

### **Influence of Height and tapping date on the yield of Gum Arabic in Jigawa State, Nigeria.**

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#### **Abstract:**

The study examined the influence of tree height classes (which was set as the vertical distance measured from ground to the uppermost live leaf) of *Acacia senegal* (gum Arabic) and tapping date on the yield of gum Arabic in Jigawa State, Nigeria. A two factorial randomized complete block design with three replicates experiment was carried out in 2015 season at two different locations (Kadoma and Kwanarduhuwa). The first factor consisted of height classes of the tree stands varied between  $>4\text{m}$  and  $\leq 4\text{m}$  and the second factor include date of tapping tested in 1<sup>st</sup> and 15<sup>th</sup> of September, 1<sup>st</sup> and 15<sup>th</sup> of October and 1<sup>st</sup> and 15<sup>th</sup> of November. Three (3) trees were tapped for each of the treatment making a total number of two hundred and sixteen trees in the two locations and one hundred and eight (108) trees at each location. The first picking of the gum yield took place 45day after tapping and each consecutive picking was collected after 15 days from the previous one. The harvested gum from each picking was weighed after drying using sensitive balance JY2002 model. Average gum yields per tree were computed and used in the analysis using SAS system where DUNCAN's Multiple Range Test was employed in determining the significance of tree height and date of tapping for the separate location on the total yield. The result has revealed that, gum Arabic tree height Classes had negligible role as per yield of *Acacia Senegal* while tapping date played significant influence on the yield of gum Arabic thus gum Arabic farmers are advised to monitor the stoppage of rainfall or the shading of 50% of gum Arabic tree leave for tapping at the right time.

**Keywords; Gum Arabic, Height, Jigawa State and Tapping.**

#### **Introduction:**

FAO (1992), defines gum Arabic as the “dried exudation obtained from the stems and branches of *Acacia senegal* L. (Wild) or closely related species. The exudates is a non-viscous liquid, rich in soluble fibers, which usually occurs under stress conditions such as drought, poor soil fertility, and injury (Williams and Phillips, 2000). This important plant is naturally well adapted to the semi-arid zones of Sudan and Sahel regions (Odo, 2003). Okatahi (1999) studied the characteristics and reported that the average minimum and maximum temperature that make acacia tree thrive are 14<sup>0</sup>C and 40<sup>0</sup>C. Such regions are generally characterized by low rainfall, which support moderately tall plants that produce large quantity of gum exudates while high rainfall and high humidity support taller trees that yield very little amount of gum Arabic. (Grams, 1998). Tapping is a traditional way

of producing gum in Sudan (Kamal and Adam, 2011). Wekesa, *et al* (2012) state that untapped trees did not produce at all or produced little gum implying that tapping is an important management tool for enhancing gum productivity. Indeed, Wekesa, *et al* (2012) state, tree should be tapped three (3) weeks after end of long rainy season, or when it shed about fifty percent (50%) of the leaves. Rocheleau (1988) in Senegal showed that gum production occurs only during the dry season, when the trees are shedding leaves. A threshold of water stress, consecutive to rain stoppage and dry air, seems required to trigger gum exudation (Dione and Vassal, 1996).

Gum Arabic plays an important role in rural life, providing a steady income to rural families especially in years when productions of crops fail (Chikemi, *et al*1997). Recognition of this fact, the Government of Northern Nigeria coupled with the Forest II project supported by World Bank in 1987 organized campaigns which promoted the planting of *Acacia senegal* and resulting in many farmers establishing large farms of *Acacia senegal* (Aghughu *et al*, 1996). Attuned, there wasn't any research conducted on the tending practices, the precise and time of tapping gum Arabic trees for most advantageous gum yield particularly in Jigawa State. Therefore this research is intended to aid farmers in overcoming this drawback in order to enable them enjoy, the full payback of their investments.

#### **The Study Area:**

Jigawa state was excised from Kano State in 1991, covers a total land area of about 22, 410 Km<sup>2</sup> (CBUDP, 2007). Currently the population of the State was estimated to be 4, 361, 002 (NBS, 2006). It is situated in the northwestern part of Nigeria and lies between latitudes 11° 141 N and 13° 091 N and between longitudes 8 ° 001 E to 10 ° 151E (Mikaill, 2001). It has a unique climate with relatively rapid changes in temperature and humidity (Mikail, 2001). The temperature may rise to 33° C during the summer months, usually in April and May and could be as low as 21° C during winter period (December/January). Rainfall varies from year to year and ranges from 635.00 mm in the north to 890.0 mm in the southern area (NEST, 1991).

