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Balanites aegyptiaca (L.) Delile: geographical distribution and ethnobotanical knowledge by local populations in the Ferlo (north Senegal)

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Balanites aegyptiaca (L.) Delile is a species of tropical flora for which the variety *aegyptiaca* is adapted to Sahelian climate. The species is among those chosen for the restoration of Sahelian ecosystems in the context of the pan-African reforestation project, the Great Green Wall for the Sahara and Sahel Initiative (GGW). This study redefines the distribution range and its ecology and studies its uses in the Ferlo region in the north of Senegal using surveys carried out among the local population. The eco-geographical study shows that the species occupies several Sahel-Saharan regions of Africa and the Middle East. With broad ecological amplitude, it is very resistant to drought and relatively indifferent to the type of soil. Results of the ethno-botanical survey show that local people in the Ferlo region have a wealth of knowledge and expertise on *B. aegyptiaca*. These surveys also revealed the extent to which local populations rely on the tree for food, fodder, construction and medicine. The fruit and wood are the most highly prized parts of the tree, with the greatest use of the fruit in people's diets. In medicinal terms, *B. aegyptiaca* is used to treat several affections. Marketing the fruits could be of socio-economic interest for local people, and in particular, for women. This study is particularly opportune since *B. aegyptiaca* var. *aegyptiaca* is currently being planted in large numbers within the Great Green Wall for the Sahara and the Sahel Initiative (GGW). It also provides information that could help in better management of this natural resource, adapted both to the hostile Sahelian climate and of great use to Mankind.
Keywords. Plant ecology, ethnobotany, multipurpose trees, reforestation, Senegal.

***Balanites aegyptiaca* (L.) Delile : distribution géographique et connaissances ethnobotaniques des populations locales du Ferlo (nord Sénégal).** *Balanites aegyptiaca* (L.) Delile est une espèce de la flore tropicale dont la variété *aegyptiaca* est adaptée aux climats sahéliens. Elle figure parmi les essences choisies pour la restauration des écosystèmes sahéliens dans le contexte du projet de reforestation panafricaine de la Grande Muraille Verte (GMV). Cette étude redéfinit les aires de répartition et son écologie et étudie ses usages dans la zone du Ferlo au nord Sénégal à travers des enquêtes menées auprès des populations. L'étude éco-géographique montre que l'espèce occupe plusieurs régions sahélo-sahariennes d'Afrique et du Moyen Orient. De large amplitude écologique, elle est très résistante à la sècheresse et relativement indifférente au type de sol. Les résultats de l'enquête ethnobotanique montrent que les populations du Ferlo disposent d'un ensemble de connaissances et de savoir-faire concernant *B. aegyptiaca*. Ces enquêtes ont mis en évidence une grande utilisation de l'arbre par les populations locales à des fins alimentaires, fourragères et pour la construction. Le fruit et le bois sont les parties les plus prisées de l'arbre. Sur le plan médicinal, *B. aegyptiaca* est utilisée pour soigner plusieurs affections. La commercialisation des fruits pourrait présenter un intérêt socio-économique pour les populations, notamment pour les femmes. Cette étude est particulièrement opportune puisque *B. aegyptiaca* var. *aegyptiaca* est actuellement plantée massivement au sein de la Grande Muraille Verte (GMV). Elle fournit des informations qui pourraient participer à une meilleure gestion de cette ressource naturelle, à la fois adaptée au climat hostile sahélien tout en étant d'une grande utilité pour l'Homme.
Mots-clés. Phytoécologie, ethnobotanique, arbre à buts multiples, reconstitution forestière, Sénégal.

1. INTRODUCTION

Balanites aegyptiaca (L.) Delile, commonly known as the desert date, is a woody plant belonging to the family Zygophyllaceae originating from tropical Africa. *Balanites aegyptiaca* var. *aegyptiaca* grows in the Sahel region where it faces multiple environmental challenges, in particular desertification, and it plays a multifunctional role in the daily lives of local people. In previous ethno-botanical studies (Creach, 1940; Imperato et al., 1968; Pousset, 1989; Nacoulma, 1996; Fortin et al., 1997; Ouedraogo et al., 2000; Chevalier et al., 2003; Malaise, 2010), its importance as food and medicine for local people throughout Africa has been illustrated. Ecologically, *B. aegyptiaca* var. *aegyptiaca* is considered as a resilient species and highly versatile towards Sahelian soil and climatic conditions (Parkan, 1993; Hiernaux et al., 2006).

