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A Preliminary Study on The Coppicing of Eucalyptus Camaldulensis and Eucalyptus Grandis During the First Growing Season Following Clear Cutting.

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ကမာဂျူ နှင့် ဂရင်းဒစ်ယူကလစ် သစ်မျိုးတို့၏ ငုတ်တက်ပေါက်ရောက်မှုကို အပြောင်ခုတ်လှဲပြီး တနှစ်အကြာတွင်၊ စူးစမ်းလေ့လာခြင်း။

ဦးစောဝင်း၊ B.Sc, [For.] [Rgn], အကြီးတန်းသုတေသနမှူး
သစ်တောသုတေသနဌာန။

စာတမ်းအကျဉ်းချုပ်

မေမြို့ရှိ စက်မှုကုန်ကြမ်းအဖြစ် အပြောင်ခုတ်လှဲ သစ်ထုတ်ပြီးဖြစ်သည့် ကမာဂျူနှင့် ဂရင်းဒစ်ယူကလစ်စိုက်ခင်း များမှ ငုတ်တက် ပြန်လည်ပေါက်ရောက်မှုကို ခုတ်လှဲပြီး (၁) နှစ်အကြာတွင် စူးစမ်းလေ့လာမှု ပြုလုပ်ခဲ့ပါသည်။ ဂရင်းဒစ် သစ်မျိုးတွင် ငုတ်တက်သေနှုန်းများကြောင်း တွေ့ရှိခဲ့ရပါသည်။ သစ်မျိုး နှစ်မျိုးတို့တွင် ငုတ်တက်ပေါက်ရောက်နှုန်း နှင့် ငုတ်တက်အမြင့်တို့ကို နှိုင်းယှဉ်လေ့လာထားပါသည်။ ငုတ်တက်ပေါက်ရောက်နှုန်းနှင့် ငုတ်တက်အချင်းတို့၏ ဆက်စပ်မှုကို လေ့လာထားပြီး တွေ့ရှိချက်များကို ဆွေးနွေးတင်ပြထားပါသည်။

A Preliminary Study on the Coppicing of Eucalyptus

Camaldulensis and Eucalyptus Grandis During the First Growing Season Following Clear Cutting

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Abstract

Coppicing of *E.camaldulensis* and *E. grandis* was investigated in the first growing period following clear cutting for pulp wood, in Maymyo. A very high stump mortality was observed in *E. grandis.* For each species, shoot production per stump and shoot height were compared. The relationship between the production of shoot and stump diameter were worked out and results discussed in this paper.

Contents

1. Introduction

Eucalyptus trees have been planted on 10 million acres in the world because of their rapid growth, adaptability to diverse sites and ability to coppice (FAO, 1979).

Eucalyptus plantations were first introduced into Burma in 1922 for trial and ornamental planting. Large scale planting of Eucalyptus species started in 1969, to meet the increased demand for forest products as a result of population pressure and the need of raw material by industry (Thet et. al, 1985).

Some of these plantations have reached the harvestable size after 10 years and were even clear felled for industrial pulpwood. As the cut-over areas are to be managed under the coppice methods, the coppicing power of the individual species is an essential requisite for the successful regeneration of the residual crop.

Even then, a species capable of producing by coppice may not produce a satisfactory crop of coppice shoots as it also depends on the period of cutting age or size of the stump at the time of cutting, and the height and characteristics of the stumps at the time of felling (Hawley, 1949).

This study is an investigation on the coppice growth of 10 year-old clear cut stands of *Eucalyptus camaldulensis* Dehnh. var. camaldulensis and *Eucalyptus grandis* Hill ex Maid one year following clear cutting.

2. Literature Review

Coppicing is the most important type of vegetative propagation for hard wood forest stands. Coppice shoots originate from either adventitious or dormant buds. These are quite different in origin (Stone and Stone, 1943). When the physiological balance of a tree is upset by cutting, injury, fire or disease, dormant and adventitious buds are stimulated to produce coppice shoots (Kramer and Kozolowski, 1960).

Among the important factors which influence coppicing are species, season of cutting, size of parent tree, and site. There is a considerable difference among species in the Eucalyptus genera in their rate of growth, adaptability to diverse sites and ability to coppice. In general, the species with lignotubers coppice well and some of the others do not. *E. pilularis, E . grandis, E. sieberi* and many forms of *E.camaldulensis* have no lignotubers, yet commonly coppice well. *E. regnans* and *E. delegatensis* generally coppice poorly (Hilllis, 1978).

