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Periodic Variations of *Lablab purpureus* Productivity Harvested at Different Growth Stages: A Case Study in Mid Northern Uganda

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Abstract: ***The nutrient profiles and yields of Lablab purpureus were determined to evaluate its potential as a crude protein (CP) supplement for protein deficient dry season forages available in northern Uganda. The study aimed at determining the stage of harvesting for optimum CP yield under the mid northern Ugandan growth conditions. Using a Completely Randomized Block Design the experimental field was divided into 3 blocks, with 9 subplots corresponding to the experimental units (days aftergermination (DAG)) within each block. Samples were taken every 15 days from 30 to 150 DAG. Data collected at each date included dry matter yield (DM), crude protein (CP), neutral detergent fibre (NDF),acid detergent fibre (ADF), acid detergent lignin (ADL), and in vitro dry matter digestibility (INVOMD) from each treatment.The average CP content in lablab had a significant (P<0.05) reduction from 30Dag to 60 DAG, which varied from 22.33% (30 DAG) to 18.04 % (150 DAG). The rate of CP accumulation increased significantly (P<0.05) from 3.82 kg/ha/day (30 DAG) to 6.19 kg/ha/day (150 DAG). The highest CP yield was recorded at 120 DAG. There was a significant increase (P<0.05) in DM from 510.12kg/ha (30 DAG) following a quadratic trend to 5115.18 (150 DAG). The rate of mean DMaccumulation increased significantly from 18.22 to 36.53kg/ha/day with the highest DMaccumulation rate of 39.76 kg/ha/day at 120 DAG. However, maximum and minimum DM yield was obtained 150 and 30 days after germination, with maximum rate of dry matter accumulation at 30 and 75 DAG. Maximum and minimum CP yield were obtained at 120 and 45Dag respectively with the optimum at 135 DAG. Optimum fibre fractions were obtained at 140 DAG and for the case of INVOMD, maximum and minimum fibre fractions were obtained at 120 and 45 DAG respectively with the optimum at 135DAG. This implies that Lablab can be utilized as a supplement as a source of crude protein. It has to be harvested at about 135 days after germination for better CP yields and utilization. This finding is very important for dry season feed resource development in northern Uganda where drought hits five consecutive months.***

Keywords: Lablab purpureus, Northern Uganda, Dairy production, nutritional characteristics, yield

1. Introduction

Due to its potential for use as a vegetative cover, soil improvement qualities, ability to fix nitrogen and control weeds, the legume lablab (*Lablab purpureus*) is an important species in the tropics which are prone to massive erosion. Besides the legume Lablab can be used as pasture environment or can be fed as a supplement to animals on poor quality forages during the dry season (Hendricksen and Minson 1985) which is the prominent scenario in northern Uganda. According to Murphy & Colucci (1999), *Lablabpurpureus* is known to contain an average of 17% CP, 46% NDF, 41% ADF and an average Dry Matter Digestibility of 53%. Recognized for its drought tolerance (Cameron, 1988), *lablabpurpureus* has the potential to offset drought induced feed scarcity in northern Uganda, sustainanimal physiological processes and increase milk production during drought. This makes the legume a suitable fodder for animal production systems threatened with escalating levels of feed insecurity attributed partly to the increased frequency and severity of droughts (Swidiq *et al*., 2011,Nviiri*et al*., 2014). It is envisaged therefore that incorporation of Lablab into farming systems particularly in small holder crop- livestock systems can offer a continuum of benefits ranging from improved crop productivity due to enhanced soil fertility(Maobe *et al*.,1998) to improved animal productivity emanating from sufficient animal nutrition (Schaaffhausen, 1963) a consequence of narrowing the CP nutrient gap.Recent work in comparing two forage systems during the dry season, has shown an improvement in milk production and body condition of cows grazing a mixture of maize stover/lablab as compared with the traditional maize stover system (Kabiriziet al., 2006). Therefore these nutritional characteristics coupled with the environmental benefits make lablab a suitable fodder crop to mitigate the nutrition related challenges especially in the dairy sector of the northern agro ecology. As at present, fundamental information of the nutritional characteristics of *lablabpurpureus* at different stages of growth and maturity based on the prevailing environmental condition is still alien. This has led to the lack of dairy feeding protocol based on lablab amidst its high feeding potential. It is probable that the dearth of information about this legume is hindering its adoption although it has been proved to have the required potential.Basing onthe background a study was carried out to establish the stage of growth at which this legume can be harvested for optimum quality forage production.

