Growth and nutritive value of *Lablab purpureus* accessions in semi-arid Kenya

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Abstract

A field study was conducted on nodulation, time to flowering, dry matter production and forage nutritive value of 17 *Lablab purpureus* accessions collected from sites between 55 and 6974 m above sea level. There were significant variations in excisable nodulation (range 0–22 nodules/plant), dry matter (DM) yields of leaf (17.1–143.9 g/plant) and stem (15.2–161.2 g/plant) but not in days to first flowering (63–85 days).

The mean nitrogen concentration in leaf (4% DM) was twice that in stem (1.9%). Mean neutral detergent fibre (41.8%) and acid detergent fibre (29.6%) concentrations in leaf were 20 percentage units lower than that of stem, whereas the *in vitro* dry matter digestibility of the leaf (64.4%) was 20 percentage units higher than that of stem. There was little variation in the level of acid detergent lignin between leaf and stem. The concentrations of soluble phenolics and insoluble proanthocyanidins were also slightly higher in leaf than in stem.

Overall, Accessions 1042, 1089, 1067, 1045 and 1071 were consistently higher yielding, irrespective of the available moisture. They have potential for use as a feed supplement in semi-arid parts of Kenya.

Introduction

Semi-arid and arid lands support the largest livestock population in East Africa. However, livestock production is low because of poor nutrition, which primarily is derived from natural pastures and limited amounts of crop residues (Tessema 1988). While the production of natural pastures is low, the roughages also have low nutritive value, but it can be improved by supplementing them with a forage legume (Van Eys *et al.* 1986). Studies with *Lablab purpureus* cv. Rongai (Thurbon *et al.* 1970; Hendricksen and Myles 1980) demonstrated the level of animal production as well as the nutritive value of Rongai herbage. In another study (Karachi 1988), lablab accessions collected from the Rongai district, the original source of cv. Rongai, showed considerable variation in dry matter yields and herbage quality. However, a large diversity of ecotypes adapted to Kenyan environments still exists, whose potential for use in conjunction with native pastures has not been examined. This paper presents data on flowering, dry matter production and forage nutritive value of 17 accessions of *Lablab purpureus* collected from different environments in Kenya.

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Materials and methods

Site

The trial was located at the National Dryland Research Station, Katumani, Kenya (37° 14′E, 1° 35′S; 1600 m above sea level). The site has a semi-arid climate with 2 rainy seasons. The 'short rains' begin in October, peak in November and end in late December–January, whereas the 'long rains' begin in March, peak in April and end in May (Wandera *et al.* 1991). The mean annual rainfall and mean maximum and minimum temperatures are 700 mm, 26°C and 14°C, respectively. The soils are classified as chromic luvisols (Mbuvi and Van de Weg 1975), and contain 53% clay, 8% silt and 39% sand. The chemical properties of surface soil (0–30 cm) were: pH (1:2.5 water) 6.9; organic carbon 0.9%; total N 0.2%;

available P (Bray 11) 18 ppm; and exchangeable cations: Ca 1.7, Mg 1.2, K 0.7 and Na 0.1 meq/100 g of soil.

Treatments

The 17 lablab accessions (Table 1) were collected from farmers' fields or market centres covering altitudes ranging from 55–6974 m above sea level. Accession 1077 was commercial seed of cv. Rongai obtained from Kenya Seed Company. Design of the experiment was a randomised complete block with 3 replications. Plots consisted of 3 rows, 7.5 m long, with an inter-row spacing of 30 cm and 1 m path. Two seeds were sown together 15 cm apart with the extra seedling thinned 14 days after germination, leaving 1 plant per station. After sowing on November 12 and April 3, 1987 and November 15 and April 5, 1988, 15 kg/ha P as single superphosphate was drilled 15 cm either side of the middle seed row. The experimental site had been used for screening cowpea (*Vigna ungiculata*) germplasm since 1985; therefore, none of the accessions was inoculated. All plots were clean weeded.

Measurements

Samples were taken from 25 plants in the middle of the central row. Nodule counts were made from plants that were uprooted at thinning. Roots were washed clean of soil, then excisable nodules removed. Dates of first flowering were recorded as a mean of days when 5 plants per accession had set flowers. Harvests for dry matter (DM) determination and chemical analysis were taken 100 days from emergence of cotyledons. Plants were cut at ground level, the fresh weight recorded and a representative subsample taken. The subsamples of the fresh material were oven-dried at 70°C for 24 hours to estimate dry matter. Dried herbage was subsequently separated into leaf and stem fractions and re-weighed and ground to pass a 2 mm mesh sieve, then stored in sealed glass jars until chemical analysis.

Chemical analysis was done on subsamples collected from (short and long rains) sowings harvested in 1988. Ground samples were bulked on the basis of replicates and a subsample of each taken for analysis. Nitrogen (N) was determined by the microkjeldahl method. Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid

Table 1. Mean number of nodules per plant, days to first flowering and dry matter yields.

