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# RATE OF DECOMPOSITION OF LEAFLITTER IN AN AGE SERIES *Gmelina arborea* Robx PLANTATION IN A NIGERIAN LOWLAND RAIN FOREST

BY

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## ABSTRACT

The study was carried out to investigate the rate of decomposition of Gmelina arborea Robx leaflitter in an age series in Gmelina plantation in shasa forest reserve in a Nigerian low land Forest. Rate of decomposition of Gmelina leaf litter was determined using litter bag technique and mass balance analysis to quantify the rate of leaf litter decay in the stands. Data collected were analyzed using descriptive and inferential statistics at 0.05 level of significance.

Nitrogen(N) and Phosphorus(P) were significantly different among the three stand ages ($p < 0.05$). A fast decomposing rate of the leaves relatively increases P after mineralization. Nitrogen, Phosphorus, Calcium and Magnesium decreased significantly with soil depth, while Potassium and $P^H$ showed no significant association with soil depth. There was a decrease in sand and silt percentages with increasing depth. Clay content however increased with increasing soil depth ($P < 0.05$). Decomposition constant (K) of 0.08 was found for the leaves, with a turnover time of 3 to 6 months. Macro nutrients concentration in the leaf litter decrease in the order Ca> N> Mg> P> K. The study revealed that the rate of decomposition is very fast in the studied site.

**Key words:** leaf litter, decomposition, mineralization, Gmelina arborea

## INTRODUCTION

Decomposition of organic materials is a term generally used for any changes in litter biochemistry, appearance, and weight. It usually occurs on the forest floor where bacteria, fungi and other micro-organisms are the earliest colonizers of fresh litter (Ola-Adams, 1987). The activities of micro-organisms in the soil depend largely on the soil; an acidic soil is known to inhibit microbial processes necessary for organic matter mineralization and nutrient release. The deficiencies of these nutrients, affect soil fertility and vegetation. Organic matter decomposition occurs under condition of moderate temperature and soil moisture content. Temperature and precipitation play a very good role in determining the rate of organic matter decomposition. In temperate coniferous forest, litter accumulates, while in the tropical forests, there is little or no litter accumulation (Madge, 1965). Landelout and Meyer cited by Ojo (2005) in Congo noted of 1.3% and 0.9% litter accumulation per day for temperate and tropical forests respectively. In Ibadan, this varies between 0 and 0.6% per day during the wet season.

Nwoboshi (2000) observed that the disappearance rate of litter generally follows an exponential decay curve, indicating that the relative rate of weight loss remains at a constant proportion of the weight remaining at any given time. This shows that the absolute weight loss is relatively rapid in early stages but slows down with time from commencement of the decay. This relationship according to Olson (1963) is usually expressed by the equation:

$$\frac{X}{X_0} = e^{-kt} \qquad (1)$$

*Where;*

$X_0$ = *the original amount of litter.*

| | | |
|---|---|---|
| $X$ | = | *amount of litter remaining at latter time* |
| $e$ | = | *the base of the natural logarithms* |
| $t$ | = | *time span between $X_0$ and $X$.* |
| $k$ | = | *decomposition constant.* |

Statistical estimation of the slope of the equation will provide an estimate of decomposition constant (k) thus equation (1) can be simplified as follows:

$$X = X_0 \, e^{-kt} \quad \ldots \quad (2)$$

$$Ln\left(\frac{X}{X_0}\right) = -kt \quad \ldots \quad (3)$$

$$Ln\,X - Ln\,X_0 = -kt \quad \ldots \quad (4)$$

*By multiplying Equation (7) by –t, it becomes*

$$(Ln\,X_0 - Ln\,X)\,t = kt^2 \quad \ldots \quad (5)$$

*By substituting $Ln\,X_0$ - $Ln\,X$ with $y^1$ in Equation (8), it becomes $yt = kt^2$* (6)

*The slope of the equation is therefore*

$$\frac{\sum y^1}{\sum t^2} = k \quad \ldots \quad (7)$$

(k) (decomposition constant), determines the rate of decomposition and provides a common basis for comparisons of decay rates in the forests. Olson (1963) stated that the estimates of k range from high values of about k=4 in the African tropical forest down to 1 for the forest of Columbia. The pine forests of South-Eastern United States have values of about k=0.25 while Minnesota pine forests range down the line to k=0.06525.

