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Factors Affecting Production and Consumption of African Yam Bean (*Sphenostylisstenocarpa*Hochst. Ex. A. Rich) Harms) in South-East Agro-ecological Zone of Nigeria

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Abstract
The study assessed factors affecting production and consumption of African yam bean, identified the socio-economic characteristics of the respondents, assessed factor affecting their production, and consumption of AYB and then identified factors affecting the adoption of African Yam Bean technologies in Imo and Enugu states. All the objectives were achieved using simple descriptive statistics such as percentages, frequencies and means. Mean score were determined using likert point scale measurement. The result revealed that African Yam Bean is cultivated majorly by women and middle aged farmers who are still within their productive age with high level of farming experience in the studied locations. Meanwhile, only a few of the farmers belonged to a cooperative societies of farmers organizations in Imo state while majority of the farmers belonged to farmers organization in Enugu state. Below revealed the factors affecting production of African Yam Bean to include high yielding ($\bar{x}$= 4.7); early maturing ($\bar{x}$=4.2); resistant to disease ($\bar{x}$= 4.1); soil selection ($\bar{x}$=4.0); drought tolerant ($\bar{x}$=4.2); ability to maintain its colour over time ($\bar{x}$=4.0); high nutritious value ($\bar{x}$=5.0); accessibility ($\bar{x}$=3.8); affordability ($\bar{x}$=4.7); complexity ($\bar{x}$=3.6); and compatibility ($\bar{x}$=3.8). Also, factors influencing African Yam Bean technology in the studied area which include high nutrient content ($\bar{x}$=5.0); simple to process ($\bar{x}$=3.6); palatability ($\bar{x}$=4.6); less expensive ($\bar{x}$=4.5); high markatebility ($\bar{x}$=3.9); high economic value ($\bar{x}$=4.6); durability ($\bar{x}$=4.5); health benefits ($\bar{x}$=4.7); and it is demand driven ($\bar{x}$=4.3).
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INTRODUCTION

African yam bean (*Sphenostylisstenocarpa*Hochst. Ex. A. Rich) Harms) is a legume, native to tropical Africa,of fabaceae family (Adewale 2010)and the most valuable species in the genus *Sphenostylis* (Potter, and Doyle 1992). It is an annual crop that is cultivated for its nutritious edible seeds and tubers [5]. Afolabi *et al.* (2019) cited Okpara and Omaliko (1997) that poor rural dwellers in Nigeria recognized AYB as a food substitute during the famine period. AYB tolerates wide geographical, climatic and edaphic ecologies and produces appreciable yield more than most of other pulses on poor soil and in hot climate. It is an annual legume and has a pattern of growth similar to those of other grain legumes. The crop can withstand unfavorable climatic conditions such as prolonged drought periods, this makes it a good source of cheap plant protein in addressing the problems of climate change that persist. The crop tubers can be roasted, fried, or cooked and eaten like yam and potato. The tuber flavor is like that of potatoes . The tubers from AYB can be store for a longer period without any form of spoilage due to microbial action as a result of its low moisture content of about 10.3%. Various researchers have reported the nutritional potential of the crop to supplement most food that lacks essential nutrients that were consumed by the poor in underdeveloped and developing nations. Both wild and cultivated types are grown in tropical Africa as far as Egypt (sub-tropical) and also throughout West and southern Africa (Busson, 2001).It is widely grown and known in low-input agricultural systems practiced in those African countries. It is an important orphan crop, highly nutritious and culturally resonant (Adewale, and Dumet, 2011). African yam bean (AYB) is a key commodity for improving nutrition security, as it is an inexpensive source of protein and other nutrients in tropical Africa but highly underutilized. The legume has long been used as a traditional dual seed and tuber food crop in Africa; it plays an integral role in the cultures of Central and Western Africa and believed to have traditional medicinal values (Adewale, and Dumet, 2011).

