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Study on the Effectiveness of the Application of Fertilizer in Dry Zone Forest Plantations

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အပူပိုင်းဒေသ သစ်တောစိုက်ခင်းများတွင် ဓါတ်မြေဩဇာ အသုံးပြုခြင်း၏ အကျိုးသက်ရောက်မှုကို စူးစမ်းလေ့လာခြင်း

ဦးစိန်သက်၊ B.Sc. (For.) (Rgn.), M.Sc. (ANU) ဌာနမှူး
ဦးခင်မောင်ရင် ၊ B.Sc. (For.) (Rgn.) သုတေသနမှူး
ဒေါ်တင်တင်အုန်း၊ B.Ag. (Mdy.), M.S. (U. F.) ဒု-သုတေသနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

မြန်မာနိုင်ငံ အပူပိုင်းဒေသတွင် လောင်စာထင်းနှင့် ဒေသသုံးပစ္စည်း ရရှိရန်အတွက် သစ်တောစိုက်ခင်း တည်ထောင်လျက်ရှိပါသည်။ အပူပိုင်းဒေသ မြေဆီဩဇာညံ့သော နေရာများတွင် ယူရီးယား၊ စူပါဖော့စ်ဖိတ် နှင့် ပိုတက်ရှမ်ဓါတ်မြေဩဇာများ အသုံးပြုခြင်းအားဖြင့် အပင်ကြီးထွားမှုနှင့် အကျိုးသက်ရောက်မှု တို့ကို သိရှိနိုင်ရန် ဖလံကျင်း (မိတ္ထီလာမြို့နယ်) ရေပိုးစား (ချောင်းဦးမြို့နယ်) ဇီးအိုင် (မင်းဘူးမြို့နယ်) ကိုးပင်ချောင်း (ရွှေဘိုမြို့နယ်) ဒေသများတွင် စမ်းသပ်မှုများ ဆောင်ရွက်ခဲ့ပါသည်။ တွေ့ရှိချက်များကို လေ့လာဆွေးနွေး တင်ပြထားပါသည်။

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Abstract

In the dryzone of Burma, forest plantations are established on a large scale for fuel wood and local use. To check the value of fertilizer (Urea, Superphosphate, Potash) to the establishment and growth on adverse sites in dryzone, a study was carried out at plangyin (Meiktila Township), Yeposa (Chaung Oo Township), Ziaing (Minbu Township) and Kobin Chaung (Shwe Bo Township). The results obtained were described and discussed.

Contents

1. Introduction

In Burma, the forest sector historically has a vital role in domestic supply, industrial demand and foreign exchange earning. Since forest conservation and afforestation play important parts to increase the productivity, plantation work has been extending annually to fulfil the requirements. Fuelled plantation is crucial for the people, especially for those living in the rural areas, for their domestic use. Several fast growing species including some leguminous species were selected for fuelled plantation. Most common indigenous species such as Sha (*Acacia catechu* Willd.), Mezali (*Cacia siamea* Lam.), Kokko (*Albizzia lebbek* Benth.) , Subyu (*Acacia arabica* Willd.), Tama (*Azadirachta indica* A-Juss.), Tanaung (*Acacia Leucophlaea* Willd.) and some exotic species such as Bawzaging (*Lacuna Leucocephala* Lam. de Wit.), (*Acacia auriculiformis* Cunn.) are planted.

Since fuelled plantations are intentionally established in adverse sites such as in dryzone, species suitable and proper technique of planting need to be investigated. One of the obstacles that has to be overcomed is that dryzone soil is low in fertility. (Sein Thet and Tin Tin Ohn, 1983).

Fertilization is imperative to establish plantation in adverse site, be it for productivity or to protect the erosion. Many investigators described the fertilization reponses of plantation established in various sites in the United State of America, England, Newzeland and Australia with different ratio and combination of application (Bellard, 1979).

The present experiment was carried out to see the effect of fertilization on different species, and efficient use of fertilizer in some dryzone adverse sites.

2. Material and Methods

The present experiment was a continuation of the one which was started in 1983 at Plangyin Reserve, Meiktila Township, Mandalay Division and Yeposa Protection Forest, Chaung Oo Township, Sagaing Division. The object of the investigation was to see the behaviour of planting in different site qualites, and for this purpose one experimental plot was chosen in Kobin chaung watershed area, Shwebo Township, Sagaing Division and another in Ziaing Protection Forest, Minbu Township, Magwe Division. the climatological data relating these experimental plots were provided by the nearest weather stations as shown in Table 1.

3. Methods

In the Ziaing experimental plot in Minbu Township, only one indigenous leguminous species of Sha (*Acacia catechu* Willd.) was tested with different ratio of fertilization.

