

A study of the relationship between size of tree and density of fruits, and the influence of light on fruits density of *Allanblackia stuhlmannii* (Engl.) in Amani Nature Reserve, Tanzania.

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Abstract

The main objective of this study was to look at the relationship between fruit density and the size of tree of *Allanblackia stuhlmannii*, in relation to soil composition and canopy cover. The study was carried out from the 14th to the 25 of September 2003 in three different forest areas: Farmland (Disturbed Forest) in Shebomezza village, Semi-disturbed forest in the Monga Forest of the Amani Nature Reserve and an undisturbed forest at the foot of the Mbomole Hill. Thirty- five plants in each site were sampled randomly, with their corresponding soil samples collected and analysed. There was a significant increase in the number of fruits of a tree as tree size increases in all three sites. Canopy cover (shade) had a negative influence on the number of fruits produced by a tree. This was evident from the fact that more fruits were observed in the farmland with very low canopy cover, followed by semi-disturbed forest, then the undisturbed forest where trees had a very small number of fruits yet had very high canopy cover. A comparison of soil ionic concentration, soil pH, and soil moisture content among all three sites revealed that there were no significant differences.

Introduction

Allanblackia stuhlmannii is a multipurpose tree species of the family Guttiferae (=Clusiaceae) (Schulman et al, 1998). It is a rainforest tree that grows to heights of 35(-45) m tall, and between altitudes 500-1200(-1600) m above sea level (Schulman et al, 1998). Moreover, it is an endemic species in the Eastern Arc Mountains, (Hamilton et al, 1989).

Schulman and colleagues also revealed that this tree species serves the following uses to the local population of Amani and settlements around the East Usambara Mountains:

- 1) timber and fuel wood;
- 2) vegetable oil used as a butter substitute or cooking oil from seeds;
- 3) dried leaves used as medicinal tea against chest pain;
- 4) heated oil is smeared on aching joints.

Though much work has been done in the East Usambara Mountains to establish the conservation status of the mountain and surrounding forests, little research has been done on *Allanblackia stuhlmannii*, whose conservation status still needs to be established especially as it is exploited by the local people for the above uses.

Also, if the objective of the Amani Nature Reserve is to conserve the biodiversity of the East Usambara Mountains and to improve the livelihood of the local people, then more research should be oriented towards those livelihood species found within the Amani Forest. On this basis we thought we should work on *Allanblackia stuhlmannii* (Engl.) Engl.

Objectives of the study

- 1) To examine the relationship between the size of tree of *Allanblackia stuhlmannii* (Engl.) Engl. and the number of fruits produced by the tree.
- 2) To study the influence of soil ionic concentration, soil pH, soil moisture content in a disturbed forest (farmland), semi-disturbed forest and an undisturbed forest in the Amani Nature Reserve.
- 3) To examine the influence of canopy cover on the number of fruits produced by *Allanblackia stuhlmannii* (Engl.) Engl.

Specific questions were:

- a) Is the number of fruits produced by *Allanblackia stuhlmannii* (Engl.) Engl., influenced by size of tree and canopy cover, in disturbed, semi-disturbed and undisturbed forest areas?

- b) Is there any difference in the soil ionic concentration, soil pH, and soil moisture content between locations in disturbed, semi-disturbed and undisturbed forest where *A. stuhlmannii* grows and do these influence fruit density?

Methodology.

The study was carried out in the Amani Nature Reserve of the East Usambara Mountains, located around latitude 5°06 S and longitude 38°38E. It has a monsoonal climate, and a mean annual rainfall of about 1918mm(Hamilton, 1989).

Three sites were selected

Farmlands around Shebomeza village considered as disturbed area, forest in Monga considered as semi-disturbed forest and forest at the base of Mbomole hill some few metres from the IUCN Hostel considered as undisturbed forest.

35 samples of trees of *Allanblackia stuhlmannii* (Engl.) Engl. were selected randomly, about ten metres away from two samples in each site and the following variables measured:

- 1) Tree DBH using diameter tape.
- 2) Number of fruits per tree sample was recorded by visual check using binoculars.
- 3) Canopy cover using spherical densiometer Model-C (Robert E. Lemmon, Oklahoma)
- 4) Soil samples were collected around each tree sampled (30cm from the bole, and at a depth of 20 cm) and were brought to the ANR laboratory for analysis
 - a. The pH values of the soil samples (35 samples per site) were determined using high quality pH papers reading to ± 0.1 pH unit. 20g of soil were put in 40 ml of tap water and stirred until a homogenous mixture was produced. A pH paper was then put into the mixture for about three minutes to determine the pH according to colour change of the pH paper.
 - b. Ionic concentrations of the soil samples were also determined using a conductivity meter (Hanna Conductivity Metre), and the average for each site taken.

