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FRUITS YIELD OF*PARKIA BIGLOBOSA* ESTABLISHED IN WASANAGARE, SAKI WEST LOCAL GOVERNMENT, OYO STATE, NIGERIA.

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ABSTRACT

The fruit yield from Parkia biglobosa sourced from eight provenances in West Africa, established 1995 in Wasangare , Saki West local Government of Oyo State were investigated. The Parkiabiglobosa were sourced from Nigeria, Ghana, Mali, Cameroun, Burkina Faso, Benin, Giunea and Senegal were planted at Wasangare Saki West Local Government Oyo State. The yields of the Parkia biglobosa were determined by harvesting all clustered fruits of Parkia from each tree under investigation. The total harvested pods for each provenance were parked in jute bag and taking to the laboratory for further assessment. The data collected were subjected to one way ANOVA, Duncan Multiple Range Test was used as a follow up test for means that were significant. Total weight per tree, total number of bunch per tree, number of pod per bunch and weight of bunch were assessed. The assessment was carried out in three consecutive years which were 2015, 2016 and 2017 respectively. The result obtained showed that Total weight per tree, total number of bunch per tree, number of pod per bunch and weight of bunch increases along the three consecutive years in all the provenances. In Year 2015 the fruit yield from Nigeria provenance was significantly different from the rest of the provenances that were investigated. At the end of year 2017, fruit yield from Nigeria and Burkina Faso were not significantly different from each other but significantly different from the rest of the provenances. This study concludes that there were significant differences in the fruit yield of Parkia biglobosa from different provenances and the years of fruiting. The fruit yield from Nigeria and Burkina Faso gives better yield at the end of the three years assessment. It is now recommended that further study on the fruit yield should continue to ascertain the quantity and the quality of the fruit yield of Parkia.

Keywords: Provenance, *Parkia biglobosa*, Fruit yield, Species, Year and clustered fruits.

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INTRODUCTION

Parkiabiglobosa, African Locust beans widely distributed in the Africa continent is one of the deciduous trees which flowers and fruit during the dry season(Janick,2008).A multipurpose tree in tropical and subtropical Africa, particularly valued for its seeds which has many economic uses. Different parts of the locust bean tree are used for medicinal and food purposes. *Parkiabiglobosa* is a dicotyledonous angiosperm belonging to the family Fabaceae.It is categorized under spermatophytes, vascular plants (Thiombiano *et al*., 2012).It is a deciduous perennial that grows to between 7 and 20 metres high, in some cases up to 30 metres.(Ntui, *et al*., 2012) The tree is a fire-resistant heliophyte characterized by a thick dark gray-brown bark (Species information, 2013).The pods of the tree, commonly referred to as locust beans, are pink in the beginning and turn dark brown when fully mature. They are 30-40 centimetres long on average, with some reaching lengths of about 45

centimetres. Each pod can contain up to 30 seeds the seeds are embedded in a sweet, powdery yellow pulp (Species information, 2013). As a standing tree, *Parkiabiglobosa*may have a positive effect on the yield of other nearby crops (Dressler *et al*., 2014).Fruit trees in which *Parkiabiglobosa* is one of them has great potential of meeting farmers need as a source of income and employment for women.*P. biglobosa* is reported to contribute up to 53% of income of nearly all households in northwestern Benin (Agbani*et al*., 2018). Dried and fermented seeds are traded locally and across international borders in West Africa. Sina and Traoré (2002) reported that the annual production of seeds in Nigeria was estimated to be 200,000 tonnes.The production and distribution of fruits tend to vary with season and environmental adaptability (Nadro and Umaru, 2004). Many studies had concerned the variability of species showing great interest to the local populations (Kelly*et al.,* 2022).*P. biglobosa* is in the early stages of domestication and although its reproductive behaviour is relatively well documented there is a lack of research on quantitative genetics (Lompo*et al.,* 2017). Diversity, which is of great importance for adaption of species, has various climatic and environmental conditions within climatic zones, the environmental conditions are known to induce a large spatial variability in the morphology and productivity of fruit trees (Arbonier, 2002) and environmental conditions can cause significant variations in the morphological characteristics of species populations (Dicko*et al.,* 2019). Tree species are characterized by high genetic diversity linked to geographical origin and to the difference between individuals within the same population (Goba*et al.*, 2019).This has been established that source of seed are genetically different from one location to another. The study of the fruit yield of *Pakiabiglobosa* is essential for tree improvement programs and domestication. Hence, selection of provenances with better yield could be visible after series of research. This study investigated the fruit yield of *Parkiabiglobosa*. However, variability studies are needed to increase plant productivity and also for future breeding work (Freigoun*etal.*, 2017)

