

ESTABLISHMENT & MANAGEMENT OF COMMERCIAL PINE PLANTATIONS IN UGANDA

PLANTATION GUIDELINE No. 12 (v.2) - Feb. 2007



Margaret Bamukyawa, a representative of a Luweero community planting group (supported by SPGS), admiring a well established pine plantation in Kyenjojo (the NFA's Oruha Forest Reserve). This is *Pinus caribaea* var. *hondurensis* (seeded from Australian seed orchards) at only 26 months.

1. WHY PINE?

Pines are generally better suited than most other commercial tree species, to the grassland and degraded woodland sites that are mostly available for plantation development in Uganda. Many of these sites experience hot, dry periods and some have fairly poor soil. Pines can tolerate such conditions, provided there is sufficient rooting depth and moisture in the soil. Some pines (e.g. *P. caribaea*) have proved to be very adaptable to a number of sites and soils.

Pines are generally well suited to growing in the plantation situation. On good sites, some pine species (especially *Pinus caribaea* var. *hondurensis* - hereafter referred to as PCH) can grow very fast (e.g. mean annual increments exceeding 30m³/ha/yr in Uganda). Most pines also produce a very versatile, general-purpose timber, which is now widely accepted by timber buyers and the Ugandan public.

In certain areas in Uganda – particularly the better sites with deep soil and high rainfall – growers could consider planting other species for timber (or pole) production: for example, *Eucalyptus grandis* (which will produce timber in considerably less time than pines); Musizi (*Maesopsis eminii*) and Hoop Pine (*Araucaria cunninghamii*). For more information refer to the SPGS Plantation Guidelines No. 5 – Tree Species for Commercial Timber Production in Uganda and No.9/10 (v.2) – Growing Eucalypts for Timber, Poles and Fuelwood.

2. PINE SPECIES FOR UGANDA

The main pine species for plantations in Uganda are PCH, *Pinus oocarpa* and *Pinus patula*. *P. patula* is easily identified from the drooping habit of its foliage – hence, its common name of weeping pine. It is not so easy to tell PCH from *P. oocarpa*, however, although generally PCH bears its needles in groups (fascicles) of 3, whereas *P. oocarpa* usually has its in groups of 5 (be warned though, each species can have fascicles of 2, 4 or 5!). Young *P. oocarpa* trees often appear very bushy for a while after planting out, with branches sprouting from very low down on their stems: this characteristic, however, enables the trees to re-sprout (coppice) if the plantation gets burnt.

Other species have been tried in Uganda but have not performed well – including, *P. radiata* and *P. kesiya*. Other pine species may become available for commercial planting in the future – e.g. naturally occurring hybrids between PCH and *P. oocarpa* (which have shown promising 'hybrid vigour' in Brazil) and also an artificial cross between PCH and *P. elliottii* (very successful in Queensland); *P. caribaea*

var. *bahamensis*, and better provenances (i.e. seed sources) of *P. tecunumanii* and *P. kesiya* – but these need to be first planted on a trial basis before we can confidently recommend them for Uganda's conditions.

3. SPECIES-SITE MATCHING

***P. caribaea* var. *hondurensis* (PCH)** is a lowland tropical pine found naturally in Central American and the Caribbean basin. In its natural environment, PCH grows best at low altitudes (from sea level to ca.700m) and on fertile, well drained sites with Mean Annual Rainfall (MAR) of 2-3,000mm.

PCH - *Pinus caribaea* var. *hondurensis* - is by far the pine suited to most sites in Uganda but only use improved seed – which for many years will have to be imported.

PCH has been extensively planted throughout the American, Asian and African tropics and subtropics, with substantial plantations in Australia, Fiji, Brazil, Venezuela, China and Vietnam. PCH is the most productive of the three varieties of *P. caribaea* (the others being var. *bahamensis* and var. *caribaea*).

PCH requires a tropical and humid climate, with Mean Annual Rainfall (MAR) of over 1500mm for optimum growth. PCH can resist moderate droughts but shallow soils and very hot, dry sites should be avoided. It grows on wide variety of soil types but requires a well-drained soil (and at least 600mm rooting depth) for good growth. In Uganda, it grows up at altitudes up to 1500m but prefers the lower altitudes.

