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

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Abstract

A research was conducted during 2013 rainy season at the Bayero University Research Farm, Kano and Zakirai, Gabasawa Local Government, Kano State. The experiment studied the response of lablab (*lablab purpureus*) varieties to phosphorus and intra-row spacing. The experiment consisted of three levels of phosphorus (0, 20 and 40kg P_2O_5 ha^{-1}), three intra-row spacing (20, 30 and 40cm) using two varieties of lablab (Highworth and Rongai). The treatments were laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The results showed that application of phosphorus significantly increased number of pods per plant, 100 grain weight and grain yield at both locations. Grain yield was higher at 40kg P_2O_5 ha^{-1} at Zakirai while at BUK 20kg P_2O_5 ha^{-1} gave satisfactory grain yield. Intra-row spacing had significantly affected number of pods per plant, 100 grain weight and grain yield at both locations and 40cm intra-row spacing prove to be superior to other spacing. Furthermore, the result indicated Highworth out yield Rongai and recorded superior number of pods per plant, 100 grain weight and grain yield at both locations. Significant interactions between phosphorus and intra -row spacing and varieties as well as phosphorus and varieties were observed on grain yield in which higher grain yield was recorded with High worth at 40kg P_2O_5 ha^{-1} and 40cm spacing. Highly Significant ($P \leq 0.01$) and positive correlations were also observed between grain yield and number pods per plant and 100 grain weight. The results indicated highly significant ($P \leq 0.01$) and positive correlations between grain yield and number of pods per plant as well as 100 grain weight at both locations. The linear response obtained from the regression analysis indicates that optimum grain yield was obtained at 40 kg P_2O_5 ha^{-1} at both locations but further increase in quantity of phosphorus rates above 40 kg P_2O_5 ha^{-1} would increase lablab grain yield.

Keywords: *Lablab, Phosphorus, intra row spacing, yield and yield components.*

1. Introduction

One of the ways of increasing food production in Nigeria is to increase the area and quality of legume. Most African countries are presently in the midst of food and feed crises. Legumes in particular are used as green manure cover crops, and rotation with cereal crops (Omokarry, 2001). They also improve nitrogen content of the soil through nitrogen fixation (Adu *et al.*, 1992) and (Omokarry, 2001). Pointed out that *Lablab purpureus* grew normally on soils with pH 5.0 to 7.8 and showed high capacity for nitrogen fixation, although it showed high mortality at ambient temperatures of >50°C.The green and seed yields of *Lablab purpureus* were 50.7 and 1.0 to 2.25t/ha/year respectively with crude protein of

16.6% and the crop susceptible to be attack by aphids at seedling and young pod stages (Ogundife, 2003). Sanginga *et al.* (1996) revealed that *Lablab purpureus* is a promising forage legume for our environment and also hay increase the live weight and milk yield of cattle from 4-6 to 6-7 liters per day which is suitable for human consumption.

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). Chemical analysis showed that *Lablab purpureus* contained about 16 - 24 % crude protein in its leaf and seed and could be comparable to many oil-seed cakes, as such it is presently suitable for food and feed formulations (Ogundife, 2003). A research by Chauchifai *et al.* (1991) found that lablab seeds have low human preference for food and unlike soybean and groundnut cake, its value in livestock feeding has not been fully investigated, like other tropical legume seeds raw lablab seeds contain some anti-nutritional factors which may limit their use in animal feeding. Heat treatment has been employed to reduce or totally eliminate the anti-nutritional factors (Marty and Chavez 1993). The aim of this paper was to find out the response of lablab varieties to phosphorus and intra row spacing on growth and development of the crop in the Sudan savanna, Nigeria.

