removing any; nevertheless I have hardened my heart with some of them and wait now to see if it makes any difference.

Secondly, we are trying to encourage growth by the use of supplementary light; 200-watt lamps are suspended three feet above the plants and left on all night. And with this treatment goes a high potash feed. We hope by this means to overwinter a good batch of plants which will make the exercise worthwhile and also establish the routine to be followed next year. If anyone has any suggestions to make — particularly with regard to the problem of growing-on — we shall be very pleased to hear them.

MISS ANSTREY: Which type of rooted cutting overwinters best — plants with good root systems but no extension growth, or those which have made appreciable new growth?

BRIAN HUMPHREY: Why not leave them in the boxes until spring instead of potting them up? I would expect almost 100% survival this way without much difficulty.

C. E. SALTER: With long cuttings, take off the two top buds to get a break. Cuttings must be at least 3 nodes to be able to cut off the top and get good growth before winter.

PETER VERMEULEN: We use Jiffy pots under a plastic cover.

JIM WELLS: At Beltsville, Maryland, it has been shown that Acers react strongly to extra light. Never take the leaves off the cuttings and keep the plants at low temperatures overwinter.

PROBLEMS IN RAISING ORNAMENTAL STOCK FROM SEED

PETER DUMMER
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Over the past few years there has been an ever-increasing demand for large quantities of trees and shrubs and, as a result, we have had to change some of our methods of raising stock from seed.

Various reports, such as those of the I.P.P.S., and the Woody Plant Seed Manual (published by the Forestry Service of the U. S. Department of Agriculture) have been found particularly useful. This latter book is notable for its detailed work on the treatment of seeds with sulphuric acid. A visit a few years ago to the Forestry Commission Nursery at West Moors, near Ringwood in Hampshire, also provided us with ideas on different seed-raising techniques. These changed practices have increased the quality of the seedlings we have raised and reduced our production costs.

DORMANCY

In most cases dormancy originates in genetic conditions of the seed itself, or by improper handling of the seeds at harvest

time, such as allowing the seeds to become too dry before sowing or before stratification.

There are two main causes of seed dormancy:

1. An impermeable or hard seed coat which prevents water and oxygen from reaching the embryo and in some cases prevents the embryo from breaking through the seed coat.
2. Conditions of the embryo or stored food within the seed which prevent germination. Double dormancy exists in quite a number of species and is said to be caused by the combination of both a hard seed coat and internal conditions.

OVERCOMING SEED DORMANCY

Stratification. This is the usual method of breaking the internal dormancy of many seeds. The medium we like to use is a coarse potting grit and peat; the use of grit allows an adequate supply of oxygen to the seeds while the peat, which has a fairly low pH, aids in breaking down the seed coat and retains moisture which is vital for the well-being of the seeds. We like to use at least three times the amount of medium to seed in order to keep the seeds separated from each other. For small quantities of seed, hand mixing is practiced. For large quantities, a cement mixer is employed.

When stratified, the seeds are placed on the north side of a greenhouse in cubicles made from concrete blocks. The blocks are simply placed down and the cubicle made large enough to allow the seed to be turned occasionally. For small quantities of seed, a large pot or box is suitable.

Warm-to-cold stratification. Besides the usual method of stratification, we also practice the warm-to-cold technique using such species as the cotoneasters.

The seeds are picked as soon as ripe and are immediately macerated through a mincing machine, adapted from a household mincer; the pulp is then put into a large bath and filled with water. After a few minutes the water is poured off. A large number of seeds always float off with the water, but these can be ignored as they will be found to be infertile. Three or four rinses like this are required to obtain well-cleaned seeds.

After this treatment, the seeds are mixed with the peat and sand and placed in boxes or large pots and stood down in a *warm* greenhouse for about six to eight weeks. The use of a warm period for these stone-like seeds helps in breaking down the seed coat; the winter frosts which they will encounter when sown on the seed beds breaks embryo dormancy.

Acid treatment. The use of acid for the treatment of seeds is a comparatively new technique for us, which we started using only a few years ago. It has proved most satisfactory, especially with members of the legume family.

This year success has been attained using acid treatment on *Gymnocladus dioicus* (*G. canadensis*), a notoriously difficult

tree to raise from seed. In the past, various treatments on *Gymnocladus* seed, such as using hot water, filing the seed, and the usual method of stratification have usually proved unsuccessful.

This year we tried a 4½-hour soak in concentrated sulphuric acid. After a thorough rinsing in running water, the seeds were stratified in the usual way then placed in a warm greenhouse. In a few days it was evident that the seeds were going to germinate for the sand in the stratification pot had risen several inches above the rim of the pot. Upon inspection, it was found that the seeds had swollen at least three times their original size and had started to germinate. They were then sown individually into 3-inch pots.

Listed below are several species whose seeds have been successfully treated with concentrated sulphuric acid, together with the duration of treatment.

SPECIES	DURATION OF TREATMENT
Cercis canadensis	½ hour
Cercis chinenensis	20 minutes
Cornus florida	3 hours
Cornus nuttallii	3 to 4 hours (depending on freshness of seed)
Gleditsia triacanthos	1½ hours
Gleditsia caspica	1 hour
Gleditsia sinensis	1 hour
Nyssa sylvatica	3 hours
Nyssa aquatica	3 hours
Robinia pseudoacacia	20 minutes