

Height 7 m including flower spike Habitat: Open forest, mountainous areas, usually in volcanic soil but also can be found in poor sandy soils in heath lands Climatic tolerance Annual rainfall 350 to 1500 mm, temperature range 10 to 35°C Propagation Quite easy from seed

These are just a few of the magnificent plants that Australia is endowed with. I trust that this gives some idea of the wide range of material that is available to us. The following references will enable further investigation of Australian flora.

#### REFERENCES

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### THE COLD STORAGE OF DORMANT MATERIAL

A.T. WOOD

*Oakover Nurseries Ltd.*

*Potters Corner, Ashford, Kent, England*

**General Considerations.** I would suggest that there are two reasons for using cold storage. Both of these are tools of management: (1) to avoid the closed season when lifting cannot be undertaken, (2) to extend the planting and lining-out season by holding material dormant and prolonging the optimum condition for planting and establishment. Our experience is wholly with this second reason, and I propose to discuss our successes and failures at some length.

In North America and on the Continental mainland of Europe, it is most necessary to avoid the closed season by placing plants in store. However, the British Isles, with their maritime climate is usually open for most of the lifting season and the necessity to lift in the autumn and hold throughout the season seldom arises. However, where stock is required for grading and dispatch of plants to more favorable climates or stock for bench grafting is required, there is no alternative to the early lift. The main problems in the storage of this material are linked to the proper hardening-off before lifting. Die-back and disease particularly become a problem when foliage is taken into store and buds are not hardened-off. Plants that are under stress in store could

result in die-back and poor establishment in the following season. We have had some experience of Continental material arriving in this condition though we have not ourselves lifted before the plants are fully dormant.

**Our Method.** We considered the reasons for which we might use storage. We wanted a storage facility, but it is expensive. Since we felt we could not afford to own one, we have worked out a very satisfactory arrangement for hiring a fruit store during its unused season. Apples are stored until around Christmas. When they are sold, the owner thoroughly cleans the room and we then begin to store our plant materials. We use cold storage for the holding of most of our lining-out stock. Off-grades and selected plants can be held in cold store and the double handling of heeling-in avoided. The stock can wait until the land is in good condition for planting and sufficient labor is available. The use of a cold store in this way is most certainly an aid to management in the growing of our seedling and transplanted crop.

There are some hazards, but in the main I consider that the practice is advantageous. The prime advantage is that material is planted in the optimum condition for establishment, and one is the master of the situation. We are all only too well aware of the sinking feeling that accompanies an early spring when good stock is flushing and deteriorating by the day, and stresses of labor requirement and soil conditions do not permit a speedy enough planting. This situation of panic and dilemma can be largely avoided; the peace of mind that comes with having plant material in cold store is worth a lot. Labor requirements can be planned effectively and planting conditions can be considered when plants can be kept dormant. The selling season can be extended, particularly where there is a long established relationship with the customer and cold stored material can be offered. The avoidance of heeling-in operations and the double handling, which is costly of labor, is also a worthy consideration.

Some nurseries use cold-stored material for open-ground planting and accompany this with cold-storage wagons to transport throughout the country. This is primarily where stock grown in the south is travelling into Scotland. Ancillary considerations such as adequate supply of water and irrigation equipment are essential where dormant stock that would normally be planted in April is coming out of store to establish in late May and June. The effect on other nursery operations and equipment are also to be considered. When labor and tractors are being used to plant in June, other jobs may be affected. These basic considerations are essential before entering into a program of cold-store planting.



**Types of Store Available.** There are basically two types, direct or indirect (jacketed stores). Direct stores are cheaper to construct and are virtually an insulated box with a coolant circulated through a convertor through which air is directed and circulated within the store. This presents some problem with humidity control, but the problem can be overcome by the use of polythene bags to protect the plants.

In a jacketed store cool air is circulated outside an inner liner within an outside insulated wall. In double-wall store plants can be kept bare-root with minimum humidity control. Purpose-built stores for holding dormant plant material should be of this type.

**Our Experience and Method of Storage.** We have built up the quantity of plant material stored over the past few years to a point where we now hire a large fruit store from the New Year onwards. This is a direct store with a capacity of 100 T of fruit. The temperature can be held very accurately at 32 to 34°F. All our plants are bagged in 250 gauge polythene, not sealed, and packed in bins which can be handled with a pallet loader. Frequent splashes of water on the concrete floor of the store enable us to hold the humidity. The amount of water used is determined by the degree of icing on the exchanger.

Our seedlings are lifted and graded in the normal way throughout the dormant season. Plants for re-lining or potting are root-trimmed. It is most important that this trimming be done before storage. Root development does take place during storage, and this development would be lost in late trimming. The seedlings are bagged loosely and sprayed with Elvaron (Euparen M, tolyfluanid, Bayer AG) to reduce *Botrytis cinerea*. The bags are labelled and numbered and the totals and dates of entries are recorded. Duration of the storage with regular inspections can be 4 to 6 months. Scionwood collected in January could be stored until June or July. Dr. Brian Howard at East Malling Research Station has done this.

We plan our input and output from the store to correspond with the natural flush of the plants. For instance *Crataegus* plants are taken out early while late flushing plants such as *Juglans* are left until last. During 1979 we had a cool damp spring with very easy establishment from store. In 1980, however, we had a dry April and May and the value of our irrigation equipment was put fully to the test. One of the useful bonuses of our cold storage was that we were able, with confidence, to stop planting, use our irrigation to apply residual herbicides and in this way ensure excellent weed control in what was for most growers in the United Kingdom a very difficult year. Our seed-sowing operation could also be given priority; we were able to take labor away

from planting to spray herbicides and insecticides. In this way the quality of our work was maintained at a high level even though the planting operation was extended far beyond our expectations.

One of the problems was that we normally use our labor for potting and containerizing after the planting operation. Since potting was delayed, some plants did not make up to a satisfactory size for autumn sales. In addition, if one extends the planting season too long, when do you take your holidays! The technique must be planned into the whole of the nursery operations for the year and, if this is done, cold storage of dormant material can only be a useful adjunct to the nursery.

In conclusion, I would say that cold storage, if treated well, is good practice. It needs a good back-up facility; we could not carry on our present level of production without this storage. The cost is high, but if you are able to hire for a short period then the facility is most economical and, in our case, preferable to owning our own storage facilities.

## **STORAGE OF DORMANT PLANTS AT MOUNTAIN CREEK NURSERY**

MIKE HALLUM

*Mountain Creek Nursery Co.  
Route 5, Box 170  
McMinnville, Tennessee 37110*

Proper storage of dormant plants is a necessity, whether the plants are to be shipped to customers or used as lining-out stock in the nursery. For this reason careful attention must be paid to controlling the environment of the area where dormant plants are stored.

At Mountain Creek Nursery we have attempted to develop a system whereby we can efficiently process dormant stock and still maintain plants in such a way as to insure maximum survival after transplanting. Our bare-root stock is dug soon after it becomes dormant and immediately transferred to our grading, baling and packaging building. Here the stock is graded and, depending on our needs, packaged, baled or boxed for shipment — or in the case of our lining-out stock, moved to our heeling area until planting time.

We also buy a quantity of bare-root plants from other growers. We maintain a cold-storage facility for storage of some of this stock, especially if we anticipate delays in spring planting. Inside the building this material is heeled-in in sand or old sawdust, or