

Assessment of varietal diversity and production systems of cowpea (*Vigna unguiculata* (L.) Walp.) in Southwest Nigeria

Jelili Olaide Saka*, Opeyemi Adeola Agbeleye,
Olukemi Titilola Ayoola, Bosede Olukemi Lawal,
Johnson Adedayo Adetumbi, Qudrah Olaitan Oloyede-Kamiyo

Institute of Agricultural Research and Training (IAR&T), Obafemi Awolowo University, Moor Plantation, P.M.B. 5029, Ibadan, Nigeria

Abstract

Cowpea (*Vigna unguiculata* (L.) Walp.) is the most important source of plant protein consumed in Nigeria with major supplies coming from the northern part of the country. However, reduction in supplies due to insurgency resulted in sharp increases in price, especially in Southwest Nigeria where cowpea is relished in different delicacies. Sustainable production increase in suitable Southwest agro-ecologies depends on suitability of cultivated varieties and production practices of the farmers. A study was conducted to identify cowpea varieties cultivated by farmers, the varietal attributes, farmers' preferences, and production constraints. Data were generated through a farm survey of 120 farmers selected by multi-stage sampling technique in Ondo and Oyo States of Southwest Nigeria. Cowpea production was male dominated, with 20.8% of cultivated area allocated to its production, averaging 0.96 ha per farm household, fragmented over circa three locations. Local varieties were cultivated by 51.6% of the farmers with seeds sourced mainly from local markets (62.7%). Cowpea was mainly cultivated as intercrop (55.1%) notably with cassava. Herbicides and insecticides were prominently used by the farmers while fertiliser was hardly used for cowpea production (12.8%). Notable attributes cherished by farmers included brown or white coat colour, smooth texture and medium sized grains, erect or creeping growth pattern, and long pod length. Average yield of cowpea on farmers' field was 530 kg ha⁻¹ while inadequate access to quality seeds, incidence of field insect pests, and rodents (storage pest) were identified as the most severe production constraints by the farmers. Community-based seed production systems should be introduced for improved access to quality seed.

Keywords: cowpea attributes, farmers' preferences, production constraints

1 Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is a leguminous crop grown mainly in the savannah regions of the tropics and subtropics. Cowpea is a very important crop in the semiarid farming systems of the West African countries. The crop is unique in that it provides food, cash and fodder (Kormawa *et al.*, 2002). It is an indigenous African grain legume rated as one of the most economically important crops and a veritable source of plant protein. It is therefore considered cru-

cial for reduction of malnutrition among children and resource poor rural households (Phillips & McWatters, 1991; Langyintuo *et al.*, 2003; Kristjanson *et al.*, 2005; Owolabi *et al.*, 2012).

Available data (FAO, 2017) indicate that West Africa sub-region produced about 81% (4,525,891 metric tonnes) of the global production of cowpea (5,589,216 metric tonnes) in 2014. Nigeria's production of 2,137,900 metric tonnes for the same period accounted for 38.3% and 47.2% of global and West African production, respectively. Consequently, Nigeria has remained the largest producer of the commodity globally despite the fall in production of about 58.5% between 2012 and 2016 which was largely attributed to in-

* Corresponding author – saka_sakang@yahoo.com
Phone: ++234 7035895802

surgency in the North-Eastern part of the country which dislodged many farmers from their farms. Nigeria is also the largest consumer of cowpea globally, arising from the economic importance of the crop among households. However, due to the inability of the country to match its population growth rate with commensurate increase in production, persistent gap has been reported between the country's supply and demand for cowpea. Langyintuo *et al.* (2003) gave Nigeria's cowpea supply deficit as 469,000 metric tonnes in 1999 while Sanni *et al.* (2014) reported a supply deficit of 518,400 metric tonnes in 2007. Similarly, per capita cowpea consumption of 23 kg per annum (Coulibaly & Lowenberg-DeBoer, 2002) for a 2014 population of 181.4 million people (NBS, 2018) implies a cowpea demand estimate of about 4.2 million metric tonnes for Nigeria. Consequently, cowpea production of 2.1 million metric tonnes in 2014 (FAO, 2017) suggests a supply deficit of 2.1 million metric tonnes for the same period. Nigeria has thus remained a net importer of the commodity alongside countries such as Ghana, Togo, Cote d'Ivoire and Mauritania while Niger, Burkina Faso, Benin, Mali, Cameroon, Chad and Senegal are net exporters according to Langyintuo *et al.* (2003).

The increasing population of Nigeria without a commensurate increase in cowpea production is likely to further widen the demand-supply gap, thus resulting in persistent increase in price of this commodity among other staple crops. A price increase of 44.2% between May 2016 and May 2017 (NBS, 2017) is indicative of the persistent pressure on the supply of the commodity. Therefore, reversing this trend would require expanded local production of the commodity to satisfy the growing demand.

