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# Influence of Type and Depth of Bark Incision on Gum Yield and Bark Recovery in *Lannea coromandelica*

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***Abstract***: Gum tapping from forest trees played a vital role in supporting both rural livelihoods and a multiple of industries in India. *Lannea coromandelica* produces commercial gum called *Jhingan* and is commonly found in the moist and dry deciduous forests. In order to explore and understand how different methods of making cuts in the bark as well as varying cut depths on gum yield and bark recovery in *L. coromandelica,* a field study was conducted at Sirsi, Karnataka. Healthy trees were selected for the experiment and each was subjected to four types of bark incisions like notch, vertical, horizontal and slant cut, with four different depths: 0.5, 0.75, 1.0, and 1.5 cm. The horizontal cuts led to the highest gum yield (1520.7 g/m²), closely followed by notch cuts (1423.6 g/m²). In contrast, vertical and slant cuts produced significantly less gum yield. This species bark is thicker, hence deeper cuts, especially those at 1.5 cm, gave the highest gum output (1653.6 g/m²) with faster bark recovery (72%). The vertical and horizontal incisions allowed the best bark recovery (70% and 69%, respectively); while shallowest depth (*i.e.,* 0.5 cm and 1.0 cm) showed the lowest bark regeneration rate (<50%). These findings suggest that while deeper, horizontally placed cuts in *L. coromandelica* can maximize gum extraction, and also increases the risk of long-term damage to the tree.

***Keywords***: Bark incision, Bark recovery, Gum yield, Jhingan, *Lannea coromandelica*

India is one of the world's top exporters of natural gums and resins, exporting goods worth USD 127 million in 2022 and USD 89 million in 2023 under HS Code 1301. However, despite this, the country imported nearly USD 241 million worth in 2023 alone, mostly from countries like Afghanistan, Indonesia, and Mali (Anon 2024). This mismatch highlights the need to boost domestic production, improve quality standards, and build stronger value chains.

The gum trade depends heavily on the species like *Anogeissus latifolia* (Gum Ghatii) and *Sterculia urens* (Gum Karaya), however, others like gums from *Acacia senegal*, *Boswellia serrata*, *Commiphora wightii* and *Lannea coromandelica* also contribute significantly to total gum production (Ramawat et al 2014, Sinha et al 2021). For many forest-based communities, gum collection is more than a livelihood therefore, programs like the minimum support price for NTFPs and TRIFED's Van Dhan Yojana have been introduced to support these communities by promoting fair trade and sustainable practices (ICAR 2021, Volza 2024). Improved tapping techniques raised the price of gum in gum karaya from ₹30 to ₹125 per kilogram (FAO 2021). Despite of these efforts, traditional tapping methods are often inefficient and can harm trees. Elements such as cut design, depth, season, tree size, and even chemical stimulants like ethephon all influence how much gum a tree produces and how well it recovers afterward (Nayak and Prajapati 2020).

*Lannea coromandelica* (Houtt.) Merr. is a lesser-explored but promising gum yielding species distributed in deciduous forests and can grow up to 24 meters height. It is commonly found throughout India and the Andaman Islands, especially in dry deciduous forests and hilly areas up to 1,500 meters above sea level. This tree is known for producing Jhingan gum during the dry season from March until the onset of monsoon (Vasishth 2017). *Jhingan* gum is used in a wide range of applications from textile sizing and ink production to varnishes, plastering, and even clarifying sugarcane juice, where its performance rivals' synthetic agents like Lytron-X 886 (Nayak and Prajapati 2020). Unfortunately, current harvesting methods often lead to low yields and stress the trees. Factors like tapping depth, method, tree age, and use of stimulants all play a role in determining both productivity and long-term sustainability (Nayak and Prajapati 2020, Dhaka et al., 2017, Sinha et al., 2021). Current practices of bark harvesting from wild populations which include girdling, bark stripping from large portion of trunk/branches or chopping off trees, followed in India are largely unsustainable (Pandey and Mandal 2012). While harvesting or damaging bark, it is essential to consider how a tree species recovers from the wound made by blazing in order to develop species-specific bark harvesting systems and parameters such as strip geometry, rotation period, age of the tree (diameter of trees), and proportion of individuals subjected to bark harvesting in a population as key parameters to be considered while developing sustainable bark harvesting and conservation including population status and genetic diversity of a species (Pandey and Mandal 2012, Hanumantha 2020, Hanumantha and Vasudeva 2022, Thakur et al., 2023). The forests face growing pressure from human activity and over extraction, species like *Lannea coromandelica* are at risk. This makes it all the more urgent to adopt standardized, tree-friendly tapping practices that align with broader goals of conservation, sustainable forest use and rural development (FAO 2021, ICAR 2021). With this backdrop, the present investigation was carried out to understand the influence of incision (cut) type and its depth on gum production, bark recovery and pest and disease occurrence in *L. coromandelica*.