In Nigeria, AYB is cultivated for seed and grown for tubers in other African countries like Coted'Ivoire, Ghana, Togo, Cameroon, Gabon, Democratic Republic of Congo, Ethiopia, Parts of East Africa, Malawi and Zimbabwe. Nutritionally, AYB is a cheaper source of protein compared to animal protein and has the potential to meet the increasing protein demands of the teeming population of sub- Saharan Africa if grown in large quantities. At around 19%, the protein content of AYB tubers are higher than those of sweet potato, yam and cassava while the protein content of the seed compares favourably with those found in seed grains.It contains approximately 50% carbohydrate (Adesoye, and Nnadi 2015). Also, the seed is high in vitamin C, dietary fibre, Vitamin B6, Potassium, and manganese but low in sodium, saturated fat and cholesterol (Okigbo 1973). AYB products generally have a lower glycemic index than other legume products which make them to provide a more sustained form of energy compared to other legumes (Busson, 2001).Milk production in lactating mothers are believed to enhanced by drinking water drained from boiled AYB seeds. Dry pods are also used to feed livestock (Klu, 2001)

In addition to the use of AYB as food and feed for livestock, its leaf litter serves as a good source of material for improvement of soil Measurement and evidence characteristics. It nodulates profusely and has the ability to fix nitrogen thereby helping to replenish soil nitrogen. Thus this indigenous crop has huge potentials for food and nutrition security in Africa

According to Gbenga (2020) plant food serves as a major source of key nutrients that the larger part of the global population and their livestock have access to. These plant foods are cheaper, affordable, and readily available compare to other sources of food. Unfortunately, in Africa, some of the plants that would have helped to broaden the food base for humans and the livestock have been ignored and under-utilized to the extent that some are on their way to extinction (Abdulkareem 2015). AYB is one of such crops that are on the track of extinction because it has been neglected and underutilized by farmers, consumers, and crop scientists (Gbenga 2020). One of the strategies to boost food production and feed availability to enhance food security is by reviving such crop species that are becoming extinct due to their declining cultivation and utilization.

Africa yam bean has the potential to combat the challenges of food and nutritional insecurity, and widen the food and feed products base for both human and livestock consumption if the crop is commercialized and is given research attention for its improvement [Oagile 2007, WHO 2002]. According to Saxon, (1998) tuberous legumes are of African origin which is used for food and feed, flouring agent, medicine, and other purposes. A review of the literature indicated that the AYB is the most important and economical of the seventeen tuberous legumes that are of Africa origin (Adewale 2013).

However, in order to revive the production and utilization of AYB, it is pertinent to identify the socio-economic characteristics of the farmers and other stakeholders in the value chain and the impact of these factors on production, consumption. and adoption of AYB technologies. Such socio-economic studies help to illuminate the underlying reasons for stakeholder's preferences and serve as guides to breeders in developing populations with preferred traits that addresses demand profiles. This study was carried out in Imo State to assess the factors affecting the production and consumption of AYB with a view to unraveling the preferred traits for incorporation into breeding populations in order to enhance the contribution of AYB to food and nutrient security in Nigeria.

Materials and method

This study was carried out in Imo and Enugu States. Imo State has a population of 3,934,899, total area of 5,530km2, and a population density of 710 persons per square kilometer (NPC 2007). The population is predominantly rural. TheState lies within latitudes 40 45'N and 70 15'N, and longitude 60 50'E and 70 25'E, and occupies the area between the lower River Niger and the upper and middle Imo River. Imo State is bounded on the east by Abia State, on the west by the River Niger and Delta State, and on the north by Anambra State, while Rivers State lies to the south. Agriculture is the major occupation of the people. The major food produce include; cassava, yam, cocoyam, maize, African yam bean and melon. Cash crops produced in Imo State include oil palm and rubber. Economic trees like the iroko, mahogany, obeche, gmelina, bamboo,rubber and oil palm predominate. But due to high population density, most of the State has been so farmedand degraded that the original vegetation has disappeared. Thus farmers are forced into marginal lands, a situation aggravated by the rising demand for fuel wood. Deforestation has triggered off acute soil erosion, especially in the Okigwe and Orlu axis. The State is also endowed with mineral resources such as petroleum, kaolin, limestone etc. Imo State is made up of 27 Local Government Areas (LGAs) and three senatorial zones; Okigwe, Owerri and Orlu.

Enugu State is one of the five States in South eastern Nigeria. The State lies between latitude 50 56'N and 70 06' N and longitude 60 53' E and 70 55'E, occupying a land area of about 802,295km2 and has a population of 2.5 million, with a population density of 248 persons per square kilometre [NPC 1996, Ezike 1998]. It is

characterised by small farm holdings with yam and cassava as the dominant crop. Enugu State comprises 17 Local Government Areas (LGAs) divided into three agricultural zones, namely Awgu, Enugu and Nsukka.

