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# Response of Proximate Composition of Lablab (*Lablab purpureus* L. Sweet) Herbage to Phosphorus Application, Cutting Height and Age of Cutting

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**Abstract:** In order to evaluate the response of lablab (*Lablab purpureus* L. Sweet) proximate composition to phosphorus application, cutting height and age of cutting, field trials were conducted at Samaru, Nigeria in the 2006-2008 wet seasons. The treatments were composed of factorial combinations of 4 rates of phosphorus application (0, 12, 24 and 36 kg P ha$^{-1}$), 2 cutting heights (10 and 20 cm) as the main plot and 4 cutting ages (6, 12, 18 weeks and at maturity) as the sub-plot a split plot design with three replications. The highest crude protein and crude fibre concentrations of lablab herbage were obtained at the 12 weeks and maturity stages of cutting, respectively and both parameters were enhanced by advanced age of cutting. Lablab ether extract concentration decreased as age of cutting increased and cutting age did not improve ether extract concentration. A phosphorus application rate of 12 kg P ha$^{-1}$ produced the highest ether extract concentration in lablab herbage when age of cutting was 6 weeks. Crude protein concentration of lablab was highest at the 0 P application rate combined with cutting at 6 weeks age while crude fibre was highest when lablab received no phosphorus application and was cut at maturity. It is suggested that lablab herbage be fed prior to maturity in order to reduce minimize crude protein loss.

**Key words:** Cutting treatments, feed quality, herbage, lablab, phosphorus nutrition, tissue analysis

## INTRODUCTION

The yield, chemical composition and nutritive value of grasses and legume species grown in Nigeria vary greatly, depending on the species and season of growth at which the grasses are cut or grazed (Aina and Onwukwe, 2002). Suitable legume species have the potential to alleviate feed constraints, especially for cattle and other ruminants during the dry season through their higher nutritive values relative to natural fallows (Minson, 1990). Lablab (*Lablab purpureus*) whose herbage can either be grazed or used for hay or silage was reported to be a promising crop for the Northern Guinea Savanna (Thomas and Sumberg, 1995; Iwuafor and Odunze, 1999; Ewansiha *et al*., 2007). The foliage has high protein content (15-30%) with high levels of lysine and about 55% digestibility (Valenzuela and Smith, 2002) while the hay is high in crude protein (>17%), ash (>8%) and digestibility (>54%) (Murungweni *et al*., 2004).

Although, phosphorus application is required for good legume productivity, soil phosphorus availability is affected by many edaphic and non-edaphic factors. The importance of good re-growth, cutting height and age of pasture to its nutritive value and overall biomass production has been reiterated by several researchers (Lowe *et al*., 1985; Slarke and Mason, 1987; Adjei and Gentry, 1996; Odion and Singh, 2005). Consequently, how these factors affect pasture legume quality is of interest to scientists. Except for studies published by Hena *et al*. (1990) and Lamidi *et al*. (1997) on Rongai and highworth varieties, respectively, studies on the effect of cutting on the quality of new lablab accessions are lacking. In view of the aforementioned reasons, it is important to further evaluate lablab accession (ILRI 147) to determine its phosphorus requirement and the appropriate stages of growth and maturity at which to cut and obtain maximum proximate parameters. The objective of this study, therefore was to evaluate the effect of phosphorus application, cutting height and age of cutting on the proximate composition of lablab herbage.

## MATERIALS AND METHODS

**Site description:** Field trials were conducted during 2006-2008 cropping seasons at the Institute for Agricultural Research (IAR) experimental farm, Ahmadu

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Bello University, Samaru (lat 11°11N', long. 7°38'E 686 m above sea level) in the Northern Guinea Savanna zone of Nigeria.

**Treatments and experimental design:** The lablab accession ILRI 147 which is also known as Highworth, black-seeded was obtained from the International Livestock Research Institute (ILRI-Nigeria) and was evaluated in the study. A row spacing of 30×30 cm and seed rate of 24 kg $ha^{-1}$ which are recommended for fodder production were used in the experiment. The gross plot size was 5×3 m (15 $m^2$). The treatments were factorial combinations of four rates of phosphorus application (0, 12, 24 and 36 kg P $ha^{-1}$) and 2 cutting height (10 and 20 cm above ground level) and 4 cutting ages (6, 12 and 18 Weeks After Sowing (WAS) and at maturity). The experiment was a split plot design where phosphorus application x cutting height represented the main plot while cutting age was the subplot. The treatments were replicated three times.

