INTERNATIONAL JOURNAL OF NATURAL AND APPLIED SCIENCES (IJNAS), VOL. 2, NO. 2(2007); P. 50 – 56, 2 TABLES, 5 FIGS.

Autecology, propagation and utilization of two endangered wrapping – leaf species (*thaumatococcus daniellii and hallea ciliate*) used in food processing and preservation in Southern Nigeria.

C. O. Akachukwu[1]

ABSTRACT

Non-Timber Forest products (NTFP^s) contribute to the livelihood of the rural people in Nigeria. These may be in form of nuts, seeds, leafy vegetable, fruits, drinks, sweeteners, species or wrapping-leaf species. Two wrapping-leaf species: Thaumatococcus daniellii and Hallea ciliate were studied. Growth characteristics, natural regeneration, propagation, harvesting and utilization of these two species were studied. The result show that in T. daniellii leaf length and leaf width ranged from 24.8-70.5cm and 16.3-38.1cm respectively, while stem length ranged from 54 – 237cm and stem girth from 1.0-3.1. In H.ciliata the leaves were also large 20-45cm long and 12.5-30cm wide, stem height and stem girth ranged from 50-400 cm and 12-250cm respectively in young tress. The inter-relationships among the growth parameters measured showed that significant positive relationships occurred between them. Results show that the best planting period for raising T.daniellii was between the month of April and May and in micro-habitat that is shaded and flooded only during the rainy season and dried up during the dry season. The leaves are used to wrap and steam cook bean pudding (locally called "moi-mio") and sometimes used to wrap cooked foods for sale. H.ciliata leaves are used for wrapping and preserving kolanuts. There is a need to encourage massive propagation of these species to ensure sustainable supplies.

INTRODUCTION

Non-timber forst products (NTFP^s) form integral part of the livelihood of the 500 million people who live in or near tropical forests that cover 20% forests that cover 20% of the worlds land area. Of the 250,000 plant species on earth, about 20,00 are known to be edible and perhaps 3,000 have been used as food (including all the non-timber forest products that are harvested from the tress shrubs, herbs and other plants in the forest) and others for various important purposes like medicine, art, and craft and cosmetics (Gbile, 1987). Extraction of leaves from forest plants for (1) wrapping (2) medical purposes (3) soup preparation (such as leafy vegetables) and (4) livestock feeds (fodders) are common especially in developing countries. For example, leaves of Thaumatococcus daniellii (Marantaccae) are used for wrapping cooked and uncooked food items while those of Hallea citiata (Rubiaccae) are used for wrapping and preserving kolanuts. The leaves have long petiole. The fruits are trigonous, winged at the angles, thick, fleshy indchiscent. Seeds are solitary, erect, oblong with a large aril-embryo that is horse shoe-shaped Rhizomes are wide creeping. Flowers are pale, bright crimson in colour. The main stem is the rhizome while the leave are borne on a petiole (Opeke 1987).

Hallea ciliate is a fresh water swamp forest species found in coastal area. It is found in Nigeria, Liberia and extends to Congo. H.ciliata is among the most common species of freshwater swamp forests in Nigersi. It is also a good source of timber being sold under the trade name "Abura". It coppice easily, and it is a natural self-prunner during early years of growth (Skoup 1980). It has 5 lobed ciliate calyces (Steentoft-Nielsen 1965). It may be recognized by the large opposite leaves with big stipules and numerous small heads of flowers and fruits.

Apart from the wood of H.ciliata that is collected from the wild in large quantities, the leaves of these two species are also collected in large quantities from the wild. The rates of exploitation of leave of these species exceed the rates. The rhizomes remain underground as only the leaves are harvested.

Manuscript received by the Editor July 19, 2005; revised manuscript accepted October. 11, 2006.
[1]Department of Forestry and Environmental Management, Michael Opara University of Agriculture, Umudike, Nigeria.

The objectives of this study were to:

1. examine the taxonomic features of the two species.
2. examine the conditions that enhance their natural regeneration
3. assess their artificial regeneration and
4. to study the indigenous methods of harvesting and utilizing the leaves of these species for wrapping and preserving food items.

MATERIALS AND METHODS

Study area

The study was carried out in Southern Nigeria. The study area of T.daniellii covered location in:

(1) Southern Nigeria: Oke Ayo Village at Apata in Ibadan, Oyo State and

(2) Southeastern Nigeria: Ikwuano Local Government Area in Abia State.