2. Materials and Methods

2.1 Site of experiment and cultivar

This study was conducted at the Ngetta Zonal Agricultural Research and Development Institute (ZARDI). This

National Agricultural Research Institute is located at a latitude of 02°17.657'N, longitude of 032°55.171'E and altitude of 1090 m above sea level. The area has a bimodal rainfall pattern, with April to May and August to November as the first and second rainy seasons, respectively. The average annual rainfall ranges between 1300 and 1660 mm. The mean daily maximum temperatures of the area may exceed 33°C, while the minimum temperatures range between 10°C and 15°C. The longai cultivar, used in this experiment in most common lablab cultivar in Uganda a consequence of its good seeding ability (Swidiq *et al.*, 2012)

2.2 Treatments and experimental design

Using a Completely Randomised Block Design (Cochran and Cox 1957), the field was divided into 3 blocks (24.5m x 6.5m). Within each block, 9 experimental units were marked and divided in such a way that the legume could be harvested at nine different stages of maturity (30, 45, 75, 90, 105, 102, 135 and 150 DPG). Each experimental unit was 3mx2m with 0.5m between the units and 1 m between the blocks. The field work for this trial was conducted during the 2013 and 2014 rainy seasons.

2.3 Cultivation

The soil was prepared with one pass of the tractor and two passes with a harrow until the soil was soft. Furrows, in which the seeds were planted, were 0.5m apart. Lablab (*Lablab purpureus*) seeds (20 kg/ha) for the experiment were provided by National Livestock Resources Research Institute (NaLIRRI). Prior to sowing, the seeds were treated with Semevin insecticide (thiodicarb - 2.5 l/100 kg of seed). Within each subplot 3 seeds were planted manually every 0.2 m at a depth of approximately 4 cm. Weeds were removed manually until the plants were established at which point the plants out competed weeds.

2.4 Sampling procedure

Ten plants from one parcel, in each block were randomly selected (a total of 30 plants) for determination of nutritional characteristics. Logistics (i.e. plant size) dictated that for the last collection date only 5 plants from each parcel, in each block were harvested. Total plant yield was determined by cutting 2 m^2 at 5 cm above ground level from one subplot, within each block.

2.5 Dry matter and yield analysis

Individual fresh plant weights were recorded within 2-3 hours after harvesting. The 10 plants from each block were separated into two groups of five plants and hand-separated into different anatomical fractionsfor dry matter (**DM**) analysis. The fractions were weighed, dried in a forced draft oven at 65° C for 48 hours, and weighed again. The wet weight was determined on an individual plant basis, while the dry weight was determined by pooling the five plants (n=3 per treatment/one sample per block). Following dry weight data collection, the two groups of five plants per block were pooled and were stored in plastic bags for subsequent evaluation. Samples for total DM yield estimation were treated using the same procedures.

