Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(4): 1428-1431
Received: 08-05-2020
Accepted: 10-06-2020

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Effect of climatic parameters and bark thickness on gum-oleoresin production in *Ailanthus triphysa*

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Abstract
The experiment was carried out in the field of Instructional Farm, College of Forestry, KAU, Thrissur Kerala, during May 2017 to April 2018. One of the objective was to know the effect of climatic parameters and bark thickness on gum-oleoresin production in *Ailanthus triphysa.* A total of twenty seven trees were selected for conducting the experiment taking three different girth class i.e., less than 75cm, 75 to 150 cm, greater than 150 cm and three different extraction techniques i.e., V-Shaped method, Cup and Lip method and Straight-Cut method. Data analysis for whole study period revealed that the bark thickness are found to be positively correlated with coefficient value (r = 0.645) and all the different climatic parameter taken were found to be not correlated with gum-oleoresin production. As the *Ailanthus triphysa* mainly respond by injury made on tree.

Keywords: Ailanthus triphysa, gum-oleoresin, bark thickness, climatic parameters

1. Introduction

Ailanthus triphysa (Dennst.) Alston also known *Ailanthus malabarica* DC. Also locally called as Matti. It belongs to the family *simarubaceae usually* having cylindrical trunk and height upto 30 meter and diameter of 1.2 meter (Chandrasekar, 1996) [3]. It is widely distributed over North Australia and Asia (Kandu and Laskar, 2010) [10]. In India it occurs mainly in natural evergreen forest of Western Ghats (PID, 1948. Its oozes gum-oleoresin from the wounded trunk of the tree is aromatic and is called Halmaddi in Kannada (Karnataka) and Mattipal in Malayalam (Kerala). Because of its fragrance, it is used in the manufacture of high value incense sticks (Nagchampa) which is used nationally as well as in other countries like USA, UK, Tibet etc. (Joshi *et al.*, 1985) [6]. *Ailanthus triphysa* wood is considered as best matchwood (Indira, 1996) [5]. The light soft wood is utilized for making packing cases, toys, catamarans, and drums (Kumar *et al.*, 2000) [8]. Ailanthus is a popular support tree for pepper vines and is important component of silvipastoral and agrisilvicultural systems in Kerala (Kumar *et al.*, 1994; Kumar, 2001) [7, 9]. As gum-oleoresin are secondary metabolites of trees which mainly depends on climatic parameters so the focus is given on the relation between climatic parameter and gumoleoresin yield. Additionally the effect of bark thickness on gum oleoresin production is also done which is again rare and unique study.

2. Materials and Methods

The present study was conducted in a 25-years-old *Ailanthus triphysa* (Dennst.) Alston. *Stand* in experimental site located at Instructional Farm, College of Forestry, Kerala Agricultural University, Vellanikkara, and Thrissur, Kerala at 10º 32’ N latitude and 76º 10’ E longitude, and 22.5 m above mean sea level. The study was conducted for a period of one year (May 2017 to April 2018). A total Three different girth class i.e., less than 75, 75-150, greater than 150 and three different extraction techniques i.e., V-Shaped method, Cup and Lip method and Straight-Cut method each with three replications at total of twenty seven trees were selected for the experiment. Climatic parameters data (May 2017-June 2018) collected from Department of Meteorology, College of Horticulture, Kerala Agricultural University, Vellanikkara (Table 1) in SPSS Version 21.0 to ascertain the significance and Haglof bark gauge was main instrument used for measuring bark thickness.

Measurement of bark thickness

The bark thickness was measured by using Haglof bark gauge. The bark gauge having a shaft with a sharp point which pushed through the bark until the underlying wood is felt. The sleeve around the shaft is shifted to the surface and thickness of the bark sample can be read from the calibrated shaft and was recorded in field data book in centimetre (cm). The bark thickness was measured on four axis of the tree and average thickness was calculated which was later subjected with correlation study in SPSS Version 21.0 to ascertain the significance.