Purposive and random sampling techniques were used. The first was the purposive selection of the two agricultural zones from each state, because of their relevance in African yam bean production. Three (3) Local Government Areas (LGAs) were randomly selected from each of the zones in the states. Then two rural communities were randomly selected from each of the selected LGAs and then five (5) AYB farmers were purposively selected from the communities through snow balling technique (snow balling is a technique through which respondents are identified by previously assessed respondent(s), that is, you need to identify a respondent and then he leads you to another and then the ball continues).This gave a sample size of 120 respondents. Primary data were collected using semi-structured questionnaire.

All the objectives were achieved using simple descriptive statistics such as percentages, frequencies and means. For objective 2, 4 and 5, Five point and four point likert-type scale were used to generate mean. The responses were categorized as strongly agreed (5), agree (4), undecided (3), disagree (2) and strongly disagree (1). The bench mark was established thus; 5+4+3+2+1=15/5=3. Therefore, the bench mark is 3. This implies that any mean score up to 3 and above is accepted and any mean score below 3 is rejected. For objective 3, four point likert-type scale were used to generate mean, the responses were categorized as always (4), often (3), rarely (2) and never (1). The bench mark was established thus; 4+3+2+1=10/4=2.5. Therefore, the bench mark is 2.5. This implies that any mean score up to 2.5 and above is accepted and any mean score below 2.5 is rejected.

Results and Discussions

Socio-Economic Background (N=120)

	IMO (N=120)		ENUGU (N=120)	
Variables	**Frequencies**	**Percentages**	**Frequencies**	**Percentages**
Sex				
Male	36	60	18	30
Female	24	40	42	70
Age				
20-30			6	10
31-40	18	30	30	50
41-50	24	40	18	30
51-60	18	30	6	10
Marital status				
Single	12	20	18	30
Married	48	80	30	50
Widowed	-	-	12	20
Household Size				
1-3	-	-	12	20
4-6	42	70	36	60
7-9	18	30	12	20
Religion				
Christianity	54	90	48	80
Traditional	6	10	12	20
Level of Education				
primary school	6	10	18	30
secondary school	48	80	30	50
Tertiary	6	10	12	20
Farming Experience				
1-10 years	30	50	46	77
11-20 years	6	10	8	13
21-30	18	30	6	10
31-40	6	10		
Cooperative Society				
Yes	24	40	42	70
No	36	60	18	30
Farm size				
1 acre	36	60	32	53
2-3 acres	18	30	12	20
4-5 acres	6	10	16	**27**
Reasons for cultivation				
No reason	-	-	-	-
Pleasure	9	15	8	13
Prestige	10	16	10	17
Income	21	35	19	31
Nutritional value	20	34	23	39
Income				
10,000-20,000	36	60	24	40

21,000-30,000	18	30	18	30
31,000-40,000	6	10	18	30
Farm Credit				
very easy	24	40	39	65
Hardly	36	60	21	35
Extension Activities				
very often	30	50	18	30
Rarely	18	30	28	47
Never	12	20	14	23
Production Level				
Below 100kg	18	30	22	37
101-300kg	30	50	29	49
301-500kg	12	20	9	14
Quantity sold				
Larger quantity is consume	18	30	14	23
Lesser quantity is come	36	60	29	48
Equal quantity of consumption	6	10	17	29

The socioeconomic characteristics of the AYB farmers in Imo and Enugu states were presented in table 1.

The result presented in Table 1 above revealed that 60% of the sample population was female. Majority of the farmers (70%) were within the age bracket of 41-50 followed by the age bracket of 31-40. 80% of the sampled farmers were married with household size of mostly 4-6 (70%) and majorly Christian (90%). Christianity is the domineering religion in the study area. All the farmers have had one form of formal education of the other with majority of the farmers (80%) attaining up to secondary education. A good majority of the farmers (60%) have been in farming for about 11years and above. Furthermore, the result revealed that the farmers sampled are mostly small scale farmers with farm sizes of 1acre (60%) and 2-3 acres (30%). Nutritional value of African Yam Bean could be the reason most farmers produce African Yam Bean as indicated by 40% of the respondents and other reasons include pleasure (30%) and prestige (20%). About 60% of the farmers made income between 10,000 to 20,000 naira from the production and sales of African Yam Bean while about 30% made up to 21,000 to 30,000 thousand naira from the same venture. The respondents affirmed that they had regular extension contact (50%) with production level ranging between 101kg to 300kg per year respectively, though 30% of the respondent produce less than 100kg while 20% produce above 301kg.

