



**Ministry of Environmental
Conservation and Forestry
Forest Department
Forest Research Institute**



**Study on Shoot and Culm Development of Hmyin
(*Dendrocalamus strictus* (Roxb.) Nees) in Old Aged
Bamboo Plantation in Moeswe**

By

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သက်ကြီးမျှင်ဝါးစိုက်ခင်း၌ မျှစ်နှင့်ဝါးထုတ်လုပ်မှုအတွက်ကြီးထွားနှုန်းအားလေ့လာခြင်း

မူမူအောင်၊ လက်ထောက်သုတေသနအရာရှိ၊ သစ်တောသုတေသနဌာန
အောင်ဇော်မိုး၊ လက်ထောက်သုတေသနအရာရှိ၊ သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်း

ဤစမ်းသပ်မှုကို ပျဉ်းမနားမြို့နယ်၊ မိုးစွဒေသ၊ ငလိုက်ကြီးဝိုင်း အကွက်အမှတ်(၇၂) အတွင်းရှိ သက်ကြီးမျှင်ဝါးစိုက်ခင်း(၂)ဧကတွင် ဆောင်ရွက်ခဲ့ပါသည်။ သုတေသန၏အကျိုးရလဒ်မှ မျှစ်နှင့်ဝါးတို့၏ ကြီးထွားနှုန်းနှင့် အထွက်နှုန်းကို နှိုင်းယှဉ်ဖော်ထုတ်နိုင်ခဲ့ပါသည်။ မျှင်ဝါးစိုက်ခင်းရှိ ဝါးရုံများအား စိုက်ခင်း စီမံအုပ်ချုပ်ခြင်းနည်း(၃)မျိုးကိုအသုံးပြု၍ (၂)နှစ်အတွင်း လေ့လာဆန်းစစ် ခဲ့ပါသည်။ ယင်းစိုက်ခင်း၏ ၂နှစ်အတွင်း ပျမ်းမျှထွက်ရှိလာသော မျှစ်အရေအတွက်၊ ဝါးရုံအလိုက် ရရှိလာသော ဝါးအရေအတွက် ယင်းတို့၏အမြင့်နှင့်လုံးပတ်တို့တွင် စမ်းသပ်မှု(၃)ခု အနက် ဝါးရုံ ရှင်းလင်းခြင်း၊ မြေပုံခြင်းနှင့် မြေဩဇာကျွေးခြင်းသည် အကျိုးအရှိဆုံးနှင့် အထိရောက်ဆုံး ဖြစ်ပါသည်။ ဤစာတမ်းသည် ဒေသခံပြည်သူများ၏ လူနေမှုဘဝ ဖွံ့ဖြိုးတိုးတက်မှုအတွက် ဝါးထုတ်လုပ်မှု အခန်းကဏ္ဍကို စဉ်ဆက်မပြတ် တိုးမြှင့် ဆောင်ရွက်ရန်နှင့် မျှစ်နှင့်ဝါးထုတ်လုပ်မှု ရေရှည် တည်တံ့စေရန် စိုက်ပျိုးပြုစုခြင်း၊ စီမံအုပ်ချုပ်ခြင်းနည်း စနစ်များကို လက်တွေ့အသုံးပြုနိုင်ရန်အတွက် အထောက်အကူပြုစေရန် ရည်ရွယ်ပါသည်။ ဝါးစိုက်ခင်း တည်ထောင်ခြင်းသည် ဇီဝမျိုးစုံ မျိုးကွဲများကို တစ်နည်းတစ်ဖုံပြောင်းလဲစေခြင်း၊ မြေယာပြောင်းလဲ အသုံးပြုမှုကို လျော့နည်းစေခြင်းတို့တွင် တစ်ခု အပါအဝင်ဖြစ်ပါသည်။

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Abstract

The study on shoot and culm development of *Dendrocalamus strictus* is old aged Bamboo plantation. The experimental site was conducted in the compartment No. (72) Ngalaik Reserved Forest at Moeswe, East Bago Yoma. *Dendrocalamus strictus* plantation area has 2 acres which was established in 1984. The growth performance of new shoots and culms of *Dendrocalamus strictus* on old aged Bamboo plantation with three treatments were assessed over a period of two years. The influence of the organic fertilizers on average number of shoot emergent, number of culm per clump, average height and culm diameter was significant during the first year and second year of this plantation. The results have shown a comparatively good growth and development of both shoots and culms. This paper provides guidelines to practice the silvicultural management techniques leading to sustainable production of shoots and culms and to improve the sustainable production of bamboo for rural development, bamboo plantation is one of the alternatives to increase the biological diversity and reduce the adverse effects of land uses.

