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Fertilizer Application on *Acacia Senegal* Plantation

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ဆီနီဂေါရှားစိုက်ခင်းတွင် ဓါတ်မြေဩဇာထည့်သွင်း၍ အကျိုးသက်ရောက်မှုကို လေ့လာခြင်း

ဦးစန်းလွင်၊ B.Sc (For.) (Ygn.), M.S (CESF, SUNY)
လက်ထောက်ညွှန်ကြားရေးမှူး
ဦးသန်းအေး၊ B.Sc (For.) (Ygn.)၊ လက်ထောက်သုတေသနအရာရှိ
ဦးထင်ကျော်၊ B.Sc (I.C.) (Ygn.)၊ သုတေသနလက်ထောက်
သစ်တောသုတေသနဌာနခွဲ

စာတမ်းအကျဉ်းချုပ်

မိတ္ထီလာမြို့နယ်တွင် တည်ထောင်လျက်ရှိသော ဆီနီဂေါရှား (*Acacia senegal*) စိုက်ခင်း စမ်းသပ်ကွက်များ၌ ယူရီယား၊ စူပါဖော့စဖိတ်နှင့်ပိုတက်ရှ် ဓါတ်မြေဩဇာတို့အား အချိုး(၉)မျိုးရောစပ်၍ ထည့်သွင်းစိုက်ပျိုးခဲ့ပါသည်။ စိုက်ခင်းမြေတွင် ဖော့စဖရပ်ဓါတ်ချို့ယွင်းမှုအား စူပါဖော့စဖိတ်အချိုး ပိုမို ထည့်သွင်းပေးခြင်းဖြင့် အပင်အမြင့်ကြီးထွားမှုကို အမြန်ဆုံးရရှိစေနိုင်သော်လည်း အပူပိုင်းဒေသများတွင် ရေရှည်သစ်တောစိုက်ခင်းများတည်ထောင်ရာ၌ ငွေကုန်ကျမှုနှင့် အကျိုးသက်ရောက်မှုတို့ကို ထည့်သွင်း စဉ်းစားသင့်ကြောင်း အကြံပြုတင်ပြထားပါသည်။

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Abstract

Nine different ratios of fertilizer (Urea, Triple superphosphate and Potash) were applied in *Acacia senegal* experimental plots in Meiktila Township. Although phosphorus deficiency for height growth could be improved by increasing amount of Triple superphosphate in short term, cost-benefit analysis should be considered in long-term plantation programmes in the dry zone.

Contents

1. Introduction

Acacia senegal, an exotic species from Tropical Africa has been introduced in the Central Dry Zone of Myanmar since 1983. It is not only a good fuelwood species but also a source of gum arabic. Although *Acacia senegal* is hardy and very drought -resistant, the growth rate is rather slow. In the Central Dry Zone, the average height of *Acacia senegal* ranged from 1.09 ft. to 1.36 ft. in the first layer and o.85 ft. to 3.88 ft. in the third layer (1). It was recommended that *Acacia senegal* should be planted in the areas where average annual rainfall was above 26 inches.

Fertilizer application on *Acacia senegal* has been experimented in the Dry Zone area of Myanmar. After four years, it was found that the average height of *Acacia senegal* ranged from 6.2 ft. to 7.1 ft. in Meiktila Township and 4.0 ft. to 7.4 ft. in Myinmu Township (2). Moreover, it was suggested to make a follow up investigation on the effectiveness of different rates of fertilizer application in the Dry Zone plantations.

The suitability of *Acacia senegal* in the Central Dry Zone has been documented by research findings and the establishment of *Acacia senegal* plantation has extended nearly 19,800 acres (Table 1). As a multipurpose tree species, the future trend of *Acacia senegal* is very promising in Myanmar. In order to fulfill the requirement of Forest Department, Natural Resources Section of Forest Research Institute carried out the fertilizer application on *Acacia senegal* in the Central Dry Zone of Myanmar in 1993.

2. Materials and Methods

The experiment was carried out in Phalangyin unclassified Forest, Meiktila Township, Mandalay Division in 1993. The plots were laid out in the watershed plantation area of Mondaing with the co-operation of Meiktila Township Forest Department.

The randomized complete block design (RCBD) was used in the experimental plot which was divided into three blocks and in each block ten plots were subdivided. 24 *Acacia senegal* seedlings were selected in each plot at a spacing of (15' x 15') in this experiment. The seedlings were planted in pits (2' x 2' x 1½') in the first week of September. Two weeks later, the premixed fertilizers (Urea, Triple Superphosphate and Potash) were applied with nine different ratios in each blocks where one plot was left as control. The application of fertilizers was practised at 4 inches around each tree in 6 inches depth randomly.

This operation was done consequently in the second and the third year of early raining season. A location of plots and ratios and amount of fertilizer applied in each plot are shown in Figure (1) and Table (2).

Weeding Operation was practised two times in the first year and three times in the consequent years. Tree height and girth measurement were carried out in the month of December every year (Table 3, 4, 5 & Figure 2, 3 & 4).

Soil samples from each plot were collected at 0-10 cm, 20-30 cm, 40-50 cm, 60-70 cm and 80-90 cm in 1993 and 1995. Total Nitrogen, Phosphorus, Sodium, Potassium, Calcium, Magnesium and texture, p^H and Organic matter contents of these soil samples were analysed at the Forest Soil Laboratory of Forest Research Institute (Appendix I, II & III).

Precipitation data for 1993 to 1995 were collected from Meiktila Meteorological and Hydrological Station as it was the only available and nearest place for this experimental plot (Appendix IV).

3. Results

Soil Analysis data showed that all of the experimental plots were mainly associated with sandy loam alkaline soil. The area has pronounced deficiency Nitrogen, Phosphorus and Potassium concentration levels which were much lower than that in the forest soils.

The assessments of tree height growth and the analysis of variance of one year, two years and three years old *Acacia senegal* are shown in Table 6,7 & 8 respectively. Height growth of Plot 8, treated by ($KN_1 P_2$) is quite significant through out the experiment while Plot 6 ($K P_2$) & Plot 10 ($KN_2 P_2$) were significant after two years except Plot 5 ($K P_1$) & Plot 7 ($KN_1 P_1$) which were significant only by the end of the third year. The mean girth growth and analysis of variance for three years old *Acacia senegal* are shown in Table 9. However, girth growth was not significant in all plots.

Table 1. List of *Acacia senegal* Plantations Established in Dry Zone from 1988 to 1995.

Location	Plantation Areas (ac.)			Total (ac.)
	Watershed	Fuelwood	Industrial	
Sagaing Division	632.08	6109.55	-	6741.63
Mandalay Division	3098.14	9064.37	823.58	12986.09
Total	**3730.22**	**15173.92**	**823.58**	**19727.72**

Source : Forest Department

Table 2. The ratio of Fertilizers treated in Experimental Plots. (Phalangyin, Meiktila)

Plot	Ratio of Fertilizers			Amount of Fertilizer (gm/tree)		
	N	P	K	Urea	Triple Super Phosphate	Potash
1	0	0	0	-	-	-
2	0	0	1	-	-	151.32
3	1	0	1	246.72	-	151.32
4	2	0	1	493.44	-	151.32
5	0	1	1	-	252.22	151.32
6	0	2	1	-	504.44	151.32
7	1	1	1	246.72	252.22	151.32
8	1	2	1	246.72	504.44	151.32
9	2	1	1	493.44	252.22	151.32
10	2	2	1	493.44	504.44	151.32

Figure 1. Layout Plan of plots and ratios of fertilizer applied in each plot

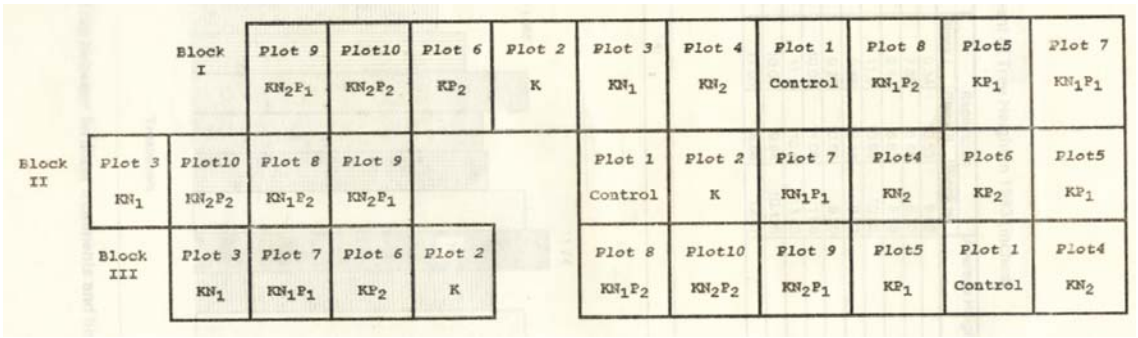


Table 3. Measurement of Tree Height in 1993 (inches)

Treatment	Replication			Average Height
	Block I	Block II	Block III	
T_1 (Control)	9.34	10.53	9.68	9.85
T_2 (K)	7.85	8.45	8.23	8.1767
T_3 (KN_1)	9.84	8.83	8.58	9.0833
T_4 (KN_2)	11.5	10.93	10.95	11.1267
T_5 (KP_1)	9.65	10.18	9.02	9.6167
T_6 (KP_2)	9.27	10.69	9.35	9.77
T_7 (KN_1P_1)	10.08	11.06	11.8	10.98
T_8 (KN_1P_2)	11.3	10.5	13.43	11.7433
T_9 (KN_2P_1)	10.09	9.64	10.125	9.9517
T_{10} (KN_2P_2)	11.03	8.88	12.87	10.9267

