

Study on Coppice Management of *Acacia Nilotica* Tree for Better Woody Biomass Production

Abrham Tezera Gessese*, Tesfaye T/haymanot Gezahegn and Hailie Shiferaw Wolle

Amhara Region Agricultural Research Institute, Debre Birhan Agricultural Research Center, P.O.Box-112, Debre Birhan, Ethiopia

Abstract

Over 90% of the energy consumed in the country is depending on woody biomass. The rising demand for tree products and expanding population pressure resulted in decline of forest cover and consequently the demand for tree products exceeded the supply. This study was conducted at Armania Kebele with the aim of to evaluate different cutting time and management practices yielding more wood biomass volume. One indigenous tree species, preferable by the farmers, namely *Acacia nilotica* was selected and the experiment design in 3×4 factorial experiment with randomized complete block design arrangement and replicated three wise. Eight trees per plot were planted in two rows with 2 meter spacing. The result shows that, *Acacia nilotica* could be coppiced well with 13 to 29 numbers of coppices per stump at all stages of cutting time. Root collar diameter and plant height were highly correlated with growth period. Hence, Leaving of two and three number of coppices could give higher woody biomass volumes as compare to leaving one and all number of coppices and control (uncut). Therefore it is necessary that farmers should allow two and three number coppice per stump to get high woody biomass volume for fuel-wood consumption.

Keywords: Acacia; Coppicing; Biomass; Nilotica

Introduction

The rising demand for tree products and expanding population pressure resulted in the decline of forest cover and consequently the demand for tree products exceeded the supply. The supply of wood and woody biomass products in the north Shewa zone comes from different forest and vegetation types and production systems, including natural forests, woodlands, bush lands, community woodlots, and farm forestry. The share of the total domestic energy is: fuel wood and tree residues 70%, dung 8%, agricultural residues 7% and the rest comes from other sources [1]. Hence, 90% of the total energy is coming from biomass. The trend in north Shewa is not different from the national, especially for the lowlands. According to EFAP [1], report a large deficit wood has occurred since 1992 (33 million m³), and fuel-wood deficit amounted to 32.5 million m³. This deficit has been the main cause for the mining of forest resource base. Based on assumed per capita consumption requirements, in 1992 total requirements for wood products have been estimated to be 47.4 million m³, of which fuel wood demand was 45 million m³ [1]. The demand for construction poles and fence posts for construction of new houses and renovation was estimated to be 2.1 million m³. The total deficit is expected to be 84.2 million m³ by the year 2014. Thus, being aware of these deficit alternative sources of energy, afforestation (massive plantation) program and efficient utilization and management of forest land should continue to receive attention based on research results for a greater biomass and quality production.

The existing experience on plantation species in northern Shewa zone indicates that most species used are exotics, dominantly Eucalyptus. There is a danger in overlying on a few species. Pest or disease epidemics could wipe the entire species with devastating effects. This will become serious when there is no alternative species to rely on. Focus has given to exotic species due to the information available and their fast growth rate. However, the indigenous species have been blamed for their slow growth rate. As a general truth, for most of the indigenous species there is no information at all and some of the indigenous species are known for their slow growth rate but there are species with fast growth rate, even faster than the exotics.

Study at Sirinka agricultural research centers revealed that *Acacia polyacantha* produces four times more biomass than *Eucalyptus*

camaldulensis at the end of three years growth [2]. Farmers also indicated their preference to *Acacia nilotica* for it produces a good charcoal and fuel wood. Moreover, survey report of the center at various weredas indicated that increasing demand for fuel-wood and the decreasing supply trend. The indigenous species which have fast growth rate also have additional desirable attributes over the exotics (e.g. termite resistance/adaptation to the environment). Wood and charcoal sale has been becoming the main stay of some farmers in northern Shewa zone specially when there is food shortage/drought. The accessibility of some weredas to the main road made current and future wood market promising. Though farmers have their own management practices of the above mentioned indigenous species, research efforts made to improve the growth rate/performance through better management is not significant.

