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# The complex distribution of plantain cultivars (*Musa* sp., AAB subgroup) in the Bas-Uele province of the Democratic Republic of Congo

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**Plantain is one of the most important sources of food in the African lowlands stretching from the lowlands of Guinea and Liberia to the central basin of the Democratic Republic of Congo (DR Congo). Because plantain cultivars do not produce seeds, plantain cultivation is based on vegetatively transplanted lateral shoots/suckers. The way by which plantain reached the African continent is still under speculation. The aim of this study was to shed light on the history of plantain cultivars through a linguistic/synonymy study in northern Democratic Republic of Congo. We report the diversity of plantains in 18 villages across the Bas-Uele province based on a survey. Three villages in which plantain production systems dominated were selected in each territory, and ten households were consulted in each village. In each selected village, a focus group discussion was conducted with a group of at least 30 men, and with a separate group of 30 women to establish a list of plantain cultivars grown and known. A total of 46 cultivars were identified and 294 synonyms detected. The cultivar names are mostly related to animal features and agronomic traits, although there is a need to revisit the list for more specific traditional names. The local differences in cultivar identity, density and distribution are explained partly due to the influence of humid forest versus savanna landscapes, but the main part seems to be due to previous movements of Benza, Boa, Ngbandi, Rambo and Zande ethnic groups with their own set of cultivars. We demonstrate that the recorded synonymy data are useful for a tentative partial reconstruction of the history of some cultivars. This is useful for the genetic improvement of plantain cultivars, which most probably will have to rely for a great deal on the unraveling and management of epigenetic mechanisms.**

**Key words:** Bas-Uele, cultivar, diversity, ethnic group, plantain, synonymy.

## INTRODUCTION

Plantain (*Musa* sp., AAB subgroup) is one of the main food crops in the forest regions of central and western Africa. Although the plant is of Asian origin (D'Hont et al., 2012), it is in Africa that it has developed by far the

greatest diversity with about 120 cultivated varieties (cultivars) (Swennen, 1990; Swennen et al., 1995; Adheka et al., 2018a).

Plantain is the second most important staple food crop after cassava in the Democratic Republic of Congo (Pemsl and Staver, 2014). Because these cultivars do not produce seeds, plantain cultivation is maintained vegetatively by transplanting suckers (that is, lateral shoots) (De Langhe et al., 1995). Cultivars are therefore clones. Therefore, their history has been very difficult to trace in the archaeobotanical record. The development of this exceptional diversity in Africa can only be explained by a century-long accumulation of somatic mutants from presumably a few basic cultivars introduced from Asia (De Langhe et al., 1995; Daniells et al., 2001; Mbida Mindzie et al., 2001). It has even been suggested that the arrival of plantains in west-central Africa caused an agricultural and demographic revolution which drove the expansion of speakers of Bantu-languages (De Langhe, 2007; Blench, 2009). The base of current rainforest agriculture is formed by *Musa* species of the AAB group (plantain) (Neumann et al., 2012).

As the plantain is a subsistence crop, the traditional farmer tends to maintain all cultivars, whatever their productivity. However, the bunches of a number of cultivars have a special post-harvest value, such as resistance to damage during transportation and various particular consumer-attractive aspects of bunch and fruits in the local markets. The wide diversity of plantain cultivars in west and central Africa has been described and classified using morphological traits (Adheka, 2014). A detailed taxonomical classification system using specific descriptors has been established for the plantains (De Langhe et al., 2005). In addition, various studies have assessed plantain growth and yield attributes (Wong et al., 2001).

During recent decades, the advent and growing presence of several diseases and pests in plantain fields have activated the genetic improvement of the crop (Ortiz and Swennen, 2013). However, while success was obtained in producing resistant hybrids, the latter are hardly reproducing the plantain-cultivar typical forms and the quality of fruits preferred by the consumers. Such desired reconstruction during resistance-breeding requires a precise understanding of the genetics of the somatic mutations that generated the cultivars. But the searches on genetic markers of *Musa* taxa have led to the conclusion that the somatic mutations are probably the result of differences in the expression of particular DNA sequences (that is, epigenetics), rather than changes in these sequences (Hippolyte et al., 2012). While the required type of genetic research for discovering such expression differences has become routine for human and animal beings, it is at its beginning in the floral world. Regarding the plantain cultivar generation, one should expect a very long time before the complex “gene expression” mechanisms will be unraveled for so many somatic mutations and before these results can be used in resistance breeding (De Las Rivas et al., 2014).

Such undertaking needs, in the first place, to identify those DNA sequences that participated at the varying morphological expressions corresponding to somatic mutant (Pillay et al., 2006; Bartoš et al., 2005; Boonruangrod et al., 2009). This in turn requires a sufficient knowledge of the history of these mutants. For example, basic mutations on bunch structure may have been followed by secondary ones on the fruits, but the reverse sequence may have occurred as well.

Unfortunately, this historical knowledge is as yet lacking. Even the history of the plantains in Africa is still a matter of speculation and hypotheses (De Langhe et al., 1995; Rossel, 1998). The reconstruction of the history of the plantain cultivars-hence the somatic mutations-stumbles against the impossibility of finding archaeological macro-traces (Vrydaghs et al., 2009). Since banana plants are herbaceous plants, they do not produce wood, the remaining of which could have been used for carbon dating.

In addition, the cultivars produce neither pollen nor seeds, unlike in other crops where these structures are commonly traced in archaeological layers (De Langhe et al., 1995). The only reliable physical micro-traces are phytoliths, intracellular silicates, which do not deteriorate even in the rather acidic soils of Equatorial Africa, and whose volcano shape is characteristic for bananas. It is based on phytoliths that the presence of plantain in Cameroon was dated to some 2,500 years ago (Lejju et al., 2006; Blench, 2009; Neumann et al., 2012). Therefore there is a need for the differentiation of phytoliths produced by particular banana groups, both wild and cultivated (Vrydaghs et al., 2009). Unfortunately, as archaeological research in Central Africa is extremely rare, the chances of finding more phytoliths are almost zero.

There remains an unexplored alternative for the characterization of plantains: comparative linguistics. It consists of collecting a consistent number of cultivar names, and determining their etymology and original appearance (Rossel, 1998). By comparing the different results of the analysis, it should be possible to tentatively reconstruct a relative history of the cultivars. This research has a multidisciplinary character, as it should develop in two major phases:

