butyric acid) and are placed into the propagation medium at the rate of 300 cuttings per flat. The flats of cuttings are then put into one of the outdoor rooting beds with intermittent mist. The rooting beds are made of concrete and supply bottom heat of about 72°F to the cutting flats through the use of copper tubing inside of the concrete which circulates hot water supplied by our boilers.

The *Metasequoia* cuttings will root in about four months at 90%. After rooting is complete, the cuttings are hardened-off and potted about two weeks later. The new plants root into the pot quickly and aready to sell in pots or be canned into larger containers 5½ months from the date that the cuttings were collected.

Our current propagation technique works well into our current set-up for the propagation of our conifers at Monrovia Nursery Company during the winter months. However, softwood cuttings root readily during the early summer months with the use of IBA rooting hormone.

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CUTTING PROPAGATION OF *ACTINIDIA CHINENSIS* (KIWIFRUIT)

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Kiwifruit is a relatively new product on our supermarket shelves, but kiwifruit plants have been around for centuries. Once again, we must go back to China where the kiwifruit, or Chinese gooseberry (*Actinidia chinensis*), is native. In the early 1900's, *Actinidia* was introduced into New Zealand. Eventually, it found its way to California where the production of major quantities did not get a foothold until the early 1970's. Presently, several thousand tons of kiwifruit are produced each year in California.

Kiwifruit is about the size of an egg and gets its name from the kiwi bird of New Zealand whose body resembles the shape of the fruit. The fruit weighs about four ounces and has a high vitamin C content. It is best eaten raw, and its use with other foods is becoming more popular.

Actinidia chinensis is a deciduous vine that is dioecious (that is, a plant produces either all male or all female flowers). To obtain fruit development, male vines are needed to pollinate the female vines. The leaves are quite large and roundish in appearance.

The most common of the female cultivars in production are 'Abbott', 'Allison', 'Bruno', and 'Chico Hayward'. The most common of the male cultivars are 'Tomuri', 'California Male', and 'Matua'.

The Monrovia Nursery Company has been growing 'Chico Hayward' since about 1975. The most common form of propagation initially was grafting or budding, but this did not give us very good percentages. Cuttings did a little better, but needed much improvement. With the existing demand for plants, we continued experimenting with *Actinidia* to improve cutting propagation.

Another problem we ran into was the chilling requirement that the 'Chico Hayward' cultivar seems to need. In Southern California, the stock plants planted out at Monrovia Nursery are sometimes not ready to collect cuttings from until late June or early July. By the time they root and are potted, fall is already upon us and the root systems are not developed well enough to get them through the winter months and, in addition, many do not break dormancy either because of the chilling requirement or because of poor root systems. Also, the 'California Male' has been more difficult to root than the female cultivar.

With all of these problems, we set out to root the plant well and grow it on into a quality item which is the Monrovia Nursery tradition. The following is an update on the cutting propagation procedure for *Actinidia* 'Chico Hayward' at Monrovia Nursery, beginning with a discussion of the female cultivar.

We started out using single node cuttings, washing with chlorine water (15 ppm chlorine) followed by a wash in Consan disinfectant (200 ppm Consan). The large leaves were cut in half. The base of the cuttings received a quick dip in 3000 ppm IBA (indole-3-butyric acid). The cuttings were then put 120 to a plastic flat containing a propagation medium (90% coarse perlite and 10% peat moss), which had been pasteurized before use. The flats of cuttings were then put into heated

greenhouses under intermittent mist where the rooting took two to three months. The rooting was poor (under 35%), and the root systems that did develop were poor.

We then tried using higher concentrations of IBA at 6000 ppm and 8000 ppm, but with no major improvements. Finally, we decided that other types of hormones and/or combinations of hormones should be tried. NAA (naphthaleneacetic acid) was tried next at 1000 ppm and rooting improved to 70%. This was a major breakthrough for us, but again the roots that did form were not well developed. Since we felt that NAA was perhaps the right hormone to work with, we set up more experiments using NAA and IBA combinations, as well as with DMSO (dimethyl sulfoxide), as a carrier. We also kept records of the appearance of the root systems as the rooted cuttings were pulled; 400 cuttings each were tried with four different hormone concentrations, with 1000 ppm NAA being used as the control. The same cutting type, heated greenhouse, and propagation medium were used as previously described. The results are presented in Table 1.

The rooting time was about the same (two to three months), but the number rooted increased with the 3000 ppm IBA + 3000 ppm NAA treatment and the 3000 ppm IBA + DMSO treatment. Root proliferation had greatly improved with the 3000 ppm IBA + 3000 ppm NAA treatment, but was less with the 3000 ppm IBA + DMSO treatment. Therefore, after again repeating the experiment, we decided to use the 3000 ppm IBA + 3000 ppm NAA treatment as our standard treatment for *Actinidia chinensis* 'Chico Hayward'.

