Management of Mopane in Southern Africa

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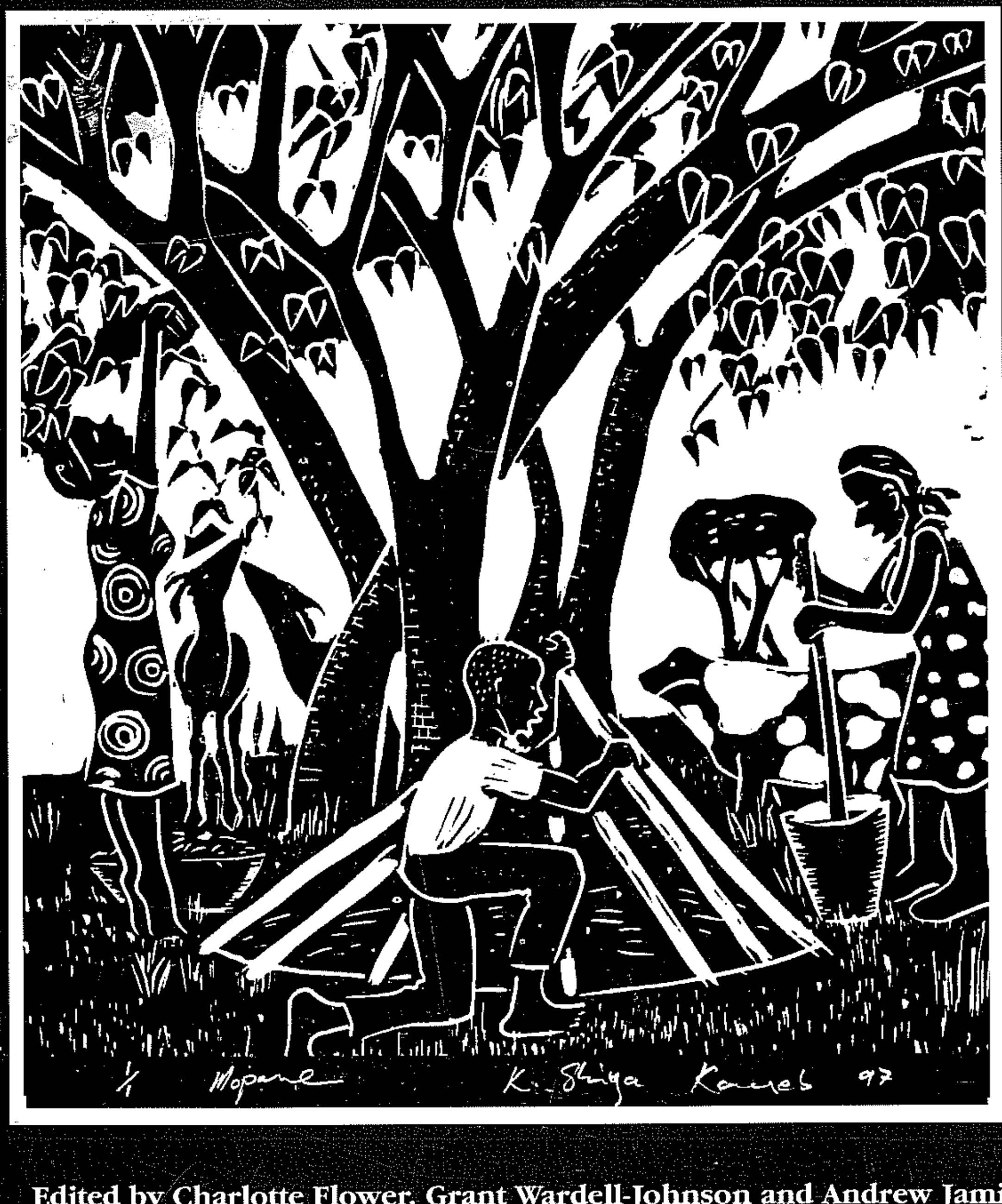

Edited by Charlotte Flower, Grant Wardell-Johnson and Andrew Jamieson

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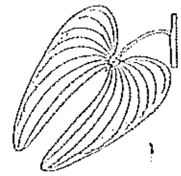
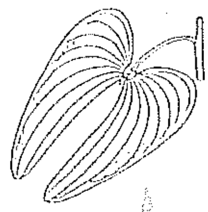
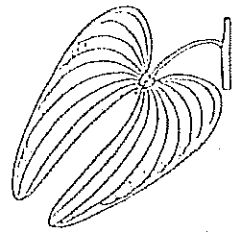




CHAPTER TWO

ON-FARM RESEARCH IN MOPANE WOODLAND: A CASE STUDY FROM CHIVI, ZIMBABWE.



