Mediterranean Plants Under Glass at Longwood Gardens

James R. Ault
Longwood Gardens, Inc., P.O. Box 501, Kennett Square, Pennsylvania 19348

INTRODUCTION

Longwood Gardens is a display garden situated on 1060 acres in southeastern Pennsylvania. Longwood is open year-round, attracting visitors to its 200 acres of outdoor displays and 3½ acres of conservatories and greenhouses. Longwood has been incorporating Mediterranean-climate plants into its conservatory displays since the mid 1980s. This was done to maintain lower greenhouse winter temperatures because of the escalating costs of heating fuel and to increase visitation during the winter months by providing the visitors with a kaleidoscope of plants in bloom. Longwood is located in USDA Hardiness Zone 6B, characterized by an average minimum winter temperature of 0 to -5F; as such, relatively few Mediterranean-climate plants are hardy outdoors in our area.

The Mediterranean-climate regions of the world include the true Mediterranean, the California chaparral, parts of coastal Chile, western and southern Australia, and the southwestern cape of South Africa. Mediterranean climates are typified by cool, moist winters that are relatively frost-free, and hot, dry summers. Most of the plants indigenous to these regions are therefore winter-growing, blooming in the late winter to early summer months. The preponderance of the Mediterranean-climate plants utilized at Longwood are South African and Australian in origin, collected during staff trips to each country and from California nurseries and botanic gardens.

Longwood is currently displaying Mediterranean-climate plants in four conservatory spaces: the Garden Path, a 2500 ft^2 garden created in 1986 as a cottage-style display of subtropical and Mediterranean-climate plants; the Silver Garden, opened in 1989 as a 4000 ft^2 garden devoted to the display of silver and grey foliaged plants; the Mediterranean Garden, opened in 1992 as a 3200 ft^2 garden devoted to the display of true Mediterranean-climate plants, and the East Conservatory, an almost 22,000 ft^2 space that currently contains a mixture of permanent and rotating displays of Mediterranean-climate, subtropical, and non-hardy, temperate plants. The roof of this conservatory is slated for replacement in 1997 and preliminary plans include the complete redesign of the displays with probable further incorporation of Mediterranean-climate plants.

CULTIVATION

Both the display areas and research greenhouses containing our Mediterranean-climate plants are maintained in winter months from 42 to 45F by night, warming up 5 to 15F by day. Summer temperatures typically go over 90F by day, cooling off into the upper 60s to mid 70s (F) at night. While our winter solar radiation values do not approach those encountered outdoors in the true Mediterranean regions, we do receive sufficient light to grow and bloom such high-solar-radiation-requiring plants as *Banksia ericifolia*, *Protea cynaroides*, and *Xanthorrhoea quadrangulata*.

Plants are grown both in containers and also permanently planted in conservatory beds. Soil mixtures vary considerably, from conservatory beds containing unamended native soil, which is very high in clay content, to soilless media. The beds of the Mediterranean Garden are filled with a soilless medium composed of 3 haydite : 3 granitic grit #3 (particle size approximately 3 to 5 mm) : 2 Douglas fir bark (¼ inch) : 1 peatmoss (by volume). Our Mediterranean mix was developed based on several cultural and display criteria. The components either do not decay or decay very slowly, minimizing bed shrinkage and settling. Its very high water infiltration and percolation rates with minimal lateral movement allow heavier irrigation of moisture-requiring plants without overwatering adjacent lower-moisture-requiring plants. The excellent drainage and aeration lessen disease problems caused by a saturated soil. The low cation exchange capacity minimizes the risk of excess fertility problems and allows us to apply different fertilizers to adjacent plants. Aesthetically, its dark color contrasts well with the stonework and plant material in the Mediterranean Garden. This medium is used to container-grow most of the backup plants for the Mediterranean Garden, as well as many of the research plants under evaluation.

SPECIFIC PLANT GROUPS

We have perhaps 500 accessions of Mediterranean-climate plants, including annuals, geophytes, and herbaceous and woody perennials. Though the majority of these are from South Africa and Australia, the other Mediterranean regions are also represented. Our two largest groups of Mediterranean-climate plants are representatives of the family Proteaceae and winter-growing geophytes.