Acacia Nilotica occurs in woodlands and scrub in dry and moist kola agro climatic zones, 600-1700 m.a.s.l [3]. It is Medium to fast growing large shrub or small tree, usually 2-6 m but can reach 14 m, branching from the base to make a rounded crown. Literatures indicate that *Acacia nilotica* do not coppice well (Tree data base CD, [3]) but farmers in the lowlands of north Shewa say it can coppices well. Therefore, the trial was conducted with the aim of evaluating *Acacia nilotica* tree species for a greater woody biomass and quality production under different management regimes.

Materials and Methods

One indigenous tree species, known for its relative fast growth rate

*Corresponding author: Senior Researcher, Debre Birhan Agricultural Research Center, Debre Birhan, Ethiopia, Tel: 251920430423; E-mail: abrhamtezera@gmail.com

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and preferable by the farmers, namely *Acacia nilotica* was selected for evaluating its coppice potential. The field experiment was conducted at Armania Kebele, Tarma-Ber district, North Shewa zone and the experiment design in 3×4 factorial experiments with randomized complete block design arrangement and replicated three wise. The dimension of a plot was $6.5 \text{ m} \times 10 \text{ m}$ (65 m^2) and eight trees per plot were planted in two rows with 2 meter spacing. At the age of three years old, four years old and five years old trees were cut close to the ground. And then after rising of sprouts from the stump Leaving one number of coppice, Leaving two number of coppice, Leaving three number of coppice and leaving all coppice per stump per cutting time were applied with one satellite control uncut trees. Growth parameters (root collar diameter, height and DBH), survival rate and fresh and dry weight data were collected.

Data analysis

Data were analyzed using SAS 9.0 followed by least significant difference (LSD) test, was applied for detecting significant differences among means.

Result and Discussion

Root collar diameter and height

The growth parameter result shows that root collar diameter (RCD) and height were increased by R^2 98 and 97 percent each month, respectively. The result indicated that root collar diameter and height were highly correlated with growth period (Figures 1 and 2).

Fresh and dry woody biomass

The result of dry wood biomass of *Acacia nilotica* ranges from 55 to 58%.

Coppiced potential and woody biomass volume of *Acacia nilotica*

The results of this study disproof the previous findings that says *Acacia nilotica* did not coppice (Tree data base CD, [3]). However, the present study confirmed that *Acacia nilotica* could be coppiced well at the age of three, four and five years after planting like other coppiced tree species [4]. From the first cutting time at the age of three years after planting, number of coppice per stump ranges from m 13 to 29 and gave higher volume of woody biomass. The result of cutting period and leaving of number of coppice indicates that leaving of two coppices

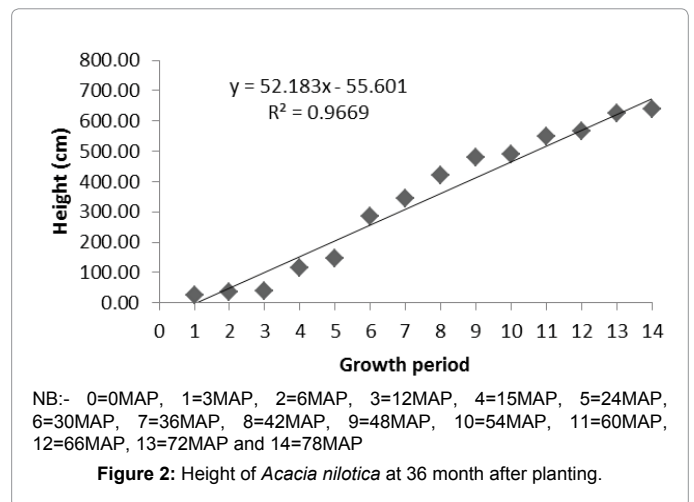


Figure 2: Height of *Acacia nilotica* at 36 month after planting.