For Enugu state, the result showed that 70% of the sample population were female.. Majority of the farmers (70%) were within the age bracket of 41-50 followed by the age bracket of 31-40. Halve of (50%) the sampled farmers were married with household size of mostly 4-6 (60%) and majorly Christian (80%). 80% of the farmers have had one form of formal education of the other but majority (40%) of them had only secondary education. 70% of the respondents have been in farming for over 11 years and majority (70%) of the farmers belonged to a cooperative societies or farmers organizations. They are mostly small scale farmers with farm sizes of 1acre (80%). The result revealed that AYB was cultivated for the major reason of consumption (40%), others include pleasure (20%) and prestige (20%). 60% of the farmers made income of between 10,000 to 20,000 naira from the production and sales of AYB while about 30% made up to 21,000 to 30,000 thousand naira from the same venture. The respondents affirmed that they had regular extension contact (60%) with production level ranging between 101kg to 300kg per year (40%), though 30% of the respondent produce less than 100kg while 30% produce above 301kg.

This means that majority of the respondents had farmed long enough and should be able to provide necessary information on farming and other value chain/addition activities that they carry out. It also implies that African Yam Bean is cultivated majorly by women in the studied location. And that it is majorly cultivated by middle aged farmers who are still within their productive age with high level of farming experience. Meanwhile, only a few of the farmers belonged to a cooperative societies of farmers organizations in Imo state while a good number of the belonged to farmers organization in Enugu state. Christianity is the domineering religion in the study area. This finding is in conformity with (Klu, 2001) who reported that there is no gender bias in the cultivation of African yam bean.

Factors Affecting Production of AYB in Imo and Enugu States (N=120)

Factors	SA	A	UN	D	SD	Mean	Decision
High yielding	42(70)	18(30)	0	0	0	4.7	Accept
Early Maturing	12(20)	48(80)	0	0	0	4.2	Accept
Resistant to disease	18(30)	30(50)	12(20)	0	1(10)	4.1	Accept
Soil selection	18(30)	24(40)	18(30)	0	0	4	Accept
Drought tolerant	24(40)	30(50)	0	6(10)	0	4.2	Accept
It easily decays	0	6(10)	24(40)	0	30(50)	1.9	Reject
It maintains the colour	6(10)	48(80)	6(10)	0	0	4	Accept
Highly nutritious	60(100)	0	0	0	0	5	Accept
Selects soil	6(10)	36(60)	12(20)	0	6(10)	3.5	Accept
Accessibility	0	48(80)	12(20)	0	0	3.8	Accept
Affordability	42(70)	18(30)	0	0	0	4.7	Accept
Complexity	12(20)	12(20)	36(60)	0	0	3.6	Accept
Compatibility	0	48(80)	12(20)	0	0	3.8	Accept

SOURCE: Field survey 2021

SA: Strongly Agree; A: Agree; UN: Undecided; D: Disagree; SD: Strongly Disagree

The result above revealed the factors affecting production of African Yam Bean to include high yielding ($\bar{x}$= 4.7); early maturing ($\bar{x}$=4.2); resistant to disease ($\bar{x}$= 4.1); soil selection ($\bar{x}$=4.0); drought tolerant ($\bar{x}$=4.2); ability to maintain its colour over time ($\bar{x}$=4.0); high nutritious value ($\bar{x}$=5.0); accessibility ($\bar{x}$=3.8); affordability ($\bar{x}$=4.7); complexity ($\bar{x}$=3.6); and compatibility ($\bar{x}$=3.8). The result also showed that African Yam Bean decays easily ($\bar{x}$=1.9) which is a factor that can limit its production in large quantities. African yam bean production in most of this area are generally facing challenges of low yield (Adewale and Dumet 2011), long cooking time (Adewale 2010), narrow genetic base and susceptibility to insect- pest attack. AYB also modulates profusely and probably has very high ability to fix nitrogen, thereby helping to replenish soil nitrogen. It is therefore an important crop which merits significant consideration for land reclamation. AYB is highly adapted to a wide range of soils. It can grow and performed reasonably on acid and leached sandy soil [Potter 1992]. According to Obiagwu [1995], the use of AYB does not only increase the soil nitrogen content in the soil by fixing atmospheric nitrogen in the soil but also increases the soil organic matter. Different research findings have reported the contributions of AYB nodulation to soil and crop productivity. Okpara and Omaliko [1995] intercrop AYB with yellow yam (*Dioscorea cayensis*) while Obiagwu [1995] also intercrop it with maize, yam, and cassava. The yield obtained in all the crops intercrop with AYB by the researchers was significantly increased in all the cases. The increase in yield was attributed to AYB capability of forming a nitrogen-fixing symbiosis with *Rhizobium.*

