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FLOWERING AND FRUITING PERIODICITY OF SOME TREE SPECIES IN SOUTH EASTERN NIGERIAN MOIST FOREST

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ABSTRACT

The phenology of 36 tree species in moist forest of South eastern Nigeria was studied form January,1996, through December, 1999. All trees observed produced flowers and fruits. For some trees, such as *Chrysophyllum albidum*, flowers and fruits were seasonal. Few other trees such as *Spathodea campanulata* did not show any seasonality. There were peaks in flowering and leaf fall between the months of December and March. The local dry harmattan wind induced some legumes and capsules to split. Premature seeds were fermented by the heat of the sun. There is need to help viable fruits to reach suitable microsite for germination and seedling establishment.

Key Words: Phenology, moist forest, capsules, fruits, fermented, germination, establishment.

INTRODUCTION

The tropical forest of Nigeria lies at the Southern part of Nigeria (White, 1983). The moist forest is made up of a complex mixture of woody plant species of which 122 have been recorded per hectare at the Omo Biosphere Reserve, Ogun State, Nigeria (Dike, 1992). The size and species composition of the moist forest has been decreasing at an alarming rate (Lanly, 1982; Dike, 1992). Over 29 plants species, including *Monodora myristica** and *Myrianthus arboreus* are in the process of being lost in Nigeria's moist forest (Okafor, 1993). Some researchers, including Jones (1956) had wondered if the emergent tree species are reproducing a forest substantially of the form existing before 1956. It is, therefore, not clear if all trees flower periodically, hence many tree species regenerate mainly from seed.

Literature on the phenology of Nigerian moist forest trees is scarce. However, Njoku (1963) reported the flowering of ten trees which he observed at the Botanical Garden of the University College, Ibadan. He observed the peak flowering period to be between the months of November and January. Some researchers (Longman, Manurung and Leakey, 1990; Njoku, 1963) have attributed the peak flowering to day length, temperature change and internal factor. There is therefore the need to study the flowering period of most of the moist forest trees. The study will attempt to highlight plant species which do not produce many flowers and fruits and the time such fruits are being dispersed. It will also provide data that will enhance the success of attempts at natural regeneration system (Lancaster, 1960; Gomez-Pompa and Burley, 1990) as well as propagation of endangered trees species (Okafor, 1993). This paper reports the study on the timing and levels of flowering and fruiting of some tree species in the moist forest at Michael Okpara University of Agriculture, Umudike, as well as in Oban Forest Reserve. Both forests are located in South eastern Nigeria

(i) MATERIALS AND METHODS:

(1) STUDY AREAS: (a) Umudike Moist Forest

The 5.0 hectare relic moist forest at Michael Okpara University of Agriculture, Umudike, Nigeria, is a 73-year old secondary forest regrowth. Previously, the area was used for the cultivation of yam, maize and cassava. During site preparation, all the trees were pollarded or cut down except such trees as *Piptadeniastrum africanum* for which adequate instrument for cutting were scarce.

The moist forest of Umudike lies at latitude 7^0 29^1 and longitude 5^0 32^1E. There are two seasons, a wet season and a dry season, in the area. The wet season starts from mid March and ends in November while the dry season continues till mid March of the following year. The mean air and soil temperatures are 26.1^0C and 28.1^0C respectively. The maximum top soil temperature is 45^0C (Dike, 1992). The total annual rainfall from the Meteorological station at Umudike ranges between

*Except where stated nomenclature follows Hutchinson and Dalzieli (1954-1972)

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Plate 1 *Daniellia ogea and Ceiba pentandra* have shaded over 90 percent of their leaves at Michael Okpara University of Agriculture, Umudike, Nigeria Moist Forest.

(1)*Ceiba pentandra* is at the middle. (2) The first tree without leaves is *Daniellia ogea*
(3) The tallest tree is (cover mainly with climbers) *Piptadeniastrum africanum (4)* at the background is *Brachysteqia eurycoma.*

1800mm and 2400mm. The abundant tree species include *Anthonotha macrocarpa; Daniellia ogea; Milicia excelsa; Entandrophragma angolense; Pycnanthus angolensis. Quassia undulata and Piptadeniastrum africanum.*

(b) **Oban Forest Reserve**

Oban Forest Reserve which is 3743km^2 in area was made a forest reserve by Forest Order No. 20 of 1932. Oban Forest Reserve lies between latitudes 5^0 15^1 and 5^0 32^1N and longitudes 8^0 14^1 and 8^0 34^1E. The reserve consists mainly of forests over 80 years old. For management purposes the Forestry Department uses the Calabar River to divide the forest reserve into Oban East and Oban West. There are two seasons, a wet season and a dry season. The wet season starts in early March and ends in mid November. The dry season continues till March of the following year. The local dry harmattan wind blows during the dry season. There is no month without rainfall but during the dry season the total monthly rainfall is often less than 30mm. Total annual rainfall from the nearest meteorological station, Calabar, which is about 60km South West of Oban is 3030mm.