#### **Description of the Study site:**

The first location of the field experiment was Kwanar Duhuwa a village six (6) kilometers away from Gumel town. The plantation, which covers up to 83.26 hectare, was established in the year 2004 at a 4x4 meters spacing distances. (Latitude 12° 341 N, Longitude 09° 241 E) it is placed at an Altitude of 374m. The soil is loamy sand while the mean annual rainfall varies from 336.8mm to 576.5mm. The second location was Kadoma village located almost three (3) kilometers away from Jahun town, the plantation which covers 20.63 hectares was established in 2003 that is a year ahead of the former plantation, at spacing distances of 4x4metres also. (Latitude 12° 061 N and Longitude 09° 391 E) it is placed at an Altitude of 372m. the soil is loamy sand and clay, the mean annual rainfall varies from 250.7mm to 1001.1mm that extended from April to September, the average wind velocity reached 5.48km/hr, the atmospheric humidity

reached 19.1% in January and 66.8% in August and the minimum and ,maximum temperature were 17.57oC and 37.13oC respectively (JSSYB, 2008).

### **Experimental Design:**

The experiment was conducted at two locations; Kadoma and Kwanarduhuwa in 2015 season which, involved two factorial of complete, randomize block design with three replicates. The first factor consisted of the height classes of the tree stands, which were varied at ( $>4$  and  $\leq 4$ ) estimated with the help of improvised stick made up of two (2) meters at each of the two sites, while the second factor comprised date tapping tested at six levels (1st and 15th September, 1st and 5th October and 1st and 15th November).

### **Tapping:**

Tapping of *Acaciasenegal*(gum Arabic tree) was done by using the developed new hand tool called (Sinki) (Elamin, 1989).The Sonki is driven under the bark of the tree without penetrating the wood between the outer bark and inner cambium (IIED and IES, 1989). Three (3) trees were tapped at each plot making a total number of hundred and eight (108) trees used in each location, which stood at (216) two hundred and sixteen trees tapped in the two locations. The first picking of the dry gum exudates took place 45 days after tapping and each consecutive picking was collected after 15 days from harvest of previous one. The gum from each picking was weighed after drying using sensitive balance JY2002 model. Average gum yields per tree were computed and used in the analysis using SAS system where DUNCAN's Multiple Range Test was used in determining the significance of weeding status and date of tapping for the separate location on the total yield.

### **Results and Discussion:**

The results of the investigation on influence of tree height classes has shown little or no connection between gum Arabic yield and tree height as seen in tables (1 and 2) where gum Arabic yields of (72.21g and 76.57g) and (72.33g and 69.31g)were obtained in HC (1 and 2) at both Kadoma and Kwanarduhuwa respectively. Similarly, Unanaonwi and Bada (2013) reported tree parameters girth and height have effects on the amount of gum yield of *Acacia senegal* with larger tree girth giving higher amount of gum yield, however, the effects of height on yield were not significant. Tree heights were expected to exercise their impact when it comes to the trapping of sunlight for increase in the photosynthetic efficiency, contrary to the right period of tapping trees for gum Arabic exudation. Wekesa, et al (2012) states, tapping for better gum exudation should begin when *Acacia senegal* tree shed about fifty percent (50%) of the leaves. Thus, Nair (1995) reported, in many situations, when water is adequate and the soil relatively fertile, competition for light may be the main limiting factor, while competition for nutrients can be severe, especially for agricultural crops in an agro-forestry system.

The findings has shown that tapping date had profound effect on the yield of gum Arabic in that gum yields of 172.24g/tree and 163.9g/tree were obtained when the trees were tapped on the 15th October, in opposition to 4.09g/tree and 2.16g/tree when they were

tapped on the 1st September, gum yields of 82.84g/tree and 90.43g/tree were realized when the trees were tapped on the 15th November at Kadoma and Kwanarduhuwa sites respectively tables (3 and 4). Therefore the gross variations on the gum yield noticed of 15th October tapping was as a result of the stoppage of rainfall three weeks to the commencement of tapping and the shedding of fifty percent (50%) of the gum Arabic tree leaves which could be the motivating factor towards the exudation of more gum when the trees were tapped on the 15th October. The result is in line with the findings of Kamal and Adam (2011) who found, the 15<sup>th</sup> October date of tapping show slight increase in gum yield. This result also agreed with the findings of Fadi and Gebauer (2006) who investigated the effect of date of tapping and tapping intensity on the gum yield of *A. seyal* and found date of tapping had significant effect on the amount gum production. The study has also observed some variations in the gum yield from tree to tree and from pick to pick. This may not be unconnected to variation on the climatic factors and the management practices, however, such observation has agreed with the results of Ballal (1991) who attributed the variation in *Acacia senegal* gum yield on the climatic factors and management practices. Also Fanshawe (1962) and Ballal (1991) attributed the differences in gum yield to the differences in the amount of rainfall and probably to the management practices.

