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Full Length Research Paper

Nutrient and mineral elements levels in four indigenous tree seeds in Sokoto State, Nigeria

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This study was conducted at Usmanu Danfodiyo University, Sokoto, Nigeria to determine the nutrient composition of four tree seeds. The tree species served as treatments and were replicated four times in a completely randomized design. The seeds of the four tree species randomly selected were analysed for the nutrient and mineral elements. The results showed that; highest moisture and fat contents of 13.75 and 17.125% were recorded in *Parkia biglobosa* seed and the lowest of 6.5 and 2.125% in *Acacia nilotica* seed. The highest ash content of 4.5% was recorded in *A. nilotica* seed and the lowest (2.375%) in *Balanites aegyptiaca* seed. The highest crude fiber content was recorded in *P. biglobosa* seed (1.375%) and the lowest (0.75%) in *Ziziphus spina-christi* seed. 17.66% was the highest crude protein in *P. biglobosa* seed and the lowest (0.73%) in *B. aegyptiaca* seed. High content of nitrogen free extract (NFE) was recorded in *A. nilotica* seed with 91.154% and the lowest in *P. biglobosa* seed with 60.458%. High sodium content was recorded in *A. nilotica* seed with 87.25 ppm and the lowest in *Z. spina christi* seed with 51.8 ppm. The highest magnesium, potassium and phosphorous contents of 2.175, 712.5 and 6.5 ppm were recorded in *p. biglobosa* seed. The highest calcium content (2.075 ppm) was found in *A. nilotica* seed. Further research with different species of tree seeds (of good quality or from plus trees) should be carried out for enhancing long term values of the trees.

Key words: Forest trees, artificial regeneration, nutrient composition, proximate analysis.

INTRODUCTION

Forest trees are of great importance because of their multiple uses. Forage for livestock and microclimates that support great crop production activities (Tambari, 2007). Evans (1982) reported that almost every part of the tree; roots, trunk, bark, leaves, flowers, fruits and seeds, is known to have some uses. Indigenous trees are species that resist drought, grow well on any type of soils in savanna environment, the trees have the ability for quick recovery. They contribute to the supply of nutrients to the soil via litter and are leguminous except few like *Balanites aegyptiaca*, thus they fix nitrogen in the soil (Danjuma, 1994). Tree seeds are of fundamental importance in silvicultural activities since natural and artificial regeneration programmes start with it. Seed is an important input for many planting programmes and serves as a conservation unit for many tree species. Tree seed is such a key element in plant production that exercises a profound influence on the success or failure of any development of tree programmes. Such programmes or regeneration according to Kamra (1973) can be affected by lack of adequate and quality seeds on the forest floor. The seeds also form a very important element in the quality of seedlings produced in the nursery, since quality of seedlings produced determined the genotype of seeds from which they are being originated. Seeds serve to aid regeneration in some plants while many can be propagated vegetatively from stem cuttings, stumps or shoot sprouts (Nwoboshi, 1982).

The harvesting and handling of seeds is the most crucial aspect of seed acquisition. Seed collection means fruits collection because it is the fruits that bear seeds. Most plants bear fruits yearly, although there are good and lean seed years. It is necessary to know about the fruiting habit of the plant of interest ahead of its collection. But it is better to collect seeds in good seed years or period of abundance. For example, *B. aegyptiaca* has good seed years in alternate years. Fruits or seeds should be collected from matured plus trees of good

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form, vigour and phenotypically good mother trees. Immature and very old trees are not recommended for seed collection, fruits should be matured enough before collection and this is indicated by a change of colour, from green to brown, yellow, red, orange and black depending on the species of trees. It is better to collect fruits straight from the mother trees as pests and diseases may likely attack the fruits while on the ground. Therefore, the fruit collector must be present at the right time to obtain viable seeds.

Method of collecting fruits or seeds

A fruit collector can collect fruits by plucking directly from the mother trees in to a fiber or poly bag. In case of thorny trees, direct plucking of fruits with long sticks or poles can be done. Trees can be trembled at the stems or branches to facilitate fruit dropping. Prunning the branches of tall trees can be applied for fruit collection, but tree felling is not encouraged. The general methods of seed extraction are: hand, machines, spreading, pounding, splitting, fermentation, soaking, etc. After seed extraction, good seeds are sorted from impurities like stones, fruit parts, twig, wings, broken and defective seeds. This can be achieved through picking with hand, floating with water, sieving/ winnowing etc. After seed sorting, next is seed storage, careless handling of seeds may impair its viability and spoil the seeds. The ability of seeds to remain viable under natural condition varies with species. Seeds that are not used immediately after harvest are often preserved or stored under room temperature and refrigerator (cold storage) for future use.