The vegetation is dominated by such tree species as *Alstonia boonei; Brachystegia spp; Entandrophragma spp; Khaya spp*; Lovoa *trichilioides; Milicia excelsa; Mimusops spp*; and *Terminalia superba*. Palms such as *Calamuns* sp; *Eremospatha* spp; *Laecosperma* spp. and *Raphia hookeri* are abundant in swampy areas (Dike, 1992). The underlying rock is undifferentiated igneous and metamorphic rock. Oban East is hilly with some of its slopes ranging between 55 and 70 degrees in many places. These hills are continuation of the Cameroon mountain.

(ii **METHODOLOGY:**

At the University of Agriculture Umudike, moist forest, a total of 252 trees up to 20.0m in height, belonging to 20 tree families and 36 tree species were marked with numbered aluminum tags. Each tree species was represented by seven individuals within the forest, the number was made up to seven by randomly selecting such tree species within the nearby forests. Observations for leaf fall, flowering and fruiting on shoots and stems of selected trees were done every two days, using binocular SWIFT

Plate 2. *Daniellia ogea* flowering at Michael Okpara University of Agriculture, Umudike moist forest.

AUDUBON HR/5 MODEL NO. 804 U. S. PAT NO 4626081. Flowering and fruiting were measured by estimation. An estimate of the total number of terminal branches on each tree was recorded. Each time the percentage of the terminal branches that had fully opened flowers or mature ripe fruits were recorded. The quantity of each was also recorded as, few or many (Frankie et al., 1974). During the blooming of each tree an estimate of the total number of flowers produced was made every day. The pollinating agents were observed and identified.

For comparison, observation was also made weekly on 252 mature trees at Oban Forest Reserve, Nigeria. The same trees species being observed at Umudike moist forest were selected at Oban Forest Reserve for observations. The observed trees were also marked with numbered aluminum tag. Observation started at both Forests in January, 1996 through 31 December, 1999.

RESULT AND DISCUSSION:

During the wet season, *Nauclea diderrichii* shaded between 12 and 25 per cent of the total number of leaves it produced per year. All other observed tree species maintained over 80 per cent of their leaves throughout the wet season. The leaves lost by *Nauclea diderrichii* could presumably be attributed to the passage of rain clouds. The sky was heavily cast with rain bearing cloud more especially in the month of July. A month after the beginning of the dry season, all the trees observed had lost between 25 and 40 per cent of the total number of leaves produced per year.

Between December and early February, the dry harmattan wind blew intermittently at variable speeds greater than 2.5ms^{-1} at a height of 30m. All the observed trees lost between 40 and 100 per cent (Plate.1) of their leaves in an attempt to minimize water loss through the stomata. The concentration of leaf fall in the dry season has been noted by Wright and Cornejo (1990). Few trees had half of their branches with 30 to 40 per cent of their leaves. New flushes were produced by some of such trees species within three weeks after leaf fall. Consequently, some trees had both old and new leaves. In some tree species such as *Entandrophragma utile* flushing preceded flowering and in some others such as *Hildegardia barteri* flowering preceded flushing.

Numerous flower buds were produced by tree species at variable intervals. While flowering was in progress , new flower buds were produced at variable interval (Plate 2, 3a, 3b).

