Comparative Bark Morphology and Recovery Ability of Four Species in Genus *Acacia*

Khin Myint Maw*

Abstract

The present research was to understand the different bark morphology and the recovery ability of barks which bark harvesting was deleterious to the tree. The stem barks of four species in genus *Acacia* were collected from 2017 to 2018 in Mandalay city and its vicinity. The result showed that different morphological features and thickness were found in all of the studied species. All of the species observed in shallow longitudinal fissure and cross cracks appearance. The shed barks were observed in irregular flakes, scale and stripes. *Acacia nilotica* (L.) Delile has sweet smell and taste and unpleasant smell observed in *Acacia auriculiformis* A. Cunn.. Gum and sap of bark exudates found in all species except in *Acacia auriculiformis* A.Cunn.. The comparison made among the four *Acacia* species, the highest rate of recovery ability in length and thickness found in *Acacia leucophloea* (Roxb.)Willd.. The lowest rate of recovery ability found in *Acacia sundra* DC.Prod. In the present study, the barks recovery rate were found in one year but vary rate in same genus and family.

Key wards; bark morphology, recovery ability, Genus *Acacia*

Introduction

Bark is the outer part of trunk and branches and root of a tree. It serves not only as a protective layer but also as a food transporting tissue from leaves to other parts of the trees. About 8%of the total volume of a tree is bark (Harkin & Rowe, 1969). It can be technically divided into two parts based on its structure, viz. inner bark and outer bark.

Inner bark is the layer of physiologically active tissue adjacent to the cambium. It comprises conducting phloem, non-conducting phloem and innermost last-formed periderm layer. Outer bark is known as rhytidome which may be deep or shallow furrow or fissure or crack in appearance. Inner bark and rhytidome demarcate by innermost last-formed periderm. Periderm consists of three layers of tissues such as phellem, phellogen and phelloderm.Bark is one of the most important features in the identification of many large trees or especially giant forest trees.

The valuable charactersof bole, buttresses, the bark pattern and the characteristics of the bark cut or slash can mainly be based for identification of the trees. (Leo junikka, 1994). Barks are useful byproducts of the forests. Fibers, tannin, dyes, gums, resins, latex materials and medicines can be obtained from barks of different species. One of the economic important extracts obtained from barks is tannin. (Panshin & et.al, 1950). The greatest use of tannin is in the manufacture of leather. In this research, the tanning producing barks of *Acacia auriculiformis* A.Cunn., *Acacia leucophloea* (Roxb.)Willd., *Acacia nilotica* (L.) Delile.and*Acacia sundra* DC.Prod. belonging to the family Mimosoideae grown in Mandalay and its vicinity werecollected. Their bark morphological and healing or recovering of barks are studied, compared and discussed.

Aims and Objectives

- To get valuable bark morphological information of *Acacia* species
- To support the bark morphological characters for plant identification

* Dr, Associate Professor, Department of Botany, Mandalay University of Distance Education

- To understand the bark recovery ability within same genus

Materials and Methods

All the specimens were collected during the flowering and fruiting periods from the year 2017 to 2018 in Mandalay city and its vicinity. The specimens were identified by using the floristic literature (Hooker, 1879; Cronquist,1988; Hundley & Chit Ko Ko,1961) at the Department of Botany, University of Mandalay. Bark terminology used in this work follows by Trockenbrodtt (1990) and Harlow &*et.al* (1978) for morphological characters. For study of recover ability, ten trees sampled in each species were selected. Then, the stem bark of each species measured about 6" × 6" was taken from outside of the sapwood of main stem. After which, the initial harvest stem barks were studied and their color, pattern, odor, taste, thickness andlength of the originalbarks were recorded.At the period of 3, 6,9 and 12 months of harvesting, the length and thickness of recoveryrate were measured respectively. Finally recover ability on harvested stem bark per tree were calculated and compared with one another.The collected data of recover ability were tested with paired and unpaired student "t" test as stated by Steel and Torrie (1960) respectively.

Results

A. Morphological Characters of Four *Acacia* Species

1. *Acacia auriculiformis* A. Cunn. ex Benth. in Lond. Journ. Bot. 1. 377. 1842.