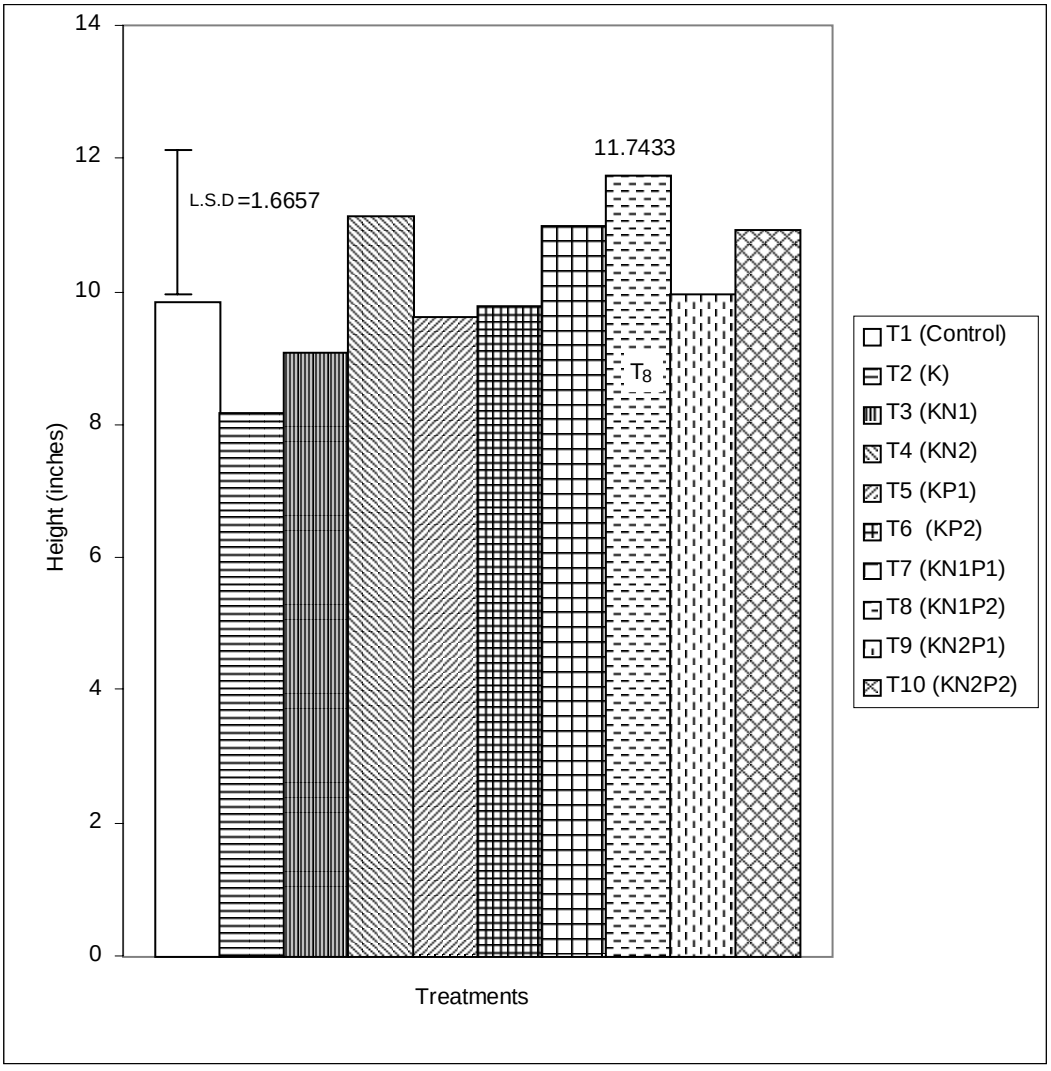


Figure 2. Relationship between fertilizer treatments and height growth in 1993.

Table 4. Measurement of Tree Height in 1994 (inches)

Treatment	Replication			Average Height
	Block I	Block II	Block III	
T_1 (Control)	14.6	9.17	10.5	11.42333
T_2 (K)	11.21	8.27	7.9	9.12667
T_3 (KN_1)	11.76	10.82	7.52	10.03333
T_4 (KN_2)	17.3	14.33	18.08	16.57
T_5 (KP_1)	15.78	19.59	18	17.79
T_6 (KP_2)	24.15	23.75	11.08	19.66
T_7 (KN_1P_1)	17.21	11.47	14.27	14.31667
T_8 (KN_1P_2)	23.4	16.3	17.81	19.17
T_9 (KN_2P_1)	21.28	9.58	16.16	15.67333
T_{10} (KN_2P_2)	30.5	12.5	20.61	21.20333

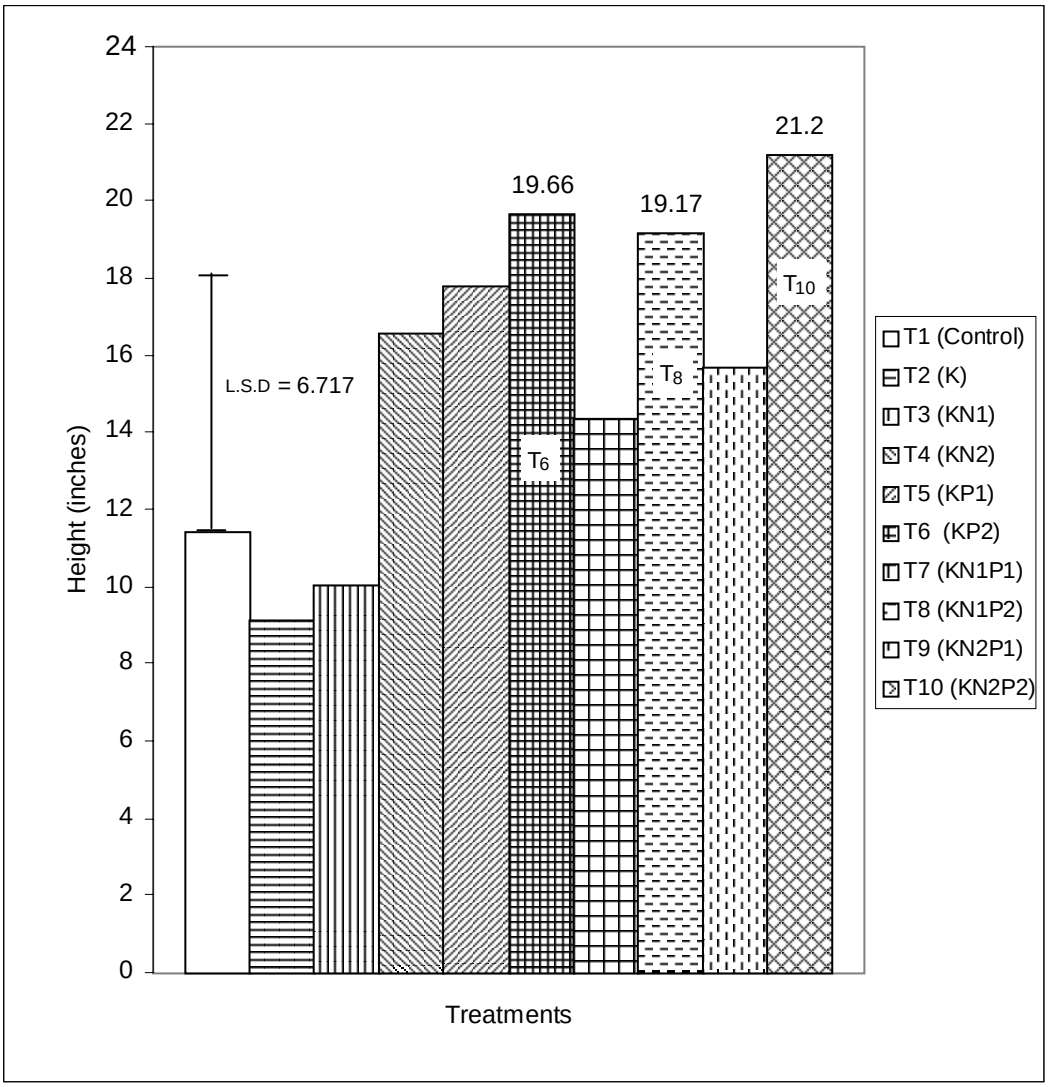


Figure 3. Relationship between fertilizer treatments and height growth in 1994.

