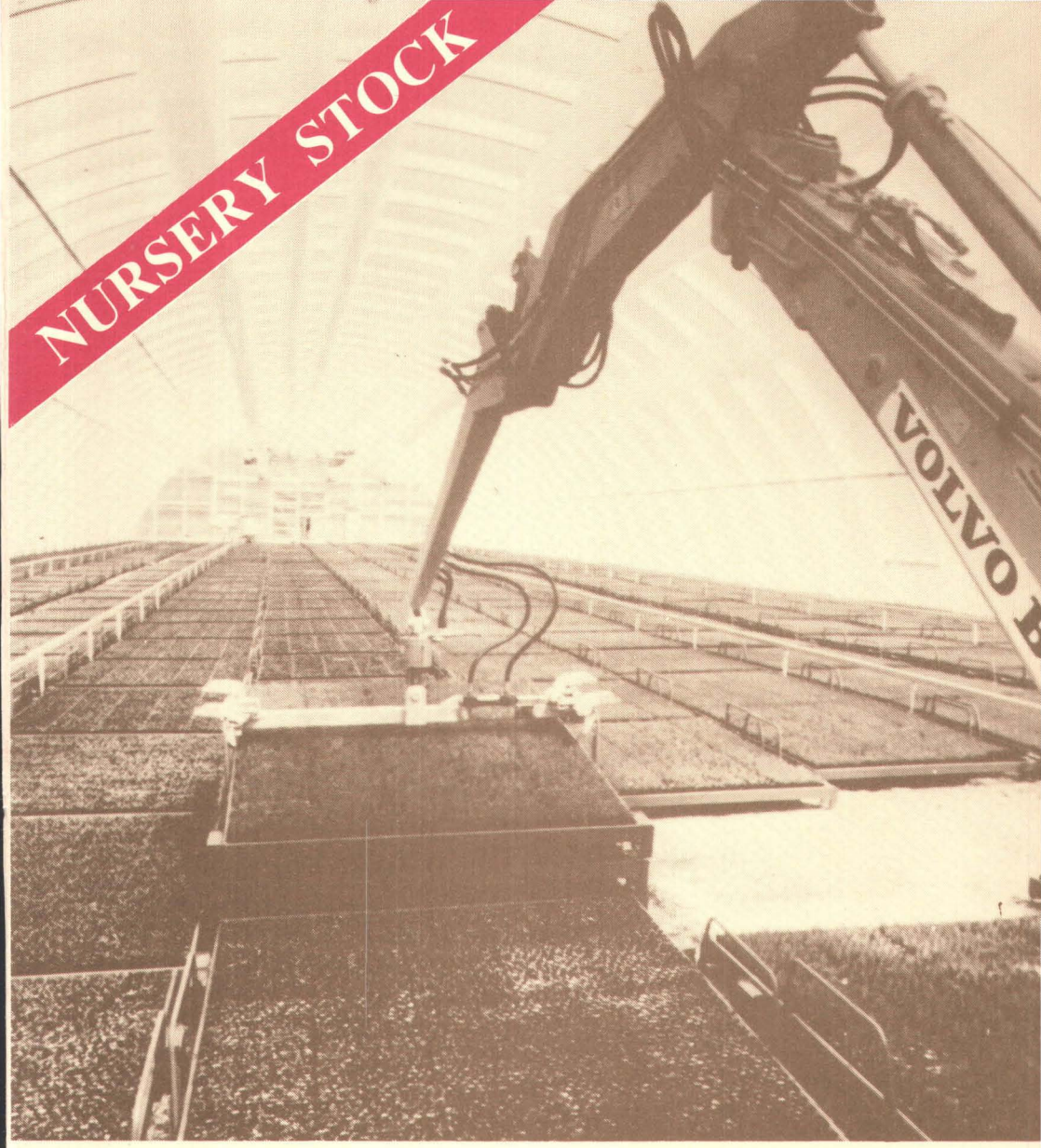
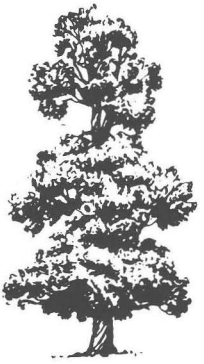


IRISH FORESTRY

JOURNAL OF THE SOCIETY OF IRISH FORESTERS

Volume 45, No. 2, 1988

IRISH FORESTRY



JOURNAL OF THE SOCIETY OF IRISH FORESTERS

Volume 45, No. 2, 1988

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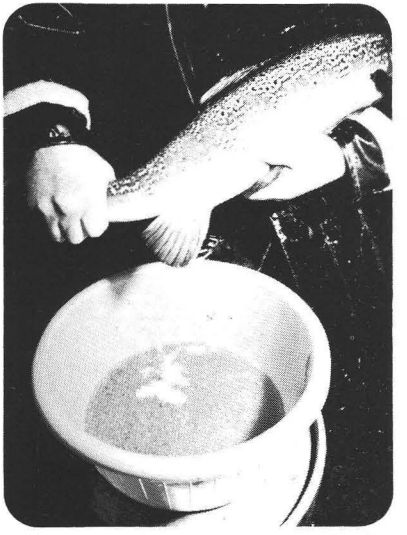

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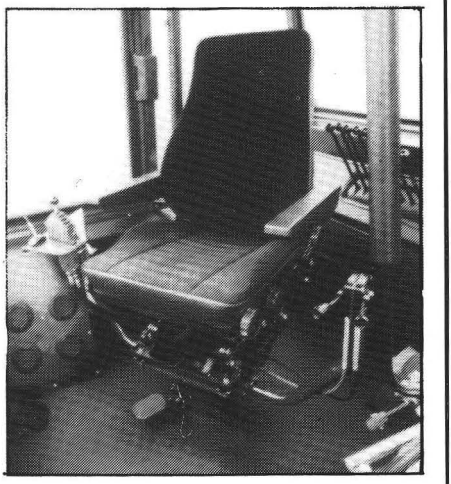

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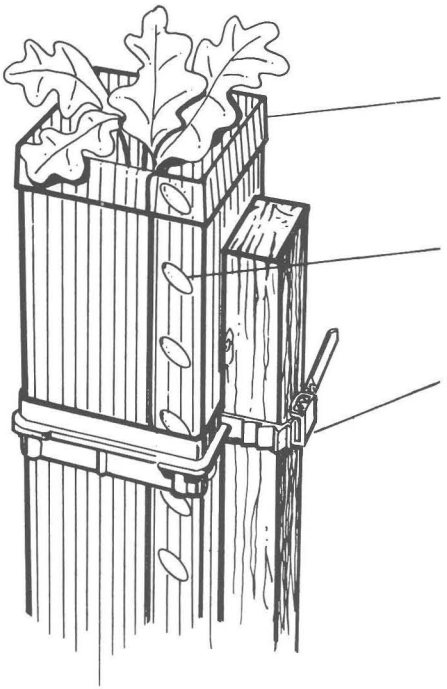

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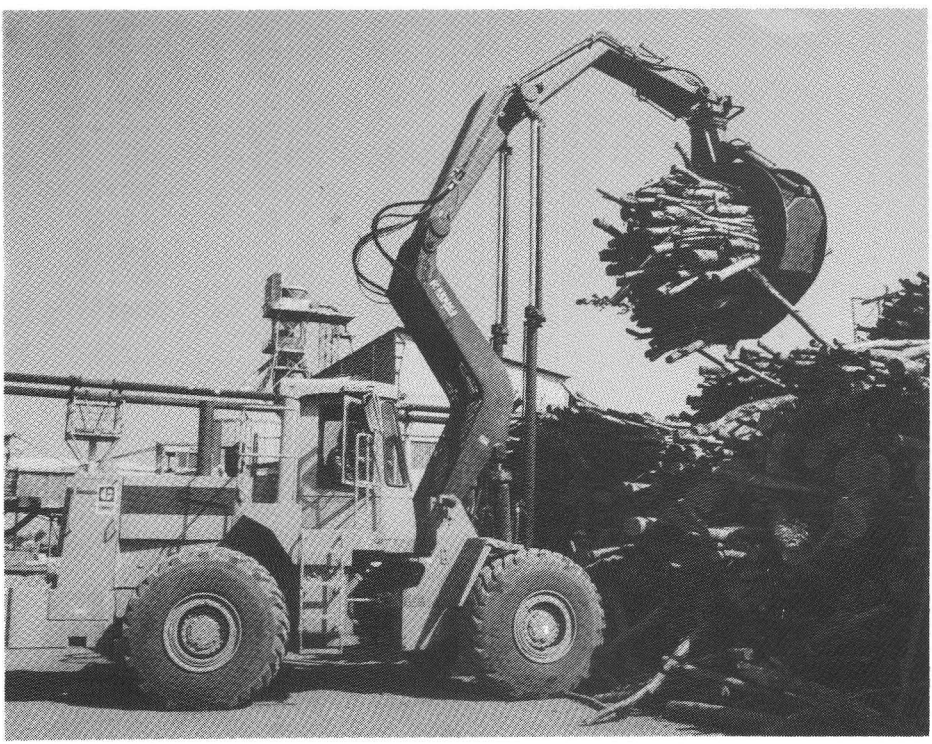

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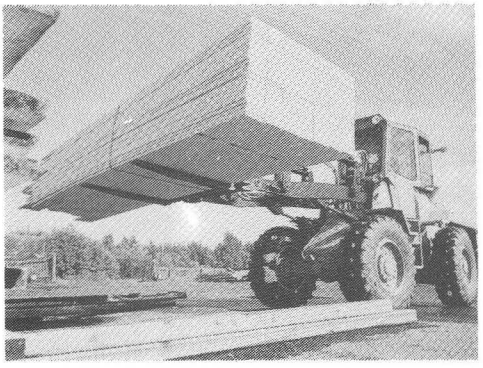

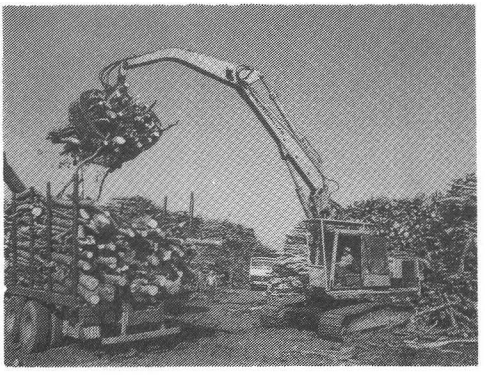

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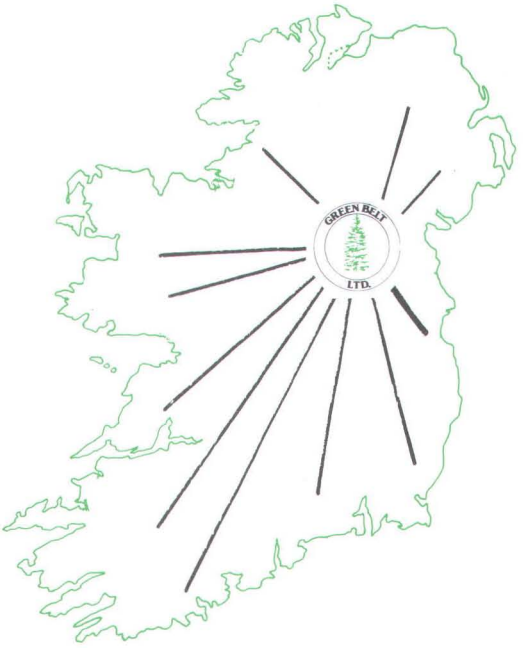

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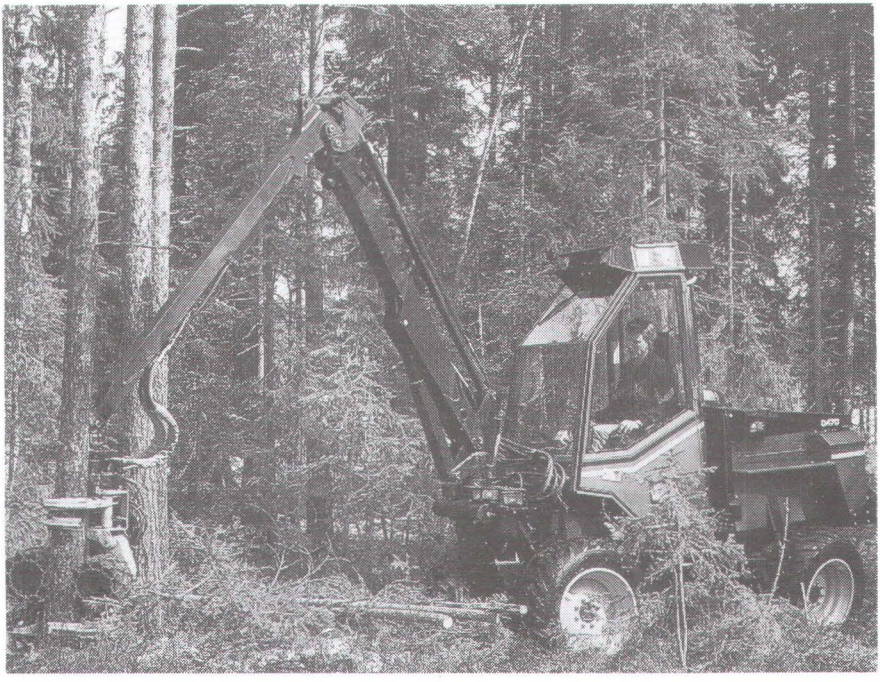

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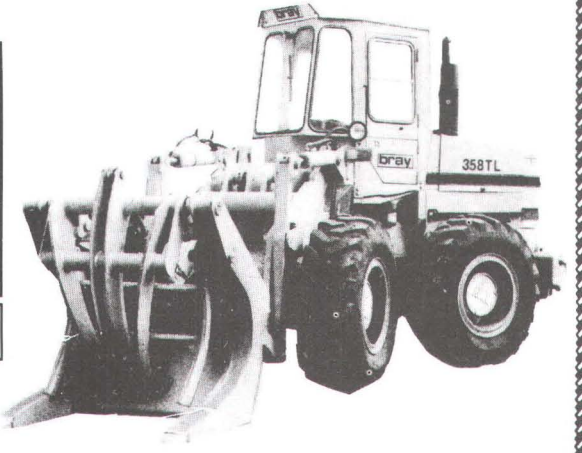

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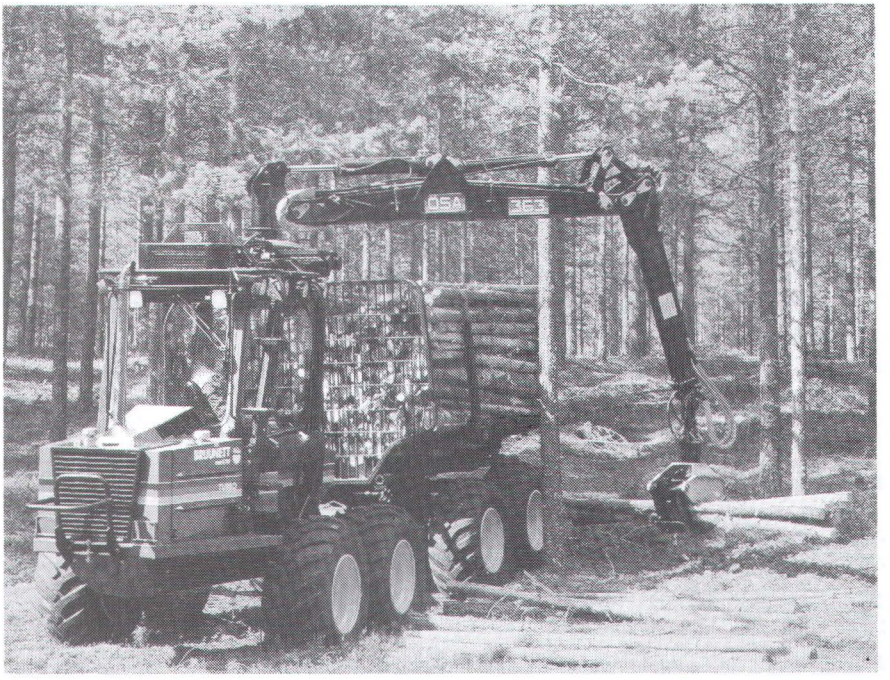

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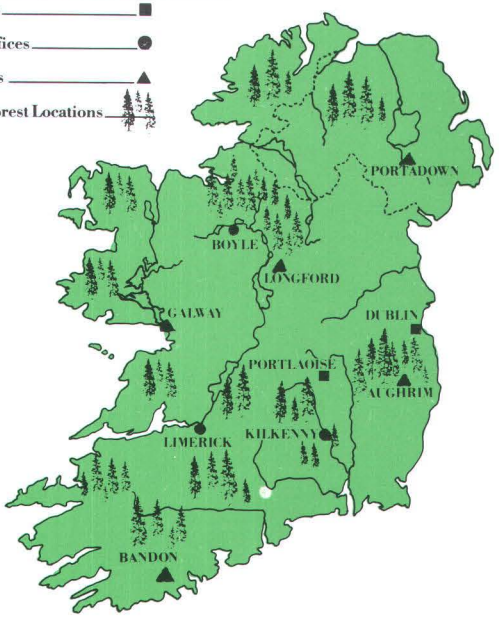

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Clonal Forestry – A View to the Future

A. R. Pfeifer

Forest Service, Research Branch, Bray, Co. Wicklow.

