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EFFECTS OF PHOSPHORUS FERTILIZER AND INTRA ROW SPACING ON THE GROWTH COMPONENTS AND GRAIN YIELD OF LABLAB (*Lablab purpureus*) VARIETIES IN THE SUDAN SAVANNA, NIGERIA

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ABSTRACT

Field studies were conducted to examine the effects of Phosphorus fertilizer (P_2O_5) and intra row spacing on the growth components and grain yield of lablab (*Lablab purpureus*) varieties during 2022 rainy season at Sule Lamido University Kafin Hausa (12.1898°N, 9.9242°E) and Binyaminu Usman Polytechnic Hadejia (12.4506°N, 10.0404°E) Research and Teaching Farms. The treatments consisted of three levels of phosphorus fertilizer (0, 20 and 40kg ha^{-1}), three intra row spacings (20, 30 and 40cm) using two varieties of lablab (Highworth and Rongai). The treatments were laid out using Randomized Complete Block Design (RCBD) and replicated three times. The resulst showed that application of P_2O_5 significantly increased plant height, number of leaves per plant, number of pod per plant, and grain yield at both locations. Grain yield was higher at 40kg $P_2O_5ha^{-1}$ at Kafin Hausa while at Hadejia 20kg $P_2O_5ha^{-1}$ gave satisfactory grain yield. Intra row spacing significantly affected number of leaves, number of pods, 100 grain weight and grain yield at both locations and 40cm intra row spacing prove to be superior to other spacings. The result also indicated that Highworth out yielded Rongai and recorded superior number of leaves, leaf area, number of pods, 100 grain weight and grain yield at both locations. Therefore, farmers in the study area could be advice to adopt Highworth variety, application of 40kgP_2O_5kgha^{-1} and use of 40cm intra row spacing in the production of lablab.

Keywords: Lablab, Highworth, Rongai, Phosphorus fertilizer (P_2O_5), Intra Row Spacing

INTRODUCTION

Lablab (*Lablab purpureus)* is an annual, multi-purpose leguminous crop belonging to the family *Fabaceae*, genus *lablab* and a specie *purpureus* locally known as ''Dan Inusa'' in Hausa. The plants are believed to have originated in India (Deka and Sarkar, 1990) and were introduced into Africa from Southeast Asia during the eighth century (Kay, 1979). Presently, lablab is common in Africa, extending from Cameroon to Swaziland and Zimbabwe, through Sudan, Ethiopia, Uganda, Kenya, Tanzania and Nigeria (Skerman *et al.*, 1991).

Lablab is a legume that thrives well in the dry season between November and February in the Northern Nigeria. It is drought resistant and is usually sown after the normal cropping season, thereby acting as a buffer crop for ruminant feeding during the period of dry season (Adu *et al* 1992). Legumes in particular are used as green manure cover crops, and rotation with cereal crops (Omokanye 2001). They also improve nitrogen content of the soil through nitrogen fixation

The plant looks like a soybean plant but grows taller and binds together to form a natural fence. Among many introduced forage legumes evaluated in Nigeria, lablab has been reported to be a promising crop for the northern Guinea savanna (Iwuafor and Odunze, 1999; Ewansiha *et al*., 2007).

Lablab as human food can be prepared into bean cakes, kosai and Moimoi while the young pods, leaves and the sprout can all be consumed as vegetable by man. The plant is also used for grazing, hay production and green manure, soil protection and weed control. Furthermore, it can be grown as a component crop in mixed farming systems. Lablab can be used for soil improvement as it has been used in various situations to increase soil fertility since it is capable of fixing its own Nitrogen through the action of certain bacteria in its nodules. The widespread use of lablab for human used is more recent perhaps because of its multiple uses to humanity (Cameron, 1988; Odunze, 2000).