The randomized complete block design (RCBD) was used in this Ziaing experimental plot. Each experimental plot was divided into three blocks and each block, subdivided into eight plots. The fertilizers (urea, superphosphate and potash) were mixed in differing ratios into seven different types of fertilization, each type being applied to a plot of block making up seven plots, one plot being left as control. Each type of fertilization were randomly selected and applied. The allocation of the differing fertilizer types are shown in Table 2.

Each plot contains 49 seedlings, and the seedling were planted at the beginning of 1986 rainy season. Spacing was according to the prescribed for the fuelled plantation (12' x 12') and the (4' x 4' x 1') pit system was used.

Table 1. Climatological Data of Study Sites.

Climatic Factors	Plangyin	Yeposa	Kobinchaung	Ziaing
Latitude (North)	20º50'	22º06'	20º35'	20º10'
Longitude (East)	95º50'	95º05'	95º34'	94º53'
Elevation (Meters) a.s.	214	81	106	51
Rainfall (m.m)	831	831	831	847
Rainy days	47	49	49	59
Ave. Minimum Temp (Cº)	21.1	21.1	21.2	21.2
Ave. Maximum Temp (Cº)	32.6	32.8	32.8	33.7
Ave. Sunshine (Hrs/ day)	7.7	7.9	7.9	7.8
Potential evapotranspiratio(mm/days)	4.4	4.0	4.0	4.7

Table 2. The Ratio of Fertilizers Treated at Ziaing Site.

Plot	Ratio of Fertilizers	Amount of Ziaing (gm/tree)		
	N : P : K	Urea	Superphos-phate	Potash
a	0 : 0 : 0	0	0	0
b	1 : 0 : 0	68.4	0	0
c	0 : 1 : 0	0	155.5	0
d	1 : 1 : 0	68.4	155.5	0
e	0 : 0 : 1	0	0	52.9
f	1 : 0 : 1	68.4	0	52.9
g	0 : 1 : 1	0	155.5	52.9
h	1 : 1 : 1	68.4	155.5	52.9

Two months after the planting, i.e after the first weeding, fertilization was done. The per-mixed seven types of fertilizers were applied at 20cm from and around each tree, In March 1987, of the 49 trees in each plot, measurements were taken from 25 trees from the central region of the plot for their height.

In Kobinchaung watershed area in Shwebo Township, The following eight species (5 indigenous and 3 exotic species) were tested with different ratio of fertilizers.

3.5.1 Auri-sha- (*Acacia auriculiformis* Cunn. (Exotic))
3.5.2 Mezali (*Cassis siamea* Lam. (Indigenous))
3.5.3 Senegal-sha (*Acacia senegal* (1) Willd. (Exotic))
3.5.4 Subyu (*Acacia arabica* Willd. (Indiagenous))
3.5.5 Sha (*Acacia catechu* Willd. (Indigenous))
3.5.6 Tanaung (*Acacia leucophlaea* Willd. (Indigenous))
3.5.7 Tama (*Azadirachta indica* A-Juss. (Indigenous))
3.5.8 Bawzaging (*Lacuna leucocephala* (lam) de Wit. (Exotic))

Completely randomized design (CRD) was used for Kobinchaung experimental plot. The experimental plot was divided into eight sub-plots and one species was planted in each sub-plot, each species was planted in each sub-plot, each species being randomly selected. Each sub-plot was again sub-divided into five sub-plots, and the fertilization was done as shown in Table 3.

Table 3. The Ratio of Fertilizers Treated at Kobinchaung Site.

Plot	Ratio of Fertilizers			Amount of Fertilizers
	Urea	Superphosphate	Potash	gm / tree
1	0	0	0	0
2	1	1	1	100
3	1	1	1	200
4	1	2	1	100
5	1	2	1	200

Each plot contains 50 seedlings, and were planted at the beginning of 1986 rainy season. Spacing was 15' x 15' according to the prescribed spacing for the watershed plantation together with 4' x 4' x 1' pits system was used.

Two moths after plating, i . e after the first weeding, fertilization was done. The pre-mixed fertilizer were applied at 20 cm from and around each tree. In March 1987, out of the 50 trees in each plot, measurements were taken from 24 trees from the central portion for height measurement.

In Plangyin and Yeposa, the centrally - located 24 trees (four year old) in each sub-plots were selected and height growth measurements were taken in march 1987, respectively.

4. Results and Discussions

The mean height growth and the analysis of variance of four years old plantations from Yeposa and Plangyin are shown in Table 4 and 5 respectively. In the experimental plot of Yeposa and Plangyin, the fertilizers treatment is not significant during the first and second treatment is not significant during the first and second year, but it was highly significant within species and year, but it was highly significant within species and blocks

(Sein Thet, 1986). But table 5 shows that treatment appears to be significant after four years only.

