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INFLUENCE OF INCORPORATED LABLAB PLANTED AT VARIOUS SPACINGS ON PRODUCTIVITY OF MAIZE (*ZEA MAYS* L.) VARIETIES IN NORTHERN GUINEA SAVANNA ZONE OF NIGERIA

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ABSTRACT

The study was conducted to evaluate the effect of incorporated lablab planted at various spacings on productivity of two maize (*Zea mays* L.) varieties in northern Guinea Savanna zone of Nigeria. Field experiment was carried out at the Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria. The treatments consisted of two varieties of maize (SAMMAZ 28 and SAMMAZ 29) and six green manure lablab (*Lablab purpureus*) plant spacings viz. 25cm x 10cm, 25cm x 20cm, 25cm x 30cm, 50cm x 10cm, 50cm x 20cm and 50cm x 30cm. The experiment was laid out in a Randomized Complete Block Design (RCBD) in factorial arrangement and was replicated three times. SAMMAZ 29 performed significantly ($P<0.05$) better than SAMMAZ 28 on growth, yield components and grain yield (kg ha^{-1}) of maize. Incorporation of lablab planted at various spacing significantly increased grain yield (kg ha^{-1}) and all the maize parameters studied except cob diameter. In combined mean, incorporation of lablab planted at 25cm x 30cm significantly increased grain yield but at par with incorporation of lablab planted at spacing 50cm x 30cm. In combined mean, incorporation of lablab planted at 25cm x 30cm gave 18.2, 20.5, 18, 28.6 and 13.6% better grain yield than incorporation of lablab planted at spacing 25cm x 10cm, 25cm x 20cm, 50cm x10cm, 50cm x 20cm and 50cm x 30cm, respectively. Conclusively, incorporation of lablab planted at 25cm x 30cm was better than other spacings on SAMMAZ 29.

Keywords: Incorporation, Spacing, Lablab, Maize, Variety, Productivity.

INTRODUCTION

The low fertility status of savanna soils in Nigeria makes crop production fertilizers dependent. No worthwhile maize crop production can be achieved without input of fertilizers either as organic or inorganic because soils in Nigerian savanna are low in organic carbon, total nitrogen, available phosphorus, effective CEC and exchangeable cations plus clay and silt contents (Singh, 1987). Obviously, using inorganic fertilizers judiciously ensures high crop yields but their long time use leads to ill-effects such as adverse environmental impact, multi-nutrient deficiency, reduction in soil organic matter and hindrance to soil natural biological activity that enhances carbon storage (Adesoji, 2015). Arisha and Bardisi (1999) had earlier reported that over-dependence on exorbitant chemical fertilizers may lead to adverse environmental impacts like pollution of water and increased production of greenhouse gases, causing global climate change. There is also a serious health risk in the reduced food quality due majorly to chemical deposits found in crop fruits and seed (Cooke, 1982). The environmental and health challenges associated with use of inorganic fertilizer make it imperative to look for alternative way of producing maize with organic fertilizer inputs like green manure. Hence, green manure is known to generate organic matter which has capacity to mitigate deleterious effects of mineral fertilizers, boost soil health and refresh environment for increased crop production for profitability and sustainability (Adesoji, 2015). Green manures are beneficial because of their fast growth ability, fixation of nitrogen, greater dry matter accumulation, embedded nutrient in their tissues and nutrient mineralization that enables crops to uptake more nutrients (Kamal *et al*., 2016).

