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A Follow-up Study on Effective Planting Techniques for Teak

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စိုက်ပင်အမျိုးအစား (၃) မျိုးဖြင့် စိုက်ပျိုးထားသော ကျွန်းစိုက်ခင်းအား (၁၀) နှစ်သားအရွယ်တွင် ဆက်လက်လေ့လာခြင်း

ရန်မျိုးနိုင်၊ ဦးစီးအရာရှိ
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်း

မြန်မာနိုင်ငံ၏ လူမှုစီးပွားဖွံ့ဖြိုးတိုးတက်မှုအတွက် လိုအပ်ချက်များကို ဖြည့်ဆည်းပေးနိုင်ရန် ရည်ရွယ်၍ ကျွန်းစိုက်ခင်းများကို ၁၉၉၈ ခုနှစ်မှစတင်၍ အထူးစီမံချက်တစ်ရပ်အနေဖြင့် အမြောက်အမြား စိုက်ပျိုးလာခဲ့ပါသည်။ ကျွန်းစိုက်ခင်းများတည်ထောင်ရာတွင် အစေ့တိုက်ရိုက်ချစိုက်ပျိုးခြင်း၊ အစေ့ပျိုးပင်များဖြင့် စိုက်ပျိုးခြင်း၊ လတ်ဆတ်ငုတ်တက်နှင့် သိုလှောင်ငုတ်တက်များဖြင့် စိုက်ပျိုးခြင်း စသည့်နည်းများအသုံးပြု၍ စိုက်ပျိုးလေ့ရှိသော်လည်း သဘာဝပတ်ဝန်းကျင်နှင့် သဟဇာတဖြစ်ပြီး စီးပွားရေးအရ တွက်ခြေကိုက်သော အောင်မြင်သည့် ကျွန်းစိုက်ခင်းဖြစ်စေရန် မည်သည့်စိုက်ပျိုးပင်၊ မည်သည့် စိုက်ပျိုးပြုစုနည်းစနစ်ကို အသုံးပြု၍ စိုက်ပျိုးခြင်းသည် သင့်လျော်သည်ဟူသော အချက်အလက်များနှင့် ပတ်သက်၍ သုတေသနဆိုင်ရာ သတင်းအချက်အလက်များ များစွာလိုအပ်ပါသည်။ ထို့ကြောင့် ဤသုတေသနကို စမ်းသပ်စိုက်ပျိုးထားသော အစေ့ပျိုးပင်၊ လတ်ဆတ်ငုတ်တက်ပင်နှင့် သိုလှောင်ငုတ်တက်ပင်များ၏ သဘာဝအရလည်းကောင်း၊ ကျင်းတူးစိုက်ခြင်းဖြင့်လည်းကောင်း၊ မြေဩဇာကျွေးခြင်းအရလည်းကောင်း စိုက်ပျိုးပင်များ၏ ရှင်သန်မှုနှင့် ကြီးထွားမှုတို့ကို သိရှိနိုင်ရန်နှင့် ကျွန်းအထူးစိုင်ခင်းလုပ်ငန်းများအတွက် အကျိုးရှိပြီး အသုံးချနိုင်မည့် သတင်းများဖြန့်ဝေပေးနိုင်ရန် ရည်ရွယ်၍ ပျဉ်းမနားမြို့နယ်၊ ငလိုက်ကြိုးဝိုင်း၊ အကွက်အမှတ် (၉) အတွင်းရှိ၊ ဧရိယာအကျယ် (၄.၃) ဧကရှိ စမ်းသပ်ကွက်တွင် Split Plot Design အား ထပ်ကြိမ် (၃) ကြိမ် ပြုလုပ်စမ်းသပ်ခဲ့ခြင်းဖြစ်ပါသည်။ ဤနှိုင်းယှဉ်လေ့လာမှုအရ သိုလှောင်ငုတ်တက်ဖြင့် စိုက်ပျိုးထားသော အပင်များ၏ ပျမ်းမျှအမြင့်မှာ အကောင်းဆုံးဖြစ်ပြီး အစေ့ပျိုးပင်နှင့် လတ်ဆတ်ငုတ်တက်ဖြင့် စိုက်ပျိုးထားသော အပင်များ၏ ပျဉ်းမျှအမြင့်မှာ ဒုတိယနှင့် တတိယအဆင့်တွင် အသီးသီးရှိကြောင်း၊ ကျင်းတူးခြင်းနှင့် မြေဩဇာကျွေးခြင်းဖြင့် စိုက်ပျိုးထားသော ကျွန်းစိုက်ပျိုးပင် (၃)မျိုး၏ အမြင့်ဖွံ့ဖြိုးမှုနှင့် သမရိုးကျ စိုက်ပျိုးထားသော အပင်များ၏ အမြင့်ဖွံ့ဖြိုးမှုကို နှိုင်းယှဉ်ရာတွင်သိသာထင်ရှားစွာ ကွာခြားမှုမရှိကြောင်း တွေ့ရှိခဲ့ရပါသည်။ သို့ရာတွင် ငုတ်တက်များကို သေချာစွာ မသိမ်းဆည်းပါက မှိုရောဂါကျရောက်နိုင်ပါသည်။ သို့ဖြစ်ပါ၍ ငုတ်တက်များကို ကောင်းမွန်စွာ သိုလှောင်နည်းများနှင့်ပတ်သက်သည့် လေ့လာမှုများ ဆက်လက်ဆောင်ရွက်သင့်ပါကြောင်း ဤလေ့လာမှုအရ အကြံပြုတင်ပြအပ်ပါသည်။