In this study, it was estimated that one *Piptadeniastrum africanum* greater than 2.0m in girth at 1.3m produced between 65 and 68 million flowers a year. The number of flowers produced varied within and between tree species depending on their sizes. Each tree species flowered either once, twice or more times a year. The exact date a tree would start to flower is not certain. For tree species which flower once a year, flowering could be done during the wet or dry season (Table 1). A few tree species such as *Piptadeniastrum africanum* could flower in both seasons. Also, ten *Milicia excelsa* which flowered on 10 December, 1997 did not flower again until 02 April, 1999. Although it

Plate 3a. *Quassia undulata* and *Pentaclethra macrophylla* flowering at the Michael Okpara University of Agriculture Umudike moist forest.,

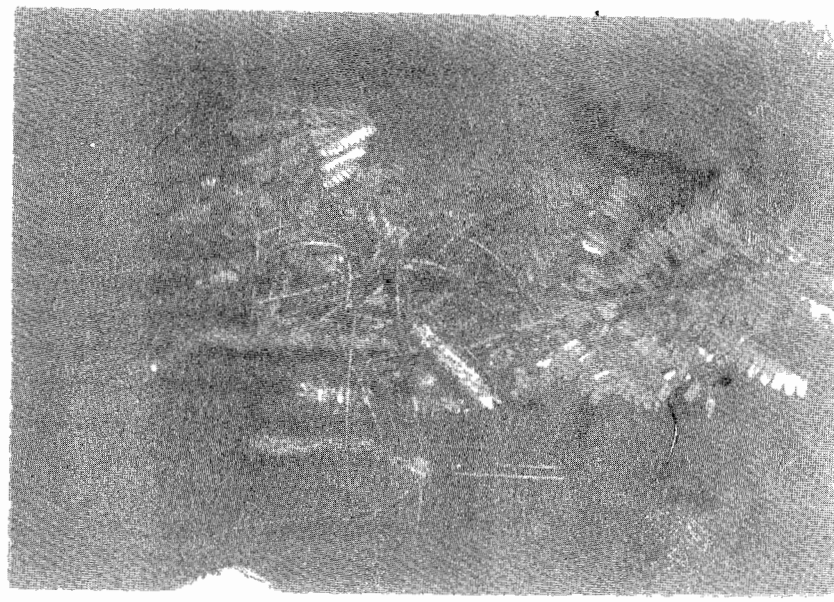

Plate 3b. Flower of *Pentaclethra macrophylla* from the Michael Okpara University of Agriculture Umudike, Moist Forest, Nigeria.

was observed that many tree families flowered between the months of December and February, the general flowering described for west Malesian region of south east Asia (Appanah, 1985 ;1990) was not observed in the study areas. However, it was observed that few species for example, *Chrysophyllum albidum*, *Entandrophragma utile* and *Piptadeniastrum africanum* when in flower, do so for over thousands of square kilometers.

The observed agents of pollination were bees, wasps, beetles, ants, butterflies and small birds. These agents were very numerous. It was observed that some trees such as *Blighia sapida* released periodically sweet smelling floral scents which helped to attract bees and other insect pollinators. The peak flowering period was in months of January and February. Fertilized flowers produced fruits. It was observed that fruit abortion was common to all the studied tree species, especially *Ceiba pentandra*. It appears that fruit abortion in some tree species such as *Ceiba pentandra* could have been an attempt to reduce the number of fruits to be filled. Fruits maturation period varied from 8 months in *Entandrophragma utile* to about 3-4 months in *Ceiba pentandra* and *Milicia excelsa*. The peak fruits bearing period was in the months of May and June with 72.2%. The least fruit bearing period was in the months of January and February with 30.5% (Figure 1). Such short period of fruit maturity for *Ceiba pentandra* and *Chlorophora spp.* (*Milicia spp.*) were also recorded by Frankie, Baker and Opler (1974) at their studied site at Costa Rica.

Many dehiscent fruits split when the dry harmattan wind blew. Dispersed pre-mature fruits especially those of *Khaya* spp. were fermented by the heat of the sun. Many drupes ripe and drop through the influence of gravity. At the study areas, dispersal of fruits by birds and animals was poor because the number of birds and animals has been greatly reduced by hunters and other human activities. Observed trees do not have adequate dispersal appendage or dust fruits/seeds to enable wind to disperse the fruits/seeds for up to 200m. Fruits/seeds and germinated seedlings were seen clustered close to the parent tree.

There were no differences in the flowering period of the two studied sites. Each trees species started flowering during the same week and in most cases on the same day at both sites. Leaf fall in all species started a week earlier at the moist forest of Umudike and many trees had both new leaves and old leaves at Oban Forest Reserve. This could be attributed to the fact that Oban Forest Reserve being nearer to the ocean could have been having the effects of the sea breeze.

