Research paper

Evaluating the Effects of Staking and Planting Dates on the Yields of African Yam Bean, *Sphenostylis stenocarpa* in Nigeria

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ABSTRACT

Aims: To evaluate the effects of staking and planting dates on the grain/tuber yields of African yam bean.

Study design: The fields were laid out in split-plots in randomized complete block design

Place and duration: Field experiments were conducted at Ebonyi State University, Abakaliki, Nigeria during 2009/10 farming seasons.

Methodology: Three different planting dates were used as the main-plot treatments, while staking and non-staking formed the sub-plots. Seven accessions of African yam bean were planted in the sub-plots. Five plants were randomly selected from each accession/treatment and tagged for data collection. Each seedling was staked independent after germination, while the non-staked plants were allowed to trail on the ground guided. Collected data were subjected to analyses of variance. Mean separation was by Student Newman's Keuls test.

Results: The results indicated that all the African yam bean accessions performed better when they were staked and planted earlier in May of each season with greater grain/tuber yields, which differed significantly ($P < 0.05$) from those that were not staked and planted later either in June or July of each season. Of all the accessions assessed, TSs86 was the most productive with the highest grain yield and differed significantly ($P < 0.05$) from the rest of the accessions, while TSs84 had the least grain yields. Results on the tuber yields showed the same trend in relation to the treatments. The tuber yield showed that some accession could produce above 2 tons of tubers per hectare; however tuber yield showed inverse relationship to that of the grain yield

across the accessions with the highest tuber yield was recorded in TSs93 and least in TSs86. **Conclusion:** for increased grain/tuber yields of African yam bean in Nigeria, it has to be staked and planted early in the season.

Keywords: *Sphenostylis stenocarpa,* staking, planting dates, yields

1. INTRODUCTION

Nigeria is one of the African countries that are endowed with varieties of grain leguminous plants that are required for sustainable food security. Unfortunately, one major causes of food insecurity experienced in many African countries and Nigeria in particular is the underutilization of some potential food security crops in the continent (Saka *et al*., 2004, 2007). Amongst the underutilized crops with high food potential in Nigeria is African yam bean (*Sphenostylis stenocarpa,* Hochst. Ex. A. Rich). African yam bean (AYB) is one of the most important grain and tuberous legumes of tropical Africa. It is cultivated as a secondary crop with yam and other crops in many parts of Africa mainly by subsistence farmers despite its nutritional values (Potter 1992, Amoatey *et al*., 2000 and Klu *et al*., 2001). The seed grain and tuber are the two major organs of immense economic importance as food for Africa with regional preferences (Potter 1992, Klu *et al*., 2001, Adewale 2010, Adewale and Dumet 2011 and Ene-Odong 1992). While the seeds are preferred in the West African countries, the tubers are preferred both in the east and central Africa. African yam bean has huge potential for food security in Africa. According to Uguru and Madukaife, (2001), AYB is well balanced in essential amino acid and has higher amino acid content than pigeon pea, cowpea and bambara nut. The grain is a good source of proteins, fibre and carbohydrate. It is rich in minerals such as phosphorus, iron and potassium. However, the under-exploitation of the crop has subjected it to be classified as minor grain legumes (Saka *et al*., 2004).

Of all the factors militating against increased African yam bean production in Nigeria is its low grain yield, when compared with other legumes (cowpea) and tuber crops (sweet potatoes) under monocrop conditions (Saka *et al*., 2007). Several factors have been reported to be responsible for the low grain yield recorded in the field. Of all the factors that challenges increased AYB production, the most important one is the cultural practices involved in its production. African yam bean is a vigorously climbing herbaceous vine whose height can reach 1.5–3 m or more with many branches which twines on any available stake (Adewale, and Dumet, 2011). Hence the believe that AYB requires a stake in its production and no wonder the practice of intercropping it with other crops that either requires stake too, like yam or with a crop that may provide a stake like cassava or millet (Klu *et al*., 2001, Adeniyan *et al*., 2007). According to

Adeniyan *et al*., (2007) AYB requires staking under monocropping for improved grain yield. To provide stakes for a better growth and yield requires extra effort and cost.