Table 5. Measurement of Tree Height in 1995 (inches)

Treatment	Replication			Average Height
	Block I	Block II	Block III	
T_1 (Control)	14.77	11.81	18.33	14.97
T_2 (K)	17.77	12.33	10.53	13.54333333
T_3 (KN_1)	14.33	13.23	9.72	12.42666667
T_4 (KN_2)	26.87	18.35	25.64	23.62
T_5 (KP_1)	30.39	28.5	36.05	31.64666667
T_6 (KP_2)	39.25	37.55	20.57	32.45666667
T_7 (KN_1P_1)	31.55	18.52	30.76	26.94333333
T_8 (KN_1P_2)	45.47	28	33.07	35.51333333
T_9 (KN_2P_1)	31.82	12.21	24.81	22.94666667
T_{10} (KN_2P_2)	46.38	13.07	29.63	29.69333333

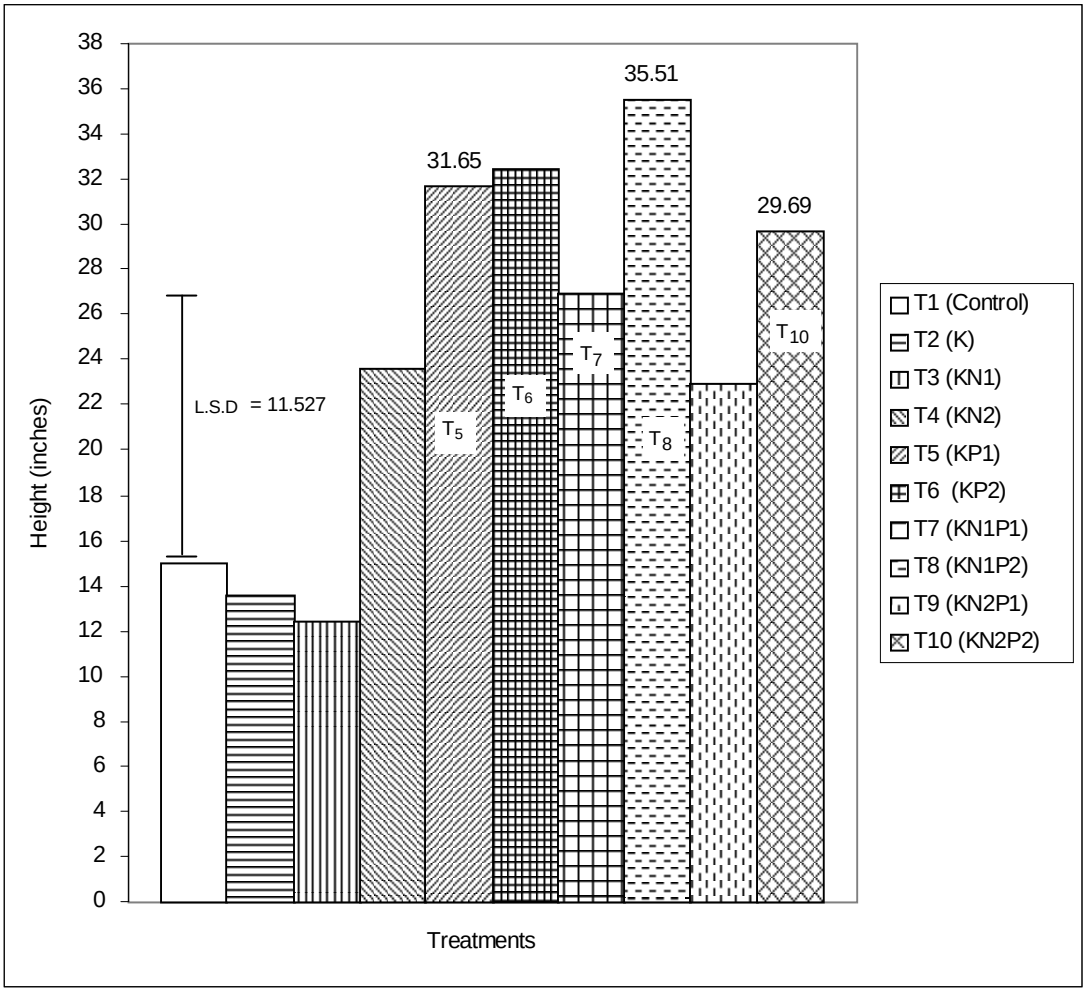


Figure 4. Relationship between fertilizer treatments and height growth in 1995.

4. Discussion

In this study, both height and girth assessment were initiated, however, the development of girth was not prominent within short time frame. It was also noted that although *Acacia senegal* enriched the nitrogen fixation through its root nodules, there was not much changes in the nitrogen concentration level in the experimental plots within three years.

Although the height growth in plot 8 ($KN_1 P_2$) showed up obviously in the first year, the cost was nearly three times higher than plot 5 ($K P_1$) which has the least cost among the significant plots. The amount and costs of fertilizers applied in experimental plots are shown in Table 10 & Figure 5. Cost - benefit analysis should be taken consideration for long - term plantation forestry programmes.

5. Conclusion

1. *Acacia senegal* plantation establishment should make use of fertilizer application programme in the Central Dry Zone area of Myanmar.
2. In this study, it is found that the best combination ratio of fertilizer (Urea, Triple Superphosphate, Potash) is 1:2:1 or 180kg/acre for tree height growth for *Acacia senegal*.
3. According to the cost- benefit analysis, the combination ratio of fertilizer (Urea, Triple Superphosphate, Potash) 0:1:1 or 80 kg/acre would be a better choice.
4. More research work on high-tech fertilizer application is needed for the plantation forestry in Myanmar. Fertilizer tablets such as Fertimal and Tropigro which has slow released properties would be a key function for the development of forest trees.

Table 6. Assessment of Tree Height in 1993 (inches)

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
T_1	3	29.55	9.85	0.3757
T_2	3	24.53	8.1766667	0.092133333
T_3	3	27.25	9.0833333	0.445033333
T_4	3	33.38	11.126667	0.104633333
T_5	3	28.85	9.6166667	0.337233333
T_6	3	29.31	9.77	0.6364
T_7	3	32.94	10.98	0.7444
T_8	3	35.23	11.743333	2.293633333
T_9	3	29.855	9.9516667	0.073158333
T_{10}	3	32.78	10.926667	3.988033333
Block I	10	99.95	9.995	1.194916667
Block II	10	99.69	9.969	0.908187778
Block III	10	104.035	10.4035	3.240711389

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Treatments	31.10142083	9	3.4557134	3.660514824	0.009201	2.456282
Blocks	1.187795	2	0.5938975	0.629094585	0.544394	3.554561
Error	16.99292167	18	0.9440512			
Total	49.2821375	29				

Treatments	**Tree Height (in)**	
T_1 (Control)	9.85	
T_2 (K)	8.176666667	
T_3 (KN_1)	9.083333333	
T_4 (KN_2)	11.12666667	
T_5 (KP_1)	9.616666667	
T_6 (KP_2)	9.77	
T_7 (KN_1P_1)	10.98	
T_8 (KN_1P_2)	11.74333333	**1.8933333** (11.74333 - 9.85)
T_9 (KN_2P_1)	9.951666667	
T_{10} (KN_2P_2)	10.92666667	
L.S.D	**1.665734773**	

Table 7. Assessment of Tree Height in 1994 (inches)

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
T_1	3	34.27	11.423333	8.010633333
T_2	3	27.38	9.1266667	3.289433333
T_3	3	30.1	10.033333	4.958533333
T_4	3	49.71	16.57	3.9153
T_5	3	53.37	17.79	3.6621
T_6	3	58.98	*** 19.66**	55.2523
T_7	3	42.95	14.316667	8.238533333
T_8	3	57.51	19.17	13.9897
T_9	3	47.02	15.673333	34.40013333
T_{10}	3	63.61	*** 21.2033333333333**	81.26403333
Block I	10	187.19	18.719	36.82949889
Block II	10	135.78	13.578	24.93224
Block III	10	141.93	14.193	21.68860111

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Treatments	474.7342667	9	52.748252	3.43613448	0.012387	2.456282
Blocks	157.6426067	2	78.821303	5.134589084	0.017204	3.554561
Error	276.3187933	18	15.351044			
Total	908.6956667	29				

Treatments	**Tree Height (in)**	
T_1 (Control)	11.42333333	
T_2 (K)	9.126666667	
T_3 (KN_1)	10.03333333	
T_4 (KN_2)	16.57	
T_5 (KP_1)	17.79	
T_6 (KP_2)	19.66	**8.236667** (19.66 - 11.4233)
T_7 (KN_1P_1)	14.31666667	
T_8 (KN_1P_2)	19.17	**7.746667** (19.17 - 11.4233)
T_9 (KN_2P_1)	15.67333333	
T_{10} (KN_2P_2)	21.20333333	**9.780000** (21.2033 - 11.4233)
L.S.D	**6.717026105**	

Table 8. Assessment of Tree Height in 1995 (inches)

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
T_1	3	44.91	14.97	10.6576
T_2	3	40.63	13.543333	14.20853333
T_3	3	37.28	12.426667	5.797033333
T_4	3	70.86	23.62	21.2079
T_5	3	94.94	**31.646667**	15.43503333
T_6	3	97.37	**32.456667**	106.6921333
T_7	3	80.83	**26.943333**	53.37043333
T_8	3	106.54	**35.513333**	80.77763333
T_9	3	68.84	22.946667	98.74203333
T_{10}	3	89.08	**29.693333**	277.3920333
Block I	10	298.6	29.86	137.3033778
Block II	10	193.57	19.357	80.60864556
Block III	10	239.11	23.911	81.93349889

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Treatments	1884.857387	9	209.4286	4.632508826	0.002776	2.456282
Blocks	554.80842	2	277.40421	6.136112547	0.009291	3.554561
Error	813.7523133	18	45.208462			
Total	3253.41812	29				

Treatments	**Tree Height (in)**	
T_1 (Control)	14.97	
T_2 (K)	13.54333333	
T_3 (KN_1)	12.42666667	
T_4 (KN_2)	23.62	
T_5 (KP_1)	31.64666667	**16.67667** (31.64667 - 14.97)
T_6 (KP_2)	32.45666667	**17.48667** (32.45667 - 14.97)
T_7 (KN_1P_1)	26.94333333	**11.97333** (26.94333 - 14.97)
T_8 (KN_1P_2)	35.51333333	**20.54333** (35.51333 - 14.97)
T_9 (KN_2P_1)	22.94666667	
T_{10} (KN_2P_2)	29.69333333	**14.72333** (29.69333 - 14.97)
L.S.D	**11.52704377**	

Table 9. Assessment of Tree Girth in 1995 (inches)

