Sustainable Agriculture Research; Vol. 2, No. 1; 2013
ISSN 1927-050X E-ISSN 1927-0518
Published by Canadian Center of Science and Education

A Review on Genetic Resources, Diversity and Agronomy of African Yam Bean (*Sphenostylis stenocarpa* (Hochst. Ex A. Rich.) Harms): A Potential Future Food Crop

Adewale B. Daniel[1, 2] & Odoh N. Celestina[3]

[1] Genetic Resources Centre, International Institute of Tropical Agriculture, Ibadan, Nigeria

[2] Department of Plant Breeding and Seed Technology, University of Agriculture, Abeokuta, Nigeria

[3] Department of Soil Science, University of Abuja, Abuja, Nigeria

Correspondence: Adewale B. Daniel, Genetic Resources Centre, International Institute of Tropical Agriculture, Ibadan, Nigeria. Tel: 234-803-922-8085. E-mail: d.adewale@gmail.com

Received: May 29, 2012 Accepted: September 3, 2012 Online Published: October 10, 2012

doi:10.5539/sar.v2n1p32 URL: http://dx.doi.org/10.5539/sar.v2n1p32

Abstract

Food-security and sustainability is a serious global concern in the recent times. Many indigenous food crops of Africa which promises to ameliorate nutritional food insecurities are presently neglected and under-utilized. African yam bean (AYB) is one of such crop with tremendous nutritional potentials. The poor awareness about the taxonomy, agronomy, genetics, medicinal value and productive potential of the crop may be due to limited research on it. The subsistence production of the crop may have been occasioned by its poor acceptability as a valuable crop among middle-aged farmers in Africa. Research information on the crop is patchy in old and poorly accessible literature. There is an indisputable threat of irrecoverable loss of information on AYB especially in old archives. Some quality information on the crop was assembled from old books and proceedings, out-of print journals, pamphlets and recent publications. This review tried to congregate the bits and lumps of information on AYB research into a discrete summary which will create awareness about the future research needs on this crop.

Keywords: *Sphenostylis stenocarpa*, synonyms, taxonomy, genetic variability, genetic potentials, agronomy, research opportunities

1. Background

Adequate information is necessary in the course of proposing new research concepts. Information on most indigenous species is poor due to gross neglect over the years; such that in some cases, clues to most indigenous species have only been gotten through cultural hand-downs. Genetic resources of indigenous species are poorly conserved; therefore, most research on these species had depended on few landraces from the farmers and local markets. However, the genetic materials in farmer's hands (species irrespective) are those they (the farmers and local consumers) preferred; implying that some initially available cultivars may have been lost to selection pressure.

The diversity spectrum of most indigenous species has gradually been reducing in parts over time. Adewale et al. (2010) identified that most classification for AYB had been dependent on the seed coat colours and its pattern. Practically, classification based on phenotypic description has some deficient genetic information; hence, resultant conclusions may be undue and even misleading.

There are about fifty tuberous legumes of international significance; seventeen of them are of African origin (Saxon, 1981). These tuberous legumes may be used as food/feed, insecticide, medicine and flavouring agents. A thorough review of literature suggests that among the 17 tuberous legumes from Africa, AYB is most prominent in use.

In 1979, National Research Council (NRC) published a sketchy summary of information on AYB. However, most of research conducted during the past three decades, were especially on the nutritional aspect of the crop. Majority of the research information is in hard copies of old and out of-print journals which is inaccessible to users. Therefore, it is extremely important to systematically review and publish valuable available information on the crop. This effort will help to update the stakeholders about past research achievements, present status, constraints and way forward to get benefit from this natural blessing in the form of crop. The present review seeks to address this objective.