- c. The moisture content was determined by weighing the soil samples just when collected from the site and then after sun drying. The difference between the fresh weight and dry weight was then taken as the moisture content which was expressed as a percentage of wet weight. Again the average moisture content for each site was taken.

Results

Relationship between size of tree and number of fruits:

There was a relationship between size of tree and number of fruits produced by a tree ($P=0.046$, $R^2=0.0738$, $DF= 102$), in combined data from all the three sites. This is illustrated by the graph below (Fig. 1).

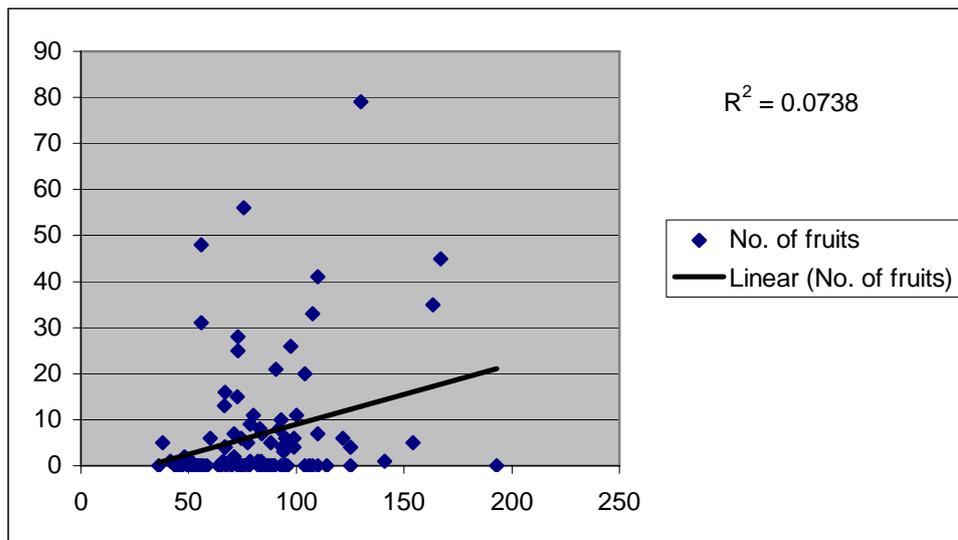


Figure 1. Relationship between size of tree and number of fruits for *A. stuhlmannii* (Engl.) Engl. growing in disturbed (farmland), semi-disturbed and undisturbed forests near Amani.

Percentage of trees with fruits

There were a higher percentage of trees with fruits in the disturbed area (Farmland) than in undisturbed forest and semi-disturbed forest. This difference was significant. ($\chi^2=13$, $DF=2$, $P= 0.001$). Fig 2 shows the percentages of trees with fruits and those without fruits for farmland (disturbed), semi-disturbed and undisturbed forests.

We tested if this difference was due to the difference in canopy cover in the three sites. Canopy cover had a negative influence on the number of fruits ($P=0.003$, $T=3.05$, $DF=102$) Fig. 3 shows the influence of canopy cover on the number of fruits produced by an *Allanblackia stuhlmannii* (Engl.) Engl tree.