Kat.[1] No.	Number of excisable nodules/plant	Mean number of days to first flowering[2]	Dry matter yields (g/plant)			
			1987		1988	
			Leaf	Stem	Leaf	Stem
1042	11	63	142.6	140.2	143.9	159.7
1089	12	69	118.4	161.2	91.6	106.8
1060	8	65	116.1	59.1	109.3	72.4
1067	22	65	106.1	72.2	103.5	87.3
1045	13	65	103.5	49.1	94.5	80.2
1003	16	70	96.3	60.2	55.5	65.3
1071	8	63	83.4	101.6	138.1	101.6
1006	13	76	79.2	70.8	86.4	61.6
1053	13	64	71.6	61.3	85.6	56.4
1051	11	65	70.6	47.3	44.1	15.2
1077	14	78	67.6	108.3	53.4	96.9
1048	5	65	65.4	87.1	63.8	20.3
1049	12	73	49.4	114.6	147.5	110.6
1068	17	70	43.1	62.1	27.9	16.3
1044	6	63	38.9	69.8	78.9	83.6
1001	0	85	28.8	61.2	121.6	88.4
1005	12	65	17.1	103.0	78.7	83.6
Mean	11	69	76.4	84.1	89.7	70.0
LSD (P<0.05)	4	NS	28.5	37.1	39.4	41.3

[1]Katumani accession number. Details on climate and soils at the sites of collection are available from the Director, National Dryland Farming Research Station, PO Box 340, Machakos, Kenya.
[2]Mean number of days when 5 plants had opened the first flower.

detergent lignin (ADL) were determined by the methods of Goering and Van Soest (1970). *In vitro* dry matter digestibility was determined by the pepsin-cellulase assay described by Goto and Minson (1977). Soluble phenolics and insoluble proanthocyanidins were determined from selected samples, bulked over replicates, representing high, medium and low leaf yielding accessions. Soluble phenolics were determined by precipitation with trivalent ytterbium (Reed *et al.* 1985) and insoluble proanthocyanidins according to Reed *et al.* (1982). Analysis of variance was conducted on nodule counts, days to first flowering, herbage dry matter yields, nitrogen and fibre concentrations and digestibility.

Results

Total annual rainfall received was 334 mm (200 mm, short rains; 134 mm, long rains) in 1987 and 541 mm (300 mm, short rains; 241 mm, long rains) in 1988. Mean maximum and minimum temperatures for the same periods were 24.0 and 12.8°C and 24.7 and 12.9°C, respectively. Both parameters were below the mean averages.

Nodulation and flowering

There were significant ($P<0.05$) differences among the accessions in excisable nodule counts (range 0–22/plant) (Table 1). Days to flowering ranged from 63–85, with no difference between accessions ($P>0.05$). The moisture stress that occurred in 1987 and the time of cropping (short or long rains) did not effect any significant variation in these attributes (data not presented).

Dry matter yields

The yields obtained from the crops sown during the long and short rains in each year were not significantly different ($P>0.05$); therefore, mean yields from the 2 seasons' harvests are presented (Table 1). Mean DM yields of leaf were 76.4 (range 17.1–142.6) g and 89.7 (27.9–143.9) g/plant and those of stem were 84.0 (47.3–161.2) g and 71.0 (16.3–106.8) g/plant for 1987 and 1988 harvests, respectively. These differences between the accessions were significant ($P<0.05$). The highest yields were recorded from Accession 1042 and the lowest from 1068 and 1051.

Chemical composition

There were significant differences ($P<0.01$) between the accessions in the nitrogen and fibre concentrations of leaf and stem (Table 2), but not

Table 2. Nitrogen (N), neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) concentrations and *in vitro* dry matter digestibilities of lablab forage at Katumani, Machakos in Kenya.

Kat. No.[1]	N		NDF		ADF		ADL		IVDMD	
	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem	Leaf	Stem
1042	4.3	2.1	39.9	65.1	34.3	51.2	10.4	15.5	61.5	44.5
1089	4.4	1.5	39.0	64.2	30.6	52.2	7.7	10.7	59.3	46.5
1060	4.9	1.8	47.8	60.2	25.0	47.6	9.6	10.4	70.0	48.3
1067	4.6	1.8	51.5	62.3	27.8	55.7	12.0	12.8	68.4	41.8
1045	4.8	2.0	42.2	60.2	30.6	47.5	9.6	12.0	56.4	41.5
1003	4.0	2.1	32.2	66.2	22.2	50.5	4.8	11.4	56.4	49.2
1071	3.9	1.8	47.7	69.2	36.0	46.9	9.4	13.3	68.0	45.4
1006	3.4	1.9	42.3	52.2	30.0	47.0	8.0	9.3	60.6	42.7
1053	2.9	1.6	43.8	68.9	27.4	52.6	7.9	11.3	66.2	40.2
1051	3.9	2.7	51.2	59.8	29.8	41.5	7.1	7.6	66.9	45.1
1077	3.4	2.0	42.3	59.7	31.8	46.3	11.4	7.7	64.9	43.4
1048	3.6	1.6	42.3	60.5	30.2	44.3	10.0	12.4	65.3	46.3
1049	4.3	1.8	38.8	63.7	28.9	51.0	9.8	9.9	63.9	40.6
1069	3.7	1.8	38.7	64.2	29.8	62.7	8.0	8.0	59.1	46.2
1044	3.6	1.5	39.3	60.3	33.4	51.1	9.5	9.5	68.7	45.2
1001	4.4	1.9	26.0	50.0	29.8	46.0	11.0	11.0	61.8	47.3
1005	4.6	1.6	45.0	63.6	25.8	44.8	11.4	11.4	61.8	42.0
Mean	4.0	1.9	41.8	61.8	29.6	49.3	10.8	10.8	64.4	44.2
LSD ($P<0.05$)	0.4	0.4	4.7	5.3	4.4	5.3	2.4	2.9	NS	NS

