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Herbage Yield of Lablab (*Lablab purpureus* L. Sweet) as Influenced by Phosphorus Application, Cutting Height and Age in a Semi-Arid Environment, Nigeria

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ABSTRACT

Because of the need to improve the productivity of forage legume crops and satisfy the demand for lablab (*Lablab purpureus* L. Sweet) herbage by livestock owners, this study was done The experiment entailed field trials that were conducted to evaluate the response of fresh and dry herbage yield of lablab to phosphorus application and cutting treatments. The treatments were factorial combinations of four rates of phosphorus application (0, 12, 24 and 36 kg P ha^{-1}). As well as two cutting heights (10 and 20 cm) combined with four ages of cutting (6, 12, 18 weeks and at maturity) in a split plot design with three replications. The highest fresh (39.7 t ha^{-1}) and dry (10.2 t ha^{-1}) herbage yields of lablab, were obtained from the 18 week age of cutting. The dry herbage (10.2 t ha^{-1}) which was obtained at 18 weeks was 67 and 117% higher than those obtained at the maturity age of cutting and the 6 week age of cutting, respectively. Cutting at 6 weeks consistently produced the lowest herbage yields (5.0 and 4.7 t ha^{-1} for fresh and dry components, respectively). It is suggested that lablab herbage be fed before seed maturity than after it is mature. This will reduce dry matter wastage by 67.0% and also to develop lablab as a ley pasture crop in the farming systems of sub-humid savanna and enhance its usefulness as a source of livestock feed. In all of the three years of experimentation, there was no effect of cutting height on the different herbage yields.

Key words: Cutting age, cutting height, herbage yield, phosphorus application, lablab (*Lablab purpureus*)

INTRODUCTION

In Nigeria, as well as in other tropical countries, quantity and quality of available forage are major constraints to optimum livestock production from the savanna rangelands, most especially during the dry seasons (Omokanye *et al*., 2004). This situation is posing a serious challenge to the livestock industry and therefore calls for the attention of stakeholders. Use of introduced forage legumes to provide high yields of good quality herbage to correct livestock feed deficit now being experienced in the Nigerian savanna is a viable option. Most tropical forage legumes can be utilized as green manures to enhance soil fertility, with a short fallow period while also providing the much-needed livestock feed (Tarawali *et al*., 1999). Among the many introduced forage legumes

evaluated in Nigeria, lablab (*Lablab purpureus* L. Sweet) has been reported to be a promising crop for the northern Guinea savanna (Thomas and Sumberg, 1995; Iwuafor and Odunze, 1999; Ewansiha *et al*., 2007). Ewansiha *et al*. (2007) selected six lablab accessions (ILRI 147, ILRI 7279, PI 164302, TLN 29, TLN 7 and PI 345608) for the sub-humid zone of Nigeria based on good establishment and forage production. Carsky *et al*. (2001) suggested that merely introducing of improved legume fallows is not sufficient where soil phosphorus is limiting. It has also been reported that phosphorus often limits establishment and persistence of legumes (Hague *et al*., 2008). The importance of good re-growth, cutting height and age of pasture to its overall biomass production has been restated by (Adjei and Gentry, 1996; Devkota and Rerkasem, 2000; Odion and Singh, 2005a, b; Ahmadi *et al*., 2009). Consequently, these factors deserve further attention of scientists interested in pasture legume production. Except for studies published by Hena *et al*. (1990) and Lamidi *et al*. (1997) on Rongai and Highworth varieties respectively, research information on the effect of cutting on any lablab accession as fodder material is lacking. It is therefore important to further evaluate lablab accession (ILRI 147) in order to determine the appropriate stages of growth to cut for maximum dry matter (DM). The objective of this study was to evaluate the response of fresh and dry herbage yields of *Lablab purpureus* L. Sweet to phosphorus application, cutting height and age of cutting during the wet cropping seasons of 2006-2008 at Samaru, Nigeria.