Materials and Methods

The experiment was carried out at the research farm Bayero University, Kano and Zakirai, Gabasawa Local Government Area, Kano State. The mean annual rainfall for the two locations was 920mm and 904mm respectively with mean monthly temperature of 27.42^{o}C and 27.76^{o}C, respectively. Land preparation was done manually while planting follows using two lablab varieties (Highworth and Rongai) at 20, 30 and 40cm intra row spacing and 75cm between rows. 0, 20 and 40kgh^{-1} of phosphorus (P_2O_5) fertilizer was applied two weeks after planting by placement method at both locations. The seeds were immersed in hot water for 10 minutes and air - dried before planting. The seeds were planted on the 14th and 21st July, 2013, respectively. Each treatment was replicated three times. The experiment was conducted using Randomized Completely Block Design (RCBD) passion. The gross and net plot size is 2m by 3m (6m^2) and 1.5 x 2m long (3m^2). Ana alleys of 0.5m and 1.5m were left between plots and replications. The seeds were sown two seeds per hole at a depth of 2cm in sandy soil. Weeding was done three times using hoe at different interval to reduce weed- crop competitions. Data were collected on yield components such as number of pods per plant, pod weight; 100 grain weight and the grain yield were all recorded. Harvesting of the pods was done manually 15-18 weeks after planting. Data collected was subjected to Analysis of Variance (ANOVA) as described by Snedecor and Cochran (1967) using Genstat. Significant treatment means was separated at 5% level of probability using SNK. The magnitude and relationship types between grain yield and some yield attribute examined are assessed through simple correlation analysis (Little and Hills, 1978).

Results and Discussions

Table 1 shows the effects of phosphorus and intra-row spacing on number of pods per plant at both BUK and Zakirai. Number of pods per plant was significantly affected by phosphorus application at both locations with 40kg $P_2O_5ha^{-1}$ producing statistically similar number of pods per plant with 20kg P_2O_5 ha^{-1} but superior to plots without phosphorus application. At Zakirai application of 40 kg P_2O_5 ha^{-1} was superior over the other treatments. Similar report were made by Njarui, (2011) pointed out that phosphorus fertilization increased the number of pods per plant by 11% in Uganda with plots amended with 80 kg P_2O_5 ha^{-1} producing the highest increment (16.4%). The effect of intra-row spacing on the number of pods per plant was significantly affected at both locations with 40cm intra-row spacing producing more pod compared with other treatments Significant differences between varieties with regard to the number of pods per plant occurred at all sampling periods at both locations. Patal *et al.,* (2003) evaluated lablab to intra-row spacing and found that spacing at 40cm recoded more number of pods per plant (204). The result revealed that Highworth variety produced significantly higher number of pods per plant than the Rongai in all the locations. No Significant interaction was observed on number of pods per plant at both locations.

Table 2 shows the effects of phosphorus and intra-row spacing on days to maturity of lablab at BUK and Zakirai. Days to maturity were not significantly affected by phosphorus application and intra-row spacing at both locations. Significant differences between varieties with regard to days to maturity occurred at both locations with Highworth attaining maturity earlier than the Rongai at both locations in all the sampling periods. The finding is similar to that of Cameron, (1988) pointed that Highworth variety is an early maturing variety and produced more pods per plant. There were no significant interactions between treatment factors on days to maturity at both locations.

The effect of phosphorus and intra-row spacing on phosphorus interaction at BUK (Table 3) shows that, keeping spacing constant, 20 and 30cm spacing were not affected by application of phosphorus from 0 – 40 kg P_2O_5 ha^{-1} however, with 40cm highest pods weight were produced with application of 40 kg P_2O_5 ha^{-1}.When P was considered, plots that did not receive P statistically similar pod weight at all the three intra-row spacing. With application of 20kgP_2O_5 ha^{-1} and 40 kg P_2O_5 ha^{-1} similar pod weights were recorded at 30 and 40cm while the lowest values were recorded at 20cm intra-row spacing. The spacing and phosphorus interaction at Zakirai (Table 3) shows that 20 and 30cm had statistically similar pod weight at 0 and 20kg $P_2O_5ha^{-1}$ while at 40cm spacing each increase in P level led to a significant increase in pod weight across the P levels, increasing spacing from 20-30cm gave higher pod weights. Further increases of intra-row spacing to 40cm decreased pod weight under control P level but for 20 and 40 kg$P_2O_5ha^{-1}$ were not significant in pod weights.

