Management of Mopane in Southern Africa

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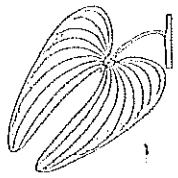
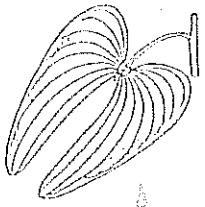
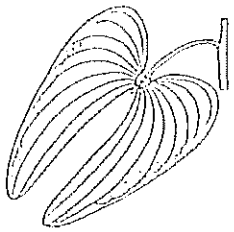




CHAPTER FIVE

A BRIEF OUTLINE OF RESEARCH FOR THE MANAGEMENT OF *COLOPHOSPERMUM MOPANE* IN MALAWI



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ABSTRACT

Colophospermum mopane (mopane) occurs naturally over a limited area of Malawi, usually as open to closed woodlands on grey clay soils overlaying nodular concretions of limestone. These sites, which are waterlogged during the rains and intensely arid in the dry season, are at relatively low altitudes in the driest and hottest areas of Malawi. An experiment established in 1958, on coppice and seedling regeneration in natural stands, indicated that early burning reduces the rate of increase of seedling and coppice establishment compared with fire protection, but permits an increase in stocking, while early burning was better for survival than late burning. An experiment, established in 1993 outside the natural range of mopane, was carried out to examine the growth of mopane against six other indigenous tree species in areas of high demand for timber. Measurements carried out in 1996 demonstrated the poor performance of mopane when grown in sites that are relatively benign for the growth of plants. The future management of the species emphasizes *in situ* conservation of the communities in which mopane occurs.

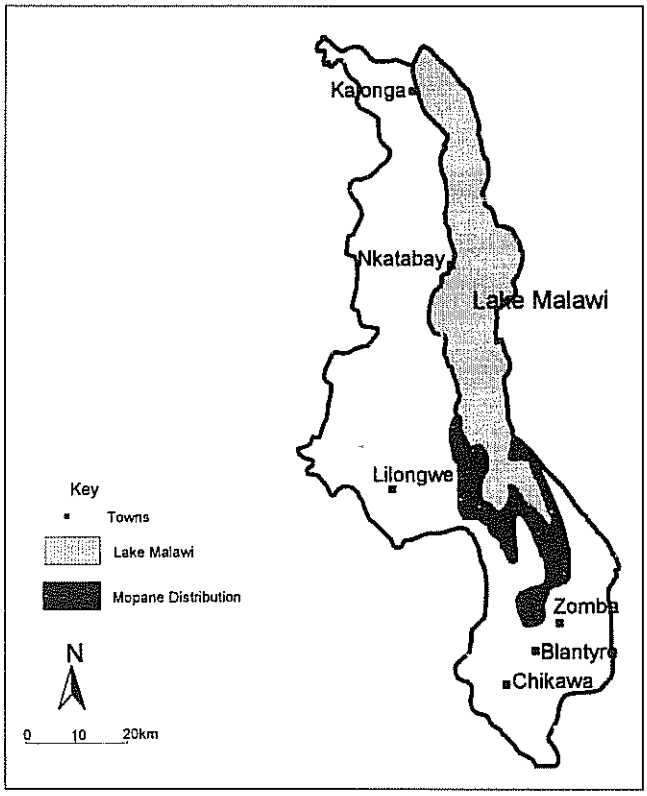
Keywords; *Colophospermum mopane*, Malawi, growth off-site, early and late burning, *in situ* conservation.

GENERAL INTRODUCTION

Colophospermum mopane (Kirk ex Benth.) Kirk ex J. Léonard, known commonly as mopane (locally known as "Tsanya") occurs naturally over a limited area in Malawi (Fig. 5.1). Malawi can be broadly divided into three agro-ecological zones; the semi-arid Rift Valley (containing Lake Malawi and the Shire Valley at an altitude of 200 - 600 MAMSL), the highlands (1,600 - 3,000 MAMSL) and the subhumid medium plateau (800 - 1,600 MAMSL) which borders the highlands. Mean annual rainfall in Malawi is between 700 and 1,000 mm, with the Lower Shire Valley and the western areas of the medium plateau receiving around 700 - 900 mm. Most rain falls between November and April. Mopane occurs naturally only in the semi-arid zone.

