

## Discussion

In response to an enquiry from Bill Flemer about the tying in of chip buds, Brian Howard replied that the most effective was polythene strip as it completely encloses and prevents water loss; rubber strip was only effective if completely overlapping, and "Fleischauer" ties had proved ineffective. The President asked whether the bud should be enclosed and was told ideally all but very big buds should be enclosed. Chris Thomas, however, emphasized the importance of removing the strip as soon as possible to prevent any 'sleepy' effects — usually five weeks was sufficient.

Ralph Shugert was interested in the speed of operation. Brian Howard replied that at East Malling skilled shield budders had been able to chip bud marginally faster, but the point was that greater productivity was achieved (i.e. fewer failures occurred) with this technique. Jolly Batchellor disagreed, suggesting that failures in shield budding could be due to excessive damage to the cambium. However, Brian Howard pointed out that the important cambium was at the bottom of the cut and was not severely damaged.

Finally, Brian Howard concluded by emphasising that the research worker produces the technique and that it is up to management to adopt it and adapt it to nursery conditions.

## NEW CONCEPTS IN BUDDING AND GRAFTING EUCALYPTUS

O. A. JOLLY BATCHELLER

*California State Polytechnic University  
Ornamental Horticulture Department  
Pomona, California 91766*

The beauty of the red-flowering eucalyptus (*Eucalyptus ficifolia*) has led many horticulturists and nurserymen to seek means of propagating selected trees vegetatively, because production by seed is totally unreliable. (4, 13, 17). A very few species of eucalyptus propagate easily from cuttings or air layers, but *E. ficifolia* does not. Reports by horticulturists of an occasional success in grafting these plants has led the author to try different techniques over the past 25 years, with no success. A meeting with I. J. Thulin<sup>1</sup> in 1970 rekindled the author's interest, for Thulin had developed in New Zealand a technique for grafting eucalyptus on very young vigorous stock. (16)

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<sup>1</sup>I. J. Thulin, Forest Research Institute, Rotorua, New Zealand

In January, 1971, attempts were made using the information obtained from Thulin and, although these grafts were not successful, the scions lived long enough to indicate that if the techniques and procedures were refined and improved, successful grafting might result.

California State Polytechnic University provides no facilities or exempt time for investigative research so the study was carried on at the author's home. Because of this situation no formal controlled experiment was set up. Careful records were kept of dates, materials, and techniques. By using previous experience, making careful observations, and by playing hunches, it was possible in two years to go from 0% of the grafts living more than one month, to a situation where 90% of the grafts lived two months, with 20% continuing to live up to the time of this writing (18 months). This improvement was a strong indication that the grafting techniques were suitable because good unions occurred in 98% of the grafts. The death of the primary bud was the major cause of the decline in percentage. Some scions, with the original primary bud alive and in apparently good condition, remained alive — but dormant — for as long as eight months.

### GROWING THE ROOTSTOCK

*Eucalyptus ficifolia* and *E. calophylla* are so closely related that it is difficult to distinguish one from the other, and in Southern California there are a good many hybrids between the two species. *Eucalyptus calophylla* seedlings were used for rootstock as most authorities consider them to have a better root system and a more vigorous habit of growth than *E. ficifolia* (2, 9, 14). Normal procedures were followed in collecting and storing the seed. Because of some fungus problems the seeds were dipped in a fungicide solution and air-dried before using. After trying many systems of growing the seedlings, it was found that direct seeding to pots was the most satisfactory from all standpoints. A UC mix type of soil was used for all growing. First germination usually occurred by the fifth day at which time the seeded pots were uncovered, and placed in direct light. Normal procedures were followed in shifting up to larger containers, and plants were staked as needed. The only unusual technique was that of using the flame of a torch rather than a knife to remove the root curl. This was found to be easier, faster, more positive, and resulted in less damage to the plant.

At all stages the weak, undesirable, or mallee type plants were discarded. By the end of the fifth month most of the plants were 18" or more in height and 3/16" in diameter and ready for grafting. A few hours before grafting all leaves and buds in the area of the graft were removed, and the stem of the rootstock was thoroughly scrubbed with a disinfectant. This area was usu-

ally 4'' to 8'' above the lignotuber and, in most cases, there were some leaves or growth below this point.

### BUD SELECTION

Because of the nature and habit of growth of the eucalyptus, and the manner in which it forms its buds, the only place on the tree where good plump vigorous buds could be consistently found was in the blossoming cluster (3). Although Penfold (11), Pryor (12) and Thulin (16) speak of using scions with no visible buds, and having the accessory, or adventitious buds, develop, we had little success in this respect with *E ficifolia*. In only two cases did these buds develop.

In handling the scion wood and bud sticks, the only treatment that varied from the normal, was that of drenching them with a solution containing a disinfectant, and an antidessicant. The wood was then shaken to remove excess liquid, air-dried, and stored at 40°F until used. It appears the fresher the scion wood the more successful the grafting. No wood was used after 48 hours storage.

