



WALNUT NOTES

Growing Containerized Seedlings

Growing walnut seedlings in containers can give them a better start than planting them as bare-root seedlings or seeds. These benefits include:

1. High-value seedlings can be protected from predation and adverse weather when grown in a greenhouse.
2. Containerized seedlings can be outplanted later in the growing season than bare-root seedlings.
3. Containerized seedlings have an extensive lateral root system that may allow them to adapt to adverse sites more quickly.

This Note is meant to serve as a general guide for the small landowner or nursery operator. For large-scale commercial production of containerized walnut, you should consult texts such as *How to Grow Tree Seedlings in Containers in Greenhouses* by Richard W. Tinus and Stephen E. McDonald (1979, USDA Forest Service General Technical Report RM-60, 256 p.) available from the Rocky Mountain Region of State and Private Forestry, Box 25127, Lakewood, CO 80225.

Facilities

To grow containerized walnut, you will need access to a shadehouse and/or a greenhouse. Shadehouses are bird- and rodent-tight structures that reduce the summer air temperature below what it would be in direct sunlight. Shadehouses are usually covered with a fabric that provides 30- to 50-percent shade, and they are used most frequently to harden-off or over-winter seedlings. Greenhouses, on the other hand, are relatively air-tight structures covered with transparent materials and equipped for controlling supplemental lighting, air circulation, temperature, and watering schedules. Typically, they have rigid frames and are covered with glass, film plastic, or rigid plastics.

When growing containerized seedlings in a greenhouse, you should have the following equipment:

1. A hygrothermograph (\$200 to \$400) to provide a 24-hour-a-day record of air temperature and relative humidity.
2. A pH meter (\$100 to \$200) to measure the pH of the watering solution and the solution leaching from the containers.
3. A conductivity meter (\$100 to \$300) to measure the salt content of the container leachate and indicate when salts from excessive fertilization are accumulating in the growing medium.
4. A programmable repeating timer (\$50 to \$100) to control the supplemental lighting and photoperiod.
5. Tensiometers (\$50 to \$100 each) or bimetal moisture probes (\$10 to \$15 each) to monitor the moisture content of the growing medium. Also, platform scales can be

used to compare the current weight of moist containers with the weight of dry and saturated containers.

Suitable Containers

Container size and shape strongly influence seedling growth. Too small containers result in large tops and small rootballs (a high shoot:root ratio). Plastic pots are usually equal in depth and diameter and are unsuitable containers because they don't have enough space for the developing taproots. Several manufacturers have designed special containers for tree seedlings (table 1). Most of these containers are typically 10 times longer than wide with vertical ribs or grooves to prevent lateral roots from spiralling.

Table 1.-Manufacturers or distributors of containers suitable for growing walnut seedlings

Supplier	Common name ¹ of container	Container material	Container volumes (cm ³)	Biodegradable container
United Asia Trading Co. 3840 Crenshaw Blvd. Los Angeles, CA 90008 (USA distributor)	Paperpot	Special paper	650	Yes
J. M. McConkey Co., Inc. F? 0. Box 309 Sumner, WA 98390	DEEPOT	High density polyethylene	656	No
Spencer-Lemaire Industries, Ltd. 9160 Jasper Ave. Edmonton, Alberta Canada	Rootainers Super-45's	Polystyrene	738	No
Tree Tech, Inc. P. O. Box 86 Mason, MI 48854	Plant bands	Paper with or without polyethylene coating	Any size	Yes

¹Trade names used in this note are for your convenience and do not constitute an implied or intended endorsement.

Containers can be either biodegradable or rigid. Rigid containers are designed so that the seedling rootball and plug of growth medium can be removed intact. Before rigid containers are reused, they should be washed, surface sterilized in a 10-percent household bleach solution (0.5-percent sodium hypochlorite) for 20 minutes, and thoroughly rinsed.

The size of container you choose depends on the length of time seedlings will be in the containers and the size of seedlings desired. Containers with volumes between 600 and 2,000 cm³ are suitable for growing succulent seedlings for outplanting in the late spring or early summer. Larger containers are usually required for seedlings that will be overwintered in the containers. Containers larger than 4,000 cm³ waste materials and valuable bench space, and walnut seedlings in them are unlikely to grow sufficient roots to hold the growth medium together.

Growing Medium

Sphagnum moss peat mixed with 1 to 2 volumes of vermiculite or perlite produces a lightweight growth medium that possesses many ideal characteristics. Sphagnum moss peat gives the medium the desired water holding capacity and fibril strength to hold the medium together. Horticulture grade #1 or "attic fill" vermiculite provides the necessary buffering capacity, is high in ion exchange capacity, and has a high pore volume. Because perlite will not compress when wet, coarse (1- to 3-mm particle size) perlite is a better bulking material than vermiculite; however, perlite has little or no buffering or ion exchange capacity. A shallow layer of perlite over the growth medium protects the germinating seed from the sun, provides a droughty surface to reduce algal and fungal growth, and allows water to penetrate better into the medium.

