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SENNA SIAMEA (LAM) AND ITS POTENTIAL FOR PROTECTIVE FORESTRY

By
OLUWADARE, A. O. and OMOLE, A. O.
Department of Forestry Resouces Management,
University of Ibadan,
Nigeria.

Abstract

There is problem of desertification worldwide. It is most prevailing in the northern part of Nigeria where the scanty vegetation cover is being destroyed daily for firewood. Firewood problem has been identified as one of the problems contributing to land degradation. There is need to plant suitable species with good calorific (fuel) value which in turn will improve the soil as well as ameliorate the encroachment of desert. ***Senna siamea*** *wood samples were collected from the Unversity of Ibadan plantation. The fuel value was determined using ballistic bomb calorimeter. Twenty trees of the same age were assessed. The mean fuel value for wood and bark were 22275kj/kg and 20961kj/kg respectively. The highest radial value was found near the pith with mean value of 23312.47kj/kg and the least toward the bark (21299.26kj/kg). Mean tree height and diameter at breast height were 14.20m and 21.68cm respectively. Based on this performance,* ***Senna siamea*** *is being proposed as a suitable species for reforestation, protective forestry in soil conservation, reclaiming denuded areas and for firewood plantation.*

Introduction

Wood is renewable fuel resource because energy removed from the forest capital stock can be replaced by the regeneration of new ones by photosynthesis. Irrespective of the availability of other sources of fuel, wood will still be a major source of household fuel (Earl 1975, Akachuku, 1993, Osadare 1986). The demand for fuel wood is increasing daily especially in the arid regions where trees are being cut indiscriminately only to leave the soil and the environment at the mercy of the severe weather. In Africa and Latin America alone, 90 percent, of all wood used is for fuel and the inadequacy of fuelwood was experienced in 1994 and 1995 in Nigeria where urban settlers in Ibadan and Lagos vigorously scramble for sawdust to prepare the meals due to scarcity of kerosene and cooking gas.

It was reasoned by Houerou (1994) that firewood consumption is one of the factors causing desertification which degrades about 6 million hectares of fertile soil around the world. The continuous increase in fuelwood demand may be due to its renewability, simple method of preparation, high inflamability of dry wood and easy accessibility. Fuelwood plantations are now a big venture in Sudan and Sahel

fuel value of

vegetation zones in Nigeria and larger plantations exists at Jos and Mambilla Plateau (Ogigirigi 1994).

The heat value obtained from unit weights of all wood is almost the same apart from those with combustible material like resins, gums and oils. (Panshin, Bethel and Bakar 1962). To protect the environment from harshness and depletion due to wood extraction from the forest and to meet the demand of the populace for firewood, there is need to establish more fuelwood plantations. Planting appropriate species with desirable fuel value as well as providing protection for the soil must be considered. Most wood consumed in Nigeria as fuelwood lack information on their calorific value. This paper examines the fuel value of *Senna siamea* as a suitable fuelwood species for reforestation and tree planting campaign programmes in Nigeria.

Desertification and Fuelwood

By definition, AGENDA 21 describes desertification as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors including climatic variations and human activities. Economic loss resulting from desertification worldwide is estimated to be US$42,308 million/year. US$9,296 (Africa), US$20,913 (Asia), US$3,136 (Australia), US$1,488 (Europe) US$4,784 (N. America), US$2,691 (S. America). The world's drylands is about 6,150 million ha with Africa having 35% and Nigeria close to 5%.

The direct causes of land degradation have been linked to:

(i) Physical causes which include erosion (wind and water),

(ii) Chemical degradation resulting from either exhaustion of nutrients, toxicity from salts such as N.P.K., NaCL, lack of adequate drainage, etc. and

(iii) Indirect socio-economic causes. Fuelwood consumption has been singled out as one of the most serious problems contributing to land degradation in Nigeria.

It has been suggested among other things that restoration of land through reforestation programmes or by protecting topsoil, and conservation of woodlands will go along a way in protecting endangered or threatened environment.

In view of this there is need to select appropriate tree species which will perform one or two or combinations of the above-mentioned measures. It is from this view point that *Senna siamea* (*Cassia siamea*) is viewed to be appropriate due to its physical and biological characteristics which not only protect the land but also enhance its productivity through humus deposits.

Reforestation is very important especially in mountainous areas which are endangered by erosion. It is suitable to use tree species which are native to the environment.

