

# MUNGONGO TREE, VÝZNAMNÝ STROM LESŮ JIŽNÍ A ZÁPADNÍ ZAMBIE A JEHO VYUŽITÍ

## THE MUNGONGO TREE, AN IMPORTANT TREE OF THE DRY FORESTS IN SOUTHERN AND WESTERN ZAMBIA AND UTILIZATION

Lukáš Karas<sup>1</sup> , Kamila Hejlíková<sup>1</sup> 

<sup>1</sup> Ústav lesnické botaniky, dendrologie a geobioceonologie, Lesnická a dřevařská fakulta, Mendelova univerzita v Brně, Zemědělská 3, 613 00 Brno, Česká republika

### Abstrakt

*Schinziophyton rautanenii* (Euphorbiaceae) patří mezi jeden z nejdůležitějších zdrojů potravy v jižní Africe, nejen pro divokou zvěř, ale také pro místní obyvatele. Především venkovské obyvatelstvo je závislé na sběru ořechů, které následně často využívají jako hlavní zdroj potravy, dodávající potřebnou výživu. Kromě toho má tento strom potenciál jak v potravinářství, tak i v kosmetice (při výrobě kvalitního oleje). Produkty z plodů mohou přispět k rozvoji venkovského obyvatelstva v jižní Africe. Je však třeba zdůraznit, že stromy jsou krátkověké a regenerace je nízká. Proto se náš výzkumný tým zaměřuje i na zjištění nejlepšího procesu, jak rychle vyklíčit semena a vypěstovat sazenice pro obnovu porostů v rámci udržitelného managementu krajiny.

**Klíčová slova:** *Mongongo*, *Mungongo*, *Manketti tree*, Euphorbiaceae, ochrana, využití

### Abstract

*Schinziophyton rautanenii* (Euphorbiaceae) is one of the most crucial food sources in southern Africa, not only for wildlife but also for local residents. Especially in rural areas, people rely on collecting nuts, which they often use as their primary food source, providing essential nutrition. Additionally, this tree has potential applications in both the food industry and cosmetics (for producing high-quality oil). Products derived from its fruits can contribute to the development of rural communities in southern Africa. However, it's important to note that these trees are short-lived, and natural regeneration is low. Therefore, our research team is focused on finding the best process for fast seed germination and seedling production to regenerate local stands as a part sustainable landscape management.

**Keywords:** *Mongongo*, *Mungongo*, *Manketti tree*, Euphorbiaceae, protection, utilization

## INTRODUCTION

*Schinziophyton rautanenii*, known locally as mungongo, mongongo, manketti, booma, or siobumbui, belongs to the family Euphorbiaceae. Originally described under the basionym *Ricinodendron rautanenii* by Dinter in 1885, this tree is well-known among the people of southern Africa and has been utilized for at least since the Holocene era. Archaeological evidence reveals that traditional tools used for cracking the hard kernels of the nuts date back 12,000 years (Robbins *et al.*, 1990). Remarkably, these same traditional tools continue to be used by local women today. The collection and traditional processing of *S. rautanenii* have been shown to be particularly important for women and children, both of whom are extremely vulnerable groups (Chidumayo *et al.*, 2010).

It is a deciduous, dioecious, short-boled tree, often multi-stemmed as a result of forking within 2 meters of the ground, and it has a wide-spreading crown. The tree grows in the sub-humid and semi-arid regions of southern Africa. It occurs in open forest as a dominant or co-dominant tree species with other species such as *Azelia quanzensis* and *Burkea africana*. The largest stands of *S. rautanenii* can be up to 450 hectares, on sand ridges and near important water sources (Peters, 1987; Chidumayo *et al.*, 2010).

The natural range of *S. rautanenii* extends from northern Namibia to northern Botswana, southwestern Zambia, and western Zimbabwe. Another area where it occurs is in eastern Malawi, as well as in eastern Mozambique (Graz, 2002). These regions share similar climate conditions. The average annual temperatures hover around 20 °C, with maximum daily temperatures often exceeding 30 °C. *S. rautanenii* can tolerate frost, but temperatures below 7 °C will kill the seedlings. The tree thrives at altitudes ranging from 200 to 1500 meters and grows well when annual rainfall falls between 200 and 1000 mm. It prefers hot, dry climates with minimal rainfall. It grows exclusively on deep sands of the Kalahari Sand Plateau, never on compacted soils, clay, or in areas prone to flooding (Chidumayo *et al.*, 2010).