Although several references have been made to the use of the AYB tubers as a source of starch and proteins in West Africa (Ene-Obong 1992; Porter 1992, Adewale and Dumet 2011), unfortunately many AYB farmers do not even know that it produces tubers talk less of harness the potential in supplementing their protein requirements. Others on the ~~order~~ hand attach no importance to the bean tubers as their yields were considered very poor compare to that of yam (Klu *et al*., 2001).

Furthermore the appropriate time of planting for enhanced yields has not been ascertained. The knowledge of these factors is necessary in guiding rural farmers that may want to engage in its production. Hence the objective~~s~~ of this study ~~were~~ to evaluate the effect of staking and date of planting on the grain/tuber yields of AYB in Nigeria.

2. MATERIAL AND METHODS

Field experiments were conducted at the experimental farm of the Faculty of Agriculture and Natural Resources Management, Ebonyi State University Abakaliki during 2009 and 2010 farming seasons under rain fed conditions. Abakaliki lies within 7^{o} 30'E, 5^{o} 45'N with a mean annual rainfall of 2000 mm. The fields were laid out in split-plots in randomized complete block design. Three different planting dates (May 4^{th}, June 2^{nd} and July 1^{st}) for 2009/10 were used as the main-plot treatments, while staking and non-staking formed the sub-plots. Seven promising accessions of ~~African yam bean~~ (TSs 9, TSs 48, TSs84, TSs86, TSs93, TSs94 and TSs166) collected from IITA genetic bank were randomly planted in the sub-plots. The AYB accessions seeds were planted in rows in each plot with a variety occupying a row. The seeds were sown at 2 seeds per hole at a planting spacing of 1 m x 0.7 m inter and intra spacing. Each treatment was replicated three times. Thinning was done after three weeks of planting to one seedling per stand. Five plants were randomly selected from each accession/treatment and tagged for data collection. Forty kilograms per hectare of compound fertilizer 15: 15: 15 NPK was added to all the plots at three weeks after germination to boost growth. Staking was done three weeks after germination using strong stake each measuring about 3 m high. Each seedling was staked independent of another to avoid mixing the accessional yields, while the non-staked plants were allowed to trail on the ground and were guided to avoid ~~missing~~ with other accessions. The experimental plots were weeded at three weeks intervals.

At harvest, data were collected on the total grain yield of individual plants based on the treatments and assessed per accession from the tagged plants. Estimate of grain yield per unit

area was done when the grains were dry using the tagged plants. The pods were threshed and winnowed. The results were extrapolated to kilogram per hectare for each accession and treatment. Equally the estimate of tuber yield per unit area was done when the plants were mature and leaves dried using the tagged plants. The tubers were harvested using hoe, weighed and the results were extrapolated to tons per hectare for each accession and treatment.

2.1. Statistical analyses

Collected data were subjected to analyses of variance through computer software (SAS, 2003). The mean separation was carried out by Student Newman's Keuls ($P < 0.05$) test. Pearson correlation coefficient (r) was used to determine the relationship between yields, planting dates and staking.

3. RESULTS

The results indicated that staking and date of planting significantly affected the grain/tuber yields of African yam bean. Highest grain yields were observed when AYB accessions were staked compared to the accessions that were planted non-staked ~~(Table 1).~~ On the other hand, the non-staked AYB had the lowest grain yield (Table 2). Amongst the accessions assessed, TSs86 when staked gave the highest grain yields across the experimental periods and differed significantly ($P< 0.05$) from the rest of the accessions, while TSs84 when staked and non-staked gave the poorest grain yield.

On the other hand, the highest grain yields were recorded when African yam beans were planted earlier in May 4th of each season, which differed significantly ($P<0.05$) from those planted in either June or July of each season. In other words, there were decreases in grain yields with delay in the planting dates with the least grain yield recorded on AYB planted on July of each season.

In the two planting seasons, the highest grain yields were recorded during the 2009 farming season than in 2010 across the accessions and planting dates.