Ola-Adams (1987) recorded decomposition rates of 0 – 7% per day in Gambari forest reserve while Egunjobi and Fasehun (1972), observed that it would take about two years for pine litter to decompose completely. Hopkins (1966) in his study in South Western Nigeria pointed out that it would take 3 – 7 months for total litter decay in Omo-forest reserve but less than 1 month in Olokemeji forest reserve. Vedrova (1995) stated that the rate of release of organic and mineral products during decomposition of plant residues is similar to their arrival with the annual litter fall. The rates of transformation of broad leaves and conifers however differ in the amount of annual returns of water; solute; C: N and ash elements to the soil. The amounts of litter in the conifer plantations are about 3 times those in the broad - leaved plantations.

It is therefore important to know that, the quality of litter can influence the fluxes of decomposition. The degree of lignifications, nutrient composition, soluble molecules and stimulatory or allelopathic molecules of biologically significant concentrations, have different influences on both the physical environment and the resource quality interactions (Swift and Anderson, 1989).Russell (1973) noted that plant materials with high lignin content had a high proportion of cellulose en-crushed with lignin, resulting in slow decomposition rates since lignin content renders such litter inaccessible to decomposers.

Tanner (1981) recorded marked differences in decay rates between tree leaf species in the same environment in the Montane region of Jamaica, while Edwards (1977), speculated that the quality of resource may change with time due to the palatability of such litter to the soil fauna following the removal of allelopathic materials. It is therefore evident that decomposition depends on the species in the forest or in the forest plantation (Egunjobi, 1974; Ola-Adams 1978; Okeke and Omaliko, 1992).

According to studies in various Nigerian ecosystems, some micro - organisms involved in litter decomposition have been identified and documented. For example, Hopkins (1966) pointed out that termites rather than microorganisms in Olokemeji and Omo forest reserves cause wood decomposition. Madge (1965) recorded a total of 38000/m$^2$ of micro fauna in the wet season and 400/m$^2$ in the dry season in Ibadan. He observed that decomposition was due to the activities of termites and collembola in a secondary re-growth forest in Ibadan. Lasebikan (1979) noted that over 60% of the micro-arthropods in the forest litter and soil were made up of *Acarina* in a secondary re-growth tropical forest in Ile-Ife. Amakiri (1979) stated that there were more bacteria than fungi in pine plots and the number increased with the age of the pines. The increase in number was attributed to the fact that more organic matter was available under the older plots.

The relationship between the rate of litter decomposition and nutrient release has been examined by Cuevas and Medina (1988) in the Podsolized Sands of Tierra Firme near San Carlos de Rio Negro in the Amazon basin. They observed that the rate of litter decomposition was inversely proportional to the lignin content and the lignin per nitrogen ratio of such litter. Therefore, the nutrient to be released will depend on the type of vegetation. This means that nutrient release under natural forests and mono-specific tree plantation will be different as a result of species composition. This study was therefore carried out to investigate the rate of leaf litter decomposition in an age series *Gmelina arborea* plantation in lowland rainforest zone Nigeria

## MATERIALS AND METHODS

This study was carried out in the *Gmelina arborea* plantations in Shasha Forest Reserve (SFR), Osun-State Nigeria. The forest reserve is located between Lats 7$^0$ and 7$^0$ 3$^0$N and longs 4$^0$ and 5$^0$E. The total annual rainfall ranges from 887mm to 2180mm. The mean annual temperature is 26.5$^0$C with the annual range between 19.5$^0$C and 32.5$^0$C. Shasha Forest Reserve is generally undulating with occasional flat terrains. The area is drained by three major rivers namely, Owena, Oni and Shasha . Bada (1977) and Kio (1978) described the geology and soils of Shasha Forest Reserve as composed of undifferentiated crystalline rocks (basement complex) with the rocks made up of granites, gnesis and schists with occasional rock out - crops on riverbeds. The soil belongs to the Ferruginous tropical group, which varies in depth from a few centimetres near rock out crops and 1 – 2 metres in areas occupied by large trees.

### Data Collection

A reconnaissance survey of the study area was carried out for the purpose of establishing experimental plots. Nine (9) plots (three plots per stand of 20 x 20-m 0.040ha) were selected randomly from the 1976, 1977 and 1978 stands in March 2005. The choice of three sample plots per stand was to ensure fair representation of the plantations, which is about 115 hectares. The sample plots were delimited with pegs and the boundaries cleared.