Homemade growth medium using topsoil, compost, or unsterilized peat should be steam sterilized at 180° F for 30 minutes or chemically sterilized with formaldehyde, chloropicrin, methyl bromide, or Vapam®¹. Chemical sterilization should only be done by trained individuals. The chemical must be thoroughly dissipated from the medium before use to prevent trapped residual chemical from injuring germinating seed.

Thoroughly mix and moisten the medium before filling the containers. The medium should not be allowed to dry out because peat is difficult to rewet when in the containers. Do not mix water-soluble fertilizers in the medium because they leach out before seedlings are large enough to use them. Slow-release fertilizers can be added if seedlings will be outplanted before the hardening-off stage.

Seedling Growth Stages and Requirements

Germination.-Fully stratified seed (see Note 1.02: Seed Handling) should be pregerminated to minimize the number of empty containers. To pregerminate seed, place 250 to 500 nuts in large 2- to 4-mil black polyethylene bags and set them in a warm shaded area. Check bags every other day for seeds with split sutures and emerging radicles.

Plant pregerminated seed on its side and cover with 1 to 2 inches of growth medium or perlite before moving containers into the greenhouse. Set containers on racks or on painted surfaces containing copper carbonate to "prune-off" emerging taproots and lateral roots. Seedlings should emerge within 7 to 10 days, depending on temperature. During this stage, maintain daytime temperatures around 75° F (65 to 80° F permissible range) and a relative humidity of 70 percent (50 to 90 percent permissible range). Providing 8 to 10 watt/ft² (450 lux) supplemental incandescent light for 1 minute out of

¹*Mention of trade names does not constitute endorsement by the USDA Forest Service.*

every 15 minutes throughout the night is also beneficial. Water containers during the day as needed to minimize the time water droplets stand on the new leaves or growth medium surface.

Juvenile Growth Phase.-After the first leaves have expanded, raise the daytime temperature to 83° F (79 to 86° F permissible range) and the night temperature to 72° F (66 to 82° F permissible range), lower the relative humidity to 60 percent (50 to 80 percent permissible range), maintain supplemental lighting, and begin fertilizing with each watering, using a complete, high nitrogen fertilizer. Water to excess and rinse foliage with clear water at each watering to avoid leaf damage and reduce algal growth on containers. Water leaching through containers should have a pH within 0.3 to 0.4 units of the watering solution and a conductivity reading below 1,800 mhos. Begin checking daily for pests. Pest problems start small and grow rapidly. Treat infested areas immediately and begin regular weekly spraying. Rotate use of pesticides to retard development of resistance.

Exponential Growth Phase.-At this stage, seedlings will become tall and slender without a visible terminal bud. Maintain the same growing conditions as for the juvenile growth phase. Increase air circulation to prevent air from stagnating in seedling crowns. Check that all seedlings are being uniformly watered and rootball moisture stress levels are between 0.5 and 3.0 bars for maximum height growth. Elevating CO₂ levels between 1,000 and 2,100 ppm during the daytime when the vents are closed will increase height growth of walnut seedlings. The CO₂ level can be raised by using specially designed propane or natural gas burners or by piling *fresh* manure in one corner of the greenhouse. At the end of this phase, seedlings can be outplanted in late spring or early summer on moist, well-prepared sites; however, the succulent stems are easily broken.

Bud Development Stage.-During this stage, seedlings are forced to set a terminal bud while growth in caliber, roots, and buds continues for another 3 to 5 weeks. Water containers heavily to remove excess nitrogen from growth medium, then allow them to dry until seedlings wilt for 12 to 24 hours. After this, fertilize the containers with each watering, using a complete fertilizer high in phosphorus and potassium. Seedlings can now be moved to a shadehouse if night temperatures are well above freezing. If seedlings are left in the greenhouse, discontinue the supplemental lighting and elevated CO₂ levels and gradually reduce the temperatures. Seedlings outplanted at the end of this phase in late summer or early fall when frosts are not expected will not reflush until the following spring.

Cold Hardening Stage.--During this stage, temperatures are brought close to freezing, and seedlings begin to develop leaf abscission layers. After 2 weeks at low temperature, seedlings can tolerate some frost; and after another 2 to 3 weeks, the stems can remain frozen for weeks at a time if protected from desiccating winds. The rootball should not be allowed to freeze. Place sawdust, straw, or coarse peat along the sides and over the top of the containers to protect rootballs from freezing. Just before outplanting cold-hardened seedlings, thoroughly water the seedlings with a complete, high nitrogen fertilizer.