In Nigeria, Petu-Ibikunle *et al.* (2008, in Aluko *et al.*, 2016) attributed the bulk of the production of the crop to the semi-arid zones of northern Nigeria despite the increasing economic importance of the commodity in the southern States. However, the current security challenges in the Northeastern part of Nigeria has been identified by Aluko *et al.* (2016) as a major factor behind the reduction in cowpea supply to the southern part of the country. The attendant threat on food security has thus become an impetus to the need to increase production in other suitable agro-ecologies. Southwest Nigeria, comprising of six states (Ekiti, Lagos, Ogun, Ondo, Osun and Oyo) is endowed with some spread of savannah agro-ecologies suitable for cowpea production and also blessed with vast genetic pool of local varieties of cowpea cultivated by farmers under different production systems. Research efforts have consistently produced cowpea varieties that are of different maturity periods and adaptability to diverse agro-ecologies of Nigeria (Brader,

2002; Ewansiha & Tofa, 2016). Many of the released varieties are however not readily adopted by the local farmers who tend to stick to their known varieties and landraces. It therefore becomes imperative to re-appraise the production systems of cowpea in this region with the aim of developing participatory breeding strategies targeted at improving the adoption of developed varieties or developing more adaptable and acceptable varieties for the region.

This study therefore assessed the diversities in the cowpea production system in the Southwest region by highlighting the relative importance, attributes and potentials of cowpea varieties cultivated by farmers; identifying cowpea traits preferred by the farmers and the implication for breeding. The study also explored the challenges experienced by farmers in the adoption of improved varieties and cowpea production, generally.

2 Materials and methods

2.1 Study area and data collection

Southwestern Nigeria represents a geographical land area of 79,665 km² spreading between latitudes 6° N and 4° S and longitudes 4° W and 6° E. The region has a largely agrarian population with a climate classified as typically equatorial with distinct dry and wet seasons and a main growing season lasting up to 9 months. Average annual rainfall is 1480 mm with a mean monthly temperature range of 18–24 °C during the rainy season and 30–35 °C during the dry season (FMA & NR, 1997). The region also has four distinct sub-ecologies, comprising of swamp mangrove forest, moist and dry lowland forest, woodland forest and Savannah mosaic. The soil has low to medium productivity potential. The farming system is dominated by arable crops such as cassava, maize, yam, cowpea, sorghum, millet and soybean while notable tree crops are cocoa, kola tree, oil palm, citrus, cashew and mango among others.

Data for this study were generated from a survey of 120 farmers selected from two prominent cowpea producing states (Ondo and Oyo States) in Southwest Nigeria. Oyo and Ondo states have 33 and 18 Local Government Areas (LGAs), respectively. These LGAs are grouped into Agricultural Development Programme (ADP) administrative zones (ADP zones) based on agro-ecological attributes, with the states having 4 ADP zones each. Saki and Ogbomoshu ADP zones in Oyo State and Owo ADP zone in Ondo State were selected purposively as main cowpea producing areas in each of the states at the second stage of the sampling process. Subsequently, LGAs were selected in each of the states based on probability proportionate to the number of LGAs in each of the state. Four and six LGAs

were selected randomly in Ondo and Oyo States, respectively. Farmers were thereafter randomly selected from the list of cowpea farmers in each of the selected LGAs based on probability proportionate to size of farming households in each of the LGAs. Southwest REFILS (2006) estimated the number of farming households in Oyo State as 415,030 while Ondo State has 250,000 farming households. Consequently, 75 cowpea farmers were selected from Oyo State while 45 farmers were selected from Ondo State.

Data were collected with the aid of structured interview schedule on socio-economic characteristics of cowpea farmers, sources of land holding, cowpea-based cropping system and land allocation to cowpea production. Data were also collected on varieties cultivated by farmers, sources of cowpea seed and production practices, farm size, cowpea output (based on farmers' estimates) and constraints experienced in cowpea production. Farmers were subsequently asked to identify and rank attributes observed on cowpea varieties on the basis of their preferences. Constraints were also identified and ranked on the basis of prevalence and severity.

2.2 Data analysis

Data analyses were carried out using descriptive statistics such as frequency, percentages and mean. Identified constraints were ranked on the basis of prevalence and severity scores. Mean values were also compared across states.

3 Results

3.1 Socio-economic characteristics of cowpea farmers

The distribution of cowpea farmers was male dominated, with an average age of 48.8 years (Table 1). None of the farmers was below 20 years of age while about a quarter of the population (23.7%) were above the productive age of 60 years. Most of the farmers (65.2%) have been cultivating cowpea for more than five years while the average years of experience of the farmers in cowpea production was 13.8 years. Majority of the farmers are educated, with average of 7.9 years in formal schools but technical training in cowpea production was predominantly lacking (Table 1).

Cowpea farmlands were mostly owned by the farmers (59.9%) with such land acquired through inheritance (56.3%) and outright purchases (3.6%). However, the relative importance of these modes of land acquisition varied between the two states, with inheritance being more common in Oyo State (78.1%) while land for cowpea production were mostly rented (51.3%) in Ondo State (Table 2). Cowpea production enjoyed substantial allocation of land resource; with 20.8% of the cultivated land area allocated

Table 1: Socio-economic characteristics of cowpea farmers.