Where it occurs in Malawi, mopane is a more or less branched tree up to 15 m tall and occurs mostly as open to closed woodland on grey clay soils overlaying nodular concretions of limestone. These sites are waterlogged during the rains and intensely arid in the dry season. Mopane occurs in areas below 700 m in altitude and with a mean annual rainfall between 700 to 840 mm. The maximum mean annual temperature for sites including mopane is from 22 to 25 °C.

Figure 5.1: Map of Malawi showing distribution of *Colophospermum mopane*.



The limited occurrence of mopane in Malawi and the wealth of indigenous fast-growing timber trees on the sites more benign for the growth of plants, has meant that only limited research has been carried out in natural stands, or towards plantation establishment of mopane. Nevertheless, mopane is an important tree where it does occur and may have potential beyond its natural range. This paper reports two experiments which have been established in Malawi to address these issues.

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COPPICE AND SEEDLING REGENERATION IN NATURAL STANDS

The first experimental research on mopane in Malawi commenced in 1958, when four 0.5 ha permanent sample plots were established near Liwonde. The aim of the experiment was to determine the influence of cutting treatment and burning on seedling and coppice growth of mopane. As the plots were not replicated, no attempt was made at statistical analysis. The four treatments and results following assessment in 1964 are shown in Table 5.1. The plots had been burnt after six years of fire protection during which time a reasonable stock of seedling and coppice over one centimetre in diameter had become established (Table 5.2).

The increase in regrowth tended to be greater under complete fire protection, while early burning appeared better for survival. There is a suggestion that early burning reduced the rate of increase of seedling and coppice establishment compared to fire protection but permitted a considerable increase in stocking.

Table 5.1: Number of plants of *Colophospermum mopane* greater than one metre in height between 1958 and 1964, at the trial near Liwonde, Malawi.

Cutting treatment	Early burnt		Late burnt	
	Seedling	Coppice	Seedling	Coppice
Clear fell	7	20	3	8
25 % over 3 cm DBH	2	6	2	4
All over 5 cm DBH cut	0	13	0	7
No cutting	2	6	1	2

GROWTH COMPARISONS WITH OTHER SPECIES

An experiment aimed at choosing appropriate species for planting in areas requiring rehabilitation was established at two sites in the relatively high rainfall areas of Malawi in 1993 (Table 5.3).

Study sites

The first site, Milare, was chosen due to its proximity to Blantyre, the main commercial town. As the population in this town is large, there is a high demand for fuelwood. The rehabilitation of the surrounding area would contribute to alleviation of the fuelwood problem. The urban population also depends on wood resources (timber, charcoal and curio making) for income generation. The second site, Chimaliro in Kasungu, is on the southern edge of Chimaliro Forest Reserve. Kasungu is a tobacco growing area and deforestation has been accelerating due to the requirement for large amounts of firewood for curing tobacco.

Both sites are more benign for the growth of plants than sites in which mopane occurs naturally. Milare is on the western verge of the Shire Highlands and experiences a Chiperoni weather. Chiperoni is a cool moist weather pattern with frequent showers common on the Shire Highlands of Malawi. The Kasungu site had been cultivated until eight years previously.

Species selection

Seven species were used for the experiment (Table 5.4). These include three species used for timber, three for fuelwood and poles, and a valuable curio species. On each site however, only six species were planted, with *Julbernardia paniculata* and *Brachystegia utilis* planted at Chimaliro and Milare respectively. Seed was supplied by the Forestry Research Institute of Malawi (FRIM) Tree Seed Centre. Collection was from registered unimproved seed sources in various parts of Malawi. Seedlings were raised at the FRIM nursery and transported to the planting sites at the time of planting.

Establishment and experimental design

A complete randomized block design was used with six treatments (species) replicated three times on each site. Each plot has 6 x 6 trees (36 plants), spaced at 3 m x 3 m intervals. Planting sites were cleared of existing vegetation prior to marking and pitting. Pits were 60 cm x 60 cm. Pitting was done to improve soil structure and keep planting stations free from weeds at the time of planting. Planting was carried out between 11th January and 9th February 1993 under favorably wet conditions. Two rows of trees were planted around the sites to serve as a buffer and perimeter fire-breaks constructed to prevent the sites from being burnt by fires, especially during the dry season when temperatures are high and winds are dry.

