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STEM ABUNDANCE AND LITTER ACCUMULATION OF EXPLOITED INDIGENOUS FALLOW SPECIES AND IMPLICATION FOR CLIMATE- SMART AGRICULTURE IN FOUR YEARS FALLOW FARMS IN OLOKORO, SOUTH EASTERN NIGERIA

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ABSTRACT

Studies on the stem abundance, distribution and litter accumulation of Monkey fruit (Dactyladenia barteri), Velvet or black tamarind (Dialium guineense) and African rose wood (Anthonatha Macarophylla) in selected four years fallow farms in Olokoro, Umuahia South- Eastern Nigeria were carried out in 2019. A randomized complete block design was used and replicated four times in four villages (Okwu, Amizi, Itu and Agbama) in selected four years fallow farms. Test involved collection of litter samples from the base of the selected fallow species using a 1m by 1m quadrat and stem population using quadrat (20m²) in 3 randomly selected four year fallow plots measuring 50m by 50m in each of the selected villages. The pooled means of data obtained were processed and later subjected to analysis of variance.

Result showed that Dactyladenia barteri, and Dialium Guineense had significantly higher litter accumulation of 5.798t/ha and 5.140t/ha respectively. For the same fallow length, Anthonotha macrophylla had the least result (3.973t/ha). Stem abundance and distribution of the fallow species under study varied from village to village and from specie to specie. Dactyladenia barteri had the highest mean percentage stem abundance in Okwu village (38.92%), while the least value was obtained at Itu village (26.86%) Anthonatha Macarophylla gave significantly the highest mean value of 35.58% in Amizi, while Dialium guineense gave the highest mean value of 45.23% in Itu village. The moderate to high litter accumulation and distribution of the fallow species in the study area is an indication of their resistance to over exploitation. This is a further indication of their effectiveness in agroforestry systems that will provide buffer against climatic variability and help build farmer's resilience to environmental, Climatic and weather –related stress, while improving arable crop productivity.

Keywords: *Dactyladenia barteri, Dialium guineense, Anthonatha macrophylla, Stem abundance, Litter accumulation, arable crops, Agroforestry, climate variability.*

Introduction

Multipurpose trees and shrubs are valuable component of the arid and semi-arid ecosystem and contribute to maintaining suitable conditions for crop cultivation, livestock and grazing and human livelihoods. They are so classified according to the attribute of the plant species as well as the plant functional role in agroforestry (Patrick and Denyse, 2001 and Gravity, 2004)

Styers and Jones (2000) stated that the use of fallow land is one of the many agricultural methods that increase the amount of humus on the field for the benefit of cultivated crops. Farmers in Nigeria rely on bush fallow to restore soil fertility (Mouthapa, 2000, Akobundu *et al*, 2000, (Okeke and Akachukwu, 2008) Earlier farming system surveys of Olokoro Community has shown that *Dactyladenia barteri*, *Dialium Guneense* and *Anthonotha mycrophylla* are the major fallow species and are selectively being protected during weeding by some

farmers (Meregini, 2000). The local over exploitation of these multipurpose trees and shrubs species is mostly related to anthropogenic activities, which included clearance of natural forest for agriculture and settlement, charcoal burning, harvesting for medicinal purpose, construction and firewood. (Quandt *et al*, 2017). These fallow species are destroyed and harvested at such a high rate that they are rendered non-renewable in certain areas (Hunde, 2015).

Abbas *et al*, (2017) reported that multipurpose trees and shrubs on degraded lands in most parts of south – east Nigeria, can help build farmers resilience to environmental, climatic and weather-related stress, by supplying additional food, fodder and alternative sources of income. Furthermore, they regulate the microclimate by providing shade and wind breaks for crops and livestock (Meregini, 2000, Okeke and Akachukwu, 2008.) Control the incidence of pest and

diseases and increase water use efficiently (Partey, *et al*, 2013).

Recent advances in global agricultural research have been focusing on the question of increasing the resilience (against drought erosion, fertility loss etc.) and productivity of agricultural systems which are directly related to increasing the adaptive capacity of farmers, (Hunde, 2015). Climate smart agriculture (CSA) can contribute to achieving this development agenda as it fosters the development and implementation of agricultural innovation (Zougmore, *et al* 2016). It can sustainably increase agricultural productivity to support equitable increase in income, food security, and development, adapts and builds resilience to climate change from the farm to national levels and develop opportunities to reduce greenhouse gas emission from agriculture compared with past trends (Partey *et al* 2013, Patrick and Denyse 2021).