The tree typically reaches a height of 7–12 meters (Peters, 1987), although it can grow even larger, up to 15–20 meters (Graz, 2002). In fact, a tree measuring 24 meters in height was reported in northern Namibia (Palmer, Pitman, 1972). Leaves begin to sprout in September–October, before the first rains of the season. They are shed around May. The leaves are digitately compound and arranged alternately on branches, consisting of three to seven leaflets borne on hairy peduncles of up to 15 cm (Palmer, Pitman, 1972; Peters, 1987). The flowers appear in slender, loose sprays or panicle cymes, measuring up to 12 cm long. These flowers are whitish or yellow and have a diameter of about 10 mm. They bloom in early summer, specifically in October to November or early December, preceding the first rains (Lee, 1973; Palmer, Pitman, 1972; Peters, 1987). The fruit of *S. rautanenii* is an ellipsoidal drupe approximately 35 mm long and 25 mm in diameter. It ripens after falling to the ground in April or May. As it ripens, the colour changes from the original yellow to a reddish brown, although by August, the mesocarp may dry out to a powdery texture, leaving only the endocarp visible (Lee, 1973; Helgren, 1982; Keegan, Van Staden, 1982).

*Schinziophyton rautanenii* has been the subject of study since the 1970s and 1980s, initially focusing on its ecology, history, and cultural significance. In more recent research, the potential benefits and utilization of this tree have been explored. Studies have demonstrated its capacity to contribute to social and economic development, and there are even suggestions that it could help alleviate poor nutrition and hunger (Maroyi, 2018). However, despite the potential that *S. rautanenii* offers, the species remains neglected and

underutilized. This situation poses a threat to local biodiversity and affects the livelihoods of vulnerable populations, especially women and youth who rely on collecting wild products for sale and home consumption. Therefore, the utilization of *S. rautanenii* must be approached with care, considering the need to protect biodiversity, cultural heritage, and enhance sustainable practices for environmental conservation.



1: *Schinziophyton rautanenii*, tree habitus in a dry season (authors's own photos)



2: Detail of a fruit of *Schinziophyton rautanenii* (on the left) (author's own photo)



3: Local woman using a traditional method of cracking of mungongo nuts' hard kernels (author's own photo)

### Threats

The primary threats include conventional agriculture, human-wildlife conflict, and economic and social barriers. Conventional agriculture demands increasing yields, leading to deforestation and contributing to the loss of local biodiversity. Chidumayo's research indicates that over 16 % of the Zambezian dry forest and woodland was converted into agricultural land at the beginning of the 21<sup>st</sup> century (Chidumayo *et al.*, 2010). Burning fields as preparation for planting season negatively impacts the germination and growth of *S. rautanenii*, which in turn affects the tree's reproduction and population (Chidumayo, 2016).

Another significant issue is human-wildlife conflict. Dry forests and woodlands are frequented by seasonal elephant movements, driven by the availability of surface water during the dry season and the seasonal fruiting of trees like marula (*Sclerocarya birrea*) and mungongo (*Schinziophyton rautanenii*) (Youldon, 2017). Elephants ranging in human-dominated landscapes inevitably lead to interactions and conflicts with communities. These conflicts often involve crop raiding, destruction of water supplies, grain stores, houses, and sometimes injuries or fatalities to people and livestock (Youldon, 2017).

Unfortunately, these species are also overlooked by researchers, agricultural extension officers, and policymakers. However, promoting their importance could contribute significantly to the ongoing fight against malnutrition and environmental sustainability in Southern Africa. During times of crop failure, local communities rely on gathering wild foods from the forest. Dry forests and woodlands serve as a safety net, and beyond that, they play a crucial role in supporting local industries (Chidumayo, 2010).



### Utilization

The fruit and timber of *S. rautanenii* have been utilized by people for thousands of years (Robbins *et al.*, 1990). The nuts of *S. rautanenii* are cooked into porridge and added to soups and vegetables. The oil pressed from the nuts is used in cooking and body care. Additionally, the timber is employed in wood crafts, furniture making, and as firewood. Interestingly, due to its low density, it was even used as a substitute for balsa (*Ochroma pyramidale*) during and after World War II in Zambia (Chidumayo, 2016). Contemporary studies suggest that biodiesel derived from *S. rautanenii* nuts performs comparably to petroleum diesel in terms of both efficiency and emissions (Kivevele, 2015; Singh *et al.*, 2020).

Despite these valuable uses, local people still rely on traditional methods to crack the hard kernels and access the nuts. However, some researchers consider these methods rudimentary and ineffective. Addressing this barrier is crucial for commercializing *S. rautanenii* products (Maroyi, 2018). Neglecting these traditional skills could lead to the overall neglect of the species. To promote sustainable utilization and management, it's essential to support the deep-rooted cultural practices and highlight the benefits of *S. rautanenii*, ultimately fostering social and economic development.