## MATERIAL AND METHODS

The study was conducted near Banavasi Road, Sirsi, Uttara Kannada district of Karnataka, India. The study area belongs to the geocoordinates- latitude of 14°36"17.10" N and longitude of 74°51'05.19" E with altitude of 613 m above mean sea level. Climatologically, the area receives a mean annual rainfall of approximately 3000 mm, with average temperatures ranging from 20 to 33°C. The region is characterized by lateritic soils and undulating topography with an average elevation of 500 meters above sea level.

Out of fifty *Lannea coromandelica* trees marked in the field, ten healthy trees of similar size class and free from pests and diseases were selected for the gum tapping experiment. Four different tapping methods and four different incision depths were implemented to evaluate their effects on gum yield. The treatments were replicated across trees. Gum was collected once every 15 days and total gum production was calculated per square meter following the protocol described by Prasad et al (2016). On every visit, per cent bark recovery was visually scored for per cent bark regeneration and photographic evidence was taken. After incision, observations of insect/pest attack if any on cut position was also noted (Hanumantha and Vasudeva 2022). Tree growth parameters such as height (7.0-12.0 m), girth (47.0-160.0 cm), bole height (1.7 to 5.0 m) and crown width (3.7-7.0 m), were recorded in the marked trees (Table 1).

### Tapping Methods

**Type of incision:** To assess the effect of different tapping methods on gum yield, four types of incisions *viz.,* notch cut (conventional method), vertical cut, horizontal cut and slant cut, were applied on five trees. Before making the cuts, dead bark was removed (10 cm² area) from four different sides of each tree trunk, one for each cut type. Five treatments were imposed on the standing trees, which included $T_1$- Notch method: 10 notches,$T_2$ - Vertical cut: 5 vertical lines, $T_3$ - Horizontal cut: 5 horizontal lines. $T_4$ - Slant cut: 5- Slanted lines (Plate 1).

**Depth of incision (cut):** To study the effect of different incision depths on gum yield, five trees were selected during the June–September period. Dead bark (10 cm²) was removed from four different sides of the trunk, and incisions of varying depths 0.5 cm ($D_1$), 0.75 cm ($D_2$), 1.0 cm ($D_3$), and 1.5 cm ($D_4$) were made on the cleared bark areas.

The gum exudates were collected at 15-day intervals from both (type and depth of cut) the treatments. Later collected gum is processed, dried, weighed, and expressed in g/m².

**Bark recovery:** After implementing treatments on selected tree bark recovery (regeneration) was recorded in response to different tapping methods and depths after four months.

**Statistical analysis:** The collected data were subjected to one-way analysis using a completely randomized design (CRD). Mean values of gum yield and bark recovery were compared at P< 0.05 significance level by using critical difference (values calculated for each parameter. OPSTAT software was used for statistical computation and result interpretation (Sheoran et al., 1998).

## RESULTS AND DISCUSSION

**Influence of type of incision on gum yield and bark recovery:** Among the various types of incisions/cuts (Plate 1), the highest gum yield was recorded in the horizontal cut (1520.70 g/m²), followed by the notch cut and it was the least in vertical cut (795.2 g/m²). The yield from the horizontal cut from the notch cut did not differ significantly between vertical and slant cuts (Table 2). Hence for production of more gum in *Lannea cormoandelica,* horizontal or notch cuts would be best as compared to slant and vertical cut. Prasad et al (2081) also reported higher gum yield in the notch cut (1033.36 g/m²) for *Butea monosperma*. The superior performance of horizontal cuts is likely due to the orientation and better exposure of gum canals along the cambial layer in *Lannea coromandelica* and enhanced exposure facilitates greater exudation. Even tapping direction in plants