### Litter fall collection

An experimental unit 20 x 20-m (0.04ha), replicated three times in each stand represented a sample plot for this study. Three sample plots (sampling units) were randomly selected in each stand. In each selected plot, five litter traps were randomly located. The litter traps were made of wooden frame (10cm) and plastic mesh base (1mm) to allow free passage of rain water. Each litter trap was raised on four wooden legs, 40cm above the ground, to avoid the decay of litter after being trapped.

**Rate of Decomposition**

Rates of weight loss and mineralization of leaf litter were investigated using litterbag technique to quantify the kinetics of leaf litter decay in each stand (Bocock and Gilbert, 1957; Chuyong *et al*, 2000, Ojo, 2005). This experiment started on August 1, 2005. Plastic sheets raised about 75cm on pegs were spread at locations in each stand to collect freshly fallen leaves. The plastic sheet was perforated to provide tiny holes to drain water resulting from through fall. Leaves of *Gmelina arborea* trapped were collected daily (mornings and evenings) for 10 days (15 – 25, August, 2005) and were air – dried at the Rest House in Area 4 (Olorunsogo). Twenty grams of air-dried leaves of *Gmelina arborea* from each stand were enclosed in eighteen 20 x 20-cm green nylon litter bags of 1mm mesh. Initially, one bag each containing leaf litter collected from $S_1$, $S_2$, $S_3$, was set aside as initial samples, oven - dried at $80^0$C and weighed to obtain the initial mass ($X_0$). These were then milled and stored in sealed plastic bags for later chemical analysis. One 5 x 3m plot was laid in each stand and delimited with pegs. The plots were selected on a relatively flat ground, which was freely drained. This selection was primarily to avoid litter bags being flooded in the wet season. The 5 x 3m plot was further divided into 1 x 1- m quadrants. Litter was removed from the forest floor so that the nylon mesh bags would have direct contact with the forest floor. Six litter bags containing 20g of *Gmelina arborea* leaf litter were randomly assigned to each quadrant in each stand. Each litter bag was anchored to a peg to avoid movement. At intervals of 4 weeks, one bag was removed from each stand (i.e. monthly harvest of three litter bags). The litter bags were put in labelled plastic bags and transported to the laboratory. The residual leaf litter in each litter bag was thoroughly cleaned to remove all exogenous materials, including roots and soil particles, and then oven dried at $80^0$C for 48 hours. Samples were weighed after re-drying for 3 hours and then milled through 0.5mm mesh screen (Wiley), and stored in well-sealed polythene bags for chemical analysis. Two milligrams of the milled leaf litter were acid-digested and analysed for total N, P, K, Mg and Ca. Nitrogen and P in the samples were determined colorimetrically using the ammonia salicylate method for N and phosphomolybdenum method for P. Concentrations of K, Mg, and Ca were determined by atomic spectrophotometry. These analyses followed the same procedures adopted by Chuyong *et al*. (2000).

**Determination of decomposition constant**

From the resulting dry weights, decomposition rate was determined using the regression equation.

$$L_n X_t = X_0 \exp(-k_t) \quad \text{------------------------------------------} \quad (12)$$

*Where,*

$X_t$ = *percentage of litter remaining (g), at time (t)*
$X_0$ = *original weight of litter (g)*
*Exp = exponential*
$t$ = *time in weeks*
$k$ = *decomposition constant.*

The decomposition constant was then determined by using the basic programme of the Analog desktop computer noting the regression of $X_t$ against t. The level of significance was then tested using the F-distribution and LSD method (Olson, 1963; Ojo, 2005).

## RESULTS AND DISCUSSIONS

**Litter fall**

Litter fall (especially leaf fall) occurred throughout the period of collection (13 months), in the stands(S). Through decomposition, litter nutrients are transferred to the mineral soil nutrient pool. Nutrients are released at this stage largely as by-products of microbial scavenging for other vital energy. The rate of breakdown of litter by microbes depends on the chemical quality of the material activities of micro-fauna and the prevailing environmental conditions (Nwoboshi, 2000). The percentage of the nutrients in the starting mass of decomposing *Gmelina arborea* leaf litter in the stands is shown in table 1 and the monthly rate of disappearance (KL) of leaf litter are given in table 2.