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ABSTRACT

Two thinning and coppicing experiments were established in 15 hectares of *Colophospermum mopane* (mopane) woodland following lengthy negotiations with local authorities in a communally owned area in Chivi, Zimbabwe. The effect of mopane stump size and season of cutting on coppicing ability, and the effect of thinning on diameter at breast height (DBH) growth were examined. Tall stumps produced significantly more coppices than short stumps. Most coppicing in the short and large stumps took place from subterranean buds, thus providing shoots suitable for pole production. Two years after thinning, control plots showed a positive mean annual increment in DBH, whereas heavy and very heavy thinning intensities appeared to have a depressive effect on DBH increment. It is concluded that heavy thinning in young coppice stands of mopane does not yield positive DBH increment results and that large diameter trees cut close to the ground produce coppices suitable for pole production. Future coppicing trials will focus on coppice-with-standards models. People's participation is recommended in natural forest management and research, particularly in arid and semi-arid areas where people's dependence on the woodlands is greatest. The researcher's presence in the experimental area should continue until all measurements are taken, particularly during electoral changes in local political leadership.

Keywords; *Colophospermum mopane*, mopane woodland, people's participation, coppicing, thinning.

INTRODUCTION

People's participation in natural resources management is an evolving paradigm much talked about today (see Chapter three). Such deliberate involvement of local people should be included in the very initial stages of project or programme planning (Chapters three and sixteen). It is generally agreed that people in arid and semi-arid areas depend on the woodlands for their livelihood to a greater extent than people in areas that receive relatively higher rainfall (Chapter eleven). *Colophospermum mopane* (Kirk ex Benth.) Kirk ex J. Léonard, commonly known as mopane, occurs in arid and semi-arid mopane and escarpment thicket that accounts for nearly one-fifth of the total land area of Zimbabwe (Mapaure 1994). Just as on-farm agricultural research is successfully conducted in such areas, it makes sense to conduct on-farm forestry research in the same areas, with the same farming communities.

This paper outlines the negotiation process with the local authorities to enable the establishment of two research experiments in a communally owned area of mopane woodland in Chivi, Zimbabwe. It also reports the results of the first three years of coppicing and thinning experiments that were established there. The effect of stump size and season of cutting on the coppicing ability of mopane and the effect of thinning on DBH growth were studied in two separate experiments.

METHODS

Site selection and acquisition

The selection of a suitable study site involved a tripartite negotiation strategy in which the author spent almost a year convincing the local district councillor and traditional leaders on the merits of having the project conducted in the area. This process was carried out through the local forest extension officer. Once the local authorities had sanctioned the project, establishment of the experiment went ahead making use of local labour for most of the operations such as fencing, thinning and general policing and protection of the trials after they were established.

The experiments were established on an area near Nyagate River (about 20° 15' S and 30° 20' E) in Chivi communal land, Zimbabwe. The altitude at the site is approximately 800 m above sea level. The soil is a pale brown, medium-grained, slightly acidic (pH = 5.7) sandy soil with a low cation exchange capacity (4.7 me per 100 grams). The rainfall averages 507 mm per year (20 year mean between 1971/1991), with about 90 % of the rain falling between November and March. The area is hot during the latter part of the dry season and during the wet season but cold to warm in winter. Mean maximum temperatures vary from 23 °C in July to 28 °C in January while the October figure may be as high as 31°C. The woody vegetation within the experimental area is dominated by mopane, but includes some *Acacia tortilis* and *Terminalia sericea* stems.

