or establishment costs.

Softwood cuttings (Ornamental shrubs and conifers)

Planted: 1½ acres 1967, 3½ acres 1972.
Number of stock plants: Approximately 15,000
Yield of cuttings: Minimum 5,000,000 — many more available, if required.
Labour input in 1975/76 season: £1988.00 (say £2,000.00).
Assuming labour to be 40% of Total Cost, then Total Cost = £5,000.00.
Therefore, cost of cuttings = £5,000.00/500 = £10.00 per 1,000.
If average selling price is 0.65p per plant (container grown) i.e. £650.00 per 1,000.

Then cutting cost = approximately 1½% of selling price. *Please note, in this particular season, just over 50% of costs* were incurred in hand weeding, due to the failure of residual weedkillers to act in dry soil conditions.

No account has been taken of cost of collecting cutting material or establishment costs. The above cost would be greatly reduced if we could make use of all the cuttings that are now being produced.

Whilst these costs may be of some interest to you, we did not decide to plant our stock beds on the basis of figures. The decision was made because we could see no other way to produce good quality material in quantity that was easy to collect. *We are still at the beginning of our understanding of stock* plant management and, in time, I am sure the treatment given to stock plants will become much more important in ensuring that the material produced will propagate more easily.

PRODUCTION OF PLANTS FROM SEED

DENIS FORDHAM

Oakover Nurseries
Ashford, Kent

The subject of raising trees from seed is rather a lengthy one, I therefore, intend to talk about production generally rather than about one particular crop or plant with reference to the methods being used at Oakover, producing seedlings in raised seed beds covered with grit.

Before raising plants from seed one might ask oneself, what are we trying to achieve? This is the key question, the answer to this is to produce plants that will fulfill the market's requirements, *i.e. large one-year plants suitable for stocks or wide* lining, for containerization, or for close lining to produce a 1 +

1 seedling. Since all the requirements for these purposes are different it is no good using the same method of growing to try to achieve this, it does not work; e.g. *Acer platanoides* seed sown in early March at about 200 per square yard will produce a large seedling at the end of the season as compared with sowing much later at a greater density, producing more smaller plants per square yard. This can only be accomplished by understanding each crop in question and using this knowledge to achieve what is required. It is acquiring this knowledge slowly that causes us to continually re-think and modify systems of production for particular plants each year.

From the start one must pay attention to detail, from the arrival or collection of seed, storage, stratification or treatment required, sowing time, plant population, soil conditions, water and nutritional requirements, pest and disease control, and lifting; all are equally important and I hope to highlight parts of these in the time available.

SEED HANDLING AND TREATMENT

This is one of the most important stages; bad handling in storage and treatment can result in rapid loss of viability and, of course, this cannot be restored. This is rather complex, the requirements vary considerably from plant to plant in the type of dormancy that may be present, e.g.:

1. Physical (hard seed coat)
2. Impervious seed coat
3. Chemical inhibitors
4. Immature embryo
5. Immature hypocotyl

As well as the life expectancy of the seed, I shall quickly mention a few ways we handle and treat our seed.

Handling. Riddling. With large seeds, e.g. oak, horse chestnut and sweet chestnut, these are all riddled to remove the small seeds that have less energy and would normally be suppressed and produce a second rate seedling.

Floating. Certain seeds, e.g. beech, horse chestnut and *Prunus avium*. When these are placed in water the empty and dead seeds float and the live sink.

EXTRACTION

1. Fruits containing seeds, e.g. *Sorbus*, *Malus* and *Pyrus* are pulped down and washed through various sizes of sieves to separate the seed.

2. Dry seed e.g.:

A) Legumes are dried to cause the pod to twist open and free the seed.

B) Birch. Collected catkins are air dried, broken up and put through sieves.

C) Norway maple and sycamore (*A. pseudoplatanum*) are collected green and air dried.

TREATMENT

1. **Traditional stratification.** A lot of seed (because we do not yet use acid) are stratified in the traditional manner using a peat/sand medium for one or more season, e.g. *Fraxinus excelsior*, *Crataegus monogyna*.

2. **Bed stratification.** With some plants the seeds are sown directly after collection, allowing the seed to be stratified in the bed, e.g. *Carpinus betulus*.

