Containers provide a quick-and-easy planting method that is often easier and less expensive than planting into a soil of dubious quality. Still, temperature fluctuations can threaten a plant's survival.

CONTAINERS: BEWARE WINTER ROOT INJURY

Planting boxes can create more problems than they were intended to solve. Choosing the right size and location is essential to keeping plant material healthy.

by Jim Borland

With increasing frequency, landscape plants are finding their way into totally artificial environments. One of these is the permanent planting box or container.

This practice is becoming more common as city planners try to beautify public areas with a variety of trees, shrubs, flowering annuals and perennials. This quick-and-easy method is often less expensive than planting into a soil of dubious quality. An additional benefit is that you don't have to tear up concrete or asphalt, under which vegetation control chemicals may have been applied.

Planting containers also help the landscape architect better achieve automobile traffic control, pedestrian traffic control and special aesthetic effects.

TEMPERATURE GUIDE

AVERAGE KILLING LOW TEMPERATURES:

Species	Killing Temperatures (°F)	
Acer palmatum 'Atropurpureum'	+14	(roots)
Agrimonia pilosa	+14	(buds); +18 (rhizomes); +23 (roots)
Anaphalis margaritacea	+18	(buds); +18 (rhizomes); +18 (roots)
Artemisia japonica	+10	(buds); +10 (rhizomes); +10 (roots)
A. montana	+14	(buds); +18 (rhizomes); +18 (roots)
Buxus sempervirens	+15	(roots); +27 (immature roots)
Chamaele decumbens	+23	(buds); +23 (rhizomes); +23 (roots)
Cornus florida*	−6 to	−22 (twigs); +21 (immature roots); +11 (mature roots); +20 (roots)
Cotoneaster adpressa var. praecox	+10	(roots)
C. dammeri	+23	(immature roots)
C. horizontalis	+15	(roots)
C. microphyllus	+25	(immature roots); +9 (mature roots)
Cryptomeria japonica	+16	(roots)
Cytisus praecox	+15	(roots)
Daphne cneorum	+20	(roots)
D. pseudo-mezerum var. jezoensis	−4	(buds); −18 (leaves); +23 (roots)
Euonymous alata 'Compacta'	+19	(immature roots); +7 (mature roots)
E. fortunei var. radicans	−4	(buds); −4 (leaves); +14 (roots)
E. fortunei 'Argenteo-marginata'	+15	(roots)
E. fortunei 'Carrierei'	+15	(roots)
E. fortunei 'Colorata'	+5	(roots)
E. fortunei var. vegeta	+23	(immature roots); +12 (mature roots)
E. kiautschovica	+21	(immature roots); +16 (mature roots)
Hedera helix 'Baltica'	+15	(roots)
Hypericum spp.	+23	(immature roots); +18 (mature roots)
Ilex cornuta 'Dazzler'	+25	(immature roots); +18 (mature roots)
I. crenata 'Convexa'	−22	+20 (roots)
I. crenata 'Helleri'	+23	(immature roots)
Illex crenata 'Hetzii'	+20	(roots)
I. crenata 'Stokesii'	+20	(roots)
I. glabra	+15	(roots)
I. X meserveae 'Blue Boy'	+23	(immature roots); +9 (mature roots)
I. 'Nellie Stevens'	+23	(immature roots); +14 (mature roots)
I. opaca	+23	(immature roots); +9 (mature roots); +20 (roots)
I. 'San Jose'	+21	(immature roots); +18 (mature roots)
Juniperus conferta	+12	(immature roots); −10 (mature roots)
J. horizontalis	0	(roots)
J. horizontalis 'Douglasii'	0	(roots)
J. horizontalis 'Plumosa'	+12	(immature roots); −4 (mature roots)
J. squamata 'Meyeri'	+12	(immature roots)
Kalmia latifolia	+16	(immature roots)
Koelreuteria paniculata	−17	(twigs); +16 (immature roots); −4 (mature roots)

* differences in temperatures for the same species indicates more than one reference or test or differences in experimental procedures.

