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Effect of Nitrogen, Phosphorus Fertilization and Rhizobial Inoculation on Yield and Nitrogen Content of Lentil Crop in Newly Reclaimed Area.

By

El-Naggar, S.M., Azazy, M.A., Zain El-Din, M.M. and Abou-Leila, B.

Bot. Lab., and Soil and Water Lab., National Research Centre, Dokki, Cairo.

ABSTRACT

Two field experiments were carried out in Kalabsha, experimental station (120 k.m. South West of Aswan), National Research Centre, to evaluate the effect of Nitrogen and Phosphorus fertilization as well as rhizobial inoculation of Lentil.

Diffsrent levels of calcium superphosphate (16.5 % P_2O_5) and Nitrokima (31 % Nitrogen) were used. The best treatment which increased seed yield, nitrogen content as well as harvest index was that of 200 kg. Calcium superphosphate with 60 kg nitrokima/fed.

Half rates of mineral fertilization were sufficient to produce the highest yield when combined with symbiotic fertilization.

INTRODUCTION

Lentil (Lens esculanta L.) is one of the most nutritive food of the legume crops which grow well under the conditions of upper Egypt.

This crop is consumed as an important source of protein, Seed emergence particularly with sensitive legumes crop such as lentil grown in newly cultivated soils, needs the earlier supply of nitrogen to establish uniform crop stand and early time of maturity. The existence of available phosphate is also important for enhancing the biological nitrogen fixation by symbiosis with the growing legume (Hamdi, 1981).

The adequate supply of fertilizers with suitable irrigation was reported by (Sakhon et al., 1981, Verma and Kalra, 1981, 1983). Sharma et el. (1984) reported that the highest seed yield with higher nitrogen and phosphorus content were obtained by using of 20 kg N and 60 kg, P with two irrigations. However, Verma and Kalra (1981) stated that the economic fertilizer rate for lentil crop was 24 - 28 kg/N and 79 - 89 kg P_2O_5.

A linear increase in both dry weight as well as nodules number was recorded by phosphorus fertilizers (Saraf and Biatha- 1982). Eweida et al. (1988) mentioned that plant height, number of pods and number of seed yield and straw yield/fed. were obtained by the application of 22.5 kg N + 40 kg P_2O_5/fed. They also mentioned that N, P fertilizers resulted in higher protein percentage as compared to control plants.

Mohamed et al. (1981) stated that soybean plants responded markedly to N and P application. The maximum yield was produced when N and P were applied, together and the optimum rates were 45 kg N + 15 kg P_2O_5/fed.

Hussein et al. (1984) also mentioned that (32 kg P/fed.) and inoculation of lentil seeds with specific rhizobia, increased the number of pods per plant and nitrogen content. However, rhizobial inoculation seemed to give higher seed yield than uninoculated treatments.

The aim of this study is to evaluate the effect of rhizobial inoculation in combination with phosphatic fertilization on the biological nitrogen fixation by lentil crop under newly reclaimed areas.

MATERIALS AND METHODS

Two field experiments were carried out at Kalabsha, Agricultural Research Station of National Research Centre, 120 km South of Aswan during 1984 - 1985 and 1985 - 1986 growing winter seasons to study the effect of Nitrogen, Phosphorus fertilization and Rhizobial inoculation on yield and nitrogen content of lentil, crops in newly reclaimed area. The soil is sandy with pH 8, its chemical and mechanical analyses are represented in Table (1). Lentil seeds variety Giza 9 were inoculated with specific rhizobia (Rhizobium leguminasum) and sown in field plots (18 m^2) at 1-10 Nov. (1985 - 1986) in two successive seasons.

Commercial inoculum (okadin) was obtained from Agricultural research Centre Dept. of soil Microbiology Containing four effective strains of Rhizobia leguminasum.

The seeds were mixed with arabic gum 48 % then okadin was added to the seeds in a shadow place by the rate of 2 bags to 45 kg. seed for the cultivation of one feddan.

The coated seeds were then sown in the most soil immediately. Superphosphate (16.5 % P_2O_5) and nitrokima (31 % N) were used for nitrogen and phosphorus fertilization. Potassium sulphate (100 kg/fed.) was applied at the same rate for all treatments.

A complete randomized block design, with four replicates were used.

The treatments were as follows :

Zero N P + 0 inoculation.
" P + 30 kg. Nitro kima.
" P + 60 kg. " " .
" P + 90 kg. " " .