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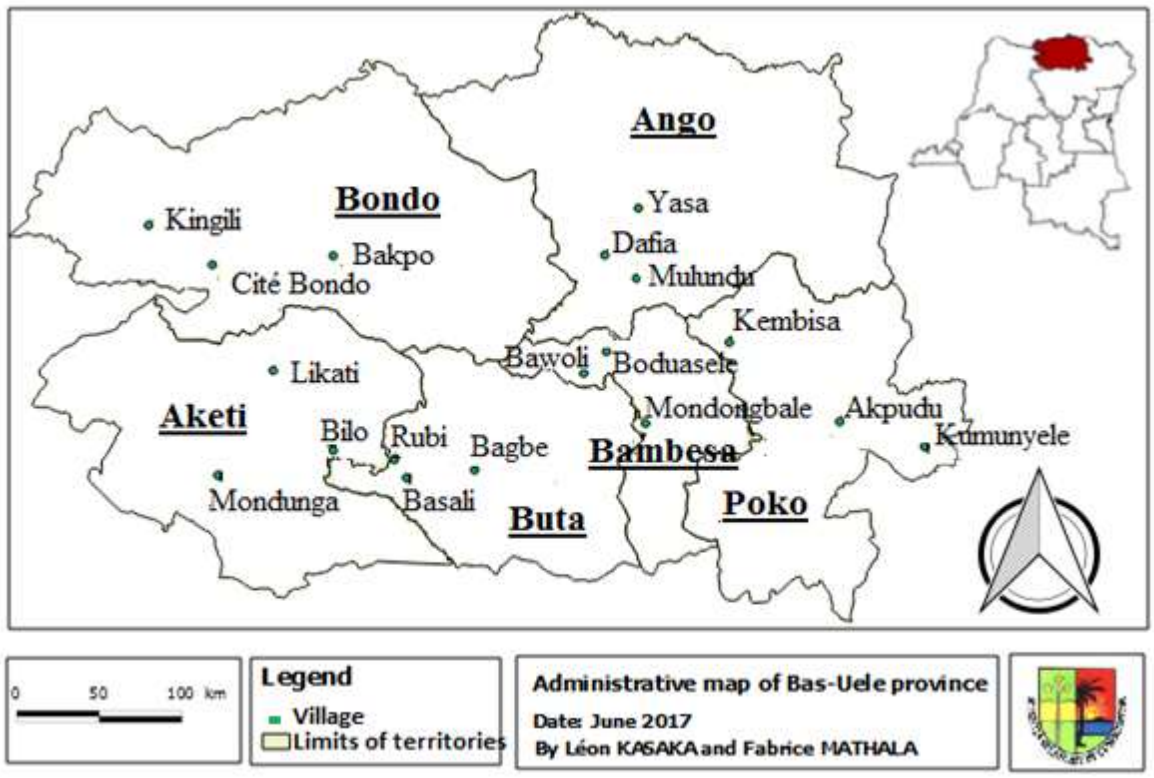


**Figure 1.** Location of the study site.

(1) The rather complete collection and correct identification of all the cultivars with their vernacular names and
(2) The comparative linguistic study of the names.

Unfortunately, the phase (1) has never been carried out in an orderly way. Many cultivars have been recorded in many areas, but their taxonomical identity has been established only in a few field collections which are found in restricted areas (Supplementary file: Table S2). The University of Kisangani (UNIKIS) is presently developing a long-term program for an extensive study of plantains across the entire DR Congo. A basic component of this program aims precisely at meeting the phase 1 requirement, the identification and name registration of all the cultivars, province by province. This article reports the results of such an effort in the Bas-Uele province, located in the extreme north of the country (Figure 1). It subsequently develops some prospects for the implementation of phase 2.

## Context

The vast majority of edible bananas are derived from two wild species *Musa acuminata* (A) and *Musa balbisiana* (B). They are diploids or triploids, classified in "groups" according to their A and B-genome composition as AA, AAA, AB, AAB, ABB (De Jesus et al., 2013; Perrier et al., 2011; Pachuau et al., 2014; Hapsari et al., 2015).

Participation of different diploids in the triploid formation process generated different hybrids of which some were selected and cloned (vegetatively propagated) till present times (Simmonds and Shepherd, 1995; Perrier et al., 2011). Continuous cloning of these basic cultivars generated an increasing number of somatic mutants, new cultivars. The resulting assembly of the original and the new cultivars is called a "subgroup". The assembly of AAB Plantain cultivars is an AAB subgroup among others, such as the AAB Mysore and AAB Pome in India, or the AAB Maia Maoli in the Pacific islands. Only recently has the entire evolution from wild species to subgroups been rather convincingly reconstructed (Perrier et al., 2011). It was thereby explained that not all the subgroups developed within the primary centre of *Musa* diversity, and how major intra-subgroup diversification took place in remote regions, such as in the Pacific Islands for AAB Maia maoli, and Africa for AAB Plantain. However, despite substantial progress in molecular genetics of bananas, the exact area where subgroups originated in the primary diversity centre remains unclear. For the AAB Plantains, it has been advanced that the basic hybrid or hybrids were probably formed in the Philippines some 3 to 4000 years ago (De

Langhe et al., 2015).

All plantain cultivars in Africa belong to the AAB plantain subgroup. Incidentally, the name “plantain” is sometimes still erroneously used also for starchy subgroups in general. How and when the initial cultivar(s) were introduced remains a matter of speculation (Blench, 2009). One hypothesis advances that the plantains arrived on the African East coast perhaps more than 3000 years ago, with Austronesian-speaking ancestors as the possible vector (De Langhe et al., 1995; Rossel, 1998; Perrier et al., 2011). It is also uncertain how the plantains diffused in the continent. An important indicator is the fact that almost all plantain cultivars are found in the humid rainforest.

Initial cultivars may have crossed the drier eastern part via the humid flanks of the mountainous range from the Usambara Hill to Mount Elgon and then along the periphery of the rainforest up to southern Cameroon (De Langhe, 2007). The agents of this move would have been already familiar with modest vegetative propagation techniques. Starting from Cameroon, Bantu ancestors would have intensively cultivated the plantains throughout the entire rainforest, thereby triggering the multiple somatic mutation process (De Langhe, 2007; Blench, 2009). The linguistics evidence, however, does not appear to be a straight case of dispersal of crops with a single term but a displacement of one regional term by another (Vansina, 1990).

Through morphological trait analysis, three major types of plantains are distinguished: French, False Horn and Horn plantains (Swennen et al., 1995; Ortiz et al., 1998). French plantains have the complete inflorescence of a typical banana plant. In False Horn plantains, the male bud becomes rapidly exhausted, well before fruit maturity, and the fruits are longer shaped like the cow horn. Horn plantains lack any male part of the inflorescence and the hornlike fruits are even longer. The French cultivars display the highest range of combinations of various distinct characteristics such as plant sizes, pseudostem colors, bunch orientations and structures, and fruit forms and colors. The number of combinations is less numerous in False Horns and only a few Horn cultivars have been recorded (Swennen and Vuylsteke, 1986; De Langhe, 2005) (Supplementary file: Table S1).

Plantains require a hot and humid environment. For optimum yield, the average air temperature should be about 30°C, while an average rainfall level of at least 100 mm per month is required. Relative humidity should range between 60% and 80% (Lu et al., 2002). Plantains are very sensitive to water deficit and yields decrease when dry seasons are long (Swennen, 1990; De Langhe, 2007). In regions of limited rainfall intensive plantations are irrigated (OECD, 2010). In DR Congo, the highest diversity of plantains is observed in the territories completely covered by the rainforest because of permanent humidity and regular rains (Adheka et al., 2018a, 2018b).

Plantains can be cultivated in soils of varied textures, from very sandy to very clayey, although the former soil requires more frequent watering or a mulching system to maintain water content. A good soil must have large amounts of potassium (K) and magnesium (Mg). A pH range between 6 and 7 is optimal (Simmonds, 1966, 1973).