Key words: *Dendrocalamus strictus*, shoot and culm, growth development, silviculture management, sustainable production

Contents

	Page
စာတမ်းအကျဉ်း	i
Abstract	ii
Contents	iii
1. Introduction	1
1.1. Distribution and Ecology	3
1.2. Uses	4
2. Objectives	4
3. Materials and Methods	5
3.1. Study Area	5
3.2. Experiment	5
3.3. Statistical Analysis	6
4. Results and Discussion	6
4.1. Effects of experiment	6
5. Conclusion	11
Appendix	
Acknowledgements	
References	

1. Introduction

Bamboo, which is known as “green gold” is one of the most important natural forest resources in Asia, Africa, Latin America, and the Pacific. It is also known as the “poor men’s timber” as it is extensively used by the poor for their needs. China considered bamboo as “friend of the people” as it produces multi-use culm, edible shoots and its long fiber is most suitable for paper making, thus, creating cash income for the rural people.

Myanmar is rich in bamboo resources and the species is greatly used by the rural people. Although the usefulness of bamboo, especially for the rural people is known and accepted, it is classified as a minor forest produce and has been neglected in the management of forests in most countries. Moreover, markets and bamboo base technology was not well established and the value of the species was not realized.

However, with the increased in population, change in time and improved technology, value added bamboo products are becoming more and more important. Export of bamboo products, such as furniture, parquet, bamboo laminated board, bamboo charcoal, plastic coated bamboo cloths drying lines, fishing rods and bamboo handicrafts, have now started and their values are now being realized and appreciated. It is therefore climbing up the ladder as the most useful and important produce that occupies a place of pride in the economy of most bamboo producing countries. Thus, Myanmar its own way has encouraged the processing, marketing and export of bamboo products by sensitizing interested persons of the potential that bamboo has and the success that other countries are enjoying. We need to encourage the promotion of bamboo products, especially in the cottage bamboo industry level.

In Myanmar, bamboo is useful material for construction, industry, transportation, food, and agriculture. Thus, it is to be said that bamboo is a traditionally multiple plant species that has rooted the human civilization and giving all needs of human beings. The use of bamboo may be more than 1500 items. Bamboo, although is important for the rural population as well as urban. Bamboos on the other hand have to substitute the tree species which may be required with the population growth. Therefore, it is now required to give attention on the bamboo management and utilization effectively.

Globally, about 75 genera and 1,250 species of bamboo existed (INBAR &

IPGRI, 1994a), (Sharma, 1979). They are distributed in tropical subtropical and temperate zones of Africa, America, Asia and the Pacific (Kress *et.al.*, 2003) The species has a wide range of distribution. Some are recorded from latitude as far north as 46⁰ and as far south as 47⁰ and occurring from sea level to as high as 4000m elevation. Majority of the species are found in subtropical or tropical habitats, a few from temperate regions of Japan and China near the snowline in the Himalayas, and the Andes are also reported (INBAR & IPGRI, 1994b). However, it is found growing mainly at altitude between 100m and 800m (Somboon, 2001).

Intensified interest in bamboos has resulted in their emergence as potential the most important non-timber forest resource to substitute wood. Their strength, straightness, lightness combined with extraordinary hardness, range in size, abundance, easy propagation and short vegetation period to attain maturity, make them suitable for a variety of purposes and uses. Furthermore, bamboo as a woody plant is uniquely suited to agroforestry.

With its intensive utilization, bamboo is now an exploited plant and the supply of raw material has already decreased. In this regard, an improved knowledge of bamboo production plays an important role. There are several production techniques that can be employed to improve and increase sustainable yields. The proper knowledge for sustainable production is vital to the improvement of local living.