Table 1: Climatic parameters data of study period (May 2017 to April 2017)

Months	Mean Rainfall(mm)	Mean Temperature (ºC)	Mean Relative Humidity (RH %)	Mean Sunshine (hrs)
May 2017	167.5	29.8	72	5.5
June 17	630.2	27.0	87	2.0
July 17	385.5	26.8	85	2.9
August 17	470.0	26.7	87	3.1
Sept 17	413.9	27.2	84	4.2
Oct 17	183.4	27.0	81	4.9
Nov 17	58.4	27.4	73	6.4
Dec 17	11.5	26.8	63	7.3
Jan 2018	0.0	27.2	53	8.2
February18	5.2	29.1	47	9.5
March 18	33.2	30.4	59	8.0
April 18	28.9	30.5	69	7.3

3. Results

3.1 Effect of bark thickness on gum-oleoresin yield.

The present study revealed that the gum-oleoresin yield from the *A. triphysa* due to different bark thickness found to be significantly different as the P value is found to be 0.00 which is significant. It was observed from the correlation studies that the girth class increases the bark thickness also increases and consequently increases the gum-oleoresin production (Table.2).

In the present study correlation between gum-oleoresin yield and bark thickness was found to be 0.65. It indicates that positively correlated with the gum-oleoresin production that means greater the girth class greater the bark thickness, consequently greater the gum-oleoresin production.

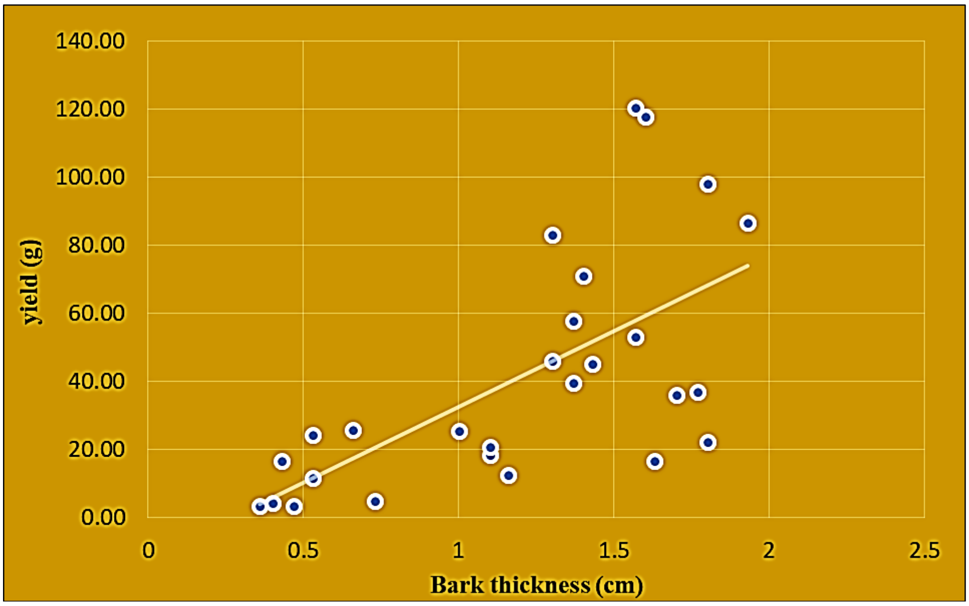

Fig 1: Correlation between bark thickness and gum-oleoresin yield (r = 0.65**).

3.2 Effect of climatic parameter in gum-oleoresin production

Based on the correlation studies, none of the climatic parameter found to be non-significant in gum-oleoresin production, However, temperature correlation coefficient (-0.53) which negatively correlated at 10 % significant level (Table. 19). Similarly, the present study revealed that other climatic parameters like relative humidity, rainfall, rainy days, sunshine hours and wind speed are found to be correlated as the r Value is not zero but it was found to non-significant it might be due to less number of observation as the study period consist of twelve months only.