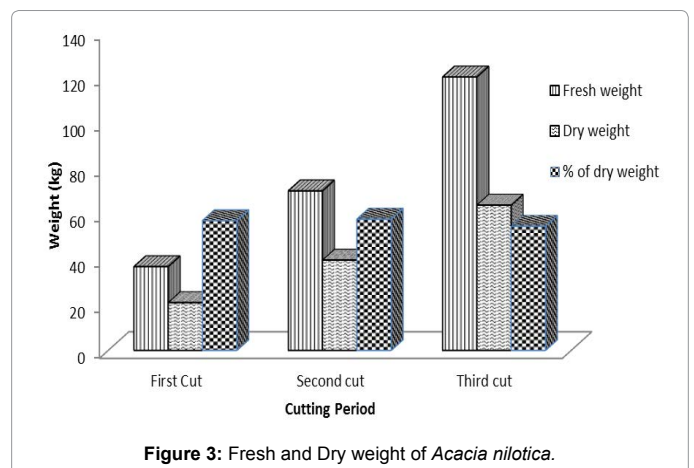


Figure 3: Fresh and Dry weight of *Acacia nilotica*.

number of *Acacia nilotica* could give higher woody biomass volumes at 36 MAP cutting period as compare to leaving one coppice at 48MAP and leaving all coppices, three coppices and one coppice at 84 MAP (Table 1).

On the other hand, at 48MAP the result shows that, leave three coppices can harvest $12,172 \text{ m}^3\text{ha}^{-1}$ volume of woody bio-mass and followed by leaving two coppices ($9982 \text{ m}^3\text{ha}^{-1}$) and all coppices ($6504 \text{ m}^3\text{ha}^{-1}$) than leaving one coppice ($4518 \text{ m}^3\text{ha}^{-1}$) at 84MAP. Leaving three, two and all coppices increases the biomass yield by 169%, 120% and 44% respectively as compared to leaving one coppice at 84 MAP. The total woody biomass volume obtained at 84 MAP by leaving two and three number of coppices had higher than leaving one coppice.

Woody biomass Volume at Coppicing Levels and Cutting Period of *Acacia nilotica*

Woody biomass volume comparison of different coppice levels with control (uncut tree) at different cutting period result indicated that there was no significant different among coppice level treatments on woody biomass volume at 84 MAP (volume at 36 MAP + 48 MAC) compared to control (Table 2). But higher volume was obtained by leaving two numbers of coppices per stump. The result indicated that, 52% higher woody biomass volume was obtained by leaving two coppices as compare to uncut (control) followed by leaving all and three coppices by 49.4% and 28.6%, respectively.

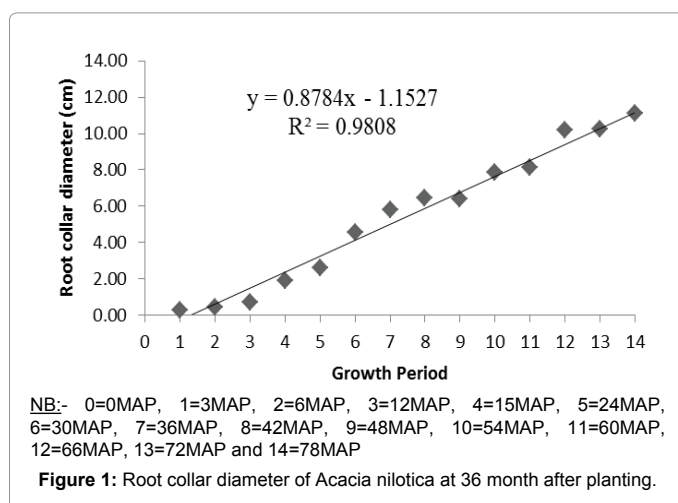


Figure 1: Root collar diameter of *Acacia nilotica* at 36 month after planting.

Leaving three coppices of *Acacia nilotica* at 48 MAP cutting period was obtained significantly higher woody biomass volume than as compare to uncut tree (control) at 84 MAP. Leaving three numbers of coppices at 48 MAP was gives 12,172 m³ha⁻¹ volume of woody biomass which is 193% higher than that of control (un-cut tree). Leaving two and all coppices was also increased woody biomass volume by 140% and 57% per hector as compare to uncut tree, respectively.