P. oocarpa occurs naturally in Mexico and Central America from 350 to 2500m altitude and with MAR of 1000 to 1500mm. As a consequence of its wide natural distribution, *P. oocarpa* is a very variable species, which means that great care has to be taken when introducing it to other countries – as can be seen from the poor performance of the



Good plantation establishment is a combination of careful planning and timing of silvicultural operations. Follow the recommendations in this Guideline to maximize yields and the returns on your investment.



Fidel Begumisa, a private planter in Kabale (SW Uganda) in his 2-yr old *Pinus patula* stand (established with SPGS support). *P. patula* only grows well in the cool highland areas of Uganda.

species in some Ugandan plantings. *P. oocarpa* is generally less productive than *P. caribaea*, having slower initial growth and poorer wind-firmness, making it less desirable than PCH. Its lighter crown encourages a weedy under-storey to develop too, which increases the fire risk in plantations.

In Uganda, *P. oocarpa* has traditionally been recommended over *P. caribaea* for higher altitude sites (>1200m) and also sites prone to periodic flooding. Such wet sites should generally be avoided for commercial tree planting with any species: additionally the poor form of the locally collected *P. oocarpa* compared with the improved PCH leads us to recommend PCH on most other planting sites. It is hoped to obtain better provenances (i.e. seed origins) of *P. oocarpa* (and its closely related species – *P. tecunumanii*) in the near future but it will obviously a number of years before results from any trial plantings bear fruit.

P. patula is the main commercial timber (and pulp) species in Southern African plantations.

***P. patula* is frequently planted off-site (at low altitudes) in Uganda.**

It is only suited to cooler, moist areas in the south-west of Uganda.

In Uganda, it is frequently being planted 'off-site' (i.e. on sites where it is not adapted to). When planted on low altitude, hot sites, *P. patula* does not perform well: it requires high altitude, with a cool and moist climate. The only region which meets the species' requirements in Uganda, are the highlands in the South-West (Kabale).

Further details can be found in SPGS Plantation Guideline No. 6 – Site Species Matching for Uganda's Main Commercial Tree Species.

4. PLANNING ISSUES

Even the tropical and sub-tropical pines cultivated in Uganda generally grow slower than most *Eucalyptus*

species, particularly in their establishment phase. Pine plantations in Uganda only close their canopies after around three years, which has consequences for planning silvicultural operations – especially weeding. The adoption of the best silvicultural practices, however, not only speeds up the onset of canopy closure but also ensures the highest yields possible on the site are obtained. These practices are a combination of techniques – namely:

- Use of improved seed (preferably seed orchard);
- good land preparation;
- timely weed control to minimise competition, especially in the first few years and
- thinning at the recommended times.

NB. Pruning is also recommended but is a quality issue not directly affecting the plantation yield. The expected rotation for pines grown in Uganda, ranges from 18-25 years. It is feasible for sawlogs to be produced earlier – from thinning operations at maybe 8-10 years and final crops from 15 years onwards – but only on productive sites where heavy, early thinnings have been carried out. With the imbalance in supply and demand predicted for Uganda, the actual rotation will undoubtedly be determined more by market forces than silvicultural ones.



An example of good pine (PCH) establishment at the Kasana-Kasambya demonstration plot, near Mubende. This 12 month old crop illustrates appropriate spacing, use of good seed and seedlings, planting at the right time and especially good weeding.

The cost for establishing commercial pine plantations in Uganda has been estimated by the SPGS to be around Ushs1.2M¹ per hectare: this is an average cost across a range of sites in the country. The costs can vary depending on a range of factors but especially the optimum timing of operations, the techniques employed for land clearance and

¹ US\$ 676 at Feb. 2007 exchange rate of 1US\$ = Ushs1775.

weed control and the experience of the workforce (both basic labour and supervisory levels). For further information refer to SPGS Guidelines: No. 3 – *Planning for Successful Plantation Development* and No. 4 – *Productivity & Costs of Plantation Development in Uganda*.

5. STOCKING

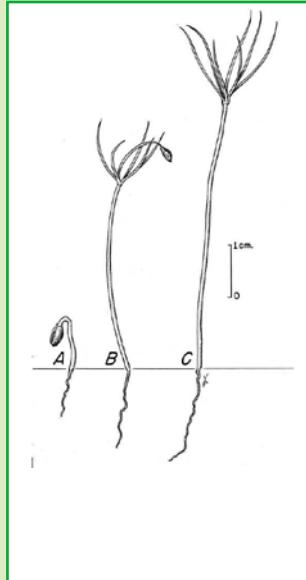
The traditional stocking for pines in many tropical and sub-tropical countries has been 9'x9', which equates approximately to 2.7m x 2.7m (or 1372 sph²).