Characteristics	Ondo (%) n = 45	Oyo (%) n = 73	Total (%) n = 118	T-Stat
<i>Sex</i>				
Male	82.2	72.6	76.3	
Female	17.9	27.4	23.7	
<i>Age</i>				
21–40	60.0	20.6	35.6	
41–60	11.1	58.9	40.6	
Above 60 years	28.9	20.6	23.7	
Average	45.3 (16.6)	51.1 (11.2)	48.9 (13.7)	5.25**
<i>Cowpea experience (years)</i>				
Not more than 5 years	33.3	35.6	34.8	
6–10	17.8	24.7	22.0	
11–20	22.2	20.6	21.2	
21–30	26.7	12.3	17.8	
Above 30 years		6.9	4.2	
Average	13.8 (12.0)	13.9 (13.3)	13.8 (12.6)	0.00
<i>Formal education</i>				
Had no formal education	42.2	35.3	37.3	
Had formal education	57.8	65.8	62.7	
Average years of education	6.4 (6.5)	7.3 (8.7)	6.9 (7.9)	0.37
<i>Training in cowpea production</i>				
Had no training	80.0	84.9	83.1	
Had training	20.0	15.3	16.9	

Source: Field Survey, 2015.

Values in parentheses are standard deviations

** Significant at $P < 0.05$

to this enterprise and this was similar across the two states (Table 3). Average cowpea field was 0.96 ha, with larger cowpea fields (1.10 ha) found in Oyo State than in Ondo State (0.73 ha). Cowpea fields were spread averagely over three locations thereby showing the high level of land fragmentation characterised by an average plot size of 0.33 ha.

Table 2: Method of land acquisition.

Method of land acquisition	Ondo (%) n = 45	Oyo (%) n = 73	Total (%) n = 118
Inheritance	15.4	78.1	56.3
Purchased	10.3		3.6
Rented	51.3	15.0	27.7
Pledged	23.0	6.9	12.5

Source: Field Survey, 2015.

Cowpea was cultivated either as sole crop or intercropped especially with cassava. However, there was no significant difference in the average plot size of cowpea cultivated as sole- (1.15 ha) or as inter-crop (0.81 ha).

Table 3: Land holding and allocation to cowpea production.

Attributes	Ondo	Oyo	Pooled	F. stat
Number of farm plot locations	2.80 (1.25)	2.97 (2.61)	2.91 (2.19)	0.17
Average size of land holding (ha)	5.32 (4.18)	5.53 (5.00)	5.45 (4.69)	0.05
Average size of land area cultivated (ha)	3.73 (3.45)	5.14 (5.72)	4.61 (5.01)	2.24
Average cultivated area under cowpea (ha)	0.73 (0.95)	1.10 (0.92)	0.96 (0.95)	4.41**
Area allocation to cowpea (%)	19.6	21.4	20.8	
Average size of cowpea plot (ha)	0.26	0.37	0.33	

Source: Field Survey, 2015.
 Values in parentheses are standard deviations
 ** Significant at $P < 0.05$

3.2 Cowpea varieties, types and sources of seed cultivated by farmers

Cultivation of local cowpea varieties (51.7%) dominated the cowpea cropping system in the two states (Table 4). Cowpea seeds were commonly sourced from local markets (62.7%) while 29.7% sourced their seed mainly from the public extension agencies (ADPs) in each of the states (Table 4). Fifteen cowpea varieties were cultivated by the farmers; four of these varieties (Ife Brown, Ife Bimpe, TVX 3236 and Ife-98-14) were known as improved varieties with Ife brown being the only prominent improved variety (Table 5).

Table 4: Type of cowpea seeds cultivated and sources.

Type of Seed	Ondo (%) n = 45	Oyo (%) n = 73	Pooled (%) n = 118
Local	40.0	58.9	51.7
Improved	60.0	41.1	48.3
<i>Sources of Seed</i>			
ADP [†]	33.3	27.4	29.7
Research Institute		4.1	2.5
Fellow farmers	2.2	4.1	3.4
Local market	64.4	61.6	62.7
Previous harvest		2.7	1.7

Source: Field Survey, 2015.

[†] ADP: Agricultural Development Programme

3.3 Production systems and input use in cowpea production

Cowpea was cultivated either as sole crop or intercropped especially with cassava. However, there was diversity in cowpea cropping systems between the two states. Intercropping was more common in Ondo State (64.4%) whereas both sole (49.3%) and intercropping (49.3%) were equally prominent among cowpea farmers in Oyo State. Where intercropping was the choice of the farmer, cowpea was intercropped with cassava (22%) or as cowpea/cassava/maize

Table 5: Distribution of farmers by cowpea varieties cultivated.