**Measurements:** At each cutting age, the fodder from a gross sub-plot was cut, weighed and sub-sampled for dry weight determination in a Gallenkamp oven at 70°C. After dry weight determination, the sample was ground with a Christy 8 lab mill (Christy and Norris Ltd., England) and labeled for proximate analysis. Proximate analysis was carried out to determine the concentrations of crude protein, ether extract, crude fibre and nitrogen-free-extract in plant samples according procedures described by the AOAC (1990). Crude protein estimated as N×6.25.

**Data analysis:** The data collected were subjected to one-way analysis of variance using the SAS software (SAS, 2001) determine the significance of treatment effects as described by Snedecor and Cochran (1967) while the means were separated using Duncan's Multiple Range Test (DMRT) at the 5% level of probability (Steel *et al*., 1997).

## RESULTS AND DISCUSSION

Effects of phosphorus application, cutting height and age of cutting on crude protein concentration of lablab at the 1st and 2nd cuttings in 2007, 2008 and the combined data for both years are showed in Table 1. The differences in Crude Protein (CP) due to phosphorus application and cutting height at the 1st and 2nd cuttings in both years and in the combined analysis were not significant. Crude protein concentration in lablab differed significantly between the ages of cutting at all sampling periods (Table 1). Generally, crude protein concentration decreased as the age of cutting increased during the 1st herbage cutting. In each of the 2 years, crude protein concentration of lablab herbage was significantly ($p = 0.05$) lower when cut at maturity compared to any of the other ages of cutting. In the combined analysis, crude protein values for herbage cut at 6 and 12 weeks were at par and significantly ($p = 0.05$) higher than the crude protein for herbage cut at 18 weeks. At the 2nd cutting, lablab cut at 6, 12 or 18 weeks had similar crude protein concentrations that were significantly higher than that for plants cut at the maturity stage. However in 2007, only

Table 1: Effect of phosphorus application, cutting height and age of cutting on crude protein in lablab herbage at the 1st and 2nd cuttings in the 2007 and 2008 wet seasons and combined >2007 and 2008 at Samaru, Nigeria

| | Crude protein (g $kg^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | 1st cutting | | | 2nd cutting | | |
| Treatments | 2007 | 2008 | Combined | 2007 | 2008 | Combined |
| **Phosphorus (kg P $ha^{-1}$)** | | | | | | |
| 0 | 138.8 | 140.3 | 139.6 | 106.1 | 122.5 | 114.1 |
| 12 | 154.8 | 140.0 | 147.3 | 111.2 | 120.2 | 116.0 |
| 24 | 146.0 | 133.4 | 139.7 | 113.0 | 122.1 | 117.3 |
| 36 | 140.0 | 135.1 | 137.4 | 109.2 | 124.0 | 116.4 |
| ±SE | 5.47 | 6.03 | 4.09 | 2.87 | 4.06 | 2.49 |
| Significance | NS | NS | NS | NS | NS | NS |
| **Cutting height (cm)** | | | | | | |
| 10 | 141.4 | 137.5 | 140.8 | 110.1 | 124.0 | 117.0 |
| 20 | 145.6 | 137.0 | 141.2 | 110.1 | 120.0 | 115.0 |
| ±SE | 0.89 | 4.26 | 2.82 | 2.03 | 2.87 | 1.76 |
| Significance | NS | NS | NS | NS | NS | NS |
| **Age of cutting age (WAS)** | | | | | | |
| 6 | $163.5^{b}$ | $160.6^{a}$ | $162.1^{a}$ | $112.1^{ab}$ | $131.3^{a}$ | $122.0^{a}$ |
| 12 | $193.6^{a}$ | $142.5^{b}$ | $168.0^{a}$ | $114.2^{a}$ | $134.1^{a}$ | $124.1^{a}$ |
| 18 | $128.1^{c}$ | $140.7^{b}$ | $134.4^{b}$ | $109.2^{ab}$ | $132.1^{a}$ | $121.1^{a}$ |
| Maturity | $94.1^{d}$ | $104.9^{c}$ | $99.5^{c}$ | $103.7^{b}$ | $91.1^{b}$ | $97.20^{b}$ |
| ±SE | 5.47 | 6.03 | 4.09 | 2.87 | 4.06 | 2.49 |
| Significance | ** | ** | ** | * | ** | ** |