Planting at 1111 sph compared with 1372 sph represents almost a 20% saving in plant costs and in the labour intensive preparation of pits.

Assuming you are using improved seed, good quality seedlings and have good standards of land preparation (as detailed in this Guideline), it is recommended to plant PCH at a spacing of 3 x 3m (1111 sph). Until improved seed is available here, however, the recommended spacing for both *P. oocarpa* and *P. patula* is 2.7 x 2.7m (1372 sph), which allows more selection from the crop at thinning stage.

6. ITS ALL IN THE GENES: SEED & SEEDLING SOURCES

As emphasised throughout these Plantation Guidelines, the seed source is critical to the success of your plantation. The pictures on page 6 should speak for themselves and illustrate why the SPGS only recommends using improved, imported pine seed.



Most of the original pine stands in Uganda were established from unselected seed from natural stands in Central America and many trials around the world have shown that PCH has a notoriously poor form in its unimproved state. Virtually all the Ugandan plantations have since been felled anyway, and those that remain are not good enough to collect seed from. It is also true that in a number

of the older *P. caribaea* stands in Uganda, seed production has generally been poor: the reasons for this are uncertain but similar observations have been reported from South Africa, Malawi and Zimbabwe,

2 sph = stems per hectare.

where poor seed availability has restricted the species' commercial planting over the last 20 years or so.

The consequence of having no locally produced, improved PCH seed means that for many years, Uganda will have to continue importing seed to meet its needs. To meet this demand for PCH seed, seed is being imported from the only countries with PCH breeding programmes – namely, Australia, South Africa and (since 2005) from Brazil. This situation will only be resolved when Uganda has its own pine breeding programme bearing fruits and to date this has not even started.

Australia: Forest Plantations Queensland (FPQ)³ in Australia, has established over 50,000 ha of PCH plantations (and a further 44,000 ha of a hybrid between *P. elliottii* and PCH). To support this major plantation development, FPQ have been involved in intensive breeding programme with PCH and it is seed from their advanced generation, clonal seed orchards which has been imported into Uganda since 2002. The parent trees in these seed orchards have been selected for their fast growth, resistance to pests and diseases, and their superior stem form and branching characteristics (see photo). PCH has formed the basis of an extensive pine breeding programme by Forest Plantations Queensland (FPQ) in Australia, for over 50 years.



One of (FPQ's (Forest Plantations Queensland) clonal PCH seed orchards in Australia – the source of much of Uganda's pine seed since 2003.

The quality of this FPQ seed is clear to see from the earliest plantings carried out by the FRMCP⁴ in 2002/03 in demonstration plantings around Uganda.

3 Prior to 2006, known as the Dept. of Primary Industries (DPI).

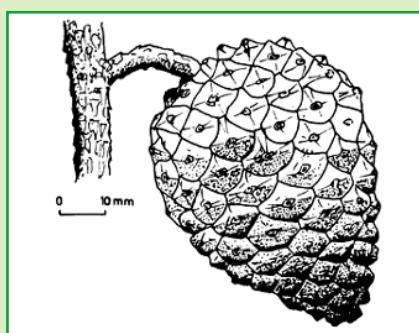
4 The EC-funded Forest Resources Management & Conservation Programme (2002-2006) – was the parent programme of the 1st phase of the SPGS.

With the major expansion into commercial forestry since 2003 (by both the private sector under the SPGS and the National Forestry Authority), the demand for the FPQ PCH seed has quickly outstripped supply. Following a visit by SPGS staff in mid-2006, however, more seed has been made available to Uganda but the supply still falls way short of total demand.

South Africa: in South Africa, PCH was planted in lowland sites near the coast but the species has now gone out of favour due to its low-density wood, which does not compare well with alternative species for either pulp or solid wood products. South Africa also started a breeding programme with PCH and although they hardly plant the species now, they have maintained their seed orchards: although very limited in quantity, Uganda imports seed from these orchards when available.

