

Dogwood Production

Cornus florida and cultivars

by Mark Halcomb, UT Extension Area Nursery Specialist
(Revised 03-2002)

The importance of the dogwood to the Tennessee Nursery Industry:

Dogwood accounted for about 16 percent of Tennessee's wholesale nursery cash value, according to surveys by Dr. Badenhop, UT Ag. Economist in the early 80's. In the early 90's, annual dogwood sales exceeded \$40 million of the states' \$200 million in annual nursery sales. Dogwood sales accounted for \$40-50 million of the state's \$282 million in annual nursery sales, according to the 2002 Hort. Census. Franklin Co. is the 4th highest nursery producer in the state with sales around \$12.5 million.

The devastating effect of powdery mildew on the dogwood industry:

Powdery mildew attacked practically every flowering dogwood in 1994, in every state that they grew, for the first time. Dogwood sales and production dropped significantly after a few years of continued severe powdery mildew epidemics. Powdery mildew severely stunts the seedlings and small liners. Seedlings will not grow large enough to bud without protective fungicide sprays every 14 days, beginning in late May and continuing till October.

Producers without air blast sprayers quit planting dogwoods when they realized that a comprehensive, expensive and labor consuming spray program was required to prevent the stunting effects of powdery mildew.

The Univ. of Tenn. Exp. Station Dogwood Research Group has estimated that the disease control costs for producing 1 acre of dogwoods soared from \$650 to \$1,700 for a 3 year cycle.

Dogwood was not the easiest nursery crop to produce prior to powdery mildew. Potential losses can be caused by: failure of trees to set a seed crop some years or shortage of enough seed, germination failure, improper seed storage, seedling diseases, frost damage to seedlings, mortality from wet site or wet year, planted too deep, borers, mechanical damage, canker, etc.

Once planted or put into stratification treatment, dogwood seed should not be allowed to dry out, nor become waterlogged. They require moisture, aeration and chilly temperatures.

Time frame

Year 1 - Collect seed in fall, clean and plant in Oct-Nov. (Or stratify seed in cold storage and plant 3rd week in April after frost.)

Year 2 - Seedlings germinate in April. Budding is done in Aug; root pruned in Nov. Un-budded seedlings will be barerooted and sold or replanted over the winter.

Year 3 - Un-budded seedlings will grow in field or container. Budded seedlings will grow and be harvested during fall/winter, graded, sold or replanted, spaced to ball in field or in pots. They will be 18-30 inches tall.

Year 4 - Budded or seedling liners will grow in field 2-5 years and be sold 4 to 5 feet, up to 2 or 2.5 inch caliper, normally.

Seedling and Liner Production

Berries are ready to be picked when the seed slides easily from the pulp when the berry is squeezed between the thumb and forefinger. Some collectors get eager and begin too soon. Berries were purchased for \$2/pound in 1999 & 2006. Nurseries buy berries from local collectors in the fall (Sept.) by the pound or gallon. Mechanical seed cleaners are used to remove the seed from the pulp. They are then air dried on burlap for a few days and bagged and hung away from rodents until planted.

The standard practice has been to plant in Oct/Nov. But recent losses from late spring freezes has caused several to build a cold storage unit, stratify the seed over winter, and plant during the 3rd week of April to avoid late frosts. It works well for those doing it.

There are several good reasons to clean dogwood seed prior to planting. Uncleaned seed come up a few days later in the spring and might miss a frost; but clean seed come up more uniformly. Cleaned seed have a higher germination percent. Don Shadow remembered losing a crop with uncleaned seed. Some of the seed failed to get covered at the end of a row. Birds found them and continued down the row; eating them. Birds eat them for the pulp, not the seed.

Small quantities of dogwood berries can be softened in water for up to 2 days, then fed by the cupful into a household blender with water, by pulsing the on/off button. Too long and the seed will be ground up. Float the pulp and discard.