At Coffs Harbour, it was found that 6 year-old *E. grandis* coppiced satisfactory only when cut during September and December or January (Clarke, 1975). Similarly, in tall forests of Tasmania, the recovery of 2-3 year old seedlings of three Eucalyptus species and several woody understory species was far better after cutting during late winter or spring than after cutting during late summer or autumn (Cremer, 1973). The ability to coppice may also vary with environment, e.g. *E. grandis* plantations are being managed by coppicing in South Africa and Brazil, but cannot be so managed at Coffs Harbour (Cremer, 1973). Also in Florida, coppicing of *E. grandis* is not as reliable, and the season of harvesting affect it. In summer, coppicing ability drops drastically in *E. grandis* and to lesser extent in *E. robusta.* In the Republic of South Africa, a major growing area for *E. grandis,* 95 percent coppicing success is excepted, except in the dry season when success is somewhat less (Stubbings and Schonau, 1980). *E.grandis* coppices reliably in some parts of Brazil (Ayling and Martins, 1981) but not in others (Campinhos and Ikemori, 1980).

As regards the coppcing of *E. camaldulensis* in Florida, coppicing does not seem to be a problem, but the experience with the species is insufficient to be sure

(Geary, Meskimen, and Franklin, 1983). Elsewhere coppicing of *E.camaldulensis* does not seem to be a problem as most of the plantations are managed on coppice rotations: 7 to 10 years is common on the better sites, but on poor sites this is prolonged (FAO, 1979).

Concerning with the coppicing of the other hardwood species, investigations on the relationships between proportion of stumps coppiced, number of shoots, and height of shoots and parent tree diameter have been reported for several hardwood species. Generally, the percentage of stumps coppicing is greater for small-diameter stumps than for large-diameter stumps (Roth and Hepting, 1943: Chruch, 1961; Wendal, 1975). However, Johnson (1975) found that the percentage of stumps coppicing increased with increasing parent tree diameter up to a certain size then decreased. Similar patterns were shown for number of coppice shoots produced versus parent-tree diameter (Keetch, 1944; Solmon and Blum, 1967. Prager and Glodsmith, 1977). Solomon add Blum (1967) found that height achieved by coppice shoots decreased with increasing parent tree diameter up to a certain size and than increased.

3. Materials and Methods

The area under study is situated in compartments 10 and 11 of Maymyo Fuel Reserve consisting of 85 acres and 125 acres of *E. grandis* and *E. camaldulensis* respectively. It is an area of high elevation with 60 inches of rainfall per year and the *E. grandis* grew at a rate of 170-175 ft^3/ac/yr. These plantations after reaching 10 years of age were clear felled as raw material for processing pulpwood. The pulpwood yield from 10 year old stands of *E. camaldulensis* and *E.grandis* were approximately 16 and 70 tons respectively. (Win et. al, 1985).

The residual stands were to be managed under the coppice system and in order to assess the condition of the coppice regrowth, a systematic sampling was carried out within the residual stands one year following clear felling.

Within each area, 20 sampling units were laid out systematically, and the dimension of each sampling unit is 72' x 72' (0.119 ac.).

Within each plot, the diameter of stumps left from the previous years fellings were measured. live stumps and dead ones were recorded separately for the assessment of stump mortality. The number of coppice shoots produced per stump (see figure 2) and then height of the tallest shoot on each stump (see figure 4) were determined.

Stump mortality (see figure 3) rate was calculated based on the proportion of live and dead stumps. The relationship between stump diameter and number of coppice shoots per stump (see figure 5), and between stump diameter and height of the tallest shoot per stump were also determined.

4. Results and Discussion

In *E. grandis* a considerable amount of stump mortality occurred. The percentage of stumps which produced coppice shoots decreased with increasing stump diameter, whereas in *E. camaldulensis* very low mortality occurred (Table 1.)

To test for the significant of the differences in average shoot height and number of coppice shoots produced per stump, between the two species, t-tests were tried based on the data obtained from the sample plots. Results indicate the superiority

of *E. camaldulensis* over *E. grandis* both in terms of shoot production and average shoot height (Table 2.)

The relationship between stump diameter and number of coppice shoots per stump, and between stump diameter and height of the shoot were examined using single variable regression analyses.