Varieties	Ondo (%)	Oyo (%)	Pooled (%)
<i>Improved varieties</i>			
Ife 98-14		1.4	0.9
Ife Bimpe		2.7	1.7
TVX 3236	8.9	12.3	11.0
Ife Brown	37.8	36.9	37.3
<i>Landraces/local varieties</i>			
Igibira White	42.2	28.7	33.9
Oloyin	31.1	9.6	17.8
Saadu	44.4	20.6	29.7
Sokoto White	24.4	5.5	12.7
Tede	22.2	17.8	19.5
Abewehe	4.4	15.1	11.0
Wewe	15.6		5.9
Abalaye	8.9	6.9	7.6
Kawoleri	4.4		1.7
Big Brown (Drum)	2.2	8.2	5.9
Gbomogungi		1.4	0.9

Source: Field Survey, 2015.

(9.3%). Most farmers plant cowpea on ridges at the recommended rate of two seeds per hole (Table 6). Cassava is a very prominent crop in the farming system of Southwest Nigeria. Its prominence in most cropping systems arises from its strategic position in the food security of households in the zone. Cassava is also considered less susceptible to crop failure but largely sensitive to market dynamics. Generally, intercropping is widely adopted by farmers as a coping strategy against risk associated with irregular rainfall and market dynamics.

Cowpea planting was done between July and August in consonance with recommended practices as reported by Dugje *et al.* (2009). However, some of the farmers (31.4%) planted as early as April at the onset of the rains especially for some local varieties. Weeding was predominantly done

Table 6: Management practices in cowpea production.

	Ondo (%)	Oyo (%)	Pooled (%)
<i>Planting period</i>			
March	17.8	6.9	11.0
April	33.3	30.1	31.4
May	4.4	12.3	9.3
June	13.3	1.4	5.9
July	37.8	30.1	33.1
August	60.0	35.6	44.9
<i>Planting method</i>			
On ridges	51.1	73.9	64.9
Flat	24.4	20.3	21.9
Ridges & flat	24.4	5.8	13.2
<i>No. of seeds/hole</i>			
Two	91.9	85.0	87.6
Three	8.1	15.0	12.4
<i>No. of weeding</i>			
One	33.3	43.5	39.5
Two	64.4	49.3	55.3
Three		5.8	3.5
<i>Method of weeding</i>			
Manual	15.6	20.3	18.4
Chemical	64.4	73.4	71.1
Manual & chemical	20.0	4.4	10.5

Source: Field Survey, 2015.

with the use of herbicides by 71.1% of the farmers while supplementary weeding was done twice by 55.3% of the farmers before harvesting. However, 3.5% of the farmers weeded thrice. Use of herbicides and insecticides for cowpea production was very prominent among the farmers. However, fertiliser application was sparingly practiced for cowpea production, although more farmers in Ondo State were favourably disposed to its application with organic manure being the most prominent fertiliser used followed by NPK and Urea. It is known that cowpea does not require much fertiliser as it fixes nitrogen unless the soil is markedly depleted of nutrients.

3.4 Farmer's preference rating for cowpea traits

Assessment of the varietal attributes preferred by farmers showed that brown or white seed coat colour, smooth texture and medium sized grains were more preferred by cowpea farmers. Also, erect and creeping growth pattern were more preferred to semi-erect type (Table 7). Ife brown was preferred by majority of the farmers for its good taste, early maturity, attractive colour and market price while Abewehe and Igbira black were noted for good taste and high yield. Sokoto white was the only variety preferred by farmers for

Table 7: Attributes preference in cowpea.

Attributes	Ondo (%)	Oyo (%)	Total (%)
<i>Seed texture</i>			
Smooth	77.8	61.6	67.8
<i>Coat colour</i>			
Brown	48.9	58.3	54.7
White	51.1	23.6	34.2
<i>Eye colour</i>			
Black	46.7	50.7	49.1
<i>Seed size</i>			
Small	31.0	24.7	27.0
Medium	50.0	28.8	36.5
<i>Days to maturity</i>			
Medium	53.3	63.5	59.3
<i>Growth habit</i>			
Erect	55.6	6.9	25.4
Creeping	40.0	20.6	28.0
<i>Pod length</i>			
Long	83.3	26.0	47.0

Only values indicating high preference by farmers are presented across varietal attributes.
Source: Field Survey, 2015.

its swelling and short cooking time attributes during processing while Oloyin was preferred by most farmers that cultivated it for its good taste (Table 8).

3.5 Cowpea yields on farmers' fields

Mean yield of cowpea varieties by farmers' assessment was estimated as 529 kg ha⁻¹. Yield across varieties ranged from 688 kg ha⁻¹ for Igbira black to 417 kg ha⁻¹ for Wewe (Table 9). There was no significant difference in cowpea yield cultivated by farmers as sole crop (532 kg ha⁻¹) or as intercrop (526 kg ha⁻¹) while overall yield of improved (520 kg ha⁻¹) and local varieties (535 kg ha⁻¹) was also comparable. Also, there were no significant differences between the individual yields of the varieties but data obtained from farmers on Igbira black, Oloyin, Saadu, and Abewehe gave an indication of high yield potential of these local varieties. This however requires further investigation as estimates given by the farmers were based on memory recall and use of local measures.

