

PERFORMANCE OF SUMMER FORAGE LEGUMES IN THE SUB-TROPICAL SUB-HUMID POTHOWAR PLATEAU

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The study was conducted at National Agricultural Research Centre (NARC) Islamabad to investigate the performance of summer forage legumes including; Cowpeas (*Vigna sinensis*), Lablab bean (*Dolichos lablab*), Rice bean (*Phaseolous calcartus*) and Sesbania (*Sesbania exalata*), in the sub-humid climate of Pothowar plateau. Adequate and nutritious forage supply is essential for enhancing livestock production to meet the human demand for dairy and allied products. The objective of the study was to determine forage yield and quality in terms of crude protein in selected forage species. Among four legumes sesbania attained the maximum height of 144 cm while rice bean had gained the minimum height of 86 cm. The highest dry weight (3.9 t ha^{-1}) was obtained by Sorghum (*Sorghum vulgare*) a non-leguminous control species. Among the legumes, the highest dry matter (3.8 t ha^{-1}) was obtained by Sesbania and the lowest dry weight (2 t ha^{-1}) was obtained by cowpeas. The results concluded that the highest crude protein contents 581 kg ha^{-1} were attributed by sesbania. Sorghum gained the lowest crude protein contents (175 kg ha^{-1}). Thus, the mixture of grasses and legumes would be a better approach for livestock diet.

Keywords: Forage legumes, sub-humid climate, fresh weight, dry matter yield, crude protein

INTRODUCTION

The importance of forage crops in agriculture can be gauged from the fact that regular supply of adequate and nutritious forage is required for better livestock production to meet the ever increasing demand of population for meat, milk, hides and wool. (Chaudhry *et al.*, 1985). In Pakistan, shortage of green forage is one of the limiting factors to maintain present livestock population. This shortage is about 40-50 percent which reaches up to 75 percent in fodder lean period i.e. May-June and November-December (Sarwar *et al.*, 2002). Pakistan has 21 million hectares of cultivable land but due to shortage of food, arable crops are cultivated even on marginal lands. Hence, these cultivable lands cannot be shifted permanently to forage crops (Iqbal *et al.*, 1998). Although about 1/6th of the total cropped area in Pakistan is put under forage crops annually but animals are generally under fed because of lesser supply of available forage supply is less than actually needed (Hussain *et al.*, 1993). Under such conditions the evolution of high yielding and good quality (in respect to protein contents) forage crops especially the leguminous fodder crops is dire

need in bridging the production and demand gaps especially during the scarcity periods.

Leguminous forages are not only rich in protein but also in minerals and vitamins B (Hill and Curse, 1992). Forage legumes not only increase fertility, control soil erosion but also used as cover crops to cut down erosion (Ahmed and Anwar, 1986). Intensive cultivation and higher crop yield(s) are likely to affect the soil nutrients status. Legumes help in maintaining soil fertility especially due to its nitrogen-fixing bacteria (Khan *et al.*, 1986).

Quality and yield are the two main criteria in the selection of forage crops. Quality of forage is determined by the nutrients they supply. Among these nutrients protein contents are of great importance and it is commonly stated that forage with a higher protein contents have superior feeding value (Qureshi, 1992). Legumes are more palatable and highly nutritious forage and are two to three times richer than cereals in protein, calcium and phosphorus with more forage yield (Chatterjee *et al.*, 1984). Forage yield of a crop depends upon its physical characteristics like plant height, weight, pods and number of leaves (Ahmed and Anwar, 1986). Legumes can produce 3282 kg ha^{-1}

of dry matter which can help to meet scarcity of green forage during lean periods (Iqbal *et al.*, 1998).

To obtain high yield and good quality of forage, such varieties are needed, which should be high yielding with more crude protein contents. Therefore, the present study was conducted to determine the performance of some forage legume crops such as Cowpeas (*Vigna sinensis*), Lablab bean (*Dolichos lablab*), Rice bean (*Phaseolous calcartus*) Sesbania (*Sesbania exalata*), under continental climate zone. The major objectives of the present study were to determine forage yield and quality in terms of crude protein in selected leguminous forage species.

MATERIALS AND METHODS

The study was carried out at the National Agriculture Research Centre (NARC), located close to the capital city of Islamabad, at an altitude of 500 m. The centre lies in the sub-tropical, sub-humid continental climatic zone. The climate is characterized by hot summers and cold winters, with some frost events in January. The mean maximum temperature in the hottest month of June is 40°C while the mean minimum temperature of January is 3°C. The mean annual rainfall is about 1000 mm, 70 percent of which falls during the summer monsoon season (July, August and September) and remaining 30 percent falls in winter (December, January and February). The soil is slightly alkaline, non-saline, loamy in texture, low in organic matter and major nutrients with exception of available K (Nizami *et al.*, 2004)

A level plot was selected and prepared by ploughing with cultivator (3 times) and planking. Plot size was 4 x 8 m with rows spaced 50 cm apart. Four legume species of Cowpeas (*Vigna sinensis*), Lablab bean (*Dolichos lablab*), Rice bean (*Phaseolous calcartus*), Sesbania (*Sesbania exalata*), and a non-leguminous control crop, Sorghum (*Sorghum vulgare*) were used in the trials.