The mean height growth of one year old trees from Ziaing experimental plot is given in Table 6 and the analysis of variance for the above data are given in Table 7.

The mean height growth of one year old trees from Kobinchaung is given in Table 8. The analysis of variance for the above data are given in Table 9. All the data appeared to be of the same trend as the results of Yeposa and Plangyin within the first year.

The effect of fertilization on plant height was not pronounced in any species in the one years old plantation of Kobinchaung, Shwebo Township. It is probable that the development of root system in young trees, is poor such that trees at the younger stages van not utilize the beneficial effect of fertilization effectively effectively. Although the effect of fertilization within a species is not significant, there is a different of height growth between different species - Auri - Sha is taller than any other species except Bawzagaing. It was found that Bawzagaing is the tallest among the species tested.

No markedly differences in tree height was observed also in the one year old test site in Minbu Township. This probably due to the fast that any increase in height growth is not significant enough for a comparison.

Significant differences in tree height response to the fertilization were found in four years old plantations at both Yeposa and Plangyin sites, although the same effect was not detected in the one years old and two years old plantations (Sein Thet, 1986).

A beneficial effect of fertilization on height was observed in Plangyin, while the reverse was found in Yeposa. In these experiments it was intended to see the effect of major nutrient such as (Nitrogen, Phosphorus, Potassium) only and other effects such as micro nutrient and site factors had not been taken into consideration. The level of crop productions is limited to the availability of essential growth factors. Therefore it is necessary to study the availability of these other essential factors to make a complete study on the responses of tree on the application of fertilizer. At Yeposes and Plangyin sites, Bawzagaing was the best for its height as compared to other species. No interaction was found between species and treatment in all the sites.

The fertilization rates on each study area were shown in Table 10. In all the study area fertilization rates were lower than that prescribed for Populus plantation and other species which is 80-40-40 kg/ha (Prichett, 1978). No significant response to the fertilization may be due to the lower rate of fertilizer application. If fertilizer with higher dose, is applied according to the Pritchett, a response could be expected. The higher rate of fertilization is used, the more costly it will be. Consequently a further investigation ion the rate of fertilization is still needed. Furthermore consideration not only on the given rate of fertilization but also on substrate and other limiting factors as well will have to be made.

Table 4. The Mean Height of Species at Plangyin and Yeposa Experimental Sites.
Four years old

Height in Inches

No.	Species	Year planted	Block I		Block II		Block III	
		PLANGYIN						
1.	Sha	1983	71.0	84.5	74.0	57.5	60.5	84.0
2.	Bawzagaing	1983	151.8	200.5	132.0	157.0	163.3	172.5
3.	Mezali	1983	71.3	55.7	57.5	117.0	64.0	59.5
4.	Kokko	1983	100.8	140.4	97.0	87.5	66.8	84.5
5.	Senegal - sha	1983	122.3	85.6	79.0	89.0	64.5	75.0
		YEPOSA						
1.	Sha	1983	131.5	118.9	91.5	43.3	24.6	20.3
2.	Bawzagaing	1983	235.6	202.4	176.0	183.1	136.2	94.8
3.	Mezali	1983	69.5	86.5	78.5	60.0	47.4	77.5
4.	Kokko	1983	62.1	27.7	32.7	30.0	160.7	107.5
5.	Senegal - sha	1983	80.4	48.0	92.0	89.5	76.7	77.0

Block I, II, III (1). No Fertilizer
Block I, II, III (2). Fertilizer

Table 5. The Analysis of Variance for Plangyin and Yeposa Experiment Sites of Four Year Old Data.

ANOVA

Source of Variation	d.f	Sums of Squares	Mean Squares	F
		Plangyin		
Block	2	1871.46	935.73	97.7*
Treatment	1	993.03	993.03	103.69**
Error	2	19.15	9.58	
Species	4	34890.99	8722.75	19.25**
Species & Treatment	4	854.4	213.6	0.47
Error	16	7251.93	483.25	
Total	29	45880.95		
		Yeposa		
Block	2	3174.61	1587.3	
Treatment	1	1741.78	1741.78	56.09*
Error	2	56.6	28.3	61.55**
Species	4	47387.26	11846.81	
Species & Treatment	4	1410.83	325.71	5.49**
Error	16	34529.46	2158.09	0.16
Total	29	88300.54		

* significant at p = 0.05

** Significant at p = 0.01

Table 6. The Mean Height Growth of Species at Minbu Experiment Site.