Introduction

The term clone can be defined as "genetically uniform material derived from a single individual and propagated exclusively by vegetative means" (Hartmann et. al. 1975). While clones may appear to be artificial they in fact do exist in nature. Many herbaceous species that reproduce by bulbs, rhizomes and runners form clones. Clonal varieties of food and ornamental crops have been used in agriculture and horticulture for centuries and today form a significant proportion of all varieties available to farmers and nurserymen. The success of these varieties lies, not only in the characteristics of the products they produce but also, in the ease with which they can be propagated. By contrast, clonal varieties of forest trees have, with a few notable exceptions proven difficult to develop. The main reason being that vegetative propagation, through the rooting of cuttings from mature trees, is problematic and has not presented foresters with the opportunity to develop clonal varieties for specific sites or end uses.

Early attempts at rooting cuttings from old trees that possessed superior characteristics generally resulted in failure or, if successful, the rooted cuttings tended to grow for many years with a plagiotropic or branch like habit. As a result most tree species are grown from seed, the few exceptions are poplars, willows and *Cryptomeria japonica.* These species have been propagated vegetatively for many years and numerous clonal varieties exist today. However, the coniferous and hardwood species that are the mainstay of forestry in the northern hemisphere have proven difficult to propagate vegetatively on a commercial scale. But what was once considered as impossible is now proving to be technically feasible, as a result of two main factors:

- The use of mist propagation units has greatly increased the success of rooting cuttings on a commercial scale.

- The realisation that it is not necessary to start developing clonal varieties from mature trees but the selection of young individuals from genetically superior populations can overcome the problem of low rooting success experienced with old material.

The Potential Uses of Clones in Forestry

The use of clonal varieties of the major tree species would provide foresters with many new opportunities. Considerable genetic gains could be achieved in traits such as growth rate, adaptability, branching habit, timber quality, insect and disease resistance, to name but a few.

Clonal varieties could be developed for specific end uses for example:

- a variety that could withstand severe exposure.
- one that could combine a high growth rate with acceptable timber density.
- a clonal variety that is more efficient than seedlings in its uptake and use of nutrients.
- a deep rooting clonal variety that would offer increased stability on windy sites.
- a variety with resistance to *Fomes annosus* that could be planted on heavily infested sites.
- clonal varieties suitable for Christmas trees and foliage production.

The opportunities are numerous and are only bounded by the limit of genetic variability that exists in a species. Many studies have been undertaken with tree species to examine the degree of genetic variability that exists in traits that are of economic importance. In many cases this is very substantial, but is often difficult to exploit easily through improved seed due to difficulties in flowering. Also with seed, segregation of genes occurs and it is often not possible to reproduce all individuals with the desired combination of traits.

The use of clones can overcome these problems since vegetative propagation will faithfully copy the individual genotype and is independent of sexual reproduction and its associated problems.

Techniques of Propagation

Clonal forestry by implication means vegetative propagation and consequently requires a different approach to plant production methods than those used for seedling stock. There are several

methods of vegetative propagation but at present, rooting cuttings is the only method that can be used to economically produce plants in quantity.

The ease with which rooted cuttings can be produced on a commercial scale depends greatly on the species and the age of the material to be propagated. Among the major commercial conifer species which form the bulk of our forest development programme the spruces and larches are the easiest to root, with the pines and Douglas fir being the most difficult. As a result, the only large scale conifer vegetative propagation programmes underway in Europe are those for spruce. Attempts at producing cuttings of Douglas fir and pine commercially have not met with much success. The only notable exception among the pine species is Monterey pine which is currently being propagated vegetatively on a large scale in New Zealand.

Physiological age can also have a major effect on the ease with which material can be rooted. Generally the younger the material the greater the ease with which it can be propagated. Good rooting percentages are possible with trees aged 10 years or less, but after 10 years rooting success diminishes rapidly. Consequently, considerable effort is being expended in order to maintain selected clonal material in a juvenile and thus easily rootable state.

The spruces are potentially the most important species for clonal forestry in this country. The propagation techniques described below will largely refer to those being employed by the Forest Service to raise rooted cuttings of Sitka spruce.

In order to achieve a consistent and repeatable high rooting success with spruce cuttings it is necessary to provide an optimum set of environmental conditions namely:

1. A humid environment – when cuttings are detached from the donor plant they continue to respire, therefore, to minimise water loss during the vulnerable period when roots are being formed they must be placed in a very humid environment. This is usually achieved by placing them under intermittent mist in a glasshouse or polyethene tunnel.

2. Rooting medium – generally a good rooting medium must:
- be able to keep cuttings in a vertical position
- have good drainage but at the same time have sufficient water content
- have good aeration

Spruce can be rooted in a wide range of rooting media. Those most commonly used consist of either pure fine gravel or a mixture of drainage such as gravel, sand or perlite with a

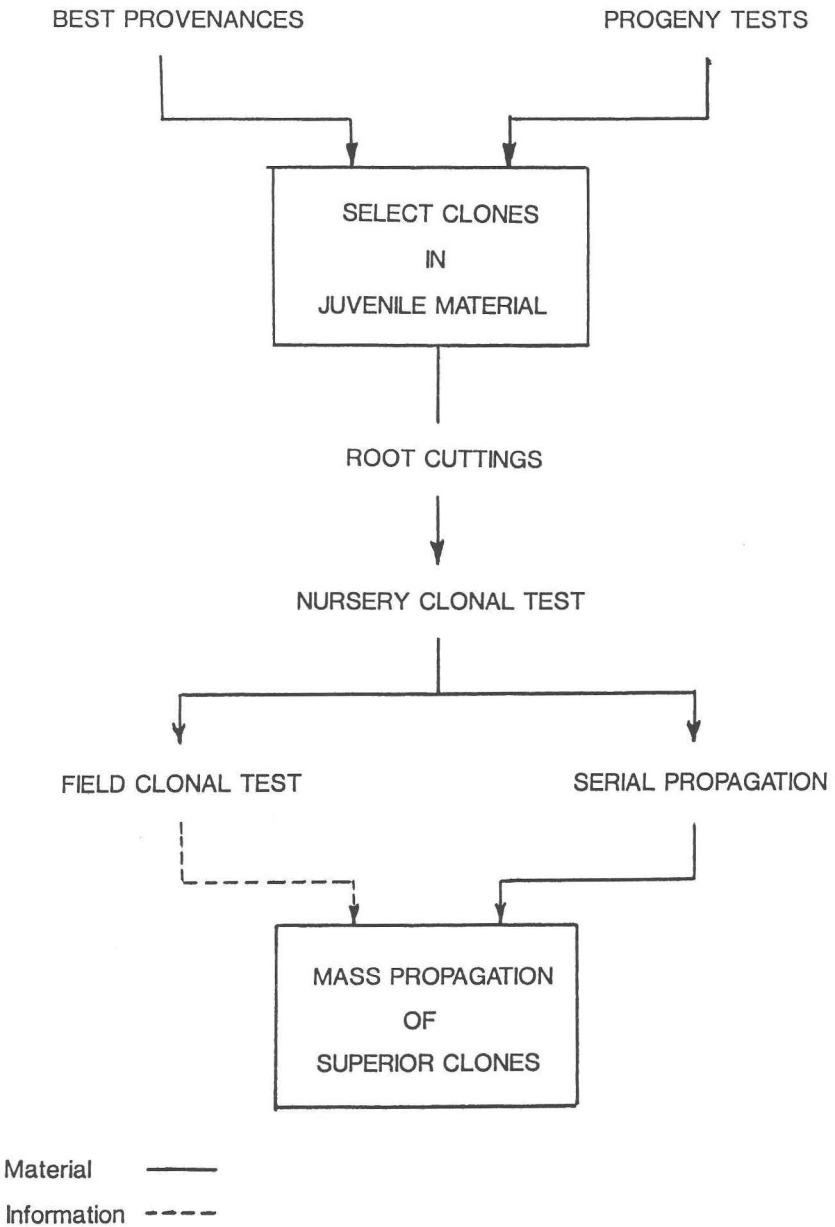

Figure 1 Outline of Sitka spruce clonal testing programme.

moisture retaining material such as sphagnum peat. The ratio of drainage material to peat depends on individual preference but a medium consisting of 20% peat is recommended when propagating under mist (Mason 1984).

3. Temperature of rooting medium and the air.
A temperature at the base of the cuttings of 18°-20° is the optimum for callus formation and will speed rooting over lower temperatures. Air temperature around the cuttings can be lower to lessen transpiration. This is not absolutely necessary and providing temperatures do not rise above 35°C for prolonged periods and humidity in the rooting house is high, a wide range of temperatures is tolerable.

4. Adequate light levels.
Light is necessary for photosynthesis and also for a good rooting response. Excessive shading can have an adverse effect on rooting as can high light intensities. However, normal light intensities experienced during the growing season are adequate for practical purposes but a light shading is often necessary to reduce the effects of sun scorch on cuttings.

The cheapest and most commonly used propagation structures for the rooting of cuttings are polyethene tunnels equipped with heated propagation beds and mist irrigation (Fig. 1). The propagating beds which contain the rooting medium, either loose or in trays, can be heated by hot water pipes or electrically heated cables. Heating is not essential but does speed up rooting significantly at these latitudes, particularly when dealing with older material. It also minimises the effects of seasonal variation in temperatures and provides constant favourable rooting temperatures. The use of heat allows cuttings to be lined out early in the year and thus achieve a good sized plant at the end of the propagation period. However, young material that is 2-3 years from seed roots very easily and generally does not require heat, thus reducing considerably the cost of production.

Spruce cuttings will root throughout the year but to achieve a high rooting success they are best taken when the levels of endogenous root promoting substances are high. This occurs in spring and again in autumn. Cuttings of 8–10cm are taken from donor plants and inserted into the rooting medium without stripping basal needles. Cuttings are usually treated with a fungicide to prevent fungus attack during the rooting period. They can be treated with auxins if so desired. However, these root promoting substances are not essential when rooting young

Figure 2 Rooting of Sitka spruce cutting under mist.

Figure 3 Clonal differences appearing in 3 year old cuttings of Sitka spruce.

material but are beneficial when dealing with older material (Girounard 1974).

The time taken to root cuttings depends very much on the physiological age of the material and also the environmental conditions, but young material taken in mid March should be rooted, hardened off and ready for transplanting by the beginning of July i.e. a period of 12 to 14 weeks.

The Development of Clonal Varieties

Unlike many of the very early clonal varieties of food and ornamental crops, which were discovered rather than created, clonal varieties of commercial forest trees are largely the result of a planned breeding effort. Large clonal propagation programmes already exist in many of the European spruce growing countries and the common link between them is the fact that they are all closely connected with breeding programmes, the reason being that further improvements in a clone are not possible. It is therefore necessary to have a breeding scheme where traits of economic importance can be improved over time. As these improvements are made new clones can be selected from a breeding population, tested and then mass produced. This is a continuous process and new improved clones can replace those that are aged and less productive.

An outline of the strategy being adopted by the Forest Service to develop clonal varieties of Sitka spruce is shown in Figure 2. This type of scheme is common to many programmes and it involves the selection of superior individuals in the best juvenile genetic material available at the time of selection.

Superior transplants are selected from the nursery stage of progeny tests and also initially from adapted provenances growing in bare root nurseries. The initial selection of plants from the commercial nurseries is usually the best plant out of 1,000-2,000 depending on the material available. A lower selection intensity is used on the material from the progeny tests since it is limited and has already gone through a process of rigorous selection. The cuttings are taken from the plants and rooted to form clones.

The clones are evaluated for growth rate and habit at the end of the second growing season by which time they are fit for transplanting in the field. The best 30-40% of clones are retained, the rest rejected. Plants of the selected clones are divided into two parts. One part is used to establish field trials to test the performance of the clones, the other, to provide cuttings for the second cycle of propagation.

During the field testing stage plants of the selected clones are retained in the nursery and are repropagated every 2 years (serial propagation) to maintain them in a juvenile and hence easily rootable state. At each propagation cycle the numbers of cuttings per clone increases and by the time superior clones are identified from the field tests (at 6 years outplanted) several hundred plants will have been propagated for each clone. Cuttings can then be collected from plants of the superior clones retained in the nursery, mass propagated and used for operational plantings.

Juvenility

The success of the scheme described depends very much on the ability to maintain the clones in a juvenile state. As clones become physiologically mature they become more difficult to root. At present there are no methods available to rejuvenate old clones and reliance must be placed on the ability to arrest the ageing process while the performance of the clones is being tested. Currently two methods are favoured. One is serial propagation already described, the other is hedging, that is the maintenance of low hedges of each clone. These have the advantage over serial propagation of being able to produce considerable quantities of cutting material but their management is more difficult. Inferior clones can be easily dropped from serial propagation but the expense of repropagating clones every 2 years can be considerable. Trials testing both systems have not been in existence long enough to come to firm conclusions although indications are that serial propagation is being favoured (St. Clair et. al. 1985).

Bulking Up

One of the great technical difficulties in propagating selected clones is achieving the situation where a superior clone can be bulked up from a single plant to many thousands available for planting. Conventional cutting propagation described will result in a slow build up of numbers at each cycle of propagation. In the future, however, biotechnology may provide a means of rapidly increasing numbers of plants per clone through tissue culture. John (1986) estimates that a multiplication rate of 0.5 million plants of a single clone can be achieved over a 7 year period. In contrast only 2,500 plants would be available from serial propagation. If, or maybe when, this technology becomes available it will enable tested clones to be rapidly moved into commercial production.

Deployment of Clones

There are risks associated with clonal forestry that at first seem overwhelming because we have such little experience in managing this type of forest. However the risks of clonal forestry can be counterbalanced with the resulting gains. These risks primarily arise from restricting the genetic diversity of plantations when reducing the number of clones from many, to one, or a very few (Thompson 1984). Examples of disasters from growing large areas of unsuitable single clones have been well documented for poplars and *Crytomeria.* In Ireland, the monoclonal biomass plantations of *Salix aquatica gigantia* have been repeatedly attacked by the rust species *Malampsora.* However, the genetic diversity of a clonal plantation is directly under the control of the forester to make it as wide or narrow as he desires. There are two deployment strategies being frequently debated and these are:

- wide spread intimately mixed plantations versus
- mosaics of monoclonal stands.

Early in a clonal programme it is probably prudent to deploy large numbers of clones in intimate mixtures to plantations. The mixture will provide a better safeguard against pest attack and spread and this provides some measure of insurance for success of the plantings. However, several factors argue for mixtures of relatively few clones. These include:

- the possibility of mixing highly selected well known complementary clones to increase unit area productivity
- easier and more efficient nursery management, and
- the possibility of reducing cross adaptation of narrowly-adapted pests following colonisation.

A safe number of clones depends on the rotation size, intensity of management, genetic variability of the species, genetic diversity of clones and the acceptable risk and loss levels of a particular situation. Theoretical evidence suggests that from 7 to 30 clones would be safe for use in a "typical" clonal plantation Liddy (1982).

Concern over the number of clones necessary to make a clonal plantation safe has led to the establishment of government regulations for clonal forestry in some European countries. In Germany, since 1977 clonal plantations must consist of mixtures of tested clones in specified proportions. Sweden has developed similar regulations that allow for fewer clones as more information on clonal preference becomes available (Thompson 1984). At present no unified EC rules on clonal forestry have been

established. However, it is probably only a matter of time before these are introduced.