Balanites aegyptiaca var. *aegyptiaca* is widely found in the Ferlo, a region situated in the Senegalese Sahel. As part of the fight against desertification in the Sahel, the species was chosen among other species such as *Acacia senegal* (L.) Willd. and *Acacia tortilis* (Forssk.) Hayne subsp. *raddiana* (Savi.) Brenan to construct the Great Green Wall (GGW). The GGW is an ambitious, large scale project which consists of a range of national and regional actions focused on the restoration and reforestation of the Sahel. The GGW will run from west to east 7,600 km long and 15 km wide, crossing 11 African countries from Senegal to Djibouti (**Figure 1**). This project is original because of its scale and its pan-African dimension. The main objectives of the project are to improve the natural environment in these areas and reduce poverty among people living there. It is important to note that *B. aegyptiaca* was chosen as a forest species to plant not just in Senegal, but also by many of the other GGW member countries. For this reason, data on this species, its uses, and its economic potential should be revisited in this context.

In Senegal, few data exist on local ecological knowledge and the different ways of using *B. aegyptiaca*. This study aims at contributing to the development of this natural heritage. It first focuses on the geographical distribution, then ecological perceptions and different uses of the species by Ferlo local people in Senegal. This study also paves the way for improving knowledge of the species, with a vision of its economic development in the region of the study.

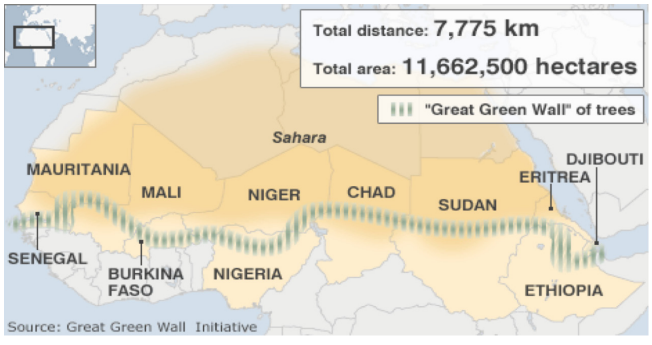

Figure 1. Indicative limits of the Sahelian strip and countries crossed by the Great Green Wall — *Tracé indicatif de la bande sahélienne et des pays traversés par la Grande Muraille Verte*.

Source: Great Green Wall Initiative.

2. MATERIALS AND METHODS

2.1. Geographical and ecological distributions of *B. aegyptiaca*

Different sources were used to determine the geographical distribution and ecological conditions of *B. aegyptiaca*. The consulted resources included flora and botanical manuals (Aubreville, 1950; Berhaut, 1979; Arbonnier, 2000; Sands, 2003), monographs (Hall et al., 1991; Skank, 1993) and different published reports (Quézel, 1965; Giffard, 1974; Le Houérou, 1989; Miehe, 1990; Hiernaux et al., 2006). The information found in the databases were complemented by our own observations and information reported by local people in the area of the study.

2.2. Ethnobotany

The ethnobotanical study was carried out within the natural distribution range of *B. aegyptiaca* in the surrounding areas of three villages in the Senegalese Sahel situated along the GGW path: Widou Thiengoli (15° 59'N and 15° 20'W), Tessekéré (15° 49'N and 15° 03'W) and Labgar (15° 50'N and 15° 48'W) (**Figure 2**). The surveys among people were carried out based on their availability and their willingness to participate. Semi-structured interviews with a mandatory questionnaire were adopted. Anecdotal conversations also provided complementary information to the interviews. In each district, those interviewed were chosen at random. Sixty people *i.e.* 20 per district responded to questions related to country people's knowledge of species (preferred habitat, morphology, and phenology), uses (food, fodder, and medicinal) and related to the marketing of plant resources.

The questionnaire related to phenology considers four phenophases: flowering, fruit ripening, foliation, and defoliation of the plant. Respondents were asked to temporally situate these phenophases according to the Ferlo Fulani calendar in which the year is sub-divided into five seasons based on the temperature