Potentials of *Senna siamea* for Reforestation Programme and Fuelwood Plantation

As other sources of fuel are getting more expensive and scarce, the importance of wood is increasing dramatically as witnessed in Nigeria in 1994 and 1995. Fortunately, trees when properly managed, are a renewable resource. The most logical approach to combating fuelwood scarcity is to plant trees in plantations, roads, in shelter belts, on farms and on unused land. For a particular tree to serve the purposes of being used as fuelwood, amenity planting, as protective or conservation for soil and ameliorate harsh weather conditions, the following characteristics are desirable:

- Rapid growth;
- Ability to coppice;
- Ability to grow successfully in a wide range of environment, including different altitudes, soil types, rainfall regimes and terrain;
- Ability to produce wood of high calorific value that burns without sparks or toxic smoke;
- It should be able to establish itself easily with little care;
- Ability to provide large foliage system and being evergreen;
- Ability to tolerate low nutrient or toxic soils and
- Nitrogen — fixing ability.

Senna siamea has been reported to have the greatest growth rate among the 20 tree species of fuelwood from the Savanna region in Nigeria with about 13,609 kilogram of dry matter per hectare per year (Fuwape, 1985).

In addition to fuel, woodlots in and around villages and cities can provide stable and pleasant surroundings. They provide shade, shelter, beautification and home of wildlife. A covering of plants slows rainfall runoff, which generally allows for greater ground water recharge and so helps maintain year-round stream flow. Thus it decreases the likelihood of floods. Reforesting denuded areas is a preventive measure that decreases the severity of flooding (NAS 1980).

Indiscriminate firewood collection is currently one of the principal destroyers of native forests. Intensively cultivated woodlots on accessible sites can help relieve this pressure on natural forests by supplying a large share of the needed firewood more conveniently.

The Choice of Senna siamea

Senna siamea commonly called yellow cassia belongs to the family leguminosae (caesalpinioideae). It has long been grown for firewood on plantations in tropical areas. It is inexpensive to establish if sown directly into the plantation site. To a reasonable extent, the wood is resistant to termites and can grow rapidly in full sunlight which gives it a shorter rotation period. *Senna siamea* is a large amenity tree which is evergreen with a dense crown of foliage and smooth, grab bark. It was much planted in the western state and scattered woodlots of it can be found in Ibadan, Osogbo, and along Lagos — Ibadan highway.

Uses, Yield and Environmental Requirements

Senna siamea is capable of producing heartwood. Both the dense sapwood (yellow) and heartwood (dark) with a calorific value of 2275KJ/Kg is quite high. the heartwood makes an attractive timber suitable for cabinetmaking.

The plant serves as dense windbreaks with virtually no undergrowth. It is very useful in reforesting denuded hills and plains. In Jos, it has been used in reclaiming abandoned tin-mining sites (NAS 1980).

The trees coppice readily and can continue yielding well for four or five rotations (NAS 1980). Observation in a small woodlot shows that humus accumulation is high and soil is well binded together and water penetration is easy.

Although the tree does not grow to a very large size like Iroko or Mahogany, it can attain a height of 5 meters in 3 years and 15m in ten years with a diameter of 15cm. Annual production could be high as $15m^3$ per ha. (NAS 1980). *Senna siamea* cannot withstand cold but grows rapidly in the tropical regions. It is found in Asia, Indonesia, Sri Lanka, West Indies Central America, West Africa and Southern Africa especially in Angola. It is a suggested tree for planting in arid and semiarid regions by National Academy of Sciences of America. It can tolerate areas where annual rainfall is as small as 500–700mm. In Ibadan, it grows well in muddy soil and also along riverbanks and steep slopes.

Materials and Method

Sample Collection

Wood samples of *Senna siamea* were collected from the University of Ibadan Teak and Senna plantations. The area lies towards the northern limit of lowland rainforest zone with annual rainfall of 1000–12000mm, average temperature is about 30°C and the average daily relative humidity is about 70 per cent with a marked dry season between November to March (Smyth and Montgenery 1962). Twenty trees were felled from a plot of $400m^2$ using simple random sampling (SRS). The following sampling strategy was used:

Number of plot	1
Tree per plot	20
Disc per tree	5
Radial position	7 (bark form the 7th)
Total determinaton	700

Sample Preparation

One of the transverse cross-sections of each disc was smoothened and later air-dried for 6 weeks in the laboratory. Each air-dried disc was cut into two equal halves, one half was used for the experiment. Radial position of six points were marked out from the pith towards the bark. From each position enough sample was chiselled out and grounded into powder for easy combustion.

Determination of Fuel Value (Calorific Value)

The determination of calorific (fuel) value was carried out in the department of Human Nutrition, University of Ibadan, using ballistic bomb calorimeter 0.5 gramme of each sample was used.