Bamboo shoots are very important local food supply and commercial products as well. The shoots of various species are consumed by the people of all income levels, particularly in southeast and East Asia. They are harvested from natural bamboo stands as well as from bamboo plantations. Rural people in Myanmar harvest bamboo shoots from the natural forest during rainy season for their household consumption and for an additional income. Culms are harvested and used as building material and various kind of handicrafts which generate a substantial income in rural community. Some particular species are raised as commercial plantation from which shoots and culms are harvested for different purposes. Suitable methods and intensity of shoot and culm harvesting are

the essential issues in sustainable management of bamboo forests and plantations. The methods and intensity of shoot harvesting will have the impacts on shoot and culm production.

Thinning is applied when new bamboo stands reach the age of four or five years. The suitable time is the dry seasons, from September to January (Le, 2000). All of the culms up to three years of age should be thinned. Unwanted formed culms such as topless culms, horseshoed culms and dry-out culms are removed as well (Dransfield and Widjaja, 1995). In addition, thinning of bamboo stands should be done before spring. After thinning, the ground should be cleaned up and tending operations are required.

Weak shoots should also be removed to ensure sufficient nutrients for the healthy ones (Fu and Banik, 1996). In general, the main period of shooting of sympodial bamboo species is from July to August and that of monopodial species is from February to

March. During these periods of time, shoots grow strongly and they should be kept to obtain new culms. The other shoots growing in earlier and later stages need to be thinned.

1.1. Distribution and ecology

Dendrocalamus strictus (Roxb.) Nees is the best known, commonest and most widely distributed of all Myanmar bamboos, occurring in deciduous forests all over the country. This species occupies 53 per cent of total bamboo area in Myanmar. Widely distributed in Myanmar in semi dry and dry zone along plains and hilly tracts usually up to an altitude of 1000 m, also commonly cultivated throughout the plains and foot hills. They are also growing in other part of Asia and Latin America. *D. strictus* is widely adaptable to temperatures as low as -5°C and as high as 45°C. This species is mainly found in drier open deciduous forests in hill slopes, ravines and alluvial plains. It prefers well-drained, poor, coarse, grained and stony soils. It occurs naturally in tracts receiving as low as 750 mm of rainfall and also in extensive gregarious patches or as an understory in mixed forests and teak plantations.

Dendrocalamus strictus is most commonly called as solid. The species is widely distributed in dry deciduous forests and grows rapidly in all climatic conditions. It grows better in the drier parts and on sandstone, granite and coarse grained soils with low moisture retaining capacity and soils with p^H 5.5 – 7.6. It grows more than 8 feet in 6 months.

Dendrocalamus strictus grows on practically all types of soils provided there is good drainage. It does not grow on water-logged or heavy soils such as pure clay or a mixture of clay and lime. Well-drained localities with sandy loam are the best for bamboo growth. The species is found growing well in the areas having a rainfall between 750 mm-4000 mm and it flourishes in regions where the relative humidity of the air is low. The species is usually not found on precipitous slopes or on flat ground unless it is well-drained. It prefers hilly ground and is tolerate to frost and drought.

Bamboo growth may be regarded as accumulation of dry matter with increment in height and diameter. The growth rate may differ depending upon the species and environment.

1.2. Uses

It is extensively used as raw material in paper mills and also for a variety of purposes such as construction, agricultural implements, musical instruments, furniture etc. It is found suitable for reclamation of ravine land. This species is one of the two most important bamboos because of its thick wall and able to take in nail without splitting the bamboo. It actually can be work like the wood. Young shoots are commonly used as food. Decoction of leaves and nodes and silicious matter is used in the traditional medicine.

