SUMMARY

We saw a diversity of agriculture, much of it unlike our own.

We could see value of collectivizing land or increasing size of farms in regard to management and mechanization.

We could see advantage of managed economy where everyone has a job.

We could see effects of lack of freedom — lack of incentive, absentee planning, inefficient use of farm implements.

Not one of us would have traded our agriculture for the best of theirs.

CUTTING PROPAGATION OF *EUCALYPTUS FICIFOLIA* USING CYTOKININ-INDUCED BASAL TRUNK SHOOTS

ROBERT L. MAZALEWSKI and WESLEY P. HACKETT

Department of Environmental Horticulture
University of California
Davis, California 95616

Abstract. The cytokinins, PBA and BA were the most effective treatments tested in inducing buds to break in the lignotuber as well as the upper trunk region of *Eucalyptus ficifolia*. BA at a concentration of 0.8% in water-ethanol (1:1) caused an average of 229 bud breaks per tree. Stem cuttings taken from the PBA-induced shoots exhibited a greater propensity to the root when taken from the area of the lignotuber than when taken from higher on the trunk. Furthermore, cuttings from basal parts of shoots, originating from the lignotuber, rooted better than cuttings taken from the apical portion of these shoots.

REVIEW OF LITERATURE

It is well-known that some species of eucalyptus can be easily propagated by using stem cuttings of shoots arising from lignotubers, whereas cuttings from the periphery of the tree are unrootable (7,10). Chattaway (3) described a lignotuber as a woody swelling in the stem of the eucalypt which contains an abundance of buds with contorted xylem elements. The lignotuber develops in the axils of the cotyledons and in the immediate successive nodes of most of the eucalypts. Carrodus (2) concluded that the primary importance of the lignotuber is the enormous number of buds held in a protected position which have the ability to produce new growth following damage to the tree.

The buds held in the lignotuber are believed to be adventitious in nature; that is, they do not initiate from the apical meristem or axillary buds. The buds of the lignotuber have been observed to develop upon the extension of vascular cambium which extends into the swelling of the developing lignotuber (3).

There is clear evidence that the ontogenetic age of the cutting wood is the most critical factor for rooting *Eucalyptus* stem cuttings. It has been shown that stem cuttings taken from young seedlings produce normal roots (1,4,7,8,9). Paton and Willing (9) showed in *E. grandis* that the ability of a stem cutting taken from a seedling to strike roots declined with increasing node number above the 4th node and ceased completely above the 15th node. The ontogenetic aging of *E. grandis* was correlated with an increased level of rooting inhibitors in leaves and stems. These inhibitors were absent in the leaves of easily-rooted stems and present only in adult tissues which rarely form roots in stem cuttings.

The results cited above suggest that cutting material with a high rooting potential could be produced by inducing bud break from the lignotuber and latent buds on the lower trunk of the tree. Derman (5) produced hemispherical intrusions (sphaeroblasts) in the internodal regions of the trunk by completely disbudding headed *Malus* plants. Adventitious buds appeared from the sphaeroblast which developed into shoots. Sachs and Thimann (4), found that kinetin applied directly to the lateral buds of *Pisum* seedlings released the lateral buds from the inhibition of the growing apex. These buds failed to elongate fully as compared to the decapitated apical control. However, an auxin treatment applied locally to the bud would cause normal elongation. Williams (12) working with *Malus* found that cytokinins applied to the axillary buds of apple shoots overcame apical dominance. Axillary buds on actively growing shoots produced spurs and laterals when treated with cytokinins, especially N-benzyl-α-(tetrahydro-2H-pyran-2yl) adenine (PBA).

Other chemicals have been used to induce growth of buds which have had insufficient low temperature chilling for growth. The cytokinin, PBA, was found to stimulate bud break in dormant peaches only when the low temperature chilling requirement had nearly been fulfilled. Erez (6) found in peach, that applications of potassium nitrate and kinetin advanced flower bud formation and thiourea hastened leaf bud opening only when applied towards the end of the growing season.

MATERIALS AND METHODS

In order to investigate the possibility that shoots originating from the base of the trunk would yield cuttings that had a higher rooting potential, it was necessary to induce bud break from latent buds. Preliminary evidence indicated pruning alone was not a successful method of inducing bud break. Therefore, other methods were investigated.