MATERIALS AND METHODS

Study Area

This study was carried out at the plantation of *Parkiabiglobosa* in Wasangare, Saki-West Local Government Area (LGA) of Oyo State.Wasangare, Saki is located at Oke-Ogun part of Oyo State on the Latitude 8˚41 North and Longitude 30˚42 East.The Local Government Area (LGA)its linked in the North by KwaraState, in the East by Saki East and Republic of Benin and Atisbo LGA are to the West and South respectively. Saki-West Local Government has an average population of about 350,000. It comprises 1,909 villages and eleven political wards with 103, 417 households.The area is open woodland vegetation. This vegetation is similar to derived savanna ecological zone with two distinct seasons, wet and short dry seasons. The annual rainfall ranges between 1000mm and 1500mm with an average of 83 rainy days starting from the month of March to October and the dry season from the month of November to February. This period is characterized with the harmattan and high temperature during the day and cold nights and temperature between 20˚C and 30˚C. Geological formation of Saki is of basement complex rock (Kolajo, 2007) and the rocks are heavily faulted to form low inselbergs.

The *Parkiabiglobosa* plantation is located in Wasangare, one of the villages in Saki West Local Government. The plantation covers a total area of 6000m^2 along Ilesaibarubaway(Plate 1). It lies on Latitude 8.8558ºN and 8.8573ºN and Longitude 3.42353ºE and 3.42519ºE.The plantation shares boundaries with Oyo State Agricultural Development Project (OYSADEP) that donates the total land area of 10,000m^2 in which part of it was used for plantation establishment.*Pakiabiglobosa* that were native to some countries in Africa as shown in Table 1 were collected and established. This plantation was established in the year 1995. The plantation was divided into blocks and the blocks were further divided into plots comprising all the provenances of *Pakiabiglobosa* from Nigeria, Ghana, Mali, Cameroun, Burkina Faso, Benin, Giunea and Senegal (Plate 1). The plot area is 30m x 30m while the enspacement is 4m x 4m in

each plot. Beacon is used to represent each plot and block with a specific label of the provenance.

Assessment of Fruit Yield of *Pakiabiglobosa*

Trees with the highest Diameter at Breast Height (DBH) were selected for harvest in each provenance represented. Trees selected for assessment of fruit yield were tied with red nylon ribbon and labelled in order to identify the tree under observation. Total harvest was done for each tree from different provenances. Clustered pods of Parkia were harvested after the pod were fully matured (colour change to dark brown). The harvesting was done manually using appropriate device (sickle with long handle). Harvested pods in cluster form were carefully packed into a jute bag after removal from the mother tree, it was transported to the laboratory whereit was weighed and kept. The assessment of fruit yield of the plantation of *Parkiabiglobosa* was carried out in three consecutive fruiting seasons. The fruit yield of the plantation were determined in 2015, 2016 and 2017 respectively.The total weights per tree, total weight per bunch and number of bunches per tree were determined.

Plate 1: *Parkiabiglobosa*Plantation at Wasangare , Saki, Oyo State.

Plate 2: Plot Beacon Showing Sample Plot and Block of each Provenance

Statistical Analysis of Data

One way analysis of variance (ANOVA) was conducted for the data obtained using Completely Randomised Design (CRD). The data obtained were expressed as mean plus or minus standard error of the means (mean ±SEM). Duncan Multiple Range Test (DMRT) was used as a follow up test for means that were significant. The value of $p<0.05$ was regarded as significant for statistical comparison in all cases.