(a) Stump diameter and height of the shoot

1.	Sh_C	$= 6.8735\ SD^{*\ .07889}$	SE =	0.09536	R = .46
2.	Sh_g	$= 3.9342 \exp(.0539\ SD)$	SE =	0.1122	R = .92

(b) Stump diameter and number of coppice shoot

1.	NC_C	$= 2.3773 \exp(.06975\ SD)$	SE =	.04658	R = .99
2.	NC_g	$= 1.9078\ SD^{*\ .1573}$	SE =	.1411	R = .57

Where,

SD	=	Stump diameter
Sh_C	=	shoot height (*E. camaldulensis)*
Sh_g	=	shoot height (*E. grandis)*
NC_C	=	number of coppice shoots *(E. camaldulensis)*
NC_g	=	number of coppice shoots *(E. grandia)*

The correlation between stump diameter and height of the coppice shoot after one growing season is positive and significant (r. 9) for *E. grandis* and fairly significant for *E. camaldulensis (*r.46). Number of coppice shoots produced was significantly correlated with stump diameter in *E. camaldulensis* but not strongly in *E. grandis* (r.57).

The mean shoot height of *E. camaldulensis* was 7.371' while that of *E. grandis* was 6.118'; the average number of coppice shoots produced per stump was 4.08 for *E. camaldilensis* and 2.84 for *E. grandis.* There was an apparent increase in shoot height and the number of shoots produced with increasing stump diameter. (See Table 2)

As has been already stated the performance of *E. grandis* under the coppice system of management is rather doubtful. Observations in Natal, South Africa, on a 7-years-old first cutting of *E. grandis* indicated that it was in the lower and higher stump diameter groups where stump mortality was greatest. The smaller stumps (3-10 cm) and the very large stump (20-30 cm) had a high mortality where as the stumps between 10 and 20 cm (4 and 8 inches had a low mortality rate (FAO, 1979). The trend is quite similar in this study, as the mortality rate becomes higher as the stump diameter reaches beyond 9 inches (see figure 1).

Observations made during the field work indicate that the majority of the dead stumps have a severe loosening of bark on the stump. This probably may have arisen from the use of axes during the felling operation. Experience in Australia and South Africa has shown better results in coppicing and growth of coppice from the use of chain-saws, bow-saws, and two man crosscut saws than of axes. With the axe there is a higher probability of loosening the bark on the stump. (FAO, 1979). This is not the case for *E. camaldulensis* although the same felling tools and method have been applied. This may be due to the difference in bark type between the two species. *E. grandis* has a smooth white silvery and sometimes greenish bark which debarks easily, and have a fibrous stocking for several metres, where as in *E. camaldulensis* the bark is thin and cannot be easily stripped off.

There have been reports on the effects of stump height on subsequent coppice production, particularly the poor coppicing when stumps are cut low for other hardwood species (DeBell, 1971, Belanger 1979, El Houri Ahmed 1977). El Houri

Ahmed (1977) suggested rapid decay of low cut stumps as a season for low coppicing of *Eucalyptus microthea.* The standard practice of cutting 1/ in the present case is to leave the stumps not exceeding 6 inches off the ground. The recommended stool height for managing Eucalyptus stands is to have a height of not more than 12 cm (4.7 in) which will usually result in a good coppice crop with adequate shoots (FAO, 1979). Even then stump mortality in *E. grandis* was greater although the cutting was done in accordance with the instructions.

5. Conclusions

E. camaldulensis is to be favoured over *E. grandis* in coppice reproduction for the following reasons:

1. More shoots produced over the stump diameter range.
2. Taller shoots produced per stump.
3. Less stump mortality during the first year.

Even though the original growth of the *E. grandis* stand was far greater than the *E. camandulensis* the coppice regrowth was not as favourable.

A substantial amount of stump mortality was observed during the first year in *E. grandis.* This could be minimised by felling with crosscut saws instead of axes in larger diameter trees as the mortality rate increased with increasing diameter. A smooth slant cut made with a crosscut saw is preferable than with an axe as there is there is a less tendency of the bark being loosened. Research is necessary on the effect of felling tools in the loosening of bark of the stumps in coppicing.

Investigations on the number of shoots to be retained on each stump should be continued with the two species depending on the final products desired in a specified coppice rotation, when the coppice shoots have reached the age of 2 - 3 years old.