Treatment	Replication			Average Height
	Rep I	Rep II	Rep III	
T1 (Control)	0.2595	0.1875	0.303	0.25
T2 (K)	0.29	0.2416	0.19	0.24053
T3 (KN1)	0.2925	0.31	0.24	0.28083
T4 (KN2)	0.3625	0.38	0.454	0.39883
T5 (KP1)	0.42	0.72	0.51	0.55
T6 (KP2)	0.59	0.6	0.27	0.48667
T7 (KN1P1)	0.51	0.3022	0.38	0.3974
T8 (KN1P2)	0.75	0.43	0.4125	0.53083
T9 (KN2P1)	0.6	0.21	0.3794	0.39647
T10 (KN2P2)	0.79	0.23	0.5175	0.5125

Summary	*Count*	*Sum*	*Average*	*Variance*
T_1	3	0.75	0.25	0.00340275
T_2	3	0.7216	0.2405333	0.002500853
T_3	3	0.8425	0.2808333	0.001327083
T_4	3	1.1965	0.3988333	0.002359083
T_5	3	1.65	0.55	0.0237
T_6	3	1.46	0.4866667	0.035233333
T_7	3	1.1922	0.3974	0.01102228
T_8	3	1.5925	0.5308333	0.036102083
T_9	3	1.1894	0.3964667	0.038243453
T_{10}	3	1.5375	0.5125	0.07841875
Rep I	10	4.8645	0.48645	0.037029636
Rep II	10	3.6113	0.36113	0.031278098
Rep III	10	3.6564	0.36564	0.012667307

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	0.365224359	9	0.0405805	2.009205571	0.099295	2.456282
Columns	0.101068329	2	0.0505342	2.502028408	0.109954	3.554561
Error	0.363551011	18	0.0201973			
Total	0.829843699	29				

Table 10. Amount and cost of fertilizer applied in experimental plots from 1993 to 1995.

Treatment	Amount of Fertilizer Kg/ac.			Cost Kyats per ac.
	Urea	TSP	Potash	
T_1 (Control)	-	-	-	0
T_2 (K)	-	-	30.24	190.3
T_3 (KN_1)	49.3	-	30.24	1062.96
T_4 (KN_2)	98.61	-	30.24	1935.63
T_5 (KP_1)	-	50.4	30.24	834.63
T_6 (KP_2)	-	100.81	30.24	1478.96
T_7 (KN_1P_1)	49.3	50.4	30.24	1707.29
T_8 (KN_1P_2)	49.3	100.81	30.24	2351.62
T_9 (KN_2P_1)	98.61	50.4	30.24	2579.96
T_{10} (KN_2P_2)	98.61	100.8	30.24	3224.29

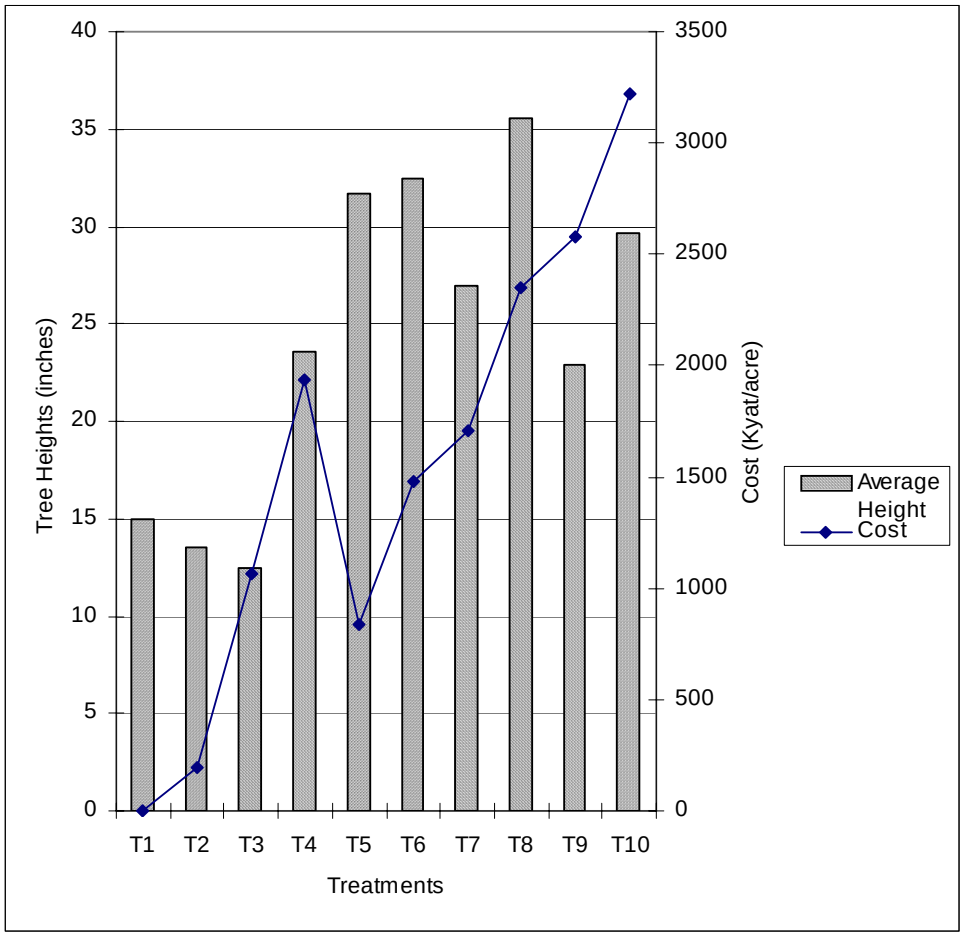


Figure 5. Comparison of Tree Height Growth and Cost on Fertilizer Application

Plate 1. Fertilizer Application Research Experimental Plots Phalagyin, Meiktila

Plate 2. 2 years old *Acacia Senegal.*

Plate 3. 2 years old *Acacia Senegal*
Treatment – Muria of Potash and Urea 1:1

Plate 4. 2 years old *Acacia Senegal*
Treatment – Muria of Potash and Urea 1:2

Plate 5. 2 years old *Acacia Senegal*
Treatment - Muria of Potash and Triple Superphosphate 1:1

Plate 6. 2 years old *Acacia Senegal*
Treatment – Muria of Potash and Triple Superphosphate 1:2

Plate 7. 2 years old *Acacia Senegal.*
Treatment – Muria of Potash, Urea and Triple Superphosphate 1:1:1

Plate 8. 2 years old *Acacia Senegal.*
Treatment – Muria of Potash, Urea and triple Superphosphate 1:1:2

Plate 9. 2 years old *Acacia Senegal.*
Treatment – Muria of Potash, Urea and triple Superphosphate 1:2:1

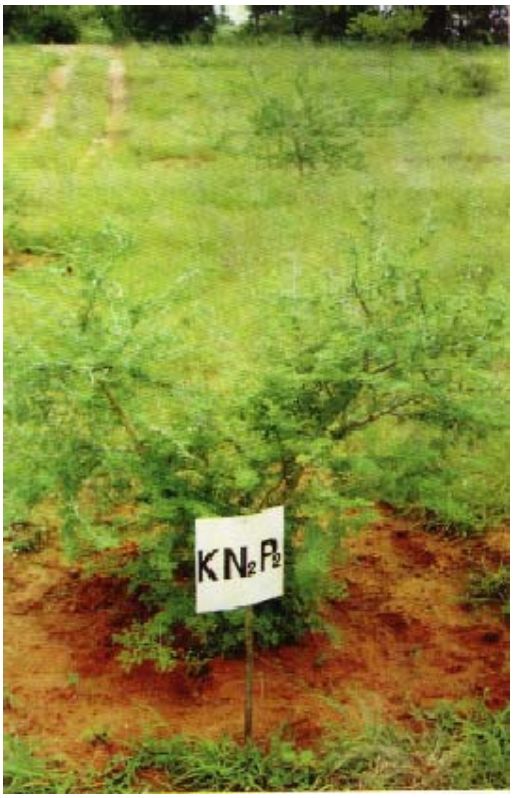


Plate 10. 2 years old *Acacia Senegal.*
Treatment – Muria of Potash, Urea and triple Superphosphate 1:2:2

