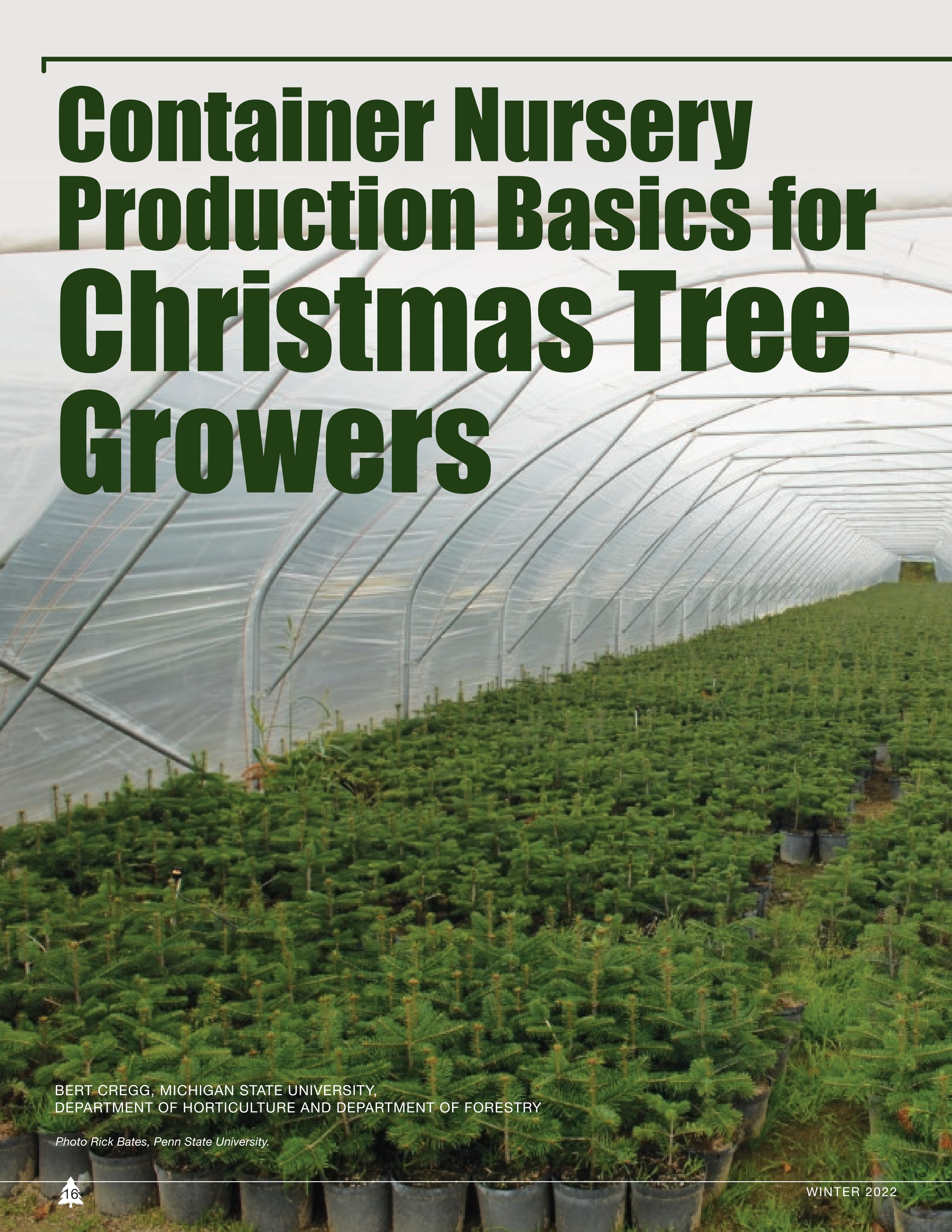
# Container Nursery Production Basics for Christmas Tree Growers



BERT CREGG, MICHIGAN STATE UNIVERSITY,
DEPARTMENT OF HORTICULTURE AND DEPARTMENT OF FORESTRY

*Photo Rick Bates, Penn State University.*

*The idea of producing and marketing conifers in containers appeals to many Christmas tree growers. Container-grown trees can address a niche market for customers that desire a living Christmas tree or table-top Christmas tree (Fig. 1). Container growing also offers growers an in-road to the landscape tree market, which provides a much broader sales window and may be less subject to the vagaries of a seasonal Christmas tree market.*

*Before we dig in, a word about terminology.* ***Containerized*** *trees (or containerized stock) refers to trees that have been field grown, dug, and then placed in containers for sale. From a production standpoint, producing containerized trees doesn't require a significant adjustment to a farm's growing practices, though some growers will root prune a year or two before digging to increase root density and facilitate digging.* ***Container-grown*** *trees, on the other hand, refers to trees that are grown in containers from the start. Containerized and container-grown trees both allow growers to market trees as living Christmas trees or for the landscape market. They also allow growers to expand their species mix to trees beyond those that are typically grown as cut Christmas trees (Fig.2). However, growing trees in containers requires significant adjustments to production practices compared to those that most Christmas tree producers are used to. Growing trees in containers differs from field growing in many aspects. In the discussion below I will highlight some of the key factors that go into successful container production.*