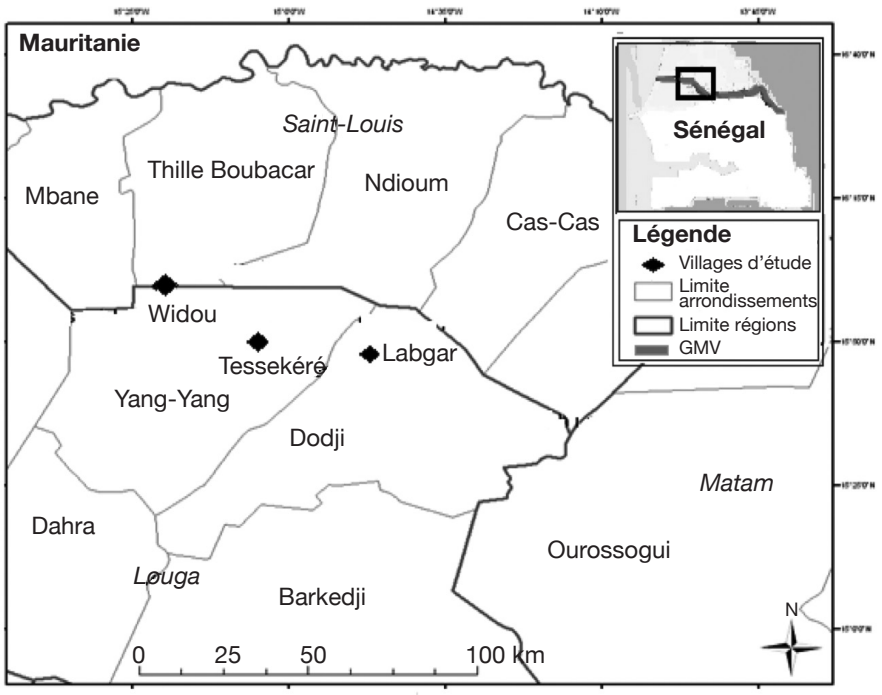

Figure 2. Map of study sites in the Ferlo region in the north of Senegal. Surveys were conducted in the villages of Widou, Tessekéré, and Labgar — *Carte des sites d'études dans le Ferlo dans le Nord du Sénégal. Les enquêtes ont été effectuées dans les villages de Widou, Tessekéré et Labgar.*

Source: adapted from — *adapté d'après* Niang, 2009.

and availability of water (Naegelé, 1971): the cool dry season, "*dabundé*" (December-February); the hot dry season, "*tchiedio*" (March-April); the pre-rainy season, "*setsellé*" (May-June); the rainy season, "*ndunggu*" (July-October); and the post-rainy season, "*kawlé*" (October- November).

The populations interviewed were made up of 78.2% men and 21.8% women belonging to five ethnic groups: Fulani (74%), Wolof (14.4%), Nares (5%), Maure (8.6%) and Laobé (3%). Our surveys were conducted on a voluntary basis, thereby explaining the unequal sex ratio of the interviewees. The Ferlo is a silvopastoral region that is largely dominated by Fulani people. This accounts for the high proportion of Fulanis who participated in the study. The respondents were mainly herdsmen (39.1%), traders (23.3%) the majority of whom were Wolof, traditional healers (13.3%), and homemakers (12%). The number of other professions (teachers, farmers, and bakers) was limited (6.7%; 3.3% and 3.3%) respectively. The average age of the population surveyed was 43 ± 17 years of age.

All the datas collected in the surveys were processed and analyzed with Sphinx Version 4.5 and the help of Excel.

3. RESULTS AND DISCUSSION

3.1. Geographical distribution of the species *B. aegyptiaca*

Balanites aegyptiaca is an Afro-Asiatic tree. It has a vast geographical distribution, mentioned in the works of Berhaut (1979), Lebrun et al. (1992), Arbonnier (2000), and Sands (2003). On the Asian continent, the tree is found in the Middle East from south to north as far as latitude 35° 25' N, in Arabia, Burma, India, and Pakistan and all along the Persian Gulf. In Africa, its area extends west to east, in the Sahelian band from the Atlantic Ocean (Senegal, Mauritania) as far as Eritrea. The distribution range of *B. aegyptiaca* extends across the Sahara, to Algeria where its boundary is situated at 27° N; then in East Africa in the strip going from Egypt and Libya, as far as Zimbabwe (19° S). It is important to note that *B. aegyptiaca* has three varieties: *Balanites aegyptiaca* var. *aegyptiaca*, *Balanites aegyptiaca* var. *tomentosa* (Mildbr. & Schltr.) Sands and *Balanites aegyptiaca* var. *quarrei* (De Wild.) G.C.C. Gilbert (Sands, 2003). *Balanites aegyptiaca* var. *aegyptiaca* is widespread and is characteristic of dry regions. Its range extends into East Africa (Uganda, Kenya and Tanzania). The other two varieties of the species are found in this part of Africa, with *B. aegyptiaca* var. *quarrei* reported in Tanzania, the Democratic Republic Congo, Zambia, and Zimbabwe and *B. aegyptiaca* var. *tomentosa* in Tanzania.

Over its entire distribution area, *B. aegyptiaca* has wide ecological amplitude and is hardy in relation to soil properties (Hall et al., 1991; Arbonnier, 2000). Indeed, it flourishes in various types of soils (sandy, clay, clay-loam, gravelly, heavy), regularly flooded and on dunes formed by the wind (Quézel, 1965; Berhaut, 1979; Skank, 1993). In its distribution area, the plant receives rainfall ranging from 150 to 1,300 mm per year and where average temperatures are between 20 and 30°C. The species is able to grow at low altitude (sea-level) and as high as 2,000 m altitude, as it is the case in the Sudan (Hall et al., 1991).