Plant spacing is a key factor in plant growth expression. Inadequate spacing hinders or constricts rhizosphere and photoshere available for the plant to explore and exploit for growth, invariably reduces full expression of growth parameters and thereby hampers dry matter accumulation which is a prime factor that determines the volume of biomass to be incorporated as green manure. It has been reported that individual plant performances especially morphological growth characters reduce when there is an increase in plant density (Galanopoulou-Sendouka *et al*. 1980) while wider spacing will cause more sunlight to be intercepted for photosynthesis, which leads to the production of more nutrients for partitioning for the development of more branches (Mehmet, 2008). Maximum light interception is possible when optimum plant space is provided right from early growth stage of the plant (Rajesh, *et al*., 2017). Total biomass production of a crop, with assumption of no water limitations, is the product of solar radiation received by the canopy of crop over the duration of the cropping period and the rate of efficiency by which the crop converts energy from light into plant dry matter (Richards, 2000). The quantity of biomass determines the volume of the incorporated biomass of the green manure crops available for decomposition and mineralization for the use of the main crop. Hence, this study was designed to evaluate the influence of lablab green manure crop planted at various spacings before incorporation on growth and yield of maize varieties without chemical fertilizer.

MATERIALS AND METHOD

Experimental site and soil characteristics

The experiment was conducted during the rainy seasons of 2014 and 2015 at the Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria (11°111 N, 07°381 E, 686 m above sea level) in the Northern Guinea Savanna ecological zone of Nigeria. The annual rainfall for the duration of the study in 2014 and 2015 was 798.6 and 915.3 mm, respectively. The physico-chemical analysis of the top soil (0-30cm depth) of the experiment site was taken before planting in 2014 and 2015 as determined by standard procedures and soil textural class was loamy sand.

Treatments and Experimental Design

The treatments made of two varieties of maize (SAMMAZ 28 and SAMMAZ 29) and six green manure lablab (*Lablab purpureus*) plant spacings viz. 25cm x 10cm, 25cm x 20cm, 25cm x 30cm, 50cm x 10cm, 50cm x 20cm and 50cm x 30cm. The experiment was conducted using a Randomized Complete Block Design (RCBD) with factorial combinations of variety and spacing with three replications. These varieties used for this experiment are extra-early of 80-85days which are adaptable to Guinea and Sudan savanna ecological zones of Nigeria. SAMMAZ 28 has yellow seeded kernels while SAMMAZ 29 has white seeded kernels.

Crop Management Practices

The experimental land was harrowed and was marked into plots of twelve plots per replicate. Each plot was 4m by 4.5m. Lablab seeds were planted on the flat using various plant spacings in the treatments. The green manure lablab was sown at two stands per hole and incorporated at 7 weeks after sowing (WAS). After seven days of lablab incorporation, maize seeds were sown with two or three seeds per hole at a spacing of 75cm by 25cm. The experimental plot made of six (6) ridges and 4m long (18m^2 gross plot) and net plot was 4m x 3m (12m^2). The maize seedlings were thinned to one plant per stand at two weeks after sowing. There was no application of chemical fertilizer and it was purely an organic farming. The weeding was done using hoe at 6WAS and was followed by earthen-up operation.

Data Collection

Data on growth and yield parameters were taken on number of leaves, leaf area index (LAI), total dry matter per plant, cob diameter, number of seeds per row, number of grain per cob, cob yield (kg ha^{-1}) and grain yield (kg ha^{-1}). Samplings of growth parameter were done at 9 weeks after sowing (WAS) from five randomly selected plants in each net plot with exception of total dry matter (TDM) per plant where data were collected from three randomly selected plants from each plot border rows at 9WAS. The TDM samples were oven dried at a temperature of 70ºC to a constant weight and weighed using a top loading Meltler-P 1210 weighing balance and the mean weight was recorded. Leaf area was determined by multiplying the leaf length by its width and a factor of 0.75 (Lazarov, 1965). Leaf area index was calculated as the ratio of leaf area to the area of ground cover at 9WAS (Watson (1947 and 1952) using the formula below:

$$\text{LAI} = \frac{\text{Total leaf area per plant x 0.75 (cm}^2\text{)}}{\text{Area of ground covered per plant (cm}^2\text{)}}$$

Cob diameter from five randomly selected cobs from the net plot was determined and the average was recorded. Number of rows from five randomly selected cobs from the net plot was counted and the average number of rows per cob was recorded. Number of grains per cob of five randomly sampled cobs from each plot was counted and the average number of grains per cob recorded. Cobs of maize from each net plot were removed, dehusked, sun-dried and weighed. The mean weight was recorded and cob yield in kilogram per hectare was calculated. The grain yield was determined at harvest. The harvested cobs from the net plots were sun-dried, shelled, winnowed and the clean grains weighed and the total weight in kilogram per hectare was calculated and recorded.