**Table 1. Influence of height classes on the average gum Arabic yield (g/picking) at Kadoma plantation**

Height classes	Gum Arabic yield gram/picking					Total Yield	Average yield
	1st picking	2nd picking	3rdpicking	4th picking	5th picking		
HC 1	8.27a	11.99a	15.42b	17.72a	18.81a	72.21	14.44
HC 2	9.28a	13.44a	17.73a	18.67a	17.45a	76.57	15.31
Total	17.55	25.43	33.15	36.38	36.26	148.78	29.76

\*Treatment means followed by the same letters in the same columns are not significantly different at P>0.001

**Table 2. Influence of height classes on the average gum Arabic yield (g/picking) at Kwanarduhuwa plantation**

Height classes	Gum Arabic yield gram/picking					Total yield	Average yield
	1st picking	2nd picking	3rdpicking	4th picking	5th picking		
HC 1	9.38a	12.05a	15.48a	17.44a	17.98a	72.33	14.47
HC 2	10.33a	13.07a	15.43a	16.47a	14.01a	69.31	13.86
Total	19.71	25.12	30.91	33.91	31.99	141.64	28.33

\*Treatment means followed by the same letters in the same columns are not significantly different at P>0.001

**Table 3: Average gum Arabic yield (g/picking) as affected by tapping date in 2015 season at Kadoma plantation**

Dates	Gum Arabic yield g/picking					Total Yield	Average yield
	1st picking	2nd picking	3rd picking	4th picking	5th picking		
1st Sept.	0.00c	0.00c	0.83c	1.68d	1.58c	4.09	0.82
15th Sept	0.00c	0.42c	2.52c	4.75d	4.77c	12.46	2.49
1st Oct.	18.33b	21.10b	20.03b	23.70bc	20.63b	103.79	20.76
15th Oct	29.67a	31.50a	36.50a	36.77a	37.80a	172.24	34.45
1st Nov.	21.37ab	20.43b	23.87b	27.37bc	22.70b	115.74	23.15
15th Nov.	15.27b	16.50b	15.97b	16.43c	18.67b	82.84	16.57
Means	14.1	15	16.6	16.6	17.69		
SE±	3.24	3.63	3.79	3.76	3.76		

\*Treatment means followed by the same letters in the same columns are not significantly different at  $p < 0.005$

**Table 4: Average gum Arabic yield of (g/picking) as affected by tapping dates in 2015 season at Kwanar dahuwaa plantation**

Dates	Gum Arabic yield gram/picking					Total yield	Average yield
	1st picking	2nd picking	3rd picking	4th picking	5th picking		
1st Sept.	0.00c	0.08c	0.08c	0.83c	1.25d	2.16	0.43
15thSept	0.00c	0.17c	0.17c	2.50c	3.08d	5.92	1.18
1st Oct.	19.67b	23.20b	23.20b	22.17b	23.60bc	111.84	22.37
15thOct	31.80a	31.33a	31.33a	34.70a	34.43a	163.9	32.78
1st Nov.	24.93ab	23.33b	23.33b	24.60b	26.70b	122.89	24.58
15thNov.	17.97b	17.83b	17.83b	18.10c	18.70c	90.43	18.09
Means	15.7	15.99	15.99	17.15	17.96		
SE±	4.02	2.03	2.87	3.22	2.57		

\*Treatment means followed by the same letters in the same columns are not significantly different at  $p < 0.00$

### Conclusion and Recommendations:

The study has revealed that height has negligible impact in relation to the yield of gum Arabic but precise timing of tapping yield better result as per gum Arabic production. Gum Arabic farmers are advised to monitor the stoppage of rainfall or the shedding of 50% of gum Arabic tree leave for tapping at the right time.