In Senegal, the species is common in the Sahelo-Sudanian climatic zone. The species population is abundant in the Sahelian zone, especially in the arid

lands of Cayor and Ferlo along the Senegal River (Tayeau et al., 1955). It gradually declines towards the south in the Sudanian area (Cornet et al., 1977). They can be located on clay deposits, continental dunes, elevations formed of silt colluvial deposits, covered in ferruginous crust and inter-tidal depressions (Giffard, 1974). In the Ferlo area in the north of Senegal, its distribution is irregular, common locally and abundant. The results of our surveys among local people revealed a much greater presence of the species in the lowland flood plains.

3.2. Ethnobotany

Phenology of the species based on local people's observations. The majority of people interviewed (80%) expressed themselves in relation to the four phenological stages of the plant (flowering, fruit ripening, foliation and defoliation) (**Figure 3**). Based on their observations, *B. aegyptiaca* var. *aegyptiaca* flowers all year-round (**Figure 3a**). However, the majority of people questioned indicated two major periods of flowering: in the cool dry season "*dabundé"*, and in the rainy season "*ndunggu"*. The ripening of fruit is reported in the cool dry season "*dabundé"*, and in the pre-rainy season "*setsellé"*. During interviews, some people, however, pointed out the production of fruits which came to maturity during the middle of the rainy season "*ndunggu"*, but was not useable due to damage by the rains. Previous scientific reports carried :out in Senegal corroborate local perceptions described herein in terms of when flowering and fruit set occur (Poupon, 1979; Ndoye et al., 2004).

The onset of tree foliation is reported in the rainy season "*ndunggu*" and defoliation in the hot dry season "*tchiedio*" until the pre-rainy season "*setsellé*" (**Figure 3b**). According to some people interviewed, *B. aegyptiaca* var. *aegyptiaca* conserves its leaves for a good part of the year. Herdsmen feed their cattle with the leaves after pruning or delimbing them.

Empirical botany of *B. aegyptiaca* var. *aegyptiaca*. Criteria for differentiating between individual *B. aegyptiaca* trees were reported by 94% of respondents (**Table 1**). The fruit was, by far, the most distinguishable trait (68.6% of those questioned); followed by vegetative growth (31.4%). The main traits described for the fruit were the taste of the pulp (bitter *vs* sweet: 37.2%) and the size (big *vs* small: 31.4%). A relation between the taste and the size of the fruit was also reported. Among those interviewed, 34.2% said that big fruits are generally bitter whilst the small ones are often sweet. In contrast, 7.4% reported the opposite. The morpho-metric studies carried out by Abasse et al. (2010) on fruit in Niger confirmed a great variability in the morphology of *B. aegyptiaca* fruit. According to the work of Malaisse (2010), the biochemical composition of the fruit varies with the variety. This characteristic can be considered as a biochemical marker used to distinguish amongst varieties.