### Regeneration

For the sustainable use of mongongo tree, fast and effective method of regeneration should be found. Nowadays, the trees are aging, slowly entering the phase of senescence, and natural regeneration is low. Our team is preparing a research on germination of mongongo seeds. Two methods of germination were designed, using different conditions during germination and pre-sowing treatments. In both methods, one half of the seeds will be intact, and other half of the seeds will be scarified by removing part of the testa, to determine if scarification has any impact on speed of germination. In first method, seeds will be stored for three months at constant temperature of 4 °C for three months (cold stratification). After that cold period, germination test will be conducted. The second method will use the effect of phytohormone Ethylone. According to Keegan, Van Staden (1982), seeds of *S. rautanenii* had the highest germination rate when aqueous solution of Ethrel was used



4: Pressing of mungongo oil



5: Cosmetic product from *S. rautanenii* developed by Booma Women Cooperative

before germination. Also, some fruits are producing Ethylene when riping (Alexander, Grieson, 2002), like tomatoes, bananas, or mangoes, and when stored in plastic bags, the produced Ethylene should affect the seeds in the bag. Thus, in the second method, one part of seeds will be treated with aqueous solution of Ethrel, and other part of seeds will be stored for selected time in plastic bags together with bananas and mangoes. After that, germination trials will be conducted as well.

## REFERENCES

- ALEXANDER, L., GRIERSON, D. 2002. Ethylene biosynthesis and action in tomato: a model for climacteric fruit ripening. *J. Exp. Bot.*, 53(377), 2039–2055.
- GRAZ, F. P. 2022. Description and Ecology of *Schinziophyton rautanenii* (Schinz) Radcl. Sm. in Namibia. *Dinteria*, No 27, 19–35.
- HELGREN, D. M. 1982. Edaphic context of the mongongo (*Ricinodendron rautanenii*) in the northwestern Kalahari. *S. Afr. J. Sci.*, 78, 131–132.
- CHEIKHYOUSSEF, A. *et al.* 2019. Mongongo/Manketti (*Schinziophyton rautanenii*) Oil. In: *Fruit Oils: Chem. Funct., Chapter 32*. [https://doi.org/10.1007/978-3-030-12473-1\\_32](https://doi.org/10.1007/978-3-030-12473-1_32)
- CHIDUMAYO, E. N. 2016. Distribution and abundance of a keystone tree, *Schinziophyton rautanenii*, and factors affecting its structure in Zambia, southern Africa. *Biodivers. Conserv.*, 25, 711–724.
- CHIDUMAYO, E. N. *et al.* 2010. *The Dry Forests and Woodlands of Africa: Managing Products and Services*. Earthscan Ltd.

- LEE, R. B. 1973. Mongongo: The ethnography of a major wild food resource. *Ecol. Food Nutr.*, 2, 307–321.
- KEEGAN, A. B., VAN STADEN, J. 1982. *Dormancy and Germination of the Manketti Nut, Ricinodendron rautanenii*. Ph.D. Thesis, University of Natal, Pietermaritzburg.
- KIVEVELE, T. *et al.* 2015. An analysis of fuel properties of fatty acid methyl ester from Manketti seeds oil. *Int. J. Green Energy*, 12(4), 291–296.
- MAROYI, A. 2018. *Contribution of Schinzioephyton rautanenii to Sustainable Diets, Livelihood Needs and Environmental Sustainability in Southern Africa*. Med. Plants Econ. Dev., University of Fort Hare, South Africa.
- PALMER, E., PITMAN, N. 1972. *Trees of Southern Africa*. Vol. 2; Balkema, Cape Town.
- PETERS, C. R. 1987. *Ricinodendron rautanenii* (Euphorbiaceae): Zambezian Wild Food Plant for All Seasons. *Econ. Bot.*, 41, 494–502.
- ROBBINS, L. H. *et al.* 1990. Prehistory of Mongongo Nut Exploitation in the Western Kalahari Desert, Botswana. *Botsw. Notes Rec.*, 22, 37–42.
- SINGH, R. *et al.* 2020. RETRACTION Tribological characteristics of Mongongo-oil-based biodiesel blended lubricant. *Retraction of Vol.*, 39, Pg 332.
- YOULDON, D. A. *et al.* 2017. *Patch-occupancy survey of elephant (Loxodonta africana) surrounding Livingstone, Zambia*. KOEDOE - Afr. Prot. Area Conserv. Sci., ISSN 2071-0771 (Online), ISSN 0075-6458 (Print).

#### Contact information

Lukáš Karas: lukas.karas@mendelu.cz,  <https://orcid.org/0000-0003-0827-0374>

Kamila Hejlíková: kamila.hejlikova@mendelu.cz,  <https://orcid.org/0009-0004-1909-3101>