# COMPARATIVE ANALYSIS OF THE EARLY GROWTH OF *Bombax buonopozense* (P. BEAUV.) and *Ceiba pentandra* (LINN.) GAERTN, A SILK PRODUCING FOREST TREES IN NIGERIAN DRY-LAND.

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**ABSTRACT**
*Nursery-experiments were conducted during the dry season at the FRIN central nursery, Kano. The study is aimed at evaluating the early growth and development of Bombax buonopozense and Ceiba pentandra for sustainable silk production development. Sown seeds of the plants were transplanted into polypots 2 weeks after sowing, selecting 10 specimens from each and replicated 4 times. These were represented graphically and the data was subjected to t-test analysis for comparative breakdown. Mean height, leaves, and leaflet numbers were recorded as 11.6 and 10.9cm; 3.6 and 3.8; 11.8 and 12.1 respectively for Bombax and Ceiba, while the basal diameters had 0.21cm constant for each species. Weekly growth rate was recorded as 1.66 and 1.56 centimeters for height, as well as 0.51 and 0.54; 1.69 and 1.73; and rhymed 0.03cm for leaf numbers, leaflets and basal diameters respectively for both Bombax and Ceiba species. At 0.05 level of significance therefore, calculated-t were 1.86cm, for mean height, 2.0 for leaf numbers, 1.20 for leaflets and 0.005cm for basal diameters, comparative within* the 2 species**.** *Moreover, at 18 DF, t-tabulated were 2.1cm for mean height, 4.3 (leaves), 2.18 (leaflets), and 1.96cm (basal diameters). The growth and development of the two species in the nursery is very tremendous, compromising their enduring comparative advantage for no significant difference between both species. Profound effort is hereby recommended for their massive regeneration, conservation and resource maximization, despite propagation ease for raw materials and industrial development, employment generation, GDP growth, and environmental development.*

***Key words:*** *Conservation; Employment; GDP; Raw material; Sustainable.*

## INTRODUCTION

The floral complex of the world's forest estate is naturally structured to provide social services for mankind. Salami, *et.al*, (2014) however hypothesized that within the concept of this provisional framework is that of raw materials for domestic and industrial process. Specific example is however driven towards the provision of silk cotton as raw materials, among other valuables from *Bombax buonoposense* and *Ceiba pentandra*, a set of forest tree species profusely distributed in Nigerian dry-land. Unfortunately, man had done more harm than good in the course of utilization. The unfortunate scenario is further aggravated with the fact that, these tree species are hardly found in streaked plantation within Nigerian forest estate, but only as an ornamental or shade trees, and they are fast disappearing into the extinct, (Salami, 2014).

*Ceiba pentandra* (Linn.) Gaertn is a deciduous tree species in the family Bombacaceae. It is commonly called the silk cotton or Kapok tree, growing up to 60m high and 8m girth. Old trees are readily recognized by their enormous trunk, supported by large plank buttresses, and also by the widely spreading branches; but young trees have conspicuously whorled branches, and are often densely covered with large conical thorns, (Keay, 1989). *Ceiba pentandra* is however native throughout the American tropics, from Mexico to Central and South America, Peru, Bolivia, Brazil, as well as West Africa; extending from Cape Verde, eastward to Chad and Angola, descending to Nigeria and Ghana, (Woodward, 2010).

Trees normally start to bear fruit when they are 3–8 years old. The fiber is fine, lightweight, elastic, even though, it is not suitable for spinning into threads, (Brown, 2015). The fruit is often shaped like a small cucumber, 10-30cm long, but varying in size and shape with respect to the variety, (Keay, 1989). When fruiting occurs in March, the mature capsules split into five segments releasing the characteristic "silk cotton" also known as kapok, (Brown, 2015). A growing tree produces about 600 to 900 seed capsules or 6 to 9 pounds of clean floss (kapok) annually, (Swarbrick, 1997).

