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Comparative Analysis of Bark Characteristics in Bijasal (Pterocarpus Marsupium)

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ABSTRACT

Pterocarpus marsupium Roxb. is a valuable multipurpose forest tree in India and Sri Lanka, popularly known as Bijasal because of its high-quality wood and pharmaceutically bioactive compound, especially from the stem bark and heartwood. Bark type is an important feature for characterization of Pterocarpus species, which varies according to its locations. Therefore, bark characteristics variation study was conducted in two states viz., Gujarat (GJ) and Maharashtra (MH) which were selected purposively as the site known for its abundantly presence; the different five places of each state were used as locations depending on the available resources. In P. marsupium, mostly rough bark was observed in all locations, except GJ-PM-4 and MH-PM-1 in which the bark texture was smooth, but in MH-PM-1 the rough bark was found at lower part of tree stem; in GJ-PM-4 and GJ-PM-3 trees the bark was fissures and cracks; whereas in MH-PM-5, special feature of bark was observed that the bark was rough and exfoliation without exudates to no-exfoliation with equal cracks; the vertical fissured bark was mostly observed in all locations of P. marsupium except GJ-PM-4 and GJ- PM-5. The bark colour mostly varied from light brown to blackish brown in all location's trees, except in GJ-PM-3, GJ-PM-4, GJ-PM-3 and MH-PM-5 in which the bark colour was yellowish brown; the bark flakes pattern varied from regular to irregular in all locations; while flakes shape was varied from no flakes to strips, square and rectangular, whereas in GJ-PM-3 the inverted flakes was recorded; while in the barks of location MH-PM-3 had lunar shape flakes with irregular type.

INTRODUCTION

The genus *Pterocarpus* belongs to the subfamily - Papilionoideae of Fabaceae in the order Leguminosae (Gupta, 1969). The genus name was given as *Pterocarpus* by Linnaeus in 1754. The genus *Pterocarpus* comprises five species *viz*., *Pterocarpus marsupium* , Roxb.; *P. santalinus* Linn.; *P. dalbergioides*, Roxb.; *P. macrocarpus*, Kurz and *P. indicus*, Wild (Troup, 1921a). The genus *Pterocarpus* is important to the forester because it contains some very valuable trees and is recognizable by its ovoid, wrinkled, or spherical winged one-seeded fruits. There was different information about the number of species of the genus *Pterocarpus*. This genus is known to include 60 - 70 species (Allen and Allen, 1981), 15

species (Hooker, 1879; Brandis, 1907) or 35 species (CD-ROM, FRI, Yezin) occurring in the tropics and subtropics of both hemispheres and that 5 species occur in India (Gamble, 1922; Troup, 1921b; Pearson and Brown,

1932 and Anonymous, 1962). Hundley and Chit (1987) listed 3 species growing in Myanmar. Within the genus, some *Pterocarpus* species are rosewood tree species that are highly valued for their high- quality wood and whose dark red, high - grade heartwood is of great economic value for the production of fine furniture, traditional medicine and handicrafts such as musical instruments. The growth rate is relatively slow, they have been overexploited, and in some cases the timber and medicinal value could also be driven to extinction (Waeber *et al*., 2019). *P. marsupium* Roxb. is a valuable multipurpose forest tree in India and Sri Lanka, popularly known as Bijasal because of its high-quality wood and pharmaceutically bioactive compounds, especially from the stem bark and heartwood. It is native to India, Nepal, and Sri Lanka, where it occurs in parts of the Western Ghats (Gamble, 1935 and Matthew, 1983). The kino tree (*Pterocarpus marsupium*) is a medium to large deciduous tree that occurs at altitudes of 200 to 500 m. The species' current population is declining in the wild, which is listed as Near Threatened in the IUCN Red Book. It is an excellent timber tree species and ranks alongside teak and rosewood in Peninsular India. It is exploited for its wood and medicinal bark (Ramya *et al*., 2008). For the latter, the plant may be felled or its bark removed (Abirami *et al*., 2012). Its wood is often compared to teak and has received less attention for extensive cultivation and native stands are rapidly disappearing despite being little known to forester's worldwide and little trialed in plantations. *P. marsupium*, a tree with timber value, is less well known to farmers. To protect and conserve the Indian kino tree, it should be planted under various afforestation and reforestation programmes (Sukhadiya *et al*., 2019). *P. marsupium* has long been used in India to treat diabetes and the gum of the tree contains the astringent "kino". *P. marsupium* which occurs in India, are commercially important timber tree which are in demand in the international market. Since, this species falls into the "near threatened" category, it should be conserved and used sustainably to prevent further depletion.