2. Taxonomy of *Sphenostylis stenocarpa*

Sphenostylis was the botanical genus evolved by Harms (1899) to describe a group of distinctive leguminous taxon formerly grouped within the genus *Dolichos* and *Vigna*. The generic name: *Sphenostylis* arose from a Greek word *sphen*, meaning wedge shape (Allen & Allen, 1981). Therefore, the genus *Sphenostylis* comprises a group of leguminous species with dorsiventrally cuneate style with flattened stigmatic tip (Milne-Redhead and Polhill, 1971). Former grouping within the two genera was because they were found to be closely related to them; hence most species in the genus *Sphenostylis* initially bears *Dolichus* and *Vigna* synonyms (Harms, 1899, 1911). From most recent update, *Nesphostylis* is the nearest sister genus to *Sphenostylis* because both genera have dorsiventrally cuneate and flattened style (Milne-Redhead & Polhill, 1971; Potter & Doyle, 1994); however, *Nesphostylis* is distinguished from *Sphenostylis* by the presence of aril onthe seed.

Sphenostylis is a small genus whose morphotype can be prostrate, climbing or erect. There are seven species within the genus; *Sphenostylis stenocarpa* is economically most important species (Potter, 1992). The taxonomic profile of African yam bean is presented as:

Kingdom- Plantae

Subkingdom - Tracheobionta

Super division - Spermatophyta

Division - Magnoliophyta

Class - Magnoliopsida

Subclass - Rosidae

Order - Fabales

Family - Fabaceae

Sub family - Papilionoideae

Tribe - Phaseoleae

Sub tribe - Phaseolinae

Genus - Sphenostylis E. Meyer

Species - *Sphenostylis stenocarpa* (Hochst. Ex. A. Rich.) Harms.

3. Synonyms of African Yam Bean

The six mostly occurring botanical synonyms of AYB in literature are: *Sphenostylis ornata* A. Chev., *Sphenostylis congensis* A. Chev., *Dolichos stenocarpus* Hochst. Ex. A. Rich., *Sphenostylis katangensis* (De Wild.) Harms, *Vigna katangensis* De Wild., *Vigna ornate* Welw. Ex. Baker. Some popular non-botanical synonyms of the crop includes: Yam pea and Tuber bean (English-Terrell et al., 1986; Rehm, 1994), Haricot igname and/or Pommedeterre du Mossi (French-Duke, 1981) and Afrikanische yam bohne and/or Knollenbohne (German - Rehm, 1994).

Some indigenous lingual synonyms for AYB in Africa according to Kay (1987) are: "Diegemtenguere" (Mali), "Girigiri" (Hausa, West Africa), "Norouko" and/or "Roya" (Sudan), "Okpududu" (Igbo, Nigeria) and "Sese" (Yoruba, Nigeria). There are many dialectical synonyms for AYB. Synonyms for AYB in Igbo (Nigeria) includes: "Akidi", "Azima" (Ohafia, Abia state, Nigeria), "Uzaaku" or "Ijiriji" (Nsukka, Enugu state, Nigeria; Asoiro and Ani, 2011). In the tribal tongue of the Yorubas in Nigeria, AYB is called:"Ewe" (Ijesha, Osun state, Nigeria), "Otiili" (Ekiti, Ekiti state, Nigeria), "Ekulu" (Ipe-Akoko, Ondo state, Nigeria), "Peu" (Ijebu, Ogun state, Nigeria),"Sunmunu" (Iseyin, Oyo state, Nigeria) etc. Some other tribal names for AYB in Nigeria are: "Ihiehie" (Ishan, Edo state, Nigeria), "Iye" (Estako, Local government, Edo state, Nigeria), "Ahuma" (Tiv, Benue state, Nigeria), "Nsama" (Efik-Ibibio, Akwa Ibom and Cross River state according to Edem et al. (1990)).

4. The Botany and Morphological Description of *Sphenostylis stenocarpa*

Sphenostylis stenocarpa is a vigorously climbing herbaceous vine whose height can reach 1.5-3 metres or more depending on the height of the stakes and cultivar. The main vine/stem may or may not be pigmented (Table 1). The crop produces many branches which also twine strongly on available stakes. The vegetative growing stage is noted with profound production of trifoliate leaves. The terminal leaflet length could be up to 14 cm long and 5 cm broad. Some quantitative descriptors are listed in Table 2.