MATERIALS AND METHODS

This research was carried out at the Institute for Agricultural Research (IAR) experimental farm, Samaru (11°11'N, 7°38'E, 686 m above sea level) in the northern Guinea savanna zone of Nigeria during 2006, 2007 and 2008. The treatments were factorial combinations of four rates of phosphorus doses (0, 12, 24 and 36 kg P ha^{-1}) and two cutting heights (10 and 20 cm above ground level) and four cutting ages (6, 12 , 18 weeks after sowing (WAS) and at maturity). The experiment was designed in a split plots three replications. Phosphorus application x cutting height represented the main plots while cutting age was the subplots. Planting and cultural practices were done as recommended to growers. Black-seeded accession, ILRI 147, "Highworth", 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 were used The plot size was 5×3 m (15 m^2). Fresh herbage yield was determined, by cutting plants within a 1 m^2 quadrate with hand sickle at appropriate height above ground level and weighing plants with a hanging spring balance scale set on a tripod, at 6, 12, 18 WAS and at maturity. A subsample of the fresh herbage was dried in a Gallenkamp model ov-440 oven at 70°C to constant weight and reweighed to estimate dry herbage yield (Muhammad *et al*., 2004; Amodu *et al*., 2003). At maturity all plots including those cut earlier at 6, 12 and 18 WAS were cut. Thus for plots cut at 6, 12 and 18 WAS there were two cuttings whereas for those cut at maturity there was one cutting. *Lablab purpureus* (ILRI 147) being of long maturity fodder legume (Ewansiha *et al*., 2007) took 7 months to reach harvest maturity hence cutting at maturity in the succeeding years was carried out on 25, 21 and 20 January 2007, 2008 and 2009, respectively. Fresh and dry herbage yields refer to the summation of two cuttings whereas initial dry herbage refers to that for a particular cutting age.

Statistical analysis: The data collected were subjected to one-way Analysis Of Variance (ANOVA) using the SAS statistical software (SAS Institute, 2001) to determine the significance of treatment

effects at the 5% level of probability as described by Snedecor and Cochran (1967). The mean grouping was done using the Duncan's Multiple Range Test (DMRT) (Steel *et al.*, 1997).

RESULTS

Fresh herbage yield: Phosphorus application and cutting height did not influence lablab fresh herbage yield throughout the study. The influence of cutting age was significant in each year and in the combined data Table 1. The fresh herbage yield produced at the 18 week cutting age was statistically higher than that produced at the other cutting intervals in 2007, 2008 and the combined data (Table 1). In addition, fresh herbage yield produced when the forage was cut at 12 weeks was statistically superior to those produced at maturity and 6 weeks cutting age Table 1. Irrespective of years, 5.0 tonnes ha^{-1} was recorded when cutting was done at 6 weeks (Table 1). Adopting a cutting age of 6 or 12 weeks produced fresh herbage yields that were 3.4 and 29.6 t ha^{-1} respectively in 2007 (Table 1). Corresponding results were 10.5 and 44.1 t ha^{-1} for 2008 and 5.0 and 30.0 t ha^{-1} for the combined data (Table 1). The fresh herbage yields for the 18 week cutting age were 40.6, 62.1 and 39.7 t ha^{-1} in 2007, 2008 and the combined data, respectively (Table 1).

Dry herbage yield: In 2008, application of 36 kg P ha^{-1} produced significantly higher dry herbage of lablab herbage of 9.3 t ha^{-1}as against 8.2 t ha^{-1} for 0 kg P ha^{-1}.

The differences in dry herbage due to cutting height were not significant in each the three years of study (Table 2). Cutting age, however, affected dry herbage of lablab significantly in all the years, although the trend varied slightly from year to year. Generally, cutting at 18 week age produced the highest dry herbage of lablab, while cutting at the 6 week age produced the lowest dry herbage yield. On the basis of the mean of the three years, cutting at 18 week age produced dry herbage of 10.2 t ha^{-1} which was higher than cutting at the 6 week age. It also produced dry herbage of 6.4 t ha^{-1} or 6.1 t ha^{-1} when cutting was at the 12 week age or at maturity (Table 2).