**Table 1: Initial weight of decomposing *Gmelina arborea* leaf litter in 3-stands of *Gmelina* plantation in Shasha Forest Reserve**

| %Concentration ($mg^{g-1}$) | | | | | |
|---|---|---|---|---|---|
| Stand | N | P | K | Mg | Ca |
| 1976(S1) | 4.69 | 0.14 | 0.08 | 0.96 | 2.49 |
| 1977(S2) | 4.37 | 0.18 | 0.09 | 0.85 | 2.46 |
| 1978(S3) | 3.69 | 0.12 | 0.07 | 0.96 | 3.03 |

Table 1 presents the percentage concentrations of nitrogen, phosphorus, potassium, magnesium and calcium in the leaf of *Gmelina arborea* before decomposition. The concentration of nitrogen (N) was greatest in all the stands, while potassium (K) concentration was the least. Stand age affected nutrient concentration of the leaf litter. On the whole, elemental concentrations of *Gmelina arborea* leaf in the age series are in the following order; Ca > N > Mg > P > K. Evans (1979) observed a declining concentration of nitrogen and potassium with age in *Gmelina arborea,* but in this study there are no significant variation in the concentration of the nutrients. The reason for this observation can be attributed to the closeness of the three age series. Consequently, the nutrient concentration in all the stands followed the same trend.

Nwoboshi (2000],noted that the disappearance of litter generally follows an exponential decay curve, indicating that the relative rate of weight loss remains at a constant proportion of the weight remaining at any given time. This shows that the absolute weight loss is relatively rapid in early stages but slows down with time that elapsed since the commencement of the decay (Figure 1).

The decomposition was faster than expected during the first 2 months in all the ages. At 3 months (12 weeks), leaf litter in all the stands had almost decomposed completely. However a relatively low mass loss was observed from the third month onwards (Table 2). After the initial weight loss, the subsequent rate of loss (3-6 months) was significantly different in all the stands at $P = 0.000038$ in S1, $P = 000002$ in S2 and $P = 0.000003$ in S3 respectively.

**Table 2: Rates of disappearance of *Gmelina arborea* leaf litter in a plantation age series in Shasha forest.**

| Stand | Age | Litter bag | Month | Initial wt. $X_o$ $gm^{-2}d^{-1}$ | Wt.at a later time $Xgm^{-2}$ $d^{-1}$ | Monthly rate of decay $X_t$/ $X_o$ $gm^{-2}$ $d^{-1}$ | Months to complete disappearance |
|---|---|---|---|---|---|---|---|
| 1 | 29 | 1 | Aug | 20 | 11.80 | 0.5900 | — |
| " | " | 2 | Sept | " | 3.50 | 0.1750 | — |
| " | " | 3 | Oct | " | 1.60 | 0.0800 | — |
| " | " | 4 | Nov | " | 1.30 | 0.0650 | — |
| " | " | 5 | Dec | " | 1.00 | 0.0500 | — |
| " | " | 6 | Jan | " | 0.75 | 0.0375 | 6 |
| 2 | 28 | 1 | Aug | 20 | 11.50 | 0.5750 | — |
| " | " | 2 | Sept | " | 2.70 | 0.1350 | — |
| " | " | 3 | Oct | " | 0.80 | 0.0400 | — |
| " | " | 4 | Nov | " | 0.50 | 0.0250 | — |
| " | " | 5 | Dec | " | 0.30 | 0.0150 | — |
| " | " | 6 | Jan | " | 0.10 | 0.050 | 6 |
| 3 | 29 | 1 | Aug | 20 | 11.50 | 0.5750 | — |
| " | " | 2 | Sept | " | 2.60 | 0.1300 | — |
| " | " | 3 | Oct | " | 0.70 | 0.0350 | — |
| " | " | 4 | Nov | " | 0.50 | 0.0250 | — |
| " | " | 5 | Dec | " | 0.30 | 0.0150 | — |
| " | " | 6 | Jan | " | 0.10 | 0.0050 | 6 |

**Table 3: Correlation result of Gmelina leaf litter after decomposition**

| | $R^2$ | $R^2$adj | SE | P-level |
|---|---|---|---|---|
| S1 | 0.97 | 0.97 | 0.439 | 0.000038 |
| S2 | 0.99 | 0.97 | 0.328 | 0.000002 |
| S3 | 0.99 | 0.99 | 0.377 | 0.000003 |

The effects of age and time were not significantly different in all the stands as shown in Table 3. The nutrient in remaining litter biomass (the residue) of the original litter at later stage of decomposition is shown in (Table 4). Also, after 6 months of decomposition, the rates of decay, decomposition constants (K) and turn over times in each stand for all the ages are shown in (Table5). Decay rates, monthly decomposition constants and turn over times in all the stands were not significantly different at (= 0.05). August to October constituted the most active period of litter mineralization, while December to January was dry and very little decomposition is expected during this period. Table 6 contains the annual litter fall, decay rates, decomposition constants (*K*) and turn-over times in each stand of *Gmelina arborea* plantation age series in Shasha forest.