Induction of Bud Break. Commercially-grown trees approximately three years of age were used in this experiment. The tree which were growing in 17 liter cans, were approximately 2 meters tall when the experiment began. The lower region of the trunk was essentially free of any lateral shoots, especially near the lignotuber. All trees were grown in a greenhouse which was maintained at a day temperature of 80°F (27°C) and a night minimum of 70°F (21°C). The trees were watered with a half-strength Hoagland solution when required.

The experimental design was a complete random design consisting of seven treatments and utilized three trees per treatment. All chemical treatments were applied from the soil level to approximately 30 cm above. Potassium nitrate and thiourea were applied as a 1.0% aqueous solution with Tween 20 R added as a surfactant. Applications were made every three days with a hand atomizer saturating the trunk to the point of run-off. The cytokinin, PBA, was used at concentrations of 0.1% and 0.01% in a paste mixture consisting of PBA and lanolin (1:1, v/v). A thin layer of paste was applied to each trunk by hand once at the beginning of the experiment.

The two mechanical methods utilized to induce bud break consisted of girdling the trunk and the continual disbudding of axillary buds and shoots. Girdling was done by removing a 6 mm wide strip of bark and phloem approximately 30 cm above the surface of the soil. Disbudding of axillary buds continued throughout the course of the experiment; buds were removed whenever any portion of the bud expanded from the axils of the stem and petiole.

In a second experiment the cytokinin benzyl-aminopurine (BA) was used to induce bud break. In this case the cytokinin was applied at 3 concentrations in water-ethanol (1:1) solution using 2 trees per treatment. The lignotuber surface was painted with cytokinin solution twice weekly for 4 weeks. Bud break was determined 1 and 2 weeks after cessation of treatment.

Rooting of Shoots from the Basal Bud Breaks. Basal shoots were removed from two areas of the trunk; the treated area of the lignotuber and the area above the lignotuber. Shoots from the two areas were subdivided in a way to produce apical and basal cuttings, basal cuttings being the section of the stem extending from the trunk of the tree toward the shoot apex for two nodes. The apical cuttings were the section of the stem from the shoot apex towards the base of the shoot for a distance of four leaves. All leaves of the cuttings were left intact. All cuttings were treated with a 5000 ppm solution of IBA as a quick dip, stuck in vermiculite-perlite mixture (1:1 v/v) and placed under an intermittent mist system.

RESULTS

Bud Break. Fifteen days following the initiation of treatment (October 3), it was evident that applications of PBA at the two concentrations were inducing a great deal of bud activity in comparison to other treatments. Plants treated with thiourea and potassium nitrate show no bud break while girdling and disbudding exhibited only slight activity (Figure 1).

Four months following the initiation of the experiment, the two treatments using PBA continued to develop buds. Shoots from the treatment with 0.01% PBA elongated more than the ones from the 0.1% PBA treatment. A common occurrence with both PBA treatments but more frequently with the higher concentration was the gradual decline in the number of surviving shoots. It appeared as if the concentrations used were causing toxic symptoms in the shoots, followed by death in some instances.

In a second bud-break experiment (Table 1) it was found that BA in a water-ethanol solution was as effective or more effective than PBA in a lanolin paste and caused no phytotoxic symptoms. At a concentration 0.8% BA, an average of 229 bud breaks per tree were produced 2 weeks after cessation of treatment.

Propagation of Basal Trunk Shoots. As reported in the literature, stem cuttings taken from shoots of the lignotuber showed considerable ability to form roots. Although the difference was not significant (at the 5% level), it appeared that the basal cuttings taken from the lignotuber had a greater propensity to initiate roots than those from the apical portion of the same shoot (Table 2). In fact, shoots from the lignotuber rooted similar to stem cuttings taken from very young seedlings.

Table 1. Influence of benzylaminopurine (BA) treatment on bud break from lignotubers 1 and 2 weeks after cessation of treatment.