RESULTS

Yield of *Parkiabiglobosa* from Eight Provenances in the Year 2015

The number of fruit bunch per tree, number of pods per bunch, weight of bunch and total weight of fruits per tree. The yield quantification showed that *P. biglobosa*from Nigeria had significantly higher number of bunches (59) per tree of *Parkiabiglobosa*compared to number of bunches from other provenances. The number of bunches per tree of *P. biglobosa*from Benin Republic, Ghana and Guinea showed similarity, also the number of bunches per tree of*Parkiabiglobosa*from Burkina Faso and Cameroun are not significantly different from each other (Table 2).

The number of pod per bunch of *P. biglobosa*from Nigeria (47.00) and Burkina Faso (42.33) are similar but are significantly higher than other provenances. *Parkiabiglobosa*from Benin Republic had the least number of pod per bunch (24.33) but not significantly different from Senegal. The fruit weight per bunch of *Parkia*from the all the provenances were not significantly different except in Burkina Faso and Ghana. The weight of bunch per tree was evaluated across the provenances and the result shows that Burkina Faso had 33.00kg which was significantly higher than others but not significantly different to the weight of bunch in Nigeria (32.67kg) however, varied significantly from the result of other provenances.Result from Table 2 also indicates that the evaluated yield of *Parkiabiglobosa*from Nigeria gave the highest number of bunch per tree (59), highest number of pod per bunch (47) and the heaviest of the weight of *Parkia* per bunch (2.7kg), Also, the weight of bunch per tree of Nigeria provenance isnot significantlydifferent from Burkina Faso with the heaviest record (33kg). Also the least among the yield qaulity for *Parkiabiglobosa*under the consideration revealed that Senegal, Benin Republic and Mali were the least in the yield parameters investigated in the year 2015 (Table 2).

Table 1: Fruit Yield of *Parkiabiglobosa*Tree from Eight Provenances in Year 2015

Provenance	No of Bunch per Tree	No of Pod per Bunch	Weight of Bunch (Kg)	Weight of Fruits per Tree (Kg)
Senegal	$35.67^{d}\pm5.13$	$24.67^{c}\pm6.35$	$1.30^{c}\pm0.17$	$25.33^{c}\pm1.528$
Benin Republic	$44.00^{bc}\pm4.00$	$24.33^{c}\pm4.04$	$1.30^{c}\pm0.10$	$19.33^{d}\pm3.06$
Nigeria	$59.00^{a}\pm2.64$	$47.00^{a}\pm2.65$	$2.70^{a}\pm0.34$	$32.67^{a}\pm2.08$
Burkina Faso	$49.67^{b}\pm2.51$	$42.33^{a}\pm3.22$	$2.23^{ab}\pm0.23$	$33.00^{a}\pm1.00$
Ghana	$45.67^{bc}\pm5.50$	$34.00^{b}\pm5.29$	$1.57^{bc}\pm0.50$	$30.33^{ab}\pm2.52$
Guinea	$44.33^{bc}\pm4.61$	$34.00^{b}\pm2.00$	$1.33^{c}\pm0.15$	$27.67^{bc}\pm4.04$
Cameroun	$47.00^{b}\pm3.46$	$34.33^{b}\pm5.86$	$1.50^{c}\pm0.61$	$26.67^{bc}\pm1.53$
Mali	$38.00^{cd}\pm4.58$	$32.00^{bc}\pm3.46$	$1.17^{c}\pm0.21$	$25.33^{c}\pm1.52$

Mean followed by the same letter in the same column are not significantly different according to DMRT ($P\leq0.05$)