In the DR Congo, the distribution of about one hundred recorded cultivars is complex as apparent from a first prospection across the country (Adheka, 2014). Some cultivars were recorded almost everywhere, while others seem to be confined to particular regions or even village groups. Ecological differences could partly explain that heterogeneity, such as the dominance of French plantains in the rainforest, and False Horns and Horns in adjacent drier zones (Adheka et al., 2018a). But the distribution pattern appeared to be linked for a major part to that of different ethnic groups, with each group growing a mix of the ubiquitous cultivars and “its own” cultivars.

One can assume that the many additional cultivars are somatic mutants generated along the history of each ethnic group, thereby receiving their vernacular names in that group’s language. Exchange of cultivars between neighboring ethnic groups is still the practice and should have occurred in the past as well. This would explain the existence of some cultivars in several ethnic groups, and the corresponding appearance of many loanwords. Understanding the etymology of the involved vernacular names should be of great help for the historical reconstruction of all these events, and eventually allow the reconstruction and clarification of the somatic mutation process itself (De Langhe et al., 1995).

Such undertaking calls for the establishment of standard names of all recently recorded cultivars, to which their various vernacular names can be referred to. This has been realized at the University of Kisangani with a field collection, its *in vitro* duplication, extensive morphological trait/growth/yield description of each accession, and the adoption of standard names (Adheka, 2014). A firm basis for the planned systematic exploration of cultivar diversity across the entire DR Congo has thus been established, and the study reported here in the Bas-Uele province is one of its first products. We thereby adopt the term “synonym” for the vernacular name of any cultivar of which the morphology was found to be identical to that of a standard cultivar in the basic field collection at Kisangani.

## MATERIALS AND METHODS

### Study area

The Bas-Uele province is located in the extreme north of the DR Congo between 2°48'20" North Longitude and 24°44'26" East Latitude with a total area of 148,321 km$^2$ (Tshonda, 2014). It is bordered to the north-west by the Central African Republic and to the north-east by South Sudan, to the east by the Haut-Uele province, to the west by the Mongala and Northern Ubangi

**Table 1.** Relative number of cultivars.

| Type | Number of cultivars | Number of cases | Frequency |
|---|---|---|---|
| French | 29 | 147 | 5.07 |
| False horn | 12 | 133 | 11.08 |
| Horn | 5 | 37 | 7.40 |

Frequency = (Number of cases)/(Number of cultivars), Number of cases = where the cultivars were observed.

provinces and to the south by the province of Tshopo. It is characterized by a progressive relief from the plains to the low plateaus which form the northern limit of the Congolese Basin. The altitude ranges from 450 to 800 masl (Tshonda, 2014).

The exploration of plantain cultivars was carried out in the six territories that make up this province (Aketi (02° 46'08,1"N, 023°35'12,5"E, 428 masl), Ango (04°02'13,2"N, 025°50'31,4"E, 611 masl), Bambesa (03°38'34,57"N, 026°03'28,13"E, 491,50 masl), Bondo (02°46'08,1"N, 023°35'12,5"E, 428 masl), Buta (02°48'52,5"N, 025°44'43,3"E, 422 masl), and Poko (03°30'25,2"N, 026°55'26,4"E, 650 masl) (Figure 1). This province, with its relatively fertile soils, rich hydrography and diverse vegetation was apparently quite attractive for the settlement of people with different agricultural practices, including plantain cultivation.

Indeed, the province hosts descendants of people who entered it in the past from different directions, hence using languages belonging to three different language families, Bantu (Niger-Congo), Central-Sudanic (Nilo-Saharian) and Ubangian. Ubangian speaking people (Azande, Rambo and Ngbandi) inhabit the territories of Ango, Bondo, Buta (partial) and Poko (partial). The Bantu (Benge, Boa and Benza) inhabit the territories of Aketi, Buta, Bambesa and Poko (Tshonda, 2014). Finally, in the territory of Poko one finds also a fraction of the Central-Sudanic (CS) speaking Kere, of which the majority lives in the Haut-Uele province (Gondo, 1987). The Azande form the majority in this province where they settled from the 17th century onwards. They are also in the Central African Republic and South Sudan (Tshonda, 2014). Here below the location of the study site (Figure 1).

#### Data collection and analyses

The surveys were carried out during 2011 to 2014 in six (6) territories (Ango, Aketi, Bambesa, Bondo, Buta and Poko) of Bas-Uele province. Before data collection, a written consent was obtained from the local leaders as stipulated in the approved research protocol. The interviews were always preceded by the interviewer's identification with a brief explanation about the purpose of work. Because participants were mainly illiterate, oral informed consent was obtained. Oral informed consent was confirmed by the supervisors. The information about cultivar meanings was given verbally by the farmers.

In each territory, three villages were selected for their known interest in plantain production. In each village, ten households were consulted for surveys, and a group of people responsible for plantain fields was formed for a participatory survey. The methodology used was based on the Bioversity International-CIALCA (Consortium for Improving Agriculture-based Livelihoods in Central Africa) survey questionnaire model, which consisted, on one hand, in the evaluation of knowledge on the varietal diversity of plantains in the villages and, on the other hand, the determination of vernacular names for each cultivar according to the different local languages followed by their meanings (Adheka et al., 2013, 2018a).

The historical factors taken into account are the names of the cultivars in their local dialect as well as their origins (stem) and the movement or distribution of populations (Rossel, 1998). In each selected village, a focus group discussion was conducted with a group of at least 30 men, and with a separate group of 30 women to establish a list of plantain cultivars grown and known by farmers (Adheka et al., 2018b).

Informants who have mastered the name and meaning of plantain assisted the surveys in the farmer's fields and along the roadsides in the area. Firstly, it was opted to work with men because they are the decision makers in the households and in charge of fields in DR Congo. Secondly, it was opted to work with women because most of the field work in DR Congo is under women control and in the markets plantains are sold especially by women. Plantain vernacular names were recorded and documented in each ethnic group. The materials used were a GPS (global position system) to take the geographical coordinates of each village and a camera for image taking of the different cultivars.

The standard cultivars of the UNIKIS collection, of which synonyms were found in Bas-Uele province, are listed in the Supplementary file: Table S1 per major category, together with their distinctive descriptors. The list is an adapted extract from an exhaustive taxonomical study on plantains in DR Congo where each cultivar was exhaustively described according to the IPGRI-INIBAP (Bioversity)/CIRAD Descriptor List (Adheka et al., 2018a). Suckers of the 46 identified cultivars were collected and afterwards transplanted in the UNIKIS collection for verification of the descriptions. The recorded distribution of the synonyms across the territories and villages of the province figures in the Supplementary file: Table S2.