CONCLUSION AND RECOMMENDATION

This study revealed that most trees flower periodically and a lot of fruits were produced after flowering. This is similar to the observations made in south western Nigeria (Njoku, 1963) and in Asia (Appanah, 1990). Consequently, flowering and fruiting do not provide problems for regeneration of the studied trees species. It appears that some fruits do not germinate at adequate microsite for survival of the seedlings. It appears that the poor flight distance and survival of seedlings have contributed to the decline of the size of the tropical moist forest. However, it is recommended that trees should be given assistant such as in dispersing their fruits to the required microsites using aircraft for the survival of their seedling and to minimize genetic loss arising from deforestation.

Table 1 Observed periods of flowering, leaflessness, leaf flush and mature fruits of some trees in South eastern Nigerian moist forest.

Family or Sub-family	Species	Observed flowering periods MOUA/OFR*	Observed period of leaflessness MOUA/ OFR	Observed period of leaf flush MOUA/OFR	Observed period of mature frui MOUA/OFR
Anacardiaceae	Spondias mombin	19/03-17/04; 15/10 - 25/11	Dec.-Feb.	Feb.-March	June: Jan.
Annonaceae	Cleistopholis patens	10/30-17/04; 03/06-12/07; 04/10-20/12	Dec-Feb.	March-April	Dec-Jan; July-Aug.
	Monodora myristica	10/30 - 30/04; 04/08-10/09	Dec-Feb.	Feb.-March	June: Dec.-Jan.
Apocynaceae	Alstonia boonei	27/10-27/03	Dec.-Jan.	Feb.-March	Jan.-Feb; May-June
	Funtumia elastica	14/02-29/03; 02/05-26/08; 12/12-10/01	Dec.-Jan.	Feb.-March	Jan-April; July-Sept.
Bignoniaceae	Spathodea campanulata	24/08-28/01	Dec.-Feb.	Feb.-March	Dec.-May
Bombacaceae	Bombax bonopozense	03/11-02/03	Dec.-Feb.	Feb.-March	Dec.-April
	Ceiba pentandra	2/10-04/03	Dec.-Feb.	Feb.-March	Dec.-April
Burseraceae	Canarium schweinfurthii	14/02-26/03; 03/07-14/10	Dec.-Feb.	Feb.-March	March-April; Aug.-Dec.
Caesalpinioideae	Afzelia africana	09/01-24/04; 16/06-28/07	Dec.-Jan.	Jan.-Feb.	April-August; Dec.-Feb.
	Brachystegia eurycoma	01/06-29/07;06/12-03/02	Dec.-Jan.	Jan.-Feb.	June-July; Nov.-Dec.
	Daniellia ogea	03/11-26/02;	Dec.-Jan.	Jan.-Feb.	Feb.- March
Combretaceae	Terminalia superba	01/02-30/03; /06 - 27/07	Dec.-Jan.	Jan.-Feb.	April - May; Nov.-Feb.
Euphorbiaceae	Macaranga barteri	01/01-31/12	Nov-Jan.	Jan.-Feb.	Feb.-Dec.
	Ricinodendron africanum	01/02-31/12	Nov-Feb.	Jan.- March	March .-Dec
Meliaceae	Entandrophragma angolense	29/01-12/04	Dec.-Jan.	Jan.-Feb.	Dec.-March
	Entandrophrama utile	22/02-12/03	Jan.	Feb	Dec.-May
	Khaya ivorensis	09/02-27/03; 02/06-28/07; 24/10-20/12	Jan.	Jan.-Feb.	March-April; Nov.-Jan
	Lovoa trichilioides	14/10-31/12	Dec.-Jan.	Jan.	March
Mimosoideae	Albizia adianthifolia	4/01-31/03; 28/10-30/11	Dec.-Jan.	Jan.	Dec.-May
	Pentaclethra macrophylla	19/03-07/05; 27/07-11/08; 23/10-09/11; 15/12-31/12	Dec.-Jan	Jan-Feb.	March ; May; July-Dec.
	Piptadeniastrum africanum	10/01-15/02; 24/03-02/05; 27/07-11/08; 14/10-25/11	Dec-Jan.	Jan.-Feb.	March: May: July-Sept.
Moraceae	Antiaris toxicaria	05/11-04/01; 09/06-20/08	Nov.-Jan.	Jan.-Feb	Feb-March, July-Aug.
	Milicia excelsa	03/10-09/04	Dec.-Jan.	Jan.-Feb.	Dec.-April
Myristicaceae	Pycnanthus angolensis	01/01-31/12	Dec.-Jan.	Jan.-Feb.	Feb.-Dec.
Olaceceae	Strombosia pustulata	12/02-23/03; 06/11-27/12	Dec.-Jan.	Feb.-March	July; Feb.
Papilionoideae	Lonchocarpus sericeus	01/01-31/12	Nov.-Jan.	Jan.-Feb.	Jan.-Feb.
	Pterocarpus mildbraedii	02/01-28/02	Dec.-Jan.	Jan.-Feb.	Feb .- April
Rubiaceae	Nauclea diderrichii	24/01-29/03; 26/05-03/06	Dec.-Jan.	Jan.-Feb.	Dec - March; June - June
	Nauclea pobeguinii	02/03-02/06	Dec.-Feb.	Feb.-March	August - Nov.
Sapotaceae	Chrysophyllum albidum	30/05-10/07	Dec.-Jan.	Jan.-Feb.	Dec. - April
Simareubaceae	Quassia undulata	27/06-28/08	Dec.-Jan.	Jan.-Feb.	August - Sept.
Spindaceae	Blighia sapida	01/04-28/05; 10/08-30/09	Dec.-Jan.	Jan.-Feb.	Aug-Sept.; Jan-Feb.
Sterculiaceae	Hidegardia barteri	15/12-02/02	Dec.-Feb.	Feb.-March	Jan. - March
	Mansonia altissima	10/04-19/05; 12/07-19/08	Dec.-Jan.	Jan-Feb.	Oct.-Jan.; June-July
	Triplochiton scleroxylon	01/12-26/02; 04/04-24/06	Dec.-Feb.	Jan.-Feb.	Nov.-March