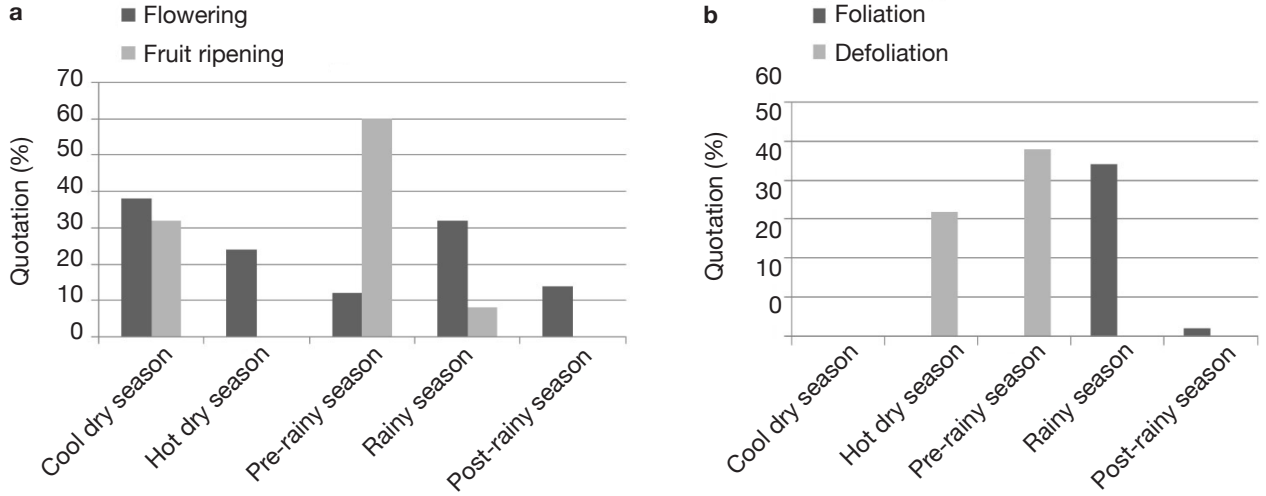

Figure 3. Phenology of *Balanites aegyptiaca* (L.) Delile based on observations of local people in the Ferlo region. **a**: reproductive phases of flowering and fruit ripening; **b**: vegetative phases of foliation and defoliation — *Phénologie du* Balanites aegyptiaca *(L.) Delile, suivant les observations des populations du Ferlo. **a** : floraison et maturation des fruits ; **b** : périodes d'activité foliaire : feuillaison, défeuillaison.*

Cool dry season — *saison sèche fraiche: "dabundé"* (December-February — *décembre-février*); hot dry season — *saison sèche chaude: "tchiedio"* (Mars-April — *mars-avril*); pre-rainy season — *saison pré-pluvieuse: "setsellé"* (May-June — *mai-juin*); rainy season — *saison des pluies: "ndunggu"* (July-October — *juillet-octobre*); post-rainy season — *saison post-pluvieuse: "kawlé"* (October-November — *octobre-novembre*).

Tableau 1. Morphological criteria used to distinguish individual *Balanites aegyptiaca* (L.) Delile trees — *Critères morphologiques de différenciation entre les individus de* Balanites aegyptiaca *(L.) Delile*.

Criteria of differentiation			Freq. cit	Total cit.
Fruit		Bitter/sweet	37.2%	68.6%
		Big/small	31.4%	
Vegetative growth	Thorns	Short/long	15.7%	31.4%
	Leaves	Big/small	12.9%	
	Trunk	Smooth/rough	2.8%	

Local populations (31.4% of respondents) also distinguished individual *B. aegyptiaca* trees based on their vegetative growth. They do this in relation to the size of the thorns (15.7%) and the leaves (12.9%), and the appearance of individual trunks (2.8%). Our own observations confirmed these distinguishing features within local *B. aegyptiaca* populations (**Figure 4**). The importance given to thorns is based on the use of the tree for fodder. Indeed, some people mentioned that it was easier to collect forage from trees with long thorns (sometimes supple) compared to trees with short, very sharp thorns. The texture of the tree trunk (smooth or rough) is likely related to their age. Indeed, Parkan (1993) had reported that smooth trunks are common among young trees, which later become cracked and chipped among aged individuals. However, these characteristics cannot be used for taxonomic classification as the distinctions are often imprecise, and therefore unreliable (Arbez, 1988).

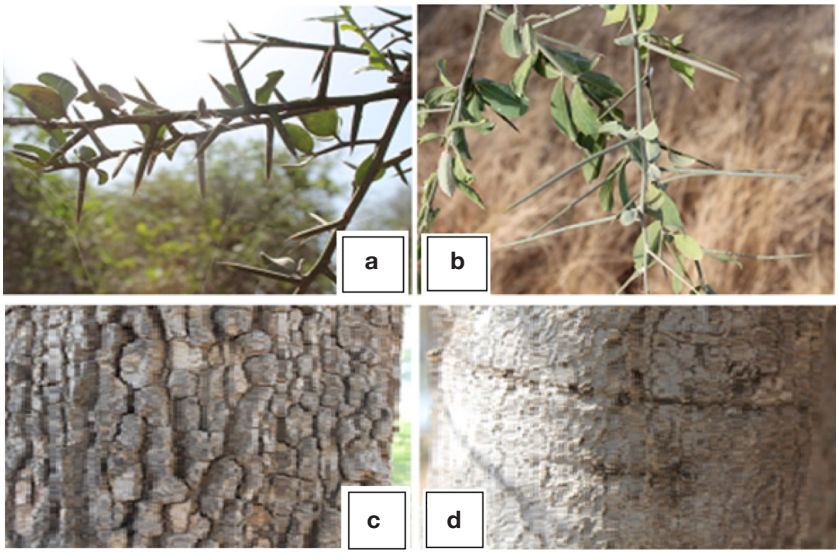

Figure 4. Distinguishing morphological criteria for differentiation of individual *Balanites aegyptiaca* (L.) Delile trees by local people — *Critères morphologiques de différenciation des individus de* Balanites aegyptiaca *(L.) Delile par les populations locales*.

