American-Eurasian J. Agric. & Environ. Sci., 9 (3): 269-272, 2010
ISSN 1818-6769

Evaluation of Leguminous Forage Crops for Nodulation, Nitrogen Fixation and Quality Yield

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Abstract: Nodulation and BNF (Biological Nitrogen Fixation) capabilities 0f 4 different fodder legumes were studied in a clay loam soil. Treatments include, i) Berseem local without inoculation ii) Berseem local with inoculation iii) Berseem Kabuli without inoculation iv) Berseem Kabuli with inoculation v) Shaftal without inoculation vi) Shaftal with inoculation vii) Lucerne without inoculation viii) Lucerne with inoculation ix) and local check barley. The maximum fresh fodder yield was obtained in treatment where Lucerne with inoculation was sown. Tillers per plant were maximum in Shaftal with inoculation. The maximum nodules per plant and N content were found in Shaftal with out inoculation and Lucerne with artificial inoculation, respectively. It was therefore recommended that inoculation of legumes with starter dose of NP improves the fodder yield and nodulation.

Key words: Legumes · Nodulation · Rhizobium · Inoculation · Nitrogen fixation

INTRODUCTION

Fodder is the most important animal feeds in Pakistan. It metabolizes energy nutrients carbohydrates and protein. Quality nutritional fodder increase milk production [1]. Mostly nutrients requirement of animals are met from fodder crops in irrigated areas [2]. Forage legume due to its importance as feed of animal and also improves soil properties [3]. Different fodder legumes have different capabilities of BNF and nodulation, the efficiency of fodder legumes depends upon various factors like soil moisture, available N and rhizobial strains. In Pakistani soil due to low organic matter content soil have very low viable count of effective rhizobial count [4]. Phosphorus (P) and nitrogen (N) are plays an important role in N_2-fixation through their effects in nodulation and N_2-fixation process [5]. P deficiency reduce N_2-fixation due to nodule mass [6, 7]. Phosphorus had a high demand for Symbiotic nitrogen fixation as the process consumes huge amounts of energy [8]. Similarly, mineral N fertilization is a crucial factor in oil seeded legume production [9]. Nitrogen requirement can be met by both mineral N assimilation and symbiotic N_2 fixation [10]. Application of reduced amount of N as starter fertilizer could improve nodulation and BNF capabilities. Therefore, a study was conducted to compare different leguminous forage crops for the natural nodulations BNF capability and yield/quality of different fodder crops.

MATERIALS AND METHODS

A field study was conducted on Research Farm of Nuclear Institute for Food and Agriculture (NIFA) during Rabi 2005-06. The site is located at 34°oo′N and 71°33′E at an altitude of 400m above sea level at North West Frontier Province of Pakistan.

Soil of the Experimental Site: The soil of the experimental site belonged to Tarnab fine silty, mixed hyperthermic Udic Ustept. Three legumes crops, berseem, shaftal and Lucerne and barley as a reference crop were sown in randomized Complete Block design (RCBD) and was replicated four times; Plot size was 4 x 3 m^2. N, P & K were applied at rate of 20, 60, 40 kg ha^{-1} in the form of urea, single super phosphate and potassium sulphate as basal dose to the crop. Irrigation as when required were applied uniformly. The experimental details are given in Table 1. Before sowing, a composite soil sample was collected from the field and was analyzed for physico-chemical properties (Table 2). Soil texture was determined by hydrometer method as described by Moodi *et al.* [11]. The pH and E.C in soil was determined by water suspension (1:2.5) with the help of pH and conductivity meters according to method outlined by Richard, [12]. Organic matter was determined by the method given by Walkley and Black [13]. In composite soil sample and in plant samples total nitrogen was determined by Kjeldhal

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Table 1: Experimental Detail:

1.Berseem local without inoculation	2.Berseem local with inoculation
3.Berseem Kabuli without inoculation	4.Berseem Kabuli with inoculation
5.Shaftal without inoculation	6.Shaftal with inoculation
7.Lucerne without inoculation	8.Lucerne with inoculation
8.Barley test crop	

Table 2: Physico- chemical properties of experimental site

Texture	Clay loam
EC (1:2.5)	0.89dS/m
pH (1:2.5)	8.0
% Nitrogen	0.028
Available Phosphorus	8 ppm
% organic matter	0.58

digestion method and available P was determined by Olsen Method [14]. The data collected were statistically analyzed by analysis of variance in RCB design. The comparison among treatments was made by least significant test tests using MSTATC statistical package.