Cost of Production

It has been estimated that the cost of production of vegetatively propagated plants will be 1.5-2.0 times that of seedling transplants (Mason and Harper 1987, Pfeifer 1988). The extra cost arises mainly from the increased labour requirement in the production of cuttings. The collection, preparation and setting of cuttings amounts to approximately a 50% increase in labour over seedling stock. The automation of these operations would greatly reduce costs but machinery has not yet been developed that is capable of doing this task.

While rooted cuttings may initially seem expensive, the extra cost of their production is more than offset by the increased quality and productivity of the crops that they form. Data on genetic gains achievable from clonal varieties of Sitka spruce are limited since little work has been done in this area. However, information from Norway spruce breeding programmes has shown that a 15-20% gain in vigour is achievable over unimproved stock (Kleinschmit et. al. 1977) and indications are that similar gains can be expected with Sitka spruce. Gains of this magnitude when translated into production figures mean a rise of one yield class. The economic effect of this is shown in table 1 when the returns from increasing the mid range of yield classes for Sitka spruce by one unit are presented. A 4% discount rate, the 1974-86 timber price size curve and current establishment costs were assumed.

Table 1: The effect of planting genetically improved planting stock on Net Discounted Revenue (NDR).

Increasing Yield Class		Net Profit (NDR) 1987 £/ha assuming cuttings at £200/1000
From	To	
12	14	435
14	16	520
16	18	600

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Production and Use of Containerised Seedlings in Sweden

Jan Twetman

Hilleshog AB, Sweden.

The use of containerised seedlings started in Sweden in the early 70s. Today, around 80% of all seedlings are produced by one of five main systems. These are Cellpot, HIKO, Pant, Paperpot and Plant 80.

Production systems for containerised seedlings can be divided into four major groups:

A. Plugs. The seedlings are grown in rigid-wall containers and the plants are removed before planting, e.g. HIKO, Pant.

B. Containers with walls through which the roots can penetrate. The container is not removed before planting, e.g. Paperpot.

C. Tubes – container with a rigid wall which is not removed before planting, e.g. Ontario Tube.

D. Containers without any walls, e.g. Hasselfors' Multicomp.

Of the four groups all but the tubes are represented in Sweden.

The transfer from bare-root to containerised seedlings was started in the north of Sweden by large forest companies. The use of this type of seedling is now fairly well geographically distributed over the country with the exception of the southernmost part.

The reasons for the transfer from bare-root to containerised seedlings are:

- Reduced cost in the planting operation. In certain areas of the country up to three times as many seedlings are planted per time unit.

- Prolonged planting season. The containerised seedlings can be planted throughout the whole vegetation period, except during bud-burst.
- Shorter production time, which makes it possible to adapt to rapid changes in demand.
- More efficient use of seed.
- Lends itself to mechanised planting.
- The possibilities of growing seedlings in a harsher climate.

In containerised production systems the basic unit, the containerset, has a very big impact on the success of the system. The following characteristics are of importance:

- Exact geometry is a pre-requisite for precision filling and seeding.
- The design should not allow any root spiralling.
- The root system should be restricted to the cavity during the growing phase in the nursery.
- The cavity wall should not restrict root growth after planting in the field.
- It should be a practical handling unit in the nursery for transport to the forest and in the field.
- For good plant care it is preferable to use the containerset throughout the entire chain, from seeding in the nursery to planting in the field.

The HIKO System

Containerset

The system's basic unit is a polythene plastic containerset which consists of a matrix of cavities. Different sized cavities can be used, depending on the crop to be grown. The overall dimensions of the containerset always remain the same.

Filling and seeding

Because of the exact geometry of the containerset, it is possible to mechanise the otherwise labour-intensive phase of filling and seeding. The automated line enables filling of peat-moss in two steps to achieve good compression and a high degree of filling. The line is also equipped with a mixing station for perlite or vermiculite.

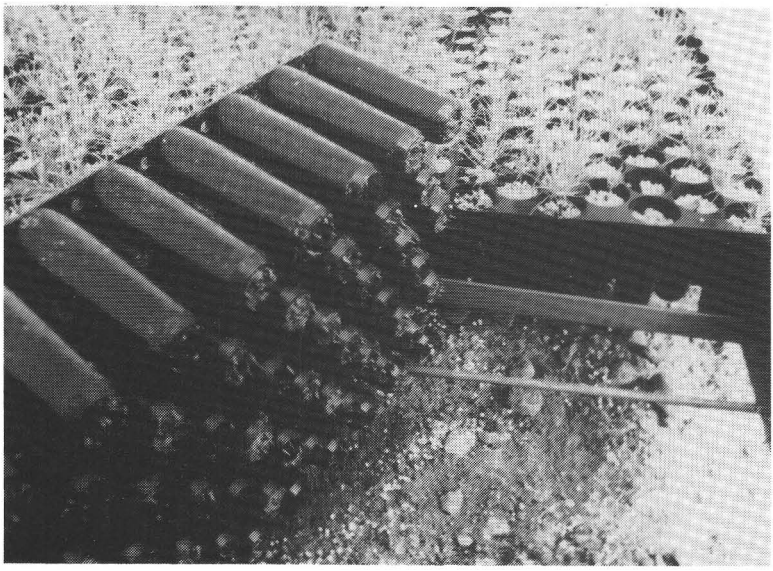

Figure 1 Containerset in growing frame.

Figure 2 The filling and sowing line with frame handling equipment produces about 250,000 cavities per 8-hour shift.

The seeding station enables precision seeding with one, two or more seeds to be placed in the centre of each cavity. The capacity is around 250,000 cavities per 8-hour shift.

Growing frames

Seeding production involves a lot of logistics. The containerset which holds 33, 40 or 67 seedings, depending on cavity size, is the ideal unit for handling in the field. It is however too small in the nursery. A growing frame holding 60 containersets has been designed to serve both as a handling unit in the nursery and during transport.

Growing

During the growing phase, the containersets are placed in the growing frames. These enable air to circulate under the seedlings. On the inside of the containerset-cavity there are vertical ribs which lead the roots down towards the large bottom hole. When the roots come into contact with the air growth is suspended and new roots are formed within the cavity. This results in improved root-growth and better seedling establishment after planting. Simultaneously, the problem of plants entwining or becoming rooted in the nursery bed is eliminated.

Growing frames from the filling line and seeding line are stacked for transport to the greenhouse. They are then laid out by a machine equipped with a special lifting arm. After 4-8 weeks in the greenhouse, the seedlings are moved out to the holding areas. There they grow for one, or at most, two, vegetation periods.

The large greenhouses – 100m long, 25m wide and 9m high – are designed to create a good growing climate. The huge air volume gives a good buffering capacity, ensuring even growing conditions. All equipment in the house is arranged so that the floor space is kept completely free. This enables the easy use of vehicles for loading and emptying the greenhouses.

Normally, three to four crops per year are cultivated in the greenhouse. For the early crops, the greenhouses are heated and additional light is needed to prevent dormancy being induced.

These, and other growth regulating factors such as irrigation and fertilisation, are controlled, continuously monitored and recorded by a central computer.

The greenhouse is used only for the sensitive germination phase. After germination the seedlings are moved outdoors to continue their final growth and for hardening-off. The growth regulating factors on the holding area are also monitored and recorded by the central computer.

The growing phase does not stop in the holding area of the nursery. The entire growing bed – the growing frame with containersets – is designed to be easily transported to the field. The seedlings can continue to photosynthesise and, with access to water and adequate fertiliser, the seedlings will be in good condition, even weeks after they have left the nursery. For the planter this facilitates planning for distribution and planting.

Planting

In the field the plants are manually transported from the storage area by a specially designed back-pack for the containersets.

When larger planting crews are working in the same regeneration area transport is by forestry tractors either carrying the whole growing frame or special racks for the individual containersets.

During the actual planting work the containerset rests in a hip bracket worn by the planter. Because of the round, somewhat conical shape of the cavities, it is easy to remove the seedlings. To reduce carrying time the site should be divided by base lines from which planting starts. The planter works his/her way to the edge of the planting area where he/she turns and goes back to pick up new containersets.

Figure 3
Seedlings are grown in the holding area for one or two vegetation periods.

An Outline of a Nursery System to Produce Quality Sitka Spruce Transplants

J. B. White

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The nursery site is situated at Tilford, Farnham, Surrey and consists of 250 acres of soil derived from sands of the Folkestone Beds with a natural pH value of 3.5 raised for nursery purposes to between 4.5 to 6.0.

An annual rainfall of 30 inches can be expected.

Advantages of the Site

1. 250 acres of production at one location is probably unique.
2. Free drainage ensures a soil that is workable all the year round.
3. Situated in the South of England a long growing season can be expected.
4. The nature of the soil gives no frost lift enabling lining-out to be carried out during any month of the year.

Disadvantages of the Site

1. High risk of late and early frosts.
2. Both rabbit and roe deer are present creating a need for fencing.
3. A short dormant period means high pressure of work during the lifting period.
4. Water is needed for both frost protection and irrigation.

IRISH FORESTRY, 1988, Vol. 45, No. 2: 117-125

Production

The production programme is for 15 million Sitka spruce transplants per annum. This species represents 85% of the total of transplant production in the nursery.

Seed

The necessity to have ample stock of good quality seed is paramount. Any shortage in a year could mean disaster to a crop representing 85% of the transplants grown in the nursery. One year's supply of seed is kept in hand by using a normal household deep freeze.

To consistently have a good and even germination of seed, pre-treatment of the seed in essential.

The seed (in known quantities by weight) is placed in polythene bags and soaked in water for 48 hours. The neck of the bag is then loosely tied so that when inverted the water will drain. The pre-treatment is completed by hanging these bags in a cold store for a period of 6 weeks at a temperature of 2°C.

Before sowing the seed must be spread out to allow it to dry sufficiently so that it will run freely through the seed drill.

Ground Preparation for Sowing

The vast majority of seed is sown on sterilised ground with a small percentage on unsterilised ground. The reason for using some unsterilised ground will be given later.

Sterilisation is by spreading Basimid onto the area by means of a Sissis Loadspread. The distributed powder is mixed into the soil by a rotovator. The area is then thrown up into seed beds and finally covered with polythene sheeting. Gas is released by the action of the powder coming into contact with the moisture in the soil and the gas is contained by the polythene. This operation is carried out in the autumn whilst soil temperatures are still warm. Six weeks is needed for the sterilising to take place.

In late March and April after minimal cultivation to allow any excess gas to escape, samples of soil from the area are tested by sowing cress seed onto the samples contained in screw topped jars. Any gas in the soil will be evident by its effect on the cress seedlings.

Four tractors, a Sissis drill, a rotovator, a bed maker together with a poly layer can sterilise up to 4.5 acres per day.

Sowing and Production of Seedlings

Sowing of seed is carried out by a specially adapted Sissis drill with its distribution limited to the width of a seed bed. The machine

is geared, enabling broadcast sowing to be carried out with great accuracy once the machine has been calibrated.

When calibrating the machine in order that the intended seedling density is achieved, it is necessary to take into account not only the quantity of seed but also the germination percentage.

Lime-free grit or coarse sand of a light colour is used to cover the seed. This is spread using a tractor-mounted distributor.

The advantages of grit or sand over a soil covering are:

1. It is quick to apply.

2. It does not cake, and thus avoids impeding emergence of the germinating seedlings.

3. It conserves moisture at this critical time.

4. Heat is reflected.

Conserving moisture and reflecting heat are important in protecting the germinating seed from dry winds and or undue heat in warm weather, both of which could adversely effect germination.

Protection against birds is needed until the seed caps have fallen from the emerged seedlings. This is provided by netting supported by hoops over each individual bed.

During the critical germination period to guarantee good germination irrigation may be necessary in the absence of sufficient precipitation.

Seed sown in March/April will produce good balanced 1+0 seedlings ready for lining-out from September onwards.

During the growing season to help produce a root system of controlled length and to encourage fibrous growth the seedlings are undercut.

Controlling the length of the root system also helps to ensure that when the seedlings are lined out, the root is correctly planted.

Earlier I said that some seed would be sown on unsterilised ground. This is usually ground sterilised the previous year from which a crop of seedlings has already been taken. The new seed will get some benefit from the year old sterilisation but will need a pre-emergent herbicide application of Diphenamid. These seedlings will tend to grow slower than those on sterilised ground and are grown on to make 1½+0 seedlings.

When required the seedlings are lifted by hand after using a *Magnefique* lifter mounted on a tractor. The lifter blade with vibrating fingers is passed under the seed bed loosening the seedlings enabling them to be lifted on piece work into plastic boxes with the seedlings standing upright.

The 1+0 seedlings are lifted from September through until March and can either go straight out to be lined out or to be stored in the cold stores until needed.

Alternatively the 1½+0 are left to grow on until June or July of the second year then being lifted and lined-out straight from the seedbeds.

Lining-Out

Due to the light nature of the soil hand lining-out is favoured over machine lining. Both systems have been tried in the past but hand lining-out has many advantages over machine lining on this site.

Each person is responsible for lining out his own area of beds and works on a piece work basis and this fixes the cost of the operation. Checking the quality of work is simplified too as you know who is responsible for a particular area.

Individual working enables the worker to work at his own speed; no one else is relying on him; no machine is held up should he fail to turn up for work and lastly the speed of the operation is not governed by the slowest member of the team.

The work force is employed on a permanent rather than a seasonal basis.

Lining-out is carried out from September to December stopping then to allow lifting and despatching of transplants and recommences in April continuing through until June. The seedlings for the later period are drawn from the cold stores. During July and August the 1½+0 seedlings are lifted from the beds after irrigation and lined-out the same day or they may spend one night on a trailer under cover after watering. Immediately after being lined-out irrigation is applied.

As well as providing continuous employment this system produces transplants of varying size depending on how long they have been growing. This means that if the transplants are lifted for orders in roughly the same order as they were planted any transplants not sold are the most suitable to be carried forward to the next season.

Weed control is by the application of Simazine immediately after planting, giving excellent results in most cases. Atrazine is used as a backup if necessary.

Irrigation and Frost Protection

Both irrigation and frost protection are essential on these light sandy soils if satisfactory plants are to be produced.

Water for these operations has for many years been pumped from the adjacent River Wey under licence from the local water authority. The restrictions imposed by the licence means that most of the water can only be abstracted during the winter period. To ensure that water is available when it is most needed it has to be stored and two reservoirs each capable of holding five million gallons have been constructed.

When water is needed it is pumped from the reservoirs into a system of underground mains which support hydrants strategically situated throughout the nursery. From these a portagrid system of overland pipes and sprinklers is used to distribute water for irrigation or frost protection.

Up to six inches of irrigation water may be needed by a crop during a dry summer.

Frost protection uses the same equipment as irrigation but it has to be on site throughout the threatened periods. These usually extend from April to June and from September to November. During these periods new growth has to be protected in the spring whilst in the autumn late growth is vulnerable until it has hardened off.

This system of water protection was devised for the protection of fruit blossom and the principle of protection is as follows.

The plant cell sap has a slightly lower freezing point than that of water and also as water freezes, it releases latent heat, until all the water is frozen.

So if one can apply water over the whole surface of the plant under freezing conditions, making sure that it is applied so that the base layer of ice is kept continuously wet, the latent heat released will maintain the ice layer at a temperature sufficiently high to prevent the plant cell freezing.

Lifting and Grading

The same *Magnefique* used to lift seedlings is employed in lifting transplants.

By careful adjustment the plants can be loosened but still left with a covering of soil over roots. this is important as it means any plants not removed by the men that day will not suffer from their roots drying out or from overnight frost.

Lifting is done on piece work, one man being responsible for lifting his own number of beds whilst grading up to two saleable grades and discarding any with imperfections.

Lifting and bundling is followed by heeling-in, the time between depending on the weather. The drier or windier the less time the plants must be left before heeling-in. Tractors and trailers transfer the plants from the heel to the cold stores.