The location in each zone was close to a stream in a moist secondary forest vegetation.

The study of H.ciliata was carried out in (1) Oluwa Forest Reserve, Ondo State in Southwestern Nigeria and in (2) Upper Orashi Forest Reserve, Rivers State in Southeastern Nigeria.

Southern Nigeria is characterized by equatorial climate. The mean annual temperature is 25.5^0C and the mean daily maximum is about 30^0C with the mean daily minimum of 18.0 to 24.0^oC. the mean relative humility is about 85%.

Autecology and regeneration studies

The study area was divided into six microhabitats in order to (1) assess the growth characteristic (2) the natural regeneration and (3) propagation of the two species growing in the wild under the different microhabitats.

The microhabitats comprised:

1. An area with illumination plus well drained soil.
2. An area with full illumination and poorly drained soil;
3. An area with full illumination, flooded during rainy season and dry during dry season;
4. Shaded and well drained area;
5. Shaded and poorly drained area and
6. Shaded area flooded during the rainy season but during the dry season.

Determination of the growth characteristic

In each of the micro-habitats studied, the following growth parameters were measured: stem height, stem girth, leaf number, leaf-length and leaf width for the two species.

In T.daniellii leaf number was not assessed since the leaf-bearing stem bears a single leaf. The relationship among the growth parameters in each microhabitat were determined.

Assessment of survival level during propagation of the species.

Planting materials were collected and propagated in each of the microhabitats to assess the levels of survival and the appropriate planting periods of the species.

The planting periods were as follows:

- At the beginning of the rainy season (April-May)
- At the peak of rainy season (August-September)
- At the beginning of dry season (December-January) in the freshwater swamp forest area.

One hundred and eighty rhizomes of T.daniellii were collected during each planting period and thirty rhizomes were planted out in each of the six-micro-habitats giving total of 540 rhizomes (i.e 30 rhizomes x 3 planting periods x 6 microhabitats).

One thousand seeds of H.ciliata were collected from young fruiting trees growing in the wild between July and August, out of which seven hundred and twenty seeds were selected in each microhabitat. One hundred and twenty seeds were sown in the nursery beds. The seeds germinated after about 14-15 days.

Thirty seedlings were selected and transplanted during each planting period. The performances and appropriate planting periods of those two species were determined from the survival rates of the rhizomes and seedlings planted out.

Relationship between leaf length and leaf width.

In order to assess the relationship leaf length and leaf width in the two species growing in the wild, one hundred and twenty leaves were sampled per species as follows:

1 micro-habitat

4 leaf size classes

5 leaves per size class.

Giving a sub-total of 20 leaves per micro-habitat and therefore a total of 120 leaves for six micro-habitats.

Assessment of natural regeneration

The rates of regeneration of the two species under natural environment (i.e. growing in the wild) and the different micro-habitats were determined by counting the number of seedling per hectare in each micro-habitat.

Leaf harvesting and utilization

Indigenous methods of harvesting and utilizing the leaves of these two species were also studied. Both the leaf collectors and users interviewed and information gathered. Filed trips were undertaken together with the leaf collectors to know the actual number of leaves harvested per man-day.

Statistical analysis

Coefficients of correlation and regression analysis were used.

RESULT AND DISCUSSION

Growth characteristics

(i) **Thaumatococcus, daniellii**

On the average the stem length ranged from 54-278 cm while the stem ranged from 1-3cm. leaf length and leaf width ranged from 24.8-70.5cm and 16.3-38.1cm respectively (fig3). The fruits, which were found growing below the ground level, had sweet taste and deep red colour. An average of three seeds per fruit was record. The seeds, which were black in colour, had hard seed and contained abundant endosperm. The rhizomes were slender and creeping.

(ii) Hallea ciliate

Stem height of H.ciliata growing in the wild ranged from 50 – 400cm while stem girth ranged from 12-250cm. the tree holes were straight. The leaves were large, 20-45cm long and 12.5-30cm wide. The flowers were densely crowed together in diameter and white in colour. The flowers were produced between January and March while the fruits (dry dehiscent) were produced between April and July. Each fruit was club-shaped and contained 50 to 100 seeds.

Inter-Relationship among the growth characteristics.