The results of the tuber yields indicated that the tuber yield per plant varied across the accessions and planting dates throughout the experimental periods. In overall, TSs86 gave the least tuber yield across the experimental periods and differed significantly from others, while TSs84 gave the highest tuber yield indicating an inverse relationship between tuber yield and grain yield (Tables 3 and 4). Similarly ~~African yam bean~~ accessions planted earlier gave higher tuber yield across all the accessions and differed significantly ($P <0.05$) from those planted later with the highest tuber yield recorded in May of each season while the least was gotten in July of each season.

There were significance positive correlations between dates of planting, grain yield and tuber yields (r = 0.67 and 0.45, P<0.05) respectively; staking and grain yield (r = 0.56, P<0.05); staking and tuber yield (r = 51, P<0.05 for 2009 and 2010 respectively. On the other hands there was significant negative correlation between grain yield and tuber yield (r = 0.69, P<0.05).

4. DISCUSSION

The highest grain yield observed when African yam beans were staked under this study could be due to the importance of staking on the yields of African yam bean. The yield increase might probably be due to the advantageous effects of staking which provided support for the numerous branches of the crop. Similar results have been reported by Adeniyan *et al*. (2007). According to them when AYB was intercropped with maize/kenaf, the maize/kenaf served as life stakes for the AYB which in turn gave higher grain yield compared to sole AYB that was not staked. It has been reported that AYB is a vigorous, herbaceous, climbing leguminous plant whose height could be up to 1.5-2 m. Hence, as a climbing crop it needs a stake for proper vegetative growth. The vegetative growing stage is characterized with the profuse production of trifoliate leaves which is required for an enhanced grain yield (Milne-Redhead and Polhill 1971).

Yield reductions observed on all the accession under non-staking condition has been reported by earlier researchers (Adeniyan *et al*., 2007). According to them, when AYB is not staked it lacks the support given by the stake material which assist it in repositioning the leaves for adequate sunlight it require for proper growth. It has equally been reported that staking plays a significant role in tuber formation of most climbing plants like yam.

On the other hands, the significant increase in grain yield recorded early in the season may be attributed to reduced pests infestation on the crop. AYB has been reported to be attacked by several flower and post flower pest that results in low yield of the crop (Ameh and Okezie, 2005). However it has been reported that such pests many a times do not infestation the crop early in the season (Ogah *et al*., 2012). According to them such serious pest of AYB like *M. vitrata* and thrips were observed to have low infestation of the early planting crops. This is also in agreement with (Akingbohungbe, 1982, Asante *et al*., 2001) who reported that cowpea planted in June or July in Southern Nigeria usually escape severe *M. vitrata* infestation while those planted late in August coincide with the peak population densities of the major post-flower pests resulting in considerable reduction of grain yield. Conversely the low grain yield observed later in the season may also be attributed to increased pest build up in the field thereby destroying the crop (Ogah *et al*., 2012). Similar results have been reported in cowpea in Uganda by (Karungi *et al*., 2000). The agronomic practices of planting crops at different dates are used in different parts of the tropics

especially in Africa (Okigbo and Greenland, 1976). This is evident in the present result that showed significant differences on both the grain and tuber yield of AYB recorded across the three planting dates. Improved crop cultivars and alteration in planting dates of crops have been reported as an effective strategy in reducing pest damage and increasing crop yields by a number of researchers (Prasa and Singh, 1997).

The fact that the accession that gave the highest grain yield was not the accession that gave the highest tuber yield may be attributed to the influence of grain yield on the tuber yield. It has been reported that grain yield of some legumes affect the development of tubers. This is in line with the inverse tuber yield recorded in the present study. Accession that gave higher grain yields were the accessions that gave the least tuber yield and this explains the significant negative correlation observed under the study. The higher grain/tuber yields recorded in some varieties compared to others may be due to differential genetic make of the different accessions.