Brazil: With rapidly increased demand in 2005, FPQ could not supply Uganda's needs and so efforts were made to find suppliers of other improved PCH seed sources. Following a recommendation from CAMCORE⁵, a reputable supplier from Brazil's São Paulo state—Schuckar Seeds—was contacted. Schuckar

have seed production stands of PCH (and other pines) and seed from these has been imported into Uganda since 2005. NB. Whilst the early performance of the Brazilian PCH seed is generally good,



The cone of *Pinus oocarpa*.

5 CAMCORE – the Central American & Mexican Coniferous Resources Cooperative.

its germination is significantly less than the Australian seed (refer table) so more has to be sown to get the required number of seedlings.

The table shows the seed origins are currently recommended for Pines in Uganda:

Contact the National Tree Seed Centre's Manager on 0772 561 227. The SPGS works closely with the NTSC regarding importing seed: see the regular Seed Update page in the SPGS's bimonthly Newsletter.

7. NURSERY MATTERS

Anyone starting planting pine (or other commercial species) on a significant scale now in Uganda, has a choice: either start your own nursery or order the seedlings from a larger, external nursery. Standards in many of the small nurseries around the country are generally poor and many commercial tree planters in Uganda are now seeing the benefits of sourcing seedlings from one of the larger, improved nurseries rather than setting up their own nurseries.



The NFA's nursery at Namanve, nr. Kampala: one of the SPGS recommended nurseries for supplying tree seedlings. Seed source must always be clearly specified when ordering seedlings

SPGS-Recommended Seed Sources for Commercial Planting in Uganda

Species	Seed Source	Viable Seeds*		Approx. Price
		Per kg	Ushs/kg	
PCH	FPQ's Clonal Seed Orchards in Queensland, Australia	35,000	2,000,000	
- ditto -	South African Seed Orchards	30,000	850,000	
- ditto -	Seed production stands, Brazil	25,000	850,000	
<i>P. oocarpa</i>	Seed production stands, Brazil	25,000	850,000	
<i>P. patula</i> [†]	'Plus' tree selections in Uganda	60,000	500,000	
others	Trial basis only [‡] .		-	-

* Always check with the supplier the germination of each batch of seed and adjust order/sowing accordingly.

† Efforts will be made in 2007 to also import seed or

chard *P. patula* seed from South Africa.

‡ See the SPGS Newsletter for latest information on tree seed.

HOW NOT TO GROW PINES



- 1 A natural population of PCH trial in Queensland, Australia, showing poor form: very similar to Uganda's initial importation of PCH seed and this is why the SPGS only recommends using improved seed.
- 2 Locally collected (unimproved) pine seed was used for this poor plantation near Jinja. With no tree improvement programme yet in place, Uganda will have to rely on imported, improved pine seed for many years.
- 3 An all too common sight: planting a weak pine seedling into a very weedy site. This seedling will struggle and grow slowly: not the way to establish fast growing, high yielding plantations!
- 4 Another example of poor pine silviculture: poor seed (locally collected) and enormous weed competition. The result is predictable: high variability, low stocking and very poor growth.
- .5 The use of taungya (growing crops and trees together) has not worked in Uganda for the last 30 years. As this typical poor pine crop shows, this is clearly not the way to establish commercial tree plantations.
- 6 The consequences of poor silviculture and management are clear here in this over mature, stressed plantation at Katugo Forest Reserve. Poor seed, no thinning or pruning and no protection from seasonal fires have taken their toll. The result is low yields and poor quality sawlogs.



GROWING PINES: BEST PRACTICE



- 1 A well established, young PCH planting by Arthur Busingye in Kasiyo-Kitomi Forest Reserve, Bushenyi. A combination of good seed, quality seedlings, good land preparation and weeding has given this crop a good start.
- 2 An excellent 12-month old PCH crop at the NFA's Oruha Forest Reserve, Kyenjojo. The benefits of pre-plant spraying with Glyphosate and good quality seedlings (ex-Australia seed) are clear.
- 3 Another good example of pine (PCH) establishment at Richard Bakojja's planting at Kasana-Kasambya CFR, near Mubende.
- 4 A mature pine crop in South Africa. Obviously well established and good genetic stock: timely thinning and pruning operations have also then ensured that this is a high value stand.
- 5 Good weeding is essential in the early phase of establishment and also provides many rural jobs.
- 6 Another excellent example of good establishment, this one by Global Woods Ltd. at Kikonda CFR, near Hoima. This is 1.5 yr old PCH from Australian seed. Weeding has been good, both before and after planting.