Table 1. Qualitative descriptions of African yam bean

Qualitative agronomic features	**Levels of description**
Pod dehiscence	Shattering; Non-shattering
Splitting of testa of seeds	Absent; Present
Seed cavity ridges on pods	Absent; Present
Seed shapes	Round; Oval; Oblong; Rhomboid
Testa basal colour of seeds	White; Grey; Cream; Light brown; Reddish brown; Purple; Variegation with various marbling
Testa texture of seeds	Smooth; Rough; Wrinkle
Brilliance of seed	Matt; Medium; Shiny
Eye colour pattern of seeds	Fork-like structure below the hilum; Incision-like structure below the hilum; Vase-like structure around the hilum
Leaf colour	Pale green; Green; Dark green
Pigmentation of plant parts	Absent; Present
Intensity of pigmentation of plant part	Slight; Moderate; Extensive
Tuber production	Yes; No
Tuber shapes	Round; Oval; Spindle; Irregular
Tuber skin colour	Brownish-orange; Cream; Pink

*Source: Adewale (2011).

Table 2. Quantitative descriptions of African yam bean

S/N	**Agronomic characters**	**Minimum**	**Mean**	**SE**	**Maximum**
1	Days to seedling emergence [Days]	4.00	6.17	0.05	9.00
2	Days to peduncle initiation [Days]	51.00	61.48	0.54	72.60
3	Days to 50% flowering [Days]	77.00	95.35	0.44	127.00
4	Terminal leave length [cm]	7.19	9.30	0.09	17.89
5	Terminal leave width [cm]	2.09	3.76	0.05	8.71
6	Peduncle length [cm]	4.66	10.04	0.20	15.40
7	Petiole length [cm]	2.80	4.13	0.05	5.13
8	Pods per peduncle	1.00	1.89	0.03	4.00
9	Internode length [cm]	3.60	7.17	0.06	10.40
10	100 seed weight [g]	11.46	23.62	0.21	36.00
11	Seed volume [cm^3]	7.69	17.53	0.17	40.00
12	Pod length [cm]	12.70	22.81	0.15	30.64
13	Pod beak length [cm]	0.35	0.97	0.03	1.66
14	Seeds per pod	6.50	13.81	0.15	22.00
15	Locules per pod	8.00	16.39	0.15	26.00
16	Seed Weight pod [g]	1.13	3.34	0.05	7.70
17	Seed length [mm]	5.54	8.74	0.04	11.45
18	Seed width [mm]	4.91	6.46	0.03	7.59

19	Seed thickness [mm]	4.39	6.16	0.03	7.53
20	Seed length/width ratio	0.82	1.36	0.01	1.48
21	Seed width/thickness ratio	0.77	1.05	0.01	1.32
22	Seed length/thickness ratio	0.93	1.44	0.01	1.88
23	Pods per plant	14.00	28.33	0.95	101.80
24	Pod weight per plant [g]	21.33	158.47	5.38	597.53
25	Seed weight per plant [g]	19.74	101.98	4.02	466.70
26	Shelling percentage [%]	34.87	62.19	0.43	83.90
27	Grain yield per hectare [Kg]	114.84	1075.56	42.05	4875.17
28	Tuber yield [Kg]	8.38	95.48	8.32	336.68
29	Tuber weight [g]	3.44	28.45	1.86	80.04
30	Tubers per plant	1.20	3.20	0.10	5.00
31	Tuber length [cm]	8.30	12.69	0.21	16.20
32	Tuber width [cm]	7.20	11.63	0.27	18.00
33	Length/width ratio of tubers	0.81	1.12	0.02	1.45

* Sample size = 80 accessions.

*Source: Adewale (2011).

Four to ten flowers are arranged on long peduncles, which are usually on the primary and the secondary branches. Its inflorescence is raceme and exhibits acropetal mode of floral maturation (Adewale, 2011). The large and excellently attractive flowers blends pink with purple, the standard petals slightly twist backward on itself at anthesis. According to the observation of Popoola et al. (2011c) using 25 AYB accessions, the pollen grains had tricolporate, fenestrate and scabrate exine. They further noted that the pollen grain had three colpus which were characteristically large with window-like spaces lacking tectum. The pollen grains were single reticulate, slightly rounded without sharp corners, the spinous cover was interrupted by three protuberances (germpores) in a fixed geometrical pattern.