Development of *E. grandis* coppice shoots in subsequent years need to be monitored to determine the affect on the composition and character of the future stand.

With time, a decrease in number of coppice shoots would be expected because of mortality resulting from competition between coppice shoots, or breakage by wind or animals. The high mortality of stumps from the residual stand may lead to a very low final yield at the time of the next harvest.

Table 1. Number of stumps and percentage of stumps which coppiced in each stump diameter class in the first growing period following clear cutting.

E. grandis

Stump dia. (in)	Class limits (in)	No. in class	% sampled stumps coppiced	Mortality %
3	2-4	17	93	7
5	4-6	79	70	30
7	6-8	117	70	30
9	8-10	124	70	30
11	10-12	147	60	40
13	12-14	62	50	50
15	14-16	20	50	50

E. camaldulensis

Stump dia. (in)	Class limits (in)	No. in class	% sampled stumps coppiced	Mortality %
3	2-4	70	100	-
5	4-6	110	100	-
7	6-8	125	99	1
9	8-10	105	99	1
11	10-12	36	97	3
13	12-14	8	100	-
15	14-16	6	100	-

Table 2. Difference between mean shoot height of *E. camaldulensis* and *E. grandis.*

Plots	No. of observation	df	Mean shoot height
ımaldulensis	20	19	7.361
E. grandis	20	19	6.118
		Sum 38	Mean diff. 1.243

Tabular t $_{.01}$ & t $_{.05}$ with 38 df is 2.326 and 1.645 respectively. Calculated value of t-value from the sample data is 2.58635, which exceeds the tabular value, so the two species are very significantly different. *E. camaldulensis* shows better mean shoot height than *E. grandis.*

Table 3. Difference between number of coppice shoots produced per stump.

Plots	No. of observation	df	Average no. of coppice shoots produced
E. camaldulensis	20	19	4.08
E. grandis	20	19	2.84
		Sum 38	Mean diff. 1.24

Tabular $t_{.01}$ & $t_{.05}$ with 38 df is 2.326 and 1.645 respectively. Calculated value of t-value from the sample data is 3.65465, which exceeds the tabular value, so the two species are very significantly different. *E. camaldulensis* has better coppice shoot production.

