EFFECT OF RHIZOBIUM INOCULATION AND PHOSPHORUS ON NODULATION AND YIELD OF LENTIL (*LENS CULINARIS* MEDIC)

M.Maqsood, A.Hussain, A.Khaliq and M.Nawaz
Department of Agronomy,
University of Agriculture, Faisalabad

The effect of seed inoculation with rhizobium and P application on nodulation, growth and yield components of lentil (*Lens culinaris* Medic) was studied. The results showed that number of pods per plant, number of seeds per pod and 1000-seed weight were influenced favourably both by rhizobium and P application. The highest seed yield (12.52 q ha^{-1}) and nodulation were obtained with rhizobium inoculation along with 60 kg P_2O_5 ha^{-1}.

INTRODUCTION

Lentil (*Lens culinaris* Medic) is an important pulse crop and is widely grown in Pakistan on variety of soils under varying climatic conditions. It provides a cheap source of protein and possesses a considerable amount of Vitamin A and B along with iron, phosphorus and calcium. The average protein content of lentil is 23.7% which is about double than that of cereals. It occupies an area of 57.4 thousand hectares with an annual production of 31.3 thousand tonnes of grain in Pakistan (Anonymous, 1987). Its average yield is 545.3 kg ha^{-1}.

It is capable of fixing atmospheric nitrogen through rhizobium, living in the nodules on its roots. Unfortunately in most of the lentil growing areas of Pakistan, it is not nodulating properly. The reasons for this behaviour are numerous but nutritional imbalance appears to be the major one. It is an admitted fact that rhizobium in the presence of phosphorus fixes more nitrogen through increased number of nodules (Eweidat *et al.*, 1990). It has also been reported that protein content, dry matter and grain yield of various legumes crops were considerably increased in response to rhizobium inoculation (Sahu, 1973). Thus, it is imperative to develop reliable information on the feasibility and utility of inoculation in lentil with rhizobium in relation to fertility status of the soil. Legumes can make up their nitrogen requirements by fixing atmospheric nitrogen, but starter (nitrogen) helps in increasing yield through better establishment of plant (Nazir, 1986). Consequently, it was contemplated in this study to evaluate the effect of seed treatment with rhizobium and fertilizer application to soil on nodulation, growth and grain yield of lentil under Faisalabad conditions.

MATERIALS AND METHODS

To evaluate the effects of seed inoculation and phosphorus application on nodulation, seed yield and quality of lentil (Lens culinaris Medic) CV masoor 85 was sown at the Agronomic Research area, University of Agriculture, Faisalabad during the year 1987/88. Quadruplicated experiment was laid out in a randomized complete block design using a plot size of 2.4 x 7 m. The single super phosphate was used as P source and fertilizer was seed dressed just after sowing with the help of a single row hand drill. Rhizobium strain isolated from the nodules of lentil was used for lentil seed inoculation. Seed of the lentil cv. Masoor-85 was inoculated with rhizobium strain by growing it on yeast extract mannitol broth medium (Somasergarn *et al.* 1980). The seeds were sown

on November 22, 1987 using a seed rate of 30 kg ha^{-1}, in 30 cm apart rows. All the other agro-practices were kept normal and uniform. The observations included number of plants per m^2 at harvest, number of pods per plant, number of grains per pod, number of nodules per plant, 1000-seed weight and seed yield. The data collected were analysed statistically using Fisher's analysis of variance technique and Duncan's New Multiple Range test was applied to compare the differences among the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The data (Table 1) revealed that application of P fertilizer and seed inoculation, in general, improved pod bearing. Application of 40 kg and 60 kg P_2O_5 ha^{-1} with or with or without inoculation increased number of pods per plant over the control. This could be attributed to the optimum availability of phosphorus. The P application @ 40 kg and 60 kg P_2O_5 ha^{-1} with inoculation produced significantly more number of seeds per pod than inoculated and un-inoculated plants without P but were statistically at par with one another. The average number of nodules per plant were 31.4 and 9.5 with and without inoculation, respectively. The data also revealed that increased application of phosphorus increased number of nodules per plant in both rhizobium treated and untreated plants. The improved nodulation in response to inoculated necessitates the addition of effective and more appropriate strains of rhizobium through seed inoculation so as to domesticate the concerned rhizobia to nodulate the crop effectively. Application of 60 kg P_2O_5 ha^{-1} with seed inoculation increased significantly number of nodules per plant over 60 kg P_2O_5 ha^{-1} with untreated seed. Increased nodulation due to the application of P can be attributed to balanced nutrition which help better root development and ultimately more root nodulation. These

Table 1. Effect of Rhizobium inoculation and Phosphorus on nodulation and yield of lentil.