Clean dry seed can be dry cold stored in sealed tins or buckets for 3 years without significant decrease in germination. These seed should be soaked in water prior to planting. Storing some seed is a good idea because we don't get a good dogwood seed crop every year. The literature did not specify a specific temperature, but I suspect 34 to 38 degrees as adequate.

Rows are ridged up 6-8 inches and a 2 inch deep furrow is pressed into the ridge. (An off-center cultivating tractor with 2 coulters under the belly form the ridge. A section from an old culti-pactor is mounted under the belly or rear and it forms the furrow, with some down pressure.

The seed are planted (12 to 18 seed per linear foot of row) in November and covered with 3-4 inches of aged sawdust that will settle. Some will blow away. Sawdust is used to prevent the soil from crusting and allow better seedling emergence. They usually begin to germinate and emerge the following April, early. The sawdust crust should be broken in late March to allow easier emergence. Seed planted shallower are expected to emerge earlier and are more likely to be killed by frost.

Late frosts and Damping-Off disease will kill a percentage of the crop each spring, unless precautions are taken. Seed planted on a north slope might be slower to emerge and safer from frost. Some producers do not clean dogwood seed on purpose, in order to delay germination. But uncleaned dogwood seed don't germinate as well and are more erratic. A higher population has to be planted to get a stand.

While fall planted dogwood seed is the standard, losses from frost encourage some spring planting. Spring planted seed must receive cold, moist stratification, 41 degrees for 100-130 days. Fall planted seed receive this treatment from Mother Nature. Plant mid-April or so to avoid losses from late frosts.

Forrest-Keeling Nsy. in Mo. broadcasts winter wheat seed over the entire block. The wheat germinates first, reducing crusting, delays dogwood seed germination by shading the soil and keeping it cooler. The dogwood seedlings emerge thru the wheat. The taller wheat protects the seedlings from late frosts. They then spray the wheat with Envoy, Fusilade or Vantage when the chance of frost is over. This has not been researched in Tennessee. Try some before investing the farm, but it sounds good to me.

If wheat is not used and weeds are present, band spray Roundup (glyphosate) over the sawdust in early to mid March. (1-1.5 ounce per gallon or 1 qt. per 25 gallon per acre.

The seedlings will grow 12 to 30 inches tall the first growing season and be dormant budded in the row during August of their first growing season. Buds placed during early September 2000 were killed by a hard freeze Oct 8 & 9, 2000.

A legal source of budwood must be obtained. Ideally, it is best to have ones own stock block of the different cultivars commercially produced. You have control of them, can irrigate and control pests. They will be near when needed. Otherwise, an arrangement must be worked out with a nursery; perhaps the one requesting this cultivar. Several hours of travel is sometimes involved; requiring an early rise, ice chests, an air conditioned van, etc. Branches will be cut that are 12 to 20 inches long.

Once back home, prepare the bud sticks. The leaves will be individually cut off while leaving half of the petiole, which later will be used to handle the bud. Ten sticks or so will be wrapped in damp newspaper, stood vertically in 5 gallon buckets with a few inches of water and place in shade or a cooler if available.

Budders were paid \$125/1000 in 1999. This included scratching, budding and tying. A budder can bud approximately 3000 per day.

They are root pruned in November following budding to produce a 'mophead' root system. A handout is available on root pruning.

The cultivar bud begins to grow the following March or April. The understock top is pruned off. They will grow 2-4 feet during the cultivars first growing season or the rootstocks second growing season; depending on the cultivar, moisture, and ability of producer to adequately spray to prevent powdery mildew.

These budded liners will be undercut and barerooted sometime between the fall and spring, at the end of the rootstocks second growing season. They can be damaged quickly by the drying action of sunlight and wind, once removed from the soil. As the digging operation progresses, the roots must be kept covered to avoid any drying, and they must be put in storage as soon as possible. The roots must be kept covered while being transported from the field. The roots must be kept moist to avoid drying.

They are graded; tied in bundles by cultivar, size and grade; stored in a packing shed or cold storage, until kept or sold. Inferior liners should be discarded. The best liners will produce the best plants and provide the highest profits.

