

Environmental Protection Agency banned DDT on what it later conceded to be political, not scientific, grounds. Few pesticides on the market today are less hazardous than DDT. Let's not lose more good chemicals by misusing them.

## SUMMARY

Follow label directions. Remember that CAUTION is the signal word on the label of even the least toxic pesticide. When used according to label directions, there is no danger from any pesticide, even the most toxic ones. No pesticide is safe when used haphazardly.

### **WATERING CONTAINER-GROWN PLANTS**

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Twenty-six years of working with Georgia nurserymen has acquainted me with a wide range of problems that can affect the production of shrubs in the artificial environment of containers. By far the most common problems that I have encountered are related to watering practices and/or soil aeration of potting mixes.

The single most important practice in container production is water application. If the grower is sensitive to the effects of water on container plant growth, then he is in a position to refine other practices, including fertilization and pest control.

Here are some observations that I would like to share with you concerning water application:

*There is often inadequate communication by nurserymen to their employees who actually make the day-to-day water management decisions. The ultimate quality of the crop depends, to a great extent, upon the quality of decisions made by the individual in charge of watering. Nurserymen often do not take the time to train their employees to identify the variables that can affect decisions of how often and how much water to apply.*

*The term "overwatering" is a poor choice of words due to the variety of meanings that it imparts. Actually the term is used to refer to two distinct situations: (1) too frequent applications of water, and (2) too much water in a single application. Irrigating too often is the cause of most water-related problems that I encounter. The result is that the potting mix is at or near field capacity for too much of the time. Applying an excessive amount of water in individual applications is a rare*

cause of root problems in southern nurseries in my estimation. Watering too frequently adversely affects the roots of plants in a number of ways. It reduces the soil oxygen supply, thus affecting root initiation and growth. It also increases the soil's content of gases such as CO<sub>2</sub> that can be toxic to the roots. It also results in an environment ideal for massive multiplication of destructive soil-borne disease organisms such as *Pythium* and *Phytophthora*.

*There is a direct relationship between root-rot disease problems and watering practices. Most growers "water" their plants into an eventual root-rot situation. Four to 6 weeks of frequent rains can result in a noticeable decline in the condition of roots of container plants during the growing season. Likewise, watering a saturated mix repeatedly for a period of 4 to 6 weeks can result in massive root deterioration. Decisions not to water are refinements in production practice that lead to high quality container plants. These decisions are always present when accelerated plant growth is obtained.*

*Root-rot disease organisms are not always the cause of root deterioration. Microscopic examination of affected roots by plant pathologists does not always reveal the presence of disease organisms. This suggests that low soil oxygen or the presence of toxic gases in the soil is the cause of the problem. In most nursery situations, however, all three factors would contribute to the root decline.*

*Other than for roots, the space between soil particles must always be occupied by either air or water. There is no way to increase soil water content without a corresponding reduction in air content. Nurserymen should have a clear concept of irrigation water forcing a portion of the air out of the pore spaces every time that they apply water.*

*Some growers "build in" long term problems when they install their irrigation system. Designing irrigation systems for container plants requires that an equal amount of water be applied to a multitude of individual plants. Many frustrating problems result when improperly designed systems are installed. Consulting with individuals knowledgeable in nursery irrigation system design is highly recommended.*

*Irrigating for short periods can result in dry spots in the mix that will affect plant growth. Other than syringing the foliage, there is no way to water "lightly." An attempt to do this usually results in uneven applications and dry areas in the mix. Water saturates an area of the mix until no more can be held (reaches field capacity), then the excess water moves on to saturate an adjacent area to field capacity.*

*If a grower is not careful, perhaps 20 to 25% of the soil*

volume can be extremely dry immediately after irrigating. These same dry pockets are likely to remain dry for long periods of time with no live roots remaining in them. Dry areas in the mix are more likely to begin when the mix is allowed to become extremely dry before re-watering. If this occurs, it may be necessary to water two or three times longer to saturate uniformly the potting mix. The problem is more common on older plants, which have large roots in contact with the sides of the container. These roots act as channels to move water down and out at a rapid rate before a uniform penetration inside can occur.

*Proper bed construction is critical for uniform growth.* Failure to crown beds or failure to provide a level surface for plastic-covered beds results in unnecessary water problems. The portion of the plants in containers "sitting" in water receives water from both the top and bottom and are thus more susceptible to root deterioration.

*Arrangement of plants in groupings with similar water requirements is the most difficult, yet critical, decision made by the nursery manager.* A successful manager becomes very skilled in arranging plants and predicting future space needs. It is obvious that a great deal more time should be allocated to planning in this area.

*Instrumentation has not been developed that will accurately measure water levels in light-weight mixes.* Tensiometers are being used effectively to measure water needs in heavier potting mixes such as those used in Southern California. Tensiometers do not perform accurately, however, in the porous bark mixes used in southern nurseries. Knocking plants out or using a soil probe are the only practical means of determining if water is needed.

*Uniformity is the key to plant quality.* Only when there is uniformity of plants in a block can all of the plants be irrigated at the optimum time. Varying size plants have different transpiration rates and thus remove the water from the mix at varying speeds.

Striving for uniformity of cuttings that root at the same time and produce identical-size liners should be a standard objective in a nursery. Instigating a grading system to discard nonuniform cuttings and liners will aid greatly in reducing problems related to watering practices.

*The installation of cutoff valves on the risers is the most practical approach to providing positive control over water applications.* Only in very large nurseries can identical plants be grown under a single irrigation line so as to provide optimum water. In my estimation, the installation and use of cutoff

valves in an average nursery can do more than any other single innovation to improve quality and reduce problems in growing plants in containers.

I have observed that there are stages in the production cycle when there are variations in water needs or stages when growers tend to misjudge water requirements. These are as follows:

1. *Immediately after sticking cuttings* — Excessive misting does not appear to be a major problem at this early stage in propagation. Adequate mist, on the other hand, is critical for survival of the cutting at this stage.
2. *After roots have formed on the cuttings* — Failure to gradually reduce the mist applied at this stage is a major cause of root deterioration.
3. *During over-wintering of liners in plastic structures* — Reduced air movement, lower temperatures, low light, and high humidity greatly reduce both leaf transpiration and evaporation of water from the soil in enclosed structures. Frequent water applications under these conditions can cause a disastrous decline in the root system.
4. *Immediately after canning* — Many plants are stressed due to canning into dry mixes that are extremely difficult to re-wet. Other problems have been observed when liners growing in a dry mix are canned into a moist mix. Failure of the water to penetrate into the liner mix at the first watering is a common occurrence in this situation. There is also a tendency to keep recently-canned liners too wet for the first 6 to 8 weeks. This reduces the soil oxygen levels and retards root growth and also predisposes the roots to heavy infestations from soil disease organisms. On the other hand, care is necessary to water when needed since the roots are occupying a small soil volume with a limited water reserve at this stage.
5. *Stage approaching maturity* — At this stage it is much more difficult to create problems during the growing season by too frequent water applications since leaf transpiration is removing the soil water at a rapid rate. Excessive drying at this stage creates stress conditions that often result in an end to accelerated top growth. Also at this stage, a high percentage of the pore spaces are now occupied by roots, thus reducing the water-holding capacity of the mix.

### QUESTION BOX

The Question Box was moderated by Carl Whitcomb, Oklahoma State University, Stillwater, Oklahoma.