WINTER PROTECTION OF CONTAINERIZED ORNAMENTAL PLANTS

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Why are plants in containers or B&B more susceptible to freezing injury than those that are in the soil? What type of poly house will give me the best winter protection? What species will be able to overwinter without much loss? With the advent of container production and handling in the northeast, these kinds of questions are now frequently being asked by growers, retailers and landscapers alike. With the financial aid of New York State Nurserymen's Association, state regional associations and individual firms we have been trying to answer these kinds of questions.

Why are plants in containers or B&B more susceptible to freezing injury?

Plants in containers suffer greater winter injury than those in the ground because the roots are exposed to lower temperatures. For instance, at Ithaca during the 1973/74 winter, the soil temperature (4" below ground level) never fell below 21 deg. F., while temperatures in a 2-gallon container were below this temperature for more than 500 hours. In fact, the container temperature was between 5 and 10 deg. F for a total of nearly 70 hours. These extremes in root zone temperatures are significant in the overwintering of containerized plants because the hardiness of the roots and shoots of the same plant can differ by as much as 50 deg. For instance, we have found that while stems of *Pyracantha coccinea* 'Lalandii' can survive -15 deg. F, mature and young roots are killed at +2 deg. F and +23 deg. F, respectively. Thus, in addition to the differences in shoot and root hardiness, different types of root tissue vary greatly in their hardiness.

Why are young roots killed at higher temperatures than other portions of the plant?

Preliminary work indicates that the freezing processes in roots and shoots of *Pyracantha* are similar, therefore the lack of hardiness in young roots must be due to their inability to 'harden' or acclimate as the mature roots and shoots can. In fact, subsequent experiments indicated that while shoots and mature roots of *Pyracantha* hardened the most when maintained at 40 deg. F, young roots did not increase in hardiness at this or any other temperature, even after 16 weeks.

What type of poly house will give me the best winter protection?

Experiments conducted in Ithaca during the winters of 73/74, 74/75 indicate that the container temperatures in houses covered with single or double layers of clear and/or milky polyethylene were similar. However, it should be noted that these were relatively mild winters and only a few nights were below -20 deg. F. Under these conditions all the houses provided substantial protection as container temperatures did not go below +20 deg. F. Whether these similarities in effectiveness of the coverings will exist during more severe winters is not known. At this time the choice of covering material should be considered from the standpoint of plant quality.

As far as the quality is concerned, those broad- and narrow-leaved evergreens over-wintered in the double-layer milky structure were in excellent condition in the spring whereas those in the single-layer milky were not quite as good but still of noteworthy quality. Those in the single- and double-layer clear houses were the poorest as extensive bleaching or yellowing of the foliage was noted.

These undesirable characteristics were attributed to very high mid-day temperatures. During sunny days in single-layer clear poly houses the temperatures commonly rose 40 deg. above outside air temperatures. Temperature increases in the double-layer clear houses were even more exaggerated. These high temperatures did not occur in either single- or double-layer milky poly houses. This suggests that if clear poly is used, more intensive management with respect to ven-

[1] Reprinted from Ohio Report, May/June, 1975.

tilation and irrigation will be required to avoid bleaching or yellowing of the foliage.

Up to this point, all species included in the study were successfully over-wintered in two-gallon containers in Ithaca. The species included were: *Ilex crenata* 'Convexa', *Ilex crenata* 'Helleri', *Rhododendron catawbiense* 'Roseum elegans', *Azalea* 'Exbury Hybrid', *Cotoneaster Dammeri, Cotoneaster conjesta, Pyracantha coccinea* 'Lalandii', *Buxus sempervirens,* and *Juniperus chinensis horizontalis.* But again, because of the mild winters, further assessment is needed.

How low will container temperatures get tonight?

From the data collected we can predict what air and container temperatures would be expected at various locations in the state if the expected low temperatures are available. In addition, in houses of the dimensions used in this study (21 x 14 x 8'), air and container temperatures at different locations in houses were similar. Furthermore temperatures at five locations in a two-gallon container were also similar. The influence of house and container size, as well as the type of container, will be considered in future work.

What kinds of plants can I overwinter most successfully in my area?

We have determined the root hardiness of several different species during the winter and found that while young roots are the most susceptible portion of the plant there are slight differences in hardiness depending on the species. Specifically, the killing points of mature roots and young roots (MR/YR) of *Cotoneaster conjesta, Cotoneaster Dammeri, Euonymus fortunei vegetus,* and *Ilex crenata* 'Helleri' were -1 def. F/19 deg. F, -1 deg. F/10 deg. F, +3 deg. F/16 deg. F, +5 deg. F/19 deg. F, respectively. The killing points of fibrous roots of *Azalea* 'Exbury Hybrid' and *Rhododendron catawbiense roseum elegans* were 3 deg. F in both species.

Currently, we are attempting to artificially acclimate other species in order to determine the root hardiness of as many species as possible. We were successful in some cases such as *Juniperus horizontalis plumosa* and *Juniperus squamata* 'Meyeri' where young roots could withstand +12 deg. F and mature roots -2 deg. F. In *Acer pseudoplatanus* young roots were killed at +4 deg. F and mature roots -5 deg. F; *Koelruteria paniculata* young roots were killed at +16 deg. F and mature roots at -5 deg. F; *Taxus media* 'Hicksi' young roots were killed at +17 deg. F and young roots at -5 deg. F. In other species, such as *Cercis canadensis* and *Viburnum plicatum tomentosum* we were only able to increase the hardiness of mature roots, while in *Buxus sempervirens* we could not increase the hardiness of either young or mature roots.

Fine, but you still haven't answered the question as to why young roots can't acclimate.

At the present time we do not have the answer to this question. In fact, we have several unanswered questions in regards to this point ourselves. Current hypotheses on the mechanisms of cold acclimation indicate that cold acclimation involves an accumulation of sugars and changes in cellular membranes. Do sugars increase in young roots during the fall? Yes, in *Pyracantha* roots there is a four-fold increase in sugars. Do changes in the cellular membranes occur? Preliminary work suggests that changes in cell membranes that occur in plants which do acclimate don't occur in young roots of *Pyracantha.* However, the problem is that we still do not know *which* changes in the membranes are responsible for increased freezing resistance. Through an understanding of these problems we can then ask the questions of:

What is preventing this change from occurring in young roots?

Can this change be induced by artificial or chemical treatments?

Can the hardiness of young roots be increased to that of mature roots or shoots?

It is hoped through further research, made possible by continued financial support of this project, that these questions can be answered.

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