Yield of *Parkiabiglobosa* from Eight Provenances in the Year 2016

The evaluation of yield of *Parkiabiglobosa*from different provenances in 2016 indicated that the highestnumber of bunches per tree of *Parkiabiglobosa*from Nigeria (62.00) which was significantly higher than bunch record in other provenances. The number of bunch per tree in 2016 yield record varied diversely across the provenances. Similar trend were recorded in the number of pod per bunch of *Parkia. Parkiabiglobosa*from Nigeria recorded the highest number of pod (55.33) per bunch and was significantly different from other provenances with varied number of pod per bunch of *Parkia* but similarities were recorded in number of pod per bunch of *Parkia*from Senegal and Benin Republic, Ghana and Guinea, while other provenances varied significantly(Table 2).Result of weight per bunch was analysed and it was revealed that there was similarity in the weight per bunch of *Parkiabiglobosa*from Ghana and Guinea, Senegal and Mali while the result of the others countries provenance of *P. biglobosa*differ significantly but *Parkiabiglobosa*from Nigeria provenance gave significantly higher weight per bunch with the value of 3.57kg per bunch. Significant variation was also observed in weight of bunch per tree of *Parkiabiglobosa*in year 2016 yield record from Cameroun and this gave the heaviest weight of 41.33kg of bunch per tree was and this was significantly higher compared to weight from other provenances such as Senegal, Guinea and Benin. Variations were recorded in the weight of bunch per tree of *Parkiabiglobosa*across the provenances except similarity was recorded in weight per tree in *Parkiabiglobosa*from Nigeria and Mali (Table 2). Also, the result revealed in Table 3 showed that there was least number of bunches per tree of *P.biglobosa* from Senegal (40.00), number of pod per bunch from same provenance (32.33) with significant similarity with Benin Republic, least weight per bunch in Benin Republic (1.13kg) and weight of bunch per tree of *Parkiabiglobosa*22.33also recorded in Benin Republic. *Parkiabiglobosa*from Nigeria recorded highest values of yield in 2016 and was significantly higher than other provenances under consideration except the result of the weight of bunch per tree.

Table 2:Fruit Yield of *Parkiabiglobosa*Tree from Eight Provenances in the Year 2016

Provenance	No of Bunches per Tree	No of Pods per Bunch	Weight per Bunch(kg)	Weight per Tree(kg)
Senegal	40.00^{d}±6.24	32.33^{e}±4.93	1.93^{d}±0.11	29.33^{c}±2.30
Benin Republic	46.67^{bcd}±6.42	32.67^{e}±4.16	1.13^{e}±0.20	22.33^{d}±2.51
Nigeria	62.00^{a}±3.60	55.33^{a}±1.52	3.57^{a}±0.25	32.33^{ab}±2.08
Burkina Faso	53.67^{b}±2.30	51.33^{ab}±2.30	3.10^{ab}0.10	38.33^{abc}±1.52
Ghana	49.67^{bc}±6.11	42.00^{cd}±4.35	2.17^{cd}±0.35	35.00^{cd}±1.00
Guinea	47.33^{bcd}±3.51	41.33^{cd}±1.15	2.20^{cd}±0.10	33.67^{bc}±3.51
Cameroun	50.00^{bc}±2.64	46.00^{bc}±3.60	2.63^{bc}±0.35	41.33^{a}±4.83
Mali	41.00^{cd}±5.00	38.67^{de}±4.72	1.73^{d}±0.51	36.67^{ab}±5.85

Mean followed by the same letter in the same column are not significantly different at ($P \leq 0.05$)

Yield of *Parkiabiglobosa*Tree from Eight Provenances in the Year 2017

The yield quantification of *Parkiabiglobosa*in the eight provenances considered for this study for the year 2017 showed limited diversity and variation in the yield parameters compared to the record of yield for years 2015 and 2016. The number of bunch per tree of *Parkia*in 2017 shows that Nigeria and Burkina Faso had significantly higher number of bunch per tree of *Parkiabiglobosa*compared to other provenances. These two provenances also shows similarity in the number of bunch per tree of *Parkiabiglobosa.* A similar trend is shown in the values obtained in the number of pods per bunch of *P. biglobosa*across the provenances with few exceptions like Mali, Benin and Senegal.

