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Survey and collection of *Jatropha curcas* L. in the northwestern Savannas of Nigeria

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ABSTRACT

The Existence and Distribution of *Jatropha curcas* L. germplasms in the Northwest zone of Nigeria is hereby reported with coordinates and point mapping. Fifty seven (57) accessions were collected from the seven States of the zone which spans across the Sahel, Sudan and Guinea Savannas. The collection was made from 18th to 22nd of August 2009. A plantation was established from these collections and the seeds from 39 different provenances of the seven States were analyzed for their oil content. The mean oil content ranged from 20.29% to 61.83% (CV 29.11%). The 100-seed weight ranged from 28.558g to 80.046g. There was a positive correlation between 100 seed weight and oil content ($r = 0.235$). The accessions from Kaduna State, spanning through the Sudan and Northern Guinea Savanna, had the highest mean oil content followed by those from Kano and Katsina States in the Sudan Savanna ecology. There were no significant differences ($p < 0.5$) in the accessions from Jigawa, Kebbi, Sokoto and Zamfara States which are mainly located in the Sudano-Sahelian Savanna agro-ecological zone. Most of the provenances visited were more than 50 yrs old as reported by the locals, implying that Jatropha has been a long existing crop in Nigeria. The existence of Jatropha in almost all the visited locations, and the impressive intensity of fruiting as sighted on the trees and their oil contents show that the potential for adopting it into the farming systems of these localities as source of renewable energy exists.

1. Introduction

Nigeria is the 8th largest petroleum producer in the world [12]. But there are speculations that her petroleum reserve will be depleted in less than 40 years, considering the rate at which it is being exploited for export (691,491 barrels per year) [10] and domestic utilization (113,228 barrels per year) [11]. Consequently she, like most countries in the world is directing attention and resources to the development of bio-fuels as the most immediate and available response to coping with depleting oil reserves and climate change. Bio-fuel production is man's ultimate success to convert biomass (plant and animal matter) to renewable energy within a very short time frame. *Jatropha curcas* L. has recently received much attention as a potential biodiesel crop in more than 50 countries. This is because the biodiesel derived from its oil

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Table 1 – Ecogeographical characteristics of the survey area in the Northwestern Zone of Nigeria where *Jatropha curca* L. germplasm were collected.

State	Location		Ecoregion	Soil type	Climate
	Latitude (N)	Longitude (E)			
Kaduna	9°30′-11°22′	8°21′-7°14′	NGS SGS	Alfisols	Tropical wet and dry
Katsina	11°23′-13°07′	7°23′-7°47′	SSS	Entisols	Tropical wet and dry
Kano	11°06′-11°58′	9°00′-9°02′	SS	Alfisols	Hot and semi-arid
Jigawa	11°00′-11°33′	9°30′-9°34′	SSS	Alfisols	Hot and semi-arid
Zamfara	11°56′-13°07′	6°25′-6°43′	SSS	Entisols	Hot and semi-arid
Sokoto	12°03′-13°10′	5°46′-4°33′	SSS NGS	Entisols	Hot and semi-arid
Kebbi	12°05′-12°41′	4°07′-4°26′	SSS		Hot and semi-arid

SS: Sudan Savannah, NGS: Northern Guinea Savannah, SSS: Sudano-Sahelian Savannah.

conforms to the International standards [2,4,8,9]. Current estimates suggest that there are now more than 2.5 million hectares of *J. curcas* planted in India and China alone [3]. Despite the interest that is being shown in the large-scale cultivation of *J. curcas*, genetic resources remain poorly characterized and conserved. Though *J. curcas* grows widely in Nigeria and several collections of the plant are also maintained, provenance records are not available. It is therefore important to document and evaluate the different Jatropha provenances in Nigeria with respect to their agro-morphological traits, oil content and diseases as well as its uses by the locals. Therefore this collection expedition set out to explore the Northwestern zone of Nigeria for *J. curcas* provenances and also collect Jatropha germplasm for future characterization, provenance trial and genetic improvement.