The future? Hybrid pine cuttings at one of FPQ's nurseries in Australia. These are selected *Pinus elliottii* x PCH crosses.

Before you buy tree seed, always ask for its full origin and collection details as well as its expected germination %.

Both the NFA and an increasing number of privately owned nurseries have improved over the last few years and many are now able to take orders to supply seedlings to private growers. Orders must be taken 6 months in advance to allow for planning, seed purchase and time to raise the plants. Payment of a 30% deposit is recommended at the time of order.

Insist on seedlings from improved seed and then only plant healthy plants, 15-25cm tall (measured

from the root collar). Reject over and under-sized plants and any that show signs of damage or sickness. Smaller seedlings may not have well developed root systems needed to cope with the harsh conditions inevitably encountered following planting out. Larger seedlings will struggle to establish themselves as the small root system tries to cope with the demands (of water and nutrients) from the leaves. For more information on tree nurseries in Uganda refer to SPGS Plantation Guideline No. 7 – *Tree Nurseries: the Key Issues*.

8. SITE PREPARATION

The chosen method of land preparation will depend on the nature of the vegetation to be cleared and the resources (labour, machinery etc.) available to the grower. The most important issue with land preparation is to time it so that the land is clear in time for subsequent operations – namely, lining out, pitting and pre-plant spraying operations. Clearing land too early will lead to heavy weed growth, which will have to be controlled prior to planting. Clearing too late leads to delays in planting; planting late in the rainy season is always risky and usually ends in failure of the crop.

Choose the most appropriate and cost-effective method for land preparation. Piling and burning the trash makes the site easier to mark out for planting and also helps with subsequent weeding operations. Lining out carefully also pays dividends for all subsequent work (and supervision of work).

It is also important to prepare good planting pits so that the young seedlings get the best start possible. Pits should be a minimum of 20cm in diameter, cultivated to a depth of 20cm. The pits should not be prepared too long in advance of planting otherwise the soil can compact again. For further details, refer SPGS Plantation Guideline No. 14 – *Land Preparation*.



Excellent land preparation and weeding are evident here at Busoga Forest Co. Ltd's 2006 PCH planting. High stocking and uniformity have been achieved to give this plantation the best possible start.

9. PRE-PLANT WEEDING See Section 13.

10. TIMING OF PLANTING

The same rule applies for all plantation species: namely, plant as early as possible in the rainy season. This gives the young trees the maximum chance of establishing themselves well before the onset of the hot, dry period that follows each rainy season in Uganda. Normal ('dry') planting can usually take place when >50mm of rain has been received – but this depends on a number of site-specific factors and the site must be checked for soil moisture down to at least 25mm depth before deciding to plant.

Depending on the region (and the season), the best times to plant are usually early in either of the two rainy seasons experienced in most of the main plantation regions in Uganda (normally March/April and Sept/Oct). The use of super-absorbants (e.g. Aqua-Soil) can also extend the planting time.

11. BEATING UP⁶

Always plan to raise (or order) up to 15% extra plants to replace the failures from the initial planting. Preferably within two weeks of the initial planting, carry out a quick survival check by counting the failures in a sample number of lines. Generally if the survival is below 90% (i.e. over 10% deaths), blanking is recommended. In the blanking operation it is important to use the same seedling stock that was used for the original planting. Late blanking and using different seed stock from the original planting are the main causes of variability in Ugandan plantations. For further details refer to SPGS Plantation Guideline No. 23 – *Planting & Beating Up*.

Blanking in season following the initial planting is not recommended except in exceptional circumstances, as it will inevitably lead to variability in the plantation.

12. FERTILISING

It has generally not been common practise to fertilise pine crops in many tropical or sub-tropical countries. South African research, however, has shown sustained response of pines to P (Phosphorus) applications on some sites. In Queensland, Australia, fertilisers have produced a very significant response in conjunction with site cultivation but these are very poor (infertile) sites compared to most of Uganda. Specific sites in Madagascar and Nigeria have also



A high quality PCH seedling (within the SPGS recommended size limits 15-25mm) just planted onto well prepared (and weeded) soil.

shown good responses to fertiliser but it is highly dependent on the site's nutrient status. At this stage in Uganda, however, we do not recommend fertilising pines in Uganda, until research proves it to be worthwhile.

13. WEEDING

There is no point wasting time and money on preparing the planting site to a high standard, planting high quality seedlings and then neglecting weeding – and yet this is exactly what many tree planters in Uganda are doing!