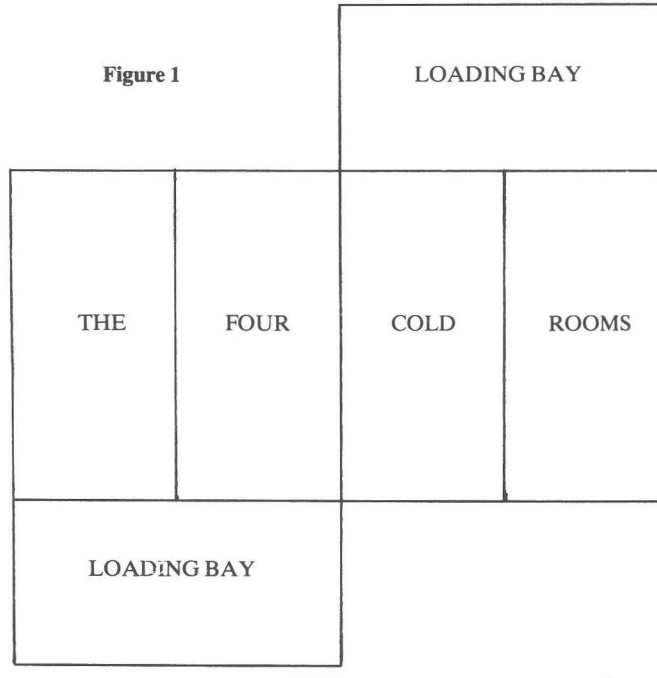
STORAGE

All lifted transplants eventually arrive at the cold stores whether they are intended for long storage or not. The stores are used as a centre for building up orders large or small to await collection or despatch.

The coldstores are of a direct humidified system. This enables plants to be stored bare-rooted without the danger of the root systems deteriorating.

The coldstore buildings consist of four rooms side by side. Each of these rooms has access to one of the two loading bays situated at either end of the building (See Figure 1). Each cold room has a potential for storing two to two and a half million transplants depending on size.

Figure 1



Access is so arranged that it is possible for a fork-lift truck to travel from any one room to another without leaving the building.

Each loading bay is large enough to accommodate a 60 foot long vehicle still leaving ample room for loading from either side. Closing the large double doors at both ends of the bay helps to control the environment whilst loading plants from the adjoining cold rooms. Plants entering the store from the nursery are either transferred to awaiting transport for despatch or crated for storage.

Crates are constructed of slatted timber at the back, bottom and front, with the sides being of one piece plywood. A chicken coop type front enables it to be removed. The specification of the crate is such that it is usable both in the cold store or on our own lorries.

Transplants are packed horizontally into the crates with roots to the two solid sides and the leaders to the middle. Each crate will hold from 1,500 to 5,000 plants depending on the size of the plants. In each cold room crates can be stacked to the side walls six high and three deep leaving a central alleyway for access. All movements of crates is by fork-lift trucks.

There are two humidified refrigeration plants in each room. Large powerful fans force cold air down ducting along the walls, in turn drawing the air through the crates and returning it via the central aisle to be cooled, humidified and then recycled.

Trees entering the store will be cooled to 2°C at which temperature they will stabilise within 24 hours regardless of their incoming temperature.

Transport and Loading

For transport and the loading of the transport we have to cope with not just our own vehicles but also those of our customers.

Customers lorries vary from open backed vehicles requiring sheeting, to enclosed containers which may or may not be insulated, down to pick-up trucks.

Trees are brought out of the cold stores into the loading bays by fork-lift trucks carrying up to three crates at a time. At this point the trees can be loaded in crates onto our own lorries or be taken from the crates and loaded by means of an elevator either bare-rooted or after being bagged in polythene sacks depending on the customers' requirements.

Our own vehicles consist of side loading six-wheeler-lorries towing trailers with insulated temperature controlled bodies.

Fork-lift trucks present three crates vertically stacked, which is the maximum height in the lorry, onto the bed of the lorry with

the removable sides of the crates outward facing. A further 3 crates loaded from the other side completes the load width. This continues until the vehicles are fully loaded. Loading can take as little time as three-quarters of an hour.

Once the side doors are closed the vehicle is insulated.

Remembering that the trees have been stored at high humidity at 2°C it is important to control any rise in temperature using the minimum chilling whilst in transit as excessive use of direct refrigeration reduces humidity. Many loads in the cooler months require no chilling. However, as in most years planting continues well into June, chilling can be essential. It can also be useful in case of a vehicle being delayed through a breakdown enroute.

The lorry and trailer configuration is used rather than an articulated lorry as it tends to be more manoeuvrable on narrow roads, negotiating gateways, etc., thus enabling plants to be delivered as close as possible to the planting site. Unloading is by removing the fronts of the crates thus enabling plants to be discharged without the crates being taken from the vehicle.

It has long been Tilhill's policy that to produce good plants is not enough. Good plants have to be carefully handled from the time they are lifted until handed over to our customers.

Our own branch managers regularly report back planting takes of 90% plus. If for any reason they experienced trouble with any batch of plants they very soon let the nursery know! This type of constructive criticism is welcomed as it is only by knowing what happens to the plants after they leave our control that lessons can be learned and improvements made.

New and Future Developments in Bare-Rooted Planting Stock Production

Most foresters consider that planting stock should be transplanted at least once in the nursery if a balanced root is to be of a standard to perform well when planted on into forest conditions.

An alternative system of precision sowing and undercutting has for some years proved satisfactory in North America and New Zealand.

Undercut seedlings have had a bad name in the past due to seedlings being sown too densely and the inability of undercutting machines to do the job correctly.

Precision drilling places the seed in rows and individually places them within the row. Instead of lifting and transplanting in the conventional fashion an undercutter and lateral pruner is used to restrict the downward and sideways growth of the root system. This in turn promotes a fibrous system.

Difficulties in undercutting have been solved by using a tractor-mounted machine with a reciprocating blade the depth of which is controlled hydraulically ensuring clean cutting of the roots at an accurate depth.

Lateral pruning is by a tractor-mounted frame with sufficient vertical discs capable of severing seedling roots either side of each row.

Wrenching is the operation of heaving the plants whilst *in situ*. A larger blade than the undercutter is mounted on the same frame and set at an angle to run through the soil under the root systems. The disturbance causes the root system to re-establish itself at the same time restricting top growth. This is a further tool to control the growth of the plant.

Both root pruning and wrenching can only be done if adequate irrigation is available immediately after the operation.

To meet the added need for extra water Tilhill is installing a new system. It is known as "Well Pointing". A similar system has been used in the construction industry to evacuate water from a wet site when footings or foundations are to be installed.

On the nursery site a line of 50 bore holes to accommodate 3" suction pipes have been bored at three foot intervals down to a depth of 30ft. The tops of the pipes are connected to a common manifold pipe which in turn links up to a vacuum pump. When in operation the pump is capable of delivering up to 1,000 gallons of water per minute being drawn from the water suspended in the sand beds which the nursery is situated on. Thus the reservoirs can be topped up as necessary. Needless to say the local water authority had to grant us a licence before this kind of operation could be started.

With this adequate supply of water satisfactory trials are on-going at Tilhill and it is anticipated that precision drilling production will take on an ever increasing proportion of our future production.

In our continual search for improvement in the quality of our products we are now engaged in looking for the ideal lifting machine for our nursery. To provide the best transplants we seek a machine that will allow us to lift under ideal conditions only. Thus we need one capable of lifting a whole bed at a time which would then allow the plants to be graded under cover before storage.

Conclusion

As indicated by the title, to meet time and space constraints, this has provided an outline only. However, hopefully it shows the continued search for methods of improving the quality of nursery produce.

Trends in Plant Demand in the Forest Service

Gerard de Brit

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ABSTRACT

Trends in plant demand during the period 1971-88 are shown and discussed with particular attention being given to total plant demand, major species variation and plant sizes. Plant production systems are briefly discussed.

INTRODUCTION

These are exciting times for forestry in Europe in general and in Ireland in particular. Private forestry has begun to expand, responding to the stimulus of EC and National incentives and to the realisation that the European Community is less than 50% sufficient in wood.

There are now greater opportunities for planting with the reduction in the production of several major agricultural commodities. There is a general and widely accepted appreciation of the exceptional potential for wood production in Ireland. If there is a necessity for further incentive, which I doubt, there is the eagerly awaited Forestry Action Programme from the European Community. The Government's commitment to forestry is evidenced by its decision to set up a commercial State Forest Company, Coillte Teo.

All of this points to an expanding balanced forestry industry in Ireland. One of the main effects of all these developments will be an increasing demand for good quality planting stock. I intend in this paper to confine my remarks largely to the State Sector.

TOTAL PLANT REQUIREMENT

Before looking at the future it is useful and interesting to look at the past. We can see (figure 1) that the total plant requirement in the Forest Service in 1971 was approximately

30 million. This figure dropped to 19 million by 1983 and then climbed back to 30 million in 1988. The reduction in plant demand from 1971-88 I attribute to a decline in new planting or afforestation during this period and also to a reduction in the stocking levels from 1975 onwards. The stocking level pre 1975 was 3,000 plants per hectare, after 1975 it was reduced to 2,500 plants per hectare.

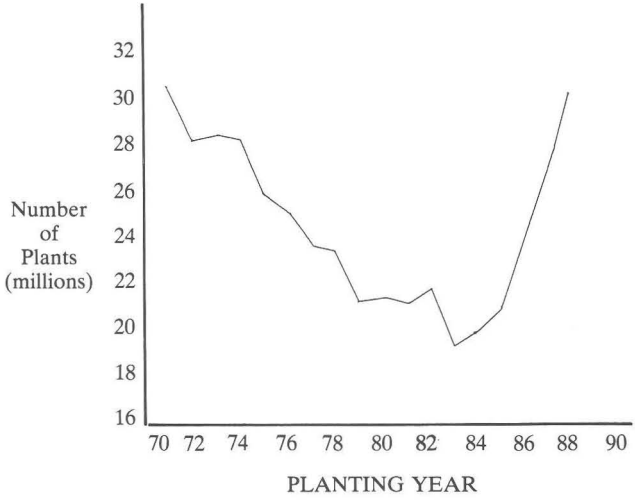


Figure 1 Forest Service plant requirement 1971-88.

The rapid increase in plant demand during the period 1984-88 reflects the enthusiasm and expectations which I referred to in my introduction.

Where the graph goes to from here is of course of great interest to nursery managers. This will depend largely on Government policy and the policy of the new State Forest Company. My own guess is that plant demand in the State sector will remain strong.

Species Composition

As we have seen nursery managers have, understandably, a keen interest in the total plant demand figure. They are also interested in the species proportions or composition of that demand. It is useful to look at some recent trends. In figure 2 the demand for *Picea sitchenis* (Sitka spruce) and *Pinus contorta* (lodgepole pine) during the period 1971-88 is shown.

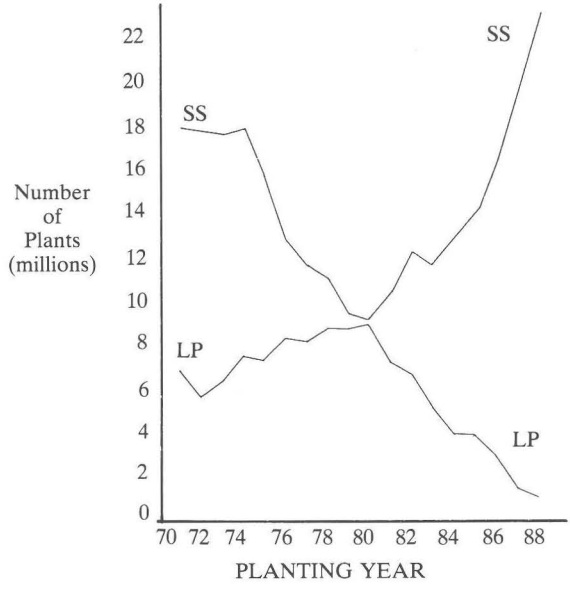


Figure 2 Sitka spruce (SS) and Lodgepole pine (LP) plant demand.

We can see that in 1971, 18 million Sitka spruce plants were required. This number fell to 9 million in 1980 and then rose to 23 million in 1988. Meanwhile during the same period lodgepole pine started in 1971 with a demand of 7 million this rose to 9 million in 1980 and has since fallen back to 1 million in 1988.

The decline in Sitka spruce plant demand during the period 1971-80 is attributed in part to the overall decline in plant demand and in part to a preference for lodgepole pine reflecting the quality of land being acquired for new planting. The rapid increase in Sitka spruce plant demand during the period 1981-88 is attributed to a a general increase in the planting programme during this period, an improvement in the quality of land being acquired and an extension of the use of Sitka spruce on to ground formerly planted down to lodgepole pine due to new fertiliser prescriptions and the introduction of nursing mixtures.

Another way of looking at this information is shown in figure 3, where the plant requirement for each of these species is shown as a % of total plant demand. It is interesting to note that the combined total of both species represents an approximate constant demand of 85% of total plant demand during the period 1971-88.

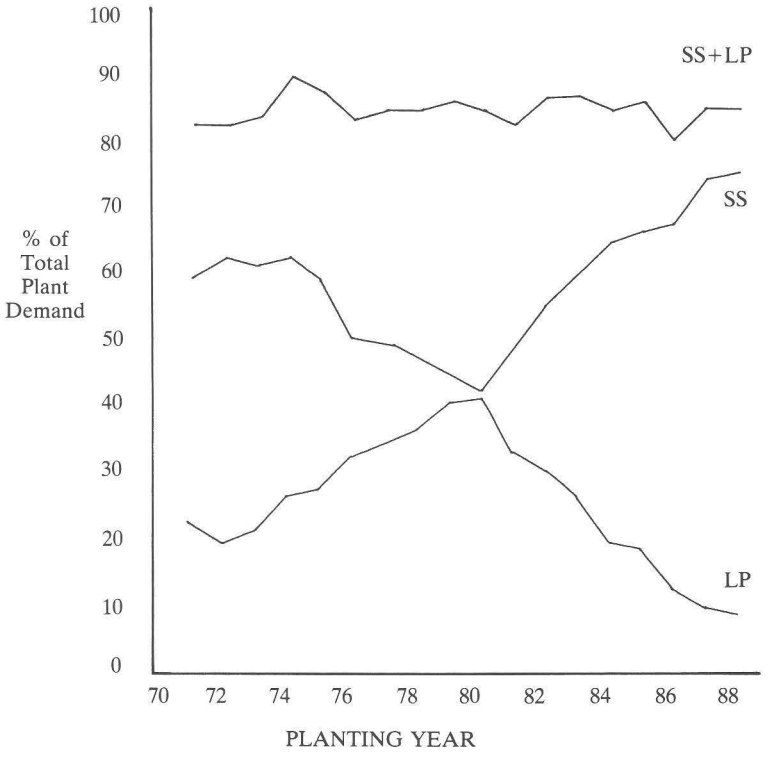


Figure 3 Sitka spruce (SS), Lodgepole pine (LP) and SS+LP as a percent of total plant demand.

While this struggle for supremacy between Sitka spruce and lodgepole pine has been going on the progress of numerically less important species has perhaps been neglected. *Pseudotsuga menziesii* (Douglas fir) during the period 1971-80 represented between 2-3% of total plant demand, from 1984-88 this has increased to 4-5% reflecting an increase in reforestation. *Picea abies* (Norway spruce) started the period at around 3% of total plant demand it dropped to 1% and has now recovered to 2%. The demand pattern for Norway spruce reflects a number of influencing factors. Firstly there has been a tendency to show preference for the higher yielding Sitka spruce, secondly there has been a dramatic swing away from Norway spruce as a Christmas tree plant in favour of *Abies procera* (Noble fir) and finally, operating in the

other direction there is renewed interest in Norway spruce as a producer of high quality sawlog material.

Broadleaves have dropped from around 5% of total demand in 1971 to 2.75% in 1988. This drop is attributed to the decline in amenity planting, with current planting concentrating on wood producing broadleaves only. Present policy now is to allocate 3% of State planting to broadleaves and to increase this by annual increments of ½% over the next few years.

Plant Sizes

The nursery manager apart from wanting to know the total plant requirement also needs to know the species proportions of the total plant demand. Finally he needs to know the size or sizes of plants required. For many species only one size of plant is required, but for Sitka spruce in the Forest Service two sizes are recognised – size I: 31-65cms and size II: 20-30cms.

Here again it is useful to look at the pattern of plant demand during the period 1971-88 (Figure 4).

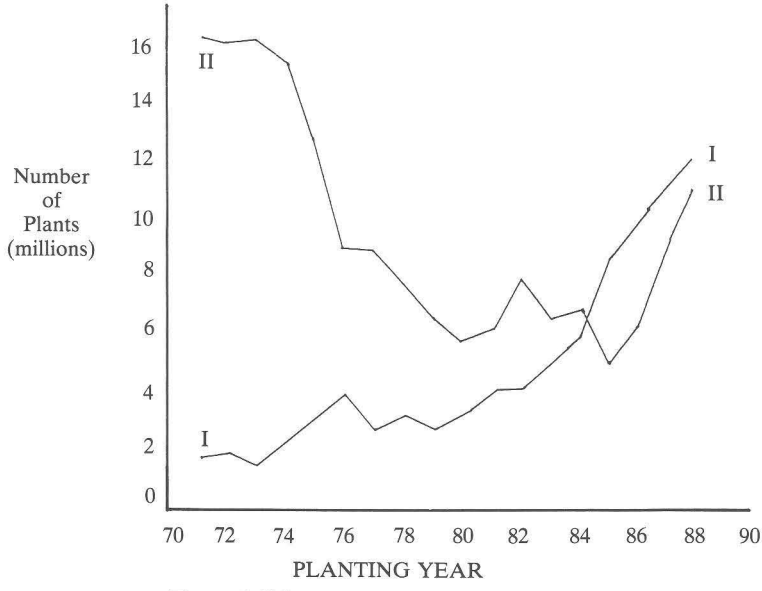


Figure 4 Sitka spruce plant demand by grade.