However, *Bombax buonopozense* (P. Beauv.), commonly known as the Gold Coast Bombax or Red-flowered Silk Cotton tree, is a tree in the mallow family, specifically known as malvaceae (Keay, 1989). The tree has almost the same characteristics with *C. pentandra* (Salami, 2014), and differs only slightly. It is native primarily to West Africa, where it is found in rainforests of Sierra Leone, Nigeria, Ghana, Uganda and Gabon, typically at an elevation of 900 to 1200 metres (Freebase, 2010). *B. buonopozense* is a large tropical tree that grows to 40 metres (130 feet) in height with large buttress roots that can spread 6 metres (20 feet).

The plant species start to bear within 4-5 years age. The conspicuous flowers emerge while the tree is leafless (Blench, 2006). The fruits are oblong and fairly large, 8 to 18cm in length by 3.5 to 6cm in diameter. They are glabrous, and open spontaneously at maturity. They contain many seeds that are 5 to 6mm in length, all of which have woolly kapok, a cotton-like fibre (Henk and Smith, 2001).

Common features to the two plant species include the floss on seeds (kapok) that is harvested for use in buoys, life belts, and similar articles, (Chudnoff, 1984; Salami, 2014). This floss is also used as an alternative to down feather, fillings in mattresses, pillows, upholstery, zafus, and stuffed toys such as teddy bears, and for insulation (Henk and Smith, 2001; Salami, 2014). It is also used for packaging industrial and agricultural products against transit damages (FRIN 2011). Nonetheless, it is only used as a cotton substitute and cannot be spun, and as such, its use is limited to stuffing for pillows and clothing (Henk and Smith, 2001; Brown, 2015). Additionally, they are both naturally dispersed by wind as well as water borne because of the cotton laden composition of the seeds, as the pods explodes mechanically at maturity (Henk and Smith, 2001; Salami, 2014; Brown, 2015).

Kapok bearing trees are found in both wet evergreen and dry semi-deciduous tropical forests, and grow well in a range of environments from savanna to forest, and rich volcanic and poor soils; as well as in moist uplands. They are rarely seen away from human settlement, (Yuncker, 1959; McMullen, 1999; Salami, 2014). The trees require abundant rainfall during the vegetative period and a drier period for flowering and fruiting. It is not tolerant of strong wind and raging fire, (Henk and Smith, 2001; Brown, 2015).

Both species' woods are rated as extremely vulnerable to decay when in ground contact, and very susceptible to insect attack, as they are soft and light, and not suitable for furniture, ((Henk and Smith, 2001; Woodward, 2010). It is easy to treat with good absorption and penetration; as it makes good plywood, packaging, lumber core stock, light construction, production of pallets, pulp and paper products, and for local canoes and rafts, (Chudnoff, 1984; Henk and Smith, 2001; Woodward, 2010). Moreover, it is suitable for making tubs, basins, stools and for carvings of all types, (Henk and Smith, 2001; Brown, 2015).

Kapok timber is desirable because of the great length of its trunks, the beautiful colour of its wood, and its straight grain (Salami, 2014). The wood is lightweight, with a density, ranging from (200–450) kg/m³ at 12% moisture content, which limits its uses to canoes and other implements. The density of the wood increases strongly from pith to bark, and varies between trees from different sites, (Henk and Smith, 2001). The wood seasons rapidly, with only slight risks of cupping, springing, twisting or bending, (Persada, 2010).

The seeds as well as the oil of both species can be used locally in soap making. Edible, the oil can be used for lighting, while the seed cake (leftover after pressing for oil) can be used to feed livestock, (Jukofsky, 2002; Woodward, 2010). Kapok oil has some potentials as a biofuel and in paint preparation; and that it can also be used as fertilizer, while flowers are an important source of nectar and pollen for honey bees, (Jukofsky, 2002; Woodward, 2010; Salami, 2014). It is reported that leaves, buds, and fruit are edible when cooked, (Henk and Smith, 2001). In Java, the young pod is eaten, and in West Africa, the seeds are eaten roasted or in soups. Cattle, goats and sheep, readily consume leaves (Henk and Smith, 2001; Brown, 2015).