Short thorns (**a**) *vs* long thorns (**b**) and rough trunk (**c**) *vs* smooth trunk (**d**) — *Courtes épines (**a**)* vs *longues épines (**b**) et tronc rugueux (**c**)* vs *tronc lisse (**d**)*.

Used for eating and cooking. The results of our survey show that the plant's uses are multiple. Of all the plant products, the fruit and the wood are the parts most used by local people; followed by the leaves, and the bark (**Figure 5**). Using the plant for food primarily concerns the fruit pulp (100% of the respondents). Despite the bitter taste, it is sucked on and greatly enjoyed by people. Using the pulp for making juice was sometimes reported (6.56%). The use of the kernels and leaves for culinary purposes was also cited, 36.7% and 20% respectively. According to most people interviewed the use of the kernels to extract oil is still practised by local Wolof people in the south of the Ferlo region. This result corroborates the work of Broutin et al. (1992) who had stated that the areas which are predominantly Wolof are those that most use the oil from *B. aegyptiaca*. As for the leaves, they are used in the preparation of a sauce eaten with pearl millet.

Some datas have been reported on the nutritional value of *B. aegyptiaca* fruits (Tayeau et al., 1955; Sagna et al., 2014). The pulp is a good dietary source of sugar (42.57 g·100 g^{-1} MF), protein (9.57 g·100 g^{-1} MF), and vitamin C (6.87 mg·100g^{-1} MF). The amino acid profile reflects its nutritional quality with the presence of essential amino acids for humans (leucine, valine, lysine, isoleucine, phenylalanine, threonine, histidine and methionine). The pulp is also a concentrated source of potassium (2,220 mg·100 g^{-1} DM), calcium (141 mg·100 g^{-1} DM), magnesium (73 mg·100 g^{-1} DM) and iron (4.94 mg·100 g^{-1} MS). Its calorific intake is 212.25 kcal (Sagna et al., 2014). As for the kernel oil, its physicochemical properties and nutritional values are comparable to peanut oil (Tayeau et al., 1955). These studies underline the potential of *B. aegyptiaca* fruits as a source of nutritional intake for local populations.

Use of wood. A high consumption of *B. aegyptiaca* wood was reported by local people in the Ferlo region (100% of respondents, data not shown). The wood is widely used for building huts (58.8%), fencing (16%) and animal pens (15.6%). Other uses of wood are

Figure 5. Use frequency of different parts of *Balanites aegyptiaca* (L.) Delile by local people in Ferlo — *Fréquences d'utilisation des différentes parties de* Balanites aegyptiaca *(L.) Delile par les populations du Ferlo*.

For example, F = 100% means that all the respondents to this question reported this use — *Par exemple, F = 100 % signifie que tous les répondants à cette question ont signalé cet usage*.

for cooking (5.2%), charcoal (2.4%), making stands for the Koran (2%), and pestles (2%). For cooking, *B. aegyptiaca* supplies local people with combustible wood commonly used in households despite the irritating effect of the smoke on the eyes reported by some households.

Used for forage. The tree is particularly appreciated for the fodder that it supplies to animals for a large part of the year. The most palatable parts of the plant cited in descending order are: leaves (100%), fruits (93.3%) and young plants (10%). The fruits are consumed exclusively by small ruminants that eat them when they fall on the ground. In Burkina Faso, *B. aegyptiaca* is also considered as one of the important species due to its quasi-permanent feed availability (leaves, branches and fruit); consumption of its fodder particularly increases in the dry season (Chevalier et al., 2003; Kaboré-Zoungrana et al., 2008). These same authors have shown through biochemical studies of leaves that they constitute a potential source of supplementary nitrogen-containing matter and mineral elements.

Medicinal uses. In the study area, different parts of the plant are cited by local people for the treatment of various human ailments. In total, ten ailments were cited. The most cited by local people are: gastric ulcer (26.4%), colds (26.4%), and high blood-pressure (24.5%). Its use to treat other ailments cited (constipation, haemorrhoids, burns and wounds, eye infections, stomach-ache, anthrax, and mental illness) is less reported (**Figure 6**). It should be noted that the use of thorns to treat mental illness was also reported by one person (a traditional healer). Unfortunately, we were unable to collect more detailed information on this aspect, as this is an extremely delicate subject and is not considered a topic for discussion with just anybody.