A Follow-up Study on Effective Planting Techniques for Teak

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Abstract

In Myanmar, a large-scale reforestation/restoration program had been implementing by Forest Department since 1980s in order to supplement the natural forests, and to compensate for the deforestation.From 1996 to 2010, the total area of commercial plantations (both pure and mixed plantations) reached to 541,781 ha representing 56% of the total planted areas.The *T. grandis* plantation constituted 424,743 ha (44% of the total planted area) while the *X. xylocarpa* and *P. macrocarpus* constituted 67,101 ha (7% of the total planted area) and 16,645 ha (2% of the total planted area), respectively.

Moreover, commencing from 1998, teak plantations are being extensively established as a special project to fulfill the socio-economic needs of the country. These plantations should be accomplished silviculturally and economically. In Myanmar, the establishments of Teak plantations have been tried in several ways such as direct seeding, transplanting, fresh stump planting and stored stump planting.Than et.al (2002) assessed the trial at the age of one year of the plantation and presented a paper to Research Congress which was held in Myanmar in 2002. Than et.al (2002) made a comment on their trial in need of further investigations. Therefore, this follow-up study was carried out again at the age of 11 years in 2012 to explore the stable results from the experiment.This study was conducted in compartment No.(9) of Ngalaik Reserved Forest by applying Split Plot Experimental Design with four replications. Data analysis was practiced by using SPSS.16 Statistical Software to explore the best planting technique.

This study highlighted that the mean GBHs of stored stump is the best and followed by that of the fresh stump. The mean GBH of potted seedling is the poorest. Moreover, it was found that there was no statistical difference between fertilizing, digging, and fertilizing and digging and control plots. This study suggested that the observation concerning exploring the best technique to store old stumps should be conducted as further study because this study highlighted that if old stumps were not stored properly, these would be infected by fungus.

Key words: Reforestation program, Commercial plantation, seedling, fresh stump, old stump, Growth, fertilizing, digging

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Acknowledgement

I would like to express my sincere thanks to the former researchers who established this experimental plantation and published the paper in 2002 which is very important to be successful teak plantation establishment. My special thanks go to Forest Department which supports funding for this research.

A Follow-up Study on Effective Planting Techniques for Teak

1. Introduction

Myanmar's forests are being experienced not only deforestation but also forest degradation because of many reasons (FAO, 2010) such as agricultural conversion, fuel wood consumption, charcoal production, commercial logging and plantation development (Leimgruber*et al.* 2005) and other activities such as urbanization and infrastructure developments and the forested area was decreased from 58% of the country's total land area of 676,577 km^2 in 1990 to 47% in 2010.

In order to supplement the natural forests, and to compensate for the deforestation, the Forest Department of Myanmar has been implementing a large-scale reforestation/restoration program that began in 1980s, and about 30,000 ha of forest plantations have annually been formed since 1984. From 1996 to 2010, the total area of commercial plantations (both pure and mixed plantations) reached to 541,781 ha representing 56% of the total planted areas. Commercial plantations are mainly composed of three species, namely: Teak (*Tectonagrandis*), Pyinkado (*Xyliaxylocarpa*) and Padauk (*Pterocarpusmacrocarpus*). The *T. grandis* plantation constituted 424,743 ha (44% of the total planted area) while the *X. xylocarpa* and *P. macrocarpus* constituted 67,101 ha (7% of the total planted area) and 16,645 ha (2% of the total planted area), respectively (Forest Department, 2011).