In the early seventies size II plants were mainly required reflecting the preponderance of new planting on ploughed ribbons. The size I plant demand was modest reflecting the low level of

reforestation. In the late seventies and early eighties there was a decline in the demand for size II plants mirroring the decline in new planting during this period, while during the same period the demand for size I plants gradually increased reflecting increasing reforestation. In the late eighties the demand for size II plants increased. This increase is attributable to the extension of the use of Sitka spruce onto western peats and more recently onto Bord na Mona cutaway bogs. There has been a rapid increase during the same period for size I Sitka spruce. This is due in part to increasing reforestation and in part to new site preparation techniques in new planting areas resulting in the need for size I plants on those areas.

Discussion

We can look back over the period 1971-88 and examine the changes in plant demand that have taken place. We may also suggest reasons to account for these changes. Such an analysis will not tell us of course what the Forest Service plant requirement will be in the future, particularly when we look at the variation in plant demand over the past 20 years or so. Planting targets for the future, as I have referred to earlier, will be a matter for the Government and the new State Forest Company.

In the present climate it seems reasonable to assume an annual planting programme of not less than 10,000 hectares over the next decade or so. Reforestation should account for from 3,000-5,000 ha of this assumed planting programme. Sitka spruce will remain the dominant species representing not less than 75% of total plant demand. The demand for bigger size I Sitka spruce is likely to increase with increased reforestation. The demand for Douglas fir is likely to increase steadily but not dramatically, as will the demand for wood producing broadleaved species such as *Quercus robur* (Pedunculate oak), *Fraxinus excelsior* (Ash) and *Fagus sylvatica* (Beech).

The position with lodgepole pine is less clear. Its use in mixture with Sitka spruce has yet to settle into any pattern. The possibility that using containerised South Coastal lodgepole pine may reduce the incidence of basal sweep is something that will also effect the future of this species.

It is therefore reasonable to assume with a certain degree of confidence what is going to happen in the medium term vis-a-viz species proportions and plant sizes. The big imponderable, the size of the planting programme, remains. Being optimistic by nature I would tend to go for growth. If the State planting programme does not reach expectations, there will be, I am sure, sufficient

development in the private sector for Forest Service Nurseries to develop market share in that sector.

Plant Production Systems

My main concern today has been to look at trends in plant demand. I would like to turn briefly to plant production systems. You have heard or will hear more detailed accounts of various systems from other speakers. It is sufficient for me to make some general observations.

In the Forest Service we produce plants under a conventional bare-root production system. I expect that this system will continue to be operated for the immediate future at least. We are currently rationalising our nursery estate, reducing the number of nurseries from 14 to 5. Each of the five retained nurseries will have a production capacity of from 6-10 million fit plants annually.

We are also looking at the suitability of containerised planting stock for use under Irish conditions. I have already mentioned this in the context of lodgepole pine South Coastal production.

Precision sown production systems developed by the New Zealand Forest Service and currently being evaluated by the Forestry Commission in Great Britain are also of interest to us. These systems would appear to have advantages with species which are poor root regenerators such as Douglas fir, larches and pines.

Finally we must note the developments in clonal coniferous forestry which are on the horizon. I could imagine a system utilising a proportion of vegetatively produced clonal material planted in a matrix of conventionally produced bare-root stock.

Summary

I have shown the variation in plant demand over the past two decades, variation in total plant demand and variation in the species proportions within that demand. I have emphasised the difficulties that this creates for the nursery manager.

To put this into todays context seed is now being sown in our nurseries which will determine the plant availability for the planting year 1991. Provision has been made for a 10,000 ha planting programme, with a contingency for an additional 2,000 ha. The species proportions have been kept broadly in line with recent trends in demand.

Whether this will be sufficient, too little or too much, or whether the species proportions are right, only time will tell.

Planting Stock for Tomorrow's Forest "What the Manager Needs"

James Dillon

Forest Service

Introduction

When it comes to planting stock the forest manager is often no different to most other consumers. He is the person at the end of the line who must more or less accept what he gets and be prepared to live with the results. In the forest management sense this may mean above average establishment costs, understocked plantations and high filling-in charges.

There is general belief among forest managers that the condition of planting stock has much to do with eventual survival. When failures are critically examined certain factors are easily recognisable – insect damage, animal browsing, vegetation competition, and even climatic causes can be identified. The human factor, loosely termed, 'careless planting', can also be recognised. Once these factors are eliminated often the only remaining clue lies in the condition of the plant itself.

Background

Two developments of recent origin have engendered an increased awareness of the need for improved plant quality among forest managers:

(a) *Increased Planting Programmes:*

For reasons outside the control of foresters we are now experiencing unprecedented annual planting rates, a most unlikely development if viewed in the atmosphere which prevailed almost a decade ago. (Table 1). Given the surpluses problem in the agricultural industry it is likely that planting rates will remain high and possibly increase for some time yet.

The area being reforested in recent years has increased substantially. In the state sector we are approaching a stage where

almost 40% of the annual planting programmes is taken up with reforestation; where the problems are usually different to those on new sites and generally more difficult to resolve.

Table 1: Planting Progress 1985-88, in the Republic of Ireland.

(ha)

	State	Private	Total
1985	6,288	764	7,052
1986	7,083	2,559	9,642
1987	7,956	3,201	11,157
1988	10,000	4,000?	14,000?

(b) *Change in Cultivation Practice:*

For the past 35 years, during which period about 75% of the state forest area in the Republic of Ireland was established, we have become conditioned to one common factor, that is – ploughing. Planting into upturned ribbons is a straightforward and relatively cheap exercise and rapid and early establishment is almost guaranteed.

However, time has overtaken this cultivation practice and we now realise that a technique which was, and still is, ideal for establishment purposes, is now causing major problems for the stability of our crops and an obstacle to harvesting systems.

In recent years there is a determined and consistent move towards cultivation systems which do not provide the ribbon-type planting position. Ripping and moling techniques on suitable sites are now rapidly replacing conventional ploughing. Mechanical mounding to provide 2,500 planting locations per hectare is another emerging cultivation feature. Both the increase in reforestation and the change in cultivation practice are shifting the emphasis from small sized plants to a greater demand for the larger size category of planting stock. Understandably these new demands have increased pressure on planting stock resources.

The Future

Facing into the years ahead there is now urgent need for both the nurseryman and the forest manager to liaise more closely and to ensure that their respective goals are clear. The forest manager must be ready to predict his likely planting stock demands well in advance and the nursery manager must be prepared to meet these demands.

RESPONSIBILITY OF FOREST MANAGERS

(a) *Quantity Requirements:* The manager must indicate his likely requirements. However, this is generally a matter outside the realms of local management, and more appropriate to over-all policy plans.

(b) *Species Requirements:* There is an obligation on the forest manager to indicate clearly his species preference for a given period of time into the future. We are familiar with the oscillations which occur between Sitka spruce and lodgepole pine and now, in 1988, Sitka spruce is probably at an all time high in the popularity ratings. While a single species might occupy up to 90% of total plant demand (State and Private) and a convenience for the nursery manager, it may not be the wisest path to follow in the broader national sense, particularly, as we are fast approaching an over supply of conifer softwood on the home market.

Increasingly Douglas fir is receiving preference on the suitable sites in the east and south at reforestation time. Norway spruce, a species now very much out of favour, surely deserves a rethink, especially on the classical frost-prone sites of the midlands where it is most suited. Norway spruce is a species that if managed correctly can yield attractive financial rewards early in the rotation as a stakewood resource, apart altogether from its value as sawlog timber and its superior finishing qualities.

In short, there is a case for the availability of choice and it is for the forest manager to recognise his requirements in this regard.

(c) *Size Categories:* The changes outlined above ought to indicate the likely size category requirements over, say, a two to three year period. While it may be difficult to predict the area of new land intake it is likely that the quality of acquisitions will continue to improve. Such sites, most probably, will be cultivated by systems other than ploughing and good sturdy plants will be preferred. Greater accuracy is possible in estimating future reforestation programmes and, again, the large size category is the likely preference.

NURSERY MANAGER'S ROLE (as seen by the Forest Manager)

On the understanding that the forest manager has clearly indicated his requirements the onus now passes to the nursery operation. The man in the field will expect to receive in due course fit plants for his particular end use.

The Forest Service Operational Directive 2, of 1985, provides a definition of a fit plant:

"(i) A straight stem with a definite leader.

(ii) Well balanced foliage with a good fibrous root system.

(iii) A specified height to provide for size above ground when planted.

(iv) A specified root collar diameter to provide for sturdiness.

(v) Age must mot exceed a specified maximum."

The Directive allows a maximum tolerance of 5% deviation for each of the size categories.

Plant Handling in the Nursery: It is not proposed to advise nursery people on how this might be carried out. However, it is an important aspect of the entire handling operation. As managers we would wish that plants, at all stages of handling, (nursery and forest) would receive the attention that they deserve, and perhaps the bagging or boxing of stock for transport is a step in the right direction.

Plant Culling: Bearing in mind the 5% tolerance, the need to cull does arise from time to time to segregate in the field, perhaps for reasons of shortfall, on size or quality. Forest managers would hold the view that the nursery must do whatever culling is necessary to conform to the standards as laid down in the supply agreement. Apart from the extra expense on the manager's side there may be wasted transport charges on planting stock which nobody requires.

Also, on occasions, managers are obliged to take a size category below what was originally requested, on the understanding that inferior planting stock can be nurtured along with suitable herbicide control. This may be partly true but, again, it does shift the burden to the consumer. It may be worthwhile for field managers to inspect their nursery stock allocations in advance of delivery.

The nursery must surely be the more suitable environment and the appropriate location for the attainment of predetermined standards in planting stock.

Availability and Despatch of Plants

The handling of bare-rooted planting stock, from lifting in the nursery to planting in the forest, is confined to the dormant season. Any upset in the lifting schedules may seriously affect

planting progress in the forest. As an increasing proportion of our planting programmes is now being undertaken by contract arrangement a guarantee of supply will be an important feature of future agreements. Any development which will ensure continuity of supply, such as cold-storage facilities, at nursery or elsewhere, is to be welcomed.

The elements of handling in the dispatch and receipt of plants are also an important aspect of co-operation. The produce of the nursery must get to the forest in as fresh a condition as is possible. It is also essential that delivery arrangements get priority at all stages. Ideally, plants should be transported direct from the production area to the receiving forests.

Centralised Dipping Facilities

From time to time the effectiveness of routine preventive measures for the control of the large pine weevil, *Hylobius abietis*, is called into question. With the increase in reforestation programmes this aspect of management is certain to receive greater attention in the future. Consideration should be given to the concept of centralised dipping facilities, and nurseries appear as the obvious locations for such operations.

Containerised Stock

The use of bare-root planting stock has been the norm in Irish forestry. Only recently have containerised plants become available in commercial quantities. The use of containerised stock has many advantages:

(i) it is a rapid method of raising overall planting stock numbers,

(ii) it allows for a quick response to any change in species preference,

(iii) in situations of scarce labour resources the extension of the planting programme into the summer months may be a sensible approach.

The use of containerised stock is a new experience for most forest managers and it requires considerable advance planning. Unless there is adequate provision for all the elements of handling and irrigation, the entire exercise may become quite expensive. (Appendix 1).

As Irish winters are not as severe as those experienced on the mainland of Europe planting operations can generally proceed without much hindrance from November to the following March

or April. Consequently bare-root stock is likely to continue as the preferred form of supply for the foreseeable future. However, much field research still remains to be done on the general use of containerised stock under Irish conditions and forest managers must be aware of the supply options and have the versatility to respond to rapidly changing circumstances.

Conclusion

The recent increases in planting programmes and the changes in cultivation practice have resulted in changing demands on nursery stock. It must be appreciated that a production unit, working in, perhaps, three-four year cycles cannot respond overnight to a new situation.

With the new awareness on the quality and the need for care in the handling of plants, greater liaison between the producer and the consumer is essential.

The forest manager must be clear about his future needs and, in good time, convey his requirements to the nursery sector. The nursery manager must then set about to meet these demands.

APPENDIX 1

Containerised Stock

Advance planning is required to ensure:

1. Prepared Planting Site.
2. Adequate Access for:
   (a) Delivery from supplier,
   (b) Distribution to planting site.
3. Efficient Handling Systems.
4. Adequate Watering Facility.
5. Protection Against Vegetation, Vermin, etc.

Forestry News

VISIT OF KOALAS TO DUBLIN ZOO

In June 1988 Dublin Zoo had the unique distinction of being the first zoo in Europe to display koalas. The two animals, a male and a female, arrived in Dublin on Friday 10th June and went on show to the public on Tuesday 14th June with an official launching by Mr. Michael Smith T.D., Minister for Forestry.

One of the main considerations in bringing the koalas to Ireland was a supply of fresh eucalyptus browse. This browse came from some of the stands of eucalyptus planted in the early fifties in forest centres in the Wicklow/Wexford region. Koalas eat only the fresh tops of about twenty varieties of eucalyptus and most of the plantations here were suitable.

The two animals on display were bred at San Diego Zoo out of parental stock from the famous Lone Pine Sanctuary, near Brisbane in Queensland, Australia. The koalas have aboriginal names – Kupal (meaning 'white') and Banjeeri (meaning 'voice of a ceptoral spirit'). They are both one year old and are almost fully mature.

J. Fennessy

Koala Bear
(Dublin Zoo)

Ms. Vickie Kuder
(Koala Keeper)
Travelled from San Diego Zoo
to Dublin with Koalas.

THE WOOD GATHERER

Piece of delightful sculpture made from beech on display in Hazelwood Forest, Sligo. The work is part of a sculpture presentation in this forest. The 'Wood Gatherer' was created by Jackie McKenna, Dublin.

FIRST NATIONAL FORESTRY SHOW

Held on the 9th and 10th of September at Garryhinch Property in Emo forest. "Forestry 88" was organised jointly by the Irish Timbermens Association (ITA) and the Society. Committee members were: Richard Whelan (Chairman), John O'Sullivan (Secretary), Jim Hurley (Treasurer) and Dominic Ryan from the ITA. Dr. Jack Gardiner (PRO), Donal Magner (Editor), Jim Neilan and Alistair Pfeifer represented the Society.

The show, which was opened by the Minister for Forestry, Mr. Michael Smith TD, featured 50 stands erected mostly by companies engaged in sale of such products as chemicals, fertilisers, harvesting machinery, nursery stock, wood products and protective clothing. Stands were also erected by the Forest Service showing its work on timber quality and silvicultural research, training and private forestry. Many of the newly founded establishment companies were also represented. Demonstrations of various machines added considerable interest to the show, particularly when these could be seen working under forest conditions.

The Society's tent featured three stands. One stand was erected

Forest Service Wood Quality Research Stand.

by Mr. Peter Sweetman, a wood turner who presented a display of magnificent bowls and wood shapes turned from unusual timbers. A second stand featured a display of hurleys manufactured by Mr. Pat Staunton from Ashford and the third was organised by Society members. This third stand consisted of a series of five panels depicting various aspects of our most commonly planted conifer and hardwood species. A further two panels titled 'Woods of the World' displayed timber samples of exotic species grown in Powerscourt Demesne and kindly lent to the Society by the UCD Forestry Department.

One of the main events of the show was the finals of the 'All Ireland Chainsaw Competition' organised and judged by the ITA. Competitors for this event had successfully competed in the area finals and teams from the North-West, East, South and Midlands were represented in the championship. In judging the competition emphasis was placed on safety and skill but speed was also a consideration. For the public, the competition was a very good demonstration of the techniques of tree felling and delimbing. Wicklow won the team prize and Mr. Noel O'Carroll, from Glencree Forest, won the individual prize. Prizes from the various sponsors were generous and one of the prizes for the best individual competitor was a trip to Elmia Wood 1989.