## RESULTS AND DISCUSSION

### Salient features

The diversity in plantain cultivars in the province of Bas-Uele is striking. Already during the short period of exploration, 46 cultivars were recorded (Supplementary file: Table S1), which is about half of the 97 accessions of the UNIKIS collection, which represents roughly the total diversity of plantains in DR Congo (Adheka et al., 2018b). The most popular cultivars are: Egbe-o-mabese, Libanga Likale, Libanga Lifombo, Libanga Liboelabokoy, Litete and Lokusu. The Kumunyele village, inhabited mostly by the Azande people, has a large number of cultivars. The relative presence of False-Horn plantains was far greater than that of the other two types, the French and the Horn (Table 1). Medium sized plantains of the False Horn type are preferred, probably because of their short production cycle, and thus better suited to an area with marked dry seasons (Dhed'a et al., 2011). The high incidence of plantain cultivars in most villages demonstrates the nutritional, technical, therapeutic and ritual importance of this plant in the tradition of local indigenous communities, as revealed during the consultation of the people.

### Cultivar diversity in relation to ethnic groups

Table 2 lists the cultivars observed by ethnic group

**Table 2.** Plantain diversity relative to ethnic groups.

| Ethnics group | Observed cultivars |
|---|---|
| Zande | FR: Afati Black, Afati Wine Red, Aleke, Andula, Angbongbolia, Apkasi, Bapkala, Boofo, Buambala, Chwachwa, Kambolokoso, Libanga Liboelabokoy, Lindimama, Litete, Masekpe,Wilingwa<br>FH: Amakake, Apoka, Bokpeta, Bubungu, Egbe-o-mabese I, Leese, Libanga Black, Libanga Lifombo, Libanga Likale, Libanga Multiple, Mangweangwea, Momuwiliagbia<br>H: Ipkolo Red, Lokusu, Tala lola |
| Boa | FR: Adili, Afati, Apkasi, Bolomaise, Boofo Black, Bosakaraka I, Chwachwa, Kpoolo, Litete, Maboto, Nguku, Sika, Sugbe, Yumba Black<br>FH: Bokpeta, Libanga Lifombo, Libanga Multiple, Mangweangwea<br>H : Lokusu, Nselenge, Tala lola |
| Benza | FR: Afati Black, Libanga Liboelabokoy, Mongele<br>FH: Egbe-o-mabese I, Libanga Black, LibangaLikale, Libanga Multiple<br>H : Ipkolo Dark-green |
| Rambo | FR: Aleke, Andula, Bokpeta, Gwekwele, Lindimama, Litete |
| Ngbandi | FR: Litete<br>FH: Libanga Likale |

FR: French; FH: False Horn; H: Horn.

(language) and type of plantain. The Zande and Boa languages dominate the province, and the large number of cultivars noted is a logical consequence.

The small diversity noted in Rambo and Ngbandi may be explained by the small area occupied by these ethnic groups, Rambo in the north of the territory Poko, Ngbandi in the extreme west of the Bondo territory. More surprising is the low number in Benza, which is spoken in a large part of the Aketi territory. Moreover, False Horn and Horn cultivars are lacking in Rambo. Horn plantains are also lacking in Ngbandi. These “gaps” seem to be in line with the hypothesis that False Horn and Horn cultivars are derived from French type cultivars by somatic mutation, an event that need not to have happened everywhere ( De Langhe et al., 2005 ).

However, it appears from this table that a great diversity of plantains is under the control of the Zande ethnic group of the Sudanese strain, who predominantly cover the whole extent of this province. The name Zande means “owning a lot of land”, and refers to the history of the Azande as conquerors and warriors (Grootaers, 1996). They are relatively the recent occupants of Bas-Uele, and their language has not yet developed its own dialects which would have created various synonyms. Consequently, it is likely that the Azande have borrowed many cultivars and their names from the farmers who were present before their arrival. Indeed, it has been linguistically demonstrated that Bantu and Central-Sudanic speaking ancestors were established in Bas-Uele (and around) long before the arrival of the Azande (McMaster, 1988).

## Synonymy

### *Nomenclature*

In the Bas-Uele province, most (54.8%) synonyms refer to animals, while 31.5% refer to agronomic characteristics of the plant and 13.7% refer to the organoleptic (taste or the quality of the fruit) and culinary characteristics (Supplementary file: Table S2, column “Meaning”). The most common vernacular names referring to animals are: Nzoku, Buambala, Mbala, Mbongo and Nganzimungu, all of which relate to the elephant; Ngonde, or ngondi, which means crocodile; Lindimama which means the leopard's tooth. Sangbulukwali refers to the hand of the gorilla, and several names of Horn cultivars with one or two hands refer to the gorilla or chimpanzee, depending on the shape of the hand. In Azande most vernacular names refer to animal teeth or species. In Rambo, the vernacular name of the Horns “pembe na suku” or “tusk of the elephant” was borrowed from the Bantu peoples who probably adopted the Swahili vernacular name “mkono wa tembo” (Rossel, 1998). The synonyms that refer to

**Table 3.** Number of synonyms found in different village.

| Territory | Village | Number | Territory | Village | Number |
|---|---|---|---|---|---|
| Buta | Bagbe | 28 | Bambesa | Mondongbale | 14 |
| Poko | Kumunyele | 28 | Bondo | Kingili | 13 |
| Poko | Kembisa | 24 | Bondo | Cité Bondo | 13 |
| Buta | Rubi | 23 | Ango | Mulundu | 13 |
| Bambesa | Bawoli | 20 | Poko | Akpudu | 13 |
| Bondo | Bakpo | 18 | Aketi | Mondunga | 12 |
| Bambesa | Boduasele | 17 | Ango | Dafia | 11 |
| Buta | Basali | 15 | Aketi | Bilo | 9 |
| Aketi | Likati | 15 | Ango | Yasa | 8 |

**Table 4.** Number of cultivars (first number) and synonyms (second number) by language and territory.

| Territory | Area($10^3$km$^2$) | Benza | Boa | Zande | Rambo | Ngbandi | Total | Density |
|---|---|---|---|---|---|---|---|---|
| Aketi | 25.5 | 7/10 | 4/4 | 10/13 | - | 1/1 | 22/28 | 86 |
| Ango | 34.5 | - | - | 11/15 | 1/1 | 1/1 | 13/17 | 38 |
| Bambesa | 9 | - | 8/10 | 10/12 | 2/2 | 1/1 | 21/25 | 233 |
| Bondo | 37.5 | 1/1 | 7/7 | 14/17 | - | 1/1 | 23/26 | 61 |
| Buta | 18 | 2/2 | 17/18 | 14/18 | 1/1 | - | 34/39 | 189 |
| Poko | 22.5 | 1/1 | 4/4 | 27/30 | 5/5 | - | 37/40 | 164 |
| Total | | 11/14 | 40/43 | 86/105 | 9/9 | 4/4 | 150/175 | - |

Source for area surfaces: (Tshonda, 2014); Density = (total number of cultivars/area) x 100.

the agronomic characteristics are partially questioned, because of being too vague. Examples: “solid plantain” for several different False Horn cultivars: “plantain/banana/robust diet” for different strong cultivars: “small” for both “Nguku” and “Leese”, while the former is a dwarf form and the second a true small banana, etc. Many more specific names, characterizing the cultivar should exist, but did not appear so/or were not known by the farmer/informant. The limited period of exploration of villages did not allow for a thorough search for the real vernacular names.