The medicinal value of the both plant species is also great. The bark decoction of *Ceiba pentandra* has been used as a diuretic, aphrodisiac, and to treat headache, as well as type II diabetes, as it is also used as an additive in some versions of the hallucinogenic drink, (Brunken, *et al*, 2008). Many parts of Bombax are also utilized for medicinal and traditional purposes, and in Ghana, the bark is burnt to produce a smoke that is believed to drive away evil spirits, (Brunken, *et al*, 2008). The abundant thorns present on the bark are burnt, and the resulting charcoal is mixed with butter to treat swelling, in addition to the dried gum produced from the tree which is also used as incense (Blench, 2006).

Because of the above mentioned veritable socio-economic values of the two plant species, it is deemed necessary to dwell into their production and regeneration techniques in order to maximize the utilization of their endowment values, and sustainably for potential development.

## MATERIALS AND METHODS

### The Study Area

Kano is the capital city of Kano state, one of the largest Hausa states in Nigeria. The state is located in the north-west geo-political zone, with current population estimate of over 9 million people. It occupies a land mass of about 20,131 Km$^2$, on a geographic location of latitude 11.76$^0$ N, and longitude 8.66$^0$ E. Rainfall is between May and October, but stable for about 4 months between June and September, approximately 510-1140 mm. per annum. Relative humidity is low and temperature varies between 14$^0$C and 38$^0$C, typical of Sudan savannah dry-land ecosystem. Over 80% of the populace is however engaged in subsistence farming and animal husbandry. This is the reason why the zone is considered agrarian, as majority of the working adults engage in agriculture as a means of livelihood, (Salami, 2014).

Nonetheless, dry-land environments are the areas where average rainfall is less than the potential moisture losses through evapotranspiration processes. This implies that dry-lands are usually dry for the greater part of the year, with less than 0.65 aridity index, (UNEP, 1992). Apart from the semi-arid and sub humid ecosystems, arid and hyper arid form the major components of the dry-land environments. These subtypes are however recognized based on an increasing level of aridity or moisture deficit. Arid environment therefore, is an area with annual rainfall of about 0.03 to less than 0.2 aridity indexes, while the hyper arid has rainfall of less than 0.03, (USGS, 1997). The level of aridity typical for each of these subtypes is given by the ratio of its mean annual precipitation to its mean annual evaporative demand expressed as potential evapotranspiration. Moreover, the long term mean of this ratio is termed the aridity index, (Salami, 2014).

Seeds of *Ceiba pentandra* and *Bombax buonopozense* were collected within the corridors of Minjibir, Gezawa, and Kabo LGAs of Kano State towards the northern end, while the experiment was conducted within the Kano metropolis at the enclosure of the central nursery of Forestry Research Institute of Nigeria (FRIN), fig. I. These were processed and sowed in germination trays. Ten polypots, representing the treatments were filled using ordinary top soil, and replicated into 4 for each of the plant species. This amounts to 40 polypots per plant species. The germinated seedlings in the germination trays were transplanted into the filled polypots 2 weeks after sowing, picking specimen of the same size to ensure uniform age from the onset. The experiments were watered on daily basis, and were put under observation for 8 weeks after transplanting.

The results of the experiments were subjected to a couple of analysis. Growth parameter readings such as height (MH), number of leaves (MNL), number of leaflets (MNLF), and basal diameter (MBD) were recorded and analyzed for their mean, and was tabularized. The growth rate was determined from the growth record analysis for height (WMHGR), number of leaves (WMNLGR), number of leaflets (WMNLFGR), and basal diameter (WMBDGR) per week intervals, fig. II. Moreover, a t-test analysis was used to compare the growth variables between the two species.

**RESULTS**

Records of total mean heights of 11.6 and 10.9 centimeters; number of leaves at 3.6 and 3.8; number of leaflets at 11.8 and 12.1; and equilateral basal diameters of 0.21cm were observed for both species of Bombax and Ceiba respectively within 8 weeks from transplanting, table I. In addition to the above, a mean height growth rates of 1.66 and 1.56; mean number of leaf growth .