*MOUA represents Michael Okpara University of Agriculture while OFR represents Oban Forest Reserve.

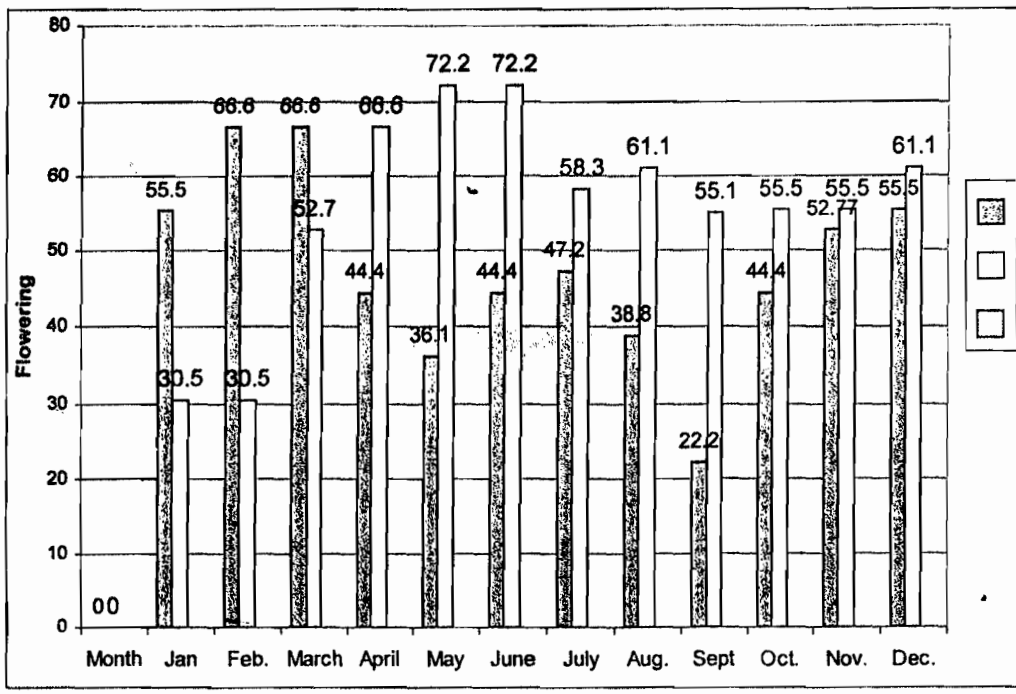

Figure 1. Percentage of trees with flowers and fruits in each month of the study of 504 trees in Oban forest.

Month	Flowering	Fruits bearing
Jan.	55 .5	30 .5
Feb.	66 .6	30 .5
March	66 .6	52 .7
April	44 .4	66 6
May	36 .1	72 .2
June	44 .4	72 .2
July	47 .2	58 .3
Aug.	38 .8	61 .1
Sept.	22 .2	55 .5
Oct.	44 .4	55 .5
Nov.	52 .77	55 .5
Dec.	55 .5	61 1

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