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# Effect of tree density and tapping techniques on productivity of gum *talha* from *Acacia seyal* var. *seyal* in South Kordofan, Sudan

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This study was carried out in Umfakarin natural forest reserve, South Kordofan, Sudan. The objective of the study was to investigate the influence of tree density and tapping tools on productivity of gum *talha* from *Acacia seyal* Del. var. *seyal* and also to estimate the probability of *Acacia seyal* to produce gum *talha* when exposed to different tapping techniques. Data for the study were collected during September 2007 to February 2008. A total of 167 *Acacia seyal* trees grown in pure natural stands, in dense, medium and slight strata, were selected based on diameter at breast height (DBH ranged from 6.7 to 36.9 cm). In order to investigate the influence of tapping on gum yield, trees were exposed to tapping on the 1st of November using local tools (*saunkey* and *makmak*) in comparison to untapped trees which were used as a control. Nine treatments (a combination of 3 strata x 3 tools) were executed. Comparison of means, correlations and logistic regression models were applied. The results of the study indicate that individual trees of *Acacia seyal* in different strata vary in gum yields. The overall mean of the gum yield was 13.68 g/tree/season. The average yield per tree/season was 7.1, 11.0 and 22.8 g in medium, dense and slight stratum respectively. Non-producing trees comprised almost more than 50 percent of the total sample. 73 percent of the selected trees produced gum below 10 g/season. Although tapping trees using *makmak* in slight stratum produced the highest gum yield (25.78 g/tree/season) but the results of the study show no significant differences between the treatments in gum yield. The outcomes of the logistic regression model showed that 59.3 percent of the predictions were correctly classified. However, when other variables are incorporated, 64.7 percent of the predictions were correct. The results of the study may be of great importance for future studies in order to improve the predictions of gum *talha* yield and to manage *Acacia seyal* trees for multipurpose objectives.

***Keywords***: *Acacia seyal*; gum *talha*; logistic model; Umfakarin natural forest reserve.

## Introduction

Gum *talha* is the dried natural exudate obtained from trees of *Acacia seyal* var. *seyal*. In Sudan, gum *talha* contributes to about 10 percent of the total gum production. In Sudan, the mean annual production is about 3739 tons per year and between 3000 to 5000 tons are exported annually (GAC 2007). Although gum from *Acacia seyal* is not quite as good as Gum Arabic from *Acacia senegal* (*Hashab*), it is still very useful and has many

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traditional and industrial uses and export potential (Hall and McAllan 1993; FAO 1995). Thus, the price of gum *talha* is about 33 percent that of gum Arabic from *A. senegal* (Iqbal 1993). *Acacia seyal var. seyal*, growing naturally in the clay plains in central and eastern Sudan, is extensively managed for firewood and charcoal production in order to meet energy requirements (Vink 1990). Although, the species is reported to produce a significant amount of natural exudates (gum *talha*), little information is known about the potential of the species to produce gum under different stand densities as well as the tree's response to tapping techniques. Moreover, the amount of gum yields per tree per season is not known. The objectives of the study were: 1) to investigate the influence of stand density and tapping tools on the productivity of gum *talha* and 2) to estimate the probability of gum *talha* production from *A. seyal*. Throughout this paper, the term *A. seyal* refers to *Acacia seyal* var. *seyal*.

**Study area**

Data for the study were collected from Umfakarin reserve forest (Lat. 12°29´- 12°35´ N and Long. 31°17´ 33´´- 31°20´ E ), south Kordofan , Sudan, during September 2007 to February 2008 . The forest covers an area of about 2689 hectares. The area, where *A. seyal* occurs naturally, is classified as a low rainfall savannah on clay and extends from Gadarif, Blue Nile, and White Nile to the clay plains in Darfur Region and in Kordofan around the Nuba Mountains (Sahni 1968; Harrison and Jackson 1958; Badi *et al*. 1989). In this area, *A. seyal* associated with *Balanites aegyptiaca* dominates the vegetation cover. Other thorny and broad-leafed, non-thorny woody species are also found. Cracking clay, non-cracking clay locally named *gardud* and soil under water bodies (locally: *Mayaat*) are the prevailing soils in the study area. In the northern parts of the South Kordofan state, where soils are *gardud* or sand, scattered thorny trees (Acacias) are dominant. However, the density of vegetation cover increases from north to south where formations of poor *Acacia senegal* and *Acacia mellifera* pave the way for *Acacia seyal-Banalities* woodland and other plant formations. The species grows in areas where the annual rainfall ranges from 400 to 1000 mm and flourishes along seasonal water courses in areas where annual rainfall is less than 400 mm (Badi *et. al*. 1989; Vogt 1995).