The flower seems to exhibit self-pollination; a peduncle can hold up to three or more pods. The usually linear and long unicarpel pods turn brown when matured. Pods may have flat or raised margin on both side. Most dried pods do dehisce along the dorsal and the ventral suture causing shattering and loss of seeds. However, Adewale (2011) observed variation in the shattering tendencies of dried pods of AYB.

Each pod can yield up to twenty seeds which may be rounded, oval, oblong or truncated (Milne-Redhead and Polhill, 1971; Adewale et al., 2012). The mat or shiny seeds can be mono-colored or mosaic. The prominent basal colours in AYB includes: white, grey, cream, light or dark brown, purple and black. The mosaic type has various modifications of speckling and varieties of colour mixtures (Table 1). There appear to be a number of 'types' according to seed colour (Oshodi et al., 1995). Moreover, considerable variation existed among seed sizes (Table 2).

The stem of the plant produces small underground tubers of various sizes and shapes (Adewale & Dumet, 2011). The tubers are very similar to sweet potatoes; its flesh is white and watery (Kay, 1987). There seem to be some evidence that yields of seeds and tubers are inversely related (Hutchinson & Dalziel, 1958; Milne-Redhead & Polhill, 1971; Dukes, 1981). An update research with the novel objective of understanding the assimilate partitioning pathway of the crop for biomass and agricultural yield is necessary to ascertain the above claim. Output from such study may provide primary information for breeding programme for specific varieties; such as grain, tuber or dual.

5. Cytogenetics of African Yam Bean

The genus *Sphenostylis* exhibits a diploid chromosomal set of 2n = 22 (Lackey, 1980). The somatic chromosome set for AYB according to Baudoin and Mergeai (2001) was 2n = 18. However, the 2n = 22 counts was reported for *Sphenostylis marginata* a sister species of *Sphenostylis stenocarpa* (Peter & Davidse, 1977). Most recently, Popoola et al. (2011b) and Adesoye and Nnadi (2011) confirmed that AYB exhibits diploid somatic chromosomal status. According to Popoola et al. (2011b), majority of AYB accessions had eleven bivalent (2n = 22) chromosomal status while an accession (TSs3) had the nine bivalent chromosomal status (2n = 18). The result of Adesoye and Nnadi (2011) indicated that the chromosome count ranged between 2n = 20 to 24 with 2n = 22 being the most frequent. Summarily, four bivalent chromosomal status (2n = 18, 20, 22 and 24) are identifiable in AYB. The sizes of the chromosomes of AYB were generally small in size (Popoola et al., 2011b; Adesoye & Nnadi, 2011) ranging between 0.58 to 1.84 µm. While the above information seems to ascertain prevalent genetic potentialities within the species, it equally submits the cytology of the crop to further investigation.

6. Geographical Distribution and Wide Adaptability of African Yam Bean

AYB tolerates wide geographical, climatic and edaphic ecologies. The stretch of the environment where it thrives lie within the latitudes of 15º North to 15º South and the longitudes of 15º West to 40º East of Africa (Adewale et al., 2008). There is no record of the origin of the crop in any other continent except Africa (Potter & Doyle, 1992; Potter & Doyle, 1994). Hence, the above geographical catchments could be referred to as the centre of diversity of AYB (Figure 1). This confirms the common claim that the crop is a tropical African legume.

Figure 1. The centre of diversity for African yam bean

Source: http://www.zipcodezoo.com/Plants/S/Sphenostylis%5Fstenocarpa/Default.asp (September 22, 2009).

The centre of diversity of AYB was presented by Germplasm Resources Information Network [GRIN]. GRIN (2009) presented the regional demarcation as: Northeast tropical Africa (i.e. Chad and Ethiopia), East tropical Africa (i.e. Kenya, Tanzania and Uganda), West-Central tropical Africa (i.e. Burundi, Central African Republic and Zaire), West tropical Africa (i.e. Cote d'Ivoire, Ghana, Guinea, Mali, Niger, Nigeria and Togo) and South tropical Africa (i.e. Angola, Malawi, Zambia and Zimbabwe).

