

Research Article

Adaptation and Growth Performance Evaluation of Lowland Bamboo Species at Oddo Shakiso District of Guji Zone Southern Ethiopia

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Abstract

Bamboo is a fast-growing plant species than other and starts to yield within three or four years of planting. Even though Ethiopia is one of the most endowed countries in having huge coverage of bamboo resource in Africa, the country has narrow genetic diversity only has two species; *Yushania alpine* (highland bamboo) and *Oxytenanthera abyssinica* (lowland bamboo). With these two species, it is very difficult to secure constant supply of bamboo benefits. So, adaptation study of lowland bamboo was conducted with objectives of to evaluate the adaptability potential of different lowland bamboo species, and to identify the best performing of lowland bamboo species in midland agroecology of Oddo Shakiso District of Guji zone from 2021 to 2024. Three different bamboo species namely: *Oxytenanthera abyssinica*, *Guadua amplexifolia*, *Dendrocalamus hamiltonii* and *Dendrocalamus membranaceus* were collected from Bako agricultural research center. Among those mentioned only *Oxytenanthera abyssinica* is indigenous while the rest are exotics. The experiment was laid out in RCBD with three replications. From these bamboo species, *Dendrocalamus hamiltonii* and *Oxytenanthera abyssinica* performed well in the study area with all growth parameters and *Dendrocalamus membranaceus* performed less. Therefore, we recommend these two species for further demonstration and pre-scaling up.

Keywords: Adaptation; Growth performance; Lowland bamboo species

Introduction

Bamboos are woody plants that belong to subfamily *Bambusoideae*, family *Graminaceae* (or *Poaceae*), comprising approximately 1250–1500 species among 75–107 genera [1]. They are spread over approximately 35 million hectares (M ha) of land, the equivalent of 0.9% of the total wooded area of the world [2]. Bamboos are broadly tolerant and adaptable to various climatic and edaphic conditions mainly in tropical and subtropical areas [3]. In the case of Ethiopia, the increase in population directed to increased demands for forest-related products and services. The fast-growing nature of bamboo enables the fulfillment of the demand for wood-related products and is more responsible to save the forest [4]. It is used as a substitute for timber and plays an important role in reducing environmental degradation [4]. In addition to the direct benefits and environmental services, the fast-growing nature of bamboo is an important species for adapting climate change through carbon sequestration [4,5].

In recent decades, bamboo has become a globally important biomass resources in many parts of the world. Bamboo forests can be planted in degraded tropical forests because they are an important component of most tropical forest ecosystems and are adaptable to adverse site conditions. While contributing to environmental sustainability, they also provide income as well as a range of goods and ecosystem services for rural households, thus, contributing to food security and poverty eradication (Solomon et., al 2020).

Therefore, it is important to introduce and adapt high economic value of exotic bamboos species to improve the income of small farm holder, to diversify the genetic resources of bamboos species and for environmental protection in Ethiopia. Bamboo is versatile with a very short growth cycle. Bamboo is a high yield renewable natural resource for agro-forestry and engineering-based products (Robert Henrikson, 2009). Based on these all-indispensable values of the species, the study of bamboo adaptation was started at shakiso condition since 2021 with the objectives of to evaluate adaptability potential of different provenance of lowland bamboo species around shakiso condition Guji zone and to provide the best performance of lowland bamboo species.

Methodology

Description of Study Area

The study was conducted at shakiso District of Guji Zone, Southern Ethiopia for four consecutive years. The area is characterized by bimodal rainfall pattern with longest rain season (locally known as Hagayya) and a short rainy season (locally known as Ganna). The district has geographical location of 5°2'29" - 5°58'24" northing latitudes and 38°35'0" - 39°13'38" easting longitudes. The district is characterized by three agro-climatic zones, namely highland (Bada), accounting for about 33%, midland (Bada dare), accounting for about

47% and lowland (Gammojjii), accounting for about 20% district area coverage. Most of the earth surface of the district is ups and down of the land surface with an elevation ranging 1500-2000 m a.s.l. in the larger southern portion of North Western part. Plains, dissected hill plateau and mountain as well as valleys and gorges characterized the relief of the district.