1.1. *The survey area*

The states that were surveyed comprise the Northwestern agro-ecological zone of Nigeria (Latitude 9°28′-13°11N and Longitude 4°02′-9°53′E). These are Kebbi, Sokoto, Zamfara, Kaduna, Katsina, Kano and Jigawa States and covers regions in the Southern and Northern Guinea Savanna, the drier Sudan Savanna, and the semi-desert Sahel Savanna. Rainfalls are generally poor and oscillate between 500 and 1,500 mm (20–60 in) in Sokoto, Zamfara and Kebbi State located at the extreme North and 1000–1,500 mm (40–60 in) in Kaduna, Kano, Katsina and Jigawa States located at southern part of the zone.

The ecologies, climates, soil types, and the locations where the Jatropha germplasms were collected are shown in Table 1.

2. Materials and methods

A working itinerary for the germplasm exploration and collection was planned and prepared as described in Guarino (1995). The collections were made between 18th and 22nd of August 2009 from seven states of the Northwest zone of Nigeria by randomly selecting different locations like range lands, land fence, farm fences and courtyards in villages. About 1 kg of fruits were collected where available from all sides of the plants in a provenance and pooled. Important agromorphological traits like plant height and fruiting intensity per provenance were estimated by visual observations. Provenances where up to 1 kg and above fruits were available

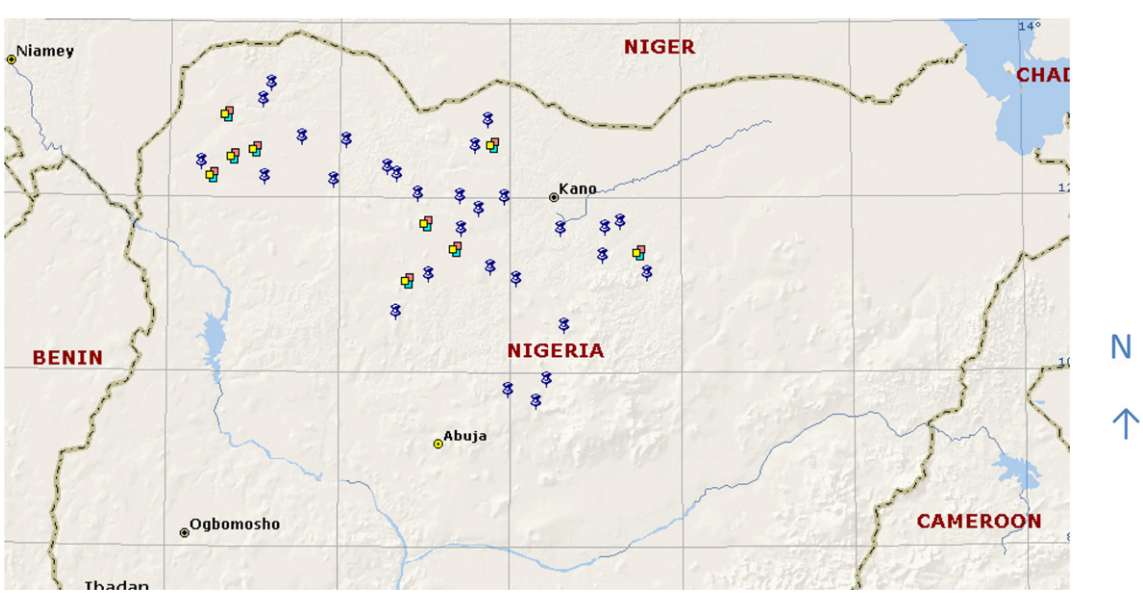

Fig. 1 – Mapping of the 57 Provenances of *Jatropha curcas* L. accessions collected from Birnin Kebbi, Sokoto, Zamfara, Kaduna, Katsina, Kano and Jigawa States of the NorthWestern zone of Nigeria.

Table 2 – Percentage oil content and 100-seed weight of *Jatropha curcas* L. provenances in the Northwestern States of Nigeria.