Means within a column of any set of treatments followed by different letter are significantly different at 5% level of probability according to the Duncan's Multiple Range Test (DMRT); NS = Not Significant; *, **Significant at 5 and 1% levels of probability, respectively; WAS = Weeks After Sowing the herbage cut at 12 weeks were statistically superior to those plants cut at maturity with respect to crude protein concentration. The interaction between phosphorus application and age of cutting for crude protein at the 1st herbage cutting in 2008 was significant (Table 2). At a constant age of cutting but varying rates of phosphorus application, it was evident that when cutting was done at 18 weeks, 36 kg P $ha^{-1}$ application rate produced significantly higher crude protein concentration than at the 24 kg P $ha^{-1}$ application rate while when cutting lablab at maturity, 24 kg P $ha^{-1}$ rate of application was significantly ($p = 0.05$) higher than the 0 P $ha^{-1}$ rate of application. At a constant rate of P fertilization in association with varying ages of cutting, it was observed that lablab herbage's crude protein concentration differed significantly ($p = 0.05$) depending on the rate of phosphorus applied.

At 0 and 12 kg P $ha^{-1}$, crude protein concentration of lablab was similar at the cutting ages of 6, 12 and 18 weeks which were significantly higher than the crude protein value obtained when cut at the maturity stage. However, at the 24 kg P $ha^{-1}$ phosphorus application rate, cutting at 6 weeks produced significantly ($p = 0.05$) higher crude protein concentration in lablab than cutting at 18 weeks while with 36 kg P $ha^{-1}$, cutting at 18 weeks produced significantly higher crude protein than cutting at 12 weeks or at maturity. However, cutting lablab either at 18 weeks or at 6 weeks produced similar crude protein concentrations when a 36 kg P $ha^{-1}$ rate of application was adopted.

Table 2: Interaction between phosphorus application rate and cutting age on herbage crude protein (g $kg^{-1}$) at the 1st herbage cutting in the 2008 wet season at Samaru, Nigeria

| Phosphorus (kg P $ha^{-1}$) | Age of cutting age (WAS) 6 | 12 | 18 | Maturity |
|---|---|---|---|---|
| 0 | $175^{a}$ | $165^{ab}$ | $141^{a-e}$ | $80^{f}$ |
| 12 | $167^{ab}$ | $133^{b-c}$ | $150^{a-d}$ | $110^{ef}$ |
| 24 | $153^{abc}$ | $143^{a-e}$ | $118^{de}$ | $120^{cde}$ |
| 36 | $147^{a-d}$ | $128^{cde}$ | $155^{ab}$ | $110^{ef}$ |
| ±SE | 12.1 | | | |

Means followed by similar letter(s) in the same row or column are not significantly different at the 5% level of probability according to the Duncan's Multiple Range Test (DMRT); WAS = Weeks After Sowing

Data on the effects of phosphorus application, cutting height and age of cutting on Crude Fibre (CF) concentration of lablab herbage at the 1st and 2nd herbage cuttings in 2007, 2008 and in the combined means for both years are showed in Table 3. At the 1st and 2nd cuttings for both years and in their combined analysis, phosphorus application and cutting height effects were not significant whereas age of cutting caused significant differences in the crude fibre concentrations of lablab herbage.

At the 1st cutting, the herbage cut at 18 weeks and at maturity contained significantly ($p = 0.05$) higher crude fibre than herbage cut at 6 and 12 weeks. However in 2007 and in the combined data, crude fibre of lablab was significantly ($p = 0.05$) higher at 6 weeks than at 12 weeks. The highest crude fibre concentration was recorded when lablab herbage was cut at 18 weeks and at maturity. In 2008 and the combined data, crude protein concentrations for 18 weeks age of cutting was 35.5 and 50.6% higher than that for the 12 weeks cut, respectively.