Local Name : Aurasia
English Name : Australian Acacia

Bark studied brownish-grey to blackish-grey in young and in age; 0.5 - 0.9 cm thick; longitudinal fissure with lenticels; dead outer bark shed in irregular small pieces, hard and brittle; inner bark 0.2 - 0.5 cm thick; yellow turned to brownish yellow in exposure, fibrous, hard; unpleasant smell; taste and exudates absent.

2. *Acacia leucophloea* (Roxb.) Willd. Sp. Pl. 4. 1083. 1086.

Local Name : Hta-naung
Common Name : White-bark acacia

Bark studied pale yellow to brownish-yellow in young and in age; 1.5 - 2.5 cm thick; smooth with branched thorn present while young, longitudinally narrow fissures and cross cracks in age; dead outer bark shed in patches or irregular flakes; hard and brittle; inner barks 0.5 - 1.0 cm thick; yellow turned to pinkish-yellow in exposure, fibrous, soft; odor and taste indistinct; pinkish watery sap present.

3. *Acacia nilotica* (L.) Delile, Fl. Aegypt. 111. 79. 1813.

Local Name : Su-byu
English Names : Indian gum-arabic trees, Babul, Gum tree

Bark studied brownish-grey to blackish-grey in young and age; 0.7 - 3.0 cm thick; longitudinally deep fissures and cross cracks in age; dead outer bark shed in patches or long stripes; hard and brittle; inner bark 0.3 - 0.7 cm thick; pale pink turned to reddish-brown in exposure, fibrous, hard; sweet smell and taste, brown sticky sap present.

4. *Acacia sundra* DC. Prod. 2:458. 1825.

Local Name : Sha
English Name : Cutch

Bark studied pale grey to brownish- gray in young and in age; 1.0 - 2.5 cm thick; deeply longitudinal fissure and cross cracks; dead outer bark shed in long narrow stripes or scale, hard and brittle; inner bark 0.5 - 1.0 cm thick; reddish-brown turned to darker in exposure, fibrous, hard; odor and taste absent, red sticky gum present.

Figure 1. Barks as seen in four *Acacia* species
A. *Acacia auriculiformis* A. cunn. C. *Acacia nilotica* (L.) Delile
B. *Acacia Leucophloea* (Roxb.)Willd. D. *Acacia sundra* DC.

B. Comparison on morphological characters of four *Acacia* species

Differentbarks morphological characters (outer and inner) of four species were shown in table 1.

Table1. Differentmorphological characters of four *Acacia* species

Character \ Species name		*Acacia auriculiformis* A. Cunn.	*Acacia leucophloea* (Roxb.) Willd.	*Acacia nilotica* (L.) Delile,	*Acacia sundra* DC.
Outer bark	Colour	blackish-grey	brownish-yellow	blackish-grey	brownish-gray
	Thickness(cm)	0.5 - 0.9 cm	1.5 - 2.5 cm	0.7 - 3.0 cm	1.0 - 2.5 cm
	Pattern	Longitudinal fissure with lenticels	longitudinal fissures and cross cracks	longitudinal fissure and cross cracks	longitudinal fissure and cross cracks
	Shape of shed bark	irregular small pieces	Patches or irregular flakes	patches or long stripes	Long narrow stripes or scale
	Texture	hard & brittle	hard&brittle	hard&brittle	hard& brittle
Inner bark	Thickness(cm)	0.2 - 0.5 cm	0.5 - 1.0 cm	0.3 - 0.7 cm	0.5 - 1.0 cm
	Exposure	Brownish-yellow	pinkish-yellow	reddish-brown	Darker reddish-brown
	Texture	fibrous, hard	fibrous, soft	fibrous, hard	fibrous, hard
	Odor &Taste	Unpleasant	indistinct	sweet	absent
	exudate	Absent	pinkish watery sap	brown sticky sap	red sticky resin