3.6 Constraints in cowpea production

The most prevalent limiting constraints experienced by the farmers in cowpea production were poor access to quality cowpea seeds (87.2%), incidence of insect pests (86.2%), poor germination (83.6%), and irregular rainfall pattern (82.7%). Other constraints included low yield

Table 8: Specific attributes cherished by farmers in cowpea varieties cultivated.

Variety	Good Taste (%)	High Yield (%)	Swelling ability (%)	Early maturing (%)	Shorter cooking time (%)	Erect Growth pattern (%)	Attractive colour (%)	Market Premium (%)
Ife Brown	68.9	17.7		66.7	28.9	24.4	42.2	68.9
Tede Local	36.4							
Saadu	40.0	35.0						
Igbira White	100.0	20.0			10.0			
TVX 3236	42.9							
Abewehe	40.0	60.0	20.0	20.0				
Oloyin	100.0							
Abalaye	25.0		25.0					
Sokoto White	25.0		100.0		100.0			
Igbira black	50.0	50.0			50.0			

Source: Field Survey, 2015.

(81.0%), incidence of diseases (80.2%), storage losses (80.2%) and shattering on the field (80.2%). In addition, the farmers ranked poor access to quality seed, incidence of diseases, rodents (storage pest), and high cost of pesticides as those constraints having the most severe effect on their productivity.

4 Discussion

Farmers in the study area allocated about 21% of their cultivated land area to cowpea production thereby showing that this commodity is highly valued in the farming system. However, the average land area of 0.96 ha cultivated with cowpea per household was lower than the cowpea area of 2 ha reported for Kano state by Sanni *et al.* (2014).

Cowpea production is well adapted to both sole and intercropping systems, and mostly found with cassava when cultivated as intercrop.

High yielding and disease resistant cowpea varieties are constantly developed to ensure sustained increase in productivity of cowpea. Dugje *et al.* (2009) listed eight improved cowpea varieties with different agronomic attributes as recommended for the Nigerian farming systems. However, only two of these varieties (Ife Brown and TVX 3236) featured prominently among the varieties cultivated by farmers in this study. The remaining cultivars in farmers' hands were local varieties. Cowpea seeds were largely sourced from local markets hence, the quality of such seeds cannot be ascertained. Similar occurrence in Benin Republic was attributed to near non-existence of dedicated cowpea seed suppliers across farming communities (Agyekum *et al.*, 2016).

Table 9: Cowpea yield across cropping systems and varieties.

Item	Yield (kg ha ⁻¹)	F-Statistics
Cropping System		
Sole	532 (269.3)	
Intercrop	525 (397.4)	0.0
Class of varieties		
Improved	520 (263.2)	
Local	535 (400.4)	0.1
Improved		
TVX-3236	525 (335.4)	
Ife Brown	520 (258.4)	
Local		
Igbira Black	688 (88.4)	
Oloyin	675 (813.2)	
Saadu	635 (611.8)	
Abewehe	583 (381.9)	
Tede Local	458 (239.4)	
Sokoto White	456 (62.5)	
Abalaye	433 (275.4)	
Igbira White	424 (225.0)	
Wewe	417 (64.6)	
Average	529 (346.1)	
F-Statistics		0.5

Source: Field Survey, 2015.

Values in parentheses are standard deviations.

Production efficiency is a necessary precursor for increased productivity and sustainable growth in agricultural production. This is in turn enhanced by timely conduct of farm operations and the use of modern inputs. Planting of cowpea was done between July and August in consonance with recommended practices. The best period of planting cowpea is August, a time when the rains would have ceased but soil moisture is still enough for the crop to be established before the resumption of rains in September (Dugje *et al.*, 2009). However, planting at earlier periods especially between May and June as done by few of the farmers, exposes cowpea to heavy rains and seed may rot causing loss of harvest and income. Incidence of pests and diseases is also high during this period (Omungo *et al.*, 1997; Karungi *et al.*, 2000) and much labour is needed to weed and spray pesticides.

Timely use of pesticides enhances productivity of cowpea by creation of environments which disallow yield depressing bio-factors from thriving (Dugje *et al.*, 2009; Awunyo-Vitor *et al.*, 2013; Awotide *et al.*, 2015). For instance, weeds constitute serious problems in cowpea production through competition for air and soil nutrients in addition to harbouring pests thereby reducing both grain yield and quality. The prominent use of herbicides and insecticides among the farmers in this study was a reflection of the relative economic importance attached to these constraints in cowpea production. The insecticides are largely targeted at insects such as aphids, leaf hoppers, flower trips, *Ootheca mutabilis* and other cowpea beetles.