Other factors include characteristic hardness of the seed coat (Ene-Obong and Okoye 2007) which makes a high demand on the cost and time of cooking, agronomic demand for stakes and the long maturation period, presence of anti-nutritional factors (ANF) or secondary metabolites as well as biotic factor like insect infestation.

Consumption of African Yam Bean (N=120)

CF	A	OC	RC	NC	Mean	Decision
Consume AYB only	48(40)	36(30)	12(10)		2.7	Accept
Consume AYB with oil	6(10)	48(80)	0	6(10)	2.9	Accept
Consume AYB with maize	18(30)	42(70)	0	0	3.3	Accept
Consume AYB with Abacha/Nsisa	12(20)	18(30)	30(50)	0	2.7	Accept
Consume AYB with yam	48(80)	12(20)	0	0	3.8	Accept
In any form	0	12(20)	24(40)	36(60)	2.0	Reject

SOURCE: Field survey 2021

A: Always: OC: Often Consumed: RC: Rarely Consumed; NC: Not Consumed

The result revealed that African Yam Bean is consumed or eaten alone ($\bar{x}$=2.7); eaten with oil ($\bar{x}$=2.9); eaten with maize ($\bar{x}$=2.9); eaten with Abacha/Nsisa ($\bar{x}$=2.7); and is also eaten with yam ($\bar{x}$=3.8). This implies that African Yam Bean can be consumed or eaten in any with varieties of other food. This explains why it is being cultivated for its nutritious value.

According to (Klu 2001) the AYB is an annual crop that is cultivated for its nutritious edible seeds and tubers. Afolabi*et al.* (Afolabia, Ogunsanyaa and Lawal 2019) cited Okpara and Omaliko (1997) that poor rural dwellers in Nigeria recognized AYB as a food substitute during the famine period.

Africa yam bean has the potential to combat the challenges of food and nutritional insecurity, and widen the food and feed products base for both human and livestock consumption if the crop is commercialized and is given research attention for its improvement (Oagile 2007; WHO 2002).

FACTORS AFFECTING CONSUMPTION OF AYB (N=120)

Factors	SA	A	UN	D	SD	Mean	Decision
Highly nutritious	120(100)	0	0	0	0	5	Accept
Simple to process	0	84(70)	24(20)	12(10)	0	3.6	Accept
It is palatable	72(60)	48(40)	0	0	0	4.6	Accept
Not expensive	60(50)	60(50)	0	0	0	4.5	Accept
Highly marketable	48(40)	72(60)	0	0	0	3.9	Accept
Highly economical	36(30)	72(60)	0	0	0	4.6	Accept
Does not spoil easily	60(50)	60(50)	0	0	0	4.5	Accept
Has health benefits	84(70)	36(30)	0	0	0	4.7	Accept
Demand driven	36(30)	84(70)	0	0	0	4.3	Accept

SOURCE: Field survey 2021

SA: Strongly Agree; A: Agree; UN: Undecided; D: Disagree; SD: Strongly Disagree

The following were ascertained as the factors influencing African Yam Bean technology in the studied area. They include high nutrient content ($\bar{x}$=5.0); simple to process ($\bar{x}$=3.6); palatability ($\bar{x}$=4.6); less expensive ($\bar{x}$=4.5); high markatebility ($\bar{x}$=3.9); high economic value ($\bar{x}$=4.6); durability ($\bar{x}$=4.5); health benefits ($\bar{x}$=4.7); and it is demand driven ($\bar{x}$=4.3). The result is in agreement with the findings of [6] that seed is high in protein content (up to 19% in the tubers which is about 2.5 times the content found in sweet potatoes, yam and cassava and greater than or equals to 30% in the seed grain) and approximately 50% carbohydrate. Also, the seed is high in vitamin C, dietary fibre, Vitamin B6, Potassium, and manganese but low in sodium, saturated fat and cholesterol. African yam bean is a key commodity for improving nutrition security, as it is an inexpensive source of protein and other nutrients in tropical Africa but highly underutilized.