2. MATERIALS AND METHODS

The survey was conducted during 2021-2022 for bark characteristics variation study of *P. marsupium* in two states, namely Gujarat (GJ) and Maharashtra (MH). The five trees per replication per treatment which had more than 25.00 cm diameter at breast height were randomly selected from purposively selected locations known for its abundantly presence or cultivation; the different five sites of each state were used as locations depending on the available resources. The locations of *P. marsupium* from Gujarat were named as GJ-PM-1, GJ-PM-2, GJ-PM-3, GJ-PM-4 and GJ-PM-5, whereas in Maharashtra it was named as MH-PM-1, MH-PM-2, MH-PM-3, MS-PM-4

and MH-PM-5 (Table - 1). Amultistage random sampling method was used to select the trees and the corresponding data were collected in the field. Bark thickness and other characteristics of randomly selected trees were measured at field. Bark thickness of randomly selected trees in different locations was measured horizontally at the four points (evenly spaced or where the caliper arms contact the bole) in the tree by using bark gauge at breast height and expressed in centimeters (cm). Bark is a type of tissue that grows over a tree's wood. It has both an inner and outer layer. The inner layer is living tissue, and the outer layer is dead tissue. Bark types can be identified as smooth, rough, elongated plate like scales, rectangular/ square plate like scales, longitudinally fissured, puffy ridges and deep furrows, shallow ridges and shallow furrows. Bark types of randomly selected trees from different locations was categorized as per above category by ocular method. Bark colour of randomly selected trees from different locations was categorized as brown, whitish-brown, yellowish- brown, reddish-brown, blackish-brown and black by colour chart. The observations were recorded and processed for statistical analysis by using complete randomized block design and two sample t-test. The recorded data were presented in table and interference was drawn.

3. RESULT AND DISCUSSION

Bark thickness (cm)

Table 3: Comparison of bark thickness (cm) in *P. marsupium* at two locations

marsupium in different locations varied significantly within Gujarat (GJ) & Maharashtra (MH). However, in case of bark thickness variation between two locations, it showed non-significant variation between two locations. In case of bark thickness

variation of *P. marsupium* within GJ locations, maximum bark thickness was recorded in GJ-PM-4 (2.38 cm), followed by GJ-PM-1 (2.20 cm) which was at par with GJ-PM-2 (2.18 cm). Whereas minimum bark thickness was noted in GJ-PM-5 (1.66 cm). Moreover, in case of MH locations, maximum bark thickness was registered in MH-PM-3 (2.18 cm), at par with MH -PM-2, MH-PM-5 and MH-PM-1. The minimum was recorded in MH-PM-4 (1.60 cm). Moreover, irrespective of all locations, maximum bark thickness was observed in GJ-PM-

Table 1: Location details of study area

Location No.	Location Code	Location	Latitude	Longitude
Gujarat (GJ) locations				
1	GJ-PM-1	Navasri Agricultural University, Campus, Gujarat	20O55'18.50"N	72O5'19.53"E
2	GJ-PM-2	Farmer's Field, Sunthwad, Gujarat	20O49'53.10"N	73O5'45.61"E
3	GJ-PM-3	Panas Medicinal Garden Kaparada, Gujarat	20O25'3.78"N	73O8'56.88"E
4	GJ-PM-4	Waghai Botanical Garden, Waghai, Gujarat	20O27'5.67"N	73O18'6.48"E
5	GJ-PM-5	Vishalkhadi Forest Range, Rajpipala Road, Gujarat	21O44'41.74"N	73O29'16.72"E
Maharashtra (MH) locations				
6	MH-PM-1	Pindkepar Forest Range, Sakoli, Maharashtra	21O21'7.47"N	80O0'10.77"E
7	MH-PM-2	Papala Khurd Forest Range, Sakoli, Maharashtra	21O5'1.06"N	80O0'15.55"E
8	MH-PM-3	Bolde Forest Range, Sakoli, Maharashtra	20O59'4.02"N	80O3'47.75"E
9	MH-PM-4	Bortekadi Forest Range, Gondia, Maharashtra	20O50'30.40"N	80O6'3.14"E
10	MH-PM-5	Kawatha-4, Pratapgad Forest Range, Gondia, Maharashtra	20O48'13.71"N	80O7'28.06"E

Table 2

Bark thickness (cm) Table 2: Variation in bark thickness (cm) among different locations of *P. marsupium*			
Location	**GJ**	**Location**	**MH**
GJ-PM-1	2.20ab	MH-PM-1	2.02a
GJ-PM-2	2.18ab	MH -PM-2	2.16a
GJ-PM-3	1.88bc	MH -PM-3	2.18a
GJ-PM-4	2.38a	MH -PM-4	1.60b
GJ-PM-5	1.66c	MH -PM-5	2.06a
S.Em. ±	0.20	S.Em. ±	0.15
C.D. at 5%	0.42	C.D. at 5 %	0.30
C.V. %	15.56	C.V. %	11.49

Table 3

Parameter	Bark thickness (cm)	
	GJ	MH
Mean (cm)	2.00	2.00
Range (cm)	1.40 - 2.90	
t - test	0.57	
P(T< t)	0.574	

4 (2.38 cm), followed by GJ-PM-1 (2.20 cm), whereas the minimum bark thickness was found in MH-PM-4 (1.60 cm) (Table 2). While, the bark thickness of *P. marsupium* was varied from 1.40 to 2.90 cm (Table 3).