2. Objectives

The objectives of the study was ----

1. To study growth performance of shoots and culms of *Dendrocalamus strictus* (Roxb.)
Nees

2. To study the effect of fertilizer (N) and humus on the productivity of shoots and culms of the species
3. To find out the most suitable silvicultural techniques as well as management practices leading to sustainable production of shoots and culms.
4. To assess the effect of three treatments on the productivity of shoots and culms
5. To investigate the effect of shoots and culms harvesting by different treatment on the performance and productivity

3. Material & Methods

3.1. Study Areas

The study area selected was the old bamboo plantation (*Dendrocalamus strictus*) which is located in the compartment No. (72) of the Ngalaik Reserved Forest, Pyinmana Township. It is at an altitude of 170-225 m above sea level, and between latitude 19°56' N and longitude 95° 56' E. The climate of the area is monsoon. The soil is sandy loam with pH between 5.76 to 6.77. The maximum and minimum temperature and rainfall was 28 °C/31.5 °C and 105mm/117.5 mm, respectively.

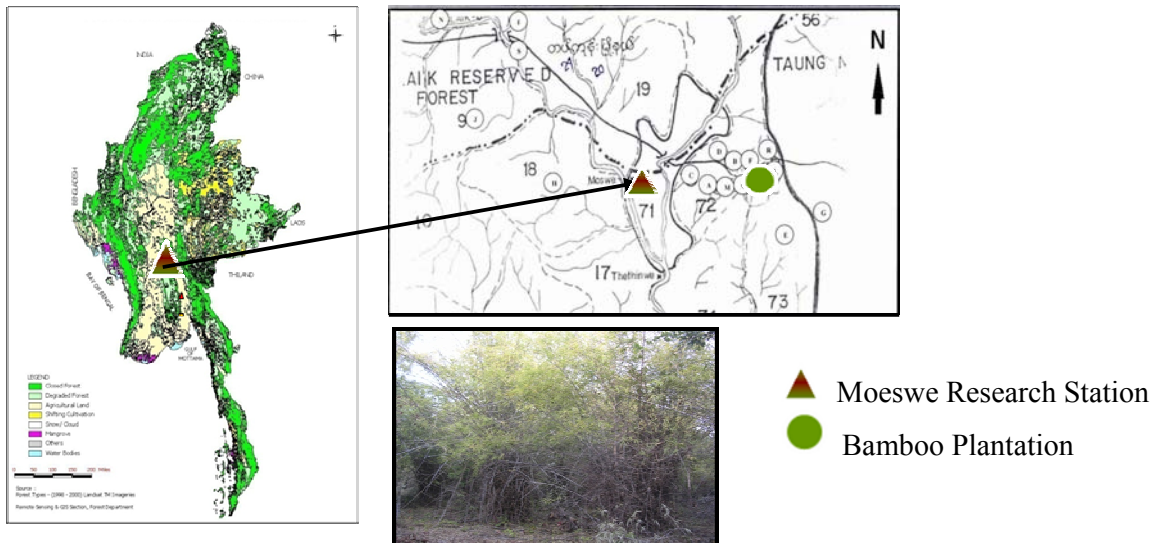


Fig. 1. Location of Study Site

The plantation has an area of 2 acres which was established in 1984. The traditional method was used by planting rhizome offsets in establishing the plantation. Rhizomes of One or two year old culms were dugout from the mother clump. The spacing of 3 m x 3m is used for this plantation. The offsets were transported from nursery to the field and planted in a 45 cm x 45 cm x 45 cm pits.

3.2. Experiment

The following 3 treatments for silvicultural management of the planted rhizome offsets were given;

Treatment 1: Thinning operation of 30 clumps

Treatment 2: Thinning and Soil mounting of 30 clumps

Treatment 3: Thinning, Soil mounting and Fertilizing of 30 clumps

Another 30 clumps other than the above were taken as control.

The statistical design for this experiment were completely randomized design. There were 3 replications of 10 clumps of each treatment. The following data were collected:

- (1) Total number of shoots and development culms, and their height and diameter.
- (2) The experimental data were collected between June 2008 and December 2009, respectively.

3.2. Statistical Analysis

Data collected has been processed and accumulated by using Microsoft Office Excel 2003. Collected data has been statistically analyzed by using statistical software: Statistical package for social science (SPSS) student version. One way analysis of variance (ANOVA) was used to test differences between treatments of the species.

Results and Discussion

4.1. Effects of experiment

The effect of growth performance in all treatments were very significantly after the operation. This very high new shoots and culms can be attributed to the quality of the clumps rather than due to the treatments.