Effects of phosphorus and intra-row spacing to lablab at BUK and Zakirai on shelling percentage are shown in Table 2. No significant differences in shelling percentage were recorded at all locations due to phosphorus application these corroborate with the finding of Kiyawa (2011) that amending soil with phosphorus enhanced yield ranging from 4 to 27% in Uganda, Burundi and Sudan. Effects of intra-row spacing on the shelling percentage were significant at both locations the finding is in agreement with that of Patel *et al.,* (2003) who indicated that 40cm row spacing produced the higher shelling percentage which is among the yield determinant factors. Significant differences between the varieties with regard to the shelling percentage were recorded at both locations. In all cases the Highworth variety produces more shelling percentage than the Rongai variety. In a similar development Nasiru (2001) conducted a research and find that Highworth variety produces more shelling percentage than the Rongai variety this is in relation to the genetic ability of the variety to produced more leaves, flowers and other growth parameters which the determinants in the quality of the grains.

The effect of phosphorus and intra-row spacing on 100 grain weight at both locations is represented in Table 2. 100 grain weight was significantly affected by phosphorus application at both locations, were 40kg P_2O_5 ha^{-1} producing more 100 grain weight than the other level of phosphorus. At BUK, increasing P level from 0-20 kg P_2O_5 ha^{-1} led to a significant increase in 100 grain weight but further increase to 40 kg P_2O_5 ha^{-1} did not resulted in a significant increase in seed weight, these finding is in consonance with that of Njarui (2011) that, 100 grain weight was noticed to increased with P application but it was not a significant increased. At Zakirai, application of 20 kgP_2O_5 ha^{-1} produced seed weights that were not statistically different from the control (0kgP_2O_5 ha^{-1}). However, further increase to 40 kg P_2O_5 ha^{-1} resulted in a significant increase in seed weight the result disagreed with the above finding of Njarui (2011). Intra-row spacing affected 100 grain weight at both locations with 30 and 40cm intra-row spacing producing statistically similar and heavier seeds compared with 20cm spacing in both locations. This report is not in conformity with the finding of Patel that 100 grain weight increased only with 40cm row spacing over 30 and 60cm row spacing. In addition, significant differences between varieties with regard to the 100 grain weight were observed at all locations. The Highworth variety produced heavier seeds than Rongai in all the location. The report is similar with the finding of Collin (1999). Pointed out that yield of Rongai is less than that of the Highworth lablab variety and is attributed to the ability of Highworth in early maturing, production of more flowers with a yield of 0.95 – 1.12t ha^{-1}.

The varieties and intra-row spacing interaction (Table 4) shows that, for Rongai variety increase in spacing from 20-30cm there was significant increase in 100 grain yield, but further increase of intra-row spacing from 30-40cm 100 grain weight differences was not significant at both locations. For Highworth variety, each increase in intra-row spacing from 20-40cm there was significant increase in 100 grain weight at both locations. A significant phosphorus and varieties interactions was observed at both locations. For Rongai each increase in P resulted in significant increase in 100 grain weight at Zakirai only while for Highworth increase in P resulted in significant increase in 100 grain weight at BUK only. However increase in P did not affect 100 grain weight for Rongai at BUK and for Highworth at Zakirai.

The effect of phosphorus and intra-row spacing of lablab on grain yield at BUK and zakirai locations is presented in Table 2. Grain yield per plot was significantly affected by phosphorus application at both locations with 40 kg $P_2O_5ha^{-1}$ producing more weight than the other level of P which produces statistically comparable grain yield per plot. The report is in agreement with the findings of Abusuwar *et al,* (2007), and Kiyawa, (2011) who pointed out that application of p fertilizer promote cell division, fat formation, flowering, fruiting seed formation and development of lateral and fibrous roots in the plant which are among the determinants of yield in the crop. Intra-row spacing also affect grain yield per plot at both locations with 40cm intra-row spacing producing more grain weight than the other spacing which produces statistically similar grain yield per plot, in a related development Patel *et al.* (2003) and Malami *et al.* (2010) conducted a research and find out that row spacing of 40cm recorded the highest grain yield compared to other row spacing. Significant differences between varieties with regard to the grain yield per plot occurred at all locations. Where, Highworth variety produces the highest grain yield per plot than the Rongai variety in all the locations. The result corroborate with that of Cameron, (1988) and Collin, (1999) who pointed out that Highworth variety significantly produces higher grain yield of 0.95 – 1.12t ha^{-1} and 0.8 – 0.9t ha^{-1} respectively.

