (combined analysis).

Mo treatments	N rates kg / fed		
	control	15	30
Tap water	8.41D	11.46C	17.18A
Mo spraying	9.01D	14.69B	18.08A

C- Correlation study:

The simple correlation coefficients between all possible pairs of the studied lupin traits of the combined analysis are presented in Table (6). Seed yield / fed was positively and highly significantly correlated with, plant height, number of branches and pods / plant , number of seeds / pod, pods weight / plant , seed yield / plant and 100–seed weight. Also, significant positive phenotypic correlation values were detected between seed yield / plant and each of other yield components. Such results indicates that selection for these traties would lead to the increase in seed yield of lupin.

Table 6.Simple correlation coefficients between seed yield and yield components (combined analysis).

Traits	Correlation matrix						
	1	2	3	4	5	6	7
1-plant height (cm)	1.000						
2-number of branches / plant	0.918	1.000					
3-number of pods / plant	0.925	0.957	1.000				
4-number of seeds / pod	0.895	0.946	0.956	1.000			
5-pods weight / plant (g)	0.848	0.919	0.931	0.971	1.000		
6-seed yield / plant (g)	0.940	0.937	0.969	0.967	0.937	1.000	
7-100-seed weight (g)	0.869	0.922	0.938	0.983	0.991	0.950	1.000
Y-seed yield / fed. (kg)	0.897	0.918	0.906	0.948	0.961	0.924	0.972

REFERENCES

Abdel -Aziz El-Set A. and N.A. Anton 1999. Influence applying methods and micro-nutrients on growth, yield quality of faba bean. Zagazig J. Agric. Res. 26 (5):1245-1257

Abo-Shetaia, A.M.A. 1990. Effect of plant density , nitrogen and phosphorus fertilization on yield and yield components of lupin (*Lupinus termis*, L.). Annals Agric. Sci. Fac. Agric., Ain Shams Univ., Cairo,35 (1): 205-222.

A.O.A.C. 1990. Official tentative methods of Analysis of Association of Official Analytical Chemists. Washington. D. C., 15th Ed.

Ayisi, K.K., D.H. Putnam, C.P. Vance, and P.H. Raham. 1992. Bradyrhizobium inoculation and nitrogen fertilizer effects on seed yield and protein of white lupin. Agron. J. 84:857-861.

Duncan, D.B. 1955. Multiple range and multiple, f test. Biometrics,11: 1 - 42.

Eaglesham, A.R.J. ; S. Sassouna and R. Seegers 1983. Fertilizer N effect on N_2 fixation by cowpea and soybean. Agron. J. 75: 61-66.

El-Karamity, A.E. and A.M.M. Hammad . 1992. Response of soybean inoculation with *Bradyrhizobium japonicum* and application of certain micronutrients. J. Agric. Res. Tanta Univ., 18 (2):313-327.

Gomez, A.K., and A.A. Gomez. 1983. Statistical Procedures for Agricultural Research. 2nd ed. John Wiley and Sons, New York.

Hanna, A.M. and M.S. Eisa 1998. Effect of rhizobium inoculation, and molybdenum application on soybean production. J. Agric. Sci. Mansoura Univ., 23 (3):953-960.

HobAllah, A.A. and A.A. Kandil. 2001. Improving seed production of sweet lupin *(Lupinus albus*, L.) 2- Role of Bradyrhizobium inoculation, nitrogen fertilization and plant density in maximizing productivity of sweet white Lupin in old clay loam soil. Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo 9 (2): 639-658.

HobAllah, A.A. ; A.A. Kandil and M.M. Shafik. 2001. Improving seed production of sweet lupin (*Lupinus albus*, L.) 1- Effect of Bradyrhizobium inoculation, nitrogen fertilization and plant density on seed yield and its components of sweet white Lupin grown in newly reclaimed sandy soils. Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo 9 (2): 623-637.

Larson, K.J. ; K.G. Cassman and D.A. Phillips. 1989. Yield, dinitrogen fixation,and aboveground nitrogen balance of irrigated white lupin in a Mediterranean climate. Agron. J. 81:538-543.