Table 3: Effect of phosphorus application, cutting height and age of cutting on crude fibre in lablab herbage at the 1st and 2nd herbage cuttings in the 2007 and 2008 wet seasons and combined >2007 and 2008 at Samaru, Nigeria

| | Crude fibre (g $kg^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | 1st cutting | | | 2nd cutting | | |
| Treatments | 2007 | 2008 | Combined | 2007 | 2008 | Combined |
| **Phosphorus (kg P $ha^{-1}$)** | | | | | | |
| 0 | 234.2 | 219.4 | 226.8 | 231.1 | 226.3 | 229.0 |
| 12 | 240.6 | 221.4 | 230.5 | 219.1 | 223.0 | 221.1 |
| 24 | 235.5 | 236.3 | 236.0 | 232.0 | 232.2 | 232.0 |
| 36 | 231.6 | 230.2 | 231.0 | 228.0 | 224.0 | 226.1 |
| ±SE | 5.71 | 12.44 | 6.70 | 10.03 | 6.03 | 5.85 |
| Significance | NS | NS | NS | NS | NS | NS |
| **Cutting height (cm)** | | | | | | |
| 10 | 237.1 | 224.2 | 230.6 | 227.0 | 224.0 | 225.3 |
| 20 | 233.4 | 229.4 | 231.4 | 227.6 | 230.1 | 228.3 |
| ±SE | 4.03 | 0.79 | 0.71 | 7.10 | 4.26 | 4.14 |
| Significance | NS | NS | NS | NS | NS | NS |
| **Age of cutting age (WAS)** | | | | | | |
| 6 | $223.1^{c}$ | $207.1^{b}$ | $215.1^{b}$ | $205.0^{b}$ | $203.3^{b}$ | $204.0^{b}$ |
| 12 | $156.3^{d}$ | $189.3^{b}$ | $172.8^{c}$ | $217.1^{b}$ | $201.5^{b}$ | $210.0^{b}$ |
| 18 | $262.0^{b}$ | $256.5^{a}$ | $260.2^{a}$ | $227.1^{b}$ | $205.2^{b}$ | $216.1^{b}$ |
| Maturity | $299.6^{a}$ | $254.4^{a}$ | $276.7^{a}$ | $262.0^{a}$ | $295.4^{a}$ | $278.5^{a}$ |
| ±SE | 0.71 | 12.44 | 6.66 | 10.03 | 6.03 | 5.85 |
| Significance | ** | ** | ** | ** | ** | ** |

Means within a column of any set of treatments followed by different letter are significantly different at the 5% level of probability according to the Duncan's Multiple Range Test (DMRT); NS = Not Significant; *, **Significant at 5 and 1% levels of probability, respectively; WAS = Weeks After Sowing

At the 2nd cutting, the crude fibre values of lablab herbage cut at 6, 12 and 18 weeks were at par but were significantly lower than the crude fibre of lablab obtained when cutting was done at maturity. The crude protein concentration for the 6 weeks cut was 21.8, 31.2 and 26.6% lower than that for the maturity stage in 2007, 2008 and for the combined.

The interaction between phosphorus application and age of cutting on crude fibre concentration at the 1st cutting in 2008 was significant (Table 4). Holding age of cutting constant and varying rates of P application, differences in crude fibre concentration were found when lablab herbage cut at either 12 weeks or at maturity. At 12 weeks, crude fibre concentration was significantly higher when 12 kg rather than of 0 kg P $ha^{-1}$ was applied whereas when cutting was done at maturity, lablab herbage accumulated more crude fibre at 0 rather than 24 kg P $ha^{-1}$ application rate. In holding P constant and varying the ages of cutting intervals, at 0 kg P $ha^{-1}$ crude fibre produced at maturity was significantly higher than that produced at 6 and 12 weeks of cutting while at 24 kg P $ha^{-1}$, crude fibre obtained at 18 weeks cutting was significantly higher than the CF concentration obtained when lablab herbage was cut at 12 weeks.