**Data**

A sample of 167 *A. seyal* individual trees, growing in pure natural stands of different tree densities (dense, medium and slight), were selected based on the diameter at breast height (DBH, 6.7-36.9 cm) for gum tapping experiments. The selected trees were exposed to tapping on the first of November, based on the results of Fadl and Gebauer (2004a), using two local tools (*Sonkey* and *Makmak*). Additionally, untapped trees were used as controls. The objective behind the selection of different tapping tools was to investigate the most appropriate tool for tapping *A. seyal* for the production of gum *talha*. The tapping was done by local people living adjacent to Umfakarin forest. The first collection or picking of gum commenced after fifteen days from the date of tapping while the other pickings were done in intervals of fifteen days. Collection was done manually; directly by hand or using tapping tools. Gum samples collected from individual target trees were dried at room temperature for 72 hours and then weighed. Gum yield in grams per tree per season and gum production (kg) per hectare per season were obtained. Correlations and multiple comparison method for means and logistic regression models were applied.

## Results and discussion

The number of trees selected for the gum experiment and the number of trees per hectare for each stratum are presented in Table 1. The mean, minimum and maximum diameters of the target trees as well as the gum *talha* yield are also presented in this table. Regardless of the tapping tool, the maximum gum yield per tree (22.80 gram) was obtained from the slight stratum. The results indicate that the non-yielding trees comprise almost more than 50 percent of the total sample (Fig. 1). However, in the medium stratum the non-yielding trees constitute more than 22 percent of the total sample. If only yielding trees are considered, the actual gum production is 2.35, 0.67 and 2.48 kg/ha for dense, medium and slight stratum, respectively.

Table 1 Number of sampled trees, trees/ha, DBH and gum yield for the three strata

| Stratum | n | N | DBH, in cm | | | Gum | |
|---|---|---|---|---|---|---|---|
| | | | Mean | Min. | Max. | g/tree | Kg/ha |
| Dense | 51 | 396 | 15.8 | 8.0 | 36.9 | 11.0 | 2.35 |
| Medium | 59 | 271 | 14.8 | 7.1 | 27.2 | 7.10 | 0.67 |
| Slight | 57 | 209 | 15.0 | 6.7 | 22.9 | 22.80 | 2.48 |

n= number of target trees selected for gum production; N = number of trees per hectare

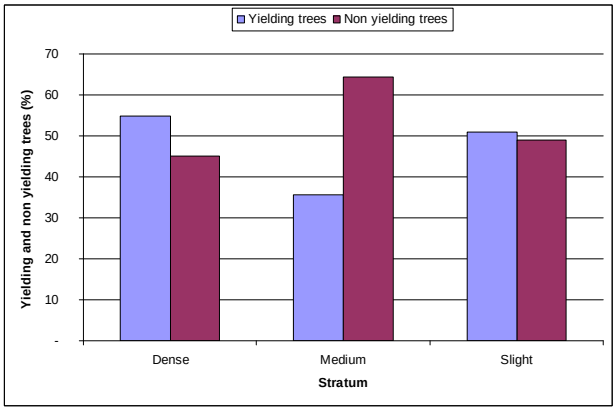


Fig. 1 Percent of gum yielding and non-yielding trees of *A. seyal*

A simple correlation analysis was conducted between gum yield, as a response variable, and a set of explanatory variables such as stratum, tapping tool, neighbourhood trees and DBH. No correlation was detected between the gum yield and these explanatory variables. To compare gum yields obtained from different strata, analysis of variance (ANOVA) was conducted and revealed no significant difference (α = 0.05) in gum yield between the three strata (Table 2). However, when considering the tapping tools, the highest gum yield (25.8 g/ tree/ season) was obtained from trees exposed to tapping by *Makmak* in the slight stratum (Fig. 2). To estimate the probability of gum productivity, logistic regression (Hosmer and Lemeshow 2000) was applied. The outcomes of the logistic regression model showed that 59.3 percent of the predictions were correctly classified when using DBH as a predictor. However, when other variables (stratum, tapping tool and neighbourhood trees) are incorporated, 64.7 percent of the predictions were classified correctly (Table 3). The model below was used to estimate the probability of a gum yield.