Similarly, there were significant interactions between treatments on the Grain yield per plot at both locations as shown in Table 5. The intra-row spacing and phosphorus interaction at BUK shows that keeping intra-row spacing constant at 20 and 40cm, increasing P level from 0-20 $kgP_2O_5ha^{-1}$ did not affect grain yield but further increase to 40kg gave the highest grain yield. At 30cm, increasing P level from 0-20 kg $P_2O_5ha^{-1}$ gave significant increase in grain yield but further increase to 40 kg $P_2O_5ha^{-1}$ did not affect the yield. Considering P levels, at 0 kg P_2O_5 ha^{-1}, 40cm gave the highest yield while the other spacing had statistically similar and lower values. However, at 20 and 40 kgP_2 O_5ha^{-1} each successive increase in spacing from 20-40cm resulted in significant increase in grain yield.

At Zakirai, the intra-row spacing and phosphorus interaction (Table 5) shows that keeping intra-row spacing constant at 20cm, application of 20 and 40 kg $P_2O_5ha^{-1}$ had similar grain yield that where higher than the control. The report is in agreement with the findings of Abusuwar *et al,* (2007), and Kiyawa, (2011) who pointed out that application of p fertilizer promote cell division, fat formation, flowering, fruiting seed formation and development of lateral and fibrous roots in the plant which are among the determinants of yield in the crop. However, each increase in Phosphorus level 0kg P_2O_5 ha^{-1}.resulted in an increase in grain yield. Considering P level at 0, 20 and 30cm intra-row spacing had similar grain yield that were lower than at 40cm, at zero and 40 kg $P_2O_5ha^{-1}$ each increase in spacing resulted in significant increase in grain yield.

The varieties and intra-row spacing interaction at both locations (Table 5) shows that, for the two varieties each increase in spacing from 20-40cm there was significant increase in grain yield. When intra-row spacing was considered, at 20 and 40cm intra-row spacing, Highworth out yielded Rongai while at 30cm, the yield difference between the two varieties was not significant at both locations. A significant varieties and phosphorus interactions was observed at BUK (Table 5). For Rongai each increase in P resulted in significant increase in grain yields. However, for Highworth increase in P did not affect grain yield.

Regression analysis was carried out using the best line of fit model to explain the grain the response to the various levels of phosphorus application at BUK and Zakirai. The analysis revealed a linear relationship at both locations. 1 and 2 indicates that differences in grain yield response to different levels of phosphorus were statistically significant and the optimum grain yield was obtained at 40 kg $P_2O_5ha^1$ at both locations. The linear relationship indicated that further increase of phosphorus quantity may increase grain yield in lablab production.

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Table 1: Physico-chemical Properties of the soil at Experimental site BUK AND ZAKIRAI, 2013.

Soil Properties		0 – 30cm
Physical (%)		
Sand		82
Clay		10
Silt		12
Textural Class		Sandy
Chemical		
pH (H_2O)	7.10	
Organic Carbon (gkg^{-1})		7.13
Total Nitrogen (gkg^{-1})		1.91
Available P ($mgKg^{-1}$)		11.50
Exchangeable base (cmol (+) kg^{-1})		
Ca		3.10
Mg		0.46
K		0.30
Na		0.11
CEC	5.19	

Table 2: Effect of Phosphorou and intra-row spacing on days to maturity,Pods weight, shelling percentage 100-seed weight and grain yield of Lablab varieties at BUK and Zakirai, 2013.