A 90 page show catalogue was prepared which contained articles and photographs on Irish forestry and is the first trade directory of the forestry industry in Ireland.

Prizewinners of All Ireland Chainsaw Championships (left to right): Noel O'Carroll (1st Prize), Anthony Reilly (2nd Prize), Pat Murphy (3rd Prize). Michael Smith, TD, Minister for Forestry, Richard Whelan, Chairman of "Forestry 88".

The weather was excellent on the Friday and there was a good turn out of forestry personnel and those employed in the industry. A dull start on Saturday deteriorated into heavy drizzle for the afternoon but despite the poor weather a large crowd attended. Over the two days it was estimated that approximately 7,000 people visited the show.

A buffet reception was held for 300 exhibitors and invited guests at Manly's Hotel in Portarlington on the night of Friday the 9th. This evening was an unqualified success and was certainly the highlight of the forestry social events in 1988.

Considerable thanks are due to the sponsors of the show, particularly the Forest Service who kindly gave permission to use the site, FBD Insurances who provided insurance cover and the Civil Defence for stewarding, security and providing a bus service within the site. Thanks are also due to those members of both organisations and particularly the site committee who worked so hard to make the show a success.

Reaction from the trade, the public and the forestry profession was very favourable. It was a fine example of how two organisations with co-operation and commitment can create something that neither would achieve alone.

We look forward to further ventures and a bigger and better show in the form of 'Forestry '90'.

A. Pfeifer

STORM DAMAGE

Southern England experienced a huge storm in October 1987 which resulted in a considerable amount of damage to trees. The following is extracted from a two page leaflet produced by the British Forestry Commission. Its logical approach to clearing up after such a storm may prove useful in other areas which may in time experience a similar catastrophe.

THE STORM OF 16th OCTOBER 1987

INFORMATION NOTE
Forestry Commission Research Division
by B. G. Hibberd, Research Communications Officer.

The exceptional windspeeds of up to 90 knots (100mph) experienced in the early hours of 16th October 1987 resulted in widespread damage to structures and trees in an area south and east of the line between Bournemouth and Kings Lynn. Many of the trees affected were broad-leaved species in private and local authority ownership. This Note gives guidance for ordering priorities in the clearance, taking account of the possible deterioration of timber, insect damage and disease among remaining trees.

Clearance

Trees blocking public roads, threatening powerlines, property or otherwise considered to be dangerous, should be attended to first. Other broken or shattered trees should be cleared next, followed by uprooted trees which are largely intact with some roots still in contact with the soil. It is clear that everything possible must be done to remove trees in the first category as quickly as possible, but trees in the remaining categories can be left for considerable periods of time. With few exceptions (notably the pines) there is a time-scale of 2-3 years, exceptionally up to 5 years, in which trees which are not dangerous can be harvested and marketed in a systematic and economical manner. The following table gives general guidance on the sequence in which tree species should be cleared:

Order of removal of species

First The pines (pine species are likely to harbour insects harmful to conifers during the summer of 1988 and suffer from early staining of timber)

Sycamore, the poplars, beech, ash, lime, plane and birch (some degrade will occur in the summer of 1988)

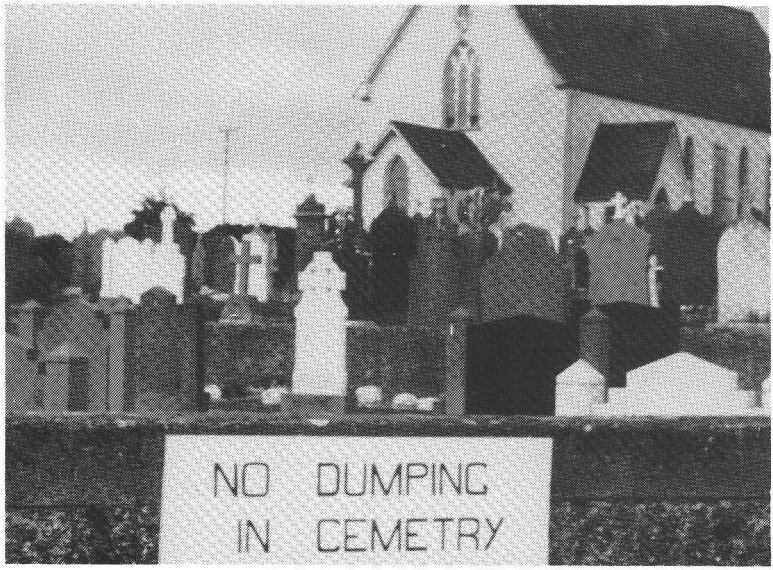
The spruces and silver firs

Douglas fir and western hemlock

The larches

Last Oaks, sweet chestnut and yew (blown over but intact may be left for up to 5 years)

Trees of species which degrade quickly but have limited value need not be given priority if they are only to be used for firewood or pulpwood. They should be removed as part of an orderly clearance programme.



Cremation the only resort! (Slide submitted by D. McAree)

NEWSFLASH

Charles (Chuck) J. Lankester, Principal Technical Adviser of the United Nations Development Programme (UNDP), has agreed to visit Ireland and address the Society of Irish Foresters under the theme:

TROPICAL DEFORESTATION – WHY BOTHER

With worldwide responsibilities for the UNDP's total programme in forestry and forest industries, watershed management, national parks and wildlife, he is well qualified to discuss this problem. He has been deeply involved with the major strategy to combat the destruction of the tropics' forests. In recognition for his efforts he was a joint recipient of the worldwide "Man of the Trees" award in 1985.

He is to deliver the talk to the Society on **Saturday 3rd December 1988 at 7.30 p.m. in Theatre N, Arts Block, University College Dublin, Belfield.** It will be a public meeting: Admission Free.

THE GOOD WOOD ANT

Wood ants, *Formica rufa,* are beneficial to woodlands – but just how good are they?

Dr. John Whittaker and a team of researchers from Lancaster University discovered that over 102,000 insects, which included 2,000 caterpillars, were collected by one nest in a woodland in one hour.

I'LL HAVE A PINT OF STOUT MYSELF PLEASE!

At one time it was common for Indians in the south-eastern United States to come together for ritual cleaning. To do this they gathered bundles of leaves of a species of holly, *Ilex vomitoria,* then boiled these leaves until they made an infusion. The Indians drank large quantities of the infusion which caused them to vomit. For several days they would continue this practice of drinking and vomiting until they had entirely cleansed themselves.

TOOTHACHE TREE

The 'Newtonia' tree from the Usambara Mountains of Tanzania produces bean pods. The local people have traditionally used the seeds to relieve toothache.

RETIREMENT OF EDITOR

I will be retiring as Editor of the Journal after this issue to allow new blood to take control. I have very much enjoyed being Editor. I would like to thank all of those who have in any way helped with the production of this Journal over the past three years. In particular, my thanks to those who agreed to be 'proof-readers' during that time.

I wish the incoming Editor all success with the Journal.

Pat McCusker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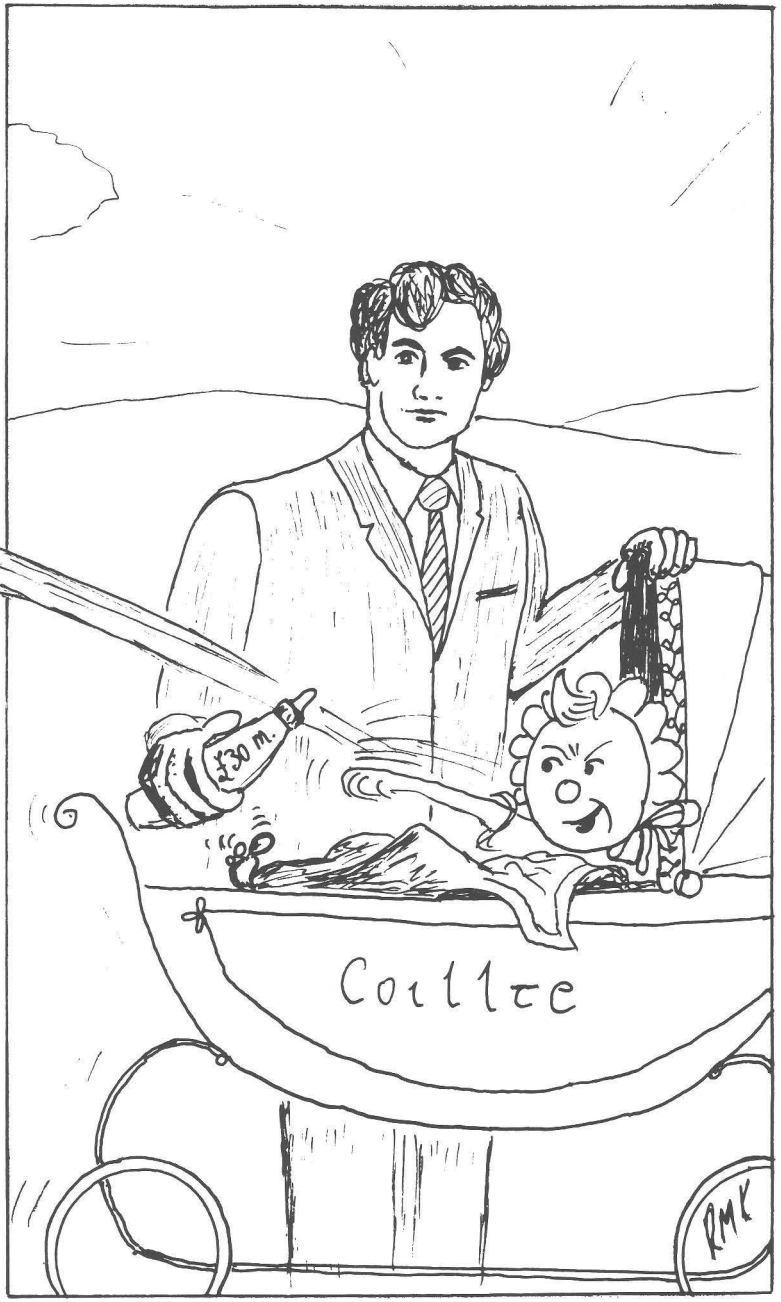
WILDLIFE?
Cameron 1950s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Obituary

JOHN McSORLEY 1910-1988

John was laid to rest in the heart of his beloved Clogher Valley on a beautiful April morning within sight of his life's work in the forests of Co. Tyrone.

He was one of that great company of foresters recruited in the hard times of the twenties and marked by dedication and commitment.

Only four of them achieved the record of 50 years unbroken service and John was the first.

Born at Motherwell in Scotland on 18 May 1910 the family moved to Baronscourt in 1913.

John left school at the age of 14 and started work that October in the forest, where three of his brothers also worked, under David Stewart. Like all that generation of foresters John had a fund of stories about that spartan regime and of cost effectiveness without the aid of work study and all for 14/- per 60½ hour week.

In September 1929 the first two local lads were selected for forester training at Denmore; they were John McSorley and John Montgomery and both were awarded their Foresters Certificates in 1931.

John found himself as a Leading Labourer at Drumrammer with his brother Joe nearby at Cam and both under Murdo Macpherson in North Derry.

However, Harry Mitchell, John's third Scots boss needed a foreman at Rostrevor and soon John was helping to plant the scree slopes of Slievemartin. Soil was so scarce that to achieve full stocking it was carried in buckets from where it could be found.

Planting was going on at Fathom Wood in Co. Armagh and the men had to cycle that 14 miles and be there at starting time.

John achieved every forester's ambition and within a year was given a forest of his own as a Foreman in Charge of Knockmany where he spent 27 happy years. Here he married Molly Corrigan and they reared their family of four girls and two boys.

Those in possession of the 1966 edition of "The Forests of Ireland" should refer to Plate VIII opposite page 21 where John is depicted beside a 119 ft Sitka spruce aged 39 years at Knockmany.

He used to relate that when he arrived at Knockmany he could shoot rabbits over the tops of these P.19 Sitka.

To begin with there were only two men at Knockmany and six at Favour Royal, which had just been acquired. Gradually he became identified with the whole Clogher Valley and East Fermanagh as each new area came in.

In 1959 he moved to Fivemiletown to be centrally placed to help with the management of the whole district working under John Phillips and later Noel Parker until 1970.

At this point the Rural Improvement Campaign started and for his final five years before retirement he organised and managed hundreds of men over four Districts covering Fermanagh, Tyrone and South Derry. This was a job which gave plenty of scope for imagination and he used his eye for landscape and his vision of the forests for the good of the community to the full.

On retirement he went back to live among the trees at Fardross Forest on the south side of the valley where he could tend his garden and the oaks which he had sown in the nursery (now abandoned) and turn it into a public amenity.

In his 70th year he unveiled a plaque and declared open a path through the wood to be called "The John McSorley Oak Wood" which remains as a fitting memorial to a man whose life personified forestry in the service of his fellow men.

To his life's partner and their family we offer our deepest sympathy.

CSK

TOMMY REA

Tommy Rea, Assistant secretary of the Department of Energy, passed away on 18 October 1988 in New York while on official business.

He will be deeply missed by those who knew him in the Forest Service.

An obituary will follow in the Spring Edition of the Journal.

(Ed.)

Book Reviews

CHOICE OF SEED ORIGINS FOR THE MAIN FOREST SPECIES IN BRITAIN

R. Lines, Forestry Commission Bulletin 66, 61 pages. 18 figures and 13 colour plates. £5.20 sterling. HMSO Publications Centre, P.O. Box 276, London, SW8 5DT. ISBN 0117102040.

This publication condenses the work of provenance research carried out in Britain over the past 60 years. The author, Roger Lines, has been associated with much of this work during his career and has become recognised as an international authority.

This Bulletin is essential reading for nursery and forest managers since the careful selection of genetic material is necessary for the successful establishment and growth of plantations. Once established there is little or no opportunity to change seed origin in mid-rotation without incurring a substantial loss in income. The Bulletin has also much to offer the specialist researcher with an extensive bibliography of 200 references for more detailed reading.

Twelve commonly planted conifer and four hardwood species are discussed in standard format under the headings of natural range, silvicultural characteristics, introduction and use, seed origin experiments and recommendations. Maps showing the natural range of the species are also included.

Recommendations are given not only for the best seed sources but lesser alternatives are listed, an important consideration given the unpredictability of seed supply. Provenances to avoid are also mentioned.

While recommendations given in the Bulletin are for Britain they are to some extent applicable to Ireland for certain species. However care must be taken when extrapolating provenance recommendations to another untested environment since genotype by site interactions can often occur leading to unexpected results. But as a general guide to the subject area this work is invaluable to practicing foresters in this part of the world.

Alistair Pfeifer

BEECH BARK DISEASE

D. Lonsdale and D. Wainhouse. Forestry Commission Bulletin 69. HMSO, London 1987. pp. 15, price £2.30 (by post).

This bulletin describes a disease which, like Dutch elm disease, involves an attack by both an insect and a fungus. On trees suffering from beech bark disease, patches of bark are killed by the fungus, *Nectria coccinea* (Pers) Fr. following heavy attacks by a small sucking insect, *Cryptococcus fagisuga* Lind. Although the disease does not occur in Ireland it is considered the most serious disease affecting beech in Britain. In their treatment of the subject the authors consider the disease by describing its symptoms/development, the ecology of both the insect and the fungus, biological and environmental influences on disease outbreaks and control measures.

As well as *Fagus sylvatica* L., the disease also affects American beech, *F. grandifolia* Ehrh. and is yet another example of a pathogen being introduced accidentally from one continent to another: spreading, in this case, from the east coast of Canada south-westwards to attack native north American stands of beech.

Using the excellent colour and black and white photographs the authors describe how the disease appears firstly on the bark as white specks. These may increase over time to cover much of the main stem. It is generally not until the *Nectria* fungus invades, however, that the bark tissue is actually killed. Where such lesions coalesce, girdling of the stem may occur resulting in tree mortality. Although the disease can kill trees, the authors suggest that the prospects for diseased stands in Britain seem quite good, with proper silvicultural regimes seen as the best option for future management of such stands.

Although beech bark disease is a relatively complex one, involving as it does an insect – fungal interaction, the authors know their subject and present it very well. Having most of the plates together on the centre pages is, however, a little distracting and they would perhaps benefit from being distributed more throughout the text. In summary therefore, this is yet another well written and professionally illustrated publication from the Forestry Commission and, although not for all practising forest managers, is a useful reference.