The role of nutrient in tree growth

Muhammad (2001) reported that sixteen (16) elements; called essential elements are at present required for healthy growth of green plants. These important elements are: carbon, hydrogen, oxygen, nitrogen, ferrous, magnesium, zinc, copper, molybdenum, biome, chlorine etc. These are essential because each of them has a specific role to play in tree physiology (Nwoboshi, 1982). If any of them is in limited supply or possibly in excess, tree growth may be impaired (Evans, 1982), and deficiency symptom specific to each element is developed and is corrected only by its application. These elements form important constituent of plant tissues, catalysts in various reactions, osmotic regulators of membrane permeability. For example, calcium is a constituent of the cell wall, magnesium is the chlorophyll and molecules, nitrogen in proteins and phosphorous in phospholipids and nucleo-protein while the trace elements, ferrous, copper and zinc form prothetic groups of co-enzymes of certain enzymes system (Nwoboshi, 1982). Nutrient constituents of the plant include carbohydrate as source of energy, protein as the vital component built up of enzymes, organelles etc., minerals associated in biological systems, fats and oils in form of simple lipids. Agishi (1985) identified some of the factors affecting nutrient content of most browse plants. These are: age of plant, season, species of plants and ecological zones. He gave instances that protein content in *Parkia biglobosa* decreases with increase in age or growth season from 6.5% at flush stage to 2.5% at later stage.

In most of the developing countries, seeds are collected and used any how without paying attention to the value of the seeds in terms of what nutrients they contain. This may lead to failure in planting programmes especially when poor nutrient soil is involved. It was also noted that much research efforts have not been made in the areas of indigenous tree species. Many of the production industries do not include this important tree seeds for lack of information on their nutrient values. Since seeds are important in any successful silvicultural programme, there is the need to procure the right quality and quantity seeds in advance of any plantation scheme. This constitutes the prime target of this research; it will also provide baseline information for the wildlife nutritionists, game birds managers and policy makers both at the local, state and federal level. The objective of this research is to determine the nutrient composition of four indigenous tree seeds in Sokoto State.

MATERIALS AND METHODS

Study area

The study was carried out at the main site of Usmanu Danfodiyo University, Sokoto. Sokoto is located at the north-western part of Nigeria at latitude 11.6° to 13.93° N and Longitude 3.75° to 6.9° E (Bashir, 1989). It is 308 m above sea level and lies within the Sudan Savanna belt (Reuben, 1981). The vegetation is characterized by scattered trees and shrubs with more or less dense continuous grass cover. Rainy season starts from May to early October with 500 to 750 mm of rainfall (Awodola, 1991). Dry season starts from October with strong wind and severe dryness and heat around April. The maximum and minimum temperatures in this area are 40 and 15°C respectively (Amborg, 1985). Soil types vary but are mostly sandy and low in organic matter due to low vegetation cover coupled with wind and water erosion.

Experimental tree species

Acacia nilotica commonly known as Egyptian thorn and *bagaruwa* in Hausa. The tree is drought resistant and survives in many difficult sites. It grows in arid and semi arid regions. The tree is extremely valued source of fuel, small timber, fodder, tannin, tools handles medicinal uses, carts, boats etc. The tree grows up to about 20 m in height but in some locations, it is only a shrub. *B. aegyptiaca* (Linn) commonly known as desert date tree, and Aduwa in Hausa. It is drought resistant and occurs naturally in dispersed form. The tree is in abundance within the study area and it is recognized due to its multipurpose uses by the inhabitants. It is a source of food, fodder, fuel, tools handles, medicinal uses etc. the tree grows up to about

Table 1. Nutrient composition of seeds of *Balanites aegyptiaca, Ziziphus-spina christi, Acacia nilotica* and *Parkia biglobosa* (%).

Treatments	Ash	Moisture	Ether (fats) extract	Crude fiber	Crude proteins	N.F.E.
Balanites aegyptiaca	2.375[b]	8.000[b]	5.125[b]	1.125	0.730[c]	90.640[a]
Ziziphus spina-christi	3.500[a]	6.625[c]	5.000[b]	0.750	2.093[b]	88.750[a]
Acacia nilotica	3.500[a]	6.500[c]	2.125[c]	1.250	0.842[c]	91.154[a]
Parkia biglobosa	4.875[a]	13.750[a]	17.125[a]	1.375	17.660[a]	60.458[b]
LSD	1.893	2.463	2.022	1.311	1.569	2.463

*Means with the same letter along the columns are not significantly different (P>0.05).