Phosphorus is vital to plant growth and is found in every living plant cell. It is involved in several key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant and transfer of genetic characteristics from one generation to the next (Miko ***et al*.,** 1996 &. Nasiru, 2001)

Despite the usefulness and nutritional values of lablab for human and animal consumption, lablab production is still very low in Nigeria. The major reasons for the low production of the crop in the country include: the low inherent fertility of the soil as a result of inadequate plant nutrients application especially the Phosphoric fertilizers or wrong timing of their applications, use of low yielding varieties, low plant population and inadequate spacing per unit area, prevalence of pests and diseases, poor financial capability of the farmers and (Jogloy, 1996).

The Nigeria growing population necessitates for the increase in food and feed production to boost farmers' income, improve their health and leaving conditions, provides quality fodder for livestock, improves soil, control erosion and reduces poverty among the teaming population. Planting of high yielding varieties of lablab, application of appropriate amount of phosphorus at the right time and use of appropriate inter and intra row spacing has been observed to increase growth and yields of lablab (David *et al*., 2011).

MATERIALS AND METHODS

The experiment was carried out at the research farm Sule Lamido University Research and Teaching Farm Kafin Hausa and Binyaminu Usman Polytechnic Research and Teaching Farm Hadejia. Land preparation was done manually while planting followed using two lablab varieties (Highworth and Rongai) at 20, 30 and 40cm intra row spacing and 75cm between rows. Phosphorus fertilizer (P_2O_5) was applied at 2WAS as per the treatments of 0, 20 and 40kg/ha^{-1} by placement method at both locations. .Lablab seeds were collected from National Animal Production Research Institute (NAPRI) Zaria. The seeds of *Lablab purpureus* were immersed in hot water (40^{oC}) for 10 minutes and air - dried before planting. The treatments were replicated three times. The experimental design used was Randomized Completely Block Design (RCBD) and the plot size was 2m x 3m with an alley of 0.5m between plot and 1.5m between the replicates. Two seeds were sown per hole at a depth of 2.0cm in sandy-loam soil. Weeding was done three times using hoe at 3 and 6 weeks after planting to reduce weed- crop competition. Harvesting of the pods was done manually between 13-18WAS.

Data were collected on plant height, number of leaves per plant, number of pods per plant, 100 grain weight and the grain yield. Data collected were subjected to Analysis of Variance (ANOVA) as described by Snedecor, G.W. and Cochran, W.G. (1989) using Genstat. Significant treatment means were separated at 5% level of probability using SNK. The magnitude and relationship types between grain yield and some attribute examined were assessed through simple correlation analysis (Little and Hills, 1978).

RESULTS AND DISCUSSION

Table 1 shows the effects of P_2O_5 and intra-row spacing on plant height of Lablab at Kafin Hausa and Hadejia. Plant height was not significantly affected by application of phosphorus fertilizer (P_2O_5) at Kafin Hausa but at Hadejia application of $40kgP_2O_5ha^{-1}$ resulted in significantly taller plants than the other rates which were at par statistically at 6, 8and 10WAS. Intra-row spacing did not significantly affect the plant height at all the sampling periods at both locations. Both Rongai and Highworth produced plants of statistically similar height. There were no significant interactions between the factors examined on the plant height across all the sampling periods at both locations.

The effects of P_2O_5 and intra-row spacing on number of leaves per plant are shown in Table 2. At both locations application of P_2O_5 significantly increased the number of leaves at 10WAS. $40kgha^{-1}$ gave significantly higher number of leaves per plant than 0 and $20kgha^{-1}$ which were statistically similar. Intra-row spacing did not significantly affect number of leaves per plant at Kafin Hausa. Rongai and Highworth not differ significantly in respect of number of leaves per plant. There was no significant interaction between the factors at both locations.

Table 3 shows the effect of phosphorus and intra row spacing on number of pods at both Kafin Hausa and Hadejia. Number of pods was significantly affected by phosphorus application at both locations with 40 $kgP_2O_5ha^{-1}$ producing similar number of pods with 20 $kgP_2O_5ha^{-1}$ but superior to plots without phosphorus application. At Hadejia application of 40 $kgP_2O_5ha^{-1}$ was superior to 20 followed by 0 $kgP_2O_5ha^{-1}$. The effects of intra row spacing on the number of pods per plant manifested also at both locations with 40cm intra row spacing producing more pod compared with 20cm followed by zero application. Significant differences between varieties with regard to the number of pods per plant occurred at all sampling period at both locations. The Highworth variety produced significantly higher number of pods than the Rongai in all the location. Significant interaction was not observed on number of pods per plant at both locations.