Some root pruning is almost always necessary. All cuts should be made cleanly with a sharp instrument. Periodically wipe the blade with alcohol, Lysol or a 10 percent solution of household bleach. Extra long roots should be shortened to stimulate branching and facilitate planting.

Avoid cutting too many fibrous roots off. After all, roots are the heart of a liner. Roots can grow a top, but a top without roots is dead. If the root mass is too large to be planted with the present transplanter, then buy or borrow a larger transplanter rather than cut too many roots off and risk death.

Many producers feel that dipping liner roots into a water holding hydrophilic polymer such as Terrasorb prior to transplanting helps to insure survival if rain does not come timely.

Fall planting regained some popularity during the drought cycle of the 1980's in middle Tennessee because spring and summer rainfall was nonexistent. Fall or early winter transplanting is actually preferred in Tennessee for early plant establishment and better survival and growth during the first growing season, with or without irrigation.

The problem with fall or early winter transplanting is the possibility that the freezing and thawing action will heave a small bareroot out of the soil. The roots of the liner would then dry and die, when exposed to the wind and sunlight. Some producers try to avoid heaving by planting deeper. Some producers try to hide the "dogleg" on a budded liner by planting it deeper than it should be.

But planting too deep is a major cause of stress and death of dogwood roots. Being too

deep can be harmful to all plants. Dogwoods, hemlocks, ericaceous plants, white pines, and yews are especially sensitive. Liners should be planted at the same depth at which they were previously grown in the field or container.

Cultivation over time can throw soil to the row, covering the roots with additional soil, and kill a percentage of the roots over time. The individual disc blade that throws the soil can be replaced with a smaller diameter disc.

New transplants should be watered-in immediately after planting. Young plants will require water during periods of low rainfall. Supplemental irrigation is necessary to ensure establishment and optimum growth of all nursery crops, but especially dogwoods.

Many revised pre-emergent herbicide labels recommend delaying application to freshly planted fields until after a good settling rain. The fear is that injury could occur if a new planting is immediately sprayed with a pre-emergent herbicide, followed by a rain that might carry the chemical to the roots through the fluffy, loose soil.

Frost Protection for Dogwood Seedlings

Management can not predict if frost damage will occur or the severity, from year to year. But like death and taxes, late frosts are more likely than not. Management can choose to protect young dogwood seedlings from frost and damping-off at a price.

I have seen producers cover their small dogwood seedlings with loose wheat straw in the afternoon, rake it off the next morning and rake it back as needed. It works well but requires a lot of labor.

I recall one spring when the producers that couldn't find straw, rolled paper towels over the seedlings. It worked. They covered the edge with soil to prevent the wind from blowing the paper away.

I have seen the white, UV stable, spun-bonded polypropylene field covers and row covers used with satisfaction. It offers a few degrees of protection. It can be used repeatedly and stored for several years. Mechanical equipment can be purchased or made to roll it out and take it up over individual rows. I like the large pieces that cover a tenth of an acre or so. Wind is the enemy of large pieces, however. This may be the best overall method, but not as effective at colder temperatures as the burlap discussed next.

I saw what I think is the best method at Knowles Nsy. several years ago. They drove 18 inch wooden stakes into the center of the rows every 20 feet or so, leaving 6 inches of the stake exposed. They ran twine down the rows, wrapping around each stake, 5 inches above the ground. New rolls of 36 inch burlap were cut in half with a band saw. The 18 inch rolls were rolled down each row, held off the seedlings by the twine. They tacked the edges down with 16-20 penny nails, every 3 feet, or so.

This was applied in March before emergence of the seedlings and removed in May when all chances of frost was gone.

I was concerned that it would be too dark under the burlap and the seedlings would stretch and be white. Not so. The burlap had sufficient light penetration. It might have been carpet backing, containing some nylon. It was a good idea not to cover the edges with soil, to avoid rotting of the burlap. It was stored in a barn loft and used over. Mice will cut it.