As emphasised throughout this series of Plantation Guidelines, weed control starts well before planting. The aim is to control problem weeds **before planting** and then to keep any subsequent weeds to a minimum. Where there is a predominance of tough, perennial grasses and tall broadleaved weeds, for example, we recommend a pre-plant spray with Glyphosate, carefully timed to minimize the period between spraying and planting.

Following planting, a manual spot (or ring) weed is generally recommended for all pine species, to minimise competition and ensure good growth of the trees. The aim of this operation is to create

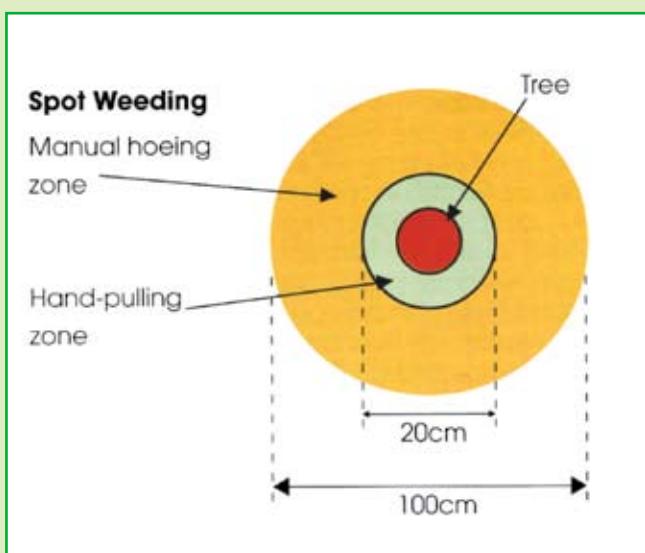
⁶ The term beating up refers to the replacement of failures: it is also known as infilling or blanking – depending on where you are from!



Spot weeding is the most important operation in the few months after planting.

a weed-free zone of 50cm radius around each planted seedling. This operation usually is carried out with a sharp hoe. One common problem, however, is that the labourers hoe right up to the tree stem. After a number of passes, the tree can become unstable and easily fall over. It is thus recommended to manually hand-pull any weeds in a zone 10cm radius around each tree.

Following the initial spot weed, a row (or line) weeding is often recommended: a 1 m strip (500 mm either side of the seedlings) is recommended. A line-weeding operation is easier to supervise – provided the tree rows have been aligned well. Further details



on weeding refer to SPGS Plantation Guidelines No. 16 (v.3) – Safe Use of Glyphosate Herbicide; No. 15 – Post-Plant Weed Control and No. 17 - Post-Plant Use of Glyphosate.

14. TAUNGYA

Taungya is the practice of establishing a tree crop in conjunction with an agricultural crop. It has been used successfully in a number of countries but over the past 30 years or so, the practice has failed to produce commercial tree plantations in Uganda. Taungya has become an excuse for people to plant their food crops in Forest Reserves under the pretence of establishing tree crops, which somehow never materialise. Poor tree stocking, low yields and very bad stem form are the consequence of employing taungya in Uganda. Consequently, taungya is not recommended for establishing timber crops in Uganda (NB. the practice is not permitted under the SPGS contracts).

It is better to completely separate the growing of food crops and timber trees in time and space. Clearing land ahead of planting and allowing local people to grow food crops for up to a year prior to planting trees can work but the trees must be planted at the right time with no other crops there. For further details refer SPGS Plantation Guideline No. 24 – Taungya.

16. PROTECTION

Although the tropical pines discussed in this Guideline are relatively fast growing, rotations may still exceed 20 years (see Section 4) and a lot can happen to a plantation in that time. The plantation will have to protected throughout its life from damage from animals, fires and pests and diseases that may come along. Protection need not be expensive but it must be carried out on time and regularly.

Refer to the following SPGS Plantation Guidelines for more information:

- No. 18 – Fire Protection.
- No. 19 – Common Pests & Diseases of Tree Plantations.
- No. 20 – Protecting Tree Plantations From Animals.

17. FOXTAILING

The phenomenon known as foxtailing (see photo) sometimes occurs in pine plantations in tropical countries – including Uganda. Foxtailing is a striking form of apical dominance, which can lead to stems of over 10 metres with no branches. Foxtailed trees are unstable and will often break in the wind. The causes of foxtailing are only partly understood.