RESULTS AND DISCUSSION

Data in Table 3 indicate that mean green yields increased with cuttings. Maximum green fodder yield were obtained in the treatment where Lucerne with inoculation was sown, followed by the treatment where Shaftal with inoculation were sown and than followed by the treatment where berseem Kabuli with inoculation were sown. These increases were 87%, 122.46% and 73.93% for green yields in between inoculated and with out inoculated Lucerne, Shaftal and berseem Kabuli. The average green fodder yields in this study were higher; therefore it is become clear that inoculation and application of basal dose of fertilizer affected the green fodder yield. It is clear that legumes may be provided inoculums which establish more efficient bacterial plant symbioses over native. Our results are in accordance with the results of Tien *et al.* [15] Ashraf *et al.* [16] and Abbasi *et al.* [17] who reported increase in yield due to inoculation. Tiller per plant (Table 4) have significant difference between inoculated and non inoculated treatments maximum number of tillers 7.16 tillers per plant were found in the barley test crop, followed by the treatments where shaftal with inoculation were sown. Nodulations were found maximum among inoculated and non inoculated treatments. The maximum nodulation was found in the treatments where berseem local with artificially inoculated were sown followed by the treatment where Berseem local with out inoculation were sown. This might be due to adequate rhizobia capable of nodule formation in soil supply were present.

Table 3: Fresh fodder yield of different leguminous forage crops (Kg/plot)

Treatments	1st cut	2nd cut	3rd cut	Mean
1. Berseem local without inoculation	12.05 c	11.18 c	6.50 d	9.910
2. Berseem local with inoculation	23.83 a	1930 abc	15.88 b	19.670
3. Berseem Kabuli without inoculation	16.75 bc	15.35 c	6.75 d	12.930
4. Berseem Kabuli with inoculation	25.63 a	27.10 a	14.75 b	22.490
5. Shaftal without inoculation	11.13 c	12.38 c	7.62 d	10.370
6. Shaftal with inoculation	26.25 a	25.92 ab	17.05 b	23.070
7. Lucerne without inoculation	13.45 c	16.27 bc	11.13 c	13.610
8. Lucerne with inoculation	25.33 a	28.38 a	22.67 a	25.460
9. Barley test crop	21.52 ab	12.43 c	5.12 d	13.025
LSD 0.05	6.736	9.936	2.952	

Table 4: Number of Tillers, Nodulation, P and N content of different forage crops

Treatments	Number of Tillers/plant	Number of Nodulation/plant	P cont (%)	N cont (%)
1.Berseem local without inoculation	1.00c	13.50ab	0.440	2.297e
2.Berseem local with inoculation	1.08c	15.50a	0.450	2.277 e
3.Berseem Kabuli without inoculation	1.23c	7.50bc	0.440	2.285e
4.Berseem Kabuli with inoculation	1.24bc	7.75bc	0.410	2.297de
5.Shaftal without inoculation	2.23bc	12.25abc	0.360	4.170 bc
6.Shaftal with inoculation	2.66b	9.75abc	0.400	4.235b
7.Lucerne without inoculation	1.18c	5.75cd	0.310	4.860ab
8.Lucerne with inoculation	1.18c	6.25cd	0.340	5.095a
9.Barley test crop.	7.16a	0.00d	0.380	3.53 bcd
LSD 0.05	1.424	6.745	0.112	0.209

However higher number of nodules due to inoculation suggested that there is better symbiotic relation between rhizobai and berseem. Larger response to inoculation and higher number of nodules per plant in comparisons with uninoculated crop were reported by Revellin *et al.* [18] and Abbasi *et al.* [17]. Phosphorus in shoots was non significant among different legumes either inoculated or non inoculated. P content in roots and shoots were not affected by P application [19]. N content in fodder was found maximum in the treatment where Lucerne with inoculation was sown followed by the treatment where uninacolated Lucerne was sown. Significant increase in shoot N of soybean inoculated was reported by Senevirante *et al.* [20], Sarr *et al.* [21] and Zhang *et al.* [22]. Rhizobium application and basal dose of P increase nitrogenease activity, mass of nodule that ultimately increased plant N content. While addition of starter dose of N fulfill the immediate need of N to plants and it lead to higher N content.

CONCLUSION

It may be concluded from this study that the inoculation of legumes cultivated in calcareous soils increased the green yields and increased the number of tillers/plant, nodules and N content. Moreover, Lucerne with inoculation produce maximum green fodder yield. Number of nodules was increased with artificial inoculation in berseem local. An N content was maximum in Lucerne when inoculated.

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