Data Analysis

The data collected from the experiment were analysed using analysis of variance (ANOVA) as reported by Gomez and Gomez (1984) using SAS package version 9.0 of statistical analysis system (SAS, 2002). The significant treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955) at 5% level of probability.

RESULTS

Physical and Chemical Characteristics of Soil of the Experimental Sites

The details of physical and chemical properties for the soil of the experimental sites in 2014 and 2015 rainy seasons are showed in Table 1. The textural class of soils of the experimental sites was loamy sand for both 2014 and 2015. The total nitrogen content of the experimental sites was low, 0.6 g kg^{-1}. Table 1 shows the other details of the physical and chemical characteristics of soil of the experimental sites.

Table 1: Physico-chemical characteristics of soil taken from 0 – 30cm depth at the experimental site at Samaru, Zaria, 2014 and 2015.

Soil Characteristics	2014	2015
Particle size (g/kg)		
Clay	9.8	10.8
Silt	6.4	7.4
Sand	83.8	81.8
Textural class	Loamy Sand	Loamy Sand
Chemical property		
pH (0.01MCacl$_2$; 1:2.5w/v)	5.4	4.0
pH in H_2O	5.6	4.8
Organic carbon (g kg^{-1})	4.5	4.4
Total nitrogen (g kg^{-1})	0.6	0.6
Available phosphorus(mg kg^{-1})	8.56	8.92
Exchangeable base (cmol kg^{-1})		
Ca	6.16	3.87
Mg	1.18	0.98
K	0.32	0.18
Na	0.65	0.48
CEC	9.01	6.18

Number of Leaves per Plant

Variety effect was significant ($P<0.05$) at 9WAS in 2015 and combined where SAMMAZ 29 produced significantly higher number of leaves per plant than SAMMAZ 28 (Table 2). Effect of plant spacing of green manure lablab before incorporation was significant ($P<0.05$) at 9WAS in 2014 (Table 2). There was no significant ($P>0.05$) difference among various plant spacings of lablab before incorporation at 9WAS in 2014 except at spacing 50cm x 10cm which gave significantly lower number of leaves but at par with spacing at 25cm x 10cm and 50cm x 30cm. The interaction between variety and spacing of lablab before incorporation was not significant on number of leaves per plant at all sampling stages in both years (Table 2).

Leaf Area Index

The effect of variety was only significant ($P<0.05$) at 9WAS in 2014 where SAMMAZ 28 significantly produced larger leaf area index than SAMMAZ 29 (Table 3). Spacing effect was significant only on leaf area index at 9WAS in 2015 where incorporation of lablab planted at 50cm x 30cm gave significantly ($P<0.05$) larger leaf area index than planting of lablab at other plant spacing but was statistically similar with planting at 25cm x 30cm which was at par with other plant spacings (Table 3). The interaction between variety and spacing was significant on leaf area index at 9WAS in 2014.

Total Dry Matter per Plant

Variety effect was significant ($P<0.05$) at 9WAS in 2015 and combined where SAMMAZ 29 significantly increased total dry matter per plant (Table 3). Plant spacing was significant ($P<0.05$) on total dry matter per plant at 9WAS in 2014 and 2015 (Table 3). At 9WAS in 2014, planting lablab at spacings 25cm x 20cm and 50cm x 10cm before incorporation significantly increased ($P<0.05$) total dry matter plant but at par with planting of lablab at 25cm x10cm (Table 3). At 9WAS in 2015, where planting lablab at spacings 50cm x 10cm and 50cm x 30cm before incorporation significantly increased total dry matter per plant but statistically similar with planting of lablab at 25cm x30cm (Table 3). The interaction between variety and spacing was significant on total dry matter per plant at 9WAS in 2015.