Table 1: Effect of phosphorus, cutting height and age on fresh herbage yield (t ha^{-1}) in lablab in 2006-2008 and combined

Treatment	2006	2007	2008	Combined
Phosphorus (kg P ha^{-1})				
0	10.8	20.3	33.0	21.3
12	11.0	22.5	33.2	22.2
24	11.0	22.5	32.4	22.1
36	10.5	22.2	33.3	22.0
SE	0.59	1.05	1.04	0.53
Cutting height (cm)				
10	11.0	22.3	33.5	22.1
20	10.6	21.4	32.4	21.5
SE	0.42	0.74	0.74	0.38
Cutting age (WAS)				
6	0.9c	3.4d	10.5d	5.0d
12	16.2a	29.6b	44.1b	30.0b
18	16.5a	40.6a	62.1a	39.7a
Maturity	9.8b	13.9c	15.1c	13.0c
SE	0.59	1.05	1.04	0.53

Mean within a column of any set of treatments followed by different letters are significantly different at 5% level of probability according to the Duncan's Multiple Range Test (DMRT). WAS: Weeks after sowing

Table 2: Effect of phosphorus application, cutting height and age on dry herbage yield (t ha^{-1}) in lablab in 2006-2008 and combined

Treatment	2006	2007	2008	Combined
Phosphorus (kg P ha^{-1})				
0	4.3	7.1	8.2b	6.5
12	5.0	7.1	8.9ab	7.0
24	5.2	7.0	8.9ab	7.0
36	4.5	6.9	9.3a	6.9
SE	0.32	0.64	0.30	0.27
Cutting height (cm)				
10	4.70	7.46	8.59	6.92
20	4.79	6.57	9.01	6.79
SE	0.223	0.454	0.213	0.192
Cutting age (WAS)				
6	5.5a	3.4c	5.3d	4.7c
12	3.2c	7.9b	8.3b	6.4b
18	5.7a	10.1a	14.8a	10.2a
Maturity	4.6b	6.8b	6.9c	6.1b
SE	0.31	0.64	0.30	0.27

Mean within a column of any set of treatments followed by different letters are significantly different at 5% level of probability according to Duncan's Multiple Range Test (DMRT). WAS: Weeks after sowing

Table 3: Interaction between cutting height and cutting age on cumulative dry herbage yield (t ha^{-1}) of lablab in the 2008 wet season at Samaru, Nigeria

	Cutting age (WAS)			
Cutting height (cm)	6	12	18	Maturity
10	4.4e	8.4b	15.3a	6.4cd
20	6.1d	8.3b	14.3a	7.4bc
SE		0.43		

Means followed by similar letter(s) in row and column are not significantly different at 5% level of probability according to the Duncan's Multiple Range Test (DMRT). WAS: Weeks after sowing

The lowest and highest values were 3.2 and 5.7 t ha^{-1} in 2006, 3.4 and 10.1 t ha^{-1} in 2007 and 5.3 and 14.8 t ha^{-1} in 2008, respectively.

The cutting height x age interaction for dry herbage in 2008 was significant (Table 3). At a fixed cutting interval in association with a variable cutting height, it was revealed that dry herbage was similar except at the earliest cutting age (6 weeks) where the higher cutting height of 20 cm produced significantly higher dry herbage yield than the lower cutting height (10 cm) (Table 3). At a variable cutting age in association with a fixed cutting height, the highest dry herbage of 15.3 t ha^{-1} was produced under the 18 week cutting age, followed by the 12 week cutting age, while the lowest dry herbage yield of 4.4 t ha^{-1}was produced when the cutting of lablab was done at the 6 week age with 10 cm cutting height (Table 3).

Initial dry herbage yield: The data on initial dry herbage (i.e., dry herbage obtained at the 1st cutting of a particular cutting age) of lablab as influenced by phosphorus application, cutting height and cutting age in 2006-2008 and the mean of the three years are presented in Table 4. The differences due to phosphorus application and cutting height in the three years of experimentation and in the combined data were not statistically significant.