Major attributes used in describing cowpea varieties include the seed coat colour, texture, days to maturity, growth pattern, pod length, size of grains and yield among others. These attributes strongly determine the adoption pattern of crop varieties among farmers.

The erect and creeping traits are two widely contrasting extremes in cowpea growth pattern. The almost equal preference of the farmers to erect or creeping growth may perhaps be connected with the convenience of weed control and harvesting. The fast growth and spreading habit of traditional cowpea varieties suppress weeds, and soil nitrogen is increased which improves cereal growth (Gómez, 2004).

The erect types were likely selected mainly due to the ease of harvest, and increased plant population because they are usually planted at closer spacing. The creeping varieties on the other hand were considered by the farmers as having the potential to smother weeds thereby reducing the frequency and cost of weeding. Kamara *et al.* (2010) attributed the continuous use of a local cowpea variety Kanannado Brown by farmers in North East Nigeria to its suitability for relay intercropping as well as its creeping and weeds smothering abilities. Also, the varieties with long pod length are

widely cherished by the farmers. The long pod is possibly indicative of a variety's ability to bear more seeds and consequently a higher yield potential.

Kasali *et al.* (2018) identified weevil tolerance, taste (sweetness), time to cook, swelling ability and coat colour as the five most preferred varietal attributes by consumers of cowpea in Osun State, Nigeria. Similar studies in Nigeria have also documented considerable evidences of the positive influence of varietal attributes on the adoption or dissemination of improved cowpea varieties by farmers in Nigeria. Mbavai *et al.* (2015) identified such attributes as including high yield, resistance to drought and early maturity. In a study on factors influencing farmer-to-farmer transfer of an improved cowpea variety, Kormawa *et al.* (2004) identified threshing quality of cowpea varieties as a significant factor in explaining willingness of farmers to transfer improved cowpea varieties to other farmers.

The higher market price attracted by brown seeded Ife brown cowpea could be considered as an influencing factor in the farmers' preference for brown coat seed colour. Kamara *et al.* (2010) also reported that brown seeds fetch higher market prices. Considering the significant influence of basic attributes of improved varieties on adoption (Omonona *et al.*, 2005; Fashola *et al.*, 2007, Saka and Lawal, 2009), it is important to target such farmer-cherished attributes in the selection and breeding programme for cowpea in the region. It is therefore pertinent that breeding objectives for the development of cowpea varieties suitable for cultivation in the Southwest agro-ecologies continues to target improved varieties that can combine early or medium maturity period, brown coat colour, smooth texture, medium sized grains, long pod length with either erect growth pattern efficient for high yield, harvesting convenience or creeping growth pattern for weed control and cost efficiency. Such varieties should also compare favourably in good taste, swelling ability and short cooking period, as well as tolerant to insect pests.

The average cowpea yield in the study area was greater than the 2014 yields given by FAO (2017) for West Africa, Burkina Faso or Mali. Although there was no significant difference in yields across varieties, the yields of some local varieties such as Igbira black and Saadu compared favourably with yields from improved varieties thereby pointing to a potential requiring further investigation.

This study has identified poor access to quality cowpea seeds, incidence of insect pests, poor germination and irregular rainfall pattern as the most limiting constraints in cowpea production in the Southwest agro-ecology of Nigeria. These set of constraints are of agronomic importance to the performance of the crop on the field and consequently held contributory to low yield identified by the

farmers as the fifth most prevalent constraint in cowpea production. Mohammed & Mohammed (2014) also reported incidence of pests and disease as the most serious constraint faced by cowpea farmers even in Kano State which is in the drier savannah agro-ecology. In the southern agro-ecology of Nigeria, incidence of insect pests and diseases has been identified (Sangoyomi & Alabi 2016; Ezeaku et al., 2017) as major limiting constraint in cowpea production. Insect pests have been known to cause maximum damage to cowpea from seedling stage to grain storage. In the midst of high cost of chemicals however, farmers are confronted with limiting capabilities to adopt recommended practices and optimum performance of cowpea is ordinarily threatened. This inadvertently makes development of varieties that are tolerant to insect pests and diseases more desirable.

5 Conclusion

Cowpea production in Southwest Nigeria is characterized by diversities in wide cultivation of landraces of differing preferred attributes among the farmers. Therefore, breeding objectives should target developing improved varieties that meet farmers' needs. Use of a participatory varietal selection breeding system would enable incorporation of cowpea attributes cherished by farmers into the cowpea breeding objectives. These efforts will entrench wide ownership of the developed technologies, wider adoption among cowpea farmers and improved cowpea cultivation in this region. In addition, the low level of adoption of improved varieties observed in the region was mainly due to inadequate access to quality seed. Consequently, introduction of community-based seed production system or out-grower schemes by the National Agricultural Research and Extension system is recommended for farmers to have adequate access to quality seeds for enhanced productivity.