## A widely different number of synonyms per village

Table 3 lists the number of synonyms found in the different villages of the Bas-Uele province. The 294 identified synonyms correspond to one or more of the 50 common names listed in Supplementary file: Table S1. There is a great difference in the number of synonyms between the villages. Those villages richest in synonyms are located in Buta, Bambesa (large dominance of the Boa) and Poko (containing the Rambo, Zande and Boa ethnic groups), which are mainly covered by the rainforest. The villages located in the territories of Ango and Bondo with savanna, and inhabited by the Azande, have a small number of synonyms. The number of synonyms can be related to the two types of vegetation cover, the savanna hardly favoring the cultivation of plantains. However, the two villages (Mondunga and Bilo) located in the Aketi territory, partly covered by the humid forest and mainly occupied by the Boa and Benza have a small number of synonyms. Such exceptions could indicate demographic interference.

## Cultivars and synonyms by language and territory

Table 4 lists the number of cultivars and synonyms recorded by territory and the spoken languages. The general total of cultivars being three times larger than that in Table 1 is explained by the repeated presence of the same cultivars in several territories and languages. The same holds true for synonyms, but to a smaller extent. The reason for the high number of synonyms compared to the cultivar number in the Zande column is a consequence of what is explained at the end of the item “Cultivar diversity in relation to ethnic groups”: the Azande borrowing cultivars from farmers of different pre-existing ethnic groups with their corresponding different synonyms. The density column shows that the Buta, Bambesa and Poko areas in the humid forest zone, inhabited mainly by the Boa and Rambo people and, to a small extent, the Azande, are predominant in the number of cultivars/synonyms. There, the density of cultivars is about three fold larger than that of the savanna territories

of Ango and Bondo where the Zande language dominates. The low density in the territory of Aketi is surprising because it is located in the middle of the forest and mainly inhabited by the Benza and Boa people. This exception is probably due to the small number of cultivars recorded in Benza as mentioned in "Cultivar diversity in relation to ethnic groups" section. We can conclude that the contrast between these two territorial groups is primarily related to vegetation but somewhat complicated by the almost omnipresent Azande who would have borrowed many cultivars from various ethnic groups dominated by them.

## Etymological and historical indications

### *The complex synonymy situation in Bas-Uele*

An ultimate objective of the UNIKIS Plantain research program, of which our work is part, is to reconstruct the way in which all the cultivars have been formed by somatic mutations. The linguistic study of the synonyms is thereby a key instrument. The question here is to what extent the synonyms recorded in Bas-Uele are sufficient for linguistic work. Analysis of Supplementary file: Table S2 leads to the distinction between cultivars of (case 1) several synonyms in different languages (including some in several territories), (case 2) several synonyms in the same language, and (case 3) the same single synonym in different languages.

Case 1 is common in general, but very rare in Bas-Uele as shown in Supplementary file: Table S2. The cultivar "Litete" is one of the examples (4 different synonyms corresponding to 4 languages). On the other hand, "Boofo", a popular cultivar, was noted in one language only. However, the fact that variants of Boofo (Apkasi, Angbongbolia) have been observed seems to indicate that "Boofo" would not have been noticed elsewhere (given the too short duration of the exploration).

Case 2 is strongly represented in Supplementary file: Table S2, with extremes as for "Libanga Liboelabokoy" and "Egbe-o-mabese I". It has three possible causes in general: (a) presence of dialects; (b) borrowed terms from nearby languages; (c) vestige of pre-existing languages in the area of the present language. If origin (a) can count for languages like the Boa, the causes (b) and (c) must apply for Zande, a language which has invaded a whole region relatively recently. The etymological study allows us to distinguish and then to investigate these causes, because the meanings of the various synonyms, as displayed in Supplementary file: Table S2 is too vague for a reliable distinction.

For the case 3, whereby for a particular concept or object (such as a cultivar), a term exists in only one language, it is considered that the concept or object was invented or formed only in the area of that single language. Thus, a cultivar (case 3) would be produced in a single ethnic group and a restricted area, and would therefore be a relatively new mutant. It must be shown, however, (1) that the etymology of the synonym follows the linguistic rules in force by the considered language and (2) that the cultivar is really absent in the neighboring languages (hence that absence is not an artefact by lack of documentation, for example as it may be with the above discussed "Boofo").

Conclusively, the configuration of the three cases in Bas-Uele points to a very complicated synonym situation, which is largely caused by the Azande intervention. Although the relatively recent Zande language invaded the common lexicon of pre-existing languages, it tended to borrow the terms of the objects of the original culture.

Linguistic analysis of the synonyms seems to be very difficult. Clearly, linguistic synonymy analysis in pure Bantu area will more fluently produce a reliable history in cultivar nomenclature as a base for deductions regarding somatic mutation lines and ramifications. Such results would then be most helpful in unraveling the Bas-Uele situation for the same cultivars and their variants.

## Consulting the vernacular collective (generic) names of plantains

The AAB Plantain subgroup in Africa has received distinct collective vernacular names, that are widespread with many reflexes and thus point to great anciennity: "Kondo/e" in the central, western and southern parts of DR Congo, and in Gabon, Cameroon, Angola, Zambia and Zimbabwe; "Buku" in the north-eastern part of DR Congo and in Central African Republic; "Gomba" in East Africa; "Go (m) ba" in Southern Africa; "Pakopa" in Sao Tomé and coastal Cameroon and in Mozambique (Vansina, 1995). The trade language Swahili has the name "Zu", again strictly applied to this subgroup. In contrast, "Tooke" is for example the collective name for the high altitude AAA cooking bananas in East-Africa (Vansina, 1995). These vernacular generic names can be of help in unraveling the links between cultivar names. The three language families in Bas-Uele have different generic names for plantains.

The common collective name for "plantain" is "kondo/e" in Bantu, "bugu" in Central- Sudanic, and "bu" in Ubangian. However, most of the Bantu speakers in Northeast (NE) Congo are an exception; in that they use the Sudanic "bugu". They are now grouped under the names "Buan", with a few exceptions which were assembled as "Leboya". The Boa language in Bas-Uele belongs to that Buan cluster. It is commonly accepted that the ancestors of the Buan people constituted the first wave of Bantu in the whole NE Congo region, occurring before the major Bantu "expansion" to the south, which led to the two main branches of West and East Bantu (Tshonda, 2014).

Since the Central Sudanic languages (such as Mamvu

and Mangbetu) are surrounded by the Buan languages, which all use the Sudanic “bugu” for ‘plantain’, the early Bantu would not have known the plantain before their arrival in the region, otherwise they certainly would have kept “kondo” (or a proto-form of it), as all other Bantu languages in Congo and beyond to the West and South did. This points to the presence of Central-Sudanic ancestors before the arrival of the Bantu ones, so that the Buans adopted Sudanic cultivar names as well.