2.6 Analytical procedures

Samples analyzed were ground in a Wiley mill to pass through 1 mm screen for fibre analysis and *in vitro* digestibility. A portion of the ground sample was ground through a 0.5 mm screen for micro-Kjeldahl analysis. After grinding, samples were allowed to moisture equilibrate at room temperature. Analytical DM and ash were measured according to the standard procedures of the AOAC (1980). Nitrogen (expressed as crude protein, **CP**) was determined using the standard micro-Kjeldahl procedure with $CuSO_4$ as a catalyst (AOAC 1980). **ADF**, **NDF**) and 72% sulfuric acid lignin (**ADL**) were analysed as described by Van Soest et al (1991). This portion of the analysis was conducted in duplicate at Makerere University department of Agricultural production animal science laboratory. The *in vitro* DM digestibility (**IVOMD**) of different plant fractions was determined in duplicate using a modification of the two stage (48 h incubation with rumen fluid followed by 24 h incubation with pepsin-HCl) method of Tilley and Terry (1963). The procedure consisted of incubation of samples (0.25 g) with 5 ml of rumen fluid and 20 ml of artificial saliva (Goering and Van Soest 1970) in screw cap test tubes. The rumen fluid used was collected two hours post-feeding from a fistulated steer consuming a hay diet and maintained in accordance with the Animal Care and Use Committee protocol.

3. Statistical Analysis

Using the Completely Randomised Block Design model, analysis of variance of growth and nutritional parameters was performed using the general linear models procedure of SAS (1996).

$Y_{ij} = a + ß_i + t_j + e_{ij}$

Where:

Y_{ij} = dry matter yield and nutritional parameters
a = general mean of the treatments
ß = block effects
i = I, II, III (block)
t = treatment effects (days post germination)
j = 1,2,3,4,5,6,7,8,9 (sampling period)

4. Results and Discussion

Table 1: Variations of nutrient parameters with stage of growth of lablab

DPG		CP (%)	CP yield/d	INVOMD	DMY kg/ha	DM yield/day
30		$22.33±0.34^{a}$	$3.82±0.03^{f}$	$11.56±0.17^{f}$	$510.12±11.6^{i}$	$18.22±1.9^{c}$
45		$21.33±0.32^{b}$	$3.60±0.03^{g}$	$11.08±0.16^{f}$	$754.22±02.4^{h}$	$17.95±1.9^{c}$
60		$19.63±0.30^{c}$	$4.83±0.04^{d}$	$16.09±0.23^{d}$	$1465.61±04.7^{g}$	$26.17±2.8^{bc}$
75		$17.24±0.26^{ef}$	$4.02±0.04^{e}$	$14.69±0.21^{e}$	$1687.79±5.4^{f}$	$24.11±2.6^{bc}$
90		$17.24±0.26^{ef}$	$5.27±0.05^{c}$	$19.39±0.28^{c}$	$2732.94±8.8^{e}$	$32.53±3.5^{ab}$

105		16.45±0.25^{f}	5.17±0.05^{c}	19.66±0.29^{c}	3277.94±10.5^{d}	33.44±3.6^{ab}
120		17.54±0.26^{de}	6.48±0.06^{a}	23.40±0.34^{a}	4403.79±14.2^{c}	39.31±4.2^{a}
135		18.24±0.28^{d}	6.30±0.06^{b}	22.16±0.32^{b}	4632.95±14.9^{b}	36.76±3.9^{a}
150		18.04±0.27^{de}	6.19±0.06^{b}	22.39±0.33^{b}	5115.18±16.5^{a}	36.53±3.9^{a}
	Lin (R^2)	0.5092	0.8303	0.8894	0.9807	0.8692
Contr	Qua(R^2)	0.9233	0.8304	0.9181	0.9819	0.9078

Contr: polynomial contrast; Lin: linear: Qua: Quadratic; DPG: Days post germination; CP: crude protein; INVOMD: invitro organic matter digestibility; DMY: Dry matter yield; DM: Dry matter; Lin: linear; Quad: quadratic.