Nigeria is prominent for AYB production among other countries of Africa (Figure 2); the contrary opinion of Abbey and Berezi (1988) and Alozie et al. (2009) on the major growing/producing area of the crop within Nigeria notwithstanding. AYB cultivation extends from the southern states of Nigeria to the north of the country (Adewale et al., 2008). The cultivation of AYB is localized around Nkwanta and Ho-West districts of the Volta region of Ghana (Amoatey et al., 2000; Klu et al., 2001).

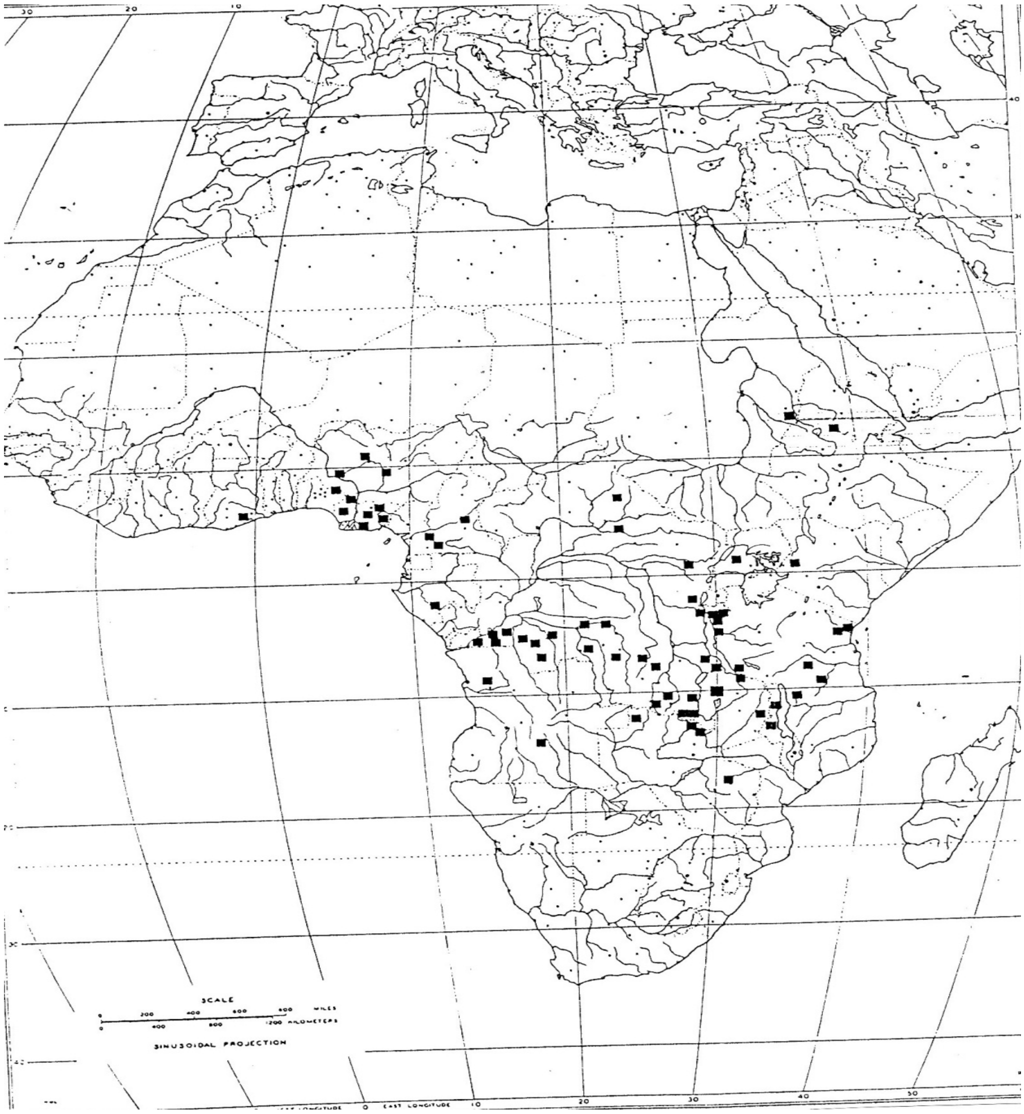

Figure 2. Distribution of African yam bean in Africa

Source: Potter and Doyle (1992).