Table 1: Effects of P_2O_5 and intra-row spacing on plant height (cm) of lablab varieties at Kafin Hausa and Hadejia, 2022 rainy season

Treatment	Kafin Hausa				Hadejia			
	4	6	8	10	4	6	8	10
P_2O_5 **(kg)**								
0	18.22	32.83	43.67	56.50	18.22	32.33b	42.67b	56.00b
20	18.89	32.56	44.06	55.06	18.89	32.06b	43.11b	55.44b
40	19.17	32.22	43.67	55.94	19.17	42.61a	51.33a	61.61a
SED	0.540	0.785	0.768	1.069	0.569	0.716	0.729	0.902
Intra-row Spacing (cm)								
20	18.89	32.72	44.22	56.33	19.44	36.06	45.78	58.28
30	18.44	32.28	44.17	55.39	18.72	35.39	45.78	56.78
40	18.94	32.61	43.00	55.78	19.33	35.50	45.56	58.00
SED	0.540	0.785	0.768	1.069	0.569	0.716	0.729	0.902
Varieties								
Rongai	19.00	32.07	43.26	56.26	19.41	35.33	45.33	58.04
Highworth	18.52	33.00	44.33	55.41	18.93	36.00	46.07	57.33
SED	0.441	0.641	0.627	0.873	0.465	0.584	0.595	0.736

Means in a column of any set of treatments followed by same letter are not significantly different at 5% level of probability using SNK, NS = Not Significant.

Table 2: Effects of P_2O_5 and intra-row spacing on number of leaves per plant of lablab varieties Kafin Hausa and Hadejia, 2022 rainy season

Treatment	Kafin Hausa				Hadejia			
	4	6	8	10	4	6	8	10
P_2O_5 **(kg)**								
0	22.33	47.94	94.39	138.9b	22.33	43.22b	86.94b	133.9
20	22.67	47.06	92.67	138.1b	22.33	44.11b	89.00a	133.4
40	22.33	49.22	96.22	142.0a	22.06	46.33a	89.11a	135.4
SED	0.625	1.867	2.218	2.48	0.561	0.697	0.904	2.054
Intra-row Spacing (cm)								
20	22.22	45.56b	87.83b	132.1b	22.11	44.11	87.33	134.7

30	22.44	47.06b	88.50b	132.4b	22.39	44.17	88.17	133.4
40	22.67	51.61a	106.94a	154.5a	22.22	45.39	89.50	134.6
SED	0.625	1.867	2.218	2.48	0.561	0.697	0.904	2.054
Variety								
Rongai	22.44	47.74	95.26	139.9	22.22	45.07	88.56	132.9
Highworth	22.44	48.41	93.59	139.4	22.26	44.04	88.15	135.5
SED	0.511	1.525	1.811	2.03	0.458	0.569	0.738	1.677

Means in a column of any set of treatments followed by same letter are not significantly different at 5% level of probability using SNK, NS = Not Significant.

Table 3: Effects of P_2O_5 and intra-row spacing on the number of pods per plant at Kafin Hausa and Hadejia, 2022 rainy season

Treatment	Kafin Hausa	Hadejia
P_2O_5 **(kg)**		
0	157.70b	159.20c
20	165.40ab	165.90a
40	163.40a	163.80b
SED	2.93	2.99
Intra-row Spacing (cm)		
20	106.70c	107.90c
30	158.90b	159.50b
40	220.80a	221.50a
SED	2.93	2.99
Variety		
Rongai	155.70b	156.60b
Highworth	168.60a	169.40a
SED	2.39	2.44

Means in a column of any set of treatments followed by same letter are not significantly different at 5% level of probability using SNK, NS = Not Significant