Table 5 shows the effects of phosphorus application, cutting height and age of cutting on ether extract concentration of lablab at the 1st and 2nd cuttings in 2007, 2008 and in the combined means for both years. Phosphorus application affected ether extract concentration significantly (p = 0.05) in 2008 and in the combined data at the 1st cutting. A phosphorus application rate of 12 kg P $ha^{-1}$ produced significantly (p = 0.05) more ether extract in lablab herbage than an application rate of 24 kg P $ha^{-1}$ at both sampling periods, being higher by 66.2 and 27.8%, respectively. The differences in ether extract concentrations in lablab herbage due to cutting height was not significant whereas of age of cutting affected ether extract concentration significantly (p = 0.05) at the 1st cutting in 2007, 2008 and in the combined data. Generally, the earliest cutting, i.e., 6 weeks favoured ether extract concentration over the later cuttings with value for the 6 weeks cutting being higher than that for the 12 or 18 weeks cutting and the maturity cutting by 58.7 and 120.4%, respectively. In the combined data, the ether extract concentrations of lablab herbage cut at 12 and 18 weeks were at par but significantly (p = 0.05) higher than for the lablab herbage cut at maturity.

Table 4: Interaction between phosphorus application rate and age of cutting on herbage crude fibre (g $kg^{-1}$) at the first herbage cutting in the 2008 wet season at Samaru, Nigeria

| | Age of cutting age (WAS) | | | |
|---|---|---|---|---|
| Phosphorus (kg P $ha^{-1}$) | 6 | 12 | 18 | Maturity |
| 0 | $197^{cd}$ | $129^{d}$ | $247^{abc}$ | $305^{a}$ |
| 12 | $188^{cd}$ | $201^{c}$ | $249^{abc}$ | $248^{abc}$ |
| 24 | $244^{abc}$ | $191^{cd}$ | $286^{ab}$ | $224^{bc}$ |
| 36 | $200^{c}$ | $236^{abc}$ | $244^{abc}$ | $240^{abc}$ |
| ±SE | 2.49 | | | |

Means followed by similar letter(s) in the same row or column are not significantly different at 5% level of probability according to the Duncan's Multiple Range Test (DMRT); WAS = Weeks After Sowing

Table 5: Effect of phosphorus application, cutting height and age of cutting on ether extract in lablab herbage at the 1st and 2nd herbage cuttings in 2007, 2008 wet seasons and combined >2007 and 2008 at Samaru, Nigeria

| | Ether extract (g $kg^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | 1st cutting | | | 2nd cutting | | |
| Treatments | 2007 | 2008 | Combined | 2007 | 2008 | Combined |
| **Phosphorus (kg P $ha^{-1}$)** | | | | | | |
| 0 | 0.6 | $8.7^{ab}$ | $7.8^{ab}$ | 4.3 | 3.9 | 4.1 |
| 12 | 7.5 | $10.8^{a}$ | $9.2^{a}$ | 5.0 | 4.2 | 4.6 |
| 24 | 8.0 | $6.5^{b}$ | $7.2^{b}$ | 4.5 | 4.0 | 4.2 |
| 36 | 8.0 | $8.3^{ab}$ | $8.2^{ab}$ | 4.9 | 4.4 | 4.7 |
| ±SE | 0.57 | 0.99 | 0.56 | 0.5 | 0.33 | 0.3 |
| Significance | NS | * | * | NS | NS | NS |
| **Cutting height (cm)** | | | | | | |
| 10 | 0.78 | 0.84 | 0.81 | 5.1 | 4.1 | 4.6 |
| 20 | 0.74 | 0.87 | 0.81 | 4.3 | 4.1 | 4.2 |
| ±SE | 0.04 | 0.069 | 0.39 | 0.34 | 0.23 | 0.21 |
| Significance | NS | NS | NS | NS | NS | NS |
| **Age of cutting age (WAS)** | | | | | | |
| 6 | $11.6^{a}$ | $12.3^{a}$ | $11.9^{a}$ | 4.2 | $4.9^{a}$ | $4.5^{a}$ |
| 12 | $6.6^{bc}$ | $8.4^{b}$ | $7.5^{b}$ | 5.5 | $4.8^{a}$ | $5.2^{a}$ |
| 18 | $7.1^{b}$ | $7.9^{b}$ | $7.5^{b}$ | 4.1 | $4.9^{a}$ | $4.4^{a}$ |
| Maturity | $5.1^{c}$ | $5.6^{b}$ | $5.4^{c}$ | 5.1 | $2.1^{b}$ | $3.5^{b}$ |
| ±SE | 0.57 | 0.99 | 0.56 | 0.5 | 0.33 | 0.3 |
| Significance | ** | ** | ** | NS | ** | ** |