**Table 1.** Biometric attributes of selected standing trees of *Lannea coromandelica*

| Tree code | Height (m) | Girth (cm) | Clear bole height (m) | Crown width (m) |
|---|---|---|---|---|
| LL-1 | 10.0 | 160.0 | 2.0 | 5.0 |
| LL-2 | 9.0 | 68.0 | 3.5 | 4.0 |
| LL-3 | 10.0 | 97.0 | 1.7 | 7.0 |
| LL-4 | 10.5 | 70.0 | 5.0 | 7.0 |
| LL-5 | 12.0 | 65.0 | 3.0 | 6.0 |
| LL-6 | 10.0 | 95.0 | 3.0 | 4.5 |
| LL-7 | 10.5 | 110.0 | 2.5 | 6.5 |
| LL-8 | 7.0 | 47.0 | 1.5 | 3.7 |
| LL-9 | 7.5 | 55.0 | 4.0 | 4.0 |
| LL-10 | 8.5 | 68.0 | 2.5 | 3.7 |

concerning sunlight is a very important factor in gum yielding. Adam et al. (2009) reported the effect of direction of the wound on gum production in *Accacia senegal*. The study revealed that the gum yield was increased to 60 per cent when the taping was in eastern and western site towards direct sunlight, as because these two sites receive the maximum amount of sunshine which help in rapid drying of the exudates accompanied by the high temperature facilitating high gum production. Gessmalla et al. (2015) on *Boswellia papyrifera* also confirmed the suitability of eastern and western sides for tapping the maximum amount of gum. Along with the side direction, tapping position also had a valuable impact on the production of gum. The different position of tapping on *Acacia seyal* leads to different production of gum. The tapping on the higher stem and upper branches causes lower production of gum than the middle and lower stem of the plant (Kamal et al., 2004).

Significant variation for recovery of bark was observed among different types of incision. The highest bark recovery was n vertical cuts (70%), followed by horizontal. However, t was slow in notch (38%), and slant cuts (37%) (Table 2). Bark recovery for vertical and horizontal incision was significantly higher than for notch and slant cuts. Pandey et al. (2011) also observed 48 per cent bark recovery in strip bark harvesting in *Holarrhena antidysenterica*. Higher recovery in vertical and horizontal methods may be attributed to clean incision that minimize the cambial damage, thus, promoting faster bark regeneration (Hanumantha 2020, Sinha et al., 2022).

**Influence of depth of incision (cut) on gum yield and bark recovery:** Significant variation in gum yield among different depths studied was where maximum gum yield was recorded in the 1.5 cm deep cut (1653.6 g/m²), followed by 1.0 and 0.75 cm depth and was the least in 0.5 cm depth incision (683.6 g/m²) (Table 3). The bark thickness varies in different species, where thickness of the bark to be considered was 1.5 to 2 cm to make wounds on gum canals cut/incision for longer depths in *Lannea coromandelica*, since 1.5 cm deep incision resulted in higher gum yield. Vasishth (2017) also reported maximum gum yield in 5 cm borehole tapping during summer in *Lannea coromandelica*. The increased yield in the 1.5 cm cut may be attributed to penetration beyond the bark's surface into gum ducts, enhancing gum exudation. However, sustainability must be weighed against potential damage to tree health. Prasad et al. (2016) conducted similar work in *Butea monosperma* and reported that the maximum gum yield occurred in 1.0 cm deep cut (31.06 g/m$^2$) than 0.5 cm and 1.5 cm deep cuts (22.06 g/m$^2$ and 25.21 g/m$^2$, respectively). The variation in gum yield between these two species could mainly attributed to the thickness of the bark. The recovery of bark, it varied significantly among different depths of incision/cut. The highest bark recovery was noted in the $D_4$ treatment where incision was made up to 1.5 cm depth (72%), followed by $D_3$ *i.e.,* 1.0 cm depth incision (71%), however, slow recovery was observed in $D_2$ (42.69%) and $D_1$ (47%) (Table 3). Pandey and Mandal (2012) reported about