Plate 11. 2 years old *Acacia Senegal.*

Appendix I

Physical and Chemical Properties of Soil Samples in 1993

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
	(cm)			Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P1	0-10	7.90	0.0215	0.000224	0.0012	0.0040	0.0660	0.0660	63	20	14
	20-30	8.10	0.0187	0.000160	0.0012	0.0048	0.0650	0.0650	64	18	14
	40-50	8.10	0.0215	0.000192	0.0010		0.0600	0.0600	68	18	19
	60-70	8.20	0.0177	0.000160	0.0012	0.0033	0.0670	0.0670	84	8	4
	80-90	8.10	0.0990	0.000640	0.0010	0.0037	0.0640	0.0640	78	8	10
B21P1	0-10	8.30	0.0565	0.000256	0.0012	0.0037	0.1210	0.1210	59	24	14
	20-30	8.30	0.0346	0.000208	0.0010	0.0023	0.0770	0.0770	62	20	14
	40-50	8.40	0.0222	0.000208	0.0010	0.0045	0.0610	0.0610	69	18	8
	60-70	8.40	0.0219	0.000240	0.0010	0.0050	0.0670	0.0670	63	24	10
	80-90	8.40	0.0247	0.000384	0.0010	0.0039	0.0650	0.0650	59	24	14
B3P1	0-10	8.20	0.0194	0.000020	0.0006	0.0007	0.0480	0.0160	69	18	8
	20-30	8.20	0.0233	0.000015	0.0006	0.0024	0.0430	0.0160	67	14	14
	40-50	8.10	0.0240	0.000026	0.0007	0.0013	0.0400	0.0200	57	30	10
	60-70	8.20	0.0173	0.000021	0.0006	0.0012	0.0440	0.0230	71	14	12
	80-90	8.40	0.0166	0.000024	0.0020	0.0072	0.5100	0.0410	44	38	14
B1P2	0-10	8.20	0.0289	0.000030	0.0014	0.0044	0.0500	0.0160	54	32	10
	20-30	8.30	0.0187	0.000020	0.0011	0.0052	0.0470	0.6150	48	30	18
	40-50	8.20	0.0208	0.000019	0.0011	0.0049	0.0380	0.0190	50	30	18
	60-70	8.30	0.0162	0.000025	0.0011	0.0051	0.0530	0.0260	49	30	18
	80-90	8.20	0.0305	0.000038	0.0010	0.0052	0.0560	0.0300	58	28	12
B2P2	0-10	8.20	0.0392	0.000040	0.0012	0.0034	0.0790	0.0780	71	14	10
	20-30	8.30	0.0364	0.000070	0.0010	0.0069	0.0770	0.0770	70	16	10
	40-50	8.40	0.0258	0.000040	0.0010	0.0039	0.0800	0.0800	60	24	14
	60-70	8.40	0.0137	0.000040	0.0010	0.0047	0.0820	0.0820	58	24	12
	80-90	8.40	0.0201	0.000030	0.0012	0.0068	0.0700	0.0700	50	30	12
B3P2	0-10	8.10	0.0166	0.000060	0.0017	0.0043	0.5600	0.3200	74	10	11
	20-30	8.10	0.0169	0.000030	0.0010	0.0038	0.4600	0.0260	63	16	17
	40-50	8.20	0.0159	0.000040	0.0020	0.0046	0.5100	0.0280	66	14	15
	60-70	8.30	0.0152	0.000030	0.0019	0.0041	0.6700	0.0420	64	18	13
	80-90	8.30	0.0138	0.000030	0.0030	0.0040	0.5200	0.0360	62	16	15

Physical and Chemical Properties of Soil Samples in 1993

	Depth (cm)	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P3	0-10	8.20	0.0240	0.000080	0.0012	0.0034	0.0790	0.0790	71	14	10
	20-30	8.30	0.0201	0.000064	0.0010	0.0069	0.0770	0.0770	70	16	10
	40-50	8.40	0.0226	0.000176	0.0010	0.0034	0.0800	0.0800	60	24	14
	60-70	8.40	0.0289	0.000096	0.0010	0.0047	0.0820	0.0820	50	26	12
	80-90	8.40	0.0409	0.000368	0.0012	0.0068	0.0700	0.0700	53	30	12
B21P3	0-10	8.10	0.0148	0.000060	0.0030	0.0004	0.0270	0.0270	68	14	11
	20-30	8.20	0.0208	0.000040	0.0024	0.0011	0.0563	0.0563	73	14	9
	40-50	8.30	0.0166	0.000040	0.0010	0.0001	0.0393	0.0393	80	12	3
	60-70	8.20	0.0138	0.000060	0.0024	0.0013	0.3720	0.0346	62	24	9
	80-90	8.20	0.0109	0.000040	0.0028	0.0001	0.0480	0.0326	73	10	12
B3P3	0-10		0.0155	0.000055	0.0019	0.0064	1.0400	0.0280	71	12	12
	20-30	8.20	0.0127	0.000040	0.0021	0.0078	1.0800	0.1260	74	12	10
	40-50	8.20	0.0124	0.000020	0.0019	0.0061	0.4800	0.0340	70	16	12
	60-70	8.00	0.0118	0.000020	0.0011	0.0031	0.4700	0.0340	72	14	12
	80-90	8.20	0.0131	0.000040	0.0056	0.0024	0.4800	0.0410	72	12	12
B1P4	0-10	7.30	0.0212	0.000140	0.0056	0.0126	0.1590	0.0096	65	14	17
	20-30	7.50	0.0240	0.000040	0.0043	0.0358	0.1650	0.0034	61	16	19
	40-50	7.50	0.0219	0.000060	0.0120	0.0008	0.3710	0.0239	75	14	7
	60-70	8.00	0.0240	0.000685	0.0026	Nil	0.5300	0.0259	70	14	11
	80-90	8.00	0.0431	0.000040	0.0030	0.0007	0.6700	0.0220	86	8	3
B2P4	0-10	8.50	0.0194	0.000013	0.0007	0.0102	0.0610	0.0160	60	16	18
	20-30	8.60	0.0226	0.000012	0.0007	0.0046	0.0730	0.0190	64	16	16
	40-50	8.70	0.0141	0.000018	0.0006	0.0044	0.0690	0.0230	60	16	20
	60-70	8.80	0.0098	0.000014	0.0006	0.0042	0.0700	0.0270	78	8	10
	80-90	8.50	0.0187	0.000016	0.0007	0.0053	0.0580	0.0280	46	38	14
B3P4	0-10	7.10	0.0197	0.000022	0.0007	0.0004	0.0170	0.0250	74	12	10
	20-30	7.50	0.0144	0.000013	0.0009	0.0024	0.0410	0.0190	84	8	6
	40-50	7.60	0.0141	0.000018	0.0009	0.0045	0.0410	0.0290	80	10	8
	60-70	7.65	0.0165	0.000019	0.0004	0.0013	0.0440	0.0290	67	14	16
	80-90	7.40	0.0172	0.000015	0.0006	0.0027	0.0450	0.0320	72	12	12

Physical and Chemical Properties of Soil Samples in 1993

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P5	0-10	8.30	0.0264	0.000031	0.0012	0.0024	0.5400	0.0200	72	12	14
	20-30	8.30	0.0130	0.000028	0.0030	0.0034	0.4700	0.0200	82	8	8
	40-50	8.40	0.0166	0.000028	0.0002	0.0066	0.0400	0.0100	84	8	6
	60-70	8.30	0.0137	0.000031	0.0005	0.0053	0.0400	0.0100	85	6	6
	80-90	8.40	0.0180	0.000037	0.0005	0.0043	0.0300	0.0100	70	10	14
B2P5	0-10	7.30	0.0300	0.000030	0.0009	0.0035	0.0500	0.0200	74	12	12
	20-30	7.40	0.0211	0.000026	0.0008	0.0030	0.0600	0.0100	66	14	16
	40-50	7.70	0.1097	0.000028	0.0008	0.0031	0.0500	0.0200	45	30	14
	60-70	7.50	0.0165	0.000266	0.0007	0.0007	0.0500	0.0300	88	6	4
	80-90	7.50	0.0130	0.000167	0.0005	0.0010	0.0500	0.0300	87	6	4
B3P5	0-10	8.20	0.0381	0.000030	0.0014	0.0044	0.0500	0.0200	54	32	10
	20-30	8.30	0.0289	0.000020	0.0011	0.0052	0.0500	0.0200	48	30	18
	40-50	8.20	0.0190	0.000019	0.0011	0.0049	0.0400	0.0200	50	30	18
	60-70	8.30	0.0222	0.000025	0.0011	0.0051	0.0500	0.0300	49	30	18
	80-90	8.20	0.0191	0.000380	0.0010	0.0052	0.0600	0.0300	58	28	12
B1P6	0-10	8.40	0.0240	0.000176	0.0008	0.0022	0.0400	0.0400	65	16	14
	20-30	8.30	0.0194	0.000176	0.0006	0.0027	0.0500	0.0500	61	16	18
	40-50	8.30	0.0173	0.000192	0.0006	0.0031	0.0500	0.0500	68	14	14
	60-70	8.40	0.0141	0.000176	0.0006	0.0036	0.0400	0.0400	62	16	18
	80-90	8.30	0.0187	0.000160	0.0006	0.0056	0.0300	0.0300			
B2P6	0-10	8.35	0.0134	0.000028	0.0031	0.0024	0.6300	0.0200	72	10	14
	20-30	8.40	0.0194	0.000029	0.0011	0.0027	0.5600	0.0400	69	14	12
	40-50	8.50	0.0158	0.000028	0.0033	0.0029	0.5600	0.0600	63	22	10
	60-70	8.60	0.0166	0.000034	0.0028	0.0028	0.5500	0.0600	60	22	16
	80-90	8.60	0.0166	0.000295	0.0015	0.0025	0.6200	0.7000	59	18	18
B3P6	0-10	8.40	0.0233	0.000030	0.0036	0.0008	0.7600	0.0300	80	6	10
	20-30	8.50	0.0279	0.000020	0.0019	0.0001	0.8000	0.0300	70	18	9
	40-50	8.70	0.0229	0.000020	0.0023	nil	0.8000	0.0600	68	16	13
	60-70	8.00	0.0180	0.000020	0.0025	0.0006	0.8900	0.0700	66	18	13
	80-90	8.10	0.0187	0.000030	0.0014	0.0009	0.6600	0.0700	76	12	7