Means within a column of any set of treatments followed by different letter are significantly different at 5% level of probability according to Duncan's multiple range test; NS = Not Significant; *, **Significant at 5 and 1% levels of probability, respectively; WAS = Weeks After Sowing

At the 2nd cutting, lablab herbage cut at 6, 12 and 18 weeks yielded similar ether extract concentrations that were significantly (p = 0.05) higher by 28.6-48.6% than what was produced when cutting was done at maturity. Phosphorus application x age of cutting interaction for ether extract combined >2007 and 2008 was significant (Table 6). At a constant age of cutting with varying rates of phosphorus application, significant differences in ether extract concentrations of lablab herbage were observed at the 6 and 18 weeks ages of cutting and at maturity. At the 6 weeks cutting, 12 kg P ha$^{-1}$ application produced significantly (p = 0.05) more ether extract (by 44.4%) than 36 kg P ha$^{-1}$.

At the 18 weeks cutting, 12 kg P ha$^{-1}$ application was statistically superior to the 24 kg P ha$^{-1}$ application while at maturity, 24 and 36 kg P ha$^{-1}$ rates were at par but statistically superior to 0 kg P ha$^{-1}$. When phosphorus application was held constant and age of cutting was varied, there were differences in ether extract concentrations when 0, 12 or 24 kg P ha$^{-1}$ application rate was adopted. Generally at these rates of P application, ether extract in lablab herbage was significantly (p = 0.05) higher when cutting was done at 6 weeks compared to the other ages of cutting (Table 6). Table 7 shows the data on Nitrogen-Free-Extract (NFE) of lablab as affected by phosphorus application, cutting height and age of cutting at the 1st and 2nd herbage cuttings in 2007, 2008 and the combined data for both years. Phosphorus application and cutting height did not affect nitrogen-free-extract significantly at any period of sampling in either of the two cuttings. The differences due to age of cutting were however, significant at both cuttings in both years and in the combined data.

Table 6: Interaction between phosphorus application rate and age of cutting on ether extract (g kg$^{-1}$) in lablab herbage at the 1st herbage cutting combined over 2007 and 2008 wet seasons at Samaru, Nigeria

| Phosphorus (kg P ha$^{-1}$) | Age of cutting age (WAS) 6 | 12 | 18 | Maturity |
|---|---|---|---|---|
| 0 | 12$^{ab}$ | 8$^{c-f}$ | 7$^{def}$ | 2$^{g}$ |
| 12 | 13$^{a}$ | 8$^{c-f}$ | 9$^{cde}$ | 5$^{fg}$ |
| 24 | 11$^{abc}$ | 6$^{def}$ | 5$^{f}$ | 5$^{f}$ |
| 36 | 9$^{bcd}$ | 6$^{def}$ | 7$^{def}$ | 8$^{c-f}$ |
| ±SE | 1.1 | | | |

Means followed by similar letter(s) in the same row or column are not significantly different at 5% level of probability according to the Duncan's Multiple Range Test (DMRT); WAS = Weeks After Sowing

At the 1st cutting, the nitrogen-free-extract concentration of lablab herbage was generally significantly (p = 0.05) highest when cutting was done. In 2007 and 2008, the lowest values for NFE were recorded for the 6 and 18 weeks ages of cutting, respectively. At the 2nd cutting, the trend was consistent. Lablab cut at the earlier intervals of 6, 12 and 18 weeks accumulated similar nitrogen-free-extract values that were significantly (p = 0.05) higher than what was accumulated by plants cut at the control. That was also true in the case of the combined data for both years. The phosphorus application x cutting height interaction for NFE at the 1st cutting in 2007 was significant.