In July, 1996, survival, height (m) and Root Collar Diameter (RCD, cm) growth of the seven species was recorded on all trees (36 plants) in each of the treatment plots.

Table 5.2: Effect of burning on recruitment of standing mopane trees in uncut plots at Liwonde, Malawi

	Recruitment into diameter class (cm)			Basal area increment m/ha		
	2 - 6	7 - 11	12 and over	1958 - 62	1962 - 64	1958 - 64
Fire protected	17	0	2	0.2	2.5	2.7
Early burnt	19	1	1	0.1	2.5	2.6

Table 5.3: Summary of location and geography of current experimental work in Malawi

Location	Geographic position	Altitude (MAMSL)	Soils	Slope	Ph	Rainfall (mm)
Milare	15° 56' S 34° 57' E	840 m	Deep, fertile, freely drained, brown clay loam.	5 - 8°	5 5	>1,000
Chimaliro	12° 30' S 33° 30' E	1,100 m	Free draining, alluvial dark brown clay loam	1 - 2°		800 - 1,000

Performance of mopane

Height growth and survival of mopane are poor on both sites (Table 5.4). This is particularly so at the Chimaliro site, possibly due to the deep soils, wet climate and high altitude. Mopane in its natural environment grows on clay soils and in dry, hot and low altitude areas. It grows best in areas where there are no physical or chemical constraints (Cole 1982). Dye and Walker (1980) reported that mopane tends to dominate where soils have restricted rooting depth, high sodium content, low infiltration rates and high water holding capacity. Choinski and Tuohy (1991) stated that mopane is indigenous to lower altitude habitats characterized by sodic soils and high growth temperatures. Dye and Walker (1980) explained that the growth of mopane depends on the interaction of several factors which affect the absorption and retention of moisture in the B horizon. These include the depth of the A horizon, the texture (and hence the available water capacity of the A and B horizons) and electrolyte : exchangeable sodium ratio of the B horizon. The soils of the sites used in this experiment have normal concentrations of sodium.

It is apparent that mopane is not a suitable species for planting in plantations in the moist, fertile areas of Malawi. Other indigenous species may be more suitable in these areas while mopane is more appropriate in difficult sites requiring rehabilitation within its natural range.

The Future

Most of the areas in which mopane was prevalent have now been depleted of the species for various uses such as conversion of the land to agriculture and cutting of fuelwood. The area which had the 1958 plots is now a tobacco estate. The Forestry Research Institute of Malawi is now converting the remainder of the existing areas into *in situ* conservation stands which will also act as community seed collection areas. Seed collected by the communities will then be sold to FRIM who will process it as well as do all the necessary laboratory tests before re-selling it to the public. In this way the communities will have a sense of ownership and will value the stands.

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Table 5.4: The performance of six indigenous tree species in the field at Milare and Chimaliro in Malawi.

Species	Local name	Principle use	Mean survival (%)		Mean height (m)		Mean root collar diameter (cm)	
			Chimaliro	Milare	Chimaliro	Milare	Chimaliro	Milare
Afzelia quanzensis	msambamfumu	Timber	90.0	78.7	1.15	1.19	2.52	5.29
Brachystegia utilis	tsamba	Fuelwoodlpoles	-	58.4	-	2.00	-	2.97
Colophospermum mopane	tsanya (mopane)	Fuelwood/poles	55.6	61.9	0.39	2.98	0.21	5.31
Dalbergia melanoxylon	phingo	Curio	90.0	90.0	1.91	1.79	2.56	8.31
Khaya anthotheca	m'bawa	Timber	60.5	85.3	1.07	1.89	2.92	13.32
Pterocarpus angolensis	mlombwa	Timber	52.1	75.9	1.11	4.51	2.87	4.99
Julbernardia paniculata	mtondo	Fuelwood/poles	40.3	-	0.12	-	0.02	-