Bark characteristics

The bark type is an important feature for characterization of *Pterocarpus* species, which varies according to its location. The various features were considered to study the variation in bark characteristics of *P. marsupium* at different locations and data are presented in Table - 4 and showed in Photo - 1. The vast variation in the bark characteristics was found among different locations. The rough type of bark was mostly observed in all locations; except GJ-PM-4 and MH-PM-1 in which the bark texture was smooth, but in MH-PM-1 the rough bark was found at lower part of tree stem. The bark of location's GJ- PM- 4 and GJ- PM- 3 t rees was f i ssures and cracks were not observed. In MH-PM-5 location, special feature of bark was noticed which was the barks were rough and exfoliation without exudates to no- exfoliation with equal cracks. Vertical fissured bark was mostly observed in all locations except GJ- PM-4 and GJ-PM-5. Most of the location's trees had shallow cracks except GJ-PM-3 and MH-PM-2. The bark colour mostly varied from light brown to blackish brown in all location's trees, except in GJ-PM-3, GJ-PM-4, GJ-PM-3 and MH-PM-5 in which the bark colour was yellowish brown. The bark flakes pattern varied from regular to irregular in all locations; while flakes shape was varied from no flakes to strips, square

Table 4

Characteristic		Gujarat					Maharashtra				
Shape		Strips & square	Strips &	Inverted flakes	No flakes	Irregu-lar to	Rectan-gular & Irregular	Rectan-gular & Irregular	Lunar shape &	Square &	Strips
Pattern		Regular	Regular	Irregular	–	Irregu-lar	Regular & irregular	Regular unequal sized	Irregular	Regu-lar	Regular
Colour		Light & blackish brown	Light & greyish brown	Light, yellowish & greyish brown	Light, yellow-ish & dark brown	Yellow-ish & dark brown	Dark, greyish & blackish brown	Light, greyish & blackish brown	Blackish brown & black	Light-ish brown	Yellowish, greyish & blackish brown
Cracks	Deep	-	-	+	-	-	-	+	-	-	-
	Shallow	+	+	-	-	+	+	-	+	+	+
Fissured	Vertical	+	+	+	-	-	+	+	+	+	+
	Hori-zontal	-	-	+	-	+	-	-	-	-	-
Texture/Fissure		Rough, corky & narrow splits	Rough, broad strips & cracks	Rough & narrow cracks to no fissures & cracks	Smooth, no fis-sures & cracks	Rough & very corky	Smooth at middle height & Rough at	Rough & corky	Rough & split not promi-nent	Rough & equal split	Rough & exfo-liation without exudates
Locations		GJ-PM-1	GJ-PM-2	GJ-PM-3	GJ-PM-4	GJ-PM-5	MH-PM-1	MH-PM-2	MH-PM-3	MH-PM-4	MH-PM-5

and rectangular. In GJ- PM-4 location, flakes were not observed in the bark and whereas in GJ-PM-3 the inverted flakes were recorded. Moreover, the barks of MH-PM-3 location had lunar shape flakes with irregular type. These variations in bark type can serve as important diagnostic characteristics for species identification. *P. marsupium* exhibited various bark types, including smooth, rough, elongated plate-like scales, and rectangular/square plate-like scales. The references by Pratikshya (2021) and Sukhadiya *et al.* (2019) confirm the presence of longitudinally fissured bark in *P. marsupium*. Pratikshya (2021) and Reddy (2018) provide consistent information regarding the thick, dark brown to grey colour of *P. marsupium* bark. This confirmed our results recorded in present investigation.

4. CONCLUSION

The analysis of bark thickness of *P. marsupium* in various locations revealed significant variability among different locations of Gujarat and Maharashtra while it showed non-significant variation between two locations. Bark thickness ranged from 1.40 to 2.90 cm, with notable differences between locations in Gujarat (GJ) and Maharashtra (MH). GJ-PM-4 exhibited the maximum bark thickness, while MH-PM-4 had the minimum. Notably, some locations displayed unique features, such as smooth bark in GJ-PM-4 and MH- PM-1, while MH-PM-5 exhibited a distinctive rough bark with exfoliation but no exudates. The bark colour mostly varied from light brown to blackish brown and yellowish brown. These variations underscore the importance of considering the geographical origin of *P. marsupium* when assessing its bark characteristics.

This variability in bark attributes, including roughness, texture, fissures, colour and flake patterns, provides valuable diagnostic characteristics for the identification of *P. marsupium*. This investigation and further emphasize the significance of bark attributes as a key factor in species identification.

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Figure 1: Photo 1: Variation in bark characteristics of P. marsupium at different locations 1. Navsari (GJ), 2. Sunthwad (GJ), 3. Panas (GJ), 4. Waghai (GJ). 5. Vishalkhadi (GJ), 6. Pindkepar (MH), 7. Papala Khurd (MH), 8. Bolde (MH), 9. Bortekadi (MH), 10. Pratapgad (MH)

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