Moreover,commencing from 1998, teak plantations are being extensively established as a special project to fulfill the socio-economic needs of the country. These plantations should be accomplished silviculturally and economically. In Myanmar, the establishments of Teak plantations have been tried in several ways such as direct seeding, transplanting, fresh stump planting and stored stump planting. To find out the suitable environmentally sound technique for teak planting in a particular locality is the critical duty of the Forest Department (Than et.al, 2002).

In temperate countries, there have been some experiences on stump planting of Conifer species since 70 years ago. Stumps were carefully prepared mixed with sawdust and husk, then stored in the cold chambers with the temperature ranges of -2°C and +2°C. Storage period was from 20 to 200 days and success was gained in plantation establishment (HOCKING and NYLAND 1971, quoted in U KHIN HLAING 1982). In 1974, LOURIDSON and KAOSAARD also observed teak fresh stump storage using sand, husk and sawdust as buffer between the stump bundles. The stumps were stored in the concrete pits for about 5-9 months and then planted in low and high rainfall areas. It was found that the plantations developed successfully and satisfactorily (U KHIN HLAING, 1982).

In 2001, the Forest Research Institute (FRI), Forest Department, established a teak planting technique trial plantation by carrying outtransplanting, fresh stump and stored stump planting followed by digging and fertilizer application at Compartment No. (9), Ngalaik Reserved Forest, Pyinmana. Than et.al(2002)assessed the trial at the age of one year of the plantation and presented a paper to Research Congress which was heldin Myanmar in 2002. Than et.al (2002) made a comment on their trial in need of further investigations. Therefore,

this follow-up study was carried out again at the age of 11 years in 2012 to explore the stable results from the experiment. In the preliminary assessment conducted by Than et.al (2002), height growth was considered due to very young age of the trial plantation and so this time, it wasconsidered to test the girth measurements.

2. Objectives

(1) To explore variations in growth responses from different planting techniques in term of girth at breast height

(2) To provide some useful and applicable information resulted from this research to teak planters

3. Material and Methods

3.1 Study Area

The study area is located in compartment No. (9) ofNgalaik Reserved Forest, Tatkone Township, Nay Pyi Taw which ismanaged by Forest Research Institute in YamethinDistrict. It is a rather flat and ploughed area with sandy clayey loam texture. It isapproximately situated at 19º96' N and 95º56' E. It is situated near the fringe of dry zone andis also part of the BagoYoma range.

3.2 Experimental Design

As this is a follow-up study, the materials and methods are the previous ones (Than et.al, 2002). The experimental design was Split Plot Design with four replications(FAO, 2000). Unfortunately, at the present study, only three replications were available.

Following lists are materials for the experiment:

(1) Potted seedling (P)

(2) One year old fresh stump (F) and,

(3) Stored stumps from one year old seedling (S)

Another two treatment factors, digging and fertilization were also applied to theyoung seedlings. Treatment plots were laid down according to the design employed and oneblock consisted of three plots for each treatment. Each treatment included 49 trees with 9' x 9'spacing. Treatment plots were detached 18' wide so as to avoid mixing the plots and todifferentiate one treatment plot from the other. The layout of the experiment design was shown in Figure 1.

Figure 1. The Layout of Experimental Design (Split Plot Design)

Replication 1

P_0	S_D	$F_{f/D}$	P_f
F_0	P_D	$S_{f/D}$	F_f
S_0	F_D	$P_{f/D}$	S_f

Replication 2

F_f	$S_{f/D}$	P_0	F_D
P_f	$F_{f/D}$	F_0	P_D
S_f	$P_{f/D}$	S_0	S_D

Replication 3

P_D	$S_{f/D}$	F_0	F_f
F_D	$F_{f/D}$	P_0	P_f
S_D	$P_{f/D}$	S_0	S_f

Legend

Subscript letters = 0,f,D,f/D (Main Plot Factors)

0 = no fertilizing and no digging

f = fertilizing

D = digging

f/D = fertilizing and digging

P,F and S are as mentioned in above.(Subplot Factors)

Statistical Analysis was carried out by SPSS.16 Statistical Software. Necessary calculations were done by Microsoft Excel 2007.

4. Results

For the test of hypothesis about mean GBH, the F test of the analysis of variance (ANOVA) is conducted and the result is given as in Table 1.