The suitability of AYB for the diverse ecologies (Anochili, 1984; Schippers, 2000; Betche et al., 2005) suggests that it can potentially serve as an important crop for food security since it can tolerate varied soil and climatic conditions. This quality confers on it an ecological advantage over most conventional legumes. Contrary to the remark of Klu et al. (2001) on the nearness of the crop to extinction, the ability of the crop to survive in diverse agro ecological conditions of Africa must have aided its continual existence over times. Presently in Ghana and Nigeria, there is a dwindling interest in the production of AYB among the farmers (Amoatey et al., 2000; Olisa et al., 2010). Only a very small sector of the farmers appreciates its cultivation, hence, they are the holder of the crop's genetic resources (Adewale et al., 2012).

7. Intra-specific Variability and Diversity within African Yam Bean

According to Adewale and Dumet (2009), the continual availability of the genetic resources of the crop is threatened and the cultivation of the crop may further decline due to continued neglect and underutilization. Wide exploration of AYB's genetic resources in Africa will provide assurance of its future genetic improvement (Adewale et al., 2011).

Seed length, width, thickness and their ratio significantly differentiated among 80 accessions of AYB (Adewale et al., 2010). For all the genotypes tested, the seed length was longer than the width and thickness but the difference between seed width and thickness was not consistent. Reliable and predictable relationship existed between the seed length, width and thickness. The three metric measurements on AYB seeds were equally very important in the seed shape determination of the crop (Adewale et al., 2010). Kay (1987) remarked that the tuber shape of AYB was only spindle-like. The tuber shapes of AYB as observed by Adewale (2011) and Adewale and Dumet (2011) varied and included round, oval, spindle and irregular. Results from phenotypic evaluation of small (≤ ten) to large (≥ 30) number of accessions of AYB revealed wide intra-specific variability for some agro-morphological variables (Potter, 1992; Ene-Obong & Okoye, 1992; Akande, 2009; Adewale et al., 2010, Popoola et al., 2011a; Adewale et al., 2012).

AYB samples significantly differed in the proximate fractions of the seeds (Adeyeye et al., 1999). Significant differences were observed in the crude protein fractions, percentage ash fraction, nitrogen-free extract, crude fibre, carbohydrate content (Ameh, 2007) and fatty acid content (Adeyeye et al., 1999). Lectin extract differed significantly among two accessions of AYB (Okeola et al., 2002). The result from the study of the anti-nutritional factor content in three varieties of AYB revealed that significant ($P < 0.05$) differences exist among the genotypes for anti-nutritional factors especially for cyanogenic glycosides (Betche et al., 2005). The range of protein and starch content in AYB (Betche et al., 2005) was 22-25 g 100 $g^{-1}$and 42-47 g 100 g^{-1}, respectively.

The application of molecular tools to unravel intra-specific diversity of the crop had been notably experimented by Moyib et al. (2008), using Random Amplified Polymorphic DNA (RAPD) technique and Adewale (2011), using Amplified Fragment Length Polymorphism (AFLP) technique. While two RAPD primers assessed diversity in 24 AYB accessions from Nigeria (Moyib et al., 2008), five AFLP primers revealed the genetic diversity among 80 AYB accessions from Nigeria and other countries (Adewale, 2011). The diversity in AYB by RAPD and AFLP techniques did not show any clear-cut eco-geographical demarcation, suggesting that environmental mutation among the accessions of AYB was low. The inherent stability of the crop across wide environment deserves further investigation and exploitation.

8. Agronomy of African Yam Bean

Planting of AYB usually starts when the rain had stabilized; between May to July, in Ghana and Nigeria (Klu et al., 2001; Okpara & Omaliko, 1995). Two to three seeds are sown at the base of the heaps of major crops. Traditionally in Nigeria and Ghana, AYB is grown as a minor crop in mixed association with crops especially, yam and cassava (Amoatey et al., 2000; Saka et al., 2007). Sole cropping of AYB is rare; it is usually planted along with yams to share the same stake for support (Amoatey et al., 2000; Ibeawuchi et al., 2007). Scarification is not a practice to aid imbibition before germination in AYB despite the hardness of the seed (Olisa et al., 2010). AYB exhibits hypogeal germination (Adewale, 2011) which occurs between the fourth and the seventh day after planting.

