operation.

Growing in Four-Inch Pots: 'Compacta' cuttings break dormancy and leaf out in mid-April, after spending as long as 7 months in cutting flats. The other mahonia cultivars, because of their shorter dormancies, can be stuck later and potted earlier. We dig the cuttings, prune the roots, and put the plants into 4-inch pots as soon as they begin to leaf out. Our potting mix is primarily coarse fir bark (⅛" to ¼"), with some lava rock, and fertilizers added. Mahonia roots require good drainage, and finer grades of bark tend to decompose more rapidly and lose their porosity. Blending a good micronutrient formula (such as Micromax) into this coarse soil mix has given us excellent results this year.

We grow the 4-inch pots in lathhouses under 30% shade, with an overhead watering system. We begin fertilizing by the hand watering method as the plants are potted, and continue this weekly throughout the growing season. Fertilizer is injected into our water system through a 1:200 proportioner. We used to fertilize through our overhead system, but found that the savings in fertilizer through hand watering was greater than the added labor cost. Also, the plants respond much better to this method.

Undersized rooted cuttings are "restuck" back into the propagation flats, moved into the lathhouse, and watered and fertilized the same as 4-inch pots until they are ready to be potted.

CALIFORNIA NATIVE PLANT PROPAGATION

PEGGY S. McLAUGHLIN

Department of Ornamental Horticulture
California State Polytechnic University, Pomona
Pomona, California 91768

Several years ago, the western part of the U.S. experienced a drought of serious magnitude, and of a severity and duration not uncommon in our natural history. Even as the rains returned to normal, we continued to remind ourselves that a drought can and will occur again. One of the most severely affected portions of our lifestyle was our landscape — lawns died and were replaced by drought resistant groundcovers or dry rockscapes. Water loving plant materials were difficult to sell to the homeowner. And one horticultural trend gained momentum — the use of California native plants in the landscape.

We felt we were very clever, using these inhabitants of our state that were already adapted to low water availability. Yet

many gardens in the West planted 20, 30 and even 50 years ago reveal examples of these natives in well established situations. Even more surprising — Kew Gardens in England has some of the finest examples of California native plants being grown in a man-made landscape. These were collected beginning several hundred years ago when European botanists explored our terrain. Clearly, we were not the first to recognize the potential of these active specimens. Now that the threat of drought is not imminent, although the reality of skyrocketing water costs are every-present, what has become of our interest in California natives?

Few articles in popular gardening magazines expound the virtues of natives. Nursery advertisements rarely feature them. Landscapers are not frequently planting them. In fact, an informal survey of retail nurseries in Southern California revealed that although there continue to be inquiries about native plants, few nurseries carry them. When they do it is the common selection — coyote bush, carmel creeper, and Oregon grape. Several nurseries responded that they had always carried natives — oleander, eucalyptus and rosemary! As these are non-native, albeit common, plants found in California, our definition of a "native" plant is either misinterpreted or is incorrectly applied by some individuals.

What appears to be the real problem, however, is the "chicken and the egg syndrome" we see regarding supply and demand: retail nurseries, landscapers and the public are not always aware of the existence of native plants, much less knowledgeable about their culture. They rarely request them of the wholesaler. The wholesaler, therefore, grows few natives. When there are requests, often for large quantities for landscape contracts, not enough of the plants are available. Disillusionment occurs and requests may dwindle. So we are caught in the dilemma of erratic demand and uneven supply. Hardly a condition to bolster a successful trend! There are, however, continual attempts by many nurseries to produce quality native plants. It can be an extremely frustrating adventure.

Seed propagation of native plants can be very successful. Certain species, such as oaks (*Quercus*), and pines (*Pinus*) grow readily from seed and are sturdy container plants. Others, however, such as certain manzanitas (*Arctostaphylos*), *Ceanothus*, and bush poppies (*Dendromecon*) have evolved elaborate dormancy requirements that must be discovered and broken. These dormancies, while protecting the plant populations from fire, drought, and flood, do make the plants very difficult to grow commercially. In other cases, viability can be low. Germination is spotty and resulting plants may be weak and spindly and not at all uniform.

Cutting propagation can solve some of these problems in that difficult germination can be bypassed. Of course, the many new cultivars of *Ceanothus* and *Arctostaphylos* require vegetative propagation to retain their ornamental characteristics. Uniform stands of vigorous rooted cuttings reward the careful propagator. But there are considerations that must be addressed in order to be successful.

Many propagators report that root formation is sometimes very slow for crops such as *Arctostaphylos*, Pacific wax myrtle (*Myrica californica*), mahonia (*Mahonia*) and toyon (*Heteromeles arbutifolia*). Naturally, the longer cuttings remain in the propagation environment, the greater the incidence of disease. Decay problems are quite common and can spread rapidly through the flats of nonvigorous cuttings. Adding to the problem of slow rooting is the fact that many cuttings defoliate under prolonged mist. When rooting finally does occur, a weakened cutting, with no leaf surface, may not be able to survive in the liner stage.

What factors cause the slow rooting problem that enhances the onset of disease? One answer may be the critical timing necessary for the collection of cutting material. It seems that the time of year and the age of wood used are of great significance when propagating native plants. The most desirable months are October through April, which approximates the growing season of natives. Generally softwood cuttings are the most successful. However, each cultivar must have its own peculiar requirements for optimum cutting success. Add to this difficulty the fact that cutting material is often not readily available and it is clear that success with cutting propagation requires planning and patience.