State	Local government area	Provenance	Percentage oil content (%)	100-seed weight (g)
JIGAWA	Birnin kudu	*Kangire*	42.57[a–h]	41.582
JIGAWA	Birnin kudu	*Burum*	36.70[a–h]	69.743
JIGAWA	Birnin kudu	*Masaya*	31.52[c–h]	59.043
KADUNA	Giwa	*Iyatawa*	56.36[a–c]	54.394
KADUNA	Giwa	*Bakin gada Gangara*	54.05[a–d]	48.391
KADUNA	Birrnin-gwari	*Dogondawa*	51.46[a–f]	52.975
KADUNA	Lere	*Kayarda*	47.13[a–h]	66.199
KADUNA	Zaria	*Kakeyi*	42.99[a–h]	54.452
KADUNA	Giwa	*Farin gida*	40.32[a–h]	59.698
KADUNA	Giwa	*Danjawei Sabon–gida*	38.50[a–h]	80.046
KADUNA	Soba	*Soba*	33.13[b–h]	41.116
KANO	Gwarzo	*Gwarzo*	45.81[a–h]	47.08
KANO	Takai	*Dirpindai*	45.51[a–h]	51.185
KANO	Makoda	*Welare*	41.87[a–h]	36.98
KANO	Rano	*Ruwan kanya*	39.17[a–h]	42.83
KANO	Gwarzo	*Muradi/Tashan gajere*	36.31[a–h]	49.757
KATSINA	Dutsenwai	*Karohi 1*	51.85[a–e]	45.012
KATSINA	Faskari	*Dakamawa*	51.12[a–f]	59.229
KATSINA	Charanchi	*Kuki*	49.65[a–g]	36.915
KATSINA	Malumfashi	*Dan janku almakiyayi*	38.55[a–h]	51.282
KATSINA	Bakori	*Kakumi 1*	38.36[a–h]	56.228
KATSINA	Funtua	*Bagire (Rufan kifi)*	23.26[f–h]	54.349
KEBBI	Wasagu	*Maga Danko–*	59.74[ab]	59.299
KEBBI	Argungu	*Ungwar Maifada*	36.87[a–h]	50.962
KEBBI	Alero	*Gangije*	33.86[b–h]	41.223
KEBBI	Alero	*Jega Birni*	28.56[c–h]	60.228
KEBBI	Zuru	*Sabongari Dabai*	21.78[gh]	35.233
SOKOTO	Tureta	*Bella Town*	51.27[a–f]	44.716
SOKOTO	Shagari	*Kajiji*	49.32[a–g]	28.558
SOKOTO	Tambuwal	*Barkeji*	35.33[a–h]	50.332
SOKOTO	Bodenga	*Pompo bodinga*	23.81[e–h]	44.615
SOKOTO	Kware	*Tsaki*	23.24[f–h]	40.081
ZAMFARA	Talata Mafara	*Takai Tsafe*	61.83[a]	46.903
ZAMFARA	Bugundu	*Dandotodaji*	55.50[a–d]	60.941
ZAMFARA	Gumi	*Daki takwas*	30.15[c–h]	55.967
ZAMFARA	Tsafe	*Chida*	28.05[c–h]	46.6
ZAMFARA	Tsafe	*Magazu*	27.31[d–h]	36.135
ZAMFARA	Gusau	*Nasarawa Wanke*	21.33[gh]	37.186
ZAMFARA	Bukkuyum	*Zugu*	20.29[h]	30.879
Mean			39.14	49.445
CV(%)			29.11%	21.99%

Means with the same letter(s) are not significantly different ($p < 0.05$).

for collection were considered as having good fruiting intensity. The existence of the Jatropha in the various locations and their uses were recorded based on information given by the locals. The diseases of the plants and eco-geograhical features of the collection sites such as the topography and soil type were also noted. The collection sites' coordinates were recorded using the Global Positioning System. Encarta World Atlas Map (Microsoft Encarta, 2009) was used for point mapping of the sites. 100-seed weights of seeds from 39 different provenances were determined and analyzed for their oil content using solvent extraction method according to the [1] protocol.

3. Results and discussion

Fifty seven accessions of *J. curcas* L. germplasms were collected from eleven locations (provenances) each in Kaduna and Zamfara states and seven each in Kebbi and Sokoto States, ten in Katsina State, five in Kano State and three in Jigawa State (Fig. 1). The plants' height ranged from 1 to 5 m. The tallest trees were found in the Guinea and Sudan Savannas of the survey sites. The stems were thick, green, glabrous, mostly herbaceous or somewhat succulent, becoming woody at base. Flowers were small, yellow and unisexual. The fruits were ovoid, 3-locular capsule, at first green and fleshy, becoming yellow and then brownish or almost black and dry at maturity. The physiologically mature fruits i.e. yellow, brownish and black fruits were collected. They contain 3 black seeds about 10 mm wide and 20 mm long. Many of the provenances in the survey area were diseased, their leaves were curly and yellowish, and such plants were not fruiting well. The diseases were suspected to be viral. Common insect pests observed were leaf blotch miner and thrips. Many of the provenances were said to be