One year old — Height in inches

No.	Block	Year Planted	a	b	c	d	e	f	g	h
			0 : 0 : 0	1: 0 : 0	0 : 1 : 0	1 : 1 : 0	0 : 0 : 1	1 : 0 : 1	0 : 1 : 1	1 : 1 : 1
			CONTROL	68.4 : 0: 0	0 : 155.5 : 0	68.4 : 155.5: 0	0 : 0 : 52.9	68.4 : 0 : 52.0	0 : 155.5 : 52.9	68. 4 : 155.5 : 52.9
1	BLOCK I	1986	15.4	15.0	13.8	14.1	16.7	15.7	15.3	14.0
2	BLOCK II	1986	16.5	18.3	14.7	14.7	17.2	18.3	17.3	15.9
3	BLOCK III	1986	14.7	15.1	16.6	16.3	14.4	14.7	18.5	19.0

Table 7. The Analysis of Variance for Minbu Experiment Site of One Year Old Plots Data.

ANOVA

No.	SOURCES OF VARIATION	SUM OF SQUARES	D.F	MEAN SQUARES FEE	F. Ratio
1	TREATMENT	9.6	7	1.7	0.29
2	BLOCK	10.8	2	5.4	0.43
3	ERROR	35.8	14	2.6	
	TOTAL	56.1	23		

Table 8. The Mean Height Growth of Species at Shwebo Experiment Site.

One Year Old						Height in inches	
			1	2	3	4	5
No.	BLOCK	Year	0 : 0 : 0	1 : 1 : 1	1 : 1 : 1	1 : 2 : 1	1 : 2 : 1
		Planted	CONTROL	100 gm	200 gm	100 gm	200 gm
1.	Auri-Sha	1986	31.5	32.2	24.0	30.3	30.6
2.	Mezali	1986	9.7	9.3	16.0	14.7	20.2
3.	Senegal-Sha	1986	11.4	10.5	14.4	15.9	19.8
4.	Subyu	1986	10.8	11.4	25.0	16.4	19.3
5.	Sha	1986	9.9	15.5	11.7	13.8	15.5
6.	Tanaung	1986	10.6	7.1	10.0	11.7	8.4
7.	Tama	1986	21.2	21.7	22.6	25.7	14.4
8.	Bawzagaing	1986	34.7	28.3	32.1	28.7	32.5

Table 9. The Analysis of Variance for Shwebo Experiment Site of One Old Plots Data.

ANOVA

No.	SOURCES OF VARIATION	SUM OF SQUARES	d . f	MEAN SQUARES ERR	F. Ratio
1	TREATMENT	62.56	4	15.64	1.11
2	SPECIES	2216.96	7	316.71	22.52**
3	ERROR	393.82	28	14.06	
	TOTAL	2673.34	37	346.41	

** Significant at p = 0.01

Table 10. Fertilizer Rate and Ratio in Experiment Sites.

Location	Treatment	Rate of Fertilizer			Rate of nutrients		
		Urea	Superphosphate	Potash	N	P	K
Kobinchaung	U : S: P						
(Shwebo)	1 : 1 : 1= 100gm/tree	16	16	16	7	3	8
	1 : 1 : 1= 200gm/tree	33	33	33	14	5	16
	1 : 2 : 1=100gm/tree	12	24	12	6	6	6
	1 : 2 : 1=200gm/tree	25	50	25	12	10	12
U =	Uria, S= Superphosphate,		P = Potash				
Yeposa	N : $P_2 0_5$: K_2O	9	19	9	4	4	4
(Chaung Oo)	1 : 2 : 1 = 50gm/tree						
Plangyin	N : $P_2 0_5$: K_2O	6	12	6	3	2	3
(Meiktila)	1 : 2 : 1 = 50gm/tree						
Ziaing	Urea = 68.4gm						
(Minbu)	Superphos - phate = 155.5gm						
	Potash = 52.9gm/tree						
	' b ' Urea only	45	-	-	21	-	-
	' c ' Superphosphate	-	105	-	-	21	-
	' d ' Urea+Superphosphate	45	105	-	21	21	-
	' e ' Potash only	-	-	36	-	-	18
	' f ' Urea+Potash	45	-	36	-	21	18
	' g ' Superphosphate+ Potash	-	105	36	-	21	18
	' h ' Urea+Superphos- phate+Potash	45	45	36	21	21	18

5. Conclusion

From the studies conducted on the effectiveness of the fertilization at dryzone forest plantations, it is conducted that.

Fast - growing suitable species should be chosen rather than relying on fertilizer application, in establishing plantations at adverse sites.

Regardless of other factors, Bawzagaing is the most suitable species judging from height growth. Among the exotic species, Senegal-Sha and Auri-Sha showed promising result compared to other indigenous species.

Effectiveness of fertilization can be expected only two years after planting.

The amount of fertilization to be effective if any, on trees under two years and cost analysis still need to be investigated.

Although the fertilizer are frugally applied in these experiments, the cost of fertilization is varied from (15 - 45) per tree. The cost of fertilizer application for watershed plantation be come (30-60) kyats per acre and (45-138) kyats per acre for fuelled plantation.

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