Indeed, we found several synonyms in Boa without prefix, or with a ‘kind of prefix’ “a-” or “e-”, a feature typical for Sudanic and nearly absent in common Bantu. The generic bugu was even found integrated in Rambo synonyms (Bukubiolo, Bukufranga, Bilibuku). Striking is “bibu” in Zande, for the same cultivar Litete in the same Poko territory as “Bilibuku”, and thus clearly a reflex. From this reflex, one can assume that several synonyms in Zande, with “bu” as first syllable are equally bugu combinations (Busumba, Buambala, Bubungu, Bumatela, Majabu, Gbagbangabu). Yet, “bu” is the generic name in Zande, and thus it cannot be excluded that the Zande “bu” is itself a reflex of the Central-Sudanic “bugu” with historical derivations thereof. This important possibility calls for a careful linguistic examination. The Bantu generic “kondo” is applied in the Benza language, which indeed is not part of the Buan group. Its appearance in the synonym “Likondolihindo”, instead of a more specific local term, indicates the rather recent origin (or introduction) of the cultivar.

A number of other synonyms can be examined in a similar way, but at the sub-generic level. The group of False Horn cultivars is called “bulu” in Central-Sudanic. It is widespread in the whole of NE Congo even far beyond the “bugu”area (e.g. Lokele, Topoke, Ngandu, Mbole and further languages to the south). Its inclusion in several Zande synonyms (Supplementary file: Table S2) points to it being a loanword from Central-Sudanic origin; hence the concerned cultivars were introduced into the Zande community. The same False Horn cultivars are called “banga” in the whole northern part of the Bantu region, to the west of the “bulu” zone, up to Cameroon. We noticed this name in Ngbandi, an Ubangian language to the west of Zande.

The same or similar synonyms of a cultivar in several languages, and with a same restrictive meaning, indicate an early origin. Unfortunately, this method could not yet be applied for Bas-Uele because the meanings given by informers are too general in many cases. A revisit of the province as well as exploration of nearby provinces, in order to collect sufficient exact data is definitely required.

## Conclusions

This first systematic exploration of the AAB plantain subgroup in the Bas-Uele province has revealed an extraordinary rich varietal diversity (Supplementary file: Table S2). About half of the nearly one hundred cultivars that have hitherto been collected across the DR Congo are cultivated in this quite small part of the country (Figure 1).

Such a high cultivar density points to a long history of plantain cultivation in the region, since most of these cultivars could be *ad hoc* somatic mutants of the original clones that would have been introduced during the initial dispersion period of the plant in Africa. However, a reliable reconstruction of such history will only be possible when the results of ongoing similar explorations in the other provinces of the country will be recorded. Only then can one assess to what extent the Bas-Uele cultivars are present elsewhere. Similar exercises are required for the other cultivars found in the rest of the country.

Of the 46 cultivars in Bas-Uele (Supplementary file: Table S2), no less than 294 synonyms have been recorded (Table 3). This multitude reflects the multiple languages spoken in that relatively small province. With a few examples, we tentatively show how a comparative study of synonyms has the potential to be of great help in the reconstruction of the plantain diversification, provided that such a study should eventually embrace the entire plantain cultivation area in DR Congo and beyond. While the presence in Bas-Uele of three different language families complicates the enterprise, the situation is much less complex in the rest of the country, where only the Bantu languages are used. In any case, such a study evidently calls for the collaboration of linguists specialized in these languages.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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**Table S1.** Standard cultivars of the UNIKIS collection recorded in the Bas-Uele province.

| Name | Description[1] |
|---|---|
| | **French type** |
| Small pseudostem; pendulous bunch | |
| Akpasi | Boofo with shorter fingers, rather perpendicular to floral axis |
| Angbongbolia | Boofo but with blunt finger apex |
| Boofo | Fingers perpendicular to floral axis and arched |
| Boofo Black | Boofo but with black pseudostem |
| Gwekwele | Fingers with rigid pedicel and parallel to the floral axis |
| Medium pseudostem; pendulous bunch | |
| *Regular variation* | |
| Adili | Dark green pseudostem and fingers with blunt apex |
| Afati | Red pseudostem and finger-tips bending outwards (abaxially) |
| Afati Wine Red | Weak red fruit colour at the emergence of hand, becoming wine-red at maturity |
| Afati Black | Afati with black pseudostem |
| Masekpe | Very compact bunch with bottle-necked finger apex |
| Sika | Black streaks on pericarp |
| Sugbe | Red pseudostem and leaves, green salient fruits |
| Yumba Black | Slightly curved fingers; black pseudostem |
| *Unusual variants* | |
| Bakpala | Red pseudostem; sub-horizontal bunch |
| Buambala | With one finger per hand |
| Kambolokoso | With pronounced wrinkle on the fruit |
| Maboto | With long pedicel (unusual in plantain) |
| Giant pseudostem; pendulous bunch | |
| *Regular variation* | |
| Andula | Bosakaraka I with black pseudostem |
| Bolomaise | Slightly angled bunch with 9-12 hands and blunt apex |
| Bosakaraka I | Bunch with ≥12 hands, salient and outward bending fingertips |
| Chwachwa | 9-12 hands. Fingers larger than Bosakaraka I |
| Kpoolo | Red pseudostem and intermediate fruit apex |
| Lindimama | Short fingers for giant with very blunt apex |
| Litete | Dark green pseudostem and fingers |
| Mongele | Red pseudostem with yellow pericarp colour before maturity |
| Wilingwa | The inner side fingers very intermingled. With 2 or 3 neutral fingers clumps just before the male bud |
| *Unusual variants* | |
| Aleke | With a spiraloid bunch |
| Libanga Liboelabokoi | Monoserial with green pseudostem |
| Dwarf pseudostem | |
| Nguku | Dwarf with a compact bunch |
| | False Horn type |
| Small pseudostem | |
| Amakake | Fingers perpendicular to floral axis and arched |
| Bubungu | Quasi-blunt finger apex with swollen/fleshy flower rests; pendulous bunch |
| Leese | Small form of the (Medium) Libanga Likale |
| Medium pseudostem | |
| Apoka | Libanga with blunt fruit apex |
| Libanga Black | Libanga with black pseudostem |
| Libanga Likale | Prototype of False Horn. At maturity, the bunch looks pendulous, but the asymmetric finger orientations point to sub-horizontal status; finger apex plump-bottlenecked |

**Table S1.** Contd.

| | |
|---|---|
| Libanga Multiple | Libanga but with bunch split in 2 or more |
| Libanga Lifombo | Libanga with red pseudostem. Trend to Giant form |
| Mangweyangweya | Libanga with white streaks on the pericarp |
| Egbe-o-mabese I | Male bud exhausting at late stage for a False Horn |
| Semi-dwarf pseudostem | |
| Bokpeta | Semi-dwarf Libanga with longer male inflorescence than usual for False Horn |
| Mumuwiliagbia | Bokpeta but with horizontal bunch and shorter fingers |
| | Horn type |
| Small pseudostem | |
| Nselenge | Pendulous bunch with fingers perpendicular to the inflorescence axis |
| Medium pseudostem | |
| | Pendulous, long fingers; yellowish immature pericarp; green pseudostem |
| Lokusu | 2-4 hands, with first hand pointing horizontally, other hands rather downwards but still arced |
| Giant pseudostem | |
| Ikpolo Red | Horizontal to erect fingers; red pseudostem |
| Ikpolo Dark-green | Ikpolo with dark green pseudostem and fingers |
| Dwarf pseudostem | |
| Tala Lola | Dwarf form of Ikpolo |

[1]Pseudostem and fruit-peel green when no other colour is mentioned.