**Response to phosphorus:** In this study, the response of lablab herbage quality parameters to phosphorus

Table 7: Effect of phosphorus application, cutting height and age of cutting on nitrogen-free-extract in lablab herbage at the 1st and 2nd herbage cuttings in 2007, 2008 wet seasons and combined >2007-2008 at Samaru, Nigeria

| Treatments | Nitrogen free extract (g kg$^{-1}$) 1st cutting 2007 | 2008 | Combined | 2nd cutting 2007 | 2008 | Combined |
|---|---|---|---|---|---|---|
| **Phosphorus (kg P ha$^{-1}$)** | | | | | | |
| 0 | 530.4 | 557.4 | 543.4 | 556.1 | 547.0 | 551.3 |
| 12 | 508.0 | 551.0 | 530.2 | 563.1 | 549.0 | 556.0 |
| 24 | 521.4 | 548.1 | 535.0 | 554.1 | 541.1 | 547.4 |
| 36 | 523.3 | 542.1 | 532.4 | 556.0 | 550.1 | 553.1 |
| ±SE | 7.70 | 11.80 | 7.10 | 8.92 | 5.94 | 5.36 |
| Significance | NS | NS | NS | NS | NS | NS |
| **Cutting height (cm)** | | | | | | |
| 10 | 518.0 | 553.1 | 536.0 | 557.0 | 550.1 | 553.1 |
| 20 | 523.0 | 546.1 | 534.3 | 557.2 | 544.1 | 550.4 |
| ±SE | 5.50 | 8.32 | 5.01 | 6.31 | 4.19 | 3.79 |
| Significance | NS | NS | NS | NS | NS | NS |
| **Cutting age (WAS)** | | | | | | |
| 6 | 493.0$^{c}$ | 551.0$^{b}$ | 521.1$^{b}$ | 579.0$^{a}$ | 5558.1$^{a}$ | 568.2$^{a}$ |
| 12 | 562.0$^{a}$ | 591.0$^{a}$ | 576.3$^{a}$ | 560.4$^{a}$ | 561.1$^{a}$ | 561.0$^{a}$ |
| 18 | 521.3$^{b}$ | 513.2$^{c}$ | 517.2$^{b}$ | 559.0$^{a}$ | 558.5$^{a}$ | 559.1$^{a}$ |
| Maturity | 505.3$^{bc}$ | 545.0$^{bc}$ | 525.0$^{b}$ | 531.5$^{b}$ | 511.0$^{b}$ | 521.0$^{b}$ |
| ±SE | 7.70 | 11.80 | 7.10 | 8.92 | 5.94 | 5.36 |
| Significance | ** | ** | ** | ** | ** | ** |

Means within a column of any set of treatments followed by different letter are significantly different at 5% level of probability according to Duncan's multiple range test; NS = Not Significant; *, **Significant at 5 and 1% levels of probability, respectively; WAS = Weeks After Sowing application was intermittent. This was probably due to the fact that the native soil available phosphorus of the experimental fields was sufficient for the lablab crop, given the high soil test levels obtained (5.3-17.5 mg $kg^{-1}$). Low soil phosphorus can be growth-limiting but soil phosphorus level/fertility does not affect crude protein and digestibility (TDN, ADF) of forages (Andrae and Pinkerton, 2008).

**Response to cutting height:** The lower cutting height (10 cm) produced significantly (p = 0.05) higher calcium and phosphorus levels in the present study. This condition may have resulted because of the slower re-growth rate of lablab which enabled these elements to accumulate over time in addition to fewer leaves compared to stems in this cutting treatment (10 cm stubble) which may have skewed the P analysis results.

**Response to age of cutting:** The results of this study indicated that timely consumption of lablab herbage will ensure quality nutrition for ruminant animals. Across the years of study, lablab crude protein concentration reduced significantly (p = 0.05) as age of cutting increased. This decline may be attributed to an increase in cell wall accumulation while cell contents decline (Buxton, 1989). Generally, there was a 20% drop in crude protein between 12 and 18 weeks and a 26% drop between 18 weeks and maturity. These drops in CP content with longer cutting interval were indicative of decreasing forage quality with crop age. Brief delays in cutting result in significantly lower forage quality and once alfalfa buds appear, feeding value will decline about 0.2% in crude protein per day (Bragg, 2003). The relatively high lablab crude protein content of 134.4 g $kg^{-1}$ even at 18 weeks is above that proposed as the minimum requirements for lactation (120 g CP $kg^{-1}$ DM) and growth (113 g CP $kg^{-1}$ DM) in ruminants (ARC, 1984). This implies that a reduction in protein concentrate use is possible if lablab herbage is conserved at this stage for the dry season feeding of dairy animals.