I also expect the white polypropylene fabric could also be left on in the same way. Limited support might be a good idea, but greater effort would be required to prevent it from blowing away. Light, air and water penetrates the burlap easily.

I have also seen winter wheat drilled into the row middles offer some frost protection, as well as offer some wind protection to the first year buds and possibly reduce the number of scions blown off the stumps. Forrest-Keeling Nsy. in Mo. uses this method. The wheat is later mowed or sprayed with Envoy, Fusilade or Vantage.

The severe April freeze in 2007 damaged the dogwood first year buds. The emerging new growth was referred by the producers as coming out 'Bull Headed'.

Damping-off of Seedlings

Dogwood seedlings are frequently attacked by damping-off in April. Cool, wet soils promote Phytophthora and Pythium. Warm, dry soils promote Fusarium and Rhizoctonia. Some seedlings will be lost each spring to 1 or more of these soil-borne diseases (fungi). They cause the stem of the tiny seedlings to appear pinched at the soil line. The dead, brown, seedling is found laying over.

I can't predict how bad these diseases will be in the spring. I don't know how many seedlings a late frost will kill. But I do know that a tank mix of Subdue and Cleary's 3336F will prevent losses from damping-off. The bad part is that a drench, not a spray is required. The fungicide must be watered into the root zone, not sprayed on the foliage.

Mix 0.5 fluid ounce of Subdue MAXX and 20 fluid ounces of Cleary's 3336F (Flowable) in 100 gallons of water. Apply 1-2 pints of that solution to every 3 feet of seedling row. The Subdue will offer control for 3 months; the Cleary's for 1 month. Do not mix it stronger.

If necessary, cultivate first to aid the soaking in of the solution near the roots without running off. Maybe you can attach at least 2 garden hoses to a tractor sprayer using a 'Y' and let 2 people walk and water a row a piece. Back the pressure way off and gravity feed it from the raised tank. Watering cans, a 55 gallon barrel and a boat paddle could also be used.

Seedling Fertility: Soil test at least 2-3 weeks prior to planting the seed. The UT Ext. Area Nsy. Spec. will recommend sufficient Phosphate and Potash to raise low and medium levels to high and sufficient lime to achieve a pH of 6.0, as the preferred range

is *5.0--6.5. The lime, Phosphate and Potash can be broadcast and incorporated anytime prior to planting.

Sidedress with 40-50 lbs. of actual nitrogen per acre when seedlings are 4 inches tall. Repeat 6 weeks later when there is good moisture. Place the fertilizer 4-6 inches to the side of the plant and in the soil if possible, rather than on the surface.

One application of a slow release nitrogen source would be better and safer at the 50 lb. rate of actual nitrogen per acre. See table 1.

Table 1: 50 pounds of actual Nitrogen can be supplied by:

Different Fertilizers	lbs/acre	lbs/1000 sq ft or row feet	Ounces/100 sq ft or row feet (by weight)	Cups/100 sq. ft or row feet
34- 0- 0	150	3.5	5.6	0.75
20-10-10	250	5.7	9.2	1.5
15-15-15	333	7.6	12.1	2.0
13-13-13	385	8.7	14.0	2.0
Sulfur Coated Urea (32-40% nitrogen)	125-140	2.9	5.0	0.66
Osmocote 40-0-0 3-4 month release	125	2.9	5.0	0.66
Osmocote 14-14-14	360	8.25	13.2	2.0
Osmocote 18- 6-12	275	6.3	10.0	1.66
Calcium nitrate (15-0-0)	330	7.6	12.1	2.0

1st year buds: Sidedress Feb. 15 - March 15 and June 15-30 with no more than 50 lbs. of actual nitrogen per acre. A slow release material would be good. See table 1.

Too much nitrogen can cause the stems to break just above the first node during a strong wind. They either become culls, or a new bud can be trained from the first node or from the shoulder of the original bud. The problem is getting a straight trunk. If time is not devoted to training the new growth to be straight, culls result.