References

- Agyekum, M., Donovan, C. & Lupi, F. (2016). Novel IPM Intervention for West Africa: Smallholder Farmers' Preferences for Biological versus Synthetic Control Strategies for Cowpea Pests. Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31–August 2. 26 pp., Available at: http://ageconsearch.umn.edu/bitstream/235993/2/Selected%20paper_2016%20AAEA%20Meeting_Agyekum%20et%20al.pdf
- Aluko, O. J., Osikabor, B., Adejumo, A. A. & Sumade, S. (2016). Perceived Effect of Boko- Haram Insurgency on Means of Accessing Cowpea from North-East Nigeria to Bodija Market, Ibadan, Oyo State, Nigeria. *Open Access Library Journal*, 3, e2723. doi:10.4236/oalib.1102723.
- Awotide, D. O., Ikudaisi, O. J., Ajala, S. O. & Kaltungo, J. H. (2015). Input Use and Profitability of Arable Crops Production in Nigeria. *Journal of Sustainable Development*, 8 (3), 139–146.
- Awunyo-Vitor, D., Bakang, J. & Smith, C. (2013). Estimation of Farm Level Technical Efficiency of Small-Scale Cowpea Production in Ghana. *American-Eurasian Journal of Agricultural & Environmental Sciences (AEJAES)*, 13 (8), 1080–1087. doi:10.5829/jidosi.aejaes.2013.13.08.11013.
- Brader, L. (2002). Forward. In: Fatokun, C. A., Tarawali, S. A., Singh, B. B., Kormawa, P. M. & Tamò, M. (eds.), *Challenges and opportunities for enhancing sustainable cowpea production. Proceedings of the World Cowpea Conference III held at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, 4–8 September 2000*. p. vi, IITA, Ibadan, Nigeria.
- Coulibaly, O. & Lowenberg-DeBoer, J. (2002). The economics of cowpea in West Africa. In: Fatokun, C. A., Tarawali, S. A., Singh, B. B., Kormawa, P. M. & Tamò, M. (eds.), *Challenges and opportunities for enhancing sustainable cowpea production. Proceedings of the World Cowpea Conference III held at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, 4–8 September 2000*. pp. 351–366, IITA, Ibadan, Nigeria.
- Dugje, I. Y., Omoigui, L. O., Ekeleme, F., Kamara, A. Y. & Ajeigbe, H. (2009). *Farmers' Guide to Cowpea Production in West Africa*. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.
- Ewansih, S. U. & Tofa, A. I. (2016). Yield Response of Cowpea Varieties to Sowing Dates in a Sudan Savannah Agroecology of Nigeria. *Bayero Journal of Pure and Applied Sciences*, 9 (1), 62–67. doi: 10.4314/bajopas.v9i1.10.
- Ezeaku, I. E., Mbah, B. N. & Baiyeri, K. P. (2017). Response of cowpea (*Vigna unguiculata* (L.) Walp genotypes to sowing dates and insecticide spraying in south eastern Nigeria. *The Journal of Animal & Plant Sciences*, 27 (1), 239–245.
- FAO (2017). FAOSTAT Online Statistical Services: Crop production data. Food and Agriculture Organization of the United Nation (FAO), Rome. Available at: <http://www.fao.org/faostat/en/#data/QC> (accessed on: 24 August 2017).