The average crude protein (CP) content in lablab had a significant (P<0.05) reduction from 30DPG to 60 DPG. The average crude protein (CP) content of lablab varied from22.33% (30 DPG) to 18.04 % (150 DPD). The Crude protein yield of lablab increased significantly (P<0.05)from 3.82 (30 DPG) to 6.19 (150 DPG). The highest CP yield was recorded at 120 DPG. There was a significant increase (P<0.05) in Dry matter of lablab from 510.12 (30 DPG) to 5115.18 (150 DPG). The dry matter yield of lablab increased significantly from 18.22 to 36.53. However, the highest dry matter yield recorded was 39.76 at 120 DPG (table 1).The NDF content of lablab increased significantly (P<0.05) from 30 DPG to 150 DPG. ADF and ADL followed similar trends increasing significantly with age. As the plant matured, the content of fibre fractions increased approximately up to 100 DPGat which point they started to decrease up to 150 DPG. The INVOMD yield of lablab increased significantly (P<0.05) from 30 DPGto 150 DPG. The trends of INVOMD over days post germination followed patterns similar to crude protein content profiles and inverse to nutrient fibre profiles.The chemical composition of plants and consequently their nutritive value is a result of the distribution of photosynthetic resources into the various plant tissues. Typically the protein content and digestibility of legumes including lablab decline with maturity while fibre fractions increase with maturity (Milford &Minson 1968). As legumes mature, the content of protein decreases as seen in Table 1. The CP content of lablab in this study carried out in northern Uganda ranged between 18 % and 22 % and these values fall within the range reported in the literature for tropical herbaceous legumes (Topps & Oliver, 1993; Norton &Poppi, 1995). The observed decline in CP content of lablab with increasing maturity is in agreement with results from another study (Khorasani*et al.*, 1997). This decline is attributed to an increase in cell wall accumulation while cell contents decline (Buxton, 1989). Zinash*et al.*, (1995) also reported the decline in CP content of the pasture along with increasing age of harvesting, which might be due to the dilution of the CP content by increasing structural carbohydrates of forages harvested at late maturity (Hassan *et al.*, 1990).

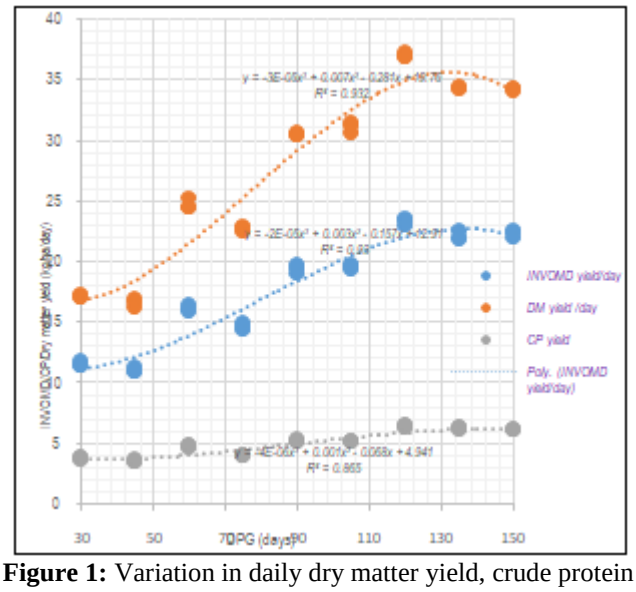

Figure 1: Variation in daily dry matter yield, crude protein yield and in-vitro Organic matter yield of Lablab with stage of growth

The rates of accumulation of dry matter, digestible organic matter, and crude protein followed quadratic trends. The optima were obtained close to 135 DPG. It implies that growing lablab and harvested at 135 days produces the highest attainable quality forage holding other factors constant. However, since lablab is grown to act as a protein supplement its wise to harvest it at 140 DPG where the maximum crude protein is attainable.