5. CONCLUSION

The results presented showed that African yam bean has high potential in contributing to food security in Nigeria. The high yield gain advantage recorded when AYB was staked over the non-staked cropping calls for its cultural practices improvement. Furthermore, the tuber yield potential of the crop indicated that if improved upon could stand to replace most of the tuber crops grown in Nigeria whose yield have been dwindling following the current low soil fertility observed virtually in all the ecologies in Nigeria. Thus, for improved growth and total yields of AYB, staking and early plant are paramount cultural practices to be observed.

Table 1: Effect of planting dates on grain yield (kg/ha) of AYB during 2009/2010.

		2009			2010		
	Varieties	May	June	July	May	June	July
		Grain yield	Grain yield	Grain yield	Grain yield	Grain yield	Grain yield
1	TSs 9	557.7b	456.9c	374.7c	511.1b	462.2b	343.0c
2	TSs 48	595.5a	517.8a	412.1b	591.0a	492.2a	384.0a
3	TSs84	425.0e	319.7e	277.1e	419.2e	403.5c	204.8e
4	TSs86	631.3a	520.0a	461a	521.6b	462.6b	353.9b
5	TSs93	512.0d	441.6cd	312.2de	491.0c	366.4d	344.8c
6	TSs94	544.7c	491.6b	343.4d	448.1d	311.8f	290.0d
7	TSs166	525.5d	393.9d	353.6cd	391.6e	344.0e	291.6d

Means followed by the same letter(s) do not significantly differ according to Student Newman Keuls ($P < 0.05$) test

Table 2: Effect of staking on grain yield (kg/ha) of AYB during 2009/2010.

S/N	Accessions	2009		2010	
		Staking	Non-staking	Staking	Non-staking
		Grain yield	Grain yield	Grain yield	Grain yield
1	TSs 9	463.1b	273.9c	438.8c	294.1a
2	TSs 48	508.5a	334.4a	489.1a	285.2b
3	TSs84	340.6c	171.8e	342.5e	189.1d
4	TSs86	537.4a	349.7a	446.0b	294.9a
5	TSs93	421.9d	241.8cd	400.7de	220.2c
6	TSs94	459.9b	290.3b	350.0d	153.7e
7	TSs166	424.3d	222.0d	342.4cd	244.0c

Means followed by the same letter(s) do not significantly differ according to Student Newman Keuls ($P < 0.05$) test

Table 3: Effect of planting dates on tuber yield (t/ha) of AYB during 2009/2010.

		2009			2010		
	Varieties	May	June	July	May	June	July
		Tuber yield	Tuber yield	Tuber yield	Tuber yield	Tuber yield	Tuber yield
1	TSs 9	1.5c	1.4c	1.3c	1.2d	1.2c	1.0d
2	TSs 48	1.4cd	1.2d	1.0d	1.4c	1.1c	1.1d
3	TSs84	2.1a	2.0a	1.7a	1.9a	1.6a	1.4b
4	TSs86	1.3d	1.3cd	0.7e	1.4c	0.6d	0.4e
5	TSs93	1.9a	1.8a	1.5b	1.7b	1.6a	1.6a
6	TSs94	1.7b	1.4c	1.2cd	1.2d	1.3b	1.2c
7	TSs166	1.9a	1.6b	1.3c	1.5c	1.5a	1.4b

Means followed by the same letter(s) do not significantly differ according to Student Newman Keuls ($P < 0.05$) test

Table 4: Effect of staking on tuber yield (kg/ha) of AYB during 2009/2010.

S/N	Accessions	2009		2010	
		Staking	Non-staking	Staking	Non-staking
		Tuber yield	Tuber yield	Tuber yield	Tuber yield
1	TSs 9	1.8b	1.5b	1.7b	1.3b
2	TSs 48	1.4c	1.1d	1.4cd	0.9d
3	TSs84	2.0a	1.7a	2.0a	1.4ab
4	TSs86	1.7b	1.5b	1.6b	1.0cd
5	TSs93	2.1a	1.7a	1.7b	1.5a
6	TSs94	1.8b	1.3c	1.3d	1.2bc
7	TSs166	1.8b	1.6a	1.5c	1.1c

Means followed by the same letter(s) do not significantly differ according to Student Newman Keuls ($P < 0.05$) test

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