(i) **Thaumatococcus daniellii**

The following parameters had significant positive relationship in all the micro-habitats in the two study sites: (a) leaf length and leaf width (b) stem height and stem girth (Tables 1 and 2). The significant positive correlations suggested that these factors were influenced by the same growth factors. A non-significant positive relationship occurred between stem height and leaf width in all the micro-habitats studied (Table 1 and 2).

The significant positive correlation that occurred between the stem height and stem girth showed that stem girth increased with increase in stem height. However the level of correlation varied among the microhabitats. This relationship becomes important when considering the uses to which the species is put. For example the stems when woven is used as ceiling mat and in weaving basket when combined with other species. Ceilings produced from this species are used in both traditional and cement building, being both attractive and effective for cooling (by reducing the intensity of heat produced by zinc roofs). In southeastern and southwestern Nigeria leaf length was strongly and positively correlated with leaf width in the entire micro-habitats studied. However the level of significance varied.

(ii) **Hallea ciliata**

In all the microhabitats in both sites a non-significant positive relationship occurred between (a) mean leaf width and (b) mean leaf length while slight positive relationship occurred between leaf number and stem girth. However the level of significance vary among microhabitats (Table 3 and 4). A non-significant positive relationship occurred between: (a) leaf number and stem height in all the microhabitats studied both in southwestern and southeastern Nigeria. This showed that the tall trees did not necessary produced more leaves than the short trees 9b) leaf length was significantly and positively correlated with leaf with. This indicated that certain growth factors had similar effect on these two parameters.

Level of survival of the two species during propagation in (a) different micro-habitats and (b) planting periods.

About 87% of T. daniellii planted out at the beginning of the rainy season (April-May) in micro-habitat that was shaded and flooded only during the rainy the rainy season, survived. The survival rate decreased in other micro-habitats with planting periods (Table, 5). The poor performance of T. daniellii in other micro-habitats and at other planting period might be as a result of lack of favourable condition that was needed for proper growth and development.

However on the average T. daniellii performed better in southwestern Nigeria than in southeastern Nigeria.

About 85% of H.ciliata transplanted between April and May i.e at the beginning of the raining season survived in the micro-habitats that was fully illuminated, flooded during raining season and dried during the dry season in southwestern Nigeria while about 75% survived in the same type of micro-habitats in southeastern Nigeria. This was followed by survival rates obtained in micro-habitats with full illumination and well drained soil in southwestern Nigeria and southeastern Nigeria respectively. In all other micro-habitats the survival rate was low. This probably showed that the species can only be propagated under certain ecological conditions and planting period to achieve maximum success.

Table 1. Inter-relationships among growth characteristics of Thaumatococcus daniellii growing in the wild under different microhabitats in South Eastern Nigeria

Micro-habitats	Coefficient of correlation (r)			
		LL	SG	SH
Full illumination with well-drained soil	LW	0.476***	0.342 ^{NS}	0.465***
	LL		0.297^{NS}	0.328^{NS}
	SG			0.427***
Full illumination with poorly drained soil i.e flooded throughout the year	LW	0.784***	0.297^{NS}	0.346^{NS}
	LL		0.548***	0.287^{NS}
	SG			0.455**
full illumination flooded during the rainy season and tried up during the dry season.	LW	0.624***	0.564***	0.346^{NS}
	LL		0.548***	0.287^{NS}
	SG			0.455**
Shaded and well-drained soil				
	LW	0.742***	0.476**	0.315^{NS}
	LL		0.589***	0.297^{NS}
	SG			0.374*
Shaded and poorly-dranined soil				
	LW	0.462***	0.324^{NS}	0.315^{NS}
	LL		0.426**	0.287^{NS}
	SG			0.374*
Shaded and flooded only during rainy Season	LW	0.576***	0.368*	0.387**
	LL		0.421**	0.579***
	SG			0.436**

*P<0.05 **P<0.01 ***P<0.001 NS = not significant

Growth characteristics

LW = Leaf Width (cm)
LL = Leaf length (cm)
SG = Stem girth (cm)
SH = Stem Height (cm)

Table 2. Inter-relationships among growth characteristics of Thaumatococcus daniellii growing in the wild under different microhabitats in South Western Nigeria