Results and Discussion

The mean fuel value of each tree is presented in table 1. Table 2 shows radial variation. Mean calorific value was 22275KJ/Kg, the range was 19806-25205KJ/Kj. This value was higher than those reported for *Gmelina arborea, Leucaena* and *Gliricidia sepium* with 19608, 195661 and 20566KJ/Kg respectively. This shows that this species can be selected for its high value for reforestation and fuelwood plantation.

Table 1: Mean Calorific Value for Wood and bark Kj/Kg — 1

Tree No.	Wood	Bark
1.	22543.85	21121.60
2	21653.56	20413.97
3.	22999.72	21518.82
4.	22958.77	21650.60
5.	22658.98	21260.06
6.	21224.41	20995.25
7.	19806.03	19439.99
8.	21433.67	21386.83
9.	22743.16	20672.01
10.	21430.42	20438.82
11.	20747.36	19088.39
12.	22013.80	21704.43
13.	22615.43	21495.80
14.	24276.75	22158.82
15.	22087 55	20525.99
16.	21350.13	20149.17
17.	20152.17	18459.95
18.	22676.22	21005.57
19.	25208.16	22498.01
20.	24921.70	23244.45
Mean	22275.09	20961.48

Table 2: Mean Calorific Value Variation from Pith Toward the Bark (Kj/Kg)

Tree No.	P1	P2	P3	P4	P5	P6
1.	23403.67	23403.25	22926.85	22396.59	21910.80	21221.97
2.	22873.63	22316.58	22153.60	21107.19	20614.00	20856.37
3.	24462.48	24175.05	22921.62	22338.36	22370.41	21730.41
4.	22948.44	23557.64	23058.42	22715.67	23076.04	22286.[illegible]
5.	23721.27	23296.82	22975.26	22132.42	22552.07	21276.02
6.	22582.01	21121.60	21100.42	21200.79	20826.43	20515.18
7.	20322.79	20056.81	19931.22	19655.19	19449.60	19439.72
8.	22210.77	21867.61	21703.59	20861.59	21063.17	20895.29
9.	24515.27	23164.42	23085.65	21782.78	22212.45	21698.37
10.	22608.82	22238.43	21682.83	20725.22	20914.81	20438.82
11.	22000.43	20990.88	20381.23	20323.63	20695.83	20089.18
12.	23510.09	22370.41	21972.37	21681.58	21489.17	21059.21
13.	24092.08	23032.43	22609.24	22286.42	22127.20	21545.21
14.	25068.50	25627.30	24754.10	24145.30	23403.67	22661.62
15.	23165.25	23006.45	21761.19	21682.41	21867.61	21042.41
16.	22184.79	22051.97	21471.24	21275.60	20958.41	20158.77
17.	21179.61	20961.96	20273.96	19639.19	19960.32	18897.97
18.	23827.27	24036.42	22767.21	22291.22	21858.01	21275.18
19.	26104.12	25415.70	25680.09	25151.31	24886.09	24011.64
20.	25468.08	25098.10	25204.53	24568.70	24780.92	24409.68
Mean	23312.47	22894.09	22420.73	21898.12	21825.88	21299.26

The radial position shows that highest fuel value was found in the heartwood region and lowest towards the bark. The range was 21299 to 23313KJ/Kg. The radial positioning implies the age of the tree and this could be used as genetic instrument to improve on the fuel value.

Growth rate parameters are shown in table 3. Mean tree height was 14.2 meters while mean diameter at breast height (Dbh) was 21.68cm. These values are similar to that reported by National Academy of Sciences, U.S.A.

Conclusion

Senna siamea has high calorific value which makes it acceptable and worthy for fuelwood plantation.

Trees with above mean calorific value could be selected as 'plus' tree for plantation establishment.

Radial variation in calorific value suggest possible genetic improvement of this property.

Growth rate measured by total tree height and diamer at breast height were on the higher level. This suggest that *Senna siamea* could be used for protective, amenity and tree planting programmes.

Table 3: Growth Rate Parameters of *Senna Siamea*

Tree No.	Total Height (m)	Diameter at Breast height (cm)
1.	14.00	24.00
2.	14.50	22.00
3.	16.00	19.70
4.	13.00	16.00
5.	14.00	22.00
6.	15.00	21.00
7.	16.80	20.20
8.	17.50	21.10
9.	16.60	21.80
10.	14.90	22.80
11.	12.60	22.40
12.	10.20	22.60
13.	13.60	22.80
14.	14.20	26.00
15.	12.40	21.20
16.	13.40	21.60
17.	15.00	22.10
18.	12.60	22.00
19.	14.40	
20.	13.20	21.00
Mean	14.20	21.68
S.D.	1.7	1.9

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