- Fashola, O. O., Oladele, O. I., Alabi, M. O., Tologbonse, D. & Wakatsuki, T. (2007). Socio-economic factors influencing the adoption of sawah rice production technology in Nigeria. *Journal of Food, Agriculture and Environment*, 5 (1), 239–242.
- FMA&NR (1997). Nigeria: National Agricultural Research Strategy Plan: 1996–2010. Department of Agricultural Sciences, Federal Ministry of Agriculture and Natural Resources, Abuja, Nigeria.
- Gómez, C. (2004). *Cowpea: post-harvest operations*. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. Available at: <http://www.fao.org/3/a-au994e.pdf>
- Kamara, A. Y., Ellis-Jones, J., Ekeleme, F., Omoigui, L., Amaza, P., Chikoye, D. & Dugje, I. Y. (2010). A participatory evaluation of improved cowpea cultivars in the Guinea and Sudan savannah zones of north east Nigeria. *Archives of Agronomy and Soil Science*, 56, 355–370.
- Karungi, J., Adipala, E., Kyamanywa, S., Ogenga-Latigo, M. W., Oyobo, N. & Jackai, L. E. N. (2000). Pest management in cowpea. Part 2. Integrating planting time, plant density and insecticide application for management of cowpea field insect pests in eastern Uganda. *Crop Protection*, 19, 237–245.
- Kasali, R., Oyewale, A. Y. & Yesufu, O. A. (2018). Analysis of consumer's WTP for cowpea varieties in Osun State, Nigeria: the Hedonic pricing approach. *Turkish Journal of Agriculture – Food Science and Technology*, 6 (9), 1120–1128. doi:10.24925/turjaf.v6i9.1120-1128.1832.
- Kormawa, P. M., Chianu, J. N. & Manyong, V. M. (2002). Cowpea demand and supply patterns in West Africa: the case of Nigeria. In: Fatokun, C. A., Tarawali, S. A., Singh, B. B., Kormawa, P. M. & Tamò, M. (eds.), *Challenges and opportunities for enhancing sustainable cowpea production. Proceedings of the World Cowpea Conference III held at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, 4–8 September 2000*. Ch. V Cowpea postharvest and socioeconomic studies, pp. 376–386, IITA, Ibadan, Nigeria.
- Kormawa, P. M., Ezedinma, C. I. & Singh, B. B. (2004). Factors influencing farmer-to-farmer transfer of an improved cowpea variety in Kano State, Nigeria. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 105 (1), 1–13. Available at: <https://jarts.info/index.php/jarts/article/view/46>
- Kristjanson, P., Okike, I., Tarawali, S., Singh, B. B. & Manyong, V. M. (2005). Farmers' perceptions of benefits and factors affecting the adoption of improved dual-purpose cowpea in the dry savannahs of Nigeria. *Agricultural Economics*, 32, 195–210.
- Langyintuo, A. S., Lowenberg-DeBoer, J., Faye, M., Lambert, D., Ibro, G., Moussa, B., Kergna, A., Kushwaha, S., Musa, S. & Ntougam, G. (2003). Cowpea supply and demand in West and Central Africa. *Field Crops Research*, 82, 215–231.
- Mbavai, J. J., Shitu, M. B., Abdoulaye, T., Kamara, A. Y. & Kamara, S. M. (2015). Pattern of adoption and constraints to adoption of improved cowpea varieties in the Sudan savanna zone of Northern Nigeria. *Journal of Agricultural Extension and Rural Development*, 7 (12), 322–329. doi: 10.5897/JAERD2015.0694.
- Mohammed, U. S. & Mohammed, F. K. (2014). Profitability analysis of cowpea production in rural areas of Zaria local government area of Kaduna state, Nigeria. *International Journal of Development and Sustainability*, 3 (9), 1919–1926.
- NBS (2017). CPI and Inflation Report August, 2017. National Bureau of Statistics (NBS), Nigeria. Available at: <https://nigerianstat.gov.ng/elibrary>
- NBS (2018). Population of Nigeria 2016. National Bureau of Statistics (NBS), Nigeria. Available at: <http://nigeria.opendataforafrica.org/crhsjdg/population-of-nigeria-2016>
- Omongo, C. A., Ogenga-Latigo, M. W., Kyamanywa, S. & Adipala, E. (1997). The effect of seasons and cropping systems on the occurrence of cowpea pests in Uganda. In: African Crop Science Conference Proceedings. Vol. 3, pp. 1111–1116.
- Omonona, B. T., Oni, O. A. & Uwagboe, A. O. (2005). Adoption of improved cassava varieties and its welfare impact on rural farming households in Edo State, Nigeria. *Journal of Agriculture and Food Information*, 7 (1), 39–55.
- Owolabi, A. O., Ndidi, U. S., James, B. D. & Amune, F. A. (2012). Proximate, antinutrient and mineral composition of five varieties (improved and local) of cowpea, *Vigna unguiculata*, commonly consumed in Samaru Community, Zaria-Nigeria. *Asian Journal of Food Science and Technology*, 4 (2), 70–72.
- Petu-Ibikunle, A. M., Abba-Mani, F. & Od, P. E. (2008). Determination of Rate and time of Nitrogen Application on Cowpea variety in the Sudan Savannah zone. *International Journal of Academic focus series*, 1 (1), 13–21.
- Phillips, R. D. & McWatters, K. M. (1991). Contribution of cowpeas to nutrition and health. *Food Technology*, 45, 127–130.

- REFILS (2006). Technology Generation and Dissemination. In: Oluokun, J. A., Oluwatosin, G. A. & Adesehinwa, A. O. K. (eds.), *Proceeding of the 19th OFAR/Extension Workshop held at the Institute of Agricultural Research and Training, Moor Plantation, Ibadan 21st February, 2006*. pp. 102–186, Research, Extension Farmers Input Linkage Systems (REFILS), Nigeria.
- Saka, J. O. & Lawal, B. O. (2009). Determinants of adoption and productivity of improved rice varieties in southwestern Nigeria. *African Journal of Biotechnology*, 8(19), 4923–4932. Available at: <https://academicjournals.org/journal/AJB/article-abstract/59F2E9E8316>
- Sangoyomi, T. & Alabi, O. (2016). Field evaluation of cowpea varieties for adaptation to the forest/savannah transition agroecology of Osun state, Nigeria. *African Journal of Agricultural Research*, 11(49), 4959–4963. doi:10.5897/AJAR2016.11710.
- Sanni, A., Abubakar, B. Z., Yakubu, D. H., Atala, T. K. & Abubakar, L. (2014). Socio-economic Factors Influencing Adoption of Dual-purpose Cowpea Production Technologies in Bichi Local Government Area of Kano State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, 3(4), 257–274. doi: 10.9734/AJAEES/2014/7981.