Micro-habitats	Coefficient of correlation (r)			
		LL	SG	SH
Full illumination with well-drained soil	LW	0.398*	0.226 ^{NS}	0.389*
	LL		0.354^{NS}	0.321^{NS}
	SG			0.433*
Full illumination with poorly drained soil i.e flooded throughout the year	LW	0.489*	0.324^{NS}	0.263^{NS}
	LL		0.402*	0.346^{NS}
	SG			0.455**
full illumination flooded during the rainy season and tried up during the dry season.	LW	0.898***	0.745***	0.331^{NS}
	LL		0.789***	0.314^{NS}
	SG			0.634***
Shaded and well-drained soil	LW	0.842***	0.695***	0.220^{NS}
	LL		0.422*	0.351^{NS}
	SG			0.423*
Shaded and poorly-dranined soil	LW	0.376*	0.364^{NS}	0.216^{NS}
	LL		0.412*	0.327^{NS}
	SG			0.406*
Shaded and flooded only during rainy Season	LW	0.819***	0.421*	0.341^{NS}
	LL		0.348^{NS}	0.296^{NS}
	SG			0.622***

*P<0.05 **P<0.01 ***P<0.001 NS = not significant

Growth characteristics

LW = Leaf Width (cm)
LL = Leaf length (cm)
SG = Stem girth (cm)
SH = Stem Height (cm)

Relationships between leaf length and leaf width

Leaf length increased with leaf width in both species. The values of r^2 were 59.1% and 82.2% for T. daniellii and H. ciliate growing in the wild respectively (figures 1 and 2). It is therefore clear that the longer leaves were also wider resulting in extensive or large leaf area suitable for wrapping purposes.

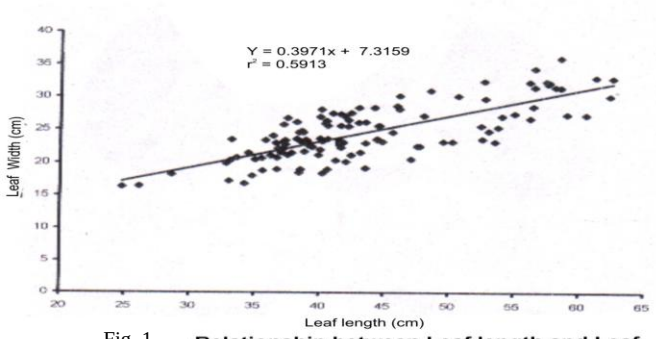

Fig. 1. **Relationship between Leaf length and Leaf width in *Thaumatococcus daniellii* growing in the wild**

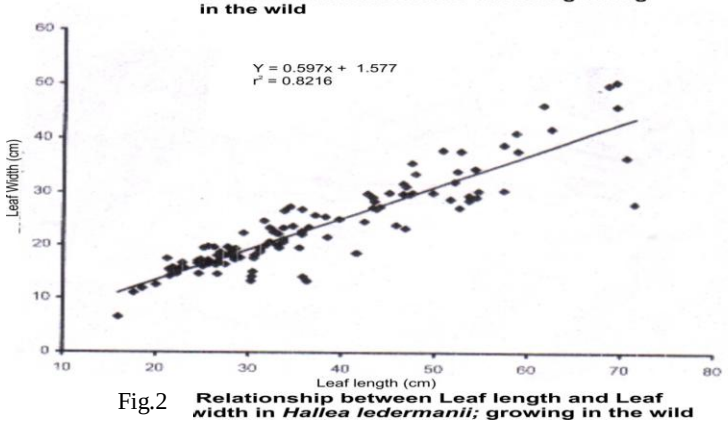

Fig.2 **Relationship between Leaf length and Leaf width in *Hallea ledermanii;* growing in the wild**

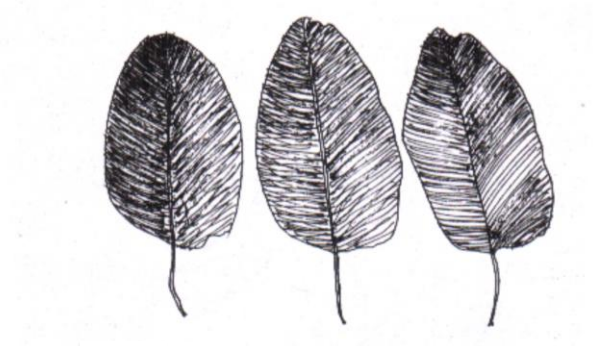

Fig. 3. Leaves of *Thaumatococcus daniellii;* leaf length is up to 70cm and leaf width is up to 38cm