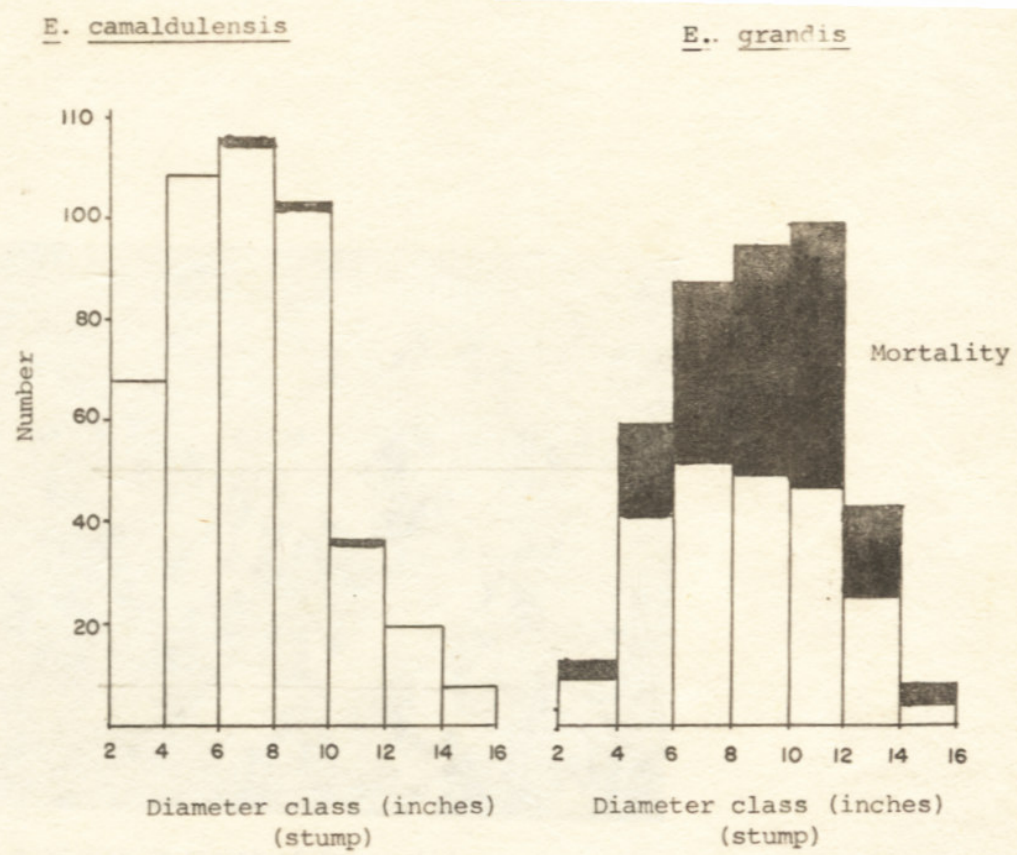

Fig.1. Diameter distribution of the stumps of E. camaldulensis and E. grandis during the first growing season following clear felling.

Fig. 2. A good coppice growth of *E. camaldulensis*, one year after clear felling.

Fig. 3. A dead stump of *E. grandis* felled with an axe with its bark being loosened off.

Fig. 4. Coppice growth of *E. grandis* from the stump felled with cross cut saw.