## References

- Aghughu O, Ojiekpon I.F., and Alabi S.O. (1996), April). Origin of *Acacia senegal* (L) Willd) and its distribution in Nigeria. A paper presented at the 31st Annual Conference of the Agricultural Society of Nigeria (ASN), Held at the National Agricultural Extension Research and Liaison Services (NAERLS), Ahmadu Bello University, Samaru – Zaria
- Ballal, M. E. (1991). *Acacia Senegal*: Multipurpose tree for the arid and semi-arid Tropics. M Sc. Thesis, University of Wales, UK.
- CBUDP (2007). Community Based Urban Development Project (2007): Pamphlet. Jigawa, Nigeria.
- Chikemi, B. N., Casadei, E., Coffen, J. J. W., Abdel Abur, H. O., and Cesareo, D. (1997). A Review of production, marketing and quality control of gum Arabic in Africa.
- Dione, M. and Vassal, R. (1996) Recherches expérimentales sur le gommier *Acacia senegal* dans le Ferlo-sénégalais. Thèse de doctorat, Université Paul Sabatier de Toulouse, France, 150 p. In; improving the traditional *Acacia senegal* crop system in Sudan: the effect of tree density on water use, gum production and crop yields. *Agroforestry Systems*.66: 1-11
- El amin H. M. A. (1989), March). The Consequences of Defoliation of Gum Arabic Tree (*Acacia senegal*) by Sahelian Tree Locust (*Anacridium melanorhodon melanorhodon*) for the Gum Producers in North Kordofan State, Sudan. Conference on International Research on Food Security, Natural Resources Management and Rural Development. Tropentag, 1989.
- Fadi K. E.M and Gebauer J.(2006).Effect of time and intensity of tapping on the gum yield of *Acacia seyal* var.*seyal* in South Kordofan, Sudan. *Journal of Forests, Trees and livelihood*, 16(3), 219-225
- FAO. (1992). Gum Arabic (published in FAO Food and Nutrition paper (110) pp.735. [Http://www.codexalimentarius.net/gsfaonline/food/details.htm?id=230](http://www.codexalimentarius.net/gsfaonline/food/details.htm?id=230) FAO. Quality control of gum arabic in Nigeria Project TCP/ RAF/4557 Document. 1995.
- Fanshawe D. B. (1962). Fifty common trees of Northern Rhodesia. Lusaka (Zambia). Natural Resources Board and Forestry Department, 132p
- Grams, J. (1998): Women’s role in the International market for gum; summary of findings. Unpublished Report. New York: UNIFEM.
- IIED and IES. (1989). Gum Arabic rehabilitation in the republic of Sudan: Stage 1 Report, International Institute for Environment and Development (IIED) and Institute of Environmental Studies (IES). IIED. London.
- JSSYB. (2008). Jigawa State Statistical year Book Pp 23. Jigawa State Government of Nigeria
- Kamal E.M. and Adam I. M. (2011). Effect of tapping tools and date of tapping on *Acacia polyacantha* gum yield in south Kordofan State, Sudan. *Journal of Forestry Research* 22(1), 117-122.
- Mikail, B .A. (2001): “Deforestation and Afforestation Policy aimed at Sustaining the Land Resources Management in Jigawa State”. *Journal of Forestry*, 2(1), 77-82.
- Nair, M. N. B., Shivanna K. R. and Mohan H.Y. R. (1995). Ethephon enhances karaya gum yield and wound healing response: *Food Hydrocolloids*, 19 (4), 687-701, ISSN: 0268-005X.
- NBS (2006). National Bureau of Statistic (2006): Core Indicators Questionnaire Survey Reports On Jigawa. Abuja, Nigeria.
- NEST (1991): Nigeria Environmental Study/Action Team. Nigeria’s Threatened Environment. A National Profile .Pp 131-175.
- Odo, P. E. (2000, January, 4).Technics for Raising Seedlings in the Arid zone of Nigeria. Bulletin, No. 3 of Afforestation Programme Coordinating Unit [APCU] Kano
- Okatahi, S. S.(1999). Gum Arabic production. Extension Bulletin number.78; Forestry Series



- number 11. (NAERLS) ABU Zaria.
- Rocheleau, D. (1988): "Agroforestry in dry lands of Africa" International Council for Research in Agroforestry, Nairobi, Kenya
- Unanaonwi O. E and Bada S.O. (2013). Effect of Tree Height and Girth on Gum Yield of Acacia senegal in Savannah Woodland of Nigeria. Journal of Tropical Forestry and Environment. 3(01), 40-44.
- Wekesa, C J., M. Lelon, M. Muga, A. Luvanda& B. Chikamai, (2012). Gum Arabic production potential of natural Acacia senegal varieties in drylands- kenya. handbook. DFID Forestry Research Programme, U.K.
- Williams, P.A. and Phillips, G.O. (2000): Studies on acacia exudate gums. PartI: the molecular weight of Acacia senegal gum exudate. Food Hydrocolloids, Vol.19, No.4, (July 2005), pp. 647-660, ISSN: 0268-005X.