**Table S2.** Distribution of cultivar names in the Bas-Uele province.

| Standard name | Synonym | Meaning | Language | Villages (Figure 1) | Total (number of villages) |
|---|---|---|---|---|---|
| | | | **French type** | | |
| Adili | Mapipi | Dark plantain | Boa | Bagbe[c], Boduasele[d] | 2 |
| Afati | Enguse | Robust plantain | Boa | Apkudu[f], Kembisa[f], Kumunyele[f] | 3 |
| Afati Black | Aleha | Antelope | Zande | Bawoli[d], Boduasele[d], Dafia[a], Kumunyele[f], Mulundu[a], Yasa[a] | 6 |
| | Mbioli | Black bird | Benza | Mulundu[a], Yasa[a], Dafia[a], Likati[b], Kembisa[f], Rubi[c] | 6 |
| Afati Wine Red | Engwe | - | Zande | Bawoli[d], Boduasele[d], Kumunyele[f] | 3 |
| | Ansele | hair-spring | Zande | Kingili[e] | 1 |
| | Bolomandongo | Snail buttock | Rambo | Apkudu[f], Kembisa[f], Kumunyele[f] | 3 |
| Aleke | Keichru | Helical plantain | Zande | Kingili[e] | 1 |
| | Kilinge | Helical plantain | Zande | Mulundu[a],Yasa[a] | 2 |
| | Mbembe | Snail | Lingala | Kingili[e] | 1 |
| Andula | Bukufranga | Money plantain | Rambo | Kembisa[f] | 1 |
| | Sugbe | Robust plantain | Zande | Kembisa[f] | 1 |
| Angbongbolia | Nsolo | Colanut | Zande | Apkudu[f], Bawoli[d], Boduasele[d], Kembisa[f], Mondongbale[d], Rubi[c] | 6 |
| | Angbongbolia | Colanut | Boa | Bagbe[c] | 1 |
| Apkasi | Nsolo | Colanut | Zande | Bagbe[c] | 1 |
| | Nagbeke | Short plantain | Zande | Bagbe[c] | 1 |
| | Yaraza | Fingers | Zande | Bagbe[c] | 1 |
| Bakpala | Bakpala | Delicious banana | Zande | Kumunyele[f] | 1 |
| Bolomaise | Enguse | Robust plantain | Boa | Bakpo[e] | 1 |
| Boofo | Bu | Plantain | Zande | Kumunyele[f] | 1 |
| Boofo Black | Manzelepete | Soft plantain | Boa | Basali[c] | 1 |
| Bosakaraka I | Enguse | Robust plantain | Boa | Basali[c] | 1 |
| Buambala | Buambala | Elephant plantain | Zande | Kumunyele[f] | 1 |
| | Ayele | Longest tree | Zande | Apkudu[f], Bapko[e], Bawoli[d], Dafia[a], Mulundu[a], Yasa[a] | 6 |
| Chwachwa | Enguse | Giant plantain | Boa | Bagbe[c], Bapko[e], Basali[c], Bawoli[d], Bilo[b], Boduasele[d], Kingili[e], Kumunyele[f], Likati[b], Mondongbale[d], Mondunga[b], Rubi[c] | 12 |
| | Gbagba-ngabu | Giant plantain | Zande | Kumunyele[f] | 1 |
| | Majabu | - | Zande | Bawoli[d] | 1 |
| Gwekwele | Sanza sita | Precocious plantain | Rambo | Bagbe[c], Basali[c], Bawoli[d], Boduasele[d], Kembisa[f], Mondongbale[d], Mulundu[a], Rubi[c] | 8 |
| Kambolokoso | Gbagbalakata | Disorder main | Zande | Kumunyele[f] | 1 |

**Table S2.** Contd.

| | | | | | |
|---|---|---|---|---|---|
| Kpoolo | Ngwea | Pig | Boa | Bagbe[c], Basali[c], Rubi[c] | 3 |
| | Babi | - | Zande | Cité Bondo[e] | 1 |
| | Bangaya | Drunkard | Zande | Apkudu[f], Kembisa[f] | 2 |
| | Kotina | - | Zande | Kembisa[f] | 1 |
| | Mangbulu | Solid plantain | Boa | Apkudu[f], Kembisa[f] | 2 |
| Libanga Liboelabokoy | Mbala | Elephant | Zande | Bagbe[c], Bakpo[e], CitéBondo[e], Rubi[c] | 4 |
| | Mbongo | Elephant | Zande | Bagbe[c], Bawoli[d], Bilo[b], Boduasele[d], Rubi[c] | 5 |
| | Mino na ngondi | Crocodile's thooth | Zande | Dafia[a] | 1 |
| | Ngondima | Toucan (bird) | Zande | Kumunyele[f] | 1 |
| | Nzoku | Elephant | Benza | Likati[b] | 1 |
| | Pembe na ngonde | Crocodile's thooth | Zande | Dafia[a] | 1 |
| Lindimama | Indibidieke | Leopard'sthooth | Zande | Apkudu[f], Kembisa[f], Kumunyele[f] | 3 |
| | Nepuka | Leopard'sthooth | Rambo | Bawoli[d], Boduasele[d], Mondongbale[d] | 3 |
| Litete | Bibu | Black plantain | Zande | Apkudu[f], Kumunyele[f] | 2 |
| | Bilibuku | Black plantain | Rambo | Kembisa[f] | 1 |
| | Libobi | Civet | Nbgandi | Bawoli[d], Dafia[a], Muludu[a] | 3 |
| | Mapipi | Black plantain | Boa | Bagbe[c], Basali[c], Bakpo[e], Bawoli[d], Bilo[b], Boduasele[d], Cité Bondo[e], Kingili[e], Likati[b], Mondongbale[d], Rubi[c] | 11 |
| Maboto | Malingiti | Frizzyhair | Boa | Bagbe[c], Kumunyele[f] | 2 |
| Masekpe | Masekpe | Delicious banana | Zande | Apkudu[f], Kembisa[f], Kumunyele[f] | 3 |
| Mongele | Mugele | Giant plantain | Benza | Likati[b], Mondunga[b] | 2 |
| Nguku | Akpeta | Small plantain | Boa | Bagbe[c], Basali[c], Rubi[c] | 3 |
| Sika | Engbe | Mouse | Boa | Boduasele[d] | 1 |
| Sugbe | Sugbe | Giant banana | Boa | Bagbe[c], Basali[c], Bawoli[d], Boduasele[d], Mondongbale[d] | 5 |
| Wilingwa | Wilingwa | Giant plantain | Zande | Cité Bondo[e], Kembisa[f], Kingili[e], Kumunyele[f] | 4 |
| Yumba Black | Manzelepete | Soft plantain | Boa | Apkudu[f], Bagbe[c], Basali[c], Boduasele[c], Kumunyele[c], Mondongbale[d], Rubi[c] | 7 |
| | | *Total noticed (147)* | | | |
| | | **False Horn type** | | | |
| | Kanamusungudile | Precocious plantain | Zande | Kembisa[f], Kumunyele[f] | 2 |
| Amakake | Mangbulu | Solid plantain | Zande | Apkudu[f], Bagbe[c], Basali[c], Rubi[c], Kembisa[f], Kumunyele[f] | 6 |
| | Nbgulukikere | Solid plantain | Zande | Bagbe[c], Basali[c], Rubi[c] | 3 |
| Apoka | Abukianakete | Solid plantain | Zande | Mondunga[b] | 1 |
| | Engbau | - | Zande | Likati[b] | 1 |
| Bokpeta | Bukubiolo | Ollacode's tail | Rambo | Apkudu[f], Kembisa[f], Kumunyele[f] | 3 |