4.1.1. Effects of treatments on monthly average number of shoots emergent during the two year of plantation development

The shoot production during the growing season of all treatments within the two years. During the two year period, a similar see- saw pattern but with variable peaks and low monthly average shoot emergence had been observed in all the treatments and the control. Very few shoots if ever there are, arise during the dry season when the soil moisture is at its lowest (Uchimura, 1978). In warm regions with frequent and well-distributed rainfall throughout the year, the growth may be virtually continuous (Latif et al., 1998).

According to Uchimura (1978), vegetative growth of bamboos is more affected by soil moisture rather than by temperature. The availability of soil moisture and the decreased in temperature during the rainy season influence the emergence of shoots. In study, April was the month with lowest rainfall. It started to increase in May and shoot emergence became very aggressive in June.

4.1.2. Effects of Thinning, Soil mounding and Fertilizing operation on monthly average number of shoots that developed into culms

In this study, the shoots that emerged and grew to its maximum height and about to produce the first branch were recorded as developed culms. It takes less than two months or 45 to 50 days for the shoots to fully develop into a culm, attain their maximum height and start to produce their branches. Ideally, the number of shoots that developed into culms is directly related to number of shoots that emerged. Effects of the various treatments on productivity of new shoots that developed into culms in this species varied. This application enhances growth and yield. Most of the new bamboo shoots fully

developed into new culms within 3 to 4 months during rainy season. This pattern only confirms the growth trend described by Suwannapinunt et al. (1988), Maoyi et. al. (1988), Uchimura (1980), Mc Clure (1966) and Holtum (1958).

In *D.strictus*, significant differences in the effects of organic fertilizers on shooting were only manifested during the one month at second years of after treatment. Among the individual treatments, the thinning, soil mounting and fertilizing gave the highest average total number of shoot emergent.

Table: Average number of culms per clump during the two years

Treatment	Average Culms per Clump of 2008	Average Culms per Clump of 2009
T 1	8.8	9.4
T 2	9.2	7
T 3	10	10.4
Control	2.16	3.2

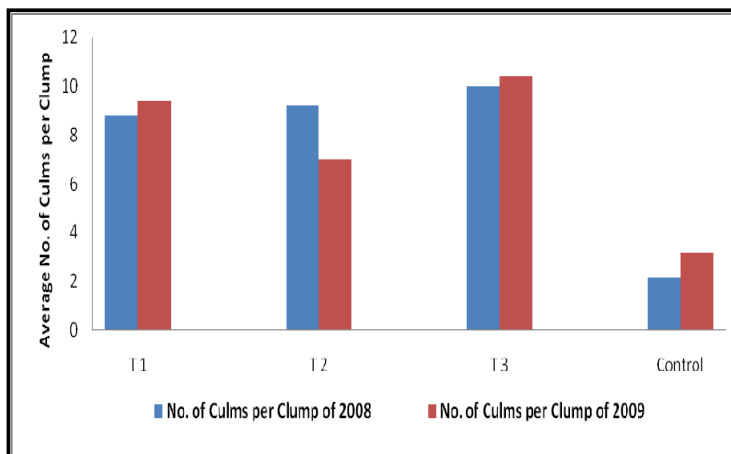


Fig.2 Average number of culms per clump during the two years

(a) Average number of culms

In *D. strictus*, significant differences on the effects of organic fertilizers on the average number of culms occurred only during the 6 months and one year of plantation development. Fig. 2 and 3 showed that the treatment with thinning, soil mounding and fertilizing gave the highest average total number of culms per clump.



Fig. 3. The growth monitoring periods during the second year of plantation development