over 50 years according to the information gathered from the elderly locals, some of who claimed the plants had been in existence before they were born. This was contrary to the reports by [5] and the Missouri Botanical Garden databases [7] reported in King et al. (2009) [6] which excluded Nigeria among those countries having Jatropha in existence. For example, an elderly local at *Kuki* in *Charanchi* Local Government Area (LGA) of Katsina State recounted that his father had preferred his Jatropha farm fencing to the Neem tree that was introduced to him by one of his white friends during the colonial era. The potential of Jatropha on marginal and eroded soil was well acknowledged by the locals. It appeals to the local basically because of its drought hardiness, rapid growth, easy propagation, short gestation period, wide adaptability, production on good and degraded soils. This explains why it is more commonly used as land and farm fences. In all the communities surveyed Jatropha is also used for the treatment of gonorrhea, mouth infections, stomach ache, arthritis and ring worm. These have led to excessive destruction of the plants by herbalists in some localities where the roots and stems are used for medicinal purposes. However in some places like *kangire* Birnin kudu LGA of Jigawa state Jatropha was believed to ward off evil spirits in homes and so it was planted in courtyards and protected. All the provenances seen were domesticated. The topography of most of the collection sites was level. Jatropha was found more in the Sudano-Sahelian Savanna than the Guinea Savannas of the states surveyed. Preliminary analysis of the seeds from 39 different provenances of the seven States for 100-seed weight and oil content showed that the mean oil content ranged from 20.29% for the collections from *Zugu* in Zamfara state to 61.83% for that from *Takai tsafe* also in Zamfara State (Table 2). Nine accessions out of the 39 accessions screened had oil content below 30%. There was high CV = 29.11% showing that variability exists among these accessions. The accessions from Kaduna state, spanning through the Sudan and Northern Guinea Savanna, had the highest mean oil content followed by those from Kano and Katsina states in the Sudan Savanna ecology. There was no significant difference ($p < 0.5$) in the provenances from Jigawa, Kebbi, Sokoto and Zamfara States (Fig. 2). The later states which are mainly located in the Sudano-sahelian Savanna agro-ecological zone had relatively the lowest oil content. 100-seed weight ranged from 28.558 g for collections from *kajiji* provenance of Shagari LGA Sokoto state to 80.046 g for those from *Danjawei sabongida* of Giwa LGA Kaduna state (CV 21.99%). There was little positive correlation between 100-seed weight and oil content ($r = 0.235$).

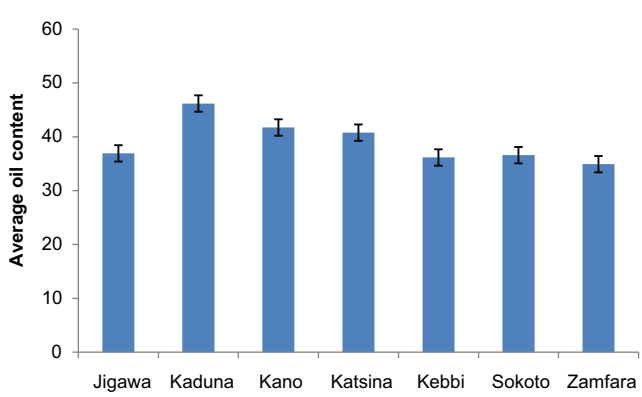

Fig. 2 – The average oil content (%) with the standard error bars of seeds of *Jatropha curcas* L. germplasms for the seven states of the Northwestern zone of Nigeria.

4. Conclusion

As the initial step in the genetic improvement of Jatropha for its potential in biodiesel production, effort has been made to actually identify the existence and distribution of this crop in the Northwestern States of Nigeria, and also to make germplasms collections. It is evident from this study that Jatropha has been long existence in Nigeria, based on the average age of the provenances visited. The survey also showed that *J. curcas* can be propagated even in the extremely hot and semi-arid climates of the Sahel Savanna and tropical wet and dry Southern Guinea Savanna. Furthermore, the existence of Jatropha in almost all the visited locations, and the impressive quantity of fruits sighted on the trees shows that the potential for adopting it into the farming systems of these localities exists. The high oil contents and the variability observed indicates a promising future for improved productivity of the renewable energy crop *J. curcas* L. in Nigeria.

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