Plants of the Proteaceae. We currently have 92 accessions, mostly from the genera *Banksia*, *Grevillea*, *Leucadendron*, *Leucospermum*, and *Protea*. About 24 accessions are on display in the conservatory, with the remainder still under evaluation in the Research Division. We grow Proteaceae plants both in plastic and clay pots. Seedlings and rooted cuttings are planted in our propagation mix, 3 or 4 granitic grit #2 (particle size 2 to 3 mm) : 1 peatmoss (v/v). Plants ready for pots, 10 inch or more in diameter, are planted in our mediterranean mix, 3 haydite : 3 grit #3 : 2 douglas fir bark (1/4 inch) : 1 peatmoss (by volume). All of the containerized Proteaceae are fertilized monthly with Olympic 20-0-20 Hi-Calcium Peat-Lite at 100 ppm N. Chlorotic plants are fertilized biweekly until they green up, then are put back on the monthly schedule. We apply Peters Excel 15-5-15 CalMag at 100 ppm N once in March and once in October, which seems to be sufficient to supply the plant's phosphorus needs. We have observed that the grevilleas tolerate much higher levels of fertilizer, having applied Peters 20-10-20 Peat-lite Special at 200 ppm N to several accessions every two weeks from June through August of this year with no apparent detrimental effects. Following this cultural regime, we have readily grown and bloomed members of all these genera and have experienced very few losses; the one exception to date has been *Leucadendron argenteum*, the silver tree, which does not appear tolerant of our summer heat and humidity.

Geophytes. The term geophyte is more appropriate for what have been called bulb plants, used incorrectly to include true bulbs, corms, and rhizomes. We have about 160 accessions of true Mediterranean-climate geophytes, predominantly from the South African cape region, including the genera *Aristea*, *Bulbinella*, *Gladiolus*,

Lachenalia, *Ixia*, *Moraea*, *Oxalis*, *Veltheimia*, and *Watsonia*. For the most part, these are winter-growing geophytes that are deciduous during their summer dormancy. We store the dormant bulbs, corms, and rhizomes in their pots in the greenhouse over summer. The Bulbinellas and Veltheimias are syringed about every two weeks, but the other geophytes are stored dry. We begin repotting in mid-August and have all the geophytes repotted and in growth by early October. Depending on corm or bulb size, most are planted in 7-inch standard clay pots containing 3 grit #2 : 1 peatmoss (v/v) or some similar sharply draining mix. The corms or bulbs are watered in after repotting then kept fairly dry until shoot growth is evident when watering is increased. The geophytes are grown over winter in 45 to 55F minimum temperature greenhouses that warm up 5 to 15F by day. Most of the geophytes do not receive any fertilizer application until flowering has commenced, which, depending on the species, will be from December to May. Once in bloom, the plants are fertilized with Peters Excel 15-5-15 CalMag weekly at 200 ppm N until foliage begins to die down in late spring to early summer. The South African cape geophytes as a group have proven very easy to cultivate and propagate. Most set seed readily, and reach blooming size from seed in two growing seasons. Our major problem has been the presence of potyviruses, which are vectored by aphids and through mechanical means. To deter the spread of virus, we vigorously screen our accessions by utilizing Agdia (Elkhart, Indiana) monoclonal antibody Potyvirus test kits and destroy any plants that test positive. We collect seed and regrow accessions when possible and also tissue culture propagate virus-free plants.

PROPAGATION METHODS

Seed Propagation. Many of the Mediterranean-climate plants we have were obtained as seed from commercial sources or other botanical gardens. We attempt to duplicate natural conditions as closely as possible in the sowing and treatment of seed. As most Mediterranean-climate plants are winter growing, we sow seed from these regions in the autumn, typically from mid-September through November. Any seed received after early February will be held in storage until the following autumn. Seed are sown in our propagation medium consisting of 3 or 4 granitic grit #2 : 1 peatmoss (v/v). This is a well-drained medium with a low pH and minimal risk of pathogen problems. For seed containers, we use 1-gal nursery pots for deep-rooting herbaceous and woody perennial species, and 3 inch × 12 inch × 16 inch propagation flats for annual and geophyte species. Seed containers are placed in a shaded greenhouse that, during the winter months will cool down to 48F nightly and warm up to nearly 75F daily. Fluctuating temperatures have proven to stimulate the germination of South African Cape species (Brown et al., 1993). Seed are watered either by hand or by intermittent mist.