Cob Diameter

Variety effect was significant ($P<0.05$) at 9WAS in 2015 and combined where SAMMAZ 29 produced significantly larger cob diameter than SAMMAZ 28 (Table 2). There was no significant ($P>0.05$) difference among various plant spacings used in planting lablab before incorporation on maize cob diameter in 2014, 2015 and combined (Table 4). The interaction between variety and spacing was not significant on cob diameter at both years and combined.

Number of Seeds per Row

Effect of variety was not significant ($P>0.05$) on number of seeds per row in both years and combined (Table 4). Plant spacing of lablab before incorporation was significant ($P<0.05$) in 2015 and combined where planting lablab before incorporation at spacing of 50cm x 20cm produced significantly lower number of seeds per row than other plant spacings which were at par but significantly higher than planting lablab at 50cm x 20cm (Table 4). The interaction between variety and spacing was not significant on number of seeds per row at both years and combined.

Table 2: Influence of incorporated lablab planted at various spacings on number of leaves plant^{-1} of two maize varieties in 2014, 2015 and combined

	Number of leaves plant^{-1}		
	9WAS		
Treatment	2014	2015	Combined
Variety (V)			
SAMMAZ 28	12.2	8.4b	10.3b
SAMMAZ 29	12.5	9.9a	11.2a
SE±	0.14	0.22	0.15
Spacing (S)			
25cm x 10cm	13.0	9.0ab	11.0
25cm x 20cm	12.2	9.3a	10.7
25cm x 30cm	12.3	9.9a	11.1
50cm x 10cm	12.3	8.0b	10.1
50cm x 20cm	12.1	9.8a	11.0
50cm x 30cm	12.1	9.0ab	10.5
SE±	0.25	0.39	0.26
VxS	NS	NS	NS

WAS: Weeks after sowing. NS: Not-significant. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT

Table 3: Influence of incorporated lablab planted at various spacings on leaf area index (LAI) and total dry matter per plant (g) of two maize varieties in 2014, 2015 and combined

	Leaf area index			Total dry matter plant^{-1} (g)		
	9WAS			9WAS		
Treatment	2014	2015	Combined	2014	2015	Combined
Variety (V)						
SAMMAZ 28	0.91a	1.01	0.96	192.8	212.9b	202.8b
SAMMAZ 29	0.84b	1.05	0.94	189.6	285.6a	237.6a
SE±	0.02	0.03	0.03	6.63	8.15	7.86
Spacing (S)						
25cm x 10cm	0.81	0.93c	0.87	192.7ab	219.8b	206.3
25cm x 20cm	0.94	0.95c	0.95	228.0a	225.5b	226.7
25cm x 30cm	0.85	1.13ab	0.99	165.7b	256.4ab	211.0
50cm x 10cm	0.86	1.02bc	0.94	214.0a	295.8a	254.9
50cm x 20cm	0.94	0.90c	0.92	171.3b	226.4b	198.8
50cm x 30cm	0.86	1.25a	1.05	175.4b	271.5a	223.4
SE±	0.036	0.06	0.05	11.50	14.11	13.62
VxS	**	NS	NS	NS	*	NS

WAS: Weeks after sowing. NS: Not-significant. **: Significant at 1% level of probability.
Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 4: Influence of incorporated lablab planted at various spacings on cob diameter (cm) and no. of seeds row^{-1} of two maize varieties in 2014, 2015 and combined.

	Cob diameter (cm)			No. of seeds row^{-1}		
Treatment	2014	2015	Combined	2014	2015	Combined
Variety (V)						
SAMMAZ 28	2.9	3.5b	3.2b	17.9	21.9	19.9
SAMMAZ 29	3.0	3.8a	3.4a	17.4	23.9	20.6
SE±	0.04	0.04	0.03	0.50	0.69	0.50
Spacing (S)						
25cm x 10cm	2.9	3.7	3.3	15.9	25.0a	20.5a
25cm x 20cm	2.9	3.7	3.3	17.5	24.4a	20.9a
25cm x 30cm	3.0	3.8	3.4	19.2	24.7a	22.0a
50cm x 10cm	3.1	3.6	3.4	18.2	22.0a	20.1a
50cm x 20cm	2.9	3.6	3.3	17.0	17.2b	17.1b
50cm x 30cm	3.0	3.6	3.3	18.0	23.9a	21.0a
SE±	0.06	0.06	0.05	0.86	1.19	0.86
VxS	NS	NS	NS	NS	NS	NS