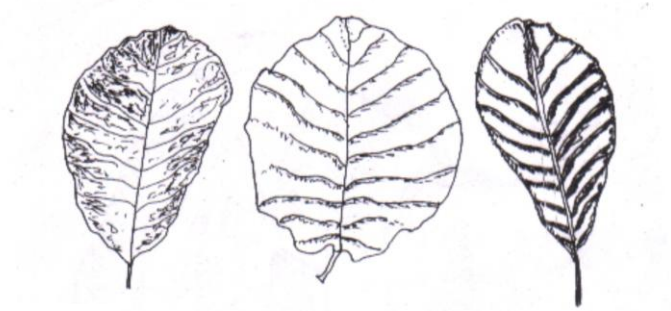

Fig 4. Leaves of *Hallea ledermanii;* leaf length is up to 45cm and leaf width is up to 30cm

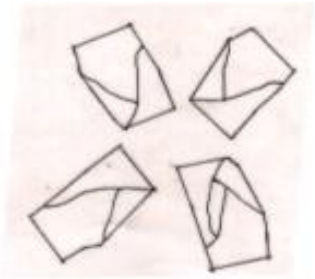

Fig.5. Wrapped leaves of *Thaumatococcus daniellii* containing foodstuff for steam cooking and storage

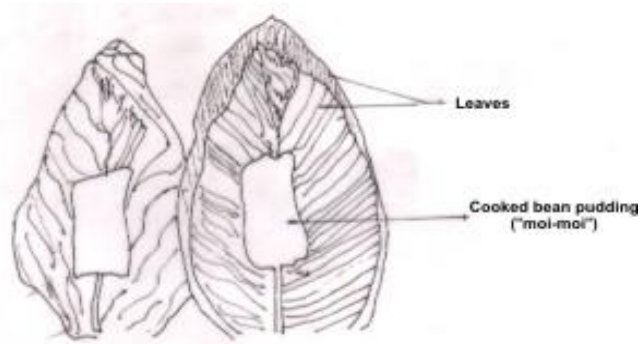

Fig. 6. Open leaves of *Thaumatococcus daniellii* containing steam cooked food. The long period of steam - cooking does not denature the leaf because of it's glaborous nature.

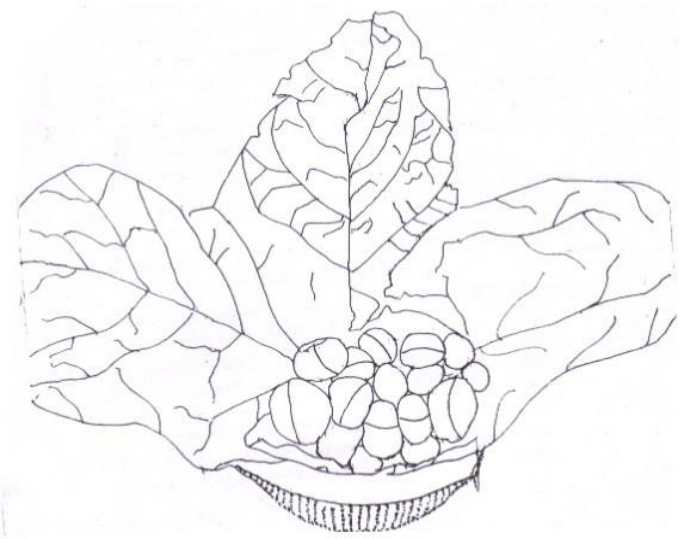

Fig.7. Kolanuts placed on leaves of *Hallea ledermanii* before the nuts are wrapped for preservation and storage

Natural regeneration

The result showed that the two species thrived to some extent on less conducive habitats. However, natural regeneration of T. daniellii was hifhest in the shaded area that was flooded during the rainy season and dried up during the dry season, while H. ciliate regeneration naturally mainly on fully illuminated area with flood water, which dried up during the dry season. The results agreed with the findings of other scientists such as Macgregor, 1932; Osain, 1973; Skoup and Company Ltd 1980

Indigenous methods of harvesting and utilizing leaves of Thaumatococcus daniellii and Hallea ciliate

Observations made showed that T.daniellii leaves were harvested by cutting the basal area of the stalk from a point close to the ground level (i.e between 5 to 10cm above the ground level) with the use of a sharp knife this enhances regeneration of this species. The cut leaves were tied in buches .