Table 2: Correlation studies of meteorological parameters with gum-oleoresin production

		Mean tempt (⁰C)	Mean RH (%)	Rainfall (mm)	Rainy days	Mean sunshine hours	Mean wind speed (Km/hr)
Gum-oleoresin yield (g)	Pearson correlation	-0.53	0.38	0.30	0.36	-0.41	-0.49
	Sig.(2-tailed)	0.08	0.221	0.34	0.25	0.19	0.11

4. Discussion

4.1. Effect of bark thickness in gum-oleoresin yield.

Bark is a term loosely applied to the outermost covering of tree stems. It can be defined anatomically as the complex of tissues located outside the vascular cambium, generally includes both live and dead cells produced by two cambia, sometimes supplemented by the products of continued cell division in primary tissues. Furthermore, the components of bark develop from different primary tissues in shoots and roots. Thus, treating bark as a single unit can obscure important aspects of biochemistry, physiology etc. As the inner bark is produced by and therefore adjacent to the vascular cambium which is composed of living secondary phloem, the tissue responsible for translocation of photosynthates and other metabolites around trees and shrubs (Romero, 2006) [13]. Beeckman (2016) [1] reported each anatomical trait, or combination of traits, plays a role in favouring one or more xylem functions, namely water transport, mechanical stability, biological defence, and storage and mobilisation of metabolites.

Based on the correlation studies, it indicates that bark thickness is positively correlated with the gum-oleoresin production that means greater the girth class greater the bark thickness, consequently greater the gum-oleoresin production. It might because of the greater girth tree has more thickness of bark. Responses to stem damage might be another reason which involve interactions of anatomical, phylogenetic, physiological, and ecological factors. Very few literature are available pertaining gum-oleoresin yield with bark thickness production.

4.2. Effect of Climatic Parameter Gum-Oleoresin

The study observed the variation on gum-oleoresin yield during different months of the year. The rate of gum exudation was found to be more in post-monsoon season followed by rainy season and least in summer season. It indicates that the seasonal changes has more influence on gum-oleoresin production as many meteorological factors or parameters changes from one season to another season. It might be due to the process of gummosis which is very much influenced by the temperature and relative humidity as in general, peak gum production is apparently as the rainy season ended and air temperature rises. This was supported by many researchers that relative humidity and temperature has major role in gum-oleoresin production as its has direct effect on secondary metabolism. Tewari *et al.* (2014) [14] reported that many of the gum yielding tree species produce gums in dry period. However, present study revealed that there is no significance different between various climatic parameters with gum-oleoresin production. But for temperature, it can be told at 10% significance level it is negatively correlated. Tewari *et al*., (2014) [14] found similar result in *Commiphora wightii* (guggul) where with an increase in temperature, the production of oleo-gums-resin decreased sharply. The present study also revealed that others climatic factors like relative humidity, sunshine hours and wind speed are correlated as their r value is not zero but they found to be non-significant (Table 2) it might be due to

1. Few number of samples trees on which experiment was conducted.
2. The study period was 12 months.
3. The experiment was conducted on trees having genetic variation.

The post monsoon period produces more resin than rainy and summer seasons which indicates the gum-oleoresin production is more when relative humidity is higher. It might be due to Kerala receive rainfall from North-East monsoon. Similar trial was done by Tewari *et al*. (2014) [14] in *Acacia senegal l*and *Acacia tortilis* which yield less amount that is (15-25gm/tree) in traditional tapping techniques which when experimented with CAZRI gum inducer + irrigation + manuring which resulted in more production of gums. This means irrigation plays an important role in increasing the production of gums as it might 97 increased the relative humidity of nearby area. Ballal *et al.* (2005a) [2] have also reported that highest yield per tree in all types of stands is obtained in early (1 October to 1 November) tapping. Dione and Vessal (1998) [4] that the temperature variations and effect on gum yield reported similar result. The low temperature and high temperature at tapping seems to seal off the gum exudation points.

Ailanthus triphysa flowering in India and Nepal is between February and March, fruiting follows in April-May (Orwa *et al*., 2009: Chandrasekar, 1996) [11, 3] which is reported as the energy demanding process like bud growth/shoot development occurs during this period. The present study also found that maximum gum-oleoresin yield obtained in post monsoon and monsoon seasons. It clearly indicates that the reserve metabolites are understand high in wood parenchyma in post-monsoon and monsoon season where no phenological events take place.

5. Conclusion

More thicker bark produces more gum-oleoresin in *Ailanthus triphysa* so it can be consider as a criteria for selecting trees for tapping. From the present study we can conclude that in Ailanthus the climatic parameters are not playing a major role in gum-oleoresin production as it primarily due to physical injury.

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