10 m in height. *P. biglobosa* (Jacq) commonly known as African locust bean tree with Hausa name as Dorowa. The tree is found in dispersed form, occurring both naturally and as planted stands in the state. The tree is recognized as multipurpose tree and serves as food, fuel, medicinal uses, fodder etc. It is a deciduous tree and grows up to about 20 m high. *Ziziphus spina-christi* commonly known as Christ-thorn and Kurna in Hausa. The tree grows in arid and semi-arid regions, grown naturally and widely dispersed in the study area. The tree is a source of food, fodder, fuel wood, etc. It grows up to about 15 m high (Hauerou, 1980).

Seed collection

Seeds of *A. nilotica, B. aegyptiaca, P. biglobosa* and *Z. spina-christi* were collected randomly but only from the plus mother trees in the study area and subjected to proximate analysis in the laboratory.

Proximate analysis

The powdered samples were digested with Hcl and H_2S0_4 and filtered. 2 g of each sample was used in determining the nutrients and minerals. Each treatment was replicated four times; the nutrients analyzed were moisture, ash, ether, crude fiber, crude protein and carbohydrate. The mineral elements analyzed included phosphorous, potassium, calcium, magnesium, copper, zinc, iron and chlorine. These parameters were analysed using the following methods or procedures: moisture by the oven dry method, ash by muffle furnace ashing method, ether by soxhlet extraction method using petroleum ether, crude fiber by muffle ashing method and crude proteins by micro-Kjeldahl method (this method involved the determination of total nitrogen content of the sample and multiplied by a conversion factor (6.25), the procedure for this proximate composition analysis was described by Udo and Ogunwale (1986). Carbohydrate content was determined by the Nitrogen-free extract (NFE) method using procedure described by Bakare (1985). These were expressed in percentage. Also, phosphorous was determined by colorimetric Vanadomolybdate (yellow) method, potassium by flame photometric method, calcium and magnesium by Versenate titration method (EDTA titration method), manganese, copper, iron and zinc by spectrophotometer method, using procedure described by Udo and Ogunwale (1986). Also chlorine was analyzed by spectrophotometer method using procedure described by Association of Official analytical Chemist (1990). These were expressed in parts per million (ppm).

Data analysis

Data collected were anlaysed using descriptive statistics such as range, percentage and mean. Analysis of variance (ANOVA) was used to test the significant difference in the values obtained and least significant difference (LSD) was used to separate the means.

RESULTS AND DISCUSSION

Proximate composition of the seeds of four indigenous trees

The proximate composition of seeds of the four indigenous trees (*B. aegyptiaca, Z. spina-christi, A. nilotica* and *P. biglobosa*) were presented in Table 1.

Ash content

P. biglobosa, Z. spina-christi and A. nilotica seeds with 4.875, 3.5 and 3.5%, respectively were not significantly different but differed statistically (P<0.05) with *B. aegyptiaca* seeds containing 2.375% ash (Table 1). *P. biglobosa* seeds had the highest ash content and *B. aegyptiaca* the lowest. It is in contradiction with the work of Danjuma (1994) on fodder trees.

Moisture content

Moisture content in the seeds of *P. biglobosa* (13.75%) was found to be statistically higher (P<0.05) than that of *B. aegyptiaca* seeds with 8.00%. *Z. spina-christi* and *A. nilotica* seeds that had 6.625 and 6.500%, respectively were the same and statistically lower (P<0.05) than moisture contents in *P. biglobosa* and *B. aegyptiaca* seeds (Table 1). *P. biglobosa* had the highest moisture content while *A. nilotica* was having the least content. These finding could be attributed to rainfall (at the time of collection) and its influence on the growth of the trees, temperature changes and the rate of chemical transformations of nutrient in the soil. Similar observations was made by Leuw (1979), who reviewed the ecology and fodder resources of the sub humid zones of West Africa and revealed that the rainfall influenced nutrient content of forage trees.

Ether extract content (Fats)

B. aeagyptiaca and *Z. spina-christi* seeds have respectively 5.125 and 5.000% fats which are statistically the same but significantly lower (P<0.05) than the values

Table 2. Mineral content of seeds of *Balanites aegyptiaca, Ziziphus-spina Christi, Acacia nilotica* and *Parkia biglobosa* (ppm).