C. Comparison on Length of Recovery Barks

Comparison makes among the four species in three months old, the length of recovery barkwere not observed. In six months old,*Acacia auriculiformis*A. Cunn. hassignificantly superior than *Acacia sundra*DC. at 5% level. *Acacia leucophloea*(Roxb.)Willd. has superior significantly than *Acacia sundra*DC. and *Acacia auriculiformis* at 5% and1% level respectively. Similary *Acacia nilotica*(L.) Delilehas superior significantly than *Acacia sundra*DC.at 1% level.In 9 months old, *Acacia auriculiformis*A. Cunn. hassignificantly than *Acacia sundra*DC. at 5% level. *Acacia leucophloea*(Roxb.)Willd.has superior significantly than *Acacia auriculiformis*A. Cunn. and *Acacia sundra*DC.at 1% level, and*Acacia nilotica*(L.) Delileat 5 % level respectively. *Acacia nilotica*(L.) Delilehas superior significantly than *Acacia sundra* DC. at 1% level.In 12 month old, *Acacia auriculiformis*A. Cunn. has superior significantly than *Acacia sundra*DC.at 1% level. *Acacia leucophloea*(Roxb.)Willd.has superior significantly than *Acacia sundra*DC., *Acacia auriculiformis*A. Cunn. and *Acacia nilotica*(L.) Delile. at 1% and 5% level

respectively. *Acacia nilotica*(L.) Delile. hassuperior significantly than *Acacia sundra*DC.at 5% significant level (Table 2).

Table 2. Comparison on length of recovery barks among the four*Acacia* species within 6 months, 9 months, 12 months

No	Identity	6 month		9 month		12 month	
		mean ± SE	t' value	mean ± SE	t' value	mean ± SE	t' value
1	A.a - A. L	3.16 ± 0.7877 4.70 ± 1.7993	- 2.4795*	4.92 ± 0.9670 7.64 ± 2.1578	- 3.6378**	7.34 ± 1.0916 9.46 ± 1.9710	- 2.9754**
2	A.a - A.n	3.16 ± 0.7877 3.72 ± 0.8390	-1.5389^{ns}	4.92 ± 0.9670 5.78 ± 1.7472	-1.3618^{ns}	7.34 ± 1.0916 7.56 ± 2.1454	- 0.2890^{ns}
3	A.a - A. S	3.16 ± 0.7877 2.52 ± 0.5672	2.0854*	4.92 ± 0.9670 3.86 ± 0.9524	2.4697*	7.34 ± 1.0916 5.42 ± 1.3870	3.4390**
4	A .l - A.n	4.70 ± 1.7993 3.72 ± 0.8390	1.5608^{ns}	7.64 ± 2.1578 5.78 ± 1.7472	2.1185*	9.46 ± 1.9710 7.56 ± 2.1454	2.0623*
5	A .l - A.s	4.70 ± 1.7993 2.52 ± 0.5672	3.6534**	7.64 ± 2.1578 3.86 ± 0.9524	5.0677**	9.46 ± 1.9710 5.42 ± 1.3870	5.3004**
6	A.n - A.s	3.72 ± 0.8390 2.52 ± 0.5672	3.7465**	5.78 ± 1.7472 3.86 ± 0.9524	3.0510**	7.56 ± 2.1454 5.42 ± 1.3870	2.6488*

* = 5 % significant level A. a = *Acacia auriculiformis* A. n = *Acacia nilotica*
** = 1 % significant level A. l = *Acacia Leucophlaea* A. s = *Acacia sundra*
ns = non significant

D. Comparison on Thickness of Recovery barks

Comparison makes among the four species in three months old, recovery ability in thickness were not observed but in six months old,*Acacia auriculiformis*A. Cunn. has superior significantly than *Acacia sundra* DC. at 5 % level. *Acacia leucophloea*(Roxb.)Willd.and *Acacia nolotica* (L.) Delile. have superior significantly than *Acacia auriculiformis* A. Cunn. and *Acacia sundra* DC.at 1 % significant level respectively (Table 3). In 9 months old, *Acacia leucophloea*(Roxb.)Willd.and *Acacia nilotica*(L.) Delile., have superior significantly than *Acacia auriculiformis*A. Cunn.and *Acacia sundra* at 1 % level respectively (Table 3). In 12 months old, *Acacia auriculiformis* A. Cunn. has superior significantly than *Acacia sundra* at 5% level. *Acacia leucophloea* (Roxb.)Willd.has superior significantly than *Acacia auriculiformis*A. Cunn. and *Acacia sundra* DC. at 1% and 5% level respectively. Similarly*Acacia nilotica*(L.) Delile. issignificant than *Acacia auriculiformis* A. Cunn. and *Acacia sundra* DC.at 1 % and 5% significant level respectively (Table 3).