Flowers -- What everyone calls flowers on a dogwood is not. The true dogwood flowers are greenish yellow and not showy, each 1/4" across, in a crowded 1/2" wide head. The showy parts of the inflorescence is the 4 bracts that are assumed incorrectly to be the flowers.

Commercially Important Cultivars of *Cornus florida*:

'Cherokee Brave' - Red bract; 1st C.f. with some natural resistance to powdery mildew. Patented and trademarked by Commercial Nsy.

'Cherokee Chief' - Ruby red bracts; one of the most popular red-bracted forms; introduced by Ike Hawkersmith, Winchester, Tenn.

'Cherokee Princess' - One of the best. Large white bracts; flowers heavy; high resistance to spot anthracnose and canker in trials at Crossville, Tenn. performed by UT. Producers are growing this one in place of the seedling white because the Princess grows faster than the seedling, looks much better and responds well to the preventative fungicide sprays for powdery mildew.

'Cloud 9' - Showy white overlapping bracts; one of the best; one of most flower bud hardy; resistant to canker. DNA proved to be same as Barton. Testing done by Mark Windham, UT.

'Daybreak' - White bracts; variegated green & white foliage; does not scorch; pink to deep red fall color; Commercial Nsy patented #6320 and trademarked.

'Rubra' - Pink to red bracts; flowers may be less cold hardy than white; resistant to canker.

'Sunset' - Red bracts; pinkish red tipped new growth, excellent fall color; good vigor; Commercial Nsy patented #6305 and trademarked.

New crosses made by Drs. Mark Windham, Bob Trigiano and Will Witte in the Orn. Hort & Landscape Dept. at The Univ. of Tenn. and released by the Dogwood Research Group within the Tenn. Agr. Exp. Station will be patented &/or trademarked. Jean, Karen and Kay may not be available to producers until 2004+???, and the consumer for 3-5 additional years. The limited amount of stock is currently being increased by vegetative propagation.

Royalty Fees: Appalachian Spring (dogwood anthracnose resistant and not patented) is \$0.60 per tree whereas the 4 powdery mildew resistant patented trees (Mist, Blush, Snow and Joy) are \$1.00/tree. Contact: Bob Trigiano at: discula3@yahoo.com or 865.386.1872 or 865.974.0221 and complete all paperwork prior to delivery.

'Appalachian Spring' - Long, white bracts. Resistant to *Distula* Anthracnose. Upright growth habit. Prolific bloomer. Unusually large, dark green foliage. Fall color is red to scarlet. Abundant, bright red berries. The first dogwood released by TAES. (It has been observed to require more moisture as a liner in production, wilting earlier in the day than the others.-Hidden Hollow)

Powdery Mildew Resistant

These 4 are the only white bracted dogwoods known to be resistant to powdery mildew. They are more resistant to powdery mildew than 'Cherokee Brave'.

'Jean's Appalachian Snow' - White bracts, clefts have yellow-green coloration. Foliage is yellow green. Fall color is reddish green. More resistant to powdery mildew than 'Cherokee Brave'. Along with Kay and Karen, will be only white bracted dogwood known to be resistant to powdery mildew.

'Karen's Appalachian Blush' - White bracts with light pink, cleft color is red purple. Foliage is yellow green. Fall color is vivid red. More resistant to powdery mildew than 'Cherokee Brave'. Along with Kay and Jean, will be only white bracted dogwood known to be resistant to powdery mildew.

'Kay's Appalachian Mist' - White bracts have clefts that are red purple. Foliage is yellow green. Fall color is vivid red. More resistant to powdery mildew than 'Cherokee Brave'. Along with Karen and Jean, will be only white bracted dogwood known to be resistant to powdery mildew.

NEW !!!!!!! **'Appalachian Joy'** - White, multiple (4-7) bracts (limited budwood).

There are many more cultivars. See Dirr's 5th ed or UT's new Dogwood pub. #1670.

Storage of Flowering Dogwood Seed by Dr. Sandra M