Balanites aegyptiaca is used not only by local populations in Senegal, but also in other countries throughout Saharo-Sahelian Africa (**Table 2**). Analysis of the compiled data on the medicinal uses of the plant shows that it is prescribed for the treatment of several sorts of illnesses and symptoms of which the

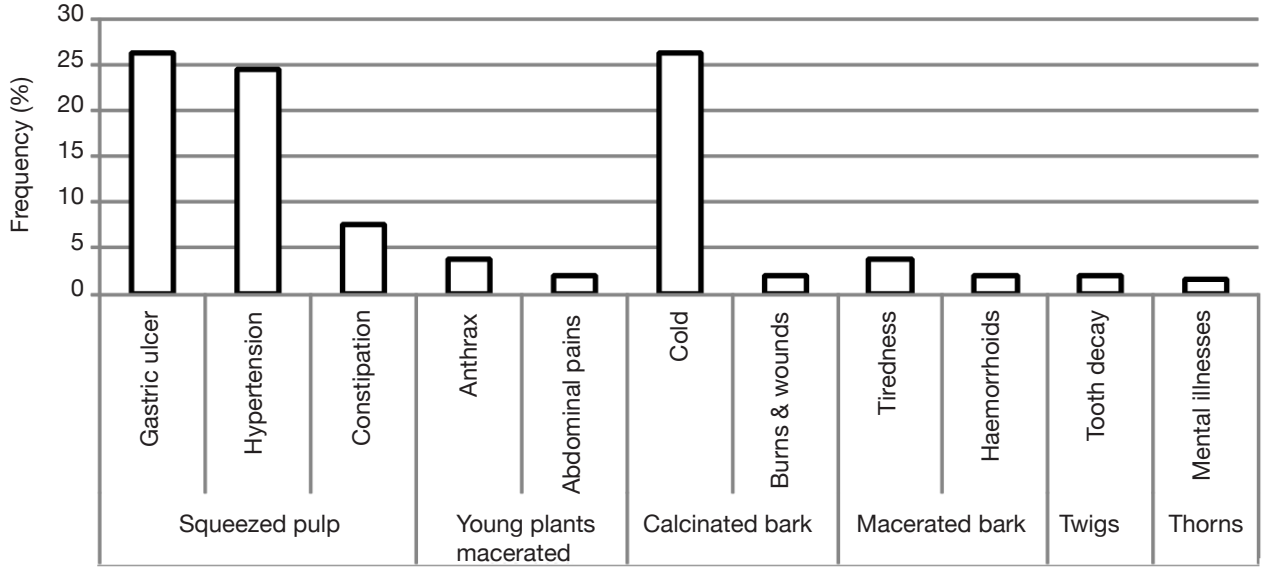

Figure 6. Use frequency of medicinal and pharmacological uses of *Balanites aegyptiaca* (L.) Delile in the Ferlo region — *Fréquence d'utilisations médicinales et pharmacologiques de* Balanites aegyptiaca *(L.) Delile dans la région du Ferlo*.

Tableau 2. Medicinal and pharmacological human uses of *Balanites aegyptiaca* (L.) Delile in the Ferlo region and in neighbouring countries in Africa — *Utilisations médicinales et pharmacologiques humaines de* Balanites aegyptiaca *(L.) Delile dans la région du Ferlo et dans les pays africains voisins*.

Parts used	**Ailments treated**	**Mode of preparation**	**Countries (references)**
Fruit (pulp)	Gastric ulcer	Squeezed pulp	* Senegal, Ferlo; Niger (Fortin et al., 1997)
	Hypertension		* Senegal, Ferlo
	Tonsils		Burkina Faso; Algeria (Chevalier et al., 2003)
	Diabetes		Egypt; Soudan (Fortin et al., 1997)
	Pains		Mali (Pousset, 1989)
	Constipation		* Senegal, Ferlo; Burkina Faso; Algeria (Chevalier et al., 2003)
Fruit (kernels)	Intestinal worms	Dried powder	Burkina Faso (Nacoulma, 1996)
	Eye infections	Oil applied to area affected	Burkina Faso; Algeria (Chevalier et al., 2003)
	Sinusitus	Baking	Burkina Faso; Algeria (Chevalier et al., 2003)
	Rhumatism		
	Constipation		Burkina Faso (Nacoulma, 1996)
Trunk (bark)	Liver illnesses	Fumigation	Tchad (Creach, 1940)
	Cold		* Senegal, Ferlo; Burkina Faso (Chevalier et al., 2003)
	Haemorrhoid	Macerated bark	* Senegal, Ferlo
	Syphilis		Tchad (Creach, 1940), Burkina Faso (Chevalier et al., 2003)
	Tiredness		* Senegal, Ferlo
	Burns and wounds	Calcinated bark	* Senegal, Ferlo; Somalia (Fortin et al., 1997)
Leaves	Smallpox	Decoction	Mali (Imperato et al., 1968)
	Nose bleeds		Burkina Faso; Algeria (Chevalier et al., 2003)
Roots	Jaundice	Maceration	Soudan; Egypt (Creach, 1940)
	Asthma		Somalia (Pousset, 1992)
	Colic		Burkina Faso; Algeria (Chevalier et al., 2003)
	Epilepsy	Unspecified	Somalia (Fortin et al., 1997)
Young plants	Abdominal pains	Maceration	* Senegal, Ferlo
	Anthrax		
Thorns	Mental illnesses	Unspecified preparation	* Senegal, Ferlo; Burkina Faso; Algeria (Chevalier et al., 2003)
Twigs	Tooth decay	Toothpick	* Senegal, Ferlo; Burkina Faso; Algeria (Chevalier et al., 2003); Niger (Fortin et al., 1997)