The mean annual rain falls about 900mm and the mean annual temperature of the district is 22.50C. The soil textural class of the experimental area is clay with pH of 6.95. The most widely cultivated crops in the district are wheat, barley, maize, teff, Haricot bean, chick peas, Linseed, rapeseed, fruits, and Vegetable (District statistical abstract of 2014/15).

Treatments and Experimental Design

The experiment was laid out in RCBD with three replications. The distance between blocks and plots was 3m and 2m, respectively. also, the space between each plant was 3m and the plot size was 9m*9m=81 m² with total area of 1386m² and with a total of 108 plants. As a treatment four lowland bamboo species was used: *Oxytenanthera abyssinica*, *Guadua amplexifolia*, *Dendrocalamus hamiltonii* and *Dendrocalamus membranaceus*. Among those mentioned species *Oxytenanthera abyssinica* is the indigenous bamboo species. Cutting of these low land bamboo species was collected from Bako Agricultural Research Center.

Data Collection Method

The adaptation of lowland bamboo at Oddo Shakiso District of Guji Zone southern Ethiopia was conducted from 2021 to 2024 to evaluate the adaptability potential of different provenance of lowland bamboo species and to provide the best performing of lowland bamboo species around Oddo shakiso areas.

Concerning about growth performance issues data like; culm height, culm diameter, internode length, number of nodes, new shoot emerging, and other growth parameters were considered during data collection. The data were collected every three months interval to see the changes among the species.

Data Analysis

The collected raw data were analyzed with analysis of variance (ANOVA) following the General Linear Model (GLM) procedure using GenStat Software. For significant differences, mean separation using LSD was conducted at 5 % level of significance.

Therefore, for these analyses the following parameters were considered and measured; Number of new emerging shoots, Survival rate in %, root collar diameter, internodes length, number of nodes, culm height and diameter data were collected.

Result and Discussion

Survival Rate

During four-year trial of lowland bamboo species at shakiso condition, *Dendrocalamus hamiltoni* shows high survival percentage (88.8%) followed by *Oxythentra abyssinica* (22.2%) while *Dendrocalamus membranaceus* shows the least survival percentage and poor adaptation which is 3.7%. This shows that temperature and soil condition of shakiso area suited for growth of *Dendrocalamus hamiltoni* lowland bamboo variety. From exotic lowland bamboo species, *Dendrocalamus hamiltonii* shows significance difference by survival percentage (Figure 1).

This result is similar with report from Bako agricultural research center by Terefe et al., [6] shows higher survival rate for *Dendrocalamus hamiltoni*.

New Emerging shoot.

Based on analyzed four year data at shakiso condition, *Dendrocalamus hamiltoni* bamboo species shows significant difference in number of new emerging shoot (8.5) followed by *Oxythentra abyssinica* (3.8) (Figure 2). The least new emerging shoot was recorded from *Dendrocalamus membranaceus* which shows (1.4). This shows that condition of the study area suited for good performance and for well adaptation of *Dendrocalamus hamiltoni* followed by *Oxythentra abyssinica*.

Internode Length and Number of Node

The mean value of internode length shows significance difference at 0.5 significance level between treatments. The highest mean was recorded from *Dendrocalamus hamiltoni* followed by *Oxythentra abyssinica*, while the least mean of Internode length recorded from *Dendrocalamus membranaceus* (Table 1). In case of number of nodes, the highest mean was recorded from *Dendrocalamus*

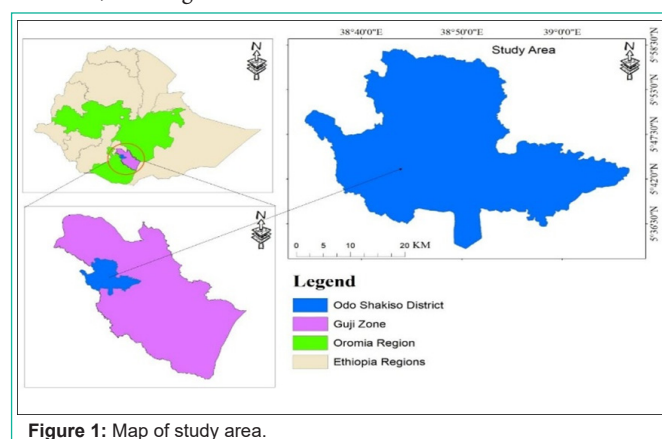


Figure 1: Map of study area.