[1]Katumani accession number.

in the leaf and stem IVDMD levels (P>0.05). The leaf contained more N (2-fold) and was more digestible (about 20 percentage units) than stem, whereas the NDF and ADF concentrations in stem were greater (about 20 percentage units) than in leaf. The mean ADL levels did not vary (P>0.05) between the 2 forage fractions.

Soluble phenolics (range 6.9–11.1% DM) and insoluble proanthocyanidins (range 1.3–6.8% DM) concentrations were higher in leaf (except soluble phenolics in Accession 1042) than in stem. The concentrations of these compounds within leaf and stem were also variable between accessions (Table 3).

Table 3. Concentrations of soluble phenolics and insoluble proanthocyanidins of lablab accessions at Katumani, Machakos in Kenya.

Kat No.[1]	Soluble phenolics (%DM)		Insoluble proanthocyanidins (A550/g)	
	Leaf	Stem	Leaf	Stem
1042	8.5	9.5	3.4	1.4
1089	3.4	2.6	6.0	2.2
1003	3.7	0.9	3.4	1.3
1006	2.5	2.5	3.1	1.5
1053	10.2	9.7	6.8	3.4
1051	9.9	3.5	5.6	2.3
1048	5.7	—[2]	5.2	—
1049	11.1	—	2.3	—
1068	10.3	—	2.2	—
1044	5.2	—	6.6	—
1005	9.1	4.6	4.7	2.9

[1]Katumani accession number.
[2]Not determined.

Discussion

The trial demonstrates the variability of yield attributes within the local lablab accessions. Although moisture stress (1987 season) would be expected to hasten flowering (Major 1980), these accessions were not responsive, indicating that their critical stress limits had not been reached. Herbage yields of some accessions were, however, sensitive to rainfall. The sensitive accessions (1049 and 1001) yielded more stem than leaf when under stress, which was partly due to poor leaf retention. In contrast, some accessions (1042, 1060 and 1067) consistently yielded more leaf than stem and outyielded cv. Rongai irrespective of the weather conditions.

The range of nitrogen and IVDMD values recorded in the present study agree with those reported by Hendricksen and Minson (1985) and published data for several browse species in Africa (Le Houerou 1980 a, 1980 b; Bayer 1990). The protein values (N × 6.25) were mostly above the recommended levels (11% CP) for growth of most young domestic ruminants (NRC 1984). The IVDMD levels for leaf but not stem were adequate for high growth rates in ruminants. Assuming a 1:1 leaf:stem ratio (values generally recorded at flowering–early podding stages of growth), this would amount to approximately 50% IVDMD. Therefore, when used as the sole diet, these accessions could support only medium levels of animal production (Van Soest 1982). However, in times of drought, they could provide valuable supplementary feed for animals foraging on poor pastures.

Soluble phenolics and insoluble proanthocyanidins can lower the nutritive value of feed through their influence on forage digestibility (Ford 1978; Reed *et al.* 1990), which partly accounts for the low digestibilities recorded for tropical forages. The concentrations measured in this study were lower than those recorded for *Acacia* species (Reed 1986). However, Reed *et al.* (1990) observed a reduction in digestibilities of NDF and ADF in rations containing lower levels of insoluble proanthocyanidins. The effect of these secondary compounds on the feed value of lablab forage should be investigated. Nevertheless, the literature suggests that their presence in the forage may reduce the value of lablab as feed.

In East Africa, lablab finds its greatest use in the smallholder sector, mainly as a source of grain for human consumption and stover as a supplement for stall-fed livestock. The current farm policies also emphasise the use of dual-purpose crops that fit into integrated livestock-crop farming patterns found in the smallholder sector. Among the ecotypes studied, Accessions 1042, 1089, 1060, 1067 and 1045 have greater potential for use as forages. They consistently produced more leaf and were tolerant of moisture stress, which suggests they have a potential as forage protein supplements under semi-arid conditions. However, due to lablab's multiple use, future research should include its grain-production abilities.

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