NS: Not-significant. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Number of Grains per Cob

Variety effect was significant (P<0.05) only in 2015 where SAMMAZ 29 produced significantly higher number of grains per cob than SAMMAZ 28 (Table 5). Plant spacing was significant (P<0.05) on number of grains per cob in 2014, 2015 and combined (Table 5). Incorporation of lablab planted at 25cm x 30cm significantly (P<0.05) increased number of grains per cob across the years and combined but statistically similar with incorporated lablab planted at 50cm x10cm, 50cm x 20cm and 50cm x 30cm in 2014, 25cm x 10cm and 25cm x 20cm in 2015 and 25cm x 20cm in combined mean (Table 5). Variety x spacing interaction was significant only on number of grains per cob in 2015.

Cob Yield (kg ha^{-1})

Effect of variety significantly (P<0.05) increased cob yield in 2015 and combined where SAMMAZ 29 gave significantly higher cob yield (Table 5). Plant spacing was significant (P<0.05) in 2015 and combined where incorporation of lablab planted at 25cm x 30cm produced significantly higher cob yield in 2015 and combined than incorporation of lablab planted in other spacings (Table 5). The interaction between variety and spacing was significant on cob yield in 2015 and combined. In combined mean, significant interaction between variety and spacing showed that the highest cob yield was produced with SAMMZ 29 which was grown in plots that received the incorporation of lablab planted at 25cm x 30cm and lowest cob yield was obtained with SAMMAZ 28 that was grown in plots that received the incorporation of lablab planted at 25cm x 20cm and 50cm x 20cm (Table 6).

Grain Yield (kg ha^{-1})

Variety effect was significant (P<0.05) only in 2015 where SAMMAZ 29 produced significantly higher grain yield than SAMMAZ 28 and 19.5% better grain yield than SAMMAZ 28 (Table 7). Plant spacing was significant (P<0.05) on grain yield in 2014, 2015 and combined (Table 7). In 2014, incorporation of lablab planted at 50cm x 30cm produced significantly (P<0.05) higher grain yield than incorporation of lablab planted at spacings 25cm x 10cm, 25cm x 20cm and 50cm x 20cm but at par with incorporation of lablab planted at spacings 25cm x 30cm and 50cm x 10cm. Incorporation of lablab planted at 25cm x 30cm significantly increased grain yield in 2015 and combined but at par with incorporation of lablab planted at spacing 50cm x 30cm in combined mean (Table 7). In combined mean, incorporation of lablab planted at 25cm x 30cm gave 18.2, 20.5, 18, 28.6 and 13.6% better grain yield than incorporation of lablab planted at spacings 25cm x 10cm, 25cm x 20cm, 50cm x 10cm, 50cm x 20cm and 50cm x 30cm, respectively. The interaction between variety and spacing was significant on grain yield in 2015 and combined. In combined mean, significant interaction between variety and spacing showed that the highest grain yield was produced with SAMMAZ 29 that was grown in plots that received the incorporation of lablab planted at 25cm x 30cm and 50cm x 30cm, and SAMMAZ 28 that was grown in plots that received the incorporation of lablab planted at 50cm x 20cm. The lowest grain yield was obtained with SAMMAZ 28 that was grown in plots that received the incorporation of lablab planted at 50cm x 20cm (Table 8).

