

sporophytes are transplanted as single plants to another prepared flat while the second leaf is still developing. The transfer is made at this young stage to avoid the root intertwining that is characteristic of older sporophytes that have grown closely together. There is reduced root tearing when intertwining is minimized. Plastic tweezers are used for the delicate separation and placement into flats and care is always taken to keep the fern crown above the soil level. As sporophytes become large enough, they are finally potted into liner containers, again keeping the crown above soil.

While our transplanted ferns are vigorous plants seemingly tolerant of fungi, algae and mosses, inoculum are ever present and cause serious problems if left unchecked. Spacing for adequate air circulation, proper irrigation using water free of inoculum and transferring only clean plants to transplant flats reduces or prevents some of these problems. Removal of diseased and infested areas is done by hand. Problems that are present in petri dishes are easily eliminated by throwing away contaminated plates. We are quite inexperienced when it comes to chemical control, but have found that tender young gametophytes and sporophytes are easily burned by particular chemicals in combination with our greenhouse temperatures and humidity.

Germinating spore and growing gametophytes on nutrient-agar solution has improved our fern propagating procedure. The transplanted gametophytes are vigorous plants having grown in a medium free of contaminants, uncrowded, and well supplied with nutrients. We rely on the vigor of these transplanted gametophytes along with cleanliness and proper cultural care to provide and maintain the sporophytes required for our canning production.

LITERATURE CITED

- 1 Tjosvold, Steven 1978 Uniform fern spore dispersal on warm nutrient agar solution University of California Nursery and Flower Report Summer, 1978 p 7

MAHONIA PLANT CONDITIONING AND PROPAGATION

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Of the four mahonia cultivars we grow, *Mahonia aquifolium* 'Compacta' is the most popular — and also the most difficult to propagate from cuttings. This paper deals mainly with 'Com-

pacta', but the same principles apply as well to our other cultivars: *M. a.* 'John Muir', *M. a.* 'Golden Abundance', and *M. pinnata* 'Ken Hartman.'

Stock Field Management: All of our mahonia stock plants are field grown in the full sun, in an acid loam, soil. The climate of the northern California coast, with foggy summers and mild rainy winters, favors the growth of our cutting wood. In other climates, stock plants might benefit from shading. We take 'Compacta' cuttings from a ½ acre stock field which is over 15 years old. Because 'Compacta' is a slow-growing cultivar, reaching only about two feet in height, we find it especially important to maintain a stock field to produce enough cuttings.

I prune the stock fields hard during their winter dormancy, in order to keep the plants in a "juvenile" state, and to produce more uniform cuttings. Juvenile wood seems to root more readily than older wood, and produces less flowers which may inhibit rooting. The best cuttings are taken from wood that is two years old.

Although weeds and insects can be a problem in the stock fields, I avoid using herbicides or systemic insecticides which might remain in the plant tissues and inhibit rooting. This year, we are having some success with cultivating, mowing, and mulching for weed control. The stock fields are fertilized monthly (following the advice of an annual soil test) and watered overhead weekly during the growing season. Plants which are well nourished produce the best cuttings.

Rooting Factors: We begin taking mahonia cuttings in the fall as soon as the wood has hardened-off. We begin 'Compacta' in September, 'John Muir' and 'Golden Abundance' in mid-October, and 'Ken Hartman' in November. These dates are relative to our Pacific Coast climate; the condition of the wood should determine when to take cuttings in other areas.

All of these cuttings except 'Ken Hartman' require a "heel" — the woody annual growth scar — at their base, from which the roots emerge. At least three compound leaves are required on each cutting, preferably in the form of a tip, for even root formation. If only one compound leaf is left on the cutting, roots will tend to emerge in a longitudinal row beneath that leaf, even if the cutting is six inches long. The length and caliper of each cutting may vary, but a heel and sufficient leaves are always included. Larger cuttings tend to produce more vigorous plants.

'Compacta' cuttings require a well-aerated rooting medium, although our other mahonia cultivars can tolerate more moisture. This year, I am using a 1:10 peat/perlite medium in well-drained plastic flats which are 2½ inches deep. This mix has given better results than higher proportions of peat/perlite and various ver-

miculite/perlite mixes, which tend to retain more water. Certain grades of pumice and sand provide suitable aeration as well, but are not available in our area and would be heavier to handle. A deeper flat would provide better drainage, but we are using the shallower flats to cut costs.

We sanitize the cuttings in a 200 ppm solution of Physan 20 disinfectant, and then dip them in a Hormex #8 (.8% IBA) rooting powder. We stick the cuttings 100 to a flat, stamping each flat with a wooden pegboard template for speed and uniform spacing. The cuttings are sprayed regularly with a Captan/Benlate fungicide mixture.

Mahonia cuttings require a low-stress environment for their leafy tops. If stressed by heat, bright sunlight, wind, or dryness, the leaves may redden and drop before the cutting can produce roots. We place our cutting flats on the gravel floor of 12×96 foot quonset structures covered with 50% polypropylene shade fabric. Fiberglass panels form 3 foot high lateral wind screens. At the outset, the cuttings are misted during the day at 10 minute intervals for 10 seconds duration. The mist is later reduced or eliminated as weather permits.

I have had difficulty finding the right mist head for use in our propagating quonsets. Greenhouse mist foggers are not suitable for outdoors — the mist blows away in the slightest breeze. Plastic spinner sprinklers put out too much water and saturate the rooting medium. While visiting Hines Nurseries in Santa Ana, I discovered a mist head manufactured by Spraying Systems Co. of Wheaton, Illinois, which is ideal for my use. It is a solid brass “whirljet” extra wide spray nozzle ¼ E series, which puts out a nearly flat hollow cone of mist at least 10 feet in diameter.

‘Compacta’ cuttings do not require additional bottom heat if taken in September, while the medium naturally reaches temperatures of 15° to 18°C (60° to 65°F). The first cuttings we take will produce roots within 3 to 4 weeks. These roots will grow throughout the winter, even though the medium partially freezes. However, as the weather gets colder, new root formation on the unrooted cuttings ceases. If these late cuttings survive the winter without defoliating or becoming diseased, they will root the following spring when the weather warms up again. Our other mahonia cultivars will root in our mild winter climate (which rarely drops below freezing) without additional bottom heat.

I am constructing a hot water bottom heat system in one of our quonsets with the hope of increasing the rooting of ‘Compacta’ cuttings in the fall. I think that the lack of bottom heat is still a major limiting factor affecting ‘Compacta’ rooting, but I will not know for certain until my bottom heat system is in

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 ($\frac{1}{8}$ " to $\frac{1}{4}$ "), 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 Micro-max) 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

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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