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Table 2.1: Summary of coppice production by treatment at Chivi, Zimbabwe

Treatment No.	Mean coppice count per stump		Mean combined length (m) of all coppices per stump		Mean annual increment of total coppice length (m)
	1994	1995	1994	1995	
Cl	10	9	7.20	7.57	2.5
C2	11	9	8.69	8.63	2.9
C3	18	21	8.74	9.93	3.3
C4	18	23	13.16	18.85	6.3
All	14	15	9.45	11.24	3.7

Table 2.2: Analysis of variance for number of coppices per stump at Chivi, Zimbabwe

Source	df	SS	MSS	F
Blocks	10	362.34	36.23	–
Treatments	7	1,298.35	185.48	9.25
seasons	1	2.56	2.56	7.84
stump size	3	1,271.58	423.86	21.13
season x size	3	24.22	8.07	2.48
Error	70	1,404.02	20.06	–
Total	87	3,064.72[1]	–	–

(1) This total excludes the seasons, size and seasons x size interaction as all these are part of the general treatments of df = 7.

Coppicing

The two coppicing experiments were established in July 1991 and January 1992. A completely randomized design of four treatments replicated 15 times and laid out as a factorial was used for both. The four treatment combinations were; C1 (short stumps, small diameter), C2 (short stumps, large diameter), C3 (tall stumps, small diameter) and C4 (tall stumps, large diameter).

In the above categories, short stumps measured 10 cm above ground level while tall stumps measured one metre above ground level; small diameters referred to DBH values less than 5 cm before the tree was felled, and large diameters referred to DBH values equal to or greater than 5 cm.

Thinning

The thinning experiment was established in July 1991. Three treatments replicated three times were applied; T0 (no thinning - control), T1 (56 % thinning "from below") and T2 (78 % thinning "from below"). Each quadrat measures 20 m x 20 m with an inner assessment quadrat of 10 m x 10 m. In all cases, only plants taller than 50 cm were measured.

RESULTS

Coppicing

Table 2.1 provides a summary of coppice production per treatment. Tall stumps (i.e. C3 and C4) produced significantly more coppices than the short stumps (Table 2.2).

Table 2.3: Analysis of variance for total coppice length in 1995 at Chivi, Zimbabwe

Source	df	SS	MSS	F
Blocks	10	615.28	61.53	–
Treatments	7	2,089.06	298.44	6.81
seasons	1	235.77	235.77	5.38
stump size	3	1,756.41	585.47	13.36
season x size	3	96.88	32.29	1.36
Error	70	3,067.45	43.82	–
Total	87	5,771.79	—	–

Table 2.4 : Analysis of variance for mean annual increment in coppice length between 1994 and 1995 at Chivi, Zimbabwe

Source	df	SS	MSS	F
Blocks	10	322.42	32.24	
Treatments	7	542.52	77.50	2.87
seasons	1	28.37	28.37	1.06
stump size	3	461.47	153.82	5.73
season x size	3	52.68	17.56	1.52
Error	70	1,879.46	26.85	
Total	87	2,744.41	-	-

There was a significant difference among stump sizes ($p < 0.01$) but no difference between seasons and no season x stump size interaction (Table 2.2). Tall stumps of large diameters (C4) produced significantly higher levels of coppice lengths than stumps in the other three treatments (Tables 2.1 and 2.2). The stumps in C4 have the greatest surface area for bud activity to take place.

There were significant differences among stump sizes ($p < 0.01$, Table 2.3). The coppice lengths for the stumps established in July 1991 were significantly higher ($p < 0.05$) than those established in January 1992. The six-month difference in growing time is still evident throughout the experiment. By 1995, the mean number of coppices per stump had started to drop in the short stump classes (C1 and C2) but it was still increasing in the tall stump classes (C3 and C4). Coppices from C1 and C2 are mainly from subterranean buds. In the case where the root systems of such stumps are at an advanced stage of development (i.e. C2), the resultant coppices have a high potential as poles and construction timber. Coppices from the other three treatments are good as fuelwood and multipurpose small timber pieces.

Thinning

The 1992 measurements were taken for all trees in the 20 m x 20 m plot but the 1995 measurements were taken only in the 10 m x 10 m inner plots with the objective of eliminating edge effects. The result was a drastic reduction in the sample sizes. This reduction in sample size was partly responsible for the depressive effect of thinning on DBH growth in some of the treatment plots.