Treatment	Mean Bud Break Per Tree	
	1 Week	2 Weeks
Control	0	3
0.01% BA	0	13
0.1% BA	0	33
0.8% BA	20	229

In another experiment cuttings taken from shoots initiated above the lignotuber failed to root with the propensity of the cuttings taken from the lignotuber. Neither apical nor basal cut-

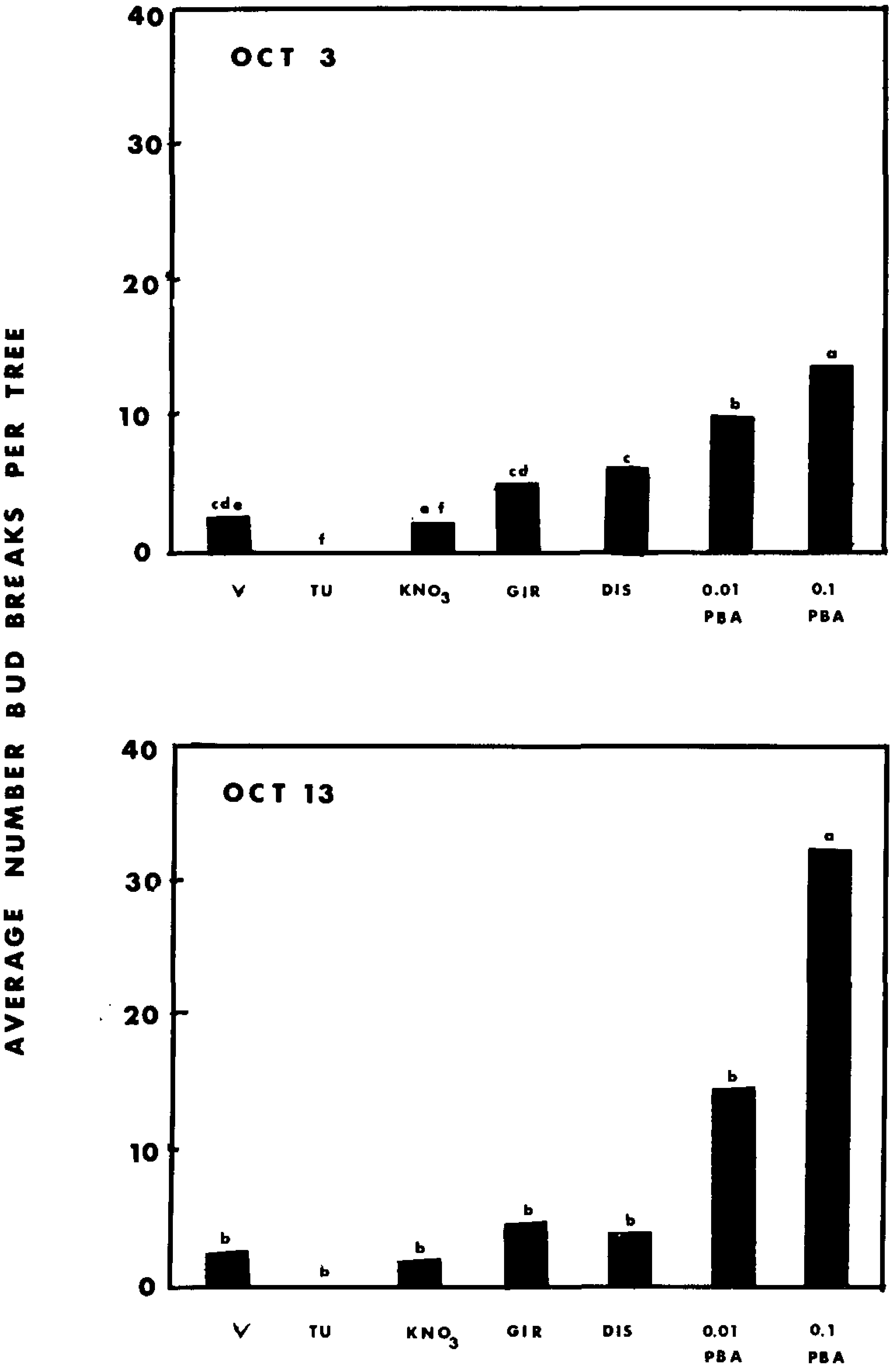

Figure 1. Average number of bud breaks per tree. Above. 15 days following initiation of treatments. Below. 30 days following initiation of treatments. (TU: thiourea; Gir: girdling; Dis: disbudded; V:control) Duncan's new multiple range test, 5% level.

tings from such shoots rooted with any notable success (Table 3).

Table 2. Rooting of cuttings taken from shoots from the area of the lignotuber, following treatment with IBA.

	% Rooting	% Anomalous Roots[1]	% Mortality
Apical Cuttings	20	73	0
Basal Cuttings	70	20	0

[1] Anomalous roots was the name given to protruberances of tissues from the basal cut of the stem cutting which were thought to be callus, but root-like in appearance (8).