Lopez-Bellido, L., and M. Fuentes. 1986. Lupin as an alternative source of protein. Advances in Agronomy 40:239-303.

Marschner, H. 1995 . Mineral nutrition of higher plant. Academic Press Inc. London LTD

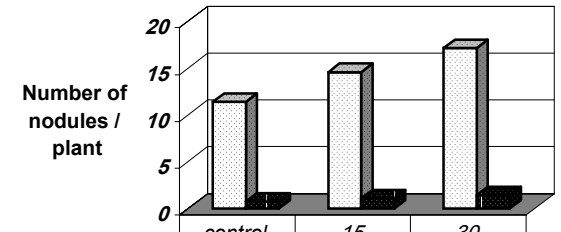
Mehasen, S.A.S. and M.A.El-Ghozoli 2003. Response of soybean plants to foliar application with iron and molybdenum and soil fertilization with rock phosphate and phosphate dissolving bacteria. Monufiya J. Agric. Res. 28 (1):87-102.

Michigan State University , (1983). MSTAT-C: Micro- computer Statistical Program, Version 2.0. Michigan State University, East Lansing.

Mokhtar, Soheir, A. .2002. Effect of plant density , nitrogen and phosphours fertilization on yield and yield components of Lupin (*Lupinus termis*, L.). Annals Agric. Sci., Ain Shams Univ., Cairo 47 (1):225-235.

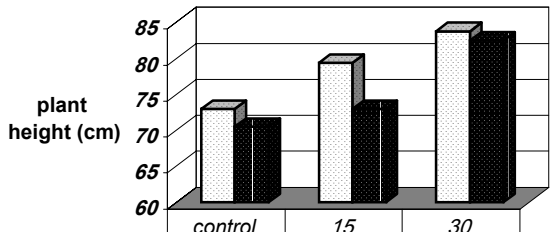
Westerman, D.T.; G. E. Kleinkopf; L.K. Porter and G.E. Leggett . 1981. Nirogen sources for bean seed production. Agron. J.73:660- 664.

Interaction effect between inoculation and N rates on number of nodules / plant (combined analysis)



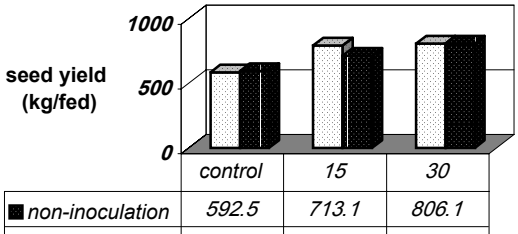
	control	15	30
non-inoculation	0.8	1.1	1.41
inoculation	11.4	14.58	17.16

Interaction effect between seed inoculation and nitrogen rates on plant height (combined analysis)



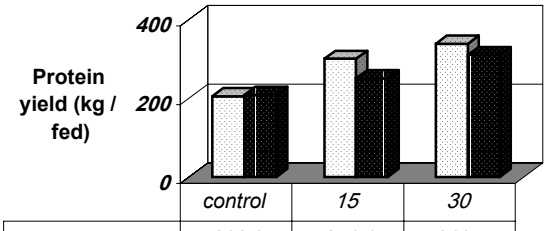
	control	15	30
non-inoculation	70.5	73.0	82.5
inoculation	73.0	79.4	83.8

Interaction effect between seed inoculation and nitrogen rates on seed yield / fed (combined analysis)



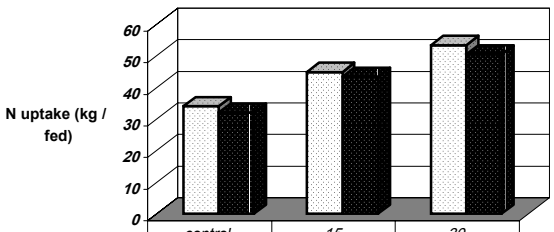
	control	15	30
non-inoculation	592.5	713.1	806.1
inoculation	584.5	791.5	807.5