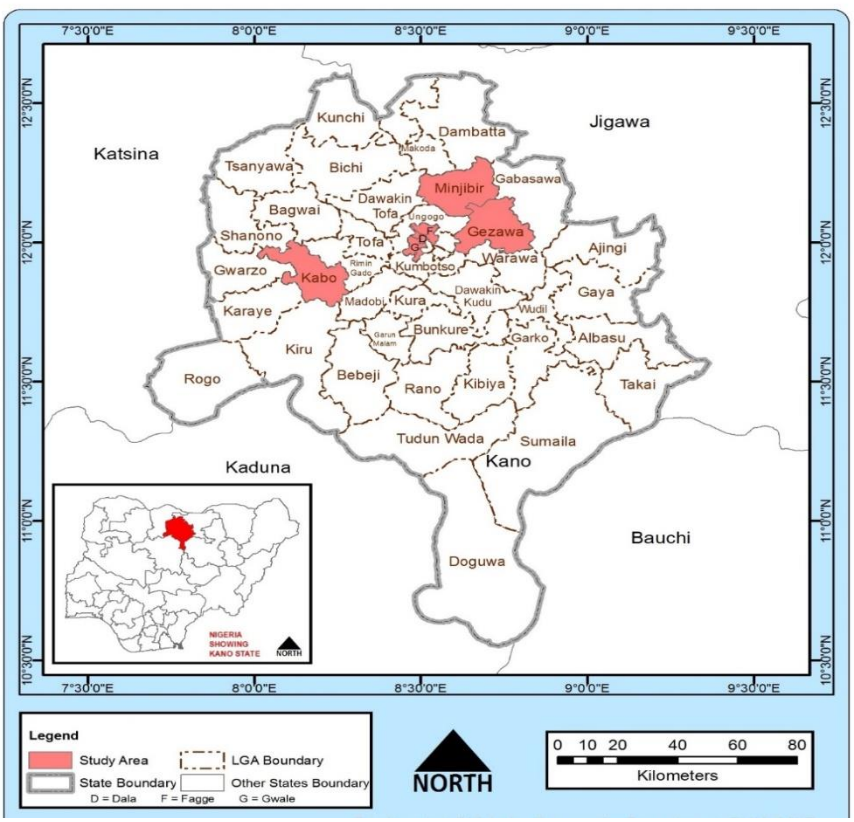


**Fig. I: Map of the study area**

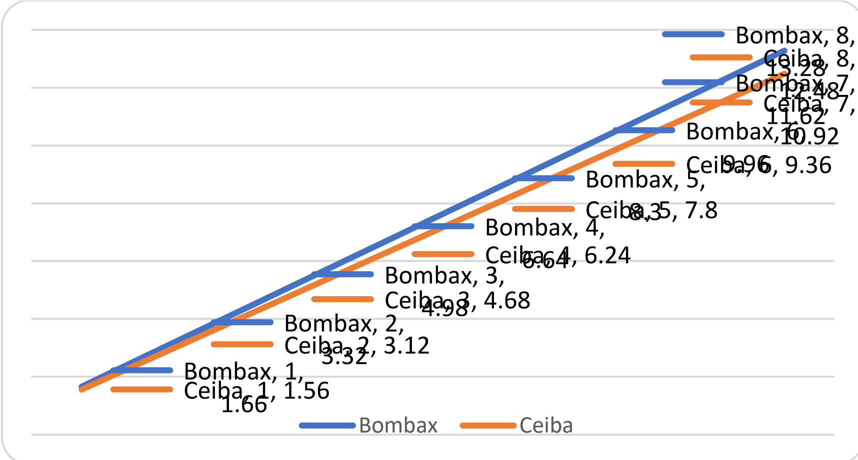


**Fig. II: Weekly Growth Rate Summary for Bombax and Ceiba in the Nursery**

**Table I: Early growth parameter analysis of *Bombax bunoposense* and *Ceiba pentandra* in the nursery.**

| SPECIES | MH (cm) | WMHGR (cm) | MNL | WMNLGR | MNLF | WMNLFGR | MBD (cm) | WMBDGR (cm) |
|---|---|---|---|---|---|---|---|---|
| **B. buonop.** | 11.6 | 1.66 | 3.6 | 0.51 | 11.8 | 1.69 | 0.21 | 0.03 |
| **C. pentan.** | 10.9 | 1.56 | 3.8 | 0.54 | 12.1 | 1.73 | 0.21 | 0.03 |