Factors Affecting Adoption Of African Yam Bean Technologies (N=120)

Factors affecting Adoption	SA	A	UN	D	SD	Mean $\bar{x}$	Decision
Cost of AYB	0	12(10)	12(10)	60(50)	36(30)	2	reject
Inadequate farm land	84(70)	36(30)	0	0	0	4.7	Accept
Diseases and pest	0	36(30)	84(70)	0	0	3.3	Accept
Marketing problems	0	0	36(30)	48(40)	36(30)	2	Reject
Poor extension contact	0	12(10)	24(20)	48(40)	36(30)	2.1	Reject
Literacy level of farmers	48(40)	36(30)	24(20)	12(10)		4	Accept
High cost of labour	84(70)	12(10)	24(20)	0	0	4.5	Accept
Lack of farm credit	96(80)	12(10)	12(10)	0	0	4.7	Accept
Inadequate information	0	24(20)	36(30)	60(50)	0	2.7	Reject
Complexity of technology	36(30)	48(40)	12(10)	24(20)	0	3.8	Accept
Socio-cultural factors	0	36(30)	24(20)	60(50)	0	2.8	Reject
Poor quality of AYB	12(10)	12(10)	24(20)	60(50)	12(10)	2.6	Reject
Inadequate fund	60(50)	12(10)	36(30)	24(20)	0	4.6	Accept
Unavailability of farm input	48(40)	24(20)	12(10)	36(30)	0	3.7	Accept
Herdsmen/cattle menace	84(70)	12(10)	24(20)	0	0	4.5	Accept

SOURCE: Field survey 2021

SA: Strongly Agree; A: Agree; UN: Undecided; D: Disagree; SD: Strongly Disagree

According to the result, inadequate farm land ($\bar{x}$=4.7); diseases and pest ($\bar{x}$=3.3); literacy level ($\bar{x}$=4); high cost of labour ($\bar{x}$=4.5); lack of farm credit ($\bar{x}$=4.7); complexity of technology ($\bar{x}$=3.8); inadequate fund ($\bar{x}$=4.6); unavailability of farm imput ($\bar{x}$=3.7); and herdsmen/ cattle menace ($\bar{x}$=4.5) were factors affecting adoption. Meanwhile the result revealed that adoption was not affected by cost of African Yam Bean ($\bar{x}$=2.0); marketing problems ($\bar{x}$=2.0); poor extension contact ($\bar{x}$=2.1); inadequate information ($\bar{x}$=2.7); and poor quality of African Yam Bean ($\bar{x}$=2.6).One of the challenges farmers are facing in the production of the crop is the long maturity period and the photoperiodic sensitivity (Okpara and Omaliko 1997), these make it impossible to cultivate the crop twice a year. The use of stakes and vine training is stressful and most farmers prefer to avoid the stress

when they compare the crop yield with the cost of labor required to carry out these operations. The low grain yield of the crop is another factor limiting its production. The low grain yield coupled with low seed quality and long gestation period discourages the farmers to go into commercial production of the crop. Pod shattering and poor market demand for the seed is other discouraging factors.

CONCLUSION

Based on the findings, the following conclusions were drawn, that farmers were relatively middle aged, possessed some form of formal education, in addition to large household sizes. This shows that there are preponderance of able bodied young men and women who if provided with basic physical infrastructure, innovation/technology and other needed information will lead to an increase in production and consumption. African yam bean (AYB) is one of the numerous crops with great potential in overcoming the problems associated with food and nutritional insecurities. AYB under-utilization, poor acceptance, and neglect by the farmers and consumers may be a result of poor awareness about its nutritional and health benefits, poor agronomy practices adopted by the farmers, and other production limiting factors such as low yield and long maturity period. Improvement of the crop through conventional breeding and biotechnology will break the production and usage constraints such as low yield, shorter maturity period, longer cooking period, shattering ability, and hard seed coat for the crop to be commercialized. Conventional breeding should be intensified in regions where their economy cannot sustain the adoption of biotechnological techniques in improving the crop. Morpho-genetical evaluation and investigation on the physiological activities controlling tuber formation in AYB should be carried out *in vivo* and *in vitro*.

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