***Figure 1.*** *Marketing 1-2-3. A grower in Denmark markets container-grown Nordmann firs as mail-order table-top Christmas trees. Photo: Rick Bates, Penn State University.*

## The container production triangle

Successful production of trees in containers requires careful consideration and management of three key factors: container substrate, irrigation practices, and fertilization. Each of these factors interacts with the other two, so they can be thought of as a triangle or a three-legged stool; if any of the factors is suboptimal, it will affect the others and make it difficult to achieve a quality crop.

## Substrate

The most obvious difference between in-ground production and growing trees in containers is the container substrate or growing media. Many people are surprised to learn that most common growing substrates do not contain any soil. A typical standard mix will contain about 80% aged pine bark and 20% peat moss (Fig. 3). The goal of substrate mixes is to provide porosity – the pores may hold air or water, both of which roots require. In standard mixes, ground pine bark provides porosity while peat moss helps to retain moisture and nutrients. Some growers will add perlite or vermiculite for porosity, and some will substitute compost for peat moss. A few growers will add sand or soil to add weight to the mix in order to keep containers upright. Finding the right container mix and keeping the substrate consistent is one of the most fundamental considerations in container growing. If a mix is too heavy – i.e., too high a proportion of peat moss or compost to pine bark – the crop will stay too wet and may experience root rot or other

***Figure 2.*** *Container growing allows producers to expand the species they can grow, such as these Norway spruce in Oregon. Photo: Chal Landgren, Oregon State University.*

issues associated with waterlogging (Fig. 4). If the mix is too light, growers will have to irrigate more heavily. This results not only in increased costs associated with increased water use but will also leach out nutrients, resulting in either nutrient deficient plants or increased fertilizer applications. My lab conducted a research trial in which we grew 2 + 2 or plug + 2 transplants of white pine, Fraser fir, Colorado blue spruce, and Black Hills spruce in 3-gallon (#3) containers in substrates that included varying ratios of pine bark to peatmoss (v:v) of 90:10, 80:20, and 70:30. The 90:10 mix reduced tree growth, but there was no difference in height or stem caliper of trees grown in 80:20 or 70:30 mixes. Given that pine bark is less expensive than peat moss, we suggest that the 80:20 ratio is a good starting point and that growers trial slightly lighter or heavier mixes to see which works best under their conditions.

## Irrigation

Irrigation marks another point of departure between container growing and conventional field production. While many growers in the Great Lakes region are able to grow Christmas trees without irrigation, irrigation is essential in container production. Most container nurseries irrigate crops on a daily basis. The choice of irrigation method is often determined by the size of the containers. For small containers (#3 or smaller), overhead irrigation is often the simplest and most logistically feasible method. A downside of applying irrigation via overhead sprinklers is that a significant portion of irrigation water is lost to evaporation or falls on the spaces between containers. Irrigating with drip emitters or spray stakes can increase irrigation application efficiency (% of irrigation water that reaches the substrate surface) to nearly 100% (Fig. 5). However, drip and spray stake irrigation increase costs and logistical issues (e.g., animals chewing on irrigation lines, workers kicking off emitters, clogged emitters) and are more commonly used on larger containers (#7 and larger) where the value of the trees warrants the larger initial outlay and maintenance costs. Regardless of the irrigation method, the next critical question is how much to irrigate. A long-held standard in the nursery industry is to irrigate containers to achieve a 10-20% leaching fraction, which is the proportion of irrigation reaching the container that leaches through the bottom. For overhead irrigation, growers can determine their leaching fraction by placing buckets in open spaces between containers and under a sub-sample of containers and running their irrigation. The volume of water collected under the containers should be 10-20% of that collected in the open. For drip emitters or spray stakes, the process is similar except the 'open' buckets contain an emitter without a tree. The logic behind the 10-20% leaching fraction is it ensures that plants are well watered and leaches away soluble salts from controlled release fertilizer (more on that below). However, research conducted at Michigan State University by Dr. Tom Fernandez and his students suggest that growers can save even more water without reducing crop growth by using deficit irrigation. In deficit irrigation, growers periodically irrigate with cycles that are only 75% of the daily water need of the crop. Again, the 10-20% leaching fraction can provide a starting point, but growers can experiment with lower volumes to find the rates that work best for their situation.