Result also revealed that there is significant different in the number of pod per bunch of *Parkiabiglobosa*with a value of (65.33) in Nigeria compared to remaining provenances, this is followed by number of pod per bunch in Burkina Faso (61.33) respectively. The number of pod per bunch of *Parkiabiglobosa*from Ghana, Guinea and Cameroun showed similarities and likewise are *Parkiabiglobosa*from Senegal, Benin Republic and Mali in their number of pod per bunch. Similar trend were recorded in number of pod per bunch and weight of bunch of *Parkia*across the provenances. *Parkiabiglobosa*from Nigeria and Burkina Faso had significantly higher weight of bunch (50.00) per tree and compared significantly with weight per tree from other provenances with exception of Senegal and Benin Republic in 2017 yield record. The result present in Table 3 showed that *P. biglobosa from* Nigeria had the highest of all yield variables measured and showed similarities with *Parkia*from Burkina Faso. However, 2017 record showed that *Parkia*from Senegal is similar with Benin Republic and Mali had the least number of bunch per tree (51.67), *Parkia*from Benin Republic (38.67) had the least number of pod per bunch which is similar to Senegal and Mali, least weight per bunch also in Benin Republic (similar with Senegal and Mali) while the lowest weight of bunch per tree of *Parkia*was recorded also in Benin Republic (with no significant difference from Senegal).

Table 3: Yieldsfrom*Parkiabiglobosa*Tree from Eight Provenances in the Year 2017

	No of bunch per tree	No of pod per bunch	Weight per bunch(kg)	Weight per tree(kg)
Senegal	51.67^{b}±10.40	40.00^{c}±3.60	1.83^{c}±0.32	37.00^{b}±2.64
Benin Republic	60.67^{b}±5.13	38.67^{c}±3.51	1.70^{c}±0.45	32.67^{b}±3.05
Nigeria	78.67^{a}±3.51	65.33^{a}±3.05	4.47^{a}±0.32	50.00^{a}±2.00
Burkina Faso	74.67^{a}±3.51	61.33^{a}±1.52	4.07^{a}±0.11	50.00^{a}±2.00
Ghana	59.33^{b}±6.02	50.33^{b}±4.50	2.93^{b}±0.45	44.67^{a}±2.08
Guinea	58.00^{b}±3.00	50.33^{b}±0.57	3.03^{b}±0.05	44.67^{a}±4.50
Cameroun	61.00^{b}±7.93	52.00^{b}±5.29	3.13^{b}±0.55	49.67^{a}±2.51
Mali	53.67^{b}±6.11	41.00^{c}±1.00	2.13^{c}±0.05	44.67^{a}±2.51

Mean followed by the same letter in the same column are not significantly different according at ($P \leq 0.05$)

The overall appraisal of the yield of *Parkiabiglobosa* in terms of number of bunches per tree, number of pods per bunch, weight per bunch and weight per tree from years 2015 to 2017 are expressed in Figure 1. The result presented in Fig. 1 show that there were increase in the yield variables for each provenance assessed over the duration of the study. Nigeria provenance has the highest yield in terms of number of pods per bunch and weight of fruits per tree for the three consecutive years. This is followed by the yield from Burkina Faso, which equally perform well.