Treatment	P Rate (Kg ha^{-1})	No. of plants (m^{-2})	No. of pods (plant $^{-1}$)	No. of grains (pod $^{-1}$)	No. of nodules (plant $^{-1}$)	100-grain weight(g)	Seed Yield (q ha^{-1})
T1 uninoculated	(control) –	124.42 ^{NS}	37.50 f	1.45 b	9.50 f	16.08 e	7.61 f
T2 Inoculated	–	124.49	43.49 e	1.66 b	18.84 e	16.96 d	8.90 e
T3 Uninoculated	+ 40 kg P_2O_5	124.68	52.40 d	1.75 ab	22.36 d	17.22 d	9.82 d
T4 Uninoculated	+ 60 kg P_2O_5	124.85	57.63 c	1.82 a	31.42 c	17.54 c	10.12 c
T5 Inoculated	+ 40 kg P_2O_5	124.84	60.92 b	1.85 a	37.62 b	18.17 b	11.62 b
T6 Inoculated	+ 60 kg P_2O_5	124.89	64.16 a	1.91 a	40.54 a	18.62 a	12.52 a

Means sharing the some letter (s) do not differ significantly at P = 0.05

results are similar to those of Rai et al. (1985).

The 1000-grain weight was 16.96 and 16.08 g in the treated and untreated plots, respectively. This difference could be due to the fact that rhizobium inoculation produced larger and plumpy grains and ultimately resulted in increased grain weight. This increase in 1000-grain weight by the application of P might be due to the increased P contents of the seed which finally improved the grain size. Increased application of P from 0 to 60 kg P_2O_5 ha^{-1} gave significantly higher seed yield than un-inoculated plants fertilized at 60 kg P_2O_5 ha^{-1}. This variation could be due to the fact that Rhizobium in the presence of phosphorus fixed greater amount of N which improved the yield potential of plant. The application of 60 kg P_2O_5 ha^{-1} to the inoculated plants produced significantly higher grain yield than inoculated plants without P application. The increased grain yield due to P application could be attributed to the increased number of pods per plant, weight of grains per plot and 1000-grain weight. These results are strongly in line with the findings of Saxena and Wassimi (1980), Nema *et al.* (1984).

REFERENCES

Eweidat, M.H.T., A.M.Hasras and K.E.A.El. Assily. 1980. Effect of some irrigation systems, fertilizer treatments and row spacing or lentil seed quality. Research Balletin Faculty of Agriculture, Ain Shams University No. 1388, 24 Dep. of Agron. Al-Azhar Univ., Cairo Egypt. (Field Crop Absts., 34(12):10266; 1981).

Nazir, M.S. 1986. Effect of P alone and in combination with starter nitrogen on the yield potential of 3 gram varieties, consolidated progress report. Appl. Agron. Res. Fld. Group:73.

Nema, V.P., S.Singh and P.P.Singh. 1984. Response of lentil to irrigation and fertility levels. Lens News letter 11(2):21-24. (Field Crop Absts., 38(11):6604; 1985).

Rai, R., S.K.T.Nasar, S.J.Singh and V. Prasad. 1985. Interaction between rhizobium strain and lentil (*Lens culinaris* Linn.) genotype under salt stress. Agri. Sci. 104(1):199-205. (Soil and Fert. 48(7):7427; 1985).

Sahu, S.K. 1973. Effect of Rhizobium inoculation and phosphate application on black gram (*Phasealus mungo*) Madras Agri. J.60(8):989-939. (Field Crop Absts., 29(2):1128; 1976).

Saxena, M.Said N.Wassimi. 1980. Effect of fertilizer application and inoculation on the performance of lentils and subsequent wheat crop. Lens 7, 52-53. (Field Crop Absts., 34(9):7372; 1981).

Somasegaran, P., H.Hoben and J.Halliday. 1982. The NIFTAL Manual, methods in legume Rhizobium technology, Univ. of Hawaii, college of Tropical agriculture and human resources U.S.A.

Steel, R.G.D. and J.H.torrie. 1980. Principles and procedures of statistics. McGraw Hill Book Co., Mr.USA.