At the 1st cutting, crude protein content of lablab herbage ranged between 99.5 and 168 g $kg^{-1}$. This is in conformity with the findings of some researchers. Under low soil moisture conditions in Mississippi, USA, Brink and Fairbrother (1988) measured 128 and 204 g CP $kg^{-1}$ in new growth lablab and whole plant lablab, respectively. In Zimbabwe, Jingura *et al.* (2001) reported 159 g CP $kg^{-1}$ whereas Mupangwa *et al.* (2006) reported a range of 162-254 g $kg^{-1}$ for highworth lablab.

Cutting lablab improved the CP concentration by 20% (98.4 vs. 122.4 g $kg^{-1}$ CP for the 1st and 2nd cuttings, respectively). Crude fibre values for lablab herbage which ranged between 172.8 and 276.7 g $kg^{-1}$ increased with age of cutting. This is consistent with the other findings and could be associated with an increase in stem growth, leaf senescence and abscission (Albrecth *et al.*, 1987). Upon evaluating three annual forage legumes in Ethiopia, Gebrehiwot *et al.* (1996) found that in all species, crude fibre content increased with maturity in total herbage and stem fractions.

In the present study, age of cutting did not favour lablab ether extract content as it did in the case of crude protein and crude fibre. Rather, there was a marked decrease (by 46%) in the ether extract concentration of lablab within the 12 weeks period between the 1st and 2nd cuttings (i.e., 8.1 vs. 4.4 g $kg^{-1}$). This is probably because components of ether extract such as galactolipids, triglycerides, waxes, pigments, organic acids and essential oils that occur in plants as steam-volatile lipids including fat-soluble vitamins (carotenes, D, E and K) as enumerated by Van Soest (1985) may have declined or been lost with lablab maturity. Ether extract content of lablab decreased as cutting interval increased and was highest at the shortest cutting interval of 6 weeks while the lowest ether extract content was recorded at the uncut control. However, Adjei and Fianu (1985) did not get a consistent pattern in the response of either the leaf or stem ether extract to cutting interval in some legumes, none of which was lablab.

**Phosphorus application x age of cutting interaction:** In 2008, there was significant interaction between phosphorus application and age of cutting for crude protein and crude fibre concentrations of lablab herbage. Crude protein content was highest at the 0 kg P $ha^{-1}$ coupled with a 6 weeks age of cutting. Nitrogen fixation and assimilate production at the early stages of lablab growth may have enhanced crude protein content. Expectedly, since CF increases with maturity, the crude fibre concentration of lablab was highest at the maturity stage when no phosphorus was applied. This implies that early utilization of lablab herbage will reduce crude fibre content, thereby improving herbage quality and by implication its digestibility. The highest crude protein and crude fibre concentrations of lablab herbage were obtained at the 12 weeks and maturity ages of cutting, respectively while the quality of both parameters improved at the 2nd cutting. Lablab ether extract concentration in dry herbage decreased at the 1st and 2nd cuttings. A phosphorus application rate of 12 kg P $ha^{-1}$ produced the highest ether extract content and proximate dry matter concentration in lablab when ages of cutting were at 6 weeks and at maturity, respectively. An application rate of 0 kg P $ha^{-1}$ combined with a cutting age of 6 weeks produced the highest crude protein concentration of lablab herbage while the crude fibre concentration was highest when lablab not given phosphorus application was cut at maturity.

## CONCLUSION

Lablab should be developed into a ley (temporary) pasture in the farming systems of Northern Nigeria and utilized for ruminant livestock feeding either before or after attainment of physiological maturity. After 18 weeks of growth, lablab herbage loses 35.1% of its crude protein content while its crude fibre content increases by 6.3%. Feeding of the 18 weeks old herbage to livestock ensures that 35% of the crude protein content is utilized by livestock and not lost.

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