Cutting Propagation. We propagate a wide array of Mediterranean-climate plants from cuttings. Cuttings may be taken any time of the year depending on the species. Terminal stem cuttings are preferred; generally, the lower leaves are stripped and the growing tips left intact. In the Research Division we use liquid formulations of KIBA dissolved in water to treat cuttings. Soft to semi-firm, herbaceous cuttings of plants such as *Boronia heterophylla*, *Lechenaultia biloba* 'Moora' (syn. 'Royale'), and *Prostanthera* species are dipped for 5 sec in 2500 ppm KIBA. Greenwood cuttings of woody plants such as *Echium candicans* (syn. *E.*

fastuosum), *Leucospermum* cvs., and *Protea neriifolia* are dipped for 5 sec in 5000 ppm KIBA. Other plants will receive different auxin treatments as determined by either literature search or through trials. For example, we have determined that a 5-sec dip in 500 ppm KIBA appears optimal for South African *Erica* species. Cuttings are stuck in 3 inch × 12 inch × 16 inch propagation flats containing 3 or 4 granitic grit #2 : 1 peatmoss (by volume). Cuttings taken from September to May are placed under intermittent mist controlled by a 24-h time clock and a programmable 1-sec-interval relay switch. Cuttings taken from June to August are placed under fog generated by a 1 HP Humidifan Turbo 1000 or a combination of mist and fog. The Humidifan is controlled by a 24-h timer and a two-stage thermostat, the flow rate of water being manually adjusted with climatic changes. The Humidifan is set to oscillate 180 degrees, which creates a drier zone below and behind the fan. This has proven ideal for weaning freshly rooted cuttings and seedlings from higher to lower relative humidity. Many of the plants we propagate are not tolerant of an overly wet propagation medium and must be removed from mist or the wetter fog zones as soon as roots are established. Fog propagation of Mediterranean-climate plants has, therefore, been very effective as the propagation medium remains drier with fog compared to mist. The propagation greenhouse is ventilated and from May to October provided with about 50% shade.

Tissue Culture Propagation. We have a small tissue culture laboratory capable of maintaining about 2400 culture tubes. Species are selected for tissue culture propagation based on their lack of availability, difficulty in seed or cutting propagation, and the number of plants needed for display. Based on these criteria, Mediterranean-climate plants we have investigated in tissue culture include *Erica fastigiata*, *Eriostemon* (Ault, 1994), and numerous South African geophytes. Many of these geophytes are not commercially available, or when available are often very expensive, and may be infected with various potyviruses such as Ornithogalum Mosaic Virus. We screen our stock for potyviruses prior to and after tissue culture propagation by utilizing Agdia monoclonal antibody Potyvirus test kits. Very often we have a limited amount of stock available for tissue culture propagation; therefore, we use leaf tissue as the explant source to avoid sacrificing the bulbs. We have successfully tissue culture propagated *Lachenalia arbuthnotiae; L. bulbifera; L. purpureo-coerulea; L. pustulata; Veltheimia bracteata*, both a yellow-flowered clone and 'Rosalba'; and *V. deasii* (*V. capensis* var. *deasii*) utilizing this approach.

Mediterranean-climate plant material has become an important part of Longwood's conservatory display. These plants have filled a role not satisfactorily met by other plant groups by providing winter flower interest, often proving easy to cultivate, and tolerating cooler growing temperatures, resulting in energy conservation. The public has been very receptive to these plants, as most of our visitors are not familiar with Mediterranean-climate flora. We anticipate the further incorporation of these plants into our current and future conservatory displays.

LITERATURE CITED

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