**Table S2.** Contd.

| | | | | | |
|---|---|---|---|---|---|
| | Busumba | Ollacode | Zande | Apkudu[f], Kumunyele[f] | 2 |
| | Galwe | Daman (Dendrohyrax) | Boa | Bawoli[d], Boduasele[d], Mondongbale[d] | 3 |
| | Momudalagbia | Daughter's breast | Zande | Mulundu[a] | 1 |
| | Ngbonda | Robust stem | Boa | Bagbe[c], Basali[c], Rubi[c] | 3 |
| | Uwa | Daman (Dendrohyrax) | Boa | Bawoli[d] | 1 |
| Bubungu | Mobwete | Soft pulp plantain | Zande | Bakpo[e], Cité Bondo[e], Rubi[c], Kingili[e] | 4 |
| | Lindingondi | Crocodile's tooth | Zande | Bapko[e] | 1 |
| | Mandololo | Threadlike fish | Benza | Bapko[e], Bilo[b], Likati[b] | 3 |
| | Mucheche | Bird | Benza | Mondunga[b] | 1 |
| Egbe-o-mabese I | Ngonde | Crocodile | Zande | Bagbe[c], Basali[c], Dafia[a], Cité Bondo[e], Likati[b], Kingili[e], Kembisa[f], Rubi[c] | 8 |
| | Ngondi | Crocodile | Zande | Apkudu[f], Bapko[e], Bawoli[d], Bilo[b], Boduasele[d], Mondongbale[d], Kembisa[f], Kumunyele[f], Yasa[a] | 9 |
| | Pembe na ngondi | Crocodile's tooth | Zande | Dafia[a] | 1 |
| | Sasumba | Ollacode | Zande | Kembisa[f] | 1 |
| Leese | Lese | Small plantain | Zande | Bakpo[e], Cité Bondo[e], Kingili[e], Likati[b] | 4 |
| | | | False Horn type | | |
| | Likondolihindo | Black plantain | Benza | Mondunga[b] | 1 |
| Libanga Black | Ngbulu | Solid plantain | Zande | Mondunga[b], Likati[b] | 2 |
| | Ngbulu noir | Solid black plantain | Zande | Bagbe[c] | 1 |
| | Ngbulumanzelepete | Solid delicious plantain | Zande | Bagbe[c] | 1 |
| | Gumba | Thunderbolt | Zande | Bakpo[e], Cité Bondo[e], Kingili[e], | 3 |
| Libanga Lifombo | Ngbulu | Solid plantain | Zande | Apkudu[f], Bagbe[c], Basali[c], Bapko[e], Bawoli[d], Bilo[b], Dafia[a], Mondongbale[d], Mulundu[a], Rubi[c] | 10 |
| | Ngbulumogbama | Solid red plantain | Zande | Bagbe[c], Boduasele[d], Likati[b] | 3 |
| | Sumbu | | Boa | Bagbe[c], Mondunga[b] | 2 |
| | Embanga | Robust plantain | Ngbandi | Cité Bondo[e], Mondunga[b] | 2 |
| | Mbudi | Solid plantain | Benza | Mondunga[b] | 1 |
| | Mudou | Solid plantain | Benza | Mondunga[b] | 1 |
| Libanga Likale | Ngbulu | Solid plantain | Zande | Apkudu[f], Bagbe[c], Basali[c], Bakpo[e], Bawoli[d], Bilo[b], Boduasele[d], Cité Bondo[e], Kembisa[f], Kingili[e], Kumunyele[f], Likati[b], Mondongbale[d], Mondunga[b], Mulundu[a], Rubi[c], Yasa[a] | 17 |
| | Ngbulumabembe | Solid green plantain | Zande | Bagbe[c], Boduasele[d] | 21 |
| | Bogo | Plantain | Boa | Rubi[c] | 1 |
| Libanga Multiple | Bozobiata | Formless | Benza | Bapko[e] | 1 |
| | Dragona | Dragon | Benza | Mondunga[b], Rubi[c] | 2 |
| | Fondo | Multiples heads | Benza | Likati[b] | 1 |

**Table S2.** Contd.

| | | | | | |
|---|---|---|---|---|---|
| Mangweangwea | Bumatela | Nice banana | Zande | Kumunyele[f] | 1 |
| | Mangweangwea | Wagtail | Boa | Boduasele[d], Cité Bondo[e], Rubi[c] | 3 |
| Momuwiliagbia | Momuwiliagbia | Girl's breast | Zande | Cité Bondo[e] | 1 |
| | | *Total noticed (133)* | | | |
| | | **Horn type** | | | |
| Ikpolo Dark-green | Mokomboso | Gorilla | Boa | Likati[b] | 1 |
| Ikpolo Red | Mangbulu | Solid plantain | Zande | Kembisa[f] | 1 |
| | Zanganzunzu | Without navel | Zande | Bakpo[e], Likati[b] | 2 |
| | Ebotave | Dog's fingers | Boa | Bapko[e], Basali[c] | 2 |
| Lokusu | Gbagawa | Stringent's hand | Zande | Mulundu[a] | 1 |
| | Kpoilo | Dog's fingers | Boa | Bagbe[c], Basali[c] | 2 |
| | Nganzombo | - | Zande | Bawoli[d], Boduasele[d], Mondongbale[d] | 3 |
| | Sangbulukwali | Gorilla's hands | Zande | Bilo[b], Dafia[a], Mulundu[a], Yasa[a] | 4 |
| Nselenge | Yogbo | Stringent's hand | Zande | Kumunyele[f], Mulundu[a], Rubi[c], Yasa[a] | 4 |
| | Ngonde | Crocodile | Boa | Basali[c] | 1 |
| Tala Lola | Bapkulosa | Stringent's hand | Zande | Kumunyele[f] | 1 |
| | Ependa | Stringent's hand | Boa | Bilo[b], Kembisa[f], Kingili[e], Likati[b] | 4 |
| | Gbagawa | Stringent's hand | Zande | Bapko[e], Cité Bondo[e], Mondongbale[e], Rubi[c], Kingili[e] | 5 |
| | Huwa | Daman (Dendrohyrax) | Boa | Bawoli[d] | 1 |
| | Nganzimungu | Elephant's rib | Zande | Kembisa[f] | 1 |
| | Sangbolukwali | Gorilla's hands | Zande | Bilo[b], Dafia[a], Mulundu[a], Yasa[a] | 4 |
| | | *Total noticed (37)* | | | |

a: Ango, b: Aketi, c: Buta, d: Bambesa, e: Bondo, f: Poko.