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Aside from all the other stress-creating situations that challenge the survival of plants in a city or urban environment is the failure of the plants to re-grow in the spring. Even with the best care during the prior growing season and attention during the winter, the entire plant will either appear to be dead come spring or buds will swell and perhaps open a bit. Then the entire plant appears to suddenly die.

This phenomenon is common in container nurseries. The plant which classically exhibits these symptoms is the tough juniper. All through winter, it appears a healthy green until spring when warm temperatures arrive. Just when the nurseryman thinks his winter headaches are over, almost overnight all the junipers take on a sickly shade of yellow-green, ultimately turning dead-brown.

The problem is often found to be dead roots, apparently killed during some period of unanticipated low temperatures—temperatures which did not affect the plant's stem and leaves.

Where landscape architects in the past have relied on available literature that lists the lowest winter temperatures at which a plant will survive, little if any information has been available on the low temperatures at which the roots of these plants will survive.

Lower temperatures

This information is important because the roots of plants contained in above-ground containers are often subjected to much lower temperatures during winter than they would ever be exposed to in either their native or transplanted home.

History and experience would lead to future planting recommendations. And scientific techniques such as differential thermal analysis can quickly be used to determine the lowest survival temperature for almost any plant tissue. However, the added artificial environment provided by planting containers introduces variables which may have to be determined on an individual basis.

First it must be realized that any soil volume elevated above ground will both cool and heat faster than on bare ground. More importantly, it will also heat to higher temperatures and cool to lower temperatures than that same surrounding soil. The dynamics of this heating and cooling occurs daily, weekly, seasonally and annually.

Larger soil volumes heat and cool slower than smaller volumes. However beneficial the use of a large soil

AVERAGE KILLING LOW TEMPERATURES:

Species	Killing Temperatures (°F)	
Leucothoe fontanesiana	+19	(immature roots); +5 (roots)
Lilium cordatum var. glehnii	+23	(buds); +23 (bulb); +23 (roots)
Lysimachia vulgaris var. davurica	+18	(buds); +18 (rhizomes); +18 (roots)
Magnolia soulangiana	+23	(roots)
M. X soulangiana	+23	(roots)
M. stellata	+23	(roots)
Mahonia bealei	+25	(immature roots); +12 (mature roots)
Maianthemum dilatatum	+14	(buds); +23 (rhizomes); +23 (roots)
Miscanthus sinensis	+18	(buds); +18 (rhizomes); +18 (roots)
Pachysandra terminalis	−4	(buds); −4 (leaves); +18 (rhizomes); +23 to +15 (roots)
Petasites japonicus var. giganteus	+23	(buds); +23 (rhizomes); +23 (roots)
Picea glauca	−10	(roots)
P. omorika	−10	(roots)
Pieris floribunda	+5	(roots)
Pieris japonica	+14 to	−8 (twigs), −11; +16 (immature roots); +10 (roots)
P. japonica 'Compacta'	+15	(roots)

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volume may appear then, the volume does not heat and cool uniformly. Outside edges, and especially southern and western edges, will be affected most dramatically—possibly to the extent that roots will be killed only there from high or low temperatures while interior roots remain undamaged.

Containers with shapes that expose a greater surface area per unit volume will both cool and heat faster than containers that expose less. Containers that present a large surface area to the ground beneath also benefit from the heat transferred from that ground.

As might be expected, the color of the container can also make a dramatic difference in the temperature dynamics as well. Darker colors absorb more light and heat than do lighter-colored ones. Where light-colored containers may prove beneficial during summer months, a darker-colored one may prove as beneficial during the winter season. However, a dark container in winter may also result in container temperatures too high during the day, leaving the roots in a condition unable to quickly adjust to lower nighttime temperatures. The material from which the container is