3. **Dry Storage.** Seeds like birch, alder and legumes are stored dry prior to sowing.

4. **Hot water.** Soaking seeds in hot water and allowing them to imbibe for 24 hours prior to sowing, i.e. *Gleditsia*.

5. **Cold Water.** Soaking seed for 24 hours prior to sowing to speed up germination, e.g. *Robinia*.

6. **Cold treatment.** Certain seeds are mixed in a peat/sand medium and placed in a cold store to remove the dormancy prior to sowing, e.g. *Pyrus communis*.

7. **Warm period.** Followed by a cold period, works with certain plants, e.g. limes, *Hamamelis*.

SOIL PREPARATION

Where possible land is left fallow and cultivated during the summer to eliminate perennial weeds or put down to mustard where possible. As much manure or spent hops that we can obtain is allocated for the seed areas.

It is applied over the area and ploughed in; this is done as early as possible during late summer to enable seed beds to be thrown up and allowed to settle naturally, also allowing early sowing to commence if required. Where land is not available until winter, it is ploughed, left and used for later sowings. After ploughing, the area may be cultivated several times before the beds are thrown up; this is governed by soil moisture at the time.

Soil sterilization. We do sterilize using bassimid, but hope on our new land to only sterilize once every 3-4 years provided weeds and diseases do not build up in the soil. Also this will reduce rotovating the soil to a minimum.

BED PREPARATION

Our beds are thrown up about 4"-6" high with a sowing area of 3"-6" and an 18" pathway on each side allowing a high clearance tractor to pass over the beds when other operations are carried out at a later date. Beds are made up with a frame containing two potato mould boards which is fixed to the three point linkage behind a tractor. It is important when making beds up to construct them with as few passes of the tractor as possible in order to obtain even compaction across the bed.

If soil conditions are good at the time when beds are being prepared very little hand work is required afterwards. As sowing may commence from late summer until mid-summer the following year, some beds may require spraying with a contact herbicide to control germinating weeds. Very light raking to loosen the surface may be necessary where the surface has capped just before sowing commences.

A dressing of phosphate is applied prior to sowing; this is raked into the surface if the operation is necessary, otherwise it is broadcast over the surface and left to be washed down. This seems to work very well with no harmful effects. In most cases where beds are thrown up early, rolling prior to sowing is not carried out; settling is allowed to occur naturally but the beds thrown up late are always rolled when soil conditions are right to provide a better soil contact with the seed. The degree of rolling is controlled by the moisture content of the soil, soil type and the time.

DETERMINATION OF THE SEED RATE

After spending a lot of time preparing the seed area, collecting, handling, and treating the seed it is important to obtain a maximum number of plants from the seed and seed bed area available. This can be achieve by sowing at the correct density. To do this we need to know the following:

a) total seed weight

b) total number of seeds

c) the viability of the seed sample at sowing

d) the required population of seedlings

e) the field factor (survival rate)

The total amount of seed is weighed and by, dividing this into a smaller unit and counting the number of seeds, the total number can be worked out. Testing a given number or weight of seed gives us the percentage or number of viable seeds capable of germinating.

Testing for viability is carried out using the following techniques:

1. **Cut test.** Large seeds, e.g. oak are cut in two, lengthways, exposing the embryo and an asessment on its condition is made.

2. **Tetrazolium.** Seeds are cut in half and placed in a 1% solution of tetrazolium for 24 hours; living tissue reacts with the chemical to produce a pink stain.

3. **Sowing.** A small sample or number of seeds are sown in trays under glass and the number or percentage of seeds that germinate are recorded.

FIELD FACTOR

This is only an assessment of the viable seeds which are capable of surviving germination and growing away to produce a plant; it is an unknown factor and can only be determined by getting to know the following:

a) *Soil* — weed seed content; diseases or pests present.

b) *Site* — Degree of exposure to wind and possible frost damage.

c) *Plant* — whether the plant is slow to develop in the early stages or grows away vigorously.

d) *Records* — only by keeping records each year of the performance, can we hope to arrive near the right figure. Using the following equation with these figures the seed rate is calculated.

$$\text{Rate} = \frac{\text{Required population of seedlings}}{\text{Sample viability} \times \text{field factor} \times \text{seed count}}$$

SOWING

When to sow? Most of our sowing is carried out in the —

a) Autumn, e.g. oaks, sweet chestnut.

b) Mid to late winter, e.g. ash, cherries, field maple.

c) Late winter to early spring, e.g. alder, birch, beech, *Gleditsia*, *Catalpa*.