**Table 4: Mean concentrations of nitrogen, phosphorus, potassium, magnesium and calcium in the residual leaf litter of *Gmelina arborea* in an age series in Shasha Forest Reserve**

| | % Concentrations (mg g-1) | | | | |
|---|---|---|---|---|---|
| STAND(S) | N | P | K | Mg | Ca |
| 1976(S1) | | | | | |
| S1LB1 | 3.51 | 0.062 | 0.049 | 0.67 | 1.98 |
| S1LB2 | 3.03 | 0.049 | 0.057 | 0.70 | 2.44 |
| S1LB3 | 0.55 | 0.082 | 0.053 | 0.61 | 1.87 |
| S1LB4 | 2.91 | 0.078 | 0.050 | 0.70 | 1.93 |
| S1LB5 | 2.76 | 0.125 | 0.060 | 0.74 | 2.05 |
| S1LB6 | 2.54 | 0.172 | 0.056 | 0.70 | 2.17 |
| X | *2.55* | *0.09* | *0.05* | *0.68* | *2.07* |
| SE | 0.39 | 0.11 | 0.023 | 0.05 | 0.10 |
| 1977(S2) | | | | | |
| S2LB1 | 3.63 | 0.084 | 0.062 | 0.71 | 2.33 |
| S2LB2 | 3.03 | 0.107 | 0.060 | 0.76 | 3.01 |
| S2LB3 | 3.27 | 0.158 | 0.059 | 0.73 | 2.92 |
| S2LB4 | 3.65 | 0.164 | 0.062 | 0.75 | 2.84 |
| S2LB5 | 3.63 | 0.074 | 0.064 | 0.76 | 3.10 |
| S2LB6 | 2.91 | 0.062 | 0.061 | 0.73 | 2.53 |
| X | *3.53* | *0.11* | *0.06* | *0.74* | *2.79* |
| SE | 0.16 | 0.01 | 0.0008 | 0.053 | 0.11 |
| 1978(S3) | | | | | |
| S3LB1 | 2.54 | 0.146 | 0.050 | 0.70 | 2.52 |
| S3LB2 | 3.54 | 0.098 | 0.046 | 0.58 | 1.99 |
| S3LB3 | 3.65 | 0.154 | 0.052 | 0.69 | 2.15 |
| S3LB4 | 3.03 | 0.098 | 0.043 | 0.57 | 1.88 |
| S3LB5 | 3.27 | 0.154 | 0.050 | 0.70 | 2.24 |
| S3LB6 | 3.64 | 0.064 | 0.049 | 0.60 | 2.10 |
| X | *3.26* | *0.12* | *0.05* | *0.64* | *2.10* |
| SE | 0.16 | 0.44 | 0.0014 | 0.02 | 0.05 |

**Litter fall and productivity in the forest ecosystem.**

The study of litter fall in any forest ecosystem is an essential step in the study of ecosystem productivity. Leaf fall in particular is measured by sampling of leaves, fruits, small, branches (> 10cm) and other litter fall (Songwe1988). Kira quoted by Songwe, (1984) found that more than 97% of litter fall was of plant origin and leaves amounted to 63%. Bray and Gorham (1964) observed that litter represents an amount somewhat less than leaf production owing to intrinsic and extrinsic weight losses prior to and following abscission which may be used as a guide to maximum levels of total net production. The leaf mass and leaf area formed annually in any forest stand increase during the first 20 years, but as the canopy closes, the leaf mass and leaf area index remain almost constant. The height of the canopy above the ground is what alters with upward growth of the trunk.