Physical and Chemical Properties of Soil Samples in 1993

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K %	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P7	0-10	7.30	0.0222	0.000120	0.0019	0.0049	0.0740	0.0220	66	10	20
	20-30	7.40	0.0158	0.000760	0.0021	0.0072	0.0520	0.0170	61	8	26
	40-50	7.40	0.0257	0.000410	0.0013	0.0047	0.0360	0.0250	58	10	24
	60-70	7.50	0.0187	0.000460	0.0011	0.0047	0.0410	0.0320	60	20	18
	80-90	7.10	0.0218	0.000220	0.0008	0.0057	0.0490	0.0320	60	16	22
B2P7	0-10	8.10	0.0364	0.000224	0.0015	0.0077	0.0760	0.0760	60	18	20
	20-30	8.10	0.0413	0.000160	0.0011	0.0056	0.0640	0.0640	49	26	22
	40-50	8.10	0.0325	0.000192	0.0011	0.0034	0.0660	0.0660	65	18	12
	60-70	8.40	0.0169	0.000160	0.0010	0.0040	0.0600	0.0600	46	34	16
	80-90	8.30	0.0212	0.000640	0.0011	0.0027	0.0560	0.0560	58	24	16
B3P7	0-10	8.00	0.0307	0.000030	0.0050	0.0010	1.1400	0.0280	67	16	13
	20-30	8.00	0.0251	0.000020	0.0022	nil	0.1290	0.0250	78	10	9
	40-50	8.30	0.0187	0.000050	0.0021	nil	1.4700	0.0270	79	10	9
	60-70	8.40	0.0159	0.000040	0.0014	0.0004	1.3800	0.0270	76	10	11
	80-90	8.30	0.0187	0.000040	0.0034	nil	0.8500	0.0300	68	14	14
B1P8	0-10	8.20	0.0226	0.000035	0.0010	0.0072	0.0480	0.0130	74	6	14
	20-30	8.10	0.0197	0.000008	0.0007	0.0046	0.0540	0.0140	62	14	18
	40-50	8.20	0.0162	0.000005	0.0006	0.0047	0.0590	0.0140	80	10	8
	60-70	8.20	0.0194	0.000020	0.0011			0.0230	68	14	14
	80-90	8.30	0.0173	0.000009	0.0006	0.0050	0.0580	0.0250	69	14	14
B2P8	0-10	8.20	0.0402	0.000040	0.0042	nil	0.6500	0.0240	65	16	16
	20-30	8.10	0.0233	0.000030	0.0024	nil	0.7200	0.0250	66	18	10
	40-50	8.30	0.0620	0.000265	0.0024	0.0025	0.5200	0.0180	78	12	7
	60-70	8.20	0.0187	0.000090	0.0021	nil	0.5400	0.0250	63	18	15
	80-90	8.50	0.0162	Trace	0.0026	0.0006	0.2380	0.0280	77	10	9
B3P8	0-10	8.30	0.0441	0.000256	0.0006	0.0036	0.0880	0.0680	56	26	12
	20-30	8.50	0.0212	0.000224	0.0007	0.0047	0.0690	0.0690	55	30	14
	40-50	8.30	0.0279	0.000192	0.0008	0.0046	0.0550	0.0550	60	22	14
	60-70	8.50	0.0244	0.000192	0.0007	0.0090	0.0540	0.0540	71	16	10
	80-90	8.30	0.0208	0.000192	0.0007	0.0070	0.0520	0.0520	54	34	9

Physical and Chemical Properties of Soil Samples in 1993

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P9	0-10	8.30	0.0201	0.000040	0.0023	0.0033	0.4300		60	20	13
	20-30	8.20	0.0226	0.000030	0.0017	0.0040	0.4600		50	28	17
	40-50	8.00	0.0198	0.000040	0.0014	0.0041	0.4600		38	38	19
	60-70	8.10	0.0226	0.000150	0.0034	0.0046	0.4800		46	30	19
	80-90	8.30	0.0177	0.000150	0.0123	0.0079	0.5000		44	34	19
B2P9	0-10	8.40	0.0254	0.000020	0.0023	nil	0.7100	0.0208	68	20	10
	20-30	8.40	0.0198	0.000020	0.0036	nil	0.7300	0.0214	74	14	10
	40-50	8.40	0.0145	0.000030	0.0015	0.0004	0.7600	0.0167	87	8	4
	60-70	8.40	0.0138	0.000080	0.0039	nil	0.6400	0.0258	86	8	4
	80-90	8.40	0.0152	0.000030	0.0013	0.0002	0.6000	0.0251	85	8	6
B3P9	0-10	8.00	0.0604	0.000040	0.0010	0.0044	0.0600	0.0250	50	34	14
	20-30	8.20	0.0416	0.000130	0.0010	0.0049	0.0600	0.0620	46	38	14
	40-50	8.20	0.0423	0.000130	0.0011	0.0060	0.0600	0.0610	47	34	16
	60-70	8.20	0.2580	0.000140	0.0010	0.0070	0.0600	0.0630	54	30	14
	80-90	8.20	0.0184	0.000140	0.0010	0.0092	0.0600	0.0620	63	20	14
B1P10	0-10	8.30	0.0477	0.000180	0.0005	0.0023	0.0300	0.0316			
	20-30	8.20	0.0494	0.000180	0.0007	0.0031	0.0700	0.0362	67	16	12
	40-50	8.30	0.0459	0.000140	0.0006	0.0038	0.0500	0.4100	62	18	16
	60-70	8.40	0.0215	0.000060	0.0017	0.0012	0.7800	0.0760			
	80-90	8.30	0.0208	0.000040	0.0037	6.0000	0.6300	0.0670	66	14	16
B2P10	0-10	8.40	0.0593	0.000040	0.0037	nil	0.2700	0.0164	51	28	17
	20-30	8.50	0.0399	0.000030	0.0022	nil	0.3600	0.0233	50	26	19
	40-50	8.60	0.0268	0.000050	0.0048	0.0002	0.3900	0.0242	65	20	18
	60-70	8.30	0.0244	0.000040	0.0024	0.0004	0.3800	0.0485	49	24	21
	80-90	8.20	0.0191	0.000030	0.0030	0.0017	0.4100	0.0540	52	24	19
B3P10	0-10	8.10	0.0349	0.000040	0.0029	0.0013	0.3600	0.0275	61	28	7
	20-30	7.90	0.0364	0.000030	0.0060	nil	0.4100	0.0307			
	40-50	7.90	0.0233		0.0017	0.0045	0.5000		60	26	9
	60-70	8.00	0.0196	0.000060	0.0022	0.0029			66	22	7
	80-90	8.20	0.0233	0.000060	0.0009	0.0047	0.5100		58	22	13

Appendix II

Physical and Chemical Properties of Soil Samples in 1995

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P1	0-10	7.78	0.0092	0.000091	0.0018	0.0096	0.0430	0.0200	74	12	13
	20-30	7.84	0.0096	0.000047	0.0010	0.0085	0.4000	0.0230	68	12	13
	40-50	7.93	0.0085	0.000072	0.0012	0.0020	0.4100	0.0300	70	12	15
	60-70	7.98	0.0085	0.000077	0.0006	0.0017	0.9000	0.0360	74	10	13
	80-100	8.07	0.0057	0.000082	0.0142	0.0028	0.6000	0.0370	72	14	13
B2P1	0-10	8.44	0.0328	0.000015	0.0028	0.0035	0.3550	0.0305	62	12	23
	20-30	8.58	0.0370	0.000013	0.0013	0.0038	0.3500	0.0364	65	16	17
	40-50	8.64	0.0321	0.000016	0.0014	0.0041	0.3000	0.0380	60	18	19
	60-70	8.67	0.0211	0.000021	0.0018	0.0042	0.3480	0.0387	98	20	19
	80-100	8.70	0.0518	0.000024	0.0020	0.0056	0.3650	0.0350	97	14	27
B3P1	0-10	8.61	0.0205	0.000036	0.0368	0.0026	0.3800	0.0290	71	16	11.4
	20-30	8.65	0.0208	0.000043	0.0366	0.0030	0.3700	0.0270	75	16	7
	40-50	8.84	0.0187	0.000044	0.0182	0.0026	0.3600	0.0330	79	12	5
	60-70	8.87	0.0124	0.009200	0.0029	0.0003	0.2700	0.0320	78	12	7
	80-100	8.87	0.0159	0.000107	0.0007	0.0004	0.2100	0.0210	84	10	3
B1P2	0-10	7.82	0.0145	0.000090	0.0393	0.0025	0.4400	0.0230	75	10	13
	20-30	7.97	0.0081	0.000077	0.0386	0.0050	0.5700	0.0260	71	12	15
	40-50	8.12	0.0099	0.000028	0.0192	0.0062	0.4110	0.0300	69	12	15
	60-70	8.75	0.0092	0.000022	0.0011	0.0035	0.4040	0.0350	79	8	11
	80-100	8.38	0.0096	0.000012	0.0012	0.0029	0.4000	0.0400	80	6	9
B2P2	0-10	8.23	0.0169	0.000032	0.0032	0.0045	0.3940	0.0403	59	16	21
	20-30	8.55	0.0165	0.000032	0.0015	0.0045	0.4020	0.0366	62	10	25
	40-50	8.61	0.0211	0.000034	0.0026	0.0048	0.4110	0.0312	67	10	21
	60-70	8.72	0.0148	0.000059	0.0018	0.0055	0.4060	0.0318	62	8	27
	80-100	8.75	0.0295	0.000034	0.0018	0.0084	0.3600	0.0364	61	10	27
B3P2	0-10	8.70	0.0328	0.000062	0.0024	0.0017	0.4300	0.0200	79	8	11
	20-30	8.18	0.0240	0.000029	0.0010	0.0014	0.4300	0.0180	78	8	11
	40-50	8.26	0.0229	0.000030	0.0008	0.0018	0.3500	0.0210	80	8	9
	60-70	8.27	0.0219	0.000106	0.0006	0.0019	0.4200	0.0220	78	10	9
	80-100	8.45	0.0177	0.000035	0.0013	0.0014	0.3800	0.0210	76	12	9