The effect of phosphorus and intra row spacing on 100 seed weight at both locations is represented in Table 4. 100 seed weight was significantly affected by phosphorus application at both locations with $40kgP_2O_5ha^{-1}$ producing more weight than the other level of P_2O which produces statistically comparable 100 seed weight. At Kafin Hausa, increasing P_2O level from $0\text{-}20kgP_2O_5ha^{-1}$ led to a significant increase in 100 seed weight but further increase to $40kgP_2O_5$ did not resulted in a significant increase in seed weight. At Hadejia application of $20kgP_2O_5ha^{-1}$ produced seed weights that were not statistically different from the control ($0kgP_2O_5ha^{-1}$). However, further increase to $40kgP_2O_5ha^{-1}$ resulted in a significant increase in seed weight. Intra row spacing affected 100 seed weight at both locations with 30 and 40cm intra row spacing producing statistically similar and heavier seeds compared with 20cm spacing in both locations. In addition, significant differences between varieties with regard to the 100 seed weight were observed at all locations. The Highworth variety produced heavier seeds than Rongai in all the location. However there were significant interactions between treatments on the 100 seed weight at both locations

Table 5 shows the effect of phosphorus and intra row spacing to lablab on Grain yield per plot at both locations. Grain yield per plot was significantly affected by phosphorus application at both locations with $40kgP_2O_5ha^{-1}$ producing more weight than the other level of P_2O which produces statistically comparable Grain yield per plot. Intra row spacing also affect Grain yield per plot at both locations with 40cm intra row spacing producing more weight than the other spacing which produces statistically similar Grain yield per plot. Intra row spacing statistically influence the Grain yield per plot at both locations. In addition, significant differences between varieties with regard to the Grain yield per plot occurred at all locations. The Highworth variety produces the highest Grain yield per plot than the Rongai variety in all the location. So there were statistical differences with regards to the Grain yield per plot recorded between the varieties.

Similarly, there were significant interactions between treatments on the Grain yield per plot at both locations as shown in Table 6. The intra row spacing and phosphorus interaction at Kafin Hausa shows that keeping intra row spacing constant at 20 and 40cm, increasing P level from $0\text{-}20kgP_2O_5ha^{-1}$ did not affect grain yield but further increase to $40kgha^{-}$ gave the highest grain yield. At 30cm, increasing P level from $0\text{-}20kgP_2O_5ha^{-1}$ gave significant increase in grain yield but further increase to $40kgP_2Oha^{-1}$ did not affect the yield. Considering P_2O levels, at $0kgP_2O_5ha^{-1}$, 40cm gave the highest yield while the other spacing had statistically similar and lower values. However, at 20 and $40kgP_2O_5ha^{-1}$ each successive increase in spacing from 20-40cm resulted in significant increase in grain yield.

Table 4: Effects of P_2O_5 and intra-row spacing on 100 grain weight of lablab varietiesat Kafin Hausa and Hadejia, 2022 rainy season

Treatment	Kafin Hausa	Hadejia
P_2O_5 **(kg)**		
0	19.92b	19.98b
20	20.18a	19.93b
40	20.38a	20.29a
SED	0.1175	0.471
Intra-row Spacing (cm)		
20	19.58b	19.31b
30	20.36a	20.21a
40	20.54a	20.69a
SED	0.1175	0.471
Variety		
Rongai	19.98b	19.89b
Highworth	20.34a	20.24a
SED	0.0959	0.385

Means in a column of any set of treatments followed by same letter are not significantly different at 5% level of probability using SNK,

Table 5: Effects of P_2O_5 and intra-row spacing on Grain yield (kg ha^{-1}) of Lablab Varieties at Kafin Hausa and Hadejia, 2022 rainy season

Treatment	Kafin Hausa	Hadejia
P_2O_5 **(kg)**		
0	783b	894c
20	828a	928b
40	856a	1011a
SED	17.98	29.00
Intra-row Spacing (cm)		
20	694c	761c
30	789b	911b
40	983a	1161a
SED	17.98	29.00
Variety		
Rongai	770b	885b
Highworth	871a	1004a
SED	14.68	24.60
Interaction		
P_2O_5 x Spacing	**	**
P_2O_5 x Variety	**	NS
Spacing x Variety	**	** \

Means in a column of any set of treatments followed by same letter are not significantly different at 5% level of probability using SNK, NS = Not Significant, ** = Highly Significant.