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Species	Killing Temperatures (°F)	
Plantago asiatica	+14	(buds); +14 (rhizomes); +14 (roots)
Potentilla fruticosa	−10	(roots)
Pyracantha coccinea	+18	(roots)
P. coccinea 'Lalandei'	+25	(immature roots); +18 (mature roots)
Pyrola alpina	+18	(buds); +9 (leaves); +23 (rhizomes)
P. incarnata	+1	(buds); +5 (leaves); +18 (rhizomes)
P. renifolia	+9	(buds); +23 (leaves); +23 (rhizomes)
P. secunda	+1	(buds); +5 (leaves); +23 (rhizomes)
Sanguisorba tenuifolia var. alba	+18	(buds); +18 (rhizomes); +23 (roots)
Sanicula chinensis	+23	(buds); +23 (rhizomes); +23 (roots)
Solidago virga-aurea	+9	(buds); +14 (rhizomes); +14 (roots)
Stephanandra incisa 'Crispa'	+18	(immature roots); 0 (mature roots)
Taxus X media 'Hicksii'	+18	(immature roots); −4 (mature roots)
T. media 'Nigra'	+10	(roots)
Tiarella polyphylla	+14	(buds); +18 (leaves); +14 (rhizomes); +23 (roots)
Trifolium pratense	+23	(buds); +23 (rhizomes); +23 (roots)
Viburnum carlesii	+15	(roots)
V. plicatum f. tomentosum	+19	(immature roots); +7 (mature roots)
Vinca minor	+15	(roots)

made can also affect soil temperatures. Just as in heat gain and loss in homes, thin dense materials transfer heat more rapidly.

Other factors

Sunshine and air temperature do not always act alone in determining the fate of the roots in containers.

The nature of the surroundings will also affect the resultant container temperature. Large expanses of nearby asphalt or concrete, as well as other large heat-absorbing masses and light-reflecting surfaces, will combine to dramatically alter the container temperature. Containers unprotected by any surrounding shelters or large material masses will cool faster and deeper than otherwise-protected containers. Containers which wick water to an outside surface can cool the interior soils to temperatures lower than air temperatures. This may be a benefit in the summer, but a few degrees lower in the winter may damage roots.

The type of soil can also affect container temperatures. The movement of heat through soil is generally affected by porosity, moisture and organic content.

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Generally, organic soils do not transfer heat as fast as mineral soils. Where soil volume and type, container color and material may afford overnight protection from low temperatures, none of these may provide any protection from a period of sustained low temperatures.

The freeze factor

When roots were killed by low temperatures, it is often said that the reason for their death was due to freezing. As evidenced by the depth to which frost penetrates in many parts of the country, the roots of most temperate zone plants will survive freezing temperatures quite well.

The damaging low temperature zone for the roots of many plants is generally between 15 and 25° (see chart). It must be realized, however, that the killing low temperatures listed for these plants was determined for plants that had become completely acclimated to the winter season. Not indicated is the increased susceptibility of damage to roots at even higher temperatures during other times of the year.

Roots in the normal position in the ground naturally acclimate more slowly in the fall to low temperatures than do the plant parts above-ground. Where a temperature of 25° may not injure a root in December or January, the same temperature experienced during October or November may prove fatal.

Where freak occurrences of low temperatures of short duration normally do not affect roots in the ground, soils in containers can be affected much more dramatically.

FACTORS AFFECTING HEALTH OF PLANTS IN ABOVE-GROUND CONTAINERS

1. LOW TEMPERATURES!
2. VOLUME OF SOIL
3. CONTAINER SHAPE
4. CONTAINER COLOR
5. CONTAINER MATERIAL
6. NATURE OF SURROUNDINGS
7. TYPE OF SOIL

Additional variables

Some of the same variables involved with potential low temperature damage to roots in containers is applicable to plantings at the top of walls. At least one side of the root system is exposed to the weather at all times. Until roots can establish themselves some distance from the wall, they are susceptible to the same problems.

There is no easy way to determine what is the best size, shape or color of container to use for any particular project since too many other variables are involved. The best piece of advice aside from not using containers is to use the largest container possible. The closer we can approximate the natural condition, the better will be the plants in the container. **LM**

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