Table 1. ANOVA for Split Plot Design

ANOVA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	320.169[a]	19	16.851	3.253	.010
Intercept	19976.524	1	19976.524	3.857E3	.000
rep	129.167	2	64.583	12.469	.001
mt	29.982	3	9.994	1.929	.166
st	135.143	2	67.571	13.045	.000
rep * mt	5.744	6	.957	.185	.977
mt * st	20.134	6	3.356	.648	.691
Error	82.875	16	5.180		
Total	20379.569	36			
Corrected Total	403.044	35			

a. R Squared = .794 (Adjusted R Squared = .550)

Legend

rep= replication

mt= main plot treatments

st=subplot treatments

rep*mt= Error (a)

mt*st = interactions between main plot treatment and subplot treatments

Error= Error (b)

According to the ANOVA of the F test, the experiment failed to detect the significant differences among mean GBHs of main plot treatments at 5% probability. And also it failed to detect the interaction effects between main plot treatment and subplot treatment statistically at 5% probability.

However, mean GBHs of subplot treatments are significantly different from each other at 1% probability level. To evaluate mean GBH of which subplot treatment is different from the other subplot treatment, LSD test was applied. LSD results are shown in table 2 and 3.

Table 2. LSD Results (Comparisons between two sub-plot means averaged over all main plot treatments)

	P	F	S
P	0	-3.94464*	-4.26168*
F		0	-0.31704*
S			0

*significant at 5% probability level

According to table 2, mean GBH of potted seedling is significantly different from that of fresh stump and stored stump. And also fresh stump is also significantly different from that of stored stump.

Table 3. LSD Results (Comparison between two subplot means at the same main plot treatment)

No Fertilizing and No Digging			
	P	F	S
P	0	-2.64454	-5.098*
F		0	-2.45347
S			0
Digging			
	P	F	S
P	0	-3.00489	-1.94266
F		0	1.062228
S			0
Fertilizing			
	P	F	S
P	0	-4.77393*	-4.38798*
F		0	0.385956
S			0
Fertilizing and Digging			
	P	F	S
P	0	-5.3552*	-5.61807*
F		0	-0.26287
S			0

*significant at 5% probability level

According to table 3, mean GBH of fresh stump is significantly different from that of stored stump under no fertilizing and no digging conditions. There are no significant differences among mean GBHs of fresh stump, stored stump and potted seedling under digging applications. Mean GBH of potted seedling is significantly different from those of fresh stump and stored stump under the fertilizing conditions. Also, under the digging and fertilizing applications, mean GBH of potted seedling has the significant differences from those of fresh stump and stored stump.

5. Discussion

This study agreed with the previous study which pointed out that the growth of stored stump gave the best. The findings of the present research showed that the stored stump has the best growth. The experiment cannot detect the significant differences among no digging and no fertilizing treatments, fertilizing treatments, digging treatments and fertilizing and digging treatments (among main plot treatments). And also the experiment failed to detect the

significant differences of interaction effects among main plot treatments and subplot treatments (fresh and stored stump and potted seedling).

However, the experiment can detect that there is significant differences between the mean GBHs of the subplot treatments. Comparisons between two subplot means averaged over all main plot treatments showed that the mean GBHs of stored stump is the best and followed by that of the fresh stump. The mean GBH of potted seedling is the poorest.

When compared between two subplot means at the same main plot treatment, the result showed that under no fertilizing and digging applications, stored stump is the best. Under fertilizing conditions, the stored stump is the best and the fresh stump is the second one. Under fertilizing and digging applications, the experiment gave the same information as in fertilizing conditions. If teak stumps can be stored properly, stored stump planting gives satisfactory resultsas compared to that of fresh stump planting and transplanting. Because of fungus infection,mismanagement in storage can lead to the poorest survival percent. Its survival percentage isfound to be down to 33% (U MehmKoKoGyi et. al 1983) under unfavorable conditions.

6. Conclusions and Recommendations

According to the results from statistical analysis, it is concluded and recommended as follow.

1) The stored stump is the best growth in terms of GBH(in) and it should be considered the first priority in the establishment of large scale teak plantations.
2) The fresh stump can be considered as second priority.
3) Planting of seedling is not recommended according to the statistical results.
4) Fertilizing, digging, and fertilizing and digging applications are not recommended because when compared to no fertilizing and no digging application, there is no statistical difference among them.

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