$Y = 1/(1 + 1/e^{(0.068*d - 1.122)})$ , where:

***Y*** = probability of gum productivity; ***e*** = base of natural logarithm (≈ 2.718); and

***d*** = diameter at breast height (DBH, in cm).

In the present study, neither tree density nor tapping tools showed any significant influence on the gum yield. This finding is in agreement with Ali's (2006) findings which showed that tapping tools have no significant effects on the yield of gum *talha*. However, Fadl and Gebauer (2004b) investigated the effect of tapping tools on the productivity of gum *talha* and revealed that tapping has a positive influence on gum yields. According to their results, the maximum annual yield per tree was 428.44 gram which was obtained by tapping trees using *Makmak*.

Table 2 Descriptive statistics of gum *talha* yield, from A. seyal, due to different tapping treatments

| Treatment | Tool | Size | Mean* | SD | S.E |
|---|---|---|---|---|---|
| Dense | Untapped | 14 | 7.70 | 15.93 | 1.14 |
| | Sonkey | 19 | 13.60 | 23.84 | 1.25 |
| | Makmak | 18 | 10.94 | 13.43 | 0.75 |
| Medium | Untapped | 15 | 3.51 | 8.66 | 0.58 |
| | Sonkey | 23 | 4.49 | 7.68 | 0.33 |
| | Makmak | 21 | 12.63 | 33.17 | 1.58 |
| Slight | Untapped | 9 | 14.61 | 43.84 | 4.87 |
| | Sonkey | 21 | 22.55 | 49.99 | 2.38 |
| | Makmak | 27 | 25.78 | 66.85 | 2.48 |
| **Overall mean** | | **19** | **13.68** | **37.40** | **0.22** |

*. Means are not significantly different (α = 0.05)

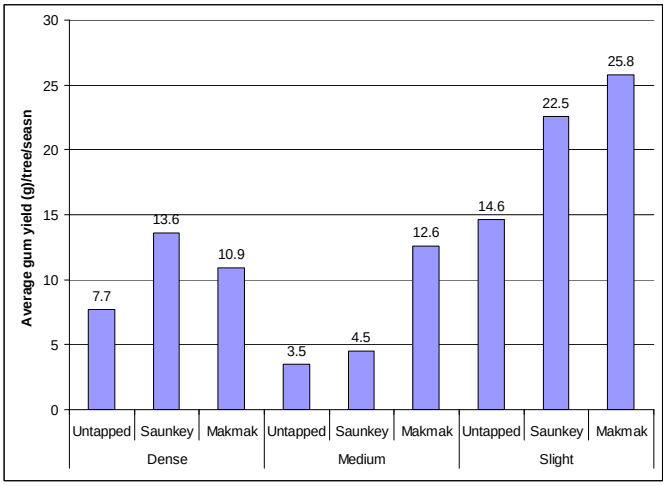


Fig 2 Effect of tapping tools on the productivity of gum *talha* from A. seyal in different stand densities

Table 3 Classification table based on logistic regression model (the cut value is 0.5)

| Observed | | Predictable: DBH Predicted Yield probability | |
|---|---|---|---|
| | Non-yielding trees | Yielding trees | Percentage Correct |
| Non-yielding trees | 58 | 29 | 66.7 |
| Yielding trees | 39 | 41 | 51.2 |
| Overall Percentage | | | 59.3 |
| | Predictables: (stratum, tool and number of neighbourhood trees) | | |
| Non-yielding trees | 59 | 28 | 67.8 |
| Yielding trees | 31 | 49 | 61.2 |
| Overall Percentage | | | 64.7 |

In contrast, the findings of this study indicate that the maximum annual yield was only 25.78 gram when tapping trees with the same tool in a slight stratum. This result is close to the estimates (35.14 gram) that Ali (2006) reports for trees that are tapped on the first of November using *Makmak*. It is worth mentioning that the three studies, Ali (2006), Fadl and Gebauer (2004) and the present study were carried out in the same forest. It is difficult to explain the difference in yields for the three studies, but it might be related to site variation and the variations between individual trees selected for the gum experiments. In contrast to the results of (Ali 2006), no correlation was found between gum yield and the diameter at breast height. This indicates that the yield of gum *talha* might not be influenced by stem diameter.
It was expected that stem diameter, tree density and tapping tools would have a positive impact on gum *talha* productivity. Nevertheless, the results of this study did not show any correlation between these variables and gum yield. However, results of the logistic regression indicate that about 60 percent of the predictions were correctly classified when using DBH as a predictor. The value jumped to about 65 percent when other predictors were incorporated. This may indicate the possibility of increasing gum predictions by increasing the number of predictors.

Although the findings of this study are rather difficult to be interpreted, more research on this field needs to be undertaken. The establishment of permanent trial plots is necessary in order to study the factors influencing yields of gum *talha*.

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