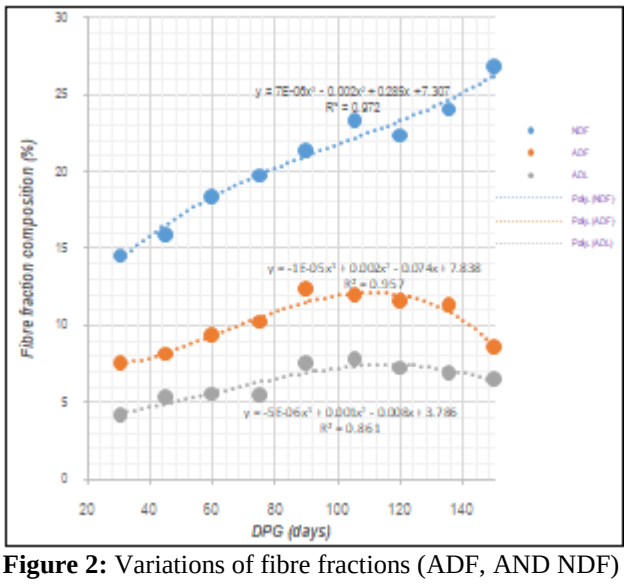

Figure 2: Variations of fibre fractions (ADF, AND NDF) composition with growth of Lablab (whole plant)

The trends in the acid detergent fibre and acid detergent lignin implied that better quality forage can be obtained by growing the lablab 140 DPG. This is attributed to the

increase in the less fibrous organs of the plant including the flowers and the seeds. However, studies need to be carried out to address the effects of the trypsin inhibitors which are likely to come along with seed development.

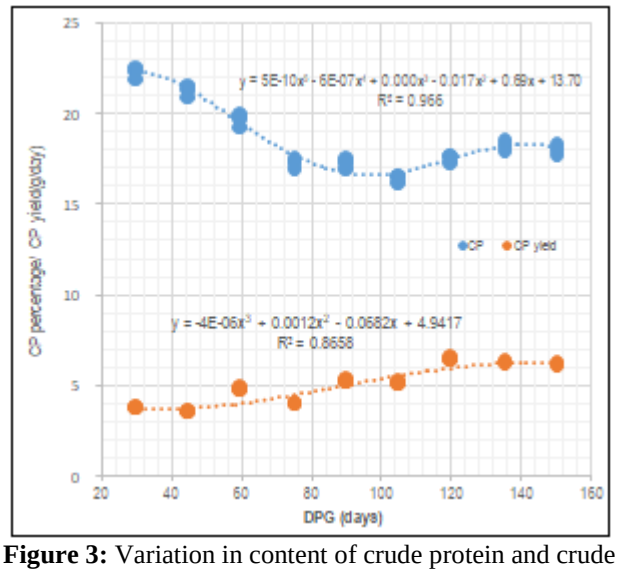

Figure 3: Variation in content of crude protein and crude protein yield of Lablab with stage of growth

The CP reduced with growth to a minimum at 95 DPG and rose to a second maximum at 140 DPG, this was attributed to the accumulations other botanical fractions fruit (pods and flowers) richer in proteins than the combination of the vegetative parts. The rate of CP accumulation increased exponentially between 60 to a maximum at 60 DPG. This implies that to maximize protein, the lablab has to be harvested at 140±5 DPG basing on the prevailing conditions in mid-northern agro ecology.

5. Conclusions

The best stage to harvest lablab for optimum crude protein yield is 140±5Days after germination for optimum crude protein yield.

6. Recommendations for future studies

In order to realize the potential of *Lablab purpureus* as a feed source in the tropics, future studies are required on Production and economic appraisal of forage sorghum based production systems with lablab and assessment of different utilization strategies of the crop, such as direct grazing, cut and feed and feeding the conserved plant material (silage or hay).