The thinning intensities applied (i.e. 56 % and 78 %) were too heavy and subsequent coppicing by the thinned out trees activated competition for nutrients and soil moisture. The criterion of "thinning from below" only considered tree height and diameter. As a result, some trees (coppices) growing from old root stocks were removed as they were considered inferior and yet, in most cases, the removal of such trees only served to provoke more intense coppicing activity by those stumps, thus contributing to the competition observed above.

The woodland is made up of mostly regrowth (the DBH range in 1992 was 2.0 cm to 4.4 cm) and a lot of the trees

Table 2.5: Summary of results from the thinning plots at Chivi, Zimbabwe

Treatment no	Rep	SPH*	1992 measurements DBH (cm)	n	1995 measurements DBH (cm)	n	DBH (cm) increment over the trial period
T0	1	6,175	2.2	169	2.9	75	+0.7
T0	2	7,125	2.0	181	2.4	99	+0.4
T0	3	5,550	2.3	156	2.8	100	+0.5
T 1	1	2,750	3.0	111	2.7	31	-0.3
T1	2	2,750	3.3	110	3.1	34	-0.2
T1	3	2,750	2.8	109	3.4	30	+0.6
T2	1	1,375	4.2	55	3.9	8	-0.3
T2	2	1,375	4.4	55	5.1	15	+0.7
T2	3	1,375	3.8	55	3.6	16	-0.2

*SPH = stems per hectare

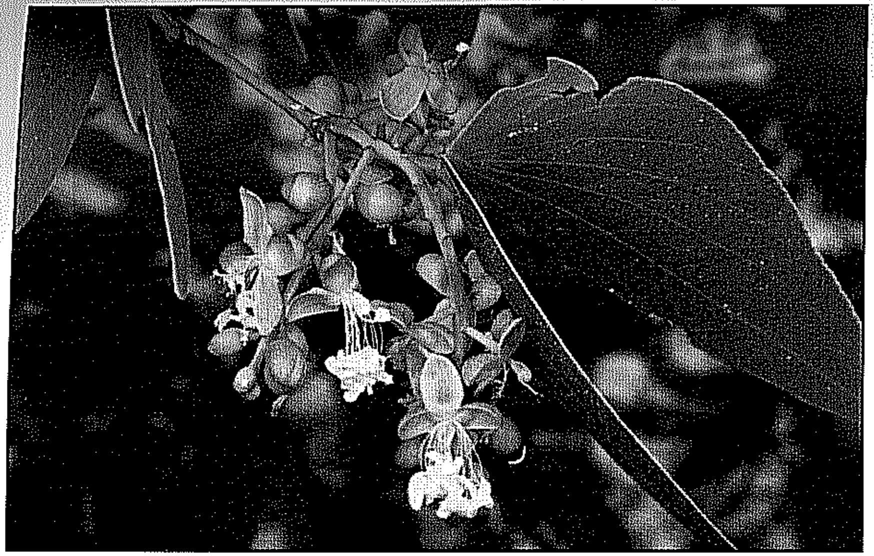

Plate 1: Inflorescence of mopane photographed on 27 February1997 near the Cunene River, northern Namibia.

Plate 2: Open woodland of mopane on alluvial plains near the Cunene River, northern Namibia. The yellow flowered plant is *Tribulus zeyheri.*