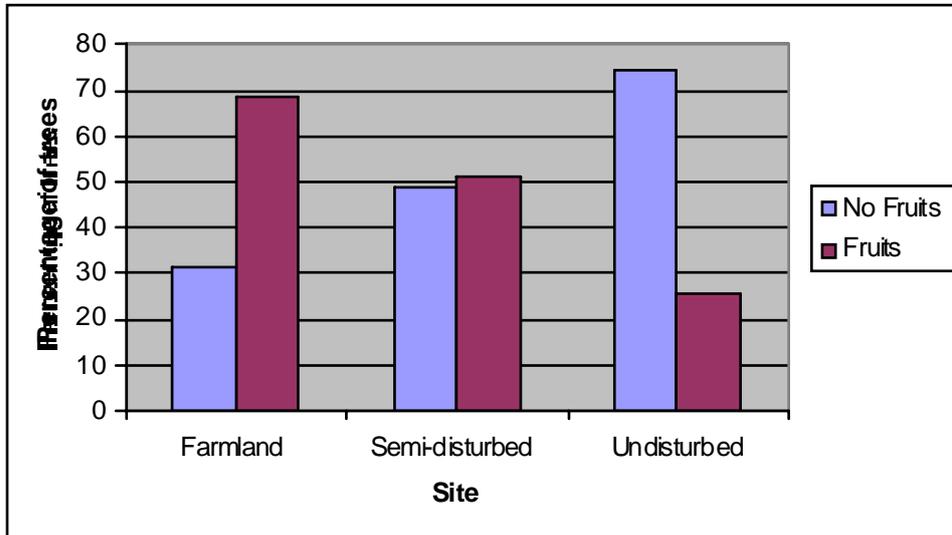


Figure 2. Comparison of percentage of trees of *A. stuhlmannii* (Engl.) Engl. with fruits and those without fruits

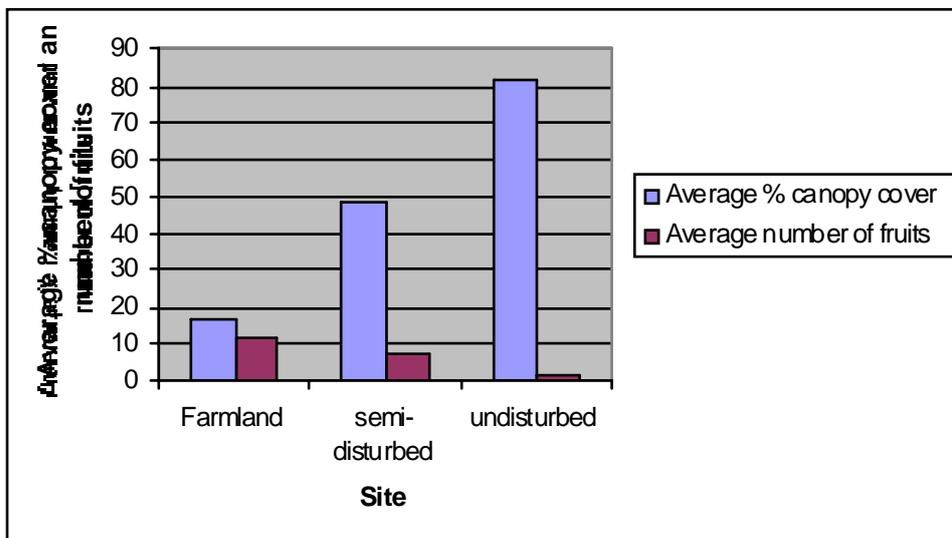


Figure 3. Influence of canopy cover on number of fruits produced by *Allanblackia stuhlmannii* (Engl.) Engl

Soil ionic concentration, soil pH and soil moisture content of the three sites compared.

Analysis of the data for soil pH, soil ionic concentration and soil moisture content shows that there was no significant difference in these factors for the three sites (Fig. 4). This is revealed by the following T-tests: for soil pH ($P=0.707$, $T= 0.38$, $DF=99$); soil ionic concentration ($P= 0.814$, $T= 0.24$, $DF= 99$); soil moisture content ($P= 0.627$, $T= 0.49$, $DF=99$).