Interaction effect between seed inoculation and nitrogen rates on protein yield (combined analysis)



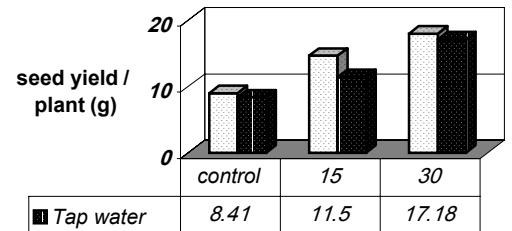
	control	15	30
non-inoculation	208.9	251.1	310.7
inoculation	205.2	301.0	338.9

Interaction effect between seed inoculation and nitrogen rates on N uptake (combined analysis)



	control	15	30
non-inoculation	32.0	43.4	50.4
inoculation	34.0	44.9	53.4

Interaction effect between N rates and Mo spraying on seed yield /plant (combined analysis)



	control	15	30
Tap water	8.41	11.5	17.18
Mo spraying	9.0	14.69	18.08

تأثير التلقيح البكتيري والتسميد النتروجيني والرش بالموليبدنيوم علي المحصول ومكوناتة وجودة البذور في الترمس

صديق عبد العزيز صديق محيسن - ناصر خميس بركات الجيزاوي

قسم المحاصيل – كلية الزراعة بمشتهر – جامعة الزقازيق (فرع بنها)

أجريت تجربتان حقليتان بمحطة البحوث والتجارب الزراعية بكلية الزراعة بمشتهر –جامعة الزقازيق خـلال موسمي ٢٠٠١ / ٢٠٠٢ ، ٢٠٠٢ / ٢٠٠٣ لدراسة تأثير التلقيح ببكتريا العقد الجذرية (بدون ، ملقح) وثـلاث معدلات من التسميد النتروجيني (صفر ، ١٥ ، ٣٠ كجم نتروجين / فدان) و الرش بالموليبدنيوم (ماء مقطر (بدون) ، ٣٠ جزء في المليون) علي المحصول ومكوناتة وجودة بذور الترمس صنف جيزة ١ .

أظهـرت نـتائج الموسمين والتحليل التجميعي تفوق معنوي للنباتات الملقحة علي الغير ملقحة في عدد العقـد البكتـيرية / نبات ، طول النبات ، عدد الفروع و القرون / نبات ، محصول البذور / نبات ، وزن ١٠٠ بـذرة ومحصول البذور / فدان . ولم يتأثر عدد بذور /قرن ، وزن قرون /نبات ومحتوي البذور من النتروجين والبروتيـن معنويا بالتلقيح. أدي التسميد النتروجيني للترمس إلي زيادة معنوية لكل الصفات المدروسة وإضافة ٣٠ كجـم نتروجيـن / فـدان أدي إلى زيادة محصول البذور بالمقارنة بعدم التسميد والتسميد بمعدل ١٥ كجم نتروجين / فدان بنسبة ٣٨,٨ و ٧,٧ % - ٣٥,٤ و ٦,٧% - ٣٧,٠ و ٧,٢ % وذلك في الموسم الأول والثاني والتحلـيل التجميعـي علـي التوالي. كما أدي الرش بالموليبدنيوم لزيادة معنوية لجميع الصفات المدروسة في الموسـم الأول والثاني والتحليل التجميعي فيما عدا طول النبات ومحصول البذور/فدان في الموسم الأول وعدد بذور القرن في الموسم الثاني.

كان للتداخل بين التلقيح البكتيري ومستويات التسميد النتروجيني تأثير معنويا علي عدد العقد البكتيرية / نـبات طـول النبات ومحصول البذور والبروتين / فدان والنتروجين الممتص / فدان بينما كان للتداخل بين معـاملات الـرش بالموليبدنـيوم و مستويات التسميد النتروجيني تأثير معنوي علي عدد العقد البكتيرية / نبات محصول البذور / نبات وذلك في التحليل التجميعي.