030. Other sowing is carried out at different times throughout the year. Some seed arrives during the summer. Because of the season of maturation and short longevity, e.g. *Acer saccharinum*, *Acer rubrum*, and *Ulmus campestre*, seeds of these species are sown immediately on arrival.

All our sowing is carried out by hand, broadcast over the surface; if we broadcast seed at the right population the plants make better use of the space available compared with drill sowing. Heavy seeds are easily broadcasted but finer seed may be bulked up with sand to prevent the wind from moving them or

to enable the operator to sow more evenly. With large areas the seed is divided into smaller units, making the distribution more accurate. After sowing medium to large seeds it may be desirable to roll them lightly into the surface to reduce the amount of grit used. Seed is covered with ⅛" washed grit using a machine tailed behind the tractor. The depth of grit used varies according to the size of the seed, e.g. birch ⅛", beech ½".

PROTECTION

A. **Frost.** Most seeds that germinate early are prone to frost damage; those which are more severely effected, e.g. beech and limes are protected using netting.

B. **Wind.** Wind breaks using netting are erected in May to reduce wind speed, prevent scorching to the foliage and water loss from the plant and bed.

C. **Birds, Mice, Squirrels.** Can cause severe damage to certain plants if left unprotected, e.g.

Pigeons — beech, oak

Finches — pines

Squirrels — most nuts

Mice — most seeds

By cóvering beds with netting, placing drainage pipes containing a poison down the row and shooting gives us good results.

WEED CONTROL

Where germination has not taken place a pre-emergence is used wherever possible, using a contact herbicide. Once germination has taken place all weeds that emerge in the bed area are removed by hand. Pathways are sprayed with a contact herbicide using a guard to prevent drift.

NUTRITION

A top dressing using an organic NPK fertilizer is applied in spring to those beds where the seeds have germinated and later on to other seedlings as they emerge. Further applications are made during the summer, but in areas where irrigation is used the fertilizer is applied more frequently but in smaller amounts. Straight fertilizers, e.g. nitro chalk are used on plants that respond to it, i.e. ash.

IRRIGATION

Water is just as important as nutrition to maintain healthy plant growth; at present our limiting factor is the rate that we can apply the water rather than how much should we apply.

Where possible we give priority to later sowings that are prone to damage if the surface dries out e.g. finer seed, birch.

PEST AND DISEASE CONTROL

Growing plants on an intensive scale produces an unnatural environment which is suitable for the spread and development of pests and diseases. Because damage can result in loss of growth or even the saleability of the crop, regular spraying is carried out as a preventative measure rather than a cure. Spraying is done using a tractor-mounted spray with booms. Examples of pests and diseases sprayed are:

Powdery mildews — oak, field maple, *Euonymus*, sycamore (maple), thorn (hawthorn)

Aphids — birch, sycamore (maple), oaks, beech, alder

Caterpillars — *Sorbus aria*

Scab — *Pyrus*

UNDERCUTTING

At the end of the growing seasons all beds are undercut using an Egedal blade fixed behind the tractor. The depth of cutting varies from 4″ on small plants, to 9″ deep on two-year beds that were undercut the previous year.

THE PRODUCTION OF CONTAINER-GROWN TREES BY BENCH GRAFTING — SOME CRITERIA FOR SUCCESS

CLAIRE F. HOWE

Hadlow College of Agriculture and Horticulture
Hadlow, Tonbridge, Kent.

The purpose of this paper is to outline the work carried out in two group projects during our third year as students in the Ordinary National Diploma in Horticulture at Hadlow College. Besides benefitting our practical skills, our two main objectives were, firstly, to assess the suitability of the subsequent trees for garden centre sales after a one season's growing from winter bench grafting; secondly, to see how a range of genera, species and cultivars respond by being grown on under protection.

PROPAGATION

1. *Time of Year.* The great majority of the grafting process