100 kg P + 0 kg. " " .
" " P + 30 kg. " " .
" " P + 60 kg. " " .
" " P + 90 kg. " " .

200 kg P + 0 kg. Nitro kima.
" " P + 30 kg. " " .
" " P + 60 kg. " " .
" " P + 90 kg. " " .

The samples were collected from each treatment after 7 weeks of sowing the roots were throughly washed with running tap water, the nodules on roots were isolated and dried at 70, Cito determine its dry weight.

All treatments were harvested at the end of the experiment, the following data are recorded.

1. Seed yield in ardab/fed. (on ardab seeds = 160 kg.).
2. Straw yield (tons/fed.).
3. Total N and P, crude protein content of lentil.
4. N uptake was calculated.
5. Harvest index (calculated as = $\frac{\text{Seed yield/plant}}{\text{Total biological yield}} \times 100$).

RESULTS AND DISCUSSION

Results in Table (2) showed that the yield of straw and seeds ae well as the total biological yields were increased by adding nitrogen fertilizer as compared with control plants. Such results lend more support to those recorded by Sharma et al., (1971).

On the other hand, Hussein (1977) recorded that the application at 8.7 and 15 kg N/fed. had no significant effect on seed and straw yield. The obtained data also revealed a linear increase in the straw and seed yield by increasing nitrogen fertilization from zero up to 90 kg/fed.

However, the highest straw yield and total biological yield was obtained by adding 60 kg.N/fed. Harvest index decreased gradually by increasing nitrogen fertilizers this may be due to the role of nitrogen in favouring plant growth which consequantly increased the total biological yield to seed yield. Such results are in agreement with those obtained by Iftikhar et al. (1971).

Nitrogen and Phosphorus fertilization showed a significant effect on seed yield straw yield, total biological yield as well as, harvest index at both seasons. Applying 100 kg.P/fed. + 60 kg N gave the highly significant increase in seed yield.

Rizk (1979) reported that phosphorus applied to lentil at the rate of 80 kg P_2O_5/hr. gave significantly higher seed yield.

The experimental results showed that the increase in nitrogen over 60 kg showed decreases in yield. This may be due to the role of phosphorus in metabolic processes.

However, 30 kg nitrokima + 100 kg phosphorus was sufficient to increase the average straw yield and total biological yield at both seasons.

The obtained data also demonstrated that harvest index gave maximum value with the addition of 100 kg phosphorus + 60 kg nitrogen/fed. In this connection it may be mentioned that Mohamed et al. (1981), stated that soybean responded to N and P application when applied together.

Increasing phosphorus fertilization to 200 kg/fed. also increased seed and straw yield as well as total biological yield and harvest index as compared with control plants. However, N, P fertilization at the rate of 200 kg P + 60 kg N/fed. gave the optimum increase effect of seed and straw yield as well as total biological yield and harvest index. Additional supply of nitrogen to 90 kg Nitrokima tended to decrease this increase in spite of the absence of significance in some cases.

2. Effect of different doses of superphosphate and nitrogen on nodule-dry weight, N content and N-uptake by lentil seeds :

Data in Table (3) showed that seed inoculation with specific rhizobia precultivation in a virgin soil, significantly increased the number and dry weight of nodules over the control treatment

which did not show any nodulation on the roots. Nitrogen fertilization without phosphorus addition to this virgin soils slightly increased nodulation on the roots of these treatments.

This may be due to the poor content of organic matter and available nitrogen in these virgin soils, needed for the growing seedlings.

The combined effect of N and P fertilization had significantly increased the nodulation of lentil roots by producing satisfactory nodular tissues. Increasing dose of phosphate fertilization had significant effect on nodulation in the presence of nitrogen fertilization, as the best treatment showed the highest significant nodule dry weight was 200 kg P in combination will 60 kg Nitrokima/fed. These results are in harmony with the finding of Mohemed et al., (1981) on soybean plants.

Data presented in Table (3) also revealed that application of Nitrokima without phosphorus at the different doses used (30, 60 and 90 kg/fed.) significantly increased lentil seed yield as well as its total nitrogen content than the control plants. However, the higher dose (90 kg Nitrokima/fed.), showed a decreasing effect, as compared with the other treatment. This may be due to the contraverse effect of these high doses of N on the activity of biological-N fixation.