***Figure 3.*** *Pine bark-based substrates make container-grown trees light-weight and easy to handle. Photo: Bert Cregg.*

## Fertilization

Providing adequate plant nutrients can be a major challenge in container growing. In conventional field production, the fertility of local native soils can often supply an adequate reservoir for most nutrients, except nitrogen, to get a crop of Christmas trees through a rotation. Container substrates, in contrast, have little inherent fertility and plants will quickly become chlorotic and nutrient deficient if they are not fertilized. Therefore, all essential plant nutrients, including micronutrients, need to be provided through a fertility program in a container production system. In most commercial production, growers apply controlled-release fertilizers (CRFs) in order to provide a continuous supply of nutrients to the crop. CRFs use polymer coatings and other technologies that release nutrients from the fertilizer prills over time. CRFs are complete fertilizers and are labeled based on their analysis (%N-P2O5-K2O). They also include all other macronutrients and include micronutrients, so they provide all essential elements needed for plant growth. In addition, CRFs are labeled on their release rate, e.g., 5-6-month or 8-9 month. It is important to remember that the release rate on CRF labels is based on standard conditions, typically 70°F. The actual release rate will be slower if temperatures are cooler than the standard and faster under warmer conditions. Irrigation will also affect the release of a CRF and the effective release time can be considerably shorter than the labeled rate if growers over-irrigate and increase leaching. Application rates for CRFs are typically based on container size using the amount of nitrogen as the reference. Typical rates are 3-4 g of N per gallon of container. Most manufacturers include rates for common sized containers and for bulk mixing on their label. CRFs can be top-dressed on the surface of the container or incorporated in the substrate. Top-dressing can reduce leaching as some incorporated fertilizer is lost before the roots reach the bottom of the container. However, top-dressed fertilizer will be lost if containers tip over.

## Winter protection

Protecting roots of container-grown trees from cold is a major concern for

*Figure 4. Over-irrigation or poorly-drained container media can lead to problems with phytophthora and other root pathogens. Photo: Bert Cregg.*

***Figure 5.** Spray stakes or drip emitters are water-efficient options for irrigating containers. Photo: Bert Cregg.*

**Figure 7.** *Pot-in-pot systems rely on the insulation of the ground to protect roots from freezing injury. Photo: Bert Cregg.*

container nurseries as plant roots are much less cold hardy than shoots. For plants grown in-ground, the soil provides sufficient insulation and keeps root temperatures above damaging levels. For container-grown plants, growers have several options to protect plant roots during winter. Many large-scale nurseries move plants into hoop-houses to overwinter (Fig. 6). Hoop houses are typically unheated but their plastic covering moderates extreme cold by trapping heat from the ground. Pot-in-pot systems protect roots in winter using the ground as insulation (Fig. 7). As the name suggests, pot-in-pot systems are based on installing socket pots in-ground with the container opening flush with ground level, which remain in the ground for the life of the nursery, and then the containers with the growing stock are placed in the socket pots. Pot-in-pot is suitable for a wide range of nursery sizes but increases costs as it requires twice as many containers at the outset and also

*Figure 6. Protecting container-grown trees in a hoop-house. Photo: Rick Bates, Penn State University.*

requires land that drains well or has been tiled. Lower-cost options for winter protection of nursery stock that are suitable for smaller scale operations include moving plants together pot-tight and covering with frost fabric or heeling-in with wood chip mulch.

## Regulation

Lastly, marketing trees as nursery stock will likely mean your operation will be subject to different regulations than selling Christmas trees. In most states, growers are required to have a license to sell nursery stock and plants are subject to periodic inspections. Contact your state's department of agriculture to get information on local nursery licensing and inspection requirements.


REFERENCES

Klooster, W. S., Cregg, B. M., Fernandez, R. T., & Nzokou, P. (2010). Growth and photosynthetic response of pot-in-pot-grown conifers to substrate and controlled-release fertilizer. *HortScience, 45(1), 36-42.*

Taylor, A. J., Fernandez, R. T., Nzokou, P., & Cregg, B. (2013). Carbon isotope discrimination, gas exchange, and growth of container-grown conifers under cyclic irrigation. *HortScience, 48(7), 848-854.*

Pershey, N. A., Cregg, B. M., Andresen, J. A., & Fernandez, R. T. (2015). Irrigating based on daily water use reduces nursery runoff volume and nutrient load without reducing growth of four conifers. *HortScience, 50(10), 1553-1561.*

Warsaw, A.L.,Fernandez, R. T., Cregg, B. M., & Andresen, J. A. (2009). Container-grown ornamental plant growth and water runoff nutrient content and volume under four irrigation treatments. *HortScience, 44(6), 1573-1580.*

Warsaw, A.L., Fernandez, R. T., Cregg, B. M., & Andresen, J. A. (2009). Water conservation, growth, and water use efficiency of container-grown woody ornamentals irrigated based on daily water use. *HortScience, 44(5), 1308-1318.*