Table 4: Effect of phosphorus application, cutting height and age on initial dry herbage yield(t ha^{-1}) in lablab in 2006-2008 and combined over 2006-2008

Treatment	2006	2007	2008	Combined
Phosphorus (kg P ha^{-1})				
0	3.0	3.0	6.5	4.5
12	3.2	4.5	6.8	4.8
24	3.5	4.4	6.8	4.9
36	3.0	4.4	7.0	4.8
SE	0.24	0.25	0.27	0.14
Cutting height (cm)				
10	3.3	4.4	7.1	4.9
20	3.1	4.2	6.5	4.6
SE	0.17	0.18	0.19	0.10
Cutting age (WAS)				
6	0.5d	0.6c	1.6c	0.8c
12	2.7c	4.8b	7.1b	4.9b
18	5.4a	7.3a	14.0a	8.9a
Maturity	4.6b	4.6b	4.3c	4.5b
SE	0.24	0.25	0.27	0.14

Mean within a column of any set of treatments followed by different letters are significantly different at 5% level of probability according to the Duncan's Multiple Range Test (DMRT). WAS: Weeks after sowing

Table 5: Interaction between phosphorus rate and cutting height on initial dry herbage yield (t ha^{-1}) in lablab in the 2007 wet season at Samaru, Nigeria

	Cutting heights (cm)	
Phosphorus (kg P ha^{-1})	10	20
0	3.7b	4.2ab
12	5.2a	3.8b
24	4.3ab	4.4ab
36	4.4ab	4.5ab
SE	0.35	

Means followed by similar letter(s) in row and column are not significantly different at 5% level of probability according to the Duncan's Multiple Range Test (DMRT)

Conversely, cutting age affected initial dry herbage significantly in all the years and in the combined analysis. Lablab consistently produced the highest dry herbage yield (5.4, 7.3, 14.0 and 8.9 t ha^{-1} in 2006, 2007, 2008 and combined, respectively) when cutting was done at 18 week age (Table 4). In 2006(4.6), 2007(4.6), 2008(4.3) and in the combined data (4.5), lablab produced significantly higher dry herbage yield (t ha^{-1}) when the cutting was done at maturity compared to cutting at the 6 week age, which usually produced the lowest initial dry herbage yield (0.5-1.6 t ha^{-1}) (Table 4).

The phosphorus x cutting height interaction for initial dry herbage yield in 2007 was significant (Table 5). If cutting height is held constant while varying phosphorus application rate, at 10 cm cutting height 12 kg P ha^{-1} produced a higher dry herbage yield than 0 kg P ha^{-1} and there was no advantage in applying P above 12 kg P ha^{-1}. At 20 cm, there was no difference in initial dry herbage yield when P application rate was varied. Holding the phosphorus rate constant and varying cutting height, initial dry herbage yield of lablab was similar irrespective of the cutting height, except at 12 kg P ha^{-1} where cutting at 10 cm produced significantly higher dry herbage

yield than at a cutting height of 20 cm. The lowest dry herbage of 3.7 t ha^{-1} was obtained with a combination of 0 kg P ha^{-1} and 10 cm cutting height while the highest initial dry herbage yield of 5.2 t $ha^{-1}$was produced by a combination of 12 kg P ha^{-1} and 10 cm cutting height.

DISCUSSION

General: This study has shown that lablab herbage yields vary with years. The highest fresh, dry and initial dry herbage yields of lablab were recorded in 2008, the year with the highest total rainfall among the three years. This underscores the importance of adequate precipitation to herbage yield development in lablab. Muir (2002) reported that yearly dry matter yields in warm-season legume were largely dependent on rainfall and that lablab yields ranged from 78 to 2,739 kg ha^{-1} under dryland conditions in north central Texas. Under irrigation, however, Muir *et al.* (2001) reported that lablab produced more than 9,000 kg ha^{-1} $year^{-1}$ of dry herbage yield.