This assumption may be confirmed by the lower nodule dry weight obtained by this treatment.

This effect could be also noticed in the presence of phosphate fertilization with the two levels used (100 and 200 kg/fed.). The application of Ca superphosphate with the two levels used (100 & 200 kg/fed.) in combination with N fertilization with Nitrokima insignificantly increased seed yield and its N content as well as N-uptake compared to the treatments received N-fertilizer only.

On the other hand, the higher dose of superphosphate (200 kg/fed.) increased the seed yield and N-content than the other levels in the presence of N-fertilization.

The optimum seed yield, N-content and N-uptake was obtained when lentil plants were fertilized by 200 kg superphosphate + 60 kg Nitrokima.

These results in agreement with the findings of Sekhon et al. (1981). It can be concluded that successful cultivation of lentil under newly reclaimed soils of upper Egypt needs continuous inoculation of the seeds with specific rhizobium in combination with N and P fertilization. The recommended dose of mineral fertilization is 60 kg N/fed. as Nitrokima added at earlier stages of growth and 200 kg P_2O_5/fed. as Ca-superphosphate.

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Table (2): Effect of nitrogen and phosphate fertilization on seed yield, straw yield and harvest index of lentile crop. (Average of two seasons).

Treatments	Seed yield Erdab/ fed.	Straw yield Ton/ fed.	Total biological yield kg/fed.	Harvest index
1. Control	0.98	0.670	827	19.00
2. OP + 30 kg N.	1.56	1.079	1328	18.75
3. OP + 60 kg N.	1.61	1.119	1376	18.68
4. OP + 90 kg N.	1.93	1.019	1328	23.27
5. 100 kg P + 0 kg N	2.15	0.993	1337	25.73
6. 100 kg P + 30 kg N	3.20	1.175	1687	30.35
7. 100 kg P + 60 kg N	3.40	0.956	1500	36.27
8. 100 kg P + 90 kg N	2.79	0.773	1219	36.59
9. 200 kg P + 0 kg N	3.33	0.803	1336	39.895
10. 200 kg P + 30 kg N	3.85	0.829	1445	42.63
11. 200 kg P + 60 kg N	4.29	1.052	1738	39.47
12. 200 kg P + 90 kg N	3.83	0.907	1520	40.33
L.S.D. at 5 %	0.029	0.018	-	-

Table (3): Effect of different doses of superphosphate and nitrokima on nodules dry weight, N-content and N_2-uptake by lentil seeds. (kg/fedden).
(Average of two seasons).

Treatments	Nodule dry wt. mg/10 plants	N-content of seeds as %	Seed kg/fed.	N-uptake kg/fed.
1. Control	0.00	2.89	156.8	4.53
2. OP + 30 kg N	135	3.63	248.8	9.03
3. OP + 60 kg N	180	3.85	256.8	9.89
4. OP + 90 kg N	166	3.47	308.8	10.72
5. 100 kg P + 0 kg N	225	3.82	344.0	13.14
6. 100 kg P + 30 kg N	388	4.24	512.0	21.71
7. 100 kg P + 60 kg N	478	4.36	544.5	23.74
8. 100 kg P + 90 kg N	410	4.26	416.1	19.00
9. 200 kg P + 0 kg N	304	3.84	532.8	20.46
10. 200 kg P + 30 kg N	585	4.34	616.0	26.73
11. 200 kg P + 60 kg N	821	4.60	686.4	31.57
12. 200 kg P + 90 kg N	535	4.37	612.8	26.78
L.S.D. at 5 %	148	0.06	-	-

Table (4) : Chemical and mechanical analyses of Kalabsha soil.

Depth (cm.)	Chemical analyses										
	pH in (1:2.5 susp.)	$CaCO_3$ (%)	E.C. in (1.5 mmhos/cm)	Cations (meq/100 gm soil)				Anions (meq/100 gm soil)			
				Na^+	K^+	Ca^{++}	Mg^{++}	CO_3	HCO_3	Cl^-	SO_4^{--}
0-30	8.1	5.31	0.65	2.10	0.28	1.80	0.30	-	0.40	2.0	1.95
30-60	8.3	0.17	0.37	0.75	0.17	2.10	0.20	-	0.30	1.8	2.00

Mechanical analyses

Organic matter (%)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	Texture
0.24	21.9	63.9	12.0	1.2	Sandy soil