Treatment	BUK DTM	PDW	SHL	GWT	GYL	ZAKIRAI DTM	PDW	SHL	GWT	GYL
Varieties (V)										
Rongai	132.2a	1.05b	34.07b	19.98b	770b	132.8a	1.02b	33.70b	19.89b	885b
Highworth	122.2b	1.17a	37.04a	20.34a	871b	123.1b	1.15a	36.67a	20.24a	1004a
SED	0.285	0.037	1.301	0.096	14.68	0.324	0.027	1.20	0.385	24.60
Phosphorous (Kg $K_2O_5ha^{-1}$) (P)										
0	127.3	1.06	35.56	19.92b	783b	128.3	1.06	35.00	19.98b	894c
30	127.2	1.01	36.67	20.18a	828a	128.1	1.12	35.60	19.93b	928b
40	127.0	1.16	34.44	20.38a	856a	127.5	1.08	35.00	20.29a	1011a
SED	0.349	0.045	1.50	0.118	17.98	0.397	0.027	1.40	0.471	29.00
Intra-row Spacing (cm) (S)										
20	127.0	0.92b	32.78b	19.58b	694c	127.7	0.92c	31.67b	19.31b	761c
30	126.9	1.16a	37.78a	20.36b	789b	127.9	1.08b	37.78a	20.21a	911b
40	127.5	1.24a	36.11a	20.54a	983a	128.3	1.26a	36.11a	20.69a	1161a
SED	0.349	0.045	1.50	0.118	14.68	0.397	0..27	1.401	0.471	29.00
Interaction										
PXS	NS	*	NS	NS	**	NS	*	NS	NS	**
PXV	NS	NS	NS	*	**	NS	NS	NS	*	NS
SXV	NS	NS	NS	*	**	NS	NS	NS	*	**
PXVXS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test.
DTM = days to maturity, PDW = pod weight, SHL = Shelling percentage, GWT = 100-grain weight and GYL = grain yield.

Table3: Pod weight as influenced by interaction between phosphorous and intra-row spacing at both locations (BUK and ZAKIRAI), 2013.

	Phosphorous ((Kg $K_2O_5^{-1}$)					
	BUK			ZAKIRAI		
Intra-row spacing	0	20	40	0	20	40
20	0.950cd	0.933cd	0.867d	0.950c	0.933c	1.150b
30	1.117bc	1.117bc	1.250ab	1.067b	1.117b	1.300a
40	1.100bc	1.283ab	1.350a	0.867c	1.067b	1.317a
SED		0.0784			0.0466	

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test.

Table4: 100-grain weight as influenced by interaction between phosphorous and variety, and between variety and intra-row spacing at both locations (BUK and ZAKIRAI), 2013.

	Intra-row spacing (cm)					
	BUK			ZAKIRAI		
Varieties	0	20	40	0	20	40
Rongai	19.47c	20.34b	20.14b	19.17c	20.20b	20.31b
Highworth	19.69c	20.38b	20.94a	1944c	20.22b	21.07a
SED		0.1662			0.1562	
	Phosphorous ((Kg $K_2O_5ha^{-1}$)					
	0	20	40	0	20	40
Rongai	19.81c	19.97bc	20.18bc	19.67b	19.70b	20.31a
Highworth	20.02bc	20.40ab	2059a	19.67b	20.20b	21.07a
SED		0.1662			0.1562	

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test.

Table5: Grain yield of lablab as influenced by interaction between phosphorous, intra-row spacing and variety at both locations (BUK and ZAKIRAI), 2013.

	Phosphorous (Kg $K_2O_5ha^{-1}$)					
	BUK			ZAKIRAI		
Treatment	0	20	40	0	20	40
Intra-row spacing (cm)						
20	683d	717d	683e	783ef	750f	750f
30	733d	817c	817c	850ef	900d	983d
40	933b	850b	1067a	1050c	1133b	1300a
SED		31.1			50.2	

	Intra-row spacing (cm)					
Treatment	0	20	40	0	20	40
Varieties						
Rongai	700d	767c	844b	711e	889cd	1056b
Highworth	689d	811bc	1122a	811d	933c	1267a
SED		25.4			41.0	

	Phosphorous (Kg $K_2O_5ha^{-1}$)		
Treatment	0	20	40
Variety			
Rongai	711c	767b	833a
Highworth	856a	889a	878a
SED		25.44	

Means with the same letter(s) in the same column are not significantly different (P < 0.05%) using SNK = Student-Newman-Keuls test.