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Food, Health and Environmental Issues in Developing Countries: The Nigerian Situation

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Variation in seed yield and nutrient contents in African yam bean (*Sphenostylis stenocarpa*)

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Abstract

Nine African yam bean accessions were evaluated for seed yield and other reproductive characters Significant differences were observed for seed yield, 100 seed weight and number of days to 50% flowering. Seed yield among the accessions ranged from 24.79 to 118.33 g per plant. Average number of seeds per pod was from 13.33 to 19.33, 100 seed weight varied between 19.69 to 28.22 g, while pod length also differed from 19.57 to 28.00 cm. The protein content of the African yam bean accessions were comparable to that of cowpea, but the concentrations of the anti-nutritional factors were significantly higher in the African yam bean accessions. Although the African yam bean accessions with low anti-nutritional factors were low yielding, they can be recombined with the high yielding accessions in developing improved varieties.

Keywords: African yam bean, evaluation, seed yield, nutrients, anti-nutrients, variation.

Introduction

African yam bean (*Sphenostylis stenocarpa* (Hochst. Ex A. Rich) Harms) is native to West and Central Africa and it is one of the underutilized grain legumes still been cultivated by some traditional farmers in certain localities mainly in the southern part of Nigeria and Benue State (middle belt). It is cultivated mainly for consumption as only about 30% of the dry grain produced is sold and also planted for soil restoration (Saka, *et al.* 2004). African yam bean is a good source of protein, fibre and carbohydrate. It is rich in minerals such as phosphorus, iron and potassium. It also contains some anti-nutrients such as trypsin inhibitor, phytate and other alkaloids (Nwokolo, 1987; Ajibade, *et al.*, 2005; Fasoyiro, *et al.*, 2006).

Although African yam bean (AYB) can be used to replace cowpea in most food preparations, its utility is highly limited when compared with prominent grain legumes such as cowpea, groundnut and soybean. For instance, in Nigeria, soybean and groundnut are usually processed into oil and defatted meals used as animal feeds. Soybean is also used in fortification of foods as in baby product formulation. Cowpea is widely utilized in the form of bean cake, pudding and in food fortification. African yam bean, is mainly cooked and eaten alone or with yams, maize, rice or in soup. This crop (AYB) has however found better utility in Ghana where it is usually processed into flour and used for pudding or fortified with cassava. The water drained after boiling the beans are also drunk by lactating mothers to increase milk production (Klu *et al* 2001).

However, AYB seeds take a long time to cook and contain higher levels of anti-nutritional factors (ANFs) than cowpea and soybean (Fasoyiro *et al.* 2006) which could be toxic or reduce the nutrient utilization, limiting its use in animal and human nutrition. There is also lack of awareness about the nutritional quality of AYB particularly among the urban dwellers. Another limiting factor is the low seed yield of the crop recorded by farmers despite the reported low level of pest and diseases attack (Saka *et al.* 2004).

Therefore in this study nine AYB accessions were evaluated to identify promising genotypes in terms of high seed yield, nutrients and anti-nutritional factors.

Materials and methods

Nine African yam bean accessions from the germplasm of the Institute of Agricultural Research and Training (IAR&T), Ibadan were evaluated for seed yield and other reproductive characters. The nine African yam bean accessions evaluated are SSWN32, SSWN44, SSWN48, SSWN33, SSWN50, SSWN3, SSWN35, SSWN15 and SSWN29. The seeds of each accession were planted out at the Research Farm of the Institute in Ibadan, Nigeria in June 2006. The planting was done in single row plot of 10 metres long at a spacing of 1m x 1m. There were three replicates. Two seeds were planted per stand and later thinned to one, two weeks after sowing. Manual weeding was done as at when due and no fertilizer was applied. Sherper Plus (Cypermetrin + dimethoate) brand of insecticide was applied at the rate of 50g a.i. ha^{-1} at anthesis and subsequently at two weeks interval for a total of 3 applications to control insect attack. At maturity, data were collected from five plants from each plot. The data collected were: number of days to 50% flowering, pod length, number of seeds per pod, 100 seed weight and seed yield per plant.

Proximate analysis: Dry seeds of each of the nine AYB accessions and a local cowpea cultivar were sorted, milled and stored in polythene bags at 4°C. Samples were analyzed for nitrogen content by the microkjedahl method and the crude protein was calculated by multiplying the Kjeldahl N by 6.25. The contents of crude fats, crude fibre and ash were determined by AOAC (1990) method.

Anti-nutritional factors analyses: Tannin content was determined using the method of Price *et al.*, (1978), trypsin inhibitor (Kakade *et al.* 1969) and phytate content (Davies and Reid 1979). All the analyses were carried out in triplicate.

Data collected from the field and laboratory were separately analyzed using analysis of variance and Duncan multiple range test.