Michael Keane

AIR POLLUTION AND FORESTRY

J. L. Innes. Forestry Commission Bulletin 70. HMSO, London 1987. pp.40, price £3 (by post).

The fact that one quarter of this publication is given over to a listing of almost two hundred references (all of them recent) might give some indication as to the amount of work presently being published in this area throughout Europe and North America. This bulletin, published during the European Year of the Environment, reviews and summarises much of this work and in so doing presents the information in a very readable and objective fashion. This latter quality is very commendable in any publication dealing with atmospheric pollution as the subject is a very emotive one and one that is often approached and written on in a biased way.

The author firstly reviews such areas as origins and depositions of pollutants, acidification of rainfall, forest soils and streams and the phenomenon of forest damage. He then concentrates on a discussion of the possible causes of forest damage and presents evidence for and against various hypotheses in such areas as climatic change, gaseous pollutants, nutrient deficiencies and disease and/or insect attack. The most popular at the present time is, however, the multiple stress hypothesis. This suggests that certain factors predispose a tree to damage while others then contribute to the damage. Air pollution, therefore, may be a likely predisposing stress while adverse soil conditions in conjunction with severe climatic factors (e.g. severe drought or frost) may then lead to an overall decline of the tree's health.

Although somewhat disjointed, the sections in the publication dealing with damage in Britain and the current research work being carried out by the Forestry Commission, suggest that figures reported from their 1986 Forest Health survey are similar to those being reported from some continental European countries. These data show higher levels of damage than those observed, for example, in the 1987 Forest Health survey in Ireland. The author, however, correctly points out that interpretation of the symptoms (discolouration and defoliation) that are observed in such surveys is extremely difficult.

This publication reviews a topic in which new information is being published constantly. It is, therefore, a valuable summary of recent work and is written in a style which makes the information available more accessible and certainly more readable to the non-specialist.

Michael Keane

Society Activities

1988 ANNUAL STUDY TOUR 24-26th MAY
NORTH TIPPERARY

DAY 1

The Tour began with a visit to Urlingford forest. At Kilcooley property Matt Fallon welcomed the Tour to Urlingford and gave an introduction to his forest.

Urlingford was established in 1936 on lands leased for 150 years from the Ponsonby family. A wide variety of soil types occur, from cutaway midland peat to dry mineral soils, to carboniferous gleys. Norway and Sitka spruce are the dominant species. Recent planting programmes are composed almost entirely of reforestation on clearfell sites and 60% of harvested timber comes from clearfellings.

Both stops during the morning were concerned with reforestation under the headings "Plant handling techniques" and "Options for reforestation". Matt Fallon spoke of the very low survival rates experienced on reforested sites. It was this that prompted Forest Service District Inspector, Pat O'Sullivan and himself to set up an experiment in plant handling last year in order to improve the situation.

There are numerous reasons for high mortality in young trees, but the one discussed here was poor handling. Rough handling and drying can reduce survival to as low as 46%. From the outset, the forester should be aware of the time of arrival of the plants and be on site to supervise careful handling during unloading. At Kilcooley the plants are trenched in a specially prepared peat bed. This medium has proven ideal and is easily worked in wet weather. Prior to dipping for pine weevil control plants are kept dry using a frame covered with corrugated iron. Emphasis was placed on dipping.

A bundle of 25 to 30 plants is arranged so that the root collars are at the same level. These are then placed foliage first (including up to ¼th of the main root) in a 2.5% solution of Gammacol and held in this position for approximately 10 seconds. They are then positioned on a draining board so that surplus dip runs to the tip of the plants and is kept *completely* away from the roots. Surplus solution returns to the dipping tank. Plants are left to drain for

about an hour, wetting the roots with a mister if necessary. Enough plants for two days planting are treated at a time. The plants are then placed in wooden boxes with a layer of peat in the bottom which helps to keep the roots moist. They are covered to keep the foliage dry, and transported to the planting site by tractor.

The use of Gammacol requires certain safety precautions. The worker doing the dipping wears an oil-skin suit, an apron, elbow length rubber gloves and rubber boots. A face shield is also worn. Peat moss is placed on the ground around the dipping area to soak up splashes. Disposal of solution requires digging a 1m x 1m x 1m hole on a site away from watercourses. Out on the site it may be advisable for workers to wear a mask against dust coming from treated plants.

At the second stop, "Options for reforestation", the rain was coming down in torrents. The site in question was reforested in 1987 with Norway spruce and present observations reveal a 95% survival rate – a result of good handling and planting. Should Norway spruce have been planted here? What other species could be used? Why not a hardwood crop? These were some of the questions raised at the stop. From this stop Mr. Peter Ponsonby took the group on a guided tour of the ruined Kilcooley Abbey. Shelter from the rain was very welcome indeed.

Translated from Irish, Kilcooley means "Church in the corner" or "Church in the angle" from its location in a corner of Co. Tipperary under the shadow of the Slieveardagh Hills. The Abbey was founded by the Cistercians in 1184 as a daughter house of the better known Jerpoint Abbey in Kilkenny. Of particular note are the chancel, transpets, and a six-light east window with a good trancery. Various tombs in the chancel include a 16th century Butler effigy. In more recent times the Abbey served as a dwelling for the inhabitants of Kilcooley House when it went on fire in the 1800s. All in all it was a most interesting visit. The Chairman for the day, Michael O'Brien, thanked Mr. Ponsonby for the tour of the Abbey and shelter from the rain. Fortunately the skies broke back and the sun came out for us to enjoy our lunch back at the forest yard. Before leaving Urlingford, the Chairman thanked Matt Fallon and his staff for a most interesting morning and providing the facilities for lunch. And so we departed Urlingford bound for nearby Littleton Forest, location of all the afternoon stops.

Denis O'Connell, Forester-in-Charge at Littleton, met us on our arrival at Longfordpass North property. Welcoming the group he went on to explain that the forest was established in 1970 from outlying properties of Urlingford and Dundrum forests to comprise an area of 840 ha. This has increased to 1,456 ha and is made

up of numerous scattered properties ranging in size from 298 to 7.7 ha. Most of the forest is growing on low-lying midland peat. There is no new land coming in at present. However, in 1990 it is expected a sizeable portion of adjoining cutaway Bord na Mona bog will be handed over for planting. The main species are Norway spruce/Scots pine mixtures (47% of area), Sitka spruce (14%) and lodgepole pine 14%. Forty-five ha of the Norway spruce/Scots pine mixtures are thinned annually by contract harvesting. The aim is to remove all the pine from the mixture to leave stands of pure Norway spruce.

In the 1950s and 1960s considerable areas of the midlands were planted with mixtures of Norway spruce and Scots pine, the latter to act as a nurse for the spruce. By the early 1980s it was evident that the spruce was becoming suppressed due to nutrient deficiency and the pine was becoming dominant. In 1982 a process of rehabilitation commenced in Littleton. A selected area was treated by applying phosphate by helicopter at 72.5kg P/ha. The area was given an application of potash in the following year at 125kg K/ha. In 1984 all the Scots pine was removed (36 m^3/ha) and 750 stems/ha of the spruce were high pruned.

As a result of the course of action growth rates of the spruce have increased dramatically. It is estimated that basal area has increased by 75% since the treatment began. Costs of the treatment were as follows (1987 values):

Phosphate materials and spread	£69.00/ha
Potash materials and spread	£50.00/ha
Felling	£8.50/m^3
Extraction	£6.25/m^3
Prune (to 3m)	50p/tree

It was impressive to see what had been done to a crop which could easily have gone by the wayside. The land soon coming in from Bord na Mona, could, depending on peat depth, produce high quality Norway spruce, which, when coupled with a pruning programme could fetch premium prices.

A short way down the road we moved to our next stop. There John Twomey, from Development Section of the Forest Service, Limerick, demonstrated the Farmi-Trac mini forwarder. Manufactured by Normet of Finland, it has a four stroke diesel engine producing 40 H.P. It is 1.7m wide, weighs 4.25 tonnes and is 2.7m high. A grab is fitted to the tractor unit and has a maximum reach of 4.5 metres with a 1m hydraulic extension onto the crane.

Between tractor and trailer there is a system whereby weight can be transferred from one section to the other thus increasing traction or ground clearance. The trailer is also equipped with an auxiliary hydrostatic drive. The cab gives all round visibility to the driver. The layout of the controls and driving position are not ideal when driving out loaded from the wood, as the operator has to concentrate more on the trailer than on forward driving.

The Farmi-Trac is limited to slopes of from 1 in 5 to 1 in 8 depending on ground roughness. On slopes greater than 1 in 5 track slip is likely to occur. On side slopes it is very unstable and is liable to come off the track or turn over. Due to ground clearance the machine is only capable of extracting across the plough ribbons. Trials have shown that the maximum economic haul distance is 300m. When transferring, a rear entry low loader is required because at present the units cannot be easily split. Careful layout of extraction racks is required. It has potential on low ground pressure sites, especially gleys and peats where it can extract 4-6 m^3/hour and it does very little damage to the soil compared to heavier machines such as the Mini-Bruunett.

Our final stop of the day was at Grallagh property. Here John Twomey demonstrated a Goliat mini-skidder/mini-tractor. Powered by a 7 H.P. petrol engine it can get in and out of trees and stumps. It is ideal for distributing plants, manures or fencing materials. It travels at walking pace and is controlled by the operator walking along side. By removing the flat load area it can be used to haul and carry timber up to a half tonne load size. We were given a demonstration of both of its capabilities.

On the same site Eugene Hendrick introduced us to the tunnel mounder. It is a development of the tunnel plough and like this it provides a covered drainage tunnel in peat and deposits a planting medium on the surface. However, the unit in the tunnel mounder breaks this medium into definite mounds, this giving an output similar to double mouldboard ploughing. An auger is fitted behind the tunnel opening which cuts the peat and moves it vertically through an enclosed pipe. A bend at the top of the pipe extrudes the peat into reciprocating boxes which deposits the peat in mounds 1 metre on either side of the centre slit. The peat over the tunnel closes back in leaving a covered drain 30cm below the bog surface. Combined with a ditcher to open the ends of tunnels the mounder provides a good method of ground preparation. The unit is mounted directly on the three point linkage of a tracked 100-120 H.P. tractor. the ditcher can also be attached and worked by the tractor.

Chairman, Michael O'Brien, thanked all those responsible for arranging the afternoon's stops which, like those in the

morning, were most interesting and gave plenty of food for thought.

On a bright sunny evening we made our way northwards back to Tour headquarters in Thurles.

Richard D. Jack

DAY 2

Hollyford Forest.
Leader: Dr. J. J. Gardiner; Forester: Pat Carroll.

Stop 1 – Rehabilitation of Lulu island lodgepole pine.

A number of treatments were seen including an untreated area:
(1) Heavy mechanical thinning and prune
(2) Heavy selection thinning and prune
(3) Chemical thinning

Approximately 40% of the volume was removed in thinnings.

DISCUSSION

On being asked about applying fertiliser P. O'Sullivan said he would apply it if he were sure there would be an economic response. J. Fennessy felt the only response to fertiliser would be the production of extra flowers and branches. Promising results had been achieved through fertilising by M. O'Sullivan in his area. In contrast J. Dillon had found little response to fertiliser application in Littleton forest. E. Hendrick mentioned research results where 500kg of phosphate had given good results in Lulu island crops which had received a spot application of phosphate at establishment. M. O'Brien drew attention to the unproven applicability of inland lodgepole pine volume to stands of Lulu island lodgepole pine. He also wondered if the crop would ever be capable of producing sawlog material. P. O'Sullivan replied that the objective was to produce small sawlog of high value. Doubt was cast on whether even this more modest ambition was possible.

The disparity between the price paid for spruce and pine sawlog was fully discussed. P. O'Sullivan felt that the present superior price paid for spruce might not obtain in the near future. As the discussion progressed the question of pruning arose. T. Purcell questioned the wisdom of pruning small areas as the sawmilling trade would only pay a premium for material if there were regular supplies of large amounts available. The consensus of the group wa that it was admirable to attempt to rehabilitate these unpromising crops rather than simply give them up as hopeless.

Stop 2 – Sitka spruce on unstable sites

A stand of Sitka spruce, 14 years old, YC 18, had been thinned by Finsa of Scariff, Co. Clare. Every fifth line had been removed with a "mechanical selection" of the remaining lines. No marking was carried out. The objective was to remove 46% of the volume – 42% was actually removed. M. O'Brien commented that he was glad to see that local management were realistic about going into thin early and that selection thinning was being done. Attention was drawn to the difficulty that may arise with second thinning due to the unavailability of slash. It was hoped by some that extraction techniques might have improved sufficiently by then so as to eliminate this problem.

Extraction in this case was by horse. Finsa were quite happy to use horses in this situation as they were felling approximately 60 m^3/ha. Further co-operation was urged between the Forest Service and the pulpwood users to tackle the kind of problems that the stand in question represented.

R. Tottenham suggested for stands like this to start at about 12 years of age by taking out 2 lines for a rack. Later felling could be done on to the rack. This would give the requisite brash. Removing a double line was felt to be unsafe by many. It was also pointed out that 80% of the volume would need to be removed with this treatment to make it attractive to contractors. On the question of future thinnings, the situation would be looked at in 3 years time and a decision made then.

Stop 3 – Chemical thinning

Three different applications of this treatment were looked at and discussed:

1. Removal of competing coastal lodgepole pine in Sitka spruce crops.
2. Thinning of high YC Sitka spruce which is inaccessible.
3. Low YC pine – avoiding the cost of mechanical thinning.

At the site visited the soil was a peaty gley with severe side slope and contour ploughing. Kevin Collins stated that chemical thinning would only suit small areas on unstable sites to allow a "selection thinning" to be carried out. He then outlined the economics of the various thinning options available including the respacement option. The best was selection thinning provided there are no physical constraints to this. Second best was no thinning.

With respacement a break even point was reached when the crop reached a height of 13m. Between the heights of 13m and

23m respacement is the best option because:

1. Larger sizes are realised earlier.
2. The cost of respacement begins to become less important.

However, respacement with pruning was found to be unprofitable.

Stop 4 – Respacement Plots at Kilmore

The crop was respaced at age 10 and the following reductions of stocking were carried out – 33, 50, 66 and 75%. Pruning was done to 2m at time of respacing and to 4m at age 14 years.

Cost

Pruning 23p/tree 2m; 23p/tree 2-4m.

Respacing: 3 SMH/100 stems removed.

Results: The 66% removal will give all sawlog and an NDR of £265/acre. This assumes the crop will stand to full rotation.

The question was asked, would the 66% removal give greater or less stability than the 33% removal. E. Hendrick suggest that the 66% removal would be more stable due to a greater root plate. J. Dillon drew attention to the alternative approaches to these kind of crops and the important consideration that they avoided, the problem of losing the pulpwood production. He pointed out that this kind of treatment was of only limited application and in that sense similar to chemical thinning.

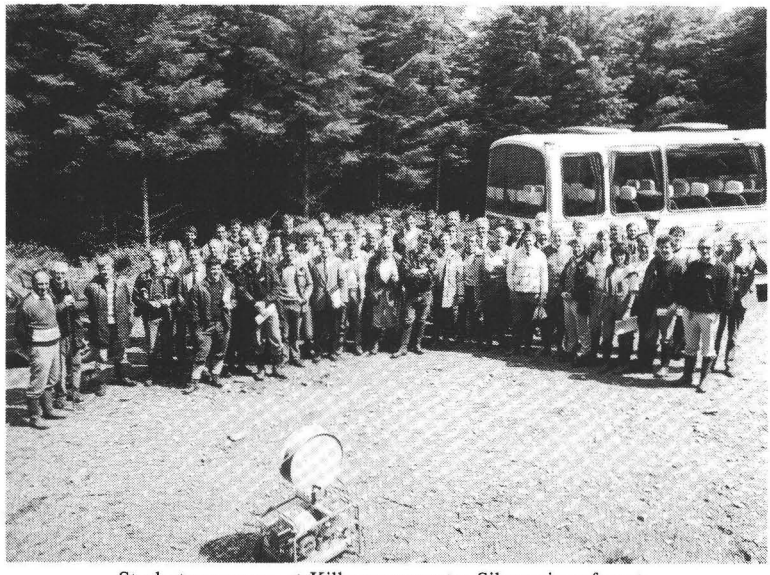
Recovery of sawlog:

Seamus Heaney, Research Forester, Forest Service, reported on sawn material he had produced from material felled in the respaced stands. From among the large amount of technical data given to the group a number of interesting points emerged.

1. The enormous disparity between the amount rejected by visual as opposed to machine grading – the latter being far lower.
2. The relation between YC and rejection – the higher the YC the greater the amount of rejection.
3. Finish: with sharpened knives the finish achieved was quite good.