Physical and Chemical Properties of Soil Samples in 1995

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P3	0-10	8.08	0.0056	0.000014	0.0038	0.0018	0.4180	0.0270	71	14	11
	20-30	8.22	0.0113	0.000007	0.0014	0.0013	0.4150	0.0290	77	10	9
	40-50	8.48	0.0113	0.000007	0.0185	0.0014	0.4180	0.0320	64	14	19
	60-70	8.51	0.0149	0.000008	0.0382	0.0028	0.4010	0.0400	64	14	17
	80-100	8.64	0.0092	0.000011	0.0378	0.0013	0.3680	0.0420	77	8	11
B2P3	0-10	8.50	0.0190	0.000039	0.0059	0.0077	0.1380	0.0394	63	10	25
	20-30	8.63	0.0176	0.000044	0.0020	0.0077	0.3410	0.0340	64	16	17
	40-50	8.93	0.0148	0.000037	0.0013	0.0050	0.4060	0.0369	65	8	23
	60-70	9.27	0.0178	0.000046	0.0032	0.0050	0.4010	0.0390	69	8	21
	80-100	9.16	0.0356	0.000475	0.0026	0.0055	0.3110	0.0340	78	6	22
B3P3	0-10	8.24	0.0353	0.000271	0.0014	0.0012	0.3600	0.0230	52	24	21
	20-30	8.28	0.0371	0.000033	0.0016	0.0017	0.3600	0.0230	35	36	27
	40-50	8.52	0.0258	0.000026	0.0020	0.0023	0.3000	0.0270	40	40	17
	60-70	8.57	0.0141	0.000028	0.0027	0.0031	0.3000	0.0270	59	22	17
	80-100	8.79	0.0141	0.000035	0.0016	0.0021	0.3700	0.0300	73	14	11
B1P4	0-10	8.46	0.0212	0.000016	0.0023	0.0012	0.3800	0.0220	57	14	27
	20-30	8.84	0.0099	0.000001	0.0013	0.0057	0.3820	0.0260	75	10	13
	40-50	8.82	0.0167	0.000006	0.0011	0.0073	0.3540	0.0230	65	14	17
	60-70	8.90	0.0089	0.000009	0.0004	0.0060	0.3710	0.0210	69	14	13
	80-100	8.94	0.0071	0.000011	0.0013	0.0058	0.3690	0.0240	71	14	11
B2P4	0-10	8.79	0.0165	0.000056	0.0042	0.0053	0.4150	0.0288	86	2	9
	20-30	9.03	0.0237	0.000035	0.0026	0.0049	0.2900	0.0238	72	10	15
	40-50	9.08	0.0219	0.000015	0.0019	0.0048	0.2400	0.0257	81	4	13
	60-70	8.97	0.0162	0.000013	0.0018	0.0043	0.3000	0.0287	75	10	13
	80-100	9.10	0.0339	0.000006	0.0021	0.0036	0.3300	0.0311	73	10	15
B3P4	0-10	8.67	0.0226	0.000027	0.0008	0.0022	0.4000	0.2110	71	16	11
	20-30	8.79	0.0261	0.000015	0.0007	0.0023	0.4000	0.0383	54	24	17
	40-50	8.81	0.0152	0.000021	0.0113	0.0024	0.3300	0.0383	49	32	17
	60-70	9.15	0.0169	0.000069	0.0225	0.0016	0.3600	0.0406	81	8	7
	80-100	8.80	0.0187	0.000022	0.0236	0.0017	0.3200	0.0397	62	22	13

Physical and Chemical Properties of Soil Samples in 1995

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P5	0-10	8.65	0.00740	0.0002	0.0036	0.0049	0.2250	0.0190	74	10	13
	20-30	8.73	0.00990	0.0001	0.0017	0.0050	0.3060	0.0200	69	8	19
	40-50	8.86	0.00710	0.0000	0.0005	0.0050	0.6300	0.0180	80	6	11
	60-70	9.03	0.00640	0.0003	0.0005	0.0033	0.7400	0.0190	90	0	5
	80-100	9.16	0.00670	0.0000	0.0003	0.0044	0.6800	0.0200	88	2	5
B2P5	0-10	8.13	0.02510	0.0000	0.0024	0.0035	0.3000	0.0219	76	10	13
	20-30	8.07	0.01690	0.0000	0.0017	0.0032	0.3300	0.0204	70	10	17
	40-50	8.26	0.01410	0.0000	0.0031	0.0036	0.2800	0.0213	65	8	23
	60-70	8.54	0.01580	0.0000	0.0013	0.0033	0.3700	0.0318	65	14	17
	80-100	9.24	0.02050	0.0001	0.0017	0.0035	0.3300	0.0250	72	8	15
B3P5	0-10	8.46	0.04770	0.0002	0.0092	0.0014	0.3300	0.0231	54	24	17
	20-30	8.60	0.02790	0.0000	0.0013	0.0014	0.4800	0.0242	54	22	21
	40-50	8.54	0.02580	0.0000	0.0006	0.0011	0.3500	0.0232	41	30	25
	60-70	8.67	0.02470	0.0000	0.0012	0.0013	0.3700	0.0269	40	32	25
	80-100	8.83	0.02120	0.0001	0.0013	0.0018	0.3600	0.0345	42	34	21
B1P6	0-10	7.83	0.01560	0.0000	0.0011	0.0030	0.6000	0.0180	73	10	13
	20-30	7.74	0.01380	0.0000	0.0011	0.0037	0.4500	0.0220	63	14	19
	40-50	7.87	0.01310	0.0000	0.0012	0.0034	0.5800	0.0290	67	14	17
	60-70	8.00	0.01240	0.0000	0.0008	0.0042	0.4700	0.0350	65	14	19
	80-100	8.13	0.01450	0.0000	0.0007	0.0042	0.5000	0.0440	66	14	17
B2P6	0-10	9.00	0.01800	0.0002	0.0027	0.0035	0.3190	0.0391	77	12	9
	20-30	9.36	0.01310	0.0000	0.0021	0.0031	0.3130	0.0380	80	6	11
	40-50	9.33	0.01620	0.0000	0.0013	0.0045	0.2800	0.0290	80	4	13
	60-70	9.28	0.01690	0.0000	0.0020	0.0042	0.2600	0.0326	72	10	15
	80-100	8.91	0.06670	0.0000	0.0023	0.0045	0.3000	0.0370	57	18	21
B3P6	0-10	8.89	0.02370	0.0000	0.0019	0.0038	0.3600	0.0151	72	12	13
	20-30	9.13	0.02440	0.0000	0.0015	0.0016	0.3600	0.0187	82	6	9
	40-50	9.16	0.01480	0.0001	0.0009	0.0022	0.3600	0.0211	84	6	7
	60-70	9.20	0.00140	0.0002	0.0006	0.0038	0.3900	0.0218	87	4	7
	80-100	9.18	0.01200	0.0000	0.0006	0.0027	0.4700	0.0261	83	8	7

Physical and Chemical Properties of Soil Samples in 1995

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P7	0-10	7.73	0.01130	0.00023	0.0011	0.0028	0.2800	0.2200	73	6	19
	20-30	7.83	0.01730	0.00054	0.0034	0.0042	0.4200	0.0260	63	8	27
	40-50	8.08	0.01240	0.00059	0.0017	0.0057	0.5100	0.0300	59	8	31
	60-70	8.27	0.01380	0.00005	0.0009	0.0078	0.4700	0.0300	61	10	25
	80-100	8.32	0.01420	0.00005	0.0009	0.0058	0.5500	0.0310	68	12	19
B2P7	0-10	8.54	0.02890	0.00005	0.0041	0.0035	0.2700	0.0360	61	18	19
	20-30	8.42	0.02330	0.00002	0.0028	0.0040	0.3200	0.0280	53	22	21
	40-50	8.56	0.02150	0.00002	0.0012	0.0042	0.3200	0.0380	46	14	37
	60-70	8.61	0.01980	0.00047	0.0018	0.0046	0.3740	0.0480	46	14	37
	80-100	8.61	0.05440	0.00004	0.0019	0.0285	0.2900	0.0180	50	14	33
B3P7	0-10	8.69	0.02510	0.00159	0.0132	0.0028	0.4200	0.0121	69	14	15
	20-30	8.67	0.01840	0.00004	0.0015	0.0037	0.5400	0.0117	63	14	21
	40-50	9.15	0.20100	0.00002	0.0023	0.0076	0.4200	0.0127	64	16	15
	60-70	9.05	0.01550	0.00001	0.0015	0.0028	0.3900	0.0161	70	12	15
	80-100	9.00	0.01590	0.00002	0.0015	0.0028	0.4500	0.0175	75	10	11
B1P8	0-10	8.20	0.01490	0.00006	0.0008	0.0051	0.4600	0.0190	76	6	13
	20-30	8.39	0.01060	0.00006	0.0033	0.0054	0.4800	0.0160	75	10	13
	40-50	8.61	0.01240	0.00004	0.0012	0.0043	0.5100	0.0170	72	8	17
	60-70	8.58	0.01420	0.00005	0.0006	0.0049	0.4700	0.0200	68	10	17
	80-100	8.56	0.01380	0.00090	0.0004	0.0058	0.4900	0.0220	64	12	19
B2P8	0-10	7.66	0.02790	0.00007	0.0024	0.0259	0.3970	0.0210	52	12	33
	20-30	7.69	0.02930	0.00003	0.0024	0.0249	0.3620	0.0240	45	14	37
	40-50	7.74	0.02580	0.00003	0.0023	0.0036	0.2840	0.0250	48	14	23
	60-70	7.84	0.02610	0.00003	0.0024	0.0036	0.2650	0.0350	46	30	17
	80-100	7.95	0.03250	0.00003	0.0033	0.0039	0.2510	0.0350	47	30	15
B3P8	0-10	8.16	0.01520	0.00002	0.0012	0.0016	0.4300	0.0210	69	14	15
	20-30	8.20	0.02290	0.00002	0.0017	0.0013	0.3800	0.0198	73	10	13
	40-50	8.40	0.02150	0.00002	0.0007	0.0021	0.3800	0.0286	75	10	11
	60-70	8.53	0.01800	0.00002	0.0005	0.0035	0.4200	0.0322	76	10	11
	80-100	8.49	0.01350	0.00000	0.0007	0.0022	0.0430	0.0408	70	12	13