Woody biomass volume at different cutting periods

The result of woody biomass volume at different cutting periods indicated that significant difference was observed among treatments (Table 3). Cutting of *Acacia nilotica* at 48 MAP and 60 MAP periods was essential and preferable to obtain higher woody biomass volume of tree as compare to uncut tree [5]. The above two cutting periods could be increase woody biomass volume by 104% and 65%, respectively as compared to uncut.

Woody biomass volume of different coppice levels

Woody biomass of different coppice levels result indicated that significant difference was observed among treatment (Table 4). Leaving of two and three number of coppices were increased the woody biomass volume of *Acacia nilotica* by 200.82%, and 197% respectively as compare to uncut tree.

Conclusion and Recommendation

Acacia nilotica could be coppiced well and it is a medium to fast growing tree species, at every three months the root collar diameter and height of this tree increased by 1.5 cm and 100 cm respectively. Therefore, Cutting of *Acacia nilotica* tree at 36 MAP and 60 MAP with leaving two and three number of coppices gives higher woody biomass volume and increases the woody biomass volume by 270% and by 365% respectively over leaving one number of coppice and control. Despite of the present findings on *Acacia nilotica* coppice management there

Treatment	Total Woody Biomass Volume at 84MAP (m ³ ha ⁻¹)
36 MAP (Three Years old)	5211bc
48 MAP (Four Years old)	8457a
60 MAP (Five Years Old)	6831ab
84 MAP (Control)	4142c
CV	32.86

Columns with the same letter subscriptions was not significantly different, MAP (months after plant), MAC (months after cutting), CV (coefficient of variance)

Table 3: Woody biomass volume at different cutting periods.

Treatment	Total Woody Biomass Volume at 84 MAP (m ³ ha ⁻¹)
All coppice	6352b
One coppice	4264c
Two coppice	8318a
Three coppice	8164ab
Un-cut (Control)	4142c
CV	33

Columns with the same letter subscription was not significant different, MAP (months after plant), MAC (months after cutting), CV (coefficient of variance).

Table 4: Woody biomass volume of different coppice levels.

is needs to do more research on other ages in order to overcome the problems of fuel wood and other wood demand shortage in the district.

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Treatment	Cutting periods					
	36MAP		48MAP		60MAP	
	48MAC m ³ ha ⁻¹	84MAP m ³ ha ⁻¹	36MAC m ³ ha ⁻¹	84MAP m ³ ha ⁻¹	24MAC m ³ ha ⁻¹	84MAP m ³ ha ⁻¹
All coppice	4830a	6190ab	3268ab	6504ab	1688ab	6412ab
One coppice	1412b	3013b	1387b	4518b	380b	5262b
Two coppice	5245a	6316a	5546ab	9982ab	1770a	8657a
Three coppice	3794ab	5327ab	8434a	12172a	1070ab	6993ab
CV	49.46	33.55	51.72	38.65	69.05	21.39

Columns with same letter are not significantly different, MAP (months after plant), MAC (months after cutting) and CV (coefficient of variance)

Table1: Woody biomass volume comparison of different cutting period and leaving of different number of coppice of *Acacia nilotica*.

Treatment	Total woody bio-mass volume (m ³ ha ⁻¹)		
	84MAP (36MAP+48 MAC)	84MAP (48MAP+36MAC)	84MAP (60MAP+24 MAC)
All coppice	6190a	6504ab	6412ab
One coppice	3013a	4518b	5262ab
Two coppice	6316a	9982ab	8657a
Three coppice	5327a	12172a	6993ab
Control (Un-cut)	4142a	4142b	4142b
CV	38.24	46.59	33.43

Columns with same letter subscription are not significantly different, MAP (months after plant), MAC (months after cutting), CV (coefficient of variance)

Table 2: Volume comparison of coppicing levels and cutting periods of *Acacia nilotica* with control.