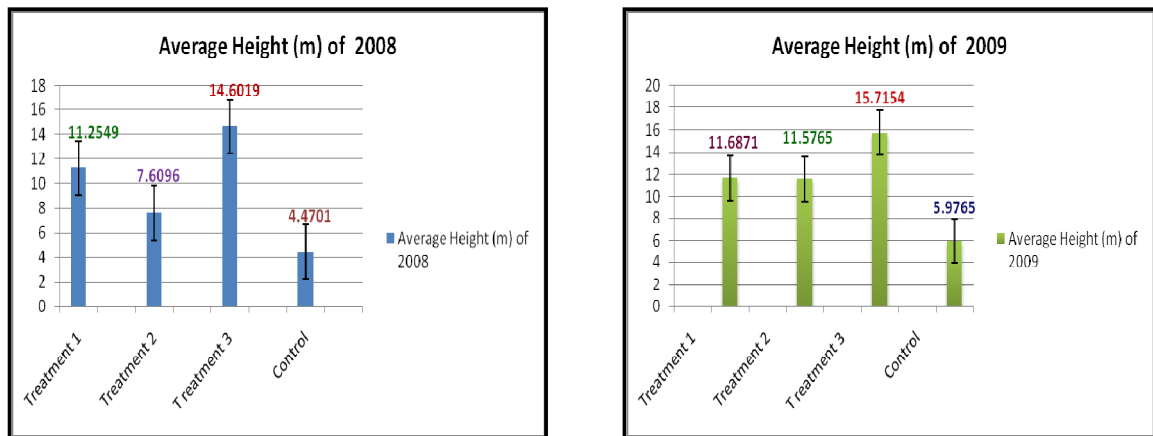


Fig. 4. Culm Production per clump of *Dendrocalamus strictus* based on height classes

(b) Average height and diameter of culms

Figures 4 and 5 showed the succession growth pattern of all treatments, respectively. no significant effects of organic fertilizers on height and diameter growth were observed in all the growth monitoring periods during the two years of plantation development. Treatment with thinning, soil mounting and fertilizing gave the highest average total height and diameter, respectively. Only for the first year the thinning, soil mounting and fertilizing resulted in bigger culms than the other treatments including the control.. However, treatment with thinning, soil mounting and fertilizing gave the highest average total height.

(c) Succession growth of culms

It can be noted that profuse shooting in all the treatments including the control occurred on the first year with culms mostly having a diameter of up to 11 cm and few with diameter of more than 4 to 7 cm.

During the second year, culms were in all the treatments including the control almost equal in number with diameter classes of less than 5 cm and 5 to 8 cm. In *D.strictus*, however, culms of less than 8 cm were greater in number than those with more than 8 to 10 cm diameter. During the two years plantation also culms of up to 11 cm and up to 12 cm developed.

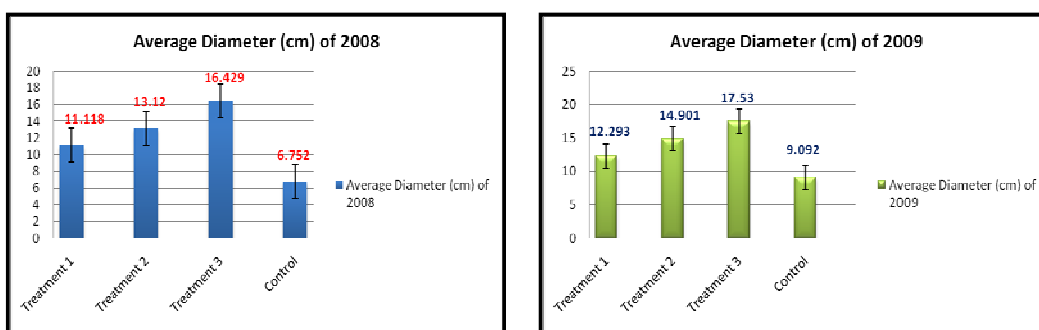


Fig. 5. Culm Production per Clump of *Dendrocalamus strictus* based on diameter classes

In *D. strictus* culms emerge during the rainy season from nodes located on the rhizomes of the previous year culms and grow to full height before branching in about 3±4 months. The production of new culms is linearly related with the number of old culms in a clump, and the majority of new culms is produced by the rhizomes of 1±2 year old culms (Tomar, 1963).

5. Conclusion

Production of vegetatively propagated planting materials is possible even without rooting hormone application but by using mist-propagation chamber. Likewise, it is possible to convert marginal lands such as an unproductive coconut plantation, into productive lands using these species. The high new shoots and culms (80%) and comparatively good growth and development of all treatments in the field, with or without organic fertilizer treatments, proved that the species can be grown in high elevation areas with acidic soil, particularly if there is well distributed rainfall throughout the year. The influence of the three treatments tested on growth and development of *D. strictus* species was only significant during the first year operation. Culms having more than 8 cm in diameter developed in species during the second year of the operation. This implies that the future of plantation development, harvest of commercial culms is already possible.