Herbage yield of lablab can be affected by pest and disease attacks as evident from the disease outbreak that occurred on the crop in 2007. Although such was not observed in 2006, the same disease outbreak occurred in 2008 and was controlled .The major disease in the complex was web blight of beans, caused by the fungus *Rhizoctonia solani* Kuhn (Imperfect state) as had been reported elsewhere by Thurston (1984).

Response to phosphorus: Lablab herbage yield responded to phosphorus application of 36 kg P ha^{-1} which increased cumulative dry herbage yield by 13% above the zero P control. This result was similar to that reported from earlier work in India, where the application of 35 kg P ha^{-1} produced further dry matter increase that was considered to be uneconomical (Verma, 1975). Although their value (1.2 t ha^{-1} at 10 weeks after planting) was considerably lower than for this study (4.9 t ha^{-1} at 12 weeks after sowing), Malami and Abdullahi (2007) reported yield increases of 34 and 58% above control for lablab bean, when phosphorus application rates of 40 kg P ha^{-1} and 80 kg P ha^{-1}, respectively were used. However their soil had lower P status (0.08 meg 100 g) while their P rates of application were also higher than those utilized in this study. This observed positive response of lablab to phosphorus application could be attributed to the role of this nutrient in forage growth. Phosphorus enhances cell division, fat formation, flowering, fruiting, seed formation and development of lateral and fibrous roots (Follett and Wilkinson, 1985). Enhancement of the root system by phosphorus could be said to have resulted in higher herbage yields.

Response to cutting height and age: Unlike cutting height, cutting interval had an overwhelming influence on lablab, having impacted significantly on the yield parameters. A sigmoid growth pattern was observed for lablab cumulative and initial dry herbage yields over time. These parameters increased with increase in cutting age and peaked at 18 WAS, after which it dropped off. This finding underscores the fact that lablab herbage should be utilized by 18 weeks after sowing either for cut and carry or grazing in order to maximize the return on investment in producing the crop. In the present study, fresh herbage yield, dry herbage yield and initial dry herbage yield at cutting of lablab were in the ranges of 1.0-62.1, 4.7-10.2 and 1.0-9.0 t ha^{-1}, respectively. The high herbage yields recorded by lablab in this study suggests that lablab has the potential to provide adequate quantity forage for ruminant livestock feeding in sub-Saharan Africa. In addition, these values fell within the range for lablab dry herbage yields either obtained elsewhere by some other workers. For instance, Jingura *et al.* (2001) obtained a dry matter yield

of 5.9 t ha^{-1} for "Highworth" lablab in Zimbabwe, a result that is supported by our present finding. Muir (2002) on the other hand reported a dry matter yield of 1.7 t ha^{-1} $year^{-1}$ for Tecomate lablab while in Texas, USA Rongai lablab produced dry matter yields of 3.7-4.1 t ha^{-1} (Muir *et al.* 2008). The values reported by these workers very many falls within the range of values that we obtained in our own study.

Cutting height x cutting age interaction: The interaction between cutting height and cutting age for dry herbage in 2008 was significant. The highest dry herbage yield (15.3 t ha^{-1} for 10 cm and 14.3 t ha^{-1} for 20 cm) was obtained at the 18 week cutting age irrespective of cutting height. This suggests that at 18 weeks, which coincided with full bloom in alfalfa or 50% flowering in lablab, the amount of root labile carbohydrates rather than the Leaf Area Index (LAI) of lablab determined the rate of crop re-growth. Normally, the closer to maturity that cutting or grazing occurs, the higher the stored food reserves will be and the easier it is for the plants to maintain vigour for productivity (Smith and Nelson, 1985).