AYB performs better when intercropped than when grown as sole crop (Kay, 1987; Baudoin & Mergeai, 2001; Saka et al., 2007; Adeniyan et al., 2007). However, the research finding of Ibeawuchi et al. (2007) was contrary; they obtained significantly higher grain yield from AYB when planted under sole cropping system. This could justifiably be due to the lack of competition for the necessary growth resources from other crops; hence, there is a promising commercial production of the crop.

Optimum plant and row to row spacing for AYB varies considerably. There is no report in literature of any recommended spacing for AYB under sole cropping. Most workers have therefore used the planting distance of most principal crops, e.g yam, cassava etc. to which AYB is usually intercropped. The plant population of 24 200 plants/ha produced a range of 3461-3872 kg/ha grain yield from some cultivars (Kay, 1987). The multilocational trial of 30 accessions of AYB evaluated at the spacing of 1m x 1m by Adewale (2011) gave a grain yield range of 248-4,130.46 kg/ha.

Inoculation of AYB with compatible rhizobial strains could possibly prevent the use of supplementary fertilizer (Oganale, 2009). AYB like every other legume can derive adequate nitrogen through atmospheric fixation (Assefa & Kleiner, 1997). Oganale (2009) described the crop as a profuse nodulator with some *Rhizobium,* strains. He remarked that the AYB landraces studied obtained 79.0-97.6% of their nitrogen from the atmosphere and the growth of the inoculated plants increased by up to 1547%.

Some of the quantitative traits of AYB had plastic response to fertilizer application. Fertilizer application improved the yield and yield components and some vegetative parameters of AYB. The values of most of the yield parameters increased with increasing level of NPK fertilizers up to 60 Kg/ha, however yield and other responses declined with the further increase of NPK dosage (Togun & Olatunde, 1998). Olaposi and Adarabioyo

(2010) obtained the highest number of flowers with the application 60 Kg ha^{-1} NPK fertilizer. This suggests that 60Kg/ha NPK fertilizer treatment favoured AYB production.

Phosphate application greatly enhanced grain yield and other yield parameters of AYB (Ikhajiagbe et al., 2009). The result of the factorial combination of Nitrogen, Phosphorus and staking levels by Okpara and Omaliko (1995) revealed that staking (among other factors) is a very important cultural practice for harvesting optimum grain yield of AYB. Information on the response of different cultivars to agronomic treatments for tuber yield evaluation is rare in literature. The low consideration of this second economic product of AYB in research could probably be due to its non-use in the meal of the West Africans.

9. Pests and Diseases of African Yam Bean

Many workers (Okigbo, 1973; Kay, 1987; Ameh & Okezie, 2005; Agu, 2008) have identified some pests and diseases attack on field planted AYB. The pests identified can be classified into two categories with reference to the stages of the crop's development namely vegetative stage pests and the reproductive stage pests. The larvae and/or adults of cutworms (*Agrotis spp*), aphids (*Aphis craccivora*), grasshopper (*Zonocerus variegatus*), *Maruca testulalis, Cydia ptychora* and leaf-rolling caterpillars (*Sylepta derogate*) attack AYB at the vegetative stage. *Cydia ptychora, Heliothis armigera, Riptortus dentipes, Apion varium* and *Nezara viridula* were identified on the crop at the reproductive stage (Ameh & Okezie, 2005). The list of some disease causing pathogens of AYB includes; *Oidium spp, Phoma spp* and *Aecidium spp.* They have been identified as effective pathogens causing powdery mildew, leaf spot and stem rust respectively. Wilting leaf mosaic and root gall have equally been identified as diseases in AYB (Kay, 1987; Ameh & Okezie, 2005; Agu, 2008).