References

[1] **AOAC 1980** Official Methods of Analysis (13th edition). Association of Official Analytical Chemists, Washington, D.C.
[2] **Cameron D G 1988** Tropical and subtropical pasture legumes. Queensland Agricultural Journal, March-April:110-113
[3] **Cochran W G and Cox G M 1957** Experimental Designs (2nd edition), John Wiley & Sons Inc., New York
[4] **Goering H K and Van Soest P J 1970** Forage fiber analysis. USDA ARS Agric. Handbook No. 379
[5] **Hendricksen R E and Minson D J 1985** *Lablab purpureus* - A Review. Herbage Abstracts 55:215-227
[6] **Hendricksen R E, Poppi D P and Minson D J 1981** The voluntary intake, digestibility and retention time by cattle and sheep of stem and leaf fractions of a tropical legume (*Lablab purpureus*). Australian Journal of Agricultural Research 32:389-398
[7] **Mayer L, Chandler D R and Taylor M S 1986** *Lablab purpureus* - A fodder crop for Botswana. Bulletin of Agricultural Research in Botswana No. 5:37-48
[8] **Milford R and Minson D J 1968** The effect of age and method of haymaking on the digestibility and voluntary intake of the forage legumes *Dolichos lablab* and *Vignasinensis*. Australian Journal of Experimental Animal Husbandry 8:409-418
[9] **Minson D J 1990** Forage in Ruminant Nutrition. Academic Press Inc. Toronto, 483 pp
[10] **Mugerwa. S,S a r a . B, Habonayo. G, Nijimbere. A and Kayiwa. A** (2012)comparativeanalysisofphosphorusfertilizerreg imesonseed productionof LablabinEast andCentralAfrica
[11] **Murphy A M and Colucci P E 1999** A tropical forage solution to poor quality diets: A review of *Lablab purpureus*. Livestock Research for Rural Development 11(2): http://www.cipav.org.co/lrrd/lrrd11/2/colu112.htm
[12] **National Research Council 1981** Nutrient Requirements of Goats. National Academy Press. Washington DC
[13] **National Research Council 1985** Nutrient Requirements of Sheep (6th Ed). National Academy Press. Washington, DC
[14] **National Research Council 1989** Nutrient Requirements of Dairy Cattle (6th Ed). National Academy Press. Washington, DC
[15] **National Research Council 1996** Nutrient Requirements of Beef Cattle (7th Ed). National Academy Press. Washington, DC
[16] **Norton B W and Poppi D P 1995** Composition and Nutritional Attributes of Pasture Legumes. In. Tropical Legumes in Animal Nutrition; D'Mello, J P F. and C Devendra (Eds). CAB International, Wallingford, UK. pp 23-47
[17] **Nviiri, Geofrey., Okello H., Nakyewa, P., Maiteki G A.** (2014).Extent of availability of major nutrients from selected Cereal Crop Residues to dairy ruminants as an alternative Dry Season Forage in Northern Uganda. *Journal of Advances in Agriculture, 4:1*
[18] **NviiriGeofrey**., MugerwaSwidiq., Constantine BakyusaKatongole. & Jolly Mary Kabirizi (2016). A Comparative Analysis Of Pasture Farming Based Dairy Production In Northern Uganda. *Agricultural research journali*
[19] **Schaaffhausen R V 1963** Economical methods for using the legume *Dolichos lablab* for soil improvement, food and feed. Turrialba 13:172-178
[20] **Sinclair R 1996** *Dolichos lablab*: unaalternativapara la **Tilley J M A and Terry R A 1963** A two-stage

technique for the *in vitro* digestion of forage crops. Journal of the British Grassland Society 18:104-111

[21] **Van Soest P J 1994** Nutritional Ecology of the Ruminant (2nd Ed). Comstock Publishing Association, Cornell University Press, Ithaca

[22] **Van Soest P J, Robertson J B and Lewis B A 1991** Methods for dietary fiber, neutral detergent fiber, and non-starch polysaccharides in relation to animal nutrition. Journal of Dairy Science 74:3583-3597

[23] **Wilson J R 1982** Environmental and nutritional factors affecting herbage quality. In: Nutritional Limits to Animal Production from Pastures; J B Hacker (Ed). Commonwealth Agricultural Bureau, Farnham Royal, UK; pp 111-131

[24] **Wood I M 1983** Lablab bean (*Lablab purpureus*) for grain and forage production in the Ord River Irrigation Area. Australian Journal of Experimental Agriculture and Animal Husbandry 23:162-171