J. Gardiner recommended that a one day meeting to cover the points brought up by Mr. Heaney's project would be well worthwhile. Most especially in view of the great interest shown by the group, the enormous importance of the subject and the limited time that was available to the members on the day.

Paddy O'Kelly



Study tour group at Killeen property, Silvermines forest.
(Photo courtesy Nenagh Guardian).

DAY 3

The final day of the study tour took us to the Silvermines forest where the Convenor introduced us to the local foresters, Mr. Michael Boland and Mr. Jim Rochford. The forest was established in 1955 and is situated in the Arra and Silvermines Mountain ranges. It has a total area of 2457 ha with an annual timber production in the region of 10,000m^3.

The first stop was a guided tour through a respacing experiment given by Mr. Ted Lynch and Mr. Arthur Buckley (Research Branch, Forest Service). Respacing is seen as a solution to the problem of producing sawlog on unstable stites which would be susceptible to windblow if thinned. In order to maximise quality pruning is essential. The respacing was carried out in 1976 on a crop of Sitka spruce planted in 1966. The original spacing of the crop was 1.8m x 1.8m (3088 stems/ha). The experiment

consists of 5 treatments.

1. *Control Treatment:* This is the where nothing is done to the plantation. The stocking here is 3088 stems/ha and it has a small mean diameter of 15.5 cm. This would indicate a high percentage of pulpwood. Mortality is about 3-3.5% but is expected to rise to around 10-15%.

2. *50% Respacing:* This was done systematically taking out every second line leaving 1520 stems. It has a mean diameter of 20.2 cm. The top height of the crop is 12m and this is unaffected by respacing.

3. *66% Respacing:* This is where two trees were removed and one tree left on a systematic basis. This left 1184 stems/ha with a present mean diameter of 21.8 cms. In terms of volume production 66% respacing shows a positive return after about 10 years if the Yield Class is high.

4. *75% Respacing:* Here every 2nd line and every 2nd tree on the line were removed, leaving 760 stems/ha with a present mean diameter of 22.8 cm.

5. *Oceanic:* This is a selection treatment where 100 of the best stems/ha were retained and the remainder are topped off at about 4 foot high. This treatment is difficult to carry out and there is the added problem of the topped stems beginning to grow again in some cases.

Having gone through the different treatments, Ted Lynch gave us results from a similar respacing experiment at Drumkeeran:

Treatment	**Stems/** ha	**DBH**	**Volume**	**Large** Sawlog	**Length** to 14cm top diam.	**Taper mm/** metre butt/ 14 metres
Control	2669	18.0	440	65	6.4	14.0
50%	1376	23.6	414	248	8.4	18.3
66%	969	26.1	343	232	8.5	20.2
75%	750	28.5	247	223	8.6	23.5
Selection	998	26.0	353	223	8.3	18.6

1. Height growth is unaffected by respacing.
2. At 75% respacing total production is reduced by about 140m^3/ha.
3. Mean tree size is increased as is sawlog production by respacing.

4. Merchantable length is increased by 2m on average over control.
5. Branch size increases as does rate of taper and ring width with increasing intensity of respacing.

After this visit we drove northwards to Killeen property in Silvermines forest. The soil in this property is a brown podzolic with considerable leaching. Here we looked at the thinning of Sitka spruce on stable sites. Mr. Pat O'Sullivan told us that due to the increased pressure to fill timber quotas they have adopted intensive thinning regimes on selected stable sites.

The plantation in question was Sitka spruce planted in 1961 at 1.7m spacing and had a YC of 24. The first thinning was carried out in 1983 removing 75m^3/ha (1 in 3), the 2nd thinning was carried out in 1986 removing 35m^3/ha (selection) and a heavy thinning has been marked that will remove 96.9m^3/ha with an average of 0.258m^3 and 19cm dbh, this corresponds to removing 100.9% of YC on a 4 year cycle. All timber has been extracted by horse.

After that it was over to Mr. John McLoughlin from Development Division, Forest Service who discussed pruning and showed us different pruning machines. Pruning should only be carried out on stable sites and about 400 to 500 stems/ha should be selected. To justify pruning a 20% premium for pruned timber is needed. In the Forest Service pruning increased from 17,722 stems pruned in 1975 to 642,233 in 1986. In 1987 there was a decline to 496,684 stems pruned and in 1988 1,185,001 stems are programmed to be pruned. From these figures it is hoped that pruning will increase as it makes good economic sense especially with pine.

Recently, Development Division have been working with mechanical pruning equipment. Three types were demonstrated:

1. KS 31
2. Yanmar AG 230
3. Pneumatic Pruning Saw

The KS 31 and Yanmar AB 230 automatically climb up the tree to a desired height while cutting the branches cleanly. After reaching the desired height it returns to the ground where it stops. Two machines can be operated at the same time. The pneumatic pruning saw is powered by a 5.5 H.P. engine and compressor (usually situated on the road) and has a 200m long air line going into the wood. From the end of this line it is possible to have 2 connections so that two men can prune at the same time. Various extensions can be put onto the pruner to get up to the desired height. The cost of pruning is reduced by 30%

by using the climbing machines and they can also prune up to 6m if the tree is straight. Studies done on the pneumatic pruning system on coastal lodgepole pine in 1987 indicated that the cost is comparable to manual pruning.

After lunch we went closer to Neanagh where we visited Jack Bayly's farm. The first stop was the pastoral forestry plot. This system of forestry and agriculture is designed to maximise economic returns from the land by utilising a two storey canopy system. The returnes are expected to be greater than either of the crops on their own. The forestry portion of the system "the upper storey" is based on trees which can produce high value timber for joinery and veneer using species such as *Nothfagus, Pinus radiata, Prunus avium, Fraxinus excelsoir.* The plot was laid down in 1986. The trees were planted in rows 13m apart. A 12m sprayer can be used between the rows. Trees were planted 7m apart in the rows, protected by Correx tree shelters and netting. By using this system grass production is reduced by 40% but as everything produced on his farm is in surplus except timber Jack considers it a worthwhile proposition.

The next stop on the farm was a Sitka spruce stand planted in 1971 with a YC of 28. The average tree volume was $0.107m^3$ giving a volume per hectare of $90m^3$. It had already been thinned, 1 line in 4 in 1986. The advice given here was to prune the final crop trees at this stage.

Next we looked at an old woodland site which had been restocked with Sitka spruce, oak, beech, ash and *Nothofagus.* The advice given here was that the area should have been mounded, this would have helped to alleviate the competing vegetation problem, also the competing scrub be cut and the regrowth treated with Roundup.

The final stop was at the pheasant release pen. Here, Jack buys and rears 100 six-week poults each year. On maturity the birds leave the pen and avail of the ample cover and food (cereals) on the farm. Two or three formal shoots are held each year which bring down 70/80 of the birds. Woodcock are also becoming common on the farm due to the planting of Sitka spruce.

After this we adjourned to the Bayly's residence where we enjoyed some light refreshment before returning to our hotel in Thurles for the annual dinner where we were joined by the Minister for Forestry, Mr. Michael Smith. An enjoyable evening was had by one and all.

Padraig Egan

Leaders:
Jim Dillon, Forest Service, Limerick.
Pat O'Sullivan, Forest Service, Nenagh.

Convenor:
Eugene Hendrick.

Participants:
Peter Alley, Denis Bergin, Pacelli Breathnach, John Cleary, Liam Cleary, Euphemia Collen, Lyall Collen, Jim Crowley, William Dick, Jim Dwyer, Padraig Egan, John Fennessy, Jack Gardiner, John Gilliland, Tony Glynn, Eugene Griffin, Eugene Hendrick, Dermot Houlihan, Richard Jack, John Kelly, Eamon Larkin, Edgar Lee, Jimmy Lehart, Joss Lowry, John Madden, Paddy McAuliffe, Frank McAuliffe, Sean McNamara, Tom Noonan, Mick O'Brien, John O'Brien, Tim O'Brien, Christy O'Dea, Tom O'Donovan, Pat O'Kelly, Joe O'Neill, Tim O'Regan, Michael O'Sullivan, Robert Percy, John Prior, Tom Purcell, Mary Ryan, Fred Topping, Robert Tottenham, Ari van der Wel, Donal Whelan, Richard Whelan, Coleman Young.

Three ways to keep trees weed-free with Roundup®

Pre-plant treatment

Overall spraying of plantation areas prior to planting. Target weeds should be actively growing, with sufficient leaf area to give good reception of the spray. Woody weeds, heather and bracken are best treated in full leaf or frond, before the foliage changes colour in the autumn. Best results are obtained between mid-July and end-August, when brambles and most scrub species will also be susceptible.

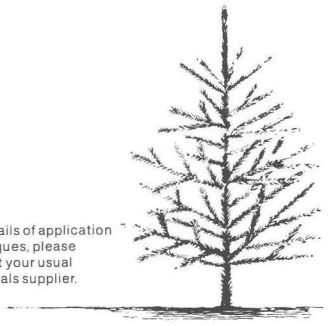
Overall treatment

During their dormant season, the following species are tolerant to Roundup:
Pine: Corsican, Scots, Lodgepole.
Spruce: Sitka, Norway.
Douglas Fir*
Japanese Larch**
Roundup applied from August to end-February, after extension growth has ceased and before buds swell in early spring, will control actively growing grass, broad-leaved and woody weeds.

* *treat only in late summer months: avoid early spring treatments.*
** *treat only during autumn and winter.*

Selective treatment

During spring and summer, Roundup may be applied using a knapsack sprayer or Micron 'Herbi.'
Care should be taken to prevent the spray from contacting any part of the tree. Use a tree guard to protect tree growth from drift in inadvertent spray contact.
Selective application of Roundup herbicide can also be made using specialised hand-held applicators, such as the Weedwiper Mini.



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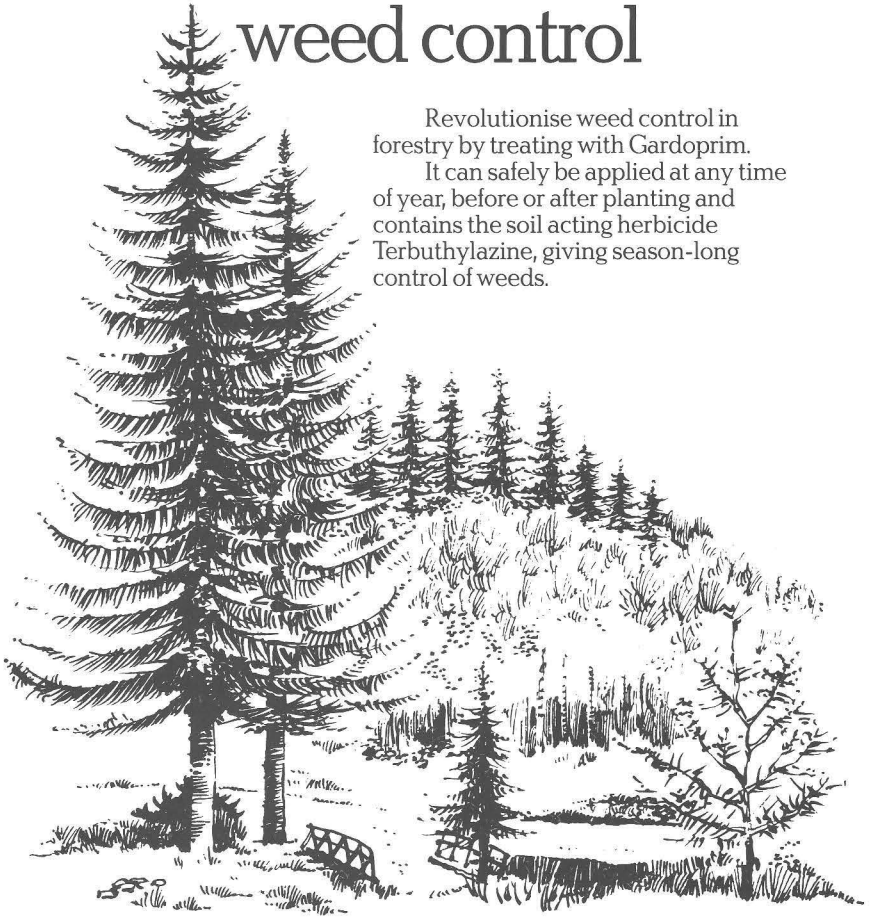

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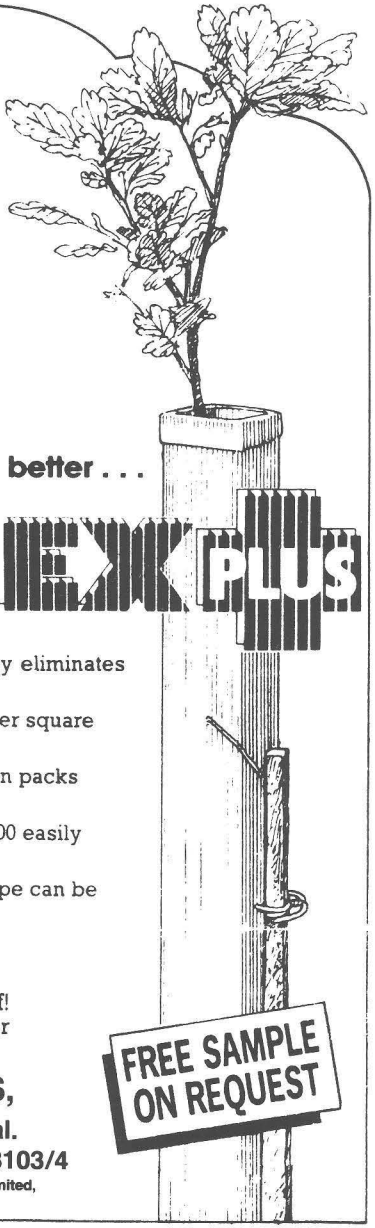

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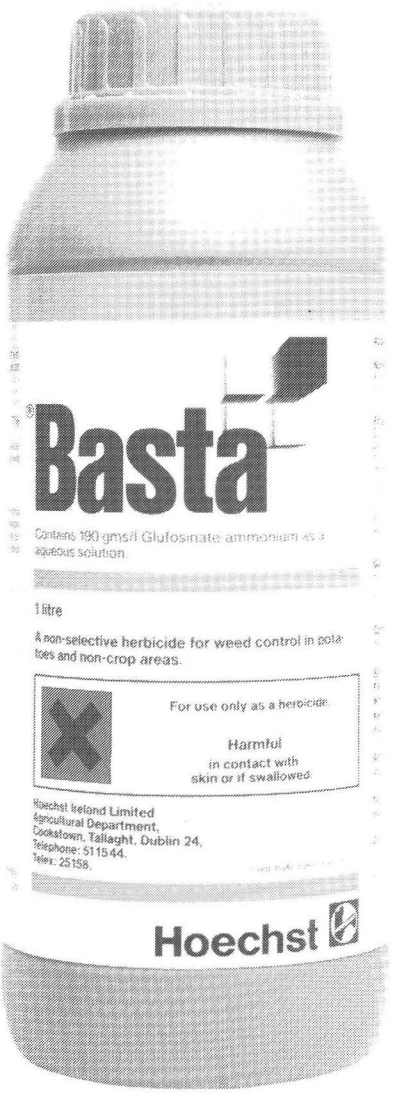

For further information contact:
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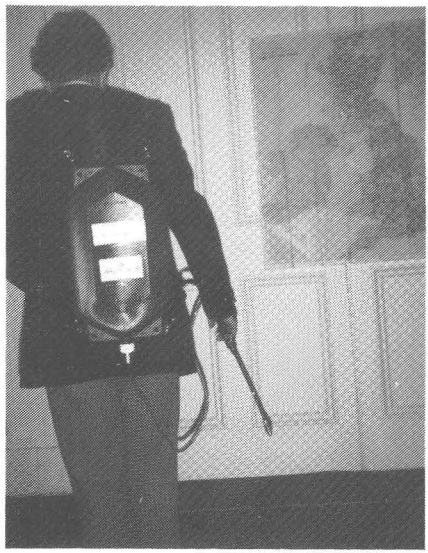
Cookstown,
Tallaght,
Dublin 24.
Telephone: 511544

SELECTOKIL SPOT GUN



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IRISH FORESTRY

JOURNAL OF THE SOCIETY OF IRISH FORESTERS

Volume 45, No. 2, 1988

Published twice yearly. Price £6

In this issue:

ISSN 0021 - 1192