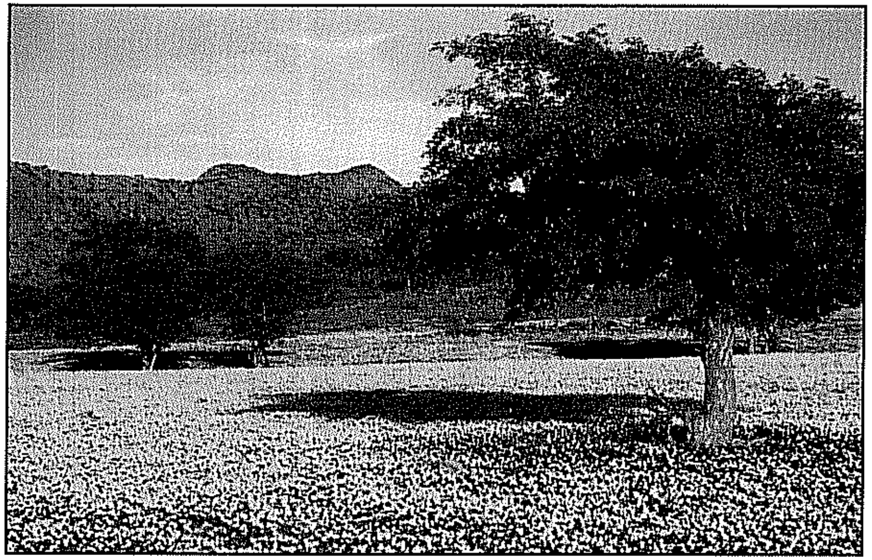

Plate 3: Open stand of mature mopane woodland in western Omusati, in an area of low human population.

Plate 4: Natural mopane shrubland near its western range-edge on the Great Western Escarpment, north-western Namibia, an area that receives less than 200 mm annual rainfall.

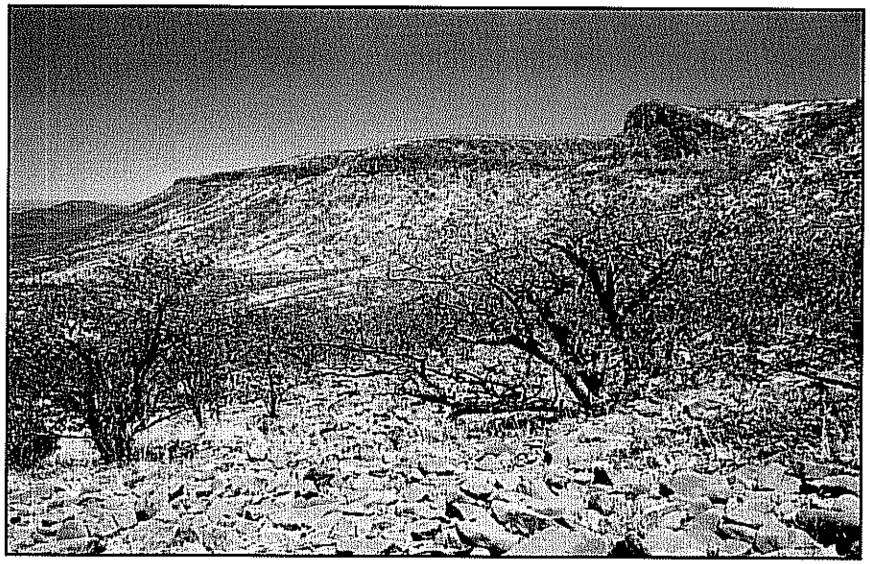

Plate 5: Mopane woodlands as wildlife habitat; Impala (*Aepyceros melampus*) in Moreme Game Reserve, Botswana.

Plate 6: Mopane in drainage line, near the Cunene River, northern Namibia.

Plate 7: Mopane woodland in Kwange National Park, Zimbabwe.

Plate 8: Mopane woodland dominated by *Colophospermum mopane, Terminalia prunioides* and *Dichrostachys cinerea* near Outjo, northern Namibia. This stand has about 7,900 stems per hectare. (Peter Cunningham).

were, in fact, coppices. Since such young plants are generally very active physiologically, the effects of thinning may not be presented easily in a definite pattern especially given the short observation period of three years.

DISCUSSION AND IMPLICATIONS FOR MANAGEMENT

Thinning does not make much silvicultural sense in mopane woodlands. Rather, it should be considered as a harvesting technique for coppice management. Thus, for sustainable pole production, large diameter trees should be cut quite close to the ground so as to facilitate the coppicing of shoots from subterranean buds, eventually creating a clump of stems from the same root stock. Pollarding or, to a less extent, lopping, should be considered where a bushy crown made up of small sized 'branches' is required. Future trials should address coppice-with-standards models replicated over different sites.

In 1996 it was observed that the trial material was being interferred with as the local people were now harvesting poles from the thinned plots and they were also removing the aluminium labels in the coppicing plot (apparently for use in mending metal cooking pots). This was possibly because the frequency of visits by research staff had declined considerably from the previous year. In addition, it was discovered that the local councillor who had been supportive of the project had been ousted during the 1995 local government elections.

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