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Table 6: Grain yield of lablab as influence by interaction between P_2O_5, varieties and Intra-row spacing Kafin Hausa and Hadejia, 2022 rainy season

Treatment	Kafin Hausa			Hadejia		
	P_2O_5 kgha^{-1})					
	0	**20**	**40**	**0**	**20**	**40**
Intra-row Spacing						
20	683d	717d	683e	783ef	750f	750f
30	733d	817c	817c	850ef	900d	983d
40	933b	950b	1067a	1050c	1133b	1300a
SED		31.1			50.2	
	Intra-row Spacing (cm)					
Treatment	**20**	**30**	**40**	**20**	**30**	**40**
Variety						
Rongai	700d	767c	844b	711e	889cd	1056b
Highworth	689d	811bc	1122a	811d	933c	1267a
SED		25.4			41.0	

Means in any set of treatments followed by same letter (s) are not significantly different at 5% level of probability using SNK.

Discussion

Growth and Yield of Lablab Varieties

The results indicated that the varieties differed significantly in respect of number of pods, 100 grain weight and grains yield with Highworth having superior values over Rongai. The superiority of Highworth could be genetic as well as its ability to utilize the environmental recourses particularly water, nutrients and light. It is important to add that, Highworth variety exhibited superior growth and yield attribute in the present experiment which indicated that it has higher potential over Rongai. However, the non-significant difference between the varieties in respect of plant height is an indication of their morphological similarities.

Response of Lablab to Phosphorus

Phosphorus application significantly affected most of characters at both locations. The response of lablab to phosphorus could be due to the role of phosphorus in the growth of leguminous crops. Phosphorus fertilization has been observed to increase diseases resistance, increases root growth, aids nodulation which will in turn improve nitrogen fixation that promote plant growth, increases leaf size, promote pods and seed development and hasten maturity. Significant differences with regards to the yield obtained from different level of phosphorus application were observed with highest yield recorded at 40kg P_2O_5 ha^1 at Hadejia.

Effects of Intra-Row Spacing on Lablab

The result showed that there intra row spacing had significant effects on most of the characters examined. This could be due to minimum competition for growth factors at wider space. At 20 and 30cm, it is likely that competition for water, nutrients and light among the lablab plants were steep and had negatively affected plant growth particularly branching and leaf development thereby reducing light interception as well as dry matter generation. However, at 40cm spacing competition could be expected to be reduced thus ensuring better growth and higher grain yield arising from abundant environmental recourses such as soil, water, nutrients, and solar radiation. In a related studies by Patel *et al*. (2006) and Malami *et al*. (2010) it was observed that the row spacing of 40cm recorded more number of pods per plant, 100 seed weight and grain yield of Lablab

Interaction between Phosphorus and Spacing

The significant phosphorus and spacing interaction on yield and yield component of lablab could be assorted with competition for P_2O_5 at the different spacing. At narrow spacing, competition for moisture could be more important than for P. thus high P_2O_5 doses may not give high yields. However at wider spacing, increase P_2O_5 level supported high crop performance and superior yields due posy soil moisture. The variety and spacing as well as variety and phosphorus interaction on growth, yield and yield component could be due to differential response of the varieties to environmental resources particularly soil nutrients. The superiority of Highworth in term of yield and yield component is an indication of its ability to exploit the environmental resources apart from genetic superiority

CONCLUSION

The result of the experiment showed that application of $40kgP_2O_5ha^{-1}$ gave the highest yield of lablab at both locations. Higher yield was also obtained at 40cm intra row spacing and the Highworth variety was found to be superior to Rongai at both locations. Therefore, farmers in the study area could be advice to adopt Highworth variety, application of $40kgP_2O_5kgha^{-1}$ and use of 40cm intra row spacing in the production of lablab

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