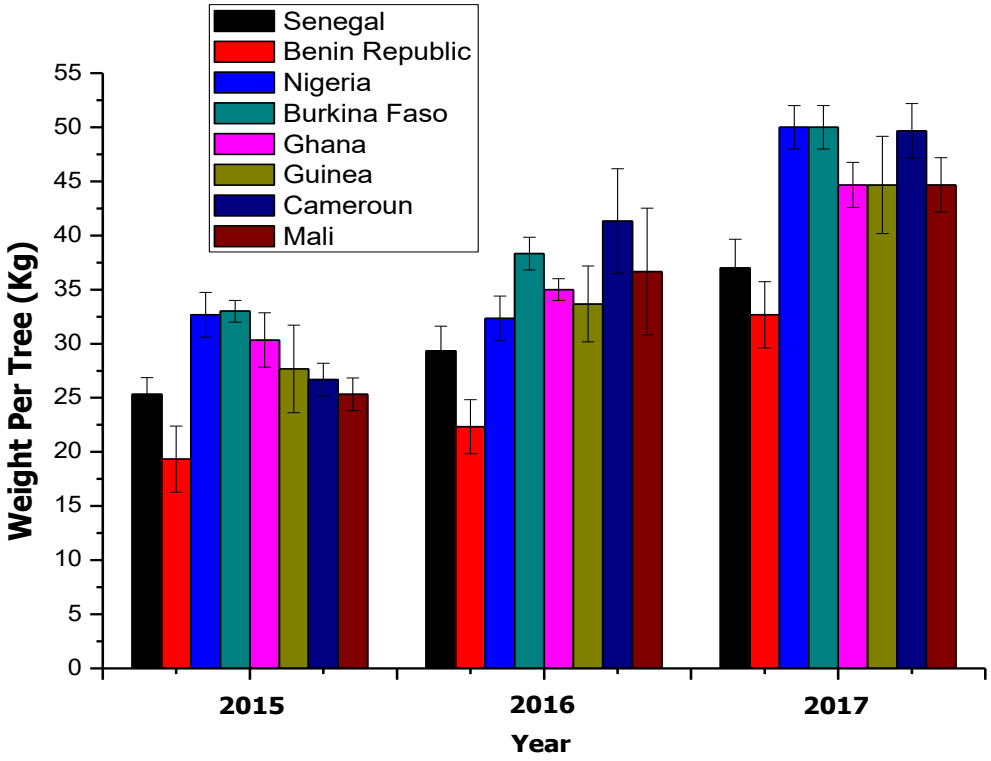

Figure 1: Average Weight per Tree of *Parkiabiglobosa*Grown from Eight Provenances at Wasangare

DISCUSSIONS

The result of the fruit yield of *Parkiabiglobosa* for the three consecutive years investigated revealed significant difference among the provenances and the years of investigation. There was an increase in the yield of the fruits of *Parkiabiglobosa* in all the provenances, though the yield varies from one provenance to another. This reveals that fruit trees tends to increase in fruit yield has the age increases irrespective of the source of the seed planted. The increase were revealed in the number of bunch per tree,number of pod per bunch, weight per bunch andweight per tree. These results correlate with Olorunmaiye*et al.* (2011), who reported that population of *Parkiabiglobosa* hadamazing character that cuts across the number of pods per bunch,number of seeds per pod, number of seeds per bunch, when fruitsand seed characteristics were studied among twenty six (26) trees of *Parkiabiglobosa* (Jacq.) G. Don.The variation in the yield of *Parkiabiglobosa* across the provenances could be supported by the report Oyerinde*et al.*, (2018) who reported that there significant variation in pod number per tree, pod weight per tree, seed weight per tree, pod length per tree and pod breadth per tree of *P. biglobosa*across the selected States in Nigeria. The observation reported could be due to the substantial effects of the environment such as

rainfall, different temperature, soil types and distribution of the trees and land use types within the same country (provenance). However, the rate of yield increase varies with the provenances. The fruit yield of Nigeria were higher probably because the Nigeria provenance is able to adapt favourably with the same climatic and edaphic condition on which it is presently grown. These results were similar to .Dicko*et. al.,* (2019) who reported that the presence of variability of traits between phytodistricts is essential for selection for domestication purposes. A report on the study of assessing morphological traits variation and fruit production of *Lophiralanceolata* (Ochnaceae) in Benin which prove that in process of domestication, variability could provide opportunities to identify and select new cultivars through an orientated selection scheme that may be involve in precocity and abundance of fruit produced. In view of conserving the genetic resources of trees, which *Parkiabiglobosa* is of great interest, intraspecific genetic variations are needed to ensure the future adaptability of the species that would occur after natural selection.