**Table 2.** Influence of different type of cuts on gum yield and bark recovery in *L. coromandelica*

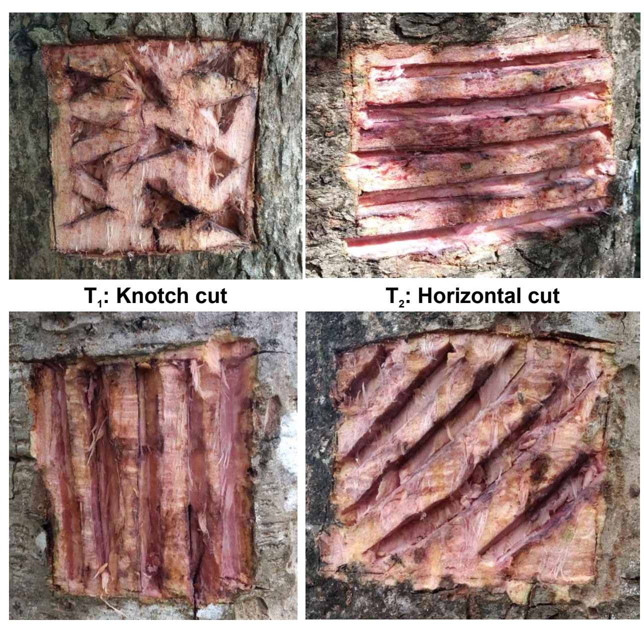
| Treatment-Type of Incision | Gum yield (g/m²) | Bark recovery (%) |
|---|---|---|
| $T_1$ – Notch cut | 1423.60 | 38.00 (38.02) |
| $T_2$ – Vertical cut | 795.20 | 70.00 (56.94) |
| $T_3$ – Horizontal cut | 1520.70 | 69.00 (56.36) |
| $T_4$ – Slant cut | 900.30 | 37.00 (37.42) |
| | | 2.04 |
| CD (p=0.05) | 110.56 | 6.18 |
| CV (%) | 35.24 | 9.69 |

*Values in parentheses are arc sine-transformed values

**Table 3.** Influence of different depth of incision (cut) on gum yield and bark recovery in *Lannea coromandelica*

| Treatment-Depth of incision | Gum yield (g/m²) | Bark recovery (%) |
|---|---|---|
| $D_1$ – 0.5 cm | 683.60 | 47.00 (43.27) |
| $D_2$ – 0.75 cm | 804.60 | 46.00 (42.69) |
| $D_3$ – 1.0 cm | 1435.94 | 71.00 (57.59) |
| $D_4$ – 1.5 cm | 1653.60 | 72.00 (58.15) |
| CD (p=0.05) | 58.89 | 5.46 |
| CV (%) | 19.03 | 8.01 |

Parentheses are arc sine-transformed values



**$T_1$: Knotch cut** **$T_2$: Horizontal cut**

**$T_3$: Vertical cut** **$T_4$: Slant cut**

**Plate 1.** Different types of incisions/cuts applied on *Lannea coromandelica* trees for gum production

38 per cent bark recovery in strip bark harvesting method in *Terminalia arjuna* using shallow incisions.

Many authors reported that several factors such as type and width of the cut, humidity, anatomical features, *etc* may have influence on the recovery of bark. Hanumantha and Vasudeva (2022) reported maximum bark recovery (51.01%) in narrow patches (25×6 cm) than broader patches (10×15 cm) with 41.11 per cent bark recovery in *Cinnamomum zeylanicum* after 12 months. Maintenance of higher humidity of the exposed surface is the single most important factor that enhances the bark recovery (Juan et al 2006). Since the narrower strips have larger perimeter, the number of living cells in the xylem that contribute towards wound closure would be higher than in the broader strips and longitudinal strips with only outer and middle bark should be removed without damaging the inner bark for quicker regeneration (Pandey 2015). However, the anatomical details of bark regeneration in *Lannea coromanelica* are still unclear.

## CONCLUSION

Study concludes that incision types and depth of cut influences the gum flow and gum production in *L. coromanelica*. The study suggested to follow horizontal cuts at a depth of around 1.0-1.5 cm for obtaining maximum gum yield and faster recovery of bark in view of sustainable yield and long-term tree health. Moving forward, research should also explore seasonal effects, physiological responses over time, and the economic aspects of tapping in this species.

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