Physical and Chemical Properties of Soil Samples in 1995

	Depth	P^H	Total N%	Extractable Nutrients					Texture		
				Ava. P %	K%	Na %	Ca %	Mg %	Sand%	Silt%	Clay%
B1P9	0-10	8.47	0.0278	0.000060	0.0005	0.0042	0.5200	0.0280	79	8	13
	20-30	8.69	0.0183	0.000048	0.0037	0.0033	0.5300	0.0260	86	6	5
	40-50	8.79	0.0172	0.000051	0.0009	0.0028	0.5600	0.0300	58	20	19
	60-70	8.86	0.0190	0.000047	0.0004	0.0028	0.5900	0.0350	66	10	21
	80-100	8.90	0.0197	0.000047	0.0004	0.0033	0.5400	0.0410	69	8	19
B2P9	0-10	7.84	0.0191	0.001140	0.0104	0.0032	0.2790	0.0470	52	30	14
	20-30	7.98	0.0201	0.000700	0.0053	0.0037	0.2290	0.0530	59	24	14
	40-50	8.38	0.0219	0.000600	0.0032	0.0059	0.1930	0.0810	67	18	12
	60-70	8.59	0.0205	0.000570	0.0034	0.0057	0.1560	0.0900	68	20	8
	80-100	9.13	0.0455	0.001340	0.0029	0.0087	0.0480	0.0760	75	18	4
B3P9	0-10	7.97	0.0127	0.000050	0.0023	0.0042	0.4600	0.0144	62	20	15
	20-30	8.16	0.0198	0.000026	0.0013	0.0032	0.4700	0.0161	65	16	15
	40-50	8.27	0.0113	0.000025	0.0032	0.0035	0.4200	0.0168	63	18	17
	60-70	8.42	0.0138	0.000039	0.0008	0.0027	0.4200	0.0195	63	18	15
	80-100	8.48	0.0227	0.000150	0.0006	0.0025	0.4200	0.0234	76	10	11
B1P10	0-10	8.74	0.0204	0.000045	0.0014	0.0024	0.6000	0.0220	68	10	17
	20-30	8.76	0.0218	0.000051	0.0020	0.0032	0.5900	0.0230	76	8	13
	40-50	8.76	0.0158	0.000049	0.0006	0.0030	0.6200	0.0300	68	10	19
	60-70	8.77	0.0127	0.000046	0.0005	0.0033	0.6700	0.0360	66	8	23
	80-100	8.82	0.0194	0.000017	0.0010	0.0047	0.7000	0.0400	60	12	25
B2P10	0-10	6.54	0.0364	0.002860	0.0070	0.0094	0.1000	0.0190	61	16	20
	20-30	7.19	0.0364	0.002040	0.0032	0.0036	0.0760	0.0140	62	16	20
	40-50	8.34	0.0208	0.000413	0.0032	0.0037	0.1310	0.0160	61	14	22
	60-70	8.43	0.0194	0.000196	0.0058	0.0037	0.2300	0.0200	65	12	20
	80-100	8.46	0.0198	0.000023	0.0023	0.0037	0.4170	0.0190	68	12	18
B3P10	0-10	8.23	0.0152	0.000034	0.0016	0.0031	0.3500	0.0159	81	4	13
	20-30	8.61	0.0145	0.000029	0.0015	0.0029	0.3800	0.0232	80	4	13
	40-50	8.67	0.0202	0.000029	0.0011	0.0011	0.4100	0.0248	78	8	11
	60-70	8.78	0.0152	0.000031	0.0011	0.0037	0.4800	0.0295	78	8	11
	80-100	8.78	0.0149	0.000030	0.0010	0.0030	0.4700	0.0358	73	10	13

Appendix III

Physical and Chemical Properties of Soil Profile

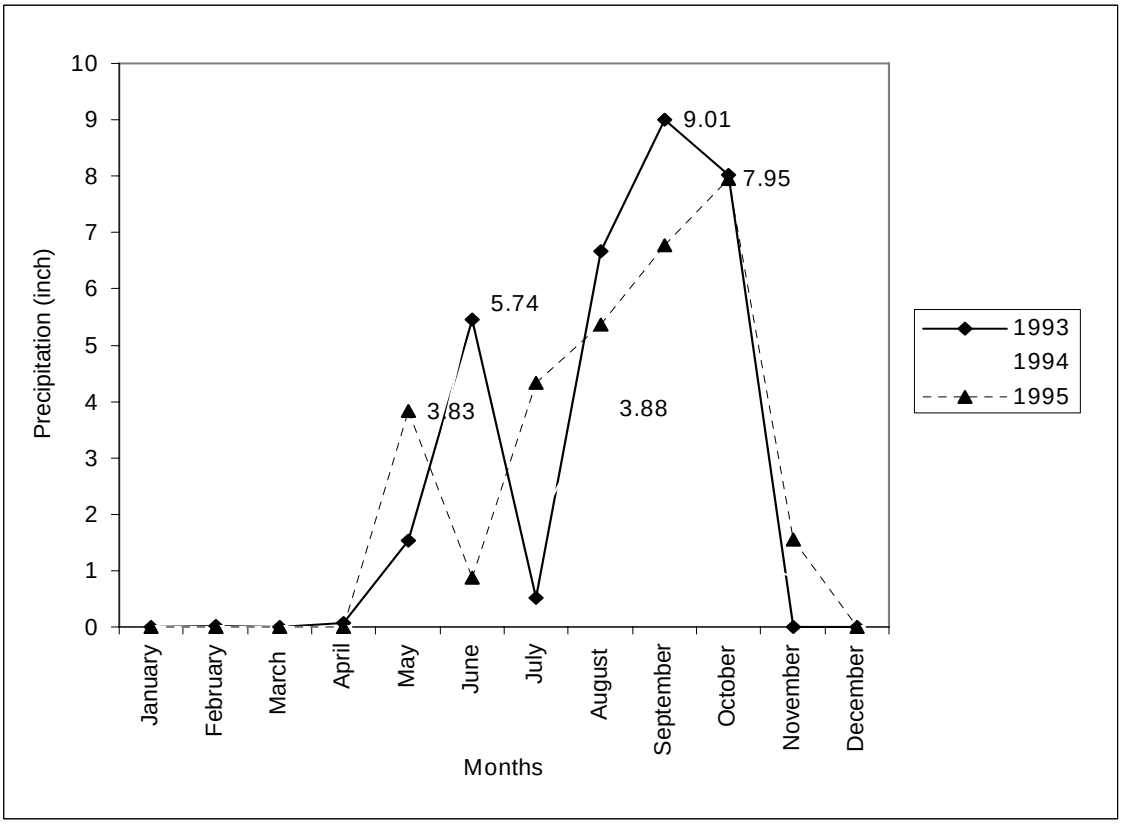
	Depth	p^H	E.C	Total N%	Ava. P%	Extractable Nutrients				O.M%	Texture			Remark
						K %	Na %	Ca %	Mg %		Sand %	Silt %	Clay %	
Proflie I	A horizon	7.8	1	0.0510	0.00047	0.0017	0.0029	0.250	0.026	0.570	70	12	12	Sandy Loam
	B_1 Horizon	7.8	1	0.0374	0.00034	0.0019	0.0026	0.580	0.032	1.480	60	16	18	Sandy Loam
	B_2 Horizon	8	1	0.0255	0.00001	0.0029	0.0065	0.500	0.041	1.250	83	6	8	Loamy Sand
Proflie I	A horizon	7.7	1	0.0595	0.00001	0.0014	0.0035	0.590	0.025	2.150	56	22	18	Sandy Loam
	B_1 Horizon	7.7	1	0.0306	Trace	0.0014	0.0090	0.072	0.032	1.970	75	12	8	Sandy Loam
	B_2 Horizon	7.4	1	0.0510	Trace	0.0013	0.0229	0.051	0.085	1.012	50	28	16	Sandy Loam
Proflie I	A horizon	7.7	1	0.0663	Trace	0.0015	0.0076	0.065	0.019	1.960	53	22	22	Sand Clay Loam
	B Horizon	7.3	1	0.0306	Trace	0.0008	0.0076	0.069	0.037	1.080	83	6	8	Loamy Sand

Appendix IV

Monthly precipitation data for Meiktila Township. (inch)

	1993	1994	1995
January	0	0	0
February	0.01	0	0
March	0	0	0
April	0.08	0	0
May	1.54	0.87	3.83
June	5.45	5.74	0.87
July	0.52	1.79	4.33
August	6.67	3.88	5.36
September	9.01	2.09	6.78
October	8.03	1.25	7.95
November	0	0.9	1.55
December	0	0	0
Total	31.83	16.52	30.67

Source: Meteorological and Hydrological Station, Meiktila



Comparison of monthly precipitation data for Meiktila Township

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