Table 1: Average means Comparisons between treatments at 0.05 significant levels (Mean).

Treatments	Av. NNS	Av. IL (cm)	Av. CH (m)	Av. CD (cm)	Av. RCD (cm)	NON (no)
D.Membranaceous	1.4 ^b	6.87 ^a	1.27 ^{ab}	0.43 ^b	0.433 ^b	0.43 ^b
D. Hamiltoni	8.5 ^a	19.77 ^a	3.7 ^a	1.7 ^a	2.533 ^a	16.5 ^a
O. abyssinica	3.8 ^{ab}	11.77 ^a	2.1 ^b	0.76 ^{ab}	1.167 ^b	15.3 ^a
Cv (%)	27.9	24.5	18.8	31.6	34.4	10.8
LSD (0.05)	5.6	12.8	2.7	1.6	1.4	18.9

*NNS -Average Number of New shoots, *IL - Average Internode Length, *CH - Average Culm Height, *CD - Average Collar Diameter, *RCD Average Root Collar Diameter, *NoN- Average Number of Node

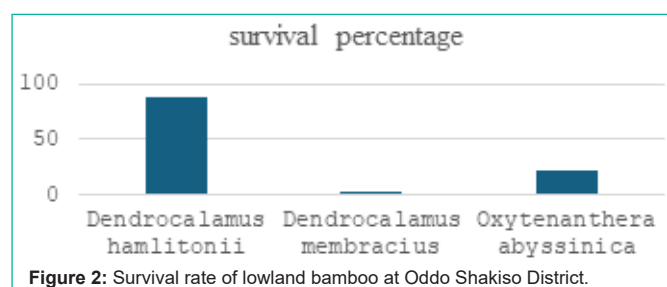


Figure 2: Survival rate of lowland bamboo at Oddo Shakiso District.

hamiltoni followed by *Oxytenanthera abyssinica*. The lowest number of node was recorded from *Dendrocalamus membranaceus* lowland bamboo species.

Culm Height and Diameter

Bamboo culm's structure is cylindrical and is divided into sections by diaphragms or nodes. The section between two nodes is called internodes. Internodes are hollow in most bamboos, but solid in some species. Direct or indirectly bamboo internodes length can indicate the quality of bamboo product which used for different purpose. The result showed that the highest mean of culm height and Diameter recorded from *Dendrocalamus hamiltonii* followed by *Oxytenanthera abyssinica*. The least bamboo culm height and diameter was from *Dendrocalamus membranaceus*. Also Terefe et al., [6,7] and Yared k, 2013 reported highest culm height and diameter for *Dendrocalamus hamiltonii* bamboo species.

Root Collar Diameter

Significant difference at ($p < 0.05$) was observed between lowland bamboo species during these four year trial for root collar Diameter. Here the highest root collar diameter was recorded from *Dendrocalamus hamiltonii* (2.5) followed by *Oxytenanthera abyssinica* (1.1) and the least root collar diameter was recorded from *Dendrocalamus membranaceus* (0.43).

Conclusion and Recommendation

As conclusion during four-year trial, *Dendrocalamus hamiltonii* and *Oxytenanthera abyssinica* bamboo species performed and adapted well based on growth performance data. Especially *Dendrocalamus hamiltonii* shows great performance at Oddo shakiso condition. So as recommendation further demonstration and prescaling up must apply for both *Dendrocalamus hamiltonii* and *Oxytenanthera abyssinica* bamboo species.

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Conflict of Interest

Authors Declares no conflict of interest on Manuscript

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