*MH=Mean Height; WMHGR=Weekly Mean Height Growth Rate; MNL=Mean Number of Leaves; WMNLGR=Weekly Mean Number of Leaf Growth Rate; MNLF=Mean Number of Leaflet; WMNLFGR=Weekly Mean Number of Leaflet Growth Rate; MBD=Mean Basal Diameter; WMBDGR=Weekly Mean Basal Diameter Growth Rate*

rates of 0.51 and 0.54; mean number of leaflets growth rates of 1.69 and 1.73; and rhymed mean basal diameter growth rates of 0.03 were also recorded per week for both plant species respectively. See table I.

Furthermore, the results of the t-test analysis on the plant species (Bombax and Ceiba) in a bid to test the significant differences in their growth and development for comparative analysis indicated that at 0.05 level of significance, calculated t were observed as 1.86cm for mean height growth, 2.0 for mean number of leaves, 1.20 for mean number of leaflets and 0.005cm for mean basal diameter, table II.

Moreover, at 18 degree of freedom (DF), t-tabulated were recorded as 2.1cm for mean height growth, 4.3 for mean number of leaves, 2.18 for mean number of leaflets, and 1.96cm for mean basal diameter. See table II. With the above comparative trends consequently, it was observed that there is no significant difference in the early growth and development of Bombax and Ceiba plant species in the nursery, as the null hypothesis is accepted.

## DISCUSSION

The physical features of Bombax and Ceiba in the early stages of growth and development in the nursery is very tremendous. This growth trend (fig. II) however corroborates

**Table II: T-test analysis for comparative growth and development of Bombax and Ceiba on various parameters.**

| PARAMETERS | MH | MNL | MNLF | MBD |
|---|---|---|---|---|
| **0.05 Confidence Level** | | | | |
| **T-Cal.** | 1.86 cm | 2.0 | 1.20 | 0.005 |
| **18 DF** | | | | |
| **T-Tab** | 2.1 cm | 4.3 | 2.18 | 1.96 |
| | | | | |

the reports of Swarbrick (1997); Henk and Smith (2001); FRIN (2011); Salami (2014); and Brown (2015) which compromised that Bombax and Ceiba plant species under focus grows well in the nursery.

Moreover, the comparative advantage of the two plant species over each other is also very enduring and competitive for no significant difference between the both species. This observation nevertheless is in agreement with the reports of Henk and Smith (2001); Blench (2006); FRIN (2011); Salami (2014); Brown (2015) that the two plant species has very common characteristics in most of their development facets, inclusive of nursery behaviours, growth and developments such as height growth, leaf and leaflets developments, and basal diameter growths.

**CONCLUSION AND RECOMMENDATIONS**

The production, multiplication and regeneration of Bombax and Ceiba plant species are not rigorous owing to the results of this experiment centering on the early growth and development of the two plant species from the nursery stage. These include the total mean heights of 11.6 and 10.9 centimeters; number of leaves at 3.6 and 3.8; number of leaflets at 11.8 and 12.1; and equilateral basal diameters of 0.21cm observed at their averages for both species of Bombax and Ceiba respectively within 8 weeks from transplanting; as well as a mean height growth rates of 1.66 and 1.56; leaf numbers growth rates of 0.51 and 0.54; leaflets growth rates of 1.69 and 1.73; and rhymed mean basal diameter growth rates of 0.03 per week for both plant species respectively is overwhelmingly encouraging.

Succinctly, the growth and development of the two species in the nursery is very tremendous, compromising their enduring comparative advantage for no significant difference between the both species. In essence therefore, profound effort is hereby recommended for their massive regeneration, conservation and resource maximization, despite ease of propagation for raw materials and industrial development, employment generation, GDP growth, and environmental development.

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