Results and Discussion

Significant differences were observed for seed yield per plant, 100 seed weight and number of days to 50% flowering (Table 1). Average number of days to 50% flowering ranged from 104 in NSWS50 to 118 days in NSWS15. Pod length varied between 19.57 to 28 cm with accessions NSWS6 and 15 having the longest pods. Number of seeds per pod ranged from 12 in NSWS29 to 19.33 in NSWS44. The accession NSWS50 had the biggest seeds with an average 100 seed weight of 28.22g while NSWS48 had the least. The highest variability was observed in seed yield per plant which ranged between 24.79 in NSWS35 and 118.3g in NSWS48. Similar results were reported by Togun and Egunjobi,(1997) for African yam bean

Proximate compositions of African yam bean accessions are shown in Table 2. Two accessions NSWS50 and 15 had the highest protein content of 24.07 and 24.13% respectively with NSWS32 and 35 having the lowest content of 21.79 and 21.73% respectively. Fat content also ranged from 3.93% in NSWS35 to 5.20% in NSWS50. The fibre content was from 5.20 to 8.02% while ash content also ranged between 3.71 to 7.05%. The accession NSWS33 had the highest carbohydrate content of 51.70% with NSWS44 having the lowest content of 46.83%. The results compared well with those of Edem *et al* (1990); Adeparusi, 2001 and Ajibade *et al* (2005). The protein content of the cowpea variety evaluated was 23.87% which was not significantly different from those of three of the African yam bean accessions evaluated. The cowpea variety also contained significantly lower concentrations of fat, fibre and ash, but its carbohydrate content was significantly higher than those of the African yam bean accessions.

The anti-nutritional contents of the nine accessions and cowpea are shown in Table 3. The highest concentrations of trypsin inhibitor were observed in three accessions NSWS32, 44 and 35 with the values of 32.90, 31.58 and 31.58 Tiu/mg respectively, while NSWS33 had least concentration of 19.74 Tiu/mg. Phytate content varied from 3.44 to 4.20 g/100g with NSWS32 having the highest value. Tannin content ranged between 3.95 in NSWS33 and 7.83 in NSWS3. Similar range of values for the anti-nutrients was also reported by Ajibade *et al* 2005. When compared with cowpea, the African yam bean accessions had significantly (P>05) higher concentrations of the three anti-nutritional factors evaluated than cowpea. Significantly (P>05) higher concentrations of the anti nutrients were also observed in African yam bean than cowpea, soybean and groundnut (Fasoyiro *et al* 2006). The two accessions with relatively lower concentrations of the three anti-nutritional factors are NSWS33 and 29. These two accessions are however, low yielding with average yield per plant of 31.83g and 48.23g respectively (Table 1). Availability of high yielding and nutritionally superior African yam bean accessions would enhance its acceptability and improve the protein intake and widen the food base of the populace. Improved utilization of this neglected crop will also ensure the conservation of its rich genetic resources.

Conclusion

In the present study, high yielding accessions such as NSWS48 and NSWS50 and the two accessions with relatively low concentrations of anti-nutrients (NSWS33 and NSWS29) have been identified. Rrecombination of these accessions through hybridization and selection may result in improved and nutritionally acceptable African yam bean varieties. However, screening of larger germplasm has to be carried for the identification of more desirable genotypes.

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Table 1. Seed yield and other reproductive characters of nine African yam bean accessions.

Accessions	Days to flowering	Pod length (cm)	Seeds/pod	100 seed weight (g)	Seed yield/ plant (g)
SSSWN32	114b	28.00	17.33	25.30abc	69.69b
SSSWN44	107c	23.33	19.33	21.59cd	58.62bc
SSSWN48	106c	21.00	14.33	19.69d	118.33a
SSSWN33	107c	22.33	10.67	25.19abc	31.83cd
SSSWN50	104d	20.67	18.00	28.22a	105.14a
SSSWN3	113b	19.57	13.33	25.91ab	27.91d
SSSWN35	107c	26.83	15.33	27.07ab	24.79d
SSSWN15	118a	28.00	16.07	25.96ab	39.85cd
SSSWN29	115b	23.67	12.00	23.73bc	48.23bcd
Mean	110.07	23.71	15.22	24.74	58.26

Means in the same column followed by different letters are significantly different at 0.05 probability level.

Table 2. Nutrient contents of nine African yam bean accessions and cowpea (% DM).

Accessions	Protein	Fat	Fibre	Ash	Carbohydrate
SSSWN32	21.79f	4.02f	6.29e	7.05a	48.76de
SSSWN44	22.30e	4.82b	7.59b	6.85b	46.83h
SSSWN48	22.97c	4.40d	6.40d	5.78d	49.56c
SSSWN33	22.75d	4.02f	5.02g	4.21g	51.70b
SSSWN50	24.07a	5.20a	6.04f	6.30c	47.79fg

SSSWN3	22.38e	4.72c	8.02a	4.60f	48.27ef
SSSWN35	21.73f	3.93g	7.58b	7.02a	47.55g
SSSWN15	24.13a	4.15e	6.10f	5.27e	49.58cd
SSSWN29	23.84b	3.79h	6.51c	3.71h	49.18c
COWPEA	23.87b	1.50i	3.93h	3.80h	55.93a
Mean	22.98	4.06	6.35	5.46	49.52

Means in the same column followed by different letters are significantly different at 0.05 probability level.

Table 3. Anti-nutritional factors in nine African yam bean accessions and cowpea.

Accessions	Trypsin Inhibitor (Tiu/mg)	Phytate (g/100g)	Tannin (g/100g)
SSSWN32	32.90a	4.20a	7.67a
SSSWN44	31.58b	3.86c	7.45ab
SSSWN48	26.32e	3.98bc	6.90bc
SSSWN33	19.74h	3.54d	3.95d
SSSWN50	28.29d	3.91c	6.79bc
SSSWN3	28.95c	4.08b	7.83a
SSSWN35	31.58b	3.99bc	7.78a
SSSWN15	25.66f	4.04b	6.25c
SSSWN29	21.05g	3.44d	4.15d
COWPEA	12.05i	1.65e	2.85e
Mean	25.81	3.67	6.16

Means in the same column followed by different letters are significantly different at 0.05 probability level.