Once successful propagules are obtained from either seed or cutting, there are some difficulties encountered in growing on the containers to saleable size. Natives in cans are as sensitive to overwatering as they are in the landscape. Root decay organisms can strike quickly. Container soils must be fast draining, yet provide a moisture reservoir for the delicate roots which may be few in number. Water quality can be a factor; salt burn shows up readily on native foliage. Air pollution damage is a problem particularly on pines, currants (*Ribes*) and some oaks.

But the strong interest in native plants has led to more experimentation in propagation. Some of the difficulties I have outlined have been at least partially overcome. The difficulties of seed dormancy can be solved by scarification of the seed coat with hot water or acid (*Fremontodendron, Arctostaphylos,* and *Ribes*). High temperature dormancies insure that seeds will germinate after a fire. To overcome this, *Dendromecon* seeds are planted in the flat and straw or pine needles are burned on top to raise soil temperature to the required level.

To enhance cutting success, bottom heat is found to increase rooting percentage, and mist in less frequent intervals than those for softer crops reduces decay problems. The use of rooting hormones in various combinations and at different concentrations requires more detailed research.

One ingenious experiment involved *Fremontodendron*, a fabulous flowering specimen that is extremely susceptible to phytophthora root decay in the landscape. To attempt a solution, *Fremontodendron* was grafted on a close relative, a *Sterculia*, to provide a more tolerant rootstock. The grafts took initially but did not survive more than two years. Hopefully future attempts will be more successful.

Even the art of tissue culture has been utilized. Certain difficult to grow native irises have been cultured to provide a more prolific propagation process.

Even with the difficulties encountered in native plant propagation, there are many successes we can observe:

— many new cultivars of *Arctostaphylos* and *Ceanothus* that are well suited to the smaller landscape can be propagated by cuttings.

— oaks and pines come easily from seed.

— native irises, coral bells (*Heuchera*) from division.

— cottonwoods (*Populus fremonti*) from seed and cutting.

— toyon (*Heteromeles arbutifolia*) from seed.

— Coyote bush (*Baccharis*) from cuttings.

— California fan palm (*Washingtonia filifera*) from seed.

— Buckwheats (*Eriogonum* spp.) hydroseeded on slopes.

— A multitude of wildflowers from seed.

There are those who may still wonder at the necessity of dealing with these plants that may not initially be economically advantageous. It seems that these plants, so well adapted to our rather harsh environments, and particularly to our long, hot, dry season, are worth the effort. They have beautiful flowering and fruiting characteristics and offer us a historical and cultural tie with our region.

They can solve many difficult landscape problems where plants are required that are low maintenance and low on water use. Revegetation of areas disturbed by highway or utility construction can be returned to near normal with natives. Fire scarred slopes can be held together with fast growing herbaceous material.

But most of all, we as horticulturists are always interested in enlarging our plant selection and in finding new and more excit-

ing members of the plant world. California natives represent a rather untapped resource for us to explore.

The outlook for the future? Hopefully the nurseries growing a few natives at the present will have greater success in the future and will add to their list. Certainly research being undertaken by institutions such as the Saratoga Horticulture Foundation, the Santa Barbara Bontanic Garden and Rancho Santa Ana Botanic Garden, as well as our colleges and universities, will help us to solve the cultural problems we face. If these plants are to be a viable part of the nursery industry, it will take a commitment on the part of those of us in the industry. I hope that you will agree that California native plants are worth the effort.

CARBONATED MIST AND HIGH INTENSITY SUPPLEMENTARY LIGHTING FOR PROPAGATION OF SELECTED WOODY ORNAMENTALS

W. C. LIN AND J. M. MOLNAR

Saanichton Research Station, Agriculture Canada
8801 East Saanich Road, Sidney, B.C. Canada V8L 1H3

Abstract. Injection of CO_2 to the mist water (CO_2 mist) promoted rooting of *Magnolia soulangiana*, *Magnolia sieboldii*, *Juniperus sabina*, and *Rhododendron* 'Anah Kruschke' Daily high intensity lighting with high pressure sodium (HPS) lamps for 16 hours promoted rooting of *Magnolia soulangiana* and *Rhododendron* 'Anah Kruschke' and inhibited rooting of *Juniperus sabina*, *Juniperus squamata* and *Rhododendron* 'May Day' These results are discussed in terms of photosynthesis, CO_2, light and water

REVIEW OF LITERATURE

Plant propagation involves a great number of plants in a small production area where use of controlled environment appears to be logical. Enrichment with CO_2 and/or high intensity lighting at the time of seeding plants has accelerated the growth of herbaceous and woody seedlings (2, 9, 10, 11, 19). Modification of environments for propagating cuttings has not been studied extensively.

Many plant species or cultivars (genotypes) are difficult or almost impossible to propagate by cuttings. Previous work (14) demonstrated that rooting was improved by CO_2 enrichment of the atmosphere or of the mist (CO_2 mist). A recent report (3) described the benefits of using high intensity lighting with herbaceous cuttings, but the effects of such lighting on woody cuttings has not been widely studied (1).

Experiments were initiated to investigate the effects of CO_2 mist and high intensity supplementary lighting on rooting of