The use of the leaves for steam cooking: T. daniellii is known locally in many parts of Nigeria as "moi-moi" leaf because of its use in wrapping the bean pudding to which other ingredients have been added in order to give the "moi-moi" delicious taste (fig.5, 6). The leaves were also used in wrapping already cooked foodstuffs such as rice and beans, which were carried about and sold in the markets. Although plastic containers, nylon or aluminum plate could be used to steam cook the bean pudding, people especially in south western Nigeria prefer the leaf of T. daniellii because of (a) the aroma it gave to the bean pudding ("moi-mio") the improved taste.

Harvesting and utilization of H.ciliata

The leaves of H. ciliate were collected from forest reserves and outside the forest reserves in south western Nigeria leaves were collected from forest reserves in large quantities and transported to Northern Nigeria. However, before entering forest reserve permission was taken as follows: application was written by the leaf collector to the state forestry office (Afforestation project office). A recognizance survey was carried out by the office to identify where the species occurred in large numbers as a suitable source of supply. The leaf collector was then granted permission to collect the leaves, a tariff was paid according to the stipulated regulation, permanent places were earmarked as collecting areas. Young saplings of H. ciliata with their characteristic large leaves were coppiced at 1.3m above ground level. This induced rapid regeneration. The leaves were plucked, arrange and packed in bundles. Each bundle contained between 2,000 and 4,000 leaves. These bundles were transported to the market where they were sold. A man could collect as much as two large bundles of H. ciliata in a day. However, the number of bundles collected increased at the peak of kolanut harvesting. The leaves were also more expensive during this period.

Kolanut were preserved by pouring the nuts in a basket that has been laid with 3 to 4 layers of H. ciliata leaves were often removed and replaced with more fresh leaves after a few weeks (fig.7).

CONCLUSION

Both T. daniellii and Hallea ciliata are important wrapping leaf species. There is need to ensure sustainable supplies through massive propagation scheme. The species are not endangered if leaf removal induces rapid regeneration.

There is a need to carry out further studied to:

(1) Determine the constituents of the aroma transferred to the food by the leaves.

(2) find out if the leaves influenced the nutrient composition of the food(s) through steam cooking.

(3) Determine the effect of Hellea cilita leaves chemistry composition of kolanuts.

(3) Determine the nutrient composition of the leaves

REFERENCES

Gbile Z. O. (1979). Exploitation of Nigeria's economic non-timber plant species in the wild: progress and prospects. An invited paper presented at the *9th Annual Conference of the Forestry Association of Nigeria* ,28th November – 2nd December 1979, 21 pp.

Hutchinson, J and Dalziel J. M. (1963). *Flora of west tropical Africa*. Second Edition edited by F.N. Hepper. Published on behalf of the Governments of Nigeria, Ghana, Sierra Leone and the Gambia by the Crown Agents for Overseas Government s and Administration, Mill Bank, London, 161 pp.

Irvine, F. R. (1961). *Woody plants of Ghana with special references to the uses.* Oxford Press, London . 768pp

MacGregor, W. D. (1932). Silvicultural Treatment of Eba Island. Federal Department of Forest Resources Forestry Records. *Number 231*. volume 1, 16pp.

Mielsen, M. S(1965). *Introduction to flowering plants of West Africa*, University of London Press Limited, Warwick Square, London E. C., 171 pp.

Opeke, L. K. (1987).*Tropical tree crops,* Published by Spectrum Books Limited, Nigeria, 327 pp.

Osain, E. J. (1973) .An auteccological study of mitragvna ciliate (Abura) with special reference to its use as a plantation species in the swamp forest of Rivers State of Nigeria. *Obeche- journal of the Tree Club,* University of Ibadan, Nigeria Volumes 8 & 9 :19 – 33.

Federal department of forestry(FDF),Nigeria)(1980). Feasibility Study of the development and management of mangrove/Swamp forests.123 pp.

Skoup 1980 or Skoup & Company Ltd, (1980). Stentoft – Nelsen 1965.