On the other hand, the lowest dry herbage yield (4.4 t ha^{-1}) of lablab was obtained when a cutting height of 10 cm was used along with the earliest cutting age of 6 weeks. This combination represents the most aggressive cutting regime. This cutting management was detrimental for lablab probably because the quantity of labile carbohydrates was very low at that stage of crop growth and with most lablab leaves removed (near zero LAI) at that lower cutting height (10 cm), assimilate production was probably partially halted, which together negatively affected dry herbage accumulation. After cutting lablab to a 10 cm stubble height, the LAI would have fallen below the critical range of 3-5 required to reduce the light value at ground level to 0.05 daylight. This might have caused a reduction in growth rate because of inadequate light interception (Humphreys, 1987). This explains why there was a better crop regrowth when lablab was cut at a height of 20 cm as against 10 cm.

CONCLUSION

It is concluded that a moderate application of phosphorus (12 kg P ha^{-1}) is likely to improve the herbage yield of lablab when rainfall is adequate. Furthermore, cutting lablab forage at 10 cm is as good as cutting it at 20 cm height. Results of this study have shown that delayed cutting (beyond 6 weeks) is favourable to high fresh and dry herbage yields. However, beyond 18 weeks of growth lablab herbage yield drops dramatically which implies that lablab fodder should be utilized before harvest maturity when seed production is not a major consideration.

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REFERENCES

Adjei, M.B. and T.G. Gentry, 1996. Forage characteristics of lablab beans in semi-arid tropics. Agron Abstr, Annual Meeting 1996, pp: 42.

Ahmadi, A.H.A., M.R. Chaichi and M. Mirabzade, 2009. Effects of nitrogen fertilizing system and harvest frequencies on forage dry matter yield and quality of snail medic (*Medicago scutellata* var. Robinson). Asian J. Plant Sci., 8: 160-165.

Amodu, J.T., O.S. Onifade, M.S. Kallah, I.A. Adeyinka and J.P. Alawa, 2003. Sowing date and spacing influence on fodder and seed yields of lablab in northern Guinea Savanna of Nigeria. Asset Series A, 304: 53-58.

Carsky, R.J., B. Oyewole and G. Tian, 2001. Effect of phosphorus application in legume cover crop rotation on subsequent maize in the Savanna zone of West Africa. Nutr. Cycl. Agroecosyst., 59: 151-159.

Devkota, N.R. and B. Rerkasem, 2000. Effects of cutting on the nitrogen economy and dry matter yield of lablab grown under monoculture and inter-cropped with maize in Northern. Thailand Exp. Agric., 36: 459-468.

Ewansiha, S.U., U.F. Chiezey, S.A. Tarawali and E.N.O. Iwuafor, 2007. Potential of *Lablab purpureus* accessions for crop-livestock production in the West African savanna. J. Agric. Sci., 145: 229-238.

Follett, R.F. and S.R. Wilkinson, 1985. Soil Fertility and Fertilization of Forages. In: Forages: The Science of Grassland Agriculture, Heath, M.E., R.F. Barnes and D.S. Metcalfe (Eds.). 4th Edn. The Iowa State University Press, Ames, Iowa, pp: 304-317.

Hague, I., L.A. Nnadi and M.A. Mohamed-Saleem, 2008. Phosphorus management with special reference to forage legumes in Sub-Saharan Africa. Food and Agriculture Organization, http://www.fao.org/wairdocs/ilri/x5488e/x5488e0a.htm

Hena, S.W., E.C. Agishi, S.A.S. Olorunju and I.R. Mohammed, 1990. The effect of time of cut on the productivity and nutritive values of lablab varieties. NAPRI Annual Report. National Animal Production Research Institute, Shika, Nigeria.

Humphreys, L.R., 1987. Tropical Pastures and Fodder Crops. Longman Group, UK., ISBN: 9780582603035, Pages: 155.

Iwuafor, E.N.O. and A.C. Odunze, 1999. Performance of Selected Legume Cover Crops in an Arid Zone of Nigeria. In: Cover Crops for Natural Resource Management in West Africa, Carsky, R.J., A.C. Eteka, J.D.H. Keatinge and V.M. Manyong, (Eds.). International Institute of Tropical Agriculture, Cotonou, Benin. pp: 209-213.