Table 3. Comparison on thickness of recovery barks among the four*Acacia* species within 6 months, 9 months, 12 months

No	Identity	6 month		9 month		12 month	
		mean ± SE	t' value	mean ± SE	t' value	mean ± SE	t' value
1	A.a - A. l	1.17 ± 0.2869 1.70± 0.5033	-2.8962**	1.56 ± 0.3373 2.43 ± 0.8705	- 2.9642**	2.07 ± 0.5229 2.87 ± 0.8602	- 2.5133*
2	A.a - A.n	1.17 ± 0.2869 1.70 ± 0.4898	-2.9543**	1.56 ± 0.3373 2.40 ± 0.6847	- 3.4783**	2.07 ± 0.5229 2.74 ± 0.7026	- 2.4196*
3	A.a - A. s	1.17 ± 0.2869 0.74 ± 0.6586	1.9809*	1.56 ± 0.3373 1.21 ± 0.6539	1.5039^{ns}	2.07 ± 0.5229 1.54 ± 0.6040	2.0982*
4	A .l - A.n	1.70 ± 0.5033 1.70 ± 0.4898	0^{ns}	2.43 ± 0.8705 2.40 ± 0.6847	0.0856^{ns}	2.87 ± 0.8602 2.74 ± 0.7026	0.3701^{ns}
5	A .l - A.s	1.70 ± 0.5033 0.74 ± 0.6586	3.9738**	2.43 ± 0.8705 1.21 ± 0.6539	3.5424**	2.87 ± 0.8602 1.54 ± 0.6040	4.0012**
6	A.n - A.s	1.70 ± 0.4898 0.74 ± 0.6586	3.6980**	2.40 ± 0.6847 1.21 ± 0.6539	3.9733**	2.74 ± 0.7026 1.54 ± 0.6040	4.0942**

* = 5 % significant level A. a = *Acacia auriculiformis*A. n = *Acacia nilotica*
** = 1 % significant level A. l = *Acacia Leucophlaea* A. s = *Acacia sundra*
ns = non significant

Figure 2. Recovery Barks of four*Acacia* species
A.*Acacia auriculiformis* A. Cunn. B.*Acacia leucophloea* (Roxb.) Willd.
C.*Acacia nilotica* (L.) Delile, D.*Acacia sundra* DC.

Discussion and Conclusion

In this research, four species of genus*Acacias*howed thatbrownish yellow color of outer barkfound in*Acacia leucophloea* (Roxb.)Willd., and*Acacia sundra* DC. are brownish gray in color. The rest other two species areblackish grey in color. The surfaces of the bark are longitudinal fissure and cross cracks pattern observed in all species. Shed outer bark was varying in shaped of studied species. *Acacia nilotica* (L.) Delile. hassweet smell and taste in bark while *Acacia auriculiformis* A. Cunn. hasunpleasant odor. The other two species are indistinct in odor and taste. Besides, the exudates of sticky resin and sap found in all species except in *Acacia auriculiformis* A. Cunn.It is no exudation in bark (Table 1).According to the present results, bark morphology are useful for an identification of genus *Acacia*.

The recovery ability of bark in the studied four species was not found in 3 months for the present study. But rate of recovery barks length and thickness were observed in6, 9 and 12 month for all studied species. The highest rate of recovery ability in the length and thickness was found in *Acacia leucophloea* (Roxb.) Willd. and the lowest rate observed in *Acacia sundra* DC.(Fagure 3,4).