Table 5: Influence of incorporated lablab planted at various spacings on number of grains per cob and Cob yield (kg ha^{-1}) of two maize varieties in 2014, 2015 and combined

	No. of grains cob^{-1}			Cob yield (kg ha^{-1})		
Treatment	2014	2015	Combined	2014	2015	Combined
Variety (V)						
SAMMAZ 28	240.7	286.2b	263.5	677	1050b	864b
SAMMAZ 29	229.1	323.0a	276.1	645	1311a	978a
SE±	7.25	7.08	6.76	28.2	47.4	36.9
Spacing (S)						
25cm x 10cm	196.6c	333.7a	265.1b	619	1242b	930b
25cm x 20cm	216.9bc	333.6a	275.2ab	568	1201b	884b
25cm x 30cm	269.4a	345.5a	307.5a	709	1555a	1132a
50cm x 10cm	246.3ab	291.7b	269.0b	692	1130bc	911b
50cm x 20cm	239.6ab	250.7c	245.1b	612	885c	749b
50cm x 30cm	240.9ab	272.5bc	256.6b	766	1068bc	917b
SE±	12.6	12.27	11.70	48.8	82.11	63.8
VxS	NS	*	NS	NS	*	*

NS: Not-significant; *: Significant at 5% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 6. Interaction between variety and spacing on cob yield (kg ha $^{-1}$) in combined mean

	Variety	
Treatment	SAMMAZ 28	SAMMAZ 29
Spacing (S)		
25cm x 10cm	921ab	940ab
25cm x 20cm	772b	997ab
25cm x 30cm	980ab	1285a
50cm x 10cm	959ab	864ab
50cm x 20cm	543b	955ab
50cm x 30cm	1007ab	827ab
SE±	148.2	

Means followed by the same letter(s) are not significantly different at 5% level of probability using DMRT.

Table 7: Influence of incorporated lablab planted at various spacings on grain yield (kg ha^{-1}) of two maize varieties in 2014, 2015 and combined

	Grain yield (kg ha^{-1})		
Treatment	2014	2015	Combined
Variety (V)			
SAMMAZ 28	511	810b	660
SAMMAZ 29	468	1006a	737
SE±	21.3	32.7	27.2
Spacing (S)			
25cm x 10cm	437b	934b	685b
25cm x 20cm	422b	907bc	665b
25cm x 30cm	523ab	1151a	837a
50cm x 10cm	529ab	844bc	686b
50cm x 20cm	448b	748c	598b
50cm x 30cm	579a	866bc	723ab
SE±	36.8	56.58	47.1
VxS	NS	**	*

NS: Not-significant; *: Significant at 5% level of probability; **: Significant at 1% level of probability. Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

Table 8. Interaction between variety and spacing on grain yield (kg ha $^{-1}$) in combined mean

	Variety	
Treatment	SAMMAZ 28	SAMMAZ 29
Spacing (S)		
25cm x 10cm	707ab	664ab
25cm x 20cm	616ab	714ab
25cm x 30cm	728ab	945a
50cm x 10cm	738ab	635ab
50cm x 20cm	385b	811a
50cm x 30cm	789a	656ab
SE±	115.9	

Means followed by the same letter(s) are not significantly different at 5% level of probability using DMRT.

DISCUSSION

Variety Effect on Maize Grain Yield, and Growth and Yield Parameters

SAMMAZ 29 outperformed SAMMAZ 28 as exemplified by significant increases observed on number of leaves, leaf area index (LAI), total dry matter per plant, cob diameter, number of grain per cob, cob yield (kg ha^{-1}) and grain yield (kg ha^{-1}). SAMMAZ 29 performed better in growth parameters, yield components and grain yield than SAMMAZ 28. This significant performance could be attributed to their differences in genetic makeup. This is in consonant with the findings of Ibrahim *et al*. (2000) and Sajjan *et al*. (2002) who reported that the differences in growth characters of crops could be attributed to their genetic constitution. This could also be linked to the inherent ability of SAMMAZ 29 to respond better to growth factors than SAMMAZ 28, which led to the better response on the parameters studied. This could be that the photosynthetic ability of SAMMAZ 29 is greater than that of SAMMAZ 28, hence higher values for the measured parameters and consequently greater grain yield. It has been reported that overall productivity of a plant is determined by the photosynthetic capacity of such a plant (Ibeawuchi *et al*., 2008).