However, our problems were still not over, as the dormancy requirement was still to be contended with. We conducted a cold storage experiment on bare-rooted *Actinidia* cuttings to encourage bud break in the spring. We found that 500 hours of cold storage (three weeks) at 39°F gave us 51% of the plants on which the buds broke after they were potted, versus only 35% of the control (which were rooted cuttings stored outside in their propagation flats through the winter). We then decided to cold store bare-rooted *Actinidia* cuttings before spring potting.[1]

Table 1. Effects of selected hormone treatments on the rooting of *Actinidia chinensis* 'Chico Hayward'.

Hormone	Percent rooted
1000 ppm NAA	72.5%
1000 ppm IBA + 1000 ppm NAA	53.5
3000 ppm IBA + 3000 ppm NAA	72.2
3000 ppm IBA + DMSO	73.5
6000 ppm IBA + DMSO	58.5

[1] Ed. Note. Hayward kiwifruit plants require about 700 hrs. of chilling below 45°F.

The 'California Male' *Actinidia* was a slightly different story. The male *Actinidia* rooted best for us with the use of IBA + NAA combinations and IBA + DMSO as well. We also got better root systems as on the female cultivar. However, the overall rooting percentages were lower. Again, 1000 ppm NAA was used as the control, as well as the same type of cutting and conditions as used for the female cultivar's propagation. The results are presented in Table 2.

Table 2. Effects of selected hormone treatments on the rooting of *Actinidia chinensis* 'Chico Male'.

Hormone	Percent rooted
1000 ppm NAA	12.8%
3000 ppm IBA + 3000 ppm NAA	32.8
3000 ppm IBA + DMSO	37.5
6000 ppm IBA + DMSO	27.0

The cold storage experiment was also repeated, again with percentages of bud development being below that of the female cultivar; 46.5% of the potted *Actinidia* males broke dormancy after potting in early spring versus 40.1% for the control which were stored outside in their propagation flats.

For the present, we are going to utilize 3000 ppm IBA + 3000 ppm NAA as our standard hormone treatment, as well as the cold storage of rooted cuttings before potting in the spring. Please note that we did not want to use the 3000 ppm + DMSO as our standard treatment for either the female or male Actinidias, even though rooting percentages were higher. That decision was made because the root proliferation was not as great as with the 3000 ppm IBA + 3000 ppm NAA treatment, and saved us working with another chemical when mixing hormones.

We have also had success rooting hardwood cuttings, but will try this again next year to verify our first year's results. So far, it looks feasible.

Monrovia Nursery is also working with other *Actinidia* cultivars that may do better in Southern California as far as chilling requirements, fruit production, and propagation are concerned. Female cultivars which we are investigating are 'Vincent' and 'Bruno'. The 'Vincent' *Actinidia* is a 'Hayward' seedling developed in Southern California by Ray Vincent of the California Rare Fruit Growers. So far, propagation indicates that these two females are easier to root and grow on than 'Chico Hayward'.

Other male cultivars of *Actinidia* are 'Tomuri' and 'Matua'. We are currently propagating these, but it will be a while before we know how they perform. There is even a monoecious cultivar being tried called 'Blake'.

It seems that we are finally on the right track with the cutting propagation of *Actinidia*, and hopefully our future production will no longer be a problem.

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MAILE SEED GERMINATION AS AFFECTED BY PREPLANT SOAKING IN WATER WITH AND WITHOUT AERATION AND BOTTOM HEAT

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Abstract. Removal of fleshy seed pulp accelerated germination of maile (*Alyxia olivaeformis*). Trendwise, presoaking in aerated water was the most effective treatment. Non-heated medium produced highest germination whereas 31°C severely inhibited germination.

REVIEW OF LITERATURE

Maile (*Alyxia olivaeformis*), a valuable foliage plant for making leis in the Hawaiian Islands, is propagated primarily by seeds. Tanabe (5) demonstrated that preconditioning with growth regulators increased the germination rate and percentage of depulped maile seeds. A 48 hr soak in 1000 ppm gibberellic acid (GA) resulted in 97% germination after 13 weeks. The control had only 3% germination for that same period. Although presoaking with growth regulators proved effective, these compounds are not readily available. GA is also expensive and requires a centigram weighing balance to weigh the small amounts of material required.

It has been documented that soaking seeds in water increases germination rate for several plant species (1,2). Kidd and West (3) found that germination rate could be increased for pea, dwarf bean, barley, and sunflower without injury. Chippendale (1) worked with cocksfood (*Dactylis glomerata* L.) and speculated that soaking seed increased water uptake through the palea, thereby accelerating germination.