The role of Agroforestry practices in climate Smart Agriculture have been reported widely: (Kim *et al* 2016) reported that agroforestry mitigates 27 +14+Co₂ equivalent ha⁻¹ year⁻¹, which is significant to reducing global carbon emission. Quandt *et al*, (2017) also found agroforestry was a key adaptation strategy to climate change in sub-Sahara Africa (SSA). Furthermore, the reports of Ajayi *et al* (2000), Albrecht *et al*, (2003) and Abbas *et al* (2017), all confirmed multipurpose fallow species improve the biological productivity of crops to household food and nutrient security. Therefore evaluating the adaptation and abundance of some fallow species to local environment in the face of over exploitation will determine their suitability as components in agroforestry systems and climate smart agriculture. The objective of this study was to determine the distribution, abundance and litter accumulation capacity of some exploited indigenous fallow species across 4 years fallow farms in Olokoro with the view of using them as components in improved agroforestry systems to harness their potential in climate smart agriculture in south eastern Nigeria.,

Materials and method:

The study area:

The study was conducted in 2019 at Olokoro community in Umuahia, Abia State in South East agro-ecological zone of Nigeria (Latitudes 5° 25' and 5° 39' N and longitudes 7° 24' and 7° 33' E), The attitude is about 122m above sea level with the following mean climatic data. Rainfall (2238mm), minimum and maximum temperatures 23^{0c} and 32^{0c} respectively and relative humidity (65-85%) (NRCRI, 2002). The climate of the study site is within the humid tropical region with lowland rainforest zone, the vegetation is mixed deciduous with highly weathered, fragile and acidic soil. (Opara-Nadi, 2000)) And have sandy clay or sand clay loam soils of the ultisol series (NRCRI, 2002). it is made up of 14 autonomous communities consisting of urban and predominantly rural settlements.

Field study:

A randomized complete block design was used for this study. Four autonomous communities (okwu, Amizi, Itu and Agbama) were randomly selected for the study and were labeled location A,B,C,D. Then three fallow plots (4 years old), each measuring 20 m x 20 m were randomly selected from each village, given a total of 12 fallow plots for the villages. The treatment comprised 3 fallow species namely *Dactyladenia barteri*, *Anthonatha macrophylla* and *Dialum guineense*, Litter materials from each fallow specie were collected randomly using a 1m x 1m quadrat.

Data Collection and analysis:

The stem populations for each fallow specie were measured using a 20m² quadrat. All stands of the fallow species within the quadrat were counted in the randomly selected 4 year fallow plots. And data obtained were processed, Litter materials were later oven dried at 70⁰ C for 3 days and weighed. And data obtained were subjected to analysis of variance

Result and Discussion:

The mean relative stem abundance of the three fallow species in the four fallow farms in Olokoro is showed in Fig. 1