The consequences of poor silviculture and management are clear here in this over mature, stressed plantation at Katuugo Forest Reserve. Poor seed, no thinning or pruning and no protection from seasonal fires have taken their toll. The result is low yields and poor quality sawlogs.

Foxtailing is known to be an inherited characteristic but it is also related to site and climatic conditions. There is increased incidence of foxtails on tropical lowland sites with consistently high temperatures, deep fertile soils and heavy, non-seasonal rainfall. Since foxtails are undesirable, they should be removed in the first thinning operation (see next section).

18. THINNING

If you want to produce the maximum yield of large sawlogs, thinning is an absolutely essential operation. Early, heavy thinnings, to remove poor quality trees and also to promote fast diameter growth are recommended. For the crop to develop to its maximum potential, the thinning operations must be carried out at the appropriate time. Late (or no) thinning results in a crop of many small stems and an unhealthy crop as competition sets in.

Suggested Thinning Regime for Pine Sawtimber in Uganda

Thin No.	Age	From (sph)	To (sph)
1	4-6	1111*	750
2	6-9	750	500
3	9-12	500	300
Fell	18-25	300	

* assumes initial planting at 3x3m.

The timing (and number) of thinning operations depends largely on the growth rate of a particular species on a site and the objectives of the grower (e.g. specific market specifications for products). The thinning intensity is obviously linked to the initial stocking (sph). A suggested thinning regime for expected growth rates of pine on an average site in Uganda is outlined in the Table (above). It is worth noting that one of the most common mistakes made by commercial tree growers is their reluctance to thin either on time or to the intensity that will really maximise the benefit to the remaining crop.

Early and heavy thinnings are strongly recommended - to produce large diameter trees as fast as possible.

Each thinning operation obviously yields some trees, though from the early (first) thinning, they will be small (and some misshapen). As the tree size increases with age, so the 2nd and 3rd thinnings will produce smaller sawlogs. This should provide some useful income to the grower, prior to the main sale of high quality sawlogs at rotation age. Refer to SPGS Plantation Guideline No. 26 – *Thinning Plantations for Timber Production* – for further details.

19. PRUNING

Pruning of Pine trees is recommended for the following main reasons:

- To improve timber quality (to produce clear timber, to prevent the formation of dead (loose) knots and to reduce the size of live (sound) knots).
- To facilitate access into the plantation (for thinning, fires and observing pests and diseases).

Clear, knot-free timber is laid down in the years following pruning thus it is important to time the operation well to maximise its effect. It is also a costly (labour intensive) operation and if done incorrectly,



This excellent pine (*P. elliottii*) plantation in Swaziland (Shiselweni forest Co.) will produce high quality, large sawlogs. the key is the use of improved (seed orchard) seed and timely thinnings.

can do more harm than good. Removal (by pruning) of up to 25% of the live crown will not affect increment significantly: the best rule to remember, however, is to never prune more than half the total tree height. Pruning is usually carried out in 3 or 4 successive stages as the trees grow in height. For further details, refer to SPGS Plantation Guideline No. 27 – *Pruning for High Quality Timber*.

20. YIELDS

It is difficult to predict the expected growth rate of pines in Uganda. There are two main reasons for this: firstly, the older pine plantations in Uganda were not thinned and secondly, the silvicultural techniques recommended throughout this (and other) SPGS Plantation Guidelines, have not been in place here before (e.g. the use of improved seed and more intense land preparation and weed control methods). We can make predictions, however, based on experience with similar crops elsewhere.

Assuming that the pine plantations have been well established, the correct species has been planted, the crop has been well maintained (especially protected from fires) and thinned on time, the following yields are predicted:

- PCH: Mean Annual Increments (MAI) of 25-35m³/ha/yr.
- *P. oocarpa*: MAI 20-30m³/ha/yr.
- *P. patula*: MAI 25-35m³/ha/yr.

Thus, at 20 years old, PCH might be expected to produce 500-700m³ per ha (total volume including what is removed in thinning operations). But remember - these high growth rates will only be achieved by following closely the recommendations made in this Guideline, particularly with regard to seed source, seedling quality, site selection, good land preparation, weeding before and after planting and then thinning to the correct stocking on time.



*It is hoped that this Guideline may sow the seeds for the establishment of a substantial and good quality pine plantation resource in Uganda.
Please send any feedback on content to the SPGS - info@sawlog.ug*

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