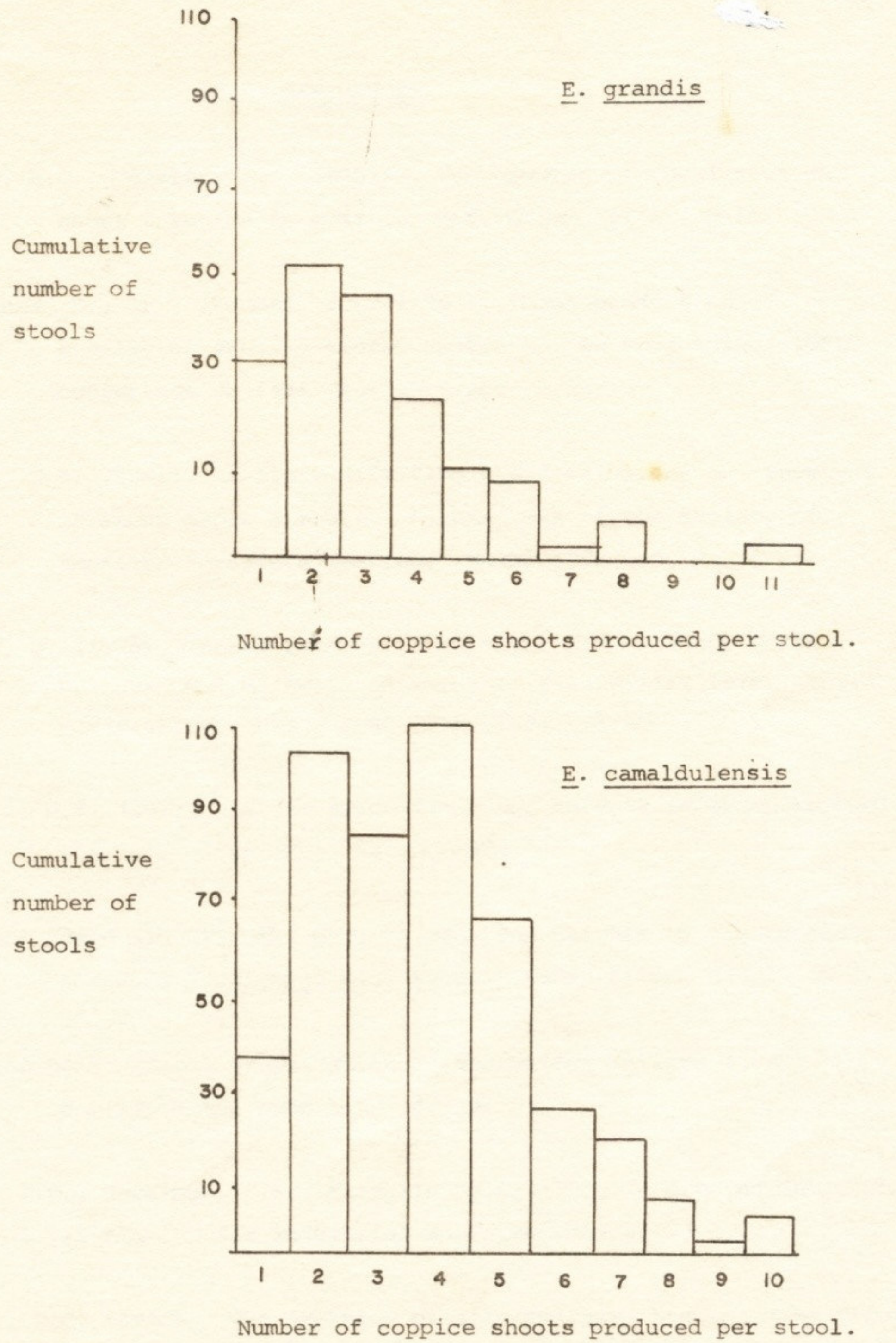

Fig.5. Histogram showing the number of coppice shoots produced per stool.

References

1. Ayling R.D. Martins, P.J. (1981). The growing of eucalyptus on short rotation in Brazil. For Chron. 57(1); 9-16.
2. Campinhos, E. Jr.; Ikemori, Y.K. (1980). Mass production of Eucalyptus spp. by rooted cuttings. In Proceeding IUFRO conference on fast growing trees; Brazil.
3. Chruch, T.W. (1961). Factors affecting the development and survival of sugar maple sprouts. Proceedings of the Society of American Foresters Meeting. Washington D.C.
4. Clarke, B. (1975). Establishment of eucalypt plantations. Coffs Harbour. N.S.W. Sci. and Technol. (Australia) 12(6): 10-13
5. Cremer, K.W (1973) Ability of Eucalyptus regnans and associated hardwoods to recover from cutting or complete defoliation in different seasons. Aust. For. Res.6:9-22.
6. De Bell, D.S (1971). Stump sprouting after harvest in swamp tupelo. U.S. For. Serv. Res. Pap.Se-83.
7. El Houri Ahmed (1977). The effects of stump heights on the coppicing power of *Eucalyptus microtheca.* Sudan Silvia. 3(22). 90-105
8. Food and Agricultural Organization of the United Nations (1979). Eucalyptus for planting. 677 p.
9. Geary, T. F., Meskimen G.F., Franklin, E.C. (1983). Growing Eucalyptus in Florida for industrial wood production. 43 p.
10. Hawley R.C. (1946). The practice of silviculture, 5^{th} ed. John Wiley and Sons Inc. New York.
11. Hillis, W.E. (1978). Eucalyptus for Wood Production. CSIRO Australia.
12. Johnson, P.S. (1975). Growth and structural development of red oak sprout clumps. For Sci. 21.413-418.
13. Keetch J.J. (1944). Sprout Development on once-burned and repeatedly burned areas in the Southern Appalachians. U.S. Dept. Agric. For. Serv. Appalachian For. Exp. Stn.
14. Kramer, P.J. and T.T Kozlowski (1960). Physiology of trees. McGraw-Hill Book Co., Inc. New York.
15. Prager, U.E. and F. B. Goldsmith, (1977). Stump sprout formation by red maple *Acer rubrum L.* in Nova Scotia. Proc. N.S. Inst. Sci. 28. 93-99
16. Roth, E.R., and G.H Hepting (1943). Origin and development of oak stump sprouts as affecting their likelihood to decay. J. For. 41 27-36.
17. Solomon, D.S., and B.M. Blum (1967). Stump sprouting of four northern hardwoods. U.S. Dept. Agric. For. Serv. Res. Pap. NE-59
18. Stone, E.L. and Stone, M.H. (1943). Dormant buds in certain species of Pines, Am. Jour. Botany, 30,346-351.
19. Stubbings, J.A. : Schonau, A.P.G. (1980). Management of short rotation coppice crops of *Eucalyptus grandis* Hillex Maiden. S. Afr. For. J. 115; 38-46.
20. Thet, Sein, Mehm Ko Ko Gyi, Thein Kywe and Htun Lynn (1985).
    Environmental impact of eucalyptus plantations with special reference to *E. camaldulensis.*
21. Wendell, G.W. (1975). Stump sprout growth and quality of several Appalachian hardwood species after clear cutting. U.S. Dep. Agric. For. Serv. Pap NE-329.
22. Win, Saw, Thein Kywe and Soe Tint (1985). Form Factors, Yield, Structure and Properties of Shanthabye *(Eucalyptus grandis)* Planted in Burma.