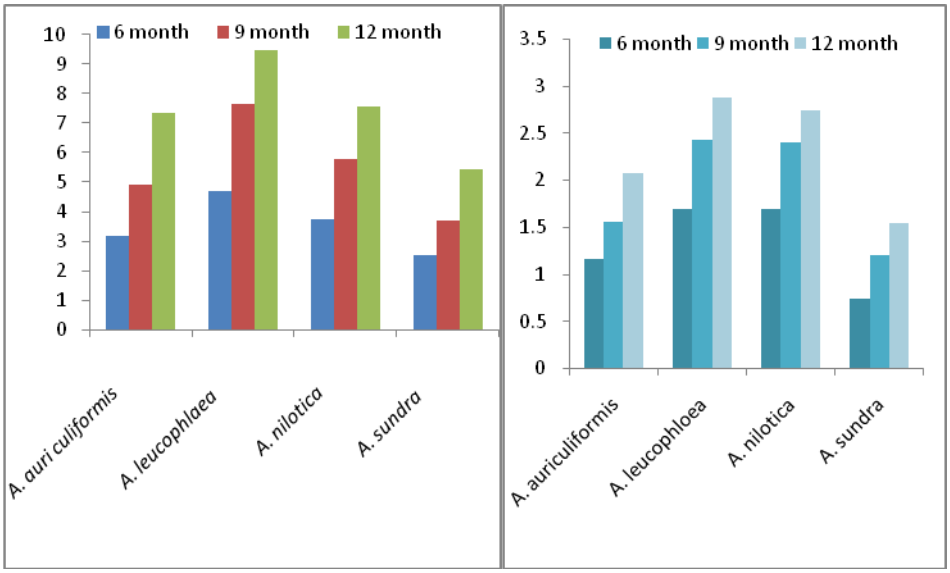

Figure 3. Comparison on mean length Figure 4. Comparison on mean thickness
of recovery barks in four *Acacia* species of recovery barks of four *Acacia* specie

Acacia auriculiformis A. Cunn. and *Acacia nilotica* (L.) Delile.showed non significant level in length of recovery bark (Table 2). These results indicated that the largest bark thickness may be supported to rapid rate of recovery ability of bark because the largest thickness bark found in *Acacia leucophloea* (Roxb.) Willd.. Ravn and Jensen, (1999) stated that the recovery rate are depend on log dimension. An addition, it has been shown in many researches that the log dimension has a strong effect on recovery rate.The bigger the diameter size is, the higher the recovery rate is.

Log size of the same class or group also increased the recovery with an increase in diameter (Yang *et.al*., 2007).Thus, the present results of recovery rate were similar with the data of Ravn and Jensen(1999) and Yang *et.al*.(2007)The presentstudy willpartially fulfill the requirement of information on bark morphology and recovery rate of bark in genus *Acacia.*

Acknowledgement

I would like to thinks to Dr. Lai Lai Thaung, Professor and Head, Department of Botany,Mandalay University of Distance Education, for her help, guidance and advice in this researchand Dr. Khin Swe Lai Professor (Retired) Mandalay University of Distance Education, for their invaluable suggestion and guidance.

References

1. Cronquist, Arther., 1988. The evolution and classification of Flowering Plants, 2nd edition. The Newyork, Botanical Garden, Bronx Newyork. USA.
2. Harlow, W. M.,Harrar and White, 1978. Text Book of Dendrology; McGraw Hill Book Company, New York, London.
3. Harkin John M., and John W. Rowe, 1969. Bark and it Possible Uses; Forest Service Forest Product Laboratory, Madison, WIS.
4. Hooker J. D., 1879. Flora of British India. Vol. I. Reeve and Co. Ltd. London.
5. Hundley, H. G & Chit Ko Ko; 1961. List of Trees, Shrubs, Herbs and principle climber of Burma. Supt. Grovt. Print and staty. Rangoon
6. Junikka L.,1994.Survey of Englishmacroscopic bark terminology. *IAWABull.n.s.*15; 3-45.
7. Panshin, A.J.E.S.Harrar, W.J.Baker,P.B.Proctor., 1950. Forest Products Their Sources, Production and Utilization; McGraw Hill Book Company, INC, New York, London.
8. Ravan,B.M.,Jensen.A.,1999.Processing of forest residues and small dimension logs. Technical Reports Volume 1. Pp.94-213.Kuala Lumpur,Forest Department Peninsular Malaysia.
9. Seeber, G.H.J.Weidelt, V.S.Banaag.,1979. Dendrological Chracters of important Forest Trees From Eastern Mindanao.
10. Steel G.D Robert,Jame H.Torrie,1960. Principles and procedures of statistic,McGraw Hill Book Company, INC, New York, London.
11. Trockenbrott, M., 1990. Survey of Discussion of the Terminology Used in Bark Anatomy. *IAWA Bull*. n.s. 11; 141-166.
12. Yang,I,S.Y.Lee,R.W.Joo and Y.C.Youn,2007.Factor affecting lumber conversion rate of sawmill industry in South Korea. J. Korea Forest Soc., 96; 197-202.