Jingura, R.M., S. Sibanda and H. Hamudikuwanda, 2001. Yield and nutritive value of tropical forage legumes grown in semi-arid parts of Zimbabwe. Trop. Grassland, 35: 168-174.

Lamidi, O.S., B. Abdullahi and A.T. Omokanye, 1997. Effect of plant spacing, phosphorus level and time of harvest on forage yield of lablab. (*Lablab purpureus*) c.v. Highworth. Nigera J. Anim. Prod., 24: 161-164.

Malami, B.S. and I.A. Abdullahi, 2007. Preliminary investigations on Egyptian bean (*Lablab purpereus* L.) for fodder in semi-arid Nigeria effects of phosphorus fertilizer on growth components and herbage yield. Int. J. Agric. Res., 2: 971-975.

Muhammad, I.R., S.A.S. Olorunju, S.W. Hena and E.C. Agishi, 2004. Forage yield, crude protein, *in vitro* dry matter digestibility and mineral content of three cultivars of lablab (*Lablab purpureus*). J. Anim. Prod. Res., 19: 51-59.

Muir, J.P., W.D. Pitman and D.F. Coombs, 2001. Seeding rate, phosphorus fertilization and location effects on Armadillo? Burr Medic. Agron. J., 93: 1269-1275.

Muir, J.P., 2002. Hand-picked forage yield and quality and seed production from annual and short-lived perennial warm season legumes fertilized with composed manure. Crop Sci., 42: 897-904.

Muir, J.P., T.J. Butler, R.M. Wolfe and J.R. Bow, 2008. Harvest techniques change annual warm-season legume forage yield and nutritive value. Agron. J., 100: 765-770.

Odion, E.C. and B.B. Singh, 2005a. Production of dual purpose cowpea varieties at two clipping heights in the Sudan savanna of Nigeria, 1. Fodder production in pure stand. J. Arid Agric., 15: 9-14.

Odion, E.C. and B.B. Singh, 2005b. Production of dual purpose cowpea varieties at two clipping heights in the Sudan savanna of Nigeria, 2. Pod and grain production in pure stand. J. Arid Agric., 15: 15-19.

Omokanye, A.T., J.T. Amodu and O.S. Onifade, 2004. Influence of intra-row plant spacing, phosphorus application and growth stage on the forage, seed yields and quality of phasey bean (*Macroptilium lathoyroides*) in subhumid area of Nigeria. Nig. J. Anim. Prod., 31: 45-50.

SAS Institute, 2001. Statistical Analysis System (SAS) User's Guide. SAS Institute Inc., North Carolina, USA.

Smith, D. and C.J. Nelson, 1985. Physiological Considerations in Forage Management. In: Forages: The Science of Grassland Agriculture, Heath, M.E., R.F. Barnes and D.S. Metcalfe (Eds.). 4th Edn., The Iowa State University Press, Ames, Iowa, pp: 326-337.

Snedecor, G.W. and W.G. Cochran, 1967. Statistical Methods. 6th Edn., Iowa State University, Ames, Iowa, pp: 456.

Steel, G.D. and J.H. Torrie and D.A. Dickey, 1997. Principles and Procedures of Statistics: A Biometrical Approach. McGraw-Hill Book, New York, ISBN: 0070610282, pp: 666.

Tarawali, S.A., M. Peters and R. Schultze-Kraft, 1999. Forage legumes for sustainable agriculture and livestock production in sub-humid West Africa. International Livestock Research Institute (ILRI) Project Report. ILRI, Nairobi, Kenya. pp: 132.

Thomas, D. and J.E. Sumberg, 1995. A review of the evaluation and use of tropical forage legumes in Sub-Saharan Africa. Agric. Ecosyst. Environ., 54: 151-163.

Thurston, H.D., 1984. Tropical Plant Diseases. The American Phytopathological Society, St. Paul, Minnesota, Pages: 208.

Verma, C.M., 1975. Effect of spacing and phosphorus fertilizer on forage and seed yield (*Dolichos lablab* c.v. Lignosus). Ann. Arid Zones, 14: 235-240.