10. Biochemical Control Strategy for Some Economic Pests of Legumes

Dukes (1981) reported that AYB was less susceptible to pests and diseases. The inherent lectin in the seeds could be implicated for this quality. AYB lectin is insecticidal to *Callosobruchus maculatus* and obviously toxic to *Clavigralla tomentosicollis* (Omitogun et al., 1999; Okeola & Machuka, 2001). Omitogun et al. (1999) had reported that crude lectin extract from AYB was toxic to *C. maculatus* and *C. tomentosicollis* at 5% (w/w). The physiological system of *C. tomentosicollis* was found to be very vulnerable to the lectin in AYB (Okeola & Machuka, 2001). Okeola et al. (2002) isolated and found that the lectin in AYB is a tetrameric protein of about 122 kDa size. The tetrameric nature of AYB lectin was similar to that of *Glycine max* (Soybean) and *Phaseolus vulgaris* (Red kidney bean) having four subunits with molecular weight of 115-140 and 120 kDa, respectively (Sharon, 1973, cited in Okeola et al., 2002). The insecticidal properties of three levels (0.2, 2.0 and 5.0% dietary lectin) of the isolated purified galactose-specific lectins from AYB were studied against two major cowpea pests: the cowpea weevil (*C. maculatus* (Coleoptera: Bruchidae)) and a pod-sucking bug (*C. tomentosicollis*). According to Okeola et al. (2002), larvae mortality of *C. maculatus* ranged from 30 to 88% and nymphal mortality of *C. tomentosicollis* ranged from 76 to 81%. Higher concentration of the lectin progressively led to higher mortality of the larvae and the nymph of *C. maculatus* and *C. tomentosicollis,* respectively. Therefore, the lectin in the seed of AYB is a promising source of a biologically potent insecticide against economic field and storage pests of most leguminous crops.

11. Towards Better Acceptability of African Yam Bean for Cultivation

According to Klu et al. (2001) the level of attention on the crop compared to other major crops by farmers' could provide an inference to the level of its neglect and underutilization. In most cases, it is a minor crop with no special care. In addition, the demand for trellises or stakes to support the crop plants appears to be a major obstacle/challenge to the increased cultivation of the crop. Staking and stem training are laborious practices which most farmers would prefer to avoid. Non-staking and wrong directional (i.e. anti-clockwise) stem training on stakes could drastically reduce the grain yield of the crop. Breeding to generate varieties with improved architecture (needing no stakes) may enhance its attraction to cultivation. Such development may be amiable to enhance the practice of sole cropping of the crop for commercial production.

Devos et al. (1980) stressed that the danger of losing essential germplasm hangs over all cultivated food crop species in tropical Africa, especially those not receiving research attention. The need to capture a high percentage of the genetic diversity of the species to be improved is fundamental to a good breeding programme. A launch for full exploration to collect and conserve AYB genetic resources in Africa is inevitable. While this will lead to the conservation of the crop's genetic resources, it will equally save the genetic resources of the species.

Long gestation period and the photoperiodic sensitivity of the crop, as hinted by Okpara and Omaliko (1995) could be responsible for its production once in a year. The essence may have enhanced the comparative advantage of other food legumes with shorter maturity period above AYB for acceptability in cultivation and production. The five to seven months duration to reach pod formation and/or tuber maturation after planting is pretty long. Mutation breeding could lead to the evolvement of genotypes with shorter maturation periods. The mutants could serve as parental stock for composite breeding programme with higher grain producing genotypes. Understanding the physiology, assimilate partitioning pattern, differential harvest index of the two economic products (grain and tuber) could present further challenge s to the breeders to produce varieties (e.g. high grain and tuber-yield). Moreover, there is the need for a large scale implementation of the research output of Omitogun et al. (1999), Okeola and Machuka (2001) and Okeola et al. (2002); leading to the commercial isolation of lectin from AYB to combat some of the economic pests of legumes. The suggestion of AYB by Asseffa and Kleiner (1997) as a probable option for land reclamation (due to its high nodulation capacity) and its remarked hardiness and wide adaptability (Schippers, 2000) may be added qualifications of this crop species for better utility.

Acknowledgement

The authors wish to appreciate the staff of the Genetic Resources Centre, International Institute of Tropical Agriculture (IITA), Ibadan for the assistance received by the first author in the centre during his doctoral fellowship. We also acknowledged the anonymous reviewers of this paper for their useful comments.

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