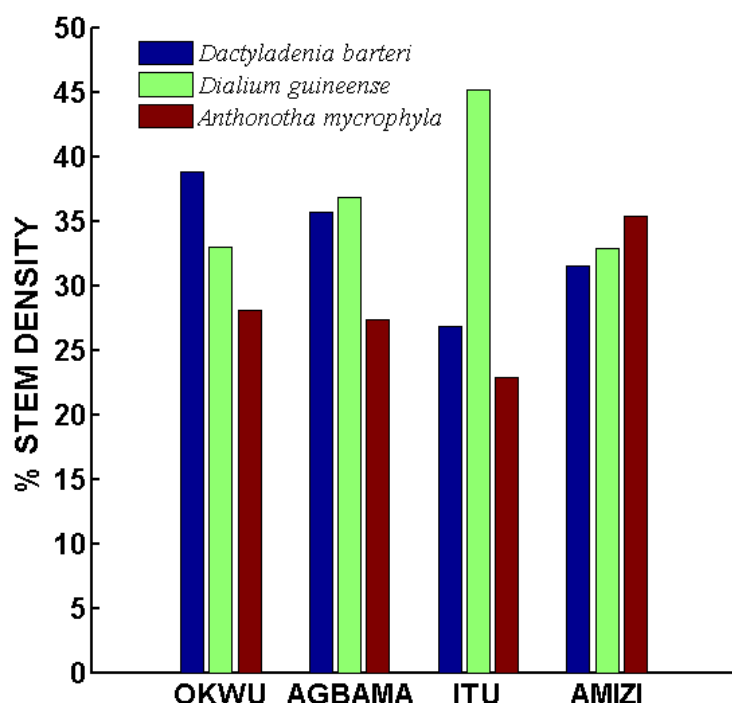


Fig. 1: Mean Relative Stem Density of fallow species

Dactyladenia barteri had significantly the highest mean relative stem density (38.92%) in Okwu village, followed by *Dialium Guneense* (32.98%) and *Anthonotha Macarophylla* (28.09%). But in Agbama village, *Dialium Guneense* had the highest mean relative stem density (36.90%) followed by *D barteri* and *A Macarophylla* (35.71% and 27.38% respectively). However, in Amizi village, *Anthonotha Macarophylla* had the highest mean stem density (35.48%) followed by *Dactyladenia barteri* and *Dialium guineense* with 31.61% and 32.98% respectively. *Dialium guineense* had a relative stem density of 45.23% in Itu village which was higher than that of *Dactyladenia barteri* and *A Macarophylla* which had mean stem densities of 26.86% and 22.92% respectively. The inconsistency in the trend observed may be as a result of different fallow regulations practiced by different villages in Olokoro. Some villages selectively protect these fallow species during clearing and weeding, while

some village regulations allow for exploitation for domestic use such as for yam staking, fodder for livestock and for building and fencing the home stead (Okeke, 2000, Robison and ,Clason, 2000, Ajayi *et al.*,2003 and Abbas *et al.*,2017)

Litter accumulation t/ha

Dactyladenia barteri and *Dialium guneense* had significantly higher litter accumulation of 5.798 and 5.140 t/ha respectively compared to a value of 3.973 t/ha obtained for *Anthonatha macrophylla* (Table 1). Mouthapa 2000 and, Asoiro, *et al.*(2017) had reported that *Dactyladenia barteri* has low level of decomposition due to its high lignin and C. N ratio and this explains the high rate of litter accumulation observed in this study. Also the low coppicing ability of *Anthonatha Macarophylla* and its high rate of decomposition (Okeke and Akackukwu,2008 and ,Etuk *et al.*,2010) may explain low litter accumulation of this species in the villages studied.

Table 1 mean litter accumulation of selected fallow species in Olokoro Community (t/ha)

Fallow Species			
Village	<i>Dactyladenia barteri</i>	<i>Dialium guineense</i>	<i>A. Macarophylla</i>
Okwu	6.10	5.10	3.90
Agbama	5.53	4.54	4.58
Itu	5.56	5.35	4.21
Amizi	5.33	5.57	3.20
Mean	5.798	5.140	3.973
LSD	0.03	1.17	NS

NS=not significant at P=0.05

Conclusion:

Stem abundance of the various fallow species varied from species to specie and from village to village. Also *Dactyladenia barteri* and *Dialium guineense* had higher rate of litter accumulation in the four year fallow farms compared to *Anthonatha Macarophylla* in the area studied. These fallow species are highly resilient and are well adapted to local conditions and their abilities to coppice when cut back and produce multiple stems is an adaptation strategy that have made them to survive hard conditions including over exploitation.

Recommendations

This study confirms the abundances of the selected indigenous fallow species, with high litter production capacities in Olokoro, south eastern Nigeria. They are therefore recommended for new agroforestry technologies designed to regulate soil temperature, and provide buffer against climatic variability and allow for varied ecological environments that will support different crops and thus help build farmer's resilience against drought, erosion and Soil fertility loss and improve on his production capacity. Cost effective approach to resilient forest management has often proven to be strengthening the right of indigenous people to protect and manage their land. The planting of climate and fire resistance species may also offer some relief, and there have been recent advances in breeding and genetic engineering climate resilient trees to help reduce pressure on the over exploited indigenous species. Also involvement of technology in fallow management can help farmers and forest managers monitor crop and forest health, adapt their practices and manage effectively climate related risk in their production systems.

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