The study was laid in a randomized complete block design (RCBD) with three replications. All the varieties were sown on 4 July, 2003 and were allowed to grow under rainfed conditions without adding N fertilizer and

harvested in the first week of October, 2003 at mature stage. Different parameters recorded during the study include plant height, fresh weight, dry weight and crude protein contents. For recording the plant height, five plants per treatment were selected at random and measured. Plant biomass of whole plot was clipped leaving one meter from border of the plots at random avoiding edge effect and fresh weight was recorded. The size of the quadrat was 1 m².

The plant material was oven dried at 70°C for 48 hours and dry weight was noted. Dried plant material was ground and samples were analyzed at the Animal Nutrition Lab., NARC using the micro- Kjeldhal method (AOAC, 1994). Data were analyzed statistically using the analysis of variance method and means were separated by using Least Significant Differences (LSD) (Steel *et al.*, 1997)

RESULTS

A significant difference ($p < 0.01$) in the heights of different crops was observed. Sesbania had the maximum height of 144 cm while rice bean attained lowest height of 86 cm (Table 1). However, there was also a significant difference among all the other three species (Lablab bean 89 cm, Cowpeas 116 cm, Sorghum 122 cm). Maximum height of sesbania can be accounted for its erect growing habit. Sorghum had the highest fresh matter yield (17.0 t ha⁻¹) while the lowest fresh matter yield (8.7 t ha⁻¹) was in lablab beans. There was a non-significant difference among the rest of legume species. The highest dry weight (3.9 t ha⁻¹) was in sorghum and the lowest dry weight (2.0 t ha⁻¹) was obtained in cowpeas. Difference among various treatments was highly significant ($p < 0.01$).

The quality of forage is influenced by percentage of crude protein present in the plant tissue. To ascertain nutritive value, protein contents were determined, as forage yield alone is not enough for measuring the feeding value of the forage crops. The data revealed that highest CP contents of 581 kg ha⁻¹ were recorded from Sesbania and lowest (175 kg ha⁻¹) from sorghum (Table 1). Differences among dry matter yield between treatments were statistically highly significant.

Table 1. Plant height, fresh and dry matter yield and crude protein in forage legumes and sorghum

Species	Plant height (cm)	Fresh matter yield (t ha ⁻¹)	Dry matter yield (t ha ⁻¹)	Crude protein contents (%)	Crude protein yield (kg ha ⁻¹)
Sesbania	144 a	13.0 b	3.8 a	15.5 c	581 a
Rice bean	86 d	12.8 b	2.6 c	20.3 ab	533 b
Lablab bean	89 d	8.7 d	2.9 b	18.5 b	532 b
Cowpeas	116 c	11.7 c	2.0 d	20.9 a	415 c
Sorghum	122 b	17.0 a	3.9 a	4.5 d	175 d
LSD	±5.86	±0.74	± 0.11	± 0.63	± 36.9

DISCUSSION

Most of the rain fed agriculture area in Pothowar is under severe threat of erosion. Most of the rain falls during the monsoon season and abundant forage cover becomes available. Sorghum, maize and millet also provide abundant forage but these are all non-leguminous fodder species with very little crude protein. Forage quality is an important consideration for optimum livestock production. It has been estimated that animal rations should include at least 8 percent crude protein in their rations (ARC, 1965). When livestock is fed on diet comprising solely of grasses, their productivity declined. The results of this study indicated (Table 1) that legumes like rice beans, lablab beans, cowpeas etc. can fulfill this criterion as crude protein percentage in these species has been observed to rarely fall below 10 percent at all stages of development. Legume feed not only improves forage quality but also increases intake of the ration, hence, gives better performance in terms of livestock production (Osman and Osman, 1982).

Legumes are capable of fixing atmospheric nitrogen with the help of *Rhizobium* living symbiotically in the root nodules. Therefore, legumes can be grown in soils with low fertility without applying chemical fertilizers. As soils of Pothowar area are low in fertility and are under threat from erosion (ABAD, 1987), therefore it is desirable that legumes may be introduced in the farming system so that soils of the area could be reclaimed.

However, legumes are comparatively low yielding as compared to grasses as is evident from the result of the present study (Table 1). Sorghum being a C₄ plant is capable of fast growth and hence, adds more to dry matter yields. As legumes are more palatable and nutritious whereas grasses are high yielding, therefore, there should always be a ratio of both grasses and legumes in the livestock diet. An alternative approach could be that grass/ legume be grown together. The mixture will not only be high yielding but will also be highly nutritious (Qamar *et al.*, 1999).

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