Table 3. Rooting of cuttings taken from shoots from the area above the lignotuber following treatment with IBA.

	% Rooting	% Anomalous Roots	% Mortality
Apical Cuttings	6	0	94
Basal Cuttings	0	7	75

DISCUSSION

Bud Break. The cytokinin treatments elicited the quickest and the greatest amount of bud break following application. It appeared that the treatments of PBA in lanolin paste were slightly toxic to the emerging shoots as evidenced by the frequent death of the shoots. Whether the cytokinins, PBA, or the lanolin paste is the toxic element remains unanswered. Concentrations as high as 0.1% PBA in lanolin showed no toxicity symptoms on *Malus* sp. when tested by Williams (12), and 0.8% BA in water-ethanol solution was not toxic in our experiment. Since the activity of different cytokinins varies, further work involving other kinds and concentrations of cytokinins should be implemented. The water-ethanol method of application is a much better and more convenient method of application than the lanolin paste method.

PBA and BA induced bud break from latent buds in the stem as well as from buds in the lignotuber. Shoots from above the lignotuber arose from latent buds rather than from adventitious buds. The greatest profusion of bud release was from the area of the lignotuber; this agrees with the hypothesis that the primary function of the lignotuber is an organ which holds a large number of buds in a protected position.

As reported previously, both potassium nitrate and thiourea are useful primarily to break buds from dormancy (6). The use of these chemicals was probably unsuccessful due to the fact that the genus *Eucalyptus* are evergreen trees without a dormant state. This study supports the theory that potassium nitrate and thiourea act as dormancy breaking substances and do not interfere with apical dominance as do the cytokinins.

Propagation of Shoots. From the results of the propagation of basal shoots induced by PBA, two conclusions can be drawn. First, the shoots, and subsequently cuttings taken from the lignotuber, behave differently from shoots taken above the lignotuber. Shoots taken from the lignotuber were more rootable and possibly more "juvenile" than shoots taken from the latent buds on the stem of the tree. It appeared that buds held in the lignotuber were juvenile in nature and had not undergone the ontogenetic development of the latent auxillary buds found in the adjacent stem.

Secondly, the shoots of the lignotuber behave very much like young seedlings. Work by Mazalewski (8) has shown that the initial node above the cotyledon retains the propensity to root, and cuttings taken from sections of the stem above the cotyledon tend to lose the propensity to root. Similar results were obtained with cuttings taken from the lignotuber. Stem cuttings taken from the lignotuber shoots rooted easily when taken from internodes close to the lignotuber, behaving much like the epicotyl of a young seedling. Above this basal cutting, the potential to root decreased.

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TOPWORKING ESTABLISHED VINIFERA GRAPEVINES

C.J. ALLEY

Department of Viticulture and Enology
University of California
Davis, California 95616

In California there are approximately 645,000 acres of *Vitis vinifera* grapevines. Of these, 325,000 acres are wine cultivars, 85,000 table cultivars and 235,000 raisin cultivars. The trend in the wine industry has been for an increased demand for white table wines because more people are beginning to consume these with their meals. Table wines are considered to supplement food with the meals.

Most persons beginning to drink wine will choose a sweet to slightly sweet white table wine because it more clearly resembles non-alcoholic beverages to which they are accustomed. Red table wines are more harsh than white wines and the dessert wines, which are higher in alcoholic content, are more difficult to drink. Because of the increased demand for white table wines a shortage in this type of wine is now present along with somewhat of a surplus of many common red wines. Consequently there is a higher premium paid for fruit of the white table wine cultivars than for the reds. In some of the newer grape areas in California, such as Monterey County, temperature data was not accurate when the vines were planted; as a result some wrong cultivars were planted there. Some of these are now being changed over to the more suitable white ones.

Some vineyard managers having red fruited cultivars in their planting are desirous to convert over to whites. In the past the quickest way to accomplish this had been to graft over the vines in the spring at ground level to the desirable white table wine cultivar using the cleft graft (9). This type of grafting requires considerable skill and high percentages of successful takes have been rare. If the grower was to remove the entire vineyard and replant, the expense would be much greater than that of grafting, plus the loss of 3 to 5 years of crops.

Wedge or saw kerf grafting was another method used to change cultivars (2). These methods enabled the grower to change only the head of the vine and save the established trunk. These methods, too, require considerable skill as well as