### GRAFTING

The most successful grafts were accomplished with the normal side graft about 4'' above the lignotuber. The disinfectant on the stock and scion plus the antidessicant on the scion seemed to be of major importance. Another graft that appears to be useful and successful is a modification of the "rind graft" suggested by L. M. Hodgson<sup>2</sup> who indicated this was used in grafting eucalyptus in South Africa. The rind graft as shown to me is much like a bark graft in that the scion is cut on an acute slope, and slid down along the cambium of a decapitated rootstock. We found that the top growth of the stock was quite important for the survival of the scion. With this in mind, we developed a cutting blade that would make a concave surface of the base of the scion. The scion is slipped into a regular T-cut as used in budding. By altering the arc of the blade it is possible to make a cut that will perfectly match the curve of any stock so that 100% cambium contact can easily be obtained. Although only limited use of this graft was made, it proved to be easier to do and gave excellent unions. It is believed that the modified "rind graft" could be useful in many situations.

### BUDDING

All attempts to bud *E ficifolia* with the normal, and usual buds were unsuccessful. It appeared that the injury to the root-

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<sup>2</sup>L. M. Hodgson, Officer in charge for the Secretary of Forestry, Forest Research Station, Politsi, North Transvaal, Republic of South Africa

stock caused by the horizontal cuts across the phloem tissue causes an excessive amount of callus, which either prevented a good union or caused the plant to force out the bud. To overcome this excessive callus we used the "Jack-knife Bud" where only a small slit is made in the phloem. The stock is bent over toward the cut; with a little effort this slit may be opened for the insertion of the budshield. Once in place, the shield is pulled down well below the cut so as to be in an area that has not been exposed to the light and air. When the bud is in place the rootstock is straightened up, and the bud properly secured. By this procedure very little callus forms, the inserted bud is held firmly in place, and a neat clean union takes place.

### SPECIAL TREATMENT AND AFTER-CARE

We could find no references or authority to substantiate our belief that the cut surfaces of the scion or stock (of eucalyptus) when exposed to light and air — even briefly — either dry out or form a substance that is incompatible with the formation of a good graft union. Several techniques were tried to overcome this problem. The most successful was the use of boiled distilled water to coat all cut surfaces as soon as possible. Results show that grafts and buds so treated were more successful than those not treated.

Thulin and Faulds (16) in New Zealand indicated that the eucalyptus were very susceptible to bruising. When it was found that the normal wrapping with thin plastic or rubber tape was causing injury a switch was made to masking tape. This 3/4" tape was not wrapped around but just pinched around and stuck to itself. This provided the necessary tension to hold scion and stock together yet allowed a freedom for growth which is most essential (5, 16)

This spring we girdled the stock under some of the grafts and buds. This was done with a razor blade and the cut was just through the phloem. No damage occurred and it appeared that the girdled grafts grew faster and made better unions than those not girdled.

For the healing period of the graft and bud unions, a small plastic sleeve-provided some shade, 100% humidity, and nearly sterile conditions. The balance of the plant was left in full sunlight and allowed to grow under normal conditions (7, 8, 10, 15). Through the clear plastic it was possible to observe any activity of the buds. As growth appeared the plastic sleeve was ruptured allowing an equalization of the humidity, and when the plant had adjusted, the entire sleeve was removed. No wax or other protectant was used.

As new growth pushed out, the rootstock was bent over, broken over, and gradually reduced. The top of the rootstock was never fully removed until the scion had produced fully mature leaves. Stubbing back usually resulted in death of the stock.

Grafted plants kept in the plastic house with minimum temperatures of 65°F during the winter set blossoms regardless of size. Plants left outside under normal conditions remained in a vegetative growth until warm weather in late spring, when they also set blossom buds.

### SUMMARY

1. It appears that cleanliness of stock and scion is of greater importance than at first realized.
2. The use of an antidessicant on the scion is advantageous.
3. Keeping air from all cut surfaces is desirable.
4. Girdling may be beneficial to grafts and buds.
5. The plastic sleeve over the grafted area appears to have merit over enclosing the entire plant in plastic. The use of grafting waxes or other sealants proved detrimental to the graft
- 6 The use of masking tape provided adequate tension and protection without damaging the grafts.
7. The use of the flame from a torch proved to be the easiest and most thorough means of eradicating root curl on the smaller sized pots.
- 8 Although not mentioned in the report, the author using the same techniques mentioned above was able to graft *Eucalyptus sideroxylon* and *E. citriodora* on seedling *E. calophylla* although only six plants each were grafted, two of each are still growing well at the end of seven months.

### PROBLEMS

Based on the author's experience, observations, reading and correspondence in the field, the important problems to be solved are.

1. Compatibility
2. Dormancy of buds and scions
3. A fungus growth that seems to attack the grafted plants.
4. Selection of the most suitable rootstock.

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