Treatments	Sodium	Calcium	Magnesium	Phosphorous	Potassium
Balanites aegyptiaca	56.925^{c}	1.45	2.075	5.73^{b}	347.5^{c}
Ziziphus spina-christi	51.800^{b}	1.462	1.825	5.69^{b}	162.75^{d}
Acacia nilotica	87.250^{a}	2.075	2.075	6.42^{ab}	548.75^{b}
Parkia biglobosa	65.250^{d}	1.65	2.175	6.5^{a}	712.5^{a}
LSD	2.85	0.69	0.69	0.759	58.14

*Means with the same letter along the columns are not significantly different (P>0.05).

17.125% obtained in *P. biglobosa* seeds and higher (P<0.05) than 2.125% ether extract in *A. nilotica* seeds (Table 1).

Fiber content

There was no significant difference in fiber content in the four trees seeds (Table 1). The highest numerical value of 1.375% for fiber was found in *P. biglobosa* seeds and the least (0.750%) in *Z. spina-christi* seeds. This work contradicts what was reported by Tambari (2007) that the fiber content in the leaves was significantly high during the dry sub-season than the rainy season.

Crude protein content

There was a high significance in crude proteins content in the seeds of the trees studied. There was no statistical difference (P>0.05) in crude protein content between *B. aegyptiaca* (0.73%) and *A. nilotica* (0.842%) seeds, but the seeds of the two species differ significantly (P<0.05) in crude protein with that of *P. biglobosa* (17.66%) (Table 1). *P. biglobosa* seed has the highest crude protein content and *B. aegyptiaca* seed the least. This result disagrees with the report of Lowder and Cheda (1982) that high protein content occur in plants in the early growing season when moisture content is also high and fiber and lignin content are low in leaves.

Nitrogen free extract content

B. aegyptiaca, Z. spina-christi and *A. nilotica* seeds with 90.64, 88.75 and 91.154%, respectively were not significantly different (P>0.05) but were statistically different (P<0.05) with *P. biglobosa* seeds containing 60.458% NFE (Table 1). *A. nilotica* seeds have the highest proportion of NFE content and *P. biglobosa* seeds the least. This is contrary to the work of Abel (1994), who reported that the content of carbohydrate were not significant in all the leaves of trees except in *B. aegyptiaca.*

Mineral composition

Sodium (Na)

The four tree seeds were highly significant in sodium content (Table 2). The highest sodium content (87.25 ppm) was found in *A. nilotica* seeds and *Z. spina-christi* seeds had the least (51.80 ppm). This fall in the range of what was found by Danjuma (1994).

Calcium (Ca)

B. aegyptiaca, *P. biglobosa, Z. spina-christi* and *A. nilotica* seeds did not differ statistically in the levels of calcium they contained (Table 2). *A. nilotica* seeds have the highest proportion of calcium content (2.075 ppm) and *B. aegyptiaca* seeds the least (1.45 ppm). These values obtained fall in the range reported by Houerou (1980). Agishi (1985) and Wood (1989) on nutrient of fodder tree species that all the tree species have almost the same level of calcium in all the trees with slight difference in the twigs

Magnesium content

B. aegyptiaca, A. nilotica, P. biglobosa and *Z. spina-christi* seeds were statistically the same in magnesium (Table 2). This differs slightly from what was obtained by Agishi (1985).

Phosphorous (P)

B. aegyptiaca and *Z. spina-christi* seeds contained statistically the same phosphorous levels (5.73 and 5.69 ppm respectively) as *A. nilotica* seeds with (6.42 ppm) but lower (P<0.05) than that of *P. biglobosa* seeds (6.50 ppm) (Table 2).

Potassium (K)

P. biglobosa, A. nilotica, B. aegyptiaca and *Z. spina- christi* seeds have statistically higher levels of potassium in that order; 712 > 548.75 > 347.5 > 162.75 ppm (Table 2). This was not the case in fodder trees where Danjuma (1994) reported that almost all the trees species contained the same level of potassium in all parts.

Conclusion

The indigenous trees species that are adapted to Sokoto State environment have not been researched well to determine the quality of seeds. Significant content or composition of the essential minerals and nutrients that favour regeneration and value addition in arid and semi-arid environment were determined.

RECOMMENDATIONS

Based on the findings of this study, the following were recommended:

(1) Further research is needed in the determination of nutrient composition of tree's seeds to enhance long term values of the trees and afforestation programmes.
(2) Supply of seeds of good quality and vigor to farmers and public nurseries.

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