Effect of Plant Spacing of Lablab before Incorporation on Maize Grain Yield, and Growth and Yield Parameters

Planting green manure lablab at various spacings before incorporation produced significant influence on number of leaves, leaf area index (LAI), total dry matter per plant, number of seeds per row, number of grain per cob, cob yield (kg ha^{-1}) and grain yield (kg ha^{-1}) of maize. This could be attributed to the fact that plant spacing influences the photosphere and rhizosphere exploitation by the plants (Ibeawuchi *et al*., 2008) which the resultant effect is a varied biomass production among various spacings. It has been reported that reducing plant densities led to increase the nutrient area per plant and this caused increase in morphological growth characters (Baloch *et al*., 2002). The larger the quantity of biomass generated the larger is the biomass that will be available for incorporation. Incorporation of lablab planted at 25cm x 30cm produced better performance on maize growth and yield components, and grain yield than planting lablab at other spacings before incorporation. This could be that planting green manure lablab at spacing 25cm x30cm caused better light utilization, space availability, water usage, and plant nutrient exploit than other spacings, thus increased performance in maize. This could also be that incorporation of lablab planted at spacing 25cm x 30cm generated larger biomass which when incorporated made available larger quantity of embedded nutrients for the use of maize than those of other spacings. Hence, better performance of the maize planted on plots that received the incorporated lablab sown at spacing 25cm x 30cm than those in other spacings. Similarly, Adesoji *et al*. (2013), who worked on incorporated mucuna, lablab and soybean, attributed the better performance on maize yield and yield components to increased total soil N got likely from the N fixed biologically and N mineralized from the decomposed incorporated legumes plus the improvement observed in the soil available P and organic matter after incorporation of legumes. In the study conducted in Sokoto, Nigeria, intra row spacing did not affect the lablab dry matter yield but intra row spacing of 30cm gave the highest dry matter yield of lablab (Tanko *et al*., 2013).

The significant increase in maize grain yield in plots that received incorporated lablab planted at spacing 25cm x 30cm could be attributed to the impact of the buried lablab on physical, chemical and biological properties of the soil, hence improvement in soil fertility for increased maize growth for enhanced yield parameters and grain yield. The significant increase observed in grain yield could also be that maize plants that were planted on plots that received incorporated lablab sown at 25cm x 30cm used effectively the incorporated lablab for enhanced performance in maize yield components for better grain yield in plots that received incorporated lablab planted at 25cm x 30cm than those in other spacings. This positive response could also be that planting lablab at 25cm x 30cm enhanced the better uptake of N from the soil. It has been reported that when leguminous crops are planted and deployed as green manures they make available up to 40% of nitrogen in soils by the decomposition of nodules and other biomass of the legumes (Rochester *et al.*, 2001). Fabunmi and Balogun (2015), who worked on different plant populations on green manure cowpea on maize, reported that grain yield of maize increased by 37-98% and 89-147% on plots that received cowpea green manure in 2009 and 2010, respectively, when compared with the control plots. The significant interactions between variety and spacing on cob yield and grain yield showed that growing SAMMAZ 29 in plots that received the incorporation of lablab sown at 25cm x 30cm was the best combination for increased cob yield and grain yield of maize. This could be that incorporation of lablab planted at 25cm x 30cm created better environment for SAMMAZ 29 to express its inherent ability for yield performance.

CONCLUSION

Based on the results obtained from this experiment, it can be concluded that SAMMAZ 29 outperformed SAMMAZ 28 on maize grain yield and almost all the growth and yield parameters studied. Plant spacing of lablab before incorporation had significant influenced on maize grain yield and all growth and yield parameters studied with exception of cob diameter. Incorporation of lablab sown at 25cm x 30cm produced better performance on maize growth and yield components, and consequently, increased grain yield. Thus, planting lablab at 25cm x 30cm before incorporation as green manure seems to be appropriate for lablab biomass production for subsequent incorporation as green manure for enhanced grain yield of maize in the study area.

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