* Data from this study — *données provenant de cette étude*.

most noted are infectious diseases (smallpox, anthrax, and yellow fever), digestive tract ailments (gastric ulcer, constipation, stomach pains and haemorrhoids), respiratory tract ailments (asthma, and colds), sexual conditions (syphilis), and chronic illnesses (hypertension and diabetes). The convergence of medicinal uses of the plant in its distribution area proves that it has some medicinal and pharmacological potentialities. However, there are also uses that appear specific according to the geographical area. For example, neither roots nor leaves were reported for medicinal use in our surveys carried out in the Ferlo region, whereas macerated leaves are used to treat nose bleeds in Burkina Faso, Algeria, and jaundice in Sudan, and Egypt. Our data demonstrating the widespread use of *B. aegyptiaca* for medicinal purposes corroborate a recent review article published by Chothani et al. (2011). These authors reported that the bark, fruit, kernels, and leaves possess a wide array of active biomolecules (*i.e.* antioxidant, antimicrobial, anticancer, diuretic, wound-healing, antiviral, antidiabetic, anti-inflammatory, and analgesic), thereby justifying the diversity of uses in folk medicine.

Balanites aegyptiaca has also been cited in veterinary medicine. In Burkina Faso for example, decoction of the bark and roots is used for treating animal anthrax; the roots to treat colic in horses; and the leaves and bark are ground and used in a paste for applying to wounds (Chevalier et al., 2003). However, veterinary uses *B. aegyptiaca* were not mentioned by people in the Ferlo. Most respondents think that the plant has never been referred to as having any mystical properties. Nevertheless, the use of its thorns to keep away bad spirits was reported.

Local marketing of *B. aegyptiaca* products. Socio-economic activities around *B. aegyptiaca* products primarily concern the marketing of fruits (100% of respondents) followed by that of oil extraction from the kernels (33.3%). Locally, the collection and marketing of fruit is carried out particularly by women but children and men also participate. The results also suggest that the majority of production is sold in the area, in particular in the local weekly markets in the Ferlo region (83.3% cited). A small proportion of fruits harvested goes to towns, to Dahra (13.9%) and Touba (2.8%) in particular. According to those interviewed, most of the buyers of fruits are traders from the interior of the country. Thus, it is probable that the benefits for local people in Ferlo in terms of marketing the fruits *B. aegyptiaca* would be based on the accessibility of internal markets through a well-organized market chain. The retail price of fruits sold is 150 F CFA per unit (a unit = 1 kg, canned tomato tin). Few cases of the existence of wholesalers are reported. Results of the survey show that women are more interested in this sector. Undoubtedly this is due to the fact that they are very often aware of the dietary and economic benefits of gathering and consuming fruit, especially in times of food scarcity (Bergeret, 1986; FAO, 1987). It is, however, important to point out that local people sell the fruit for the pulp and do not seem to know that the kernels can be a source of revenue.

4. CONCLUSION

Its adaptation to the Sahelian climate and diversity of soils in which the variety prospers explains *B. aegyptiaca* var. *aegyptiaca*'s wide geographical distribution and domination in many Sahelian landscapes. Uses of the plant in the Ferlo region in Senegal are multiple. They concern all use categories: food for humans and livestock, energy, construction, and medicine. The ideal would be to develop schemes for exploitation and development compatible with local people's needs. The success of such a strategy should be the number one priority, especially considering the choice of this species of great socio-economic potential by several of the countries along the GGW path.

Local and empirical knowledge of the species should serve as a basis for future work in the characterization of adapted agro-forestry systems and genetic improvement of *B. aegyptiaca* in plant breeding programs. To make the most of the plant's medicinal virtues, it would be interesting to research the active ingredients that justify its multiple uses in traditional medicine. As an important fruit in local markets, performing fruit market chain analysis would be an obvious way forward. Finally, the conservation and protection of *B. aegyptiaca* is vital in both preserving the environment in the Sahelian area and in diversifying resources for local people and their livestock.

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