**Table 5: Decay rates, decomposition constants ($K_L$) and turn - over times in a *Gmelina* age series, in Shasha Forest Reserve (Aug 2005-Sept 2006).**

| Stand $gm^{-2}d^{-1}$ | Age | Forest type | Decay rate | ($K_1$) | Turnover (months) |
|---|---|---|---|---|---|
| 1 | 29 | *G. arborea* | 1.01 | 0.629 | 9.53 |
| 2 | 28 | *G. arborea* | 0.81 | 0.898 | 6.68 |
| 3 | 27 | *G. arborea* | 0.80 | 0.904 | 6.63 |

Table 6: Decomposition Constant (k) and turn overtime in *Gmelina arborea* Plantation age series in Shasha Forest Reserve

| Stand | Age | Forest type | Leaflitter Decay rate | ($K_1$) | Turnover (months) |
|---|---|---|---|---|---|
| 1 | 29 | *G. arborea* | 0.02 | 0.06 | 6.29 |
| 2 | 28 | *G. arborea* | 0.08 | 0.08 | 8.89 |
| 3 | 27 | *G. arborea* | 0.08 | 0.09 | 9.04 |

A large proportion of the nutrients taken up annually into the above ground components of the vegetation are returned to the forest floor in litter fall (Nwoboshi, 2000). According to Bray and Gorham (1964), leaves small twigs, barks and fruits add from 1000 to 5000kg of oven - dry organic material to the surface of fully stock hectare of forest in a year, depending on the forest type. Nwoboshi (2000) noted that in coniferous stands, the weight of litter fall may be less than 1000kg per ha, while in the tropical rain forest, it could be as much as 10,000kg. The under storey vegetation including the liana, also plays a significant role in this transfer process, especially in the early and later stages of development of the stand, when the amount of light reaching the under storey is greatest.

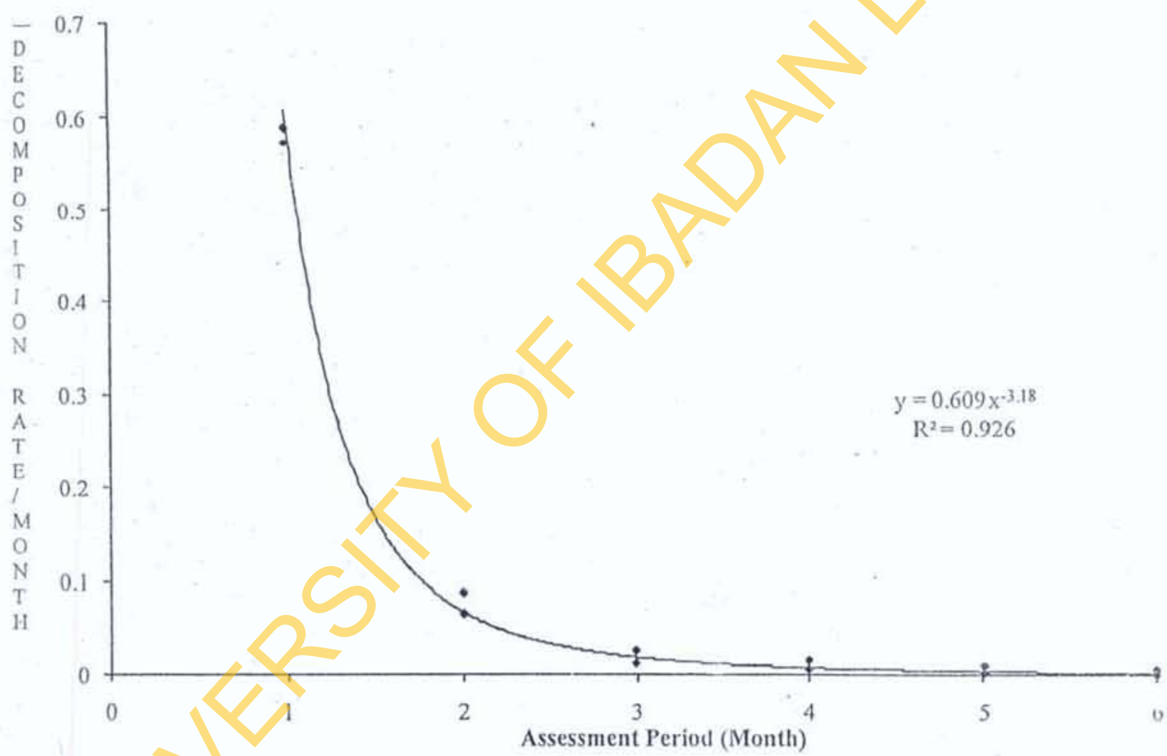


Fig1: Rate of decomposition of *Gmelina arborea* Leaf litter per month across the assessment period.