Appendix

Table (1). Analysis of Variance for Total Culm Height (m) of the Three Treatments

S . V	d.f	SS	MS	Computed F	CV%
Between groups	2	49.15573	24.57787	4.92*	17.8%
Within groups	57	284.62163	4.99336		
Total	59	333.77736			

* significant at 5% level

Table (2). Analysis of Variance for Total Culm Diameter (cm) of the Three Treatments

S . V	d.f	SS	MS	Computed F	CV%
Between groups	2	41.256763	20.628382	22.12**	17.0%
Within groups	57	53.153535	0.932518		
Total	59	94.410298			

** Highly significant at 1% level

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References

Sharma, Y.M.L Production and utilization of bamboos and related species in the South Asian region in the rural sector. *Indian For.* 114: 603-609. (1987).

Abd. Latif, M. and W. Liese. 1998. The moisture content of two Malaysian bamboos in relation to age, culm height, site and harvesting month. *Proceedings 5th International Bamboo Congress, San Jose, Costa Rica, 2-6 November 1998.* 10 p.

Diver, S. 2001. Bamboo. A Multi-purpose Agroforestry Crop. Current Topic. *Appropriate Technology Transfer for Rural Areas (ATTRA)*, August 2001. 13 p.

Espiloy, Z. B. 1994. Effect of age on the physico-mechanical properties of some Philippine bamboo. In *Bamboo in Asia and the Pacific. Proceedings of the 4th International Bamboo Workshop, Chiangmai, Thailand, 27-30 November 1991.* International Development Research Centre, Ottawa, Canada; Forestry Research Support Programme for Asia and the Pacific, Bangkok, Thailand. pp. 180-182.

Farrelly, D. 1984. *The Book of bamboo: a comprehensive guide to this plant, its uses and its history.* Sierra Club Books. San Francisco. CA, United States of America. 340 p.

Gonzales, L.L. and P.A. Umali. 1995 . The Art and Technique of Establishing Bamboo plantation in cogonal and stony areas. *The Magalang Experience.* *Canopy International.* 21 (1-2): 9-11.

Hartman, H.T. and D.E. Kester. 1959. *Plant Propagation: Principles and Practices.* Prentice Hall, New York.

Hoanh, N. H. 1992. Effects of complete fertilizer (14-14-14) on the performance of *Bambusa blumeana* in Mt Makiling, Los Baños, Laguna. *Proceedings of the Third National Bamboo Research and Development Symposium, 27-28 April 1992.* pp. 41-52.

Holttum, R. E. 1958. *The Bamboos of Malay Peninsula.* *Bull. Botanic Gardens.* Singapore. 135pp.

Maoyi, Fu, X. Jingshong, F. Mingyu, R. Xiaojing and L. Daiyi. 1988. Fertilization studies in bamboo timber stands. *Proceedings of the International bamboo Workshop, Cochin, India 14-18 November 1988.* pp. 121-127.

Mc Clure, F. A. 1966. *The Bamboos: A Fresh perspective.* Harvard University Press. Cambridge, Massachusetts. 347 p.

PCARRD. 1991. The Philippine Recommends For Bamboo Production. Philippines Recommends Series No. 53- A. 33 p.

Rojo, J. P. 1996. Bamboo resources of the Philippines. Paper presented at the 1st National Conference of bamboo. August 1-2, 1996. Sarabia Manor, Iloilo City, Philippines.

Suwannapinunt, W. and B. Thaiutsa. 1988. Effects of fertilization on growth and yield of bamboos. Proceedings of the International Bamboo Workshop, Cochin, India, 14-18 November 1988. pp. 117-120.

Uchimura, E. 1978. Ecological studies of cultivation of tropical bamboo forest in the Philippines. Bull. No. 301. Forestry and Forest Products Research Institute, Ibaraki, Japan, pp. 79-118.