Also, the fruit yield *Parkiabiglobosa* from Burkinafaso, Ghana and Cameroun could be rated good, having grown in a new environmental condition and yet it'sgive good yield. This implies that the fruit yield of *Parkiabiglobosa* tree from these provenances may possess some genetic adaptive features which may allow it to adapt favourably with the climatic condition in Nigeria. The provenance of *Parkiabiglobosa* from Benin, Guinea, Senegal and Mali may contain some good quality traits which may probablyberecessive on Nigeria soil and environment.The result of variability in the fruit yield of *Parkiabiglobosa* from different provenances under investigation, suggest specific genetic traits from their provenances within and among the same species. The variability result of the yield of *Parkiabiglobosa*correlates with Agboladet *al.,* (2012), in study of genetic variability and diversity analysis in fruits Characteristics of Some Neglected and Underutilized Legumes also revealed that genetic variability is either the presence of or the generation of genetic differences and could be explained as the formation of individuals differing in genotypes or the presence of genotypically different individuals in contrast to environmentally induced differences which has a rule cause only temporary non-heritable changes of the phenotype Genetic variability in a population is important for biodiversity (Agboladet *al.,* 2019). Genetic diversity deals with the total number of genetic characteristics in the genetic make-up of a species (Ammar*et al*., 2015,Agboladet *al*., 2013). In addition, genetic diversity in a population of plant species is a crucial resource for increasing food production and for development of sustainable agricultural practices (Esquinas-Alcazar, 2005).

The yield in terms of weight of fruit, number of bunches per tree and number of pod per bunch increases with the year. The result obtained showed that the fruit yield increases with the age of the tree. As the year increases from 2015 to 2017, the result from the yield parameter measured increases. At a particular level, the yield from Burkina Faso is not significantly different from the yield from Nigeria provenances. It could be deduce from this result that *P. biglobosa* from other provenances were showing some adaptability traits, has their fruit yield tends to increase over the period of three years of study. The result obtained correlates with the Bondé*et al.* (2019) who reported in a monitoring study of the fruit production of shea tree over four consecutive years aimed to assess the interannual variation in fruit production and understand the production patterns of the species.Itwassubmittedthat effects of internal an d external factors couldberesponsible for the interannual variation in fruit production of sheatr ee from the study.

The obtainable weight of pods harvested from different provenances of *Parkiabiglobosa* were within the same rangereported byJanick and Paull (2008) on the fruiting *Parkiabiglobosa*starts at the age of 8 years. Total harvest from a particular tree of Parkia could yield 25-100 kg of pods/tree/year can be harvested from 15- to 20-year-old trees. Moreover, even among large, potentially reproductive individuals of the same species, reproduction is unequal, with most of the fruit being produced by a few individuals. This variation among individuals indicates that there are additional factors influencing fruit production in treeshas reported by González-Martínez*et*

al., 2006, Herrera & Jovani, 2010; Minor & Kobe, 2017; Moran & Clark, 2012.

This implies that some of these provenances may perform better as the age increase until the peak of fruit yield is attained. This could be that fruit yield from different provenances can be affected by several factors which are, climatic factor, edaphic factor, genetic factor and more so adaptive factor. All the earlier mentioned factors are key sources of variability in the fruit yield of *Parkiabiglobosa* from different provenances. These key factors need to be assessed before a provenance could be tagged with a better yield for tree improvement program and domestication.

CONCLUSION AND RECOMMENDATION

It has been confirmed that there are variations in fruits yield of the provenances of *Parkiabiglobosa*established in Wasangare, Saki West Local Government Area of Oyo State. The study of *Parkiabiglobosa* plantation has highlighted its fruit qualities features which could be a precursor to its domestication and plantation establishment. *Parkiabiglobosa* fruit yield increases with the age of the tree but varies in yield among the provenance investigated. The difference in the fruit yield of Parkia could probably be as a result of genetic variation within the species and the provenance adaptability of individual trees established. This study also showed that each trees of *Parkiabiglobosa* display disparity in fruit yield despite under the same environmental condition. However, conservation and sustainability of genetic diversity within the species is essential for tree improvement and breeding purposes. It is recommended from this study that seed sourced from Nigeria, Burkina Faso, Cameroun and Ghana could probably further study for domestication and tree improvement program in Nigeria.

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