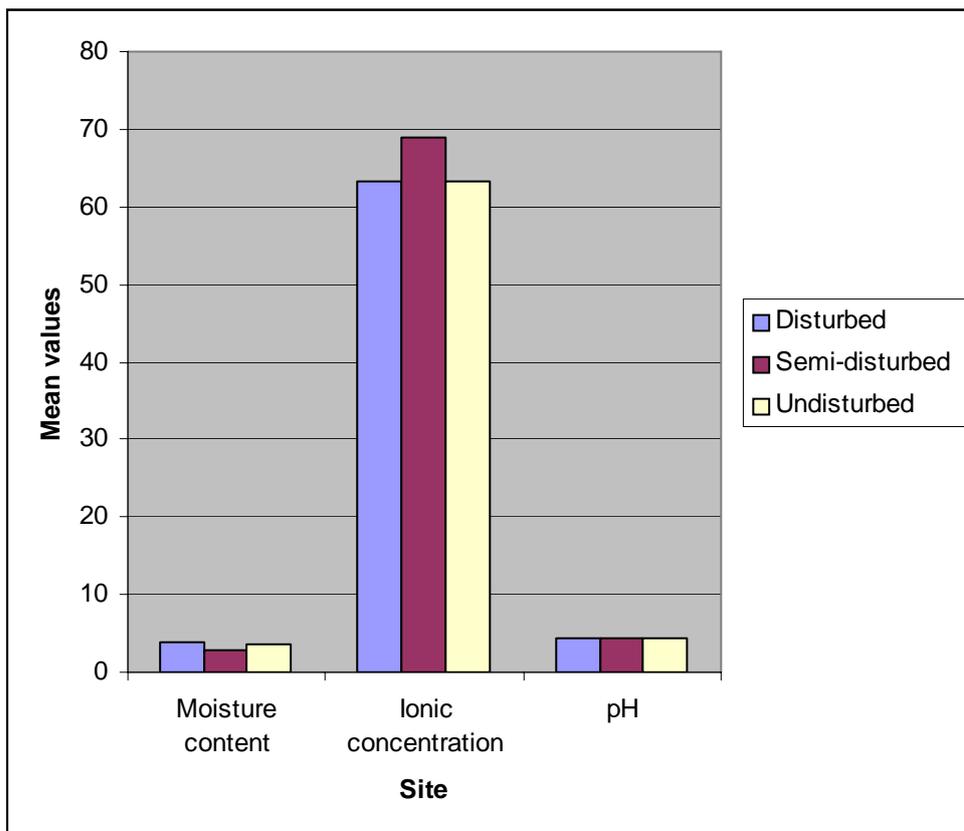


Figure 4. Comparison of mean values of soil pH (Log units), soil ionic concentration ($\mu\text{s}/\text{cm}$) and soil moisture content (% fresh weight) for 3 study sites.

Discussion

Our tests show that there is a relationship between the size of tree and the number of fruits, but do not reveal the physiological mechanism underlying this relationship.

Canopy had a negative influence on the number of fruits produced by *Allanblackia stuhlmannii* (Engl.) Engl. i.e. the greater the canopy cover, the fewer fruits produced and vice versa. However, the level of herbivory might also explain this observation. A

low number of fruits observed in the undisturbed forest could result from the presence of more herbivores in this area than in the farmland which has been widely cleared by human activities for agricultural purposes, thereby scaring the herbivores away into the forest.

However, it could also be argued that if this difference were actually due to the level of herbivory, then similar results would have been obtained between semi-disturbed and the undisturbed forest, which is not the case. The level of exploitation by man could not be used to explain this observation because the forest in Mbomole is under protection and human exploitation of resources has been reduced drastically. We can then conclude that canopy cover has an influence on the number of fruits produced by a tree of *Allanblackia stuhlmannii*. (Engl.) Engl. through a physiological mechanism e.g. more light so more energy to produce more fruits.

Soil ionic concentration, soil pH and soil moisture content were similar amongst the three sites. Different results could be obtained in the rainy season. In the rainy periods, we expect more moisture in the farmlands because its very open canopy allows more water to penetrate to the soil than in the undisturbed forest with a more closed canopy that retains water. Also we expected greater ionic concentration in the undisturbed forest than in the semi-disturbed and the disturbed areas because more leaf litter is found in the undisturbed forest, which maintains ions and limits leaching of them through recycling from the soil.

An interesting observation was that there were more fruits observed in the farmlands than in the undisturbed and semi-disturbed forests, which turns to dismiss the fact that the fruits of this plant are highly exploited by the local people as many writers and other people claim. We could not reconcile the claim that the plant is highly exploited by local people with our observation that many trees in the farmlands had more than 40 fruits, with many also getting rot on the ground.

Conclusions and recommendations

The results of our research show that there is a relationship between size of tree and number of fruits produced i.e. the bigger a tree, the more number of fruits obtained. Also, canopy cover influences the number of fruits of a tree negatively i.e. the more

canopy cover the fewer fruits produced. However, more research should be carried out on the influence of light on the number of fruits produced by *Allanblackia stuhlmannii*. (Engl.) Engl. with the use of more data sets. Its phenology should also be well studied.

On the other hand, soil moisture content, soil pH and soil ionic concentration were not different between the disturbed, semi-disturbed and undisturbed forests, but this fact would need to be confirmed by similar studies carried out during the rainy periods, and using more sites.

Finally, we would like to recommend that more studies on the socio-economic status of this plant be carried out, as our observations seem to show that the local people do not use this plant very much.

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