Under relatively open conditions, this group will contribute up to 25% of the total litter (Bray and Gorham 1964).The shrubs and herbs according to Nwoboshi (2000) contain higher percentage of nutrient elements than matured tree foliage, hence a good proportion of the annual nutrient return to the soil comes through under storey components.

The pattern and rate of litter fall is largely determined by the species and the climatic regimes in that area. Lam and Dudgeon quoted by Ola-Adams and Egunjobi, (1992) noted that litter fall throughout the year however the monthly mean rates of production of individual litter components and total litter do not necessarily correlate with monthly mean temperatures or monthly rainfall. John (1973) noted that leaf fall is mainly seasonal while woody litter production is largely governed by physiological processes.

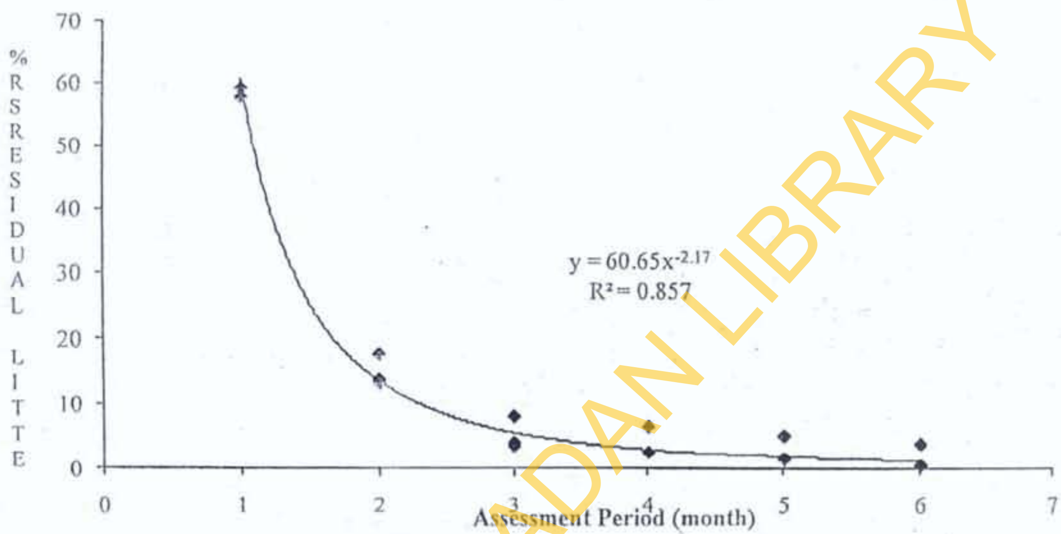


Fig2 : Percentage of residual litter of *Gmelina arborea* across the assessment period.

Generally, wet season peaks in litter fall throughout the tropics, but *Acacia albida* is an example of tree that losses its leaves in the wet season and remain leafy throughout the dry season. Other researchers like Edwards (1979) and Proctor *et al* (1983) have also reported higher leaf litter fall during the wet season in various parts of the tropics. This has been attributed to the high species diversity that characterize these forests, indicating that litter fall may be spread out as a result of interspecific differences in leaf shedding time (Rogers and Westman quoted by Nwoboshi (2000).These differences make it difficult to generalize about patterns of litter fall within and between complex ecosystems.

Litter decomposition and mineralization to a large extent determine the rate at which nutrients are readily made available to plant roots for absorption from the soil nutrient pool into the tree. The cycling of nutrient elements in an ecosystem involves a lot of physical and biological processes that influence efficient recycling system. Mineral nutrient elements are generally added to the soil through rainfall, litter fall and decomposition retain location while nutrient elements are removed from the ecosystem through soil erosion, leaching, volatilization, burning, unplanned farming system etc.

Decomposition of *Gmelina* leaf litter was faster than one would have expected during the first two months (2 Mo) of investigation (August – September) in the stands. At the end the nylon litter bags had almost decomposed. At the end of 6 months, all the samples had decomposed completely. It could therefore be put forward that the half-life of *Gmelina arborea* leaf litter is between 3 – 6 months (that is, the time that *Gmelina arborea* leaf decomposed and mineralized). The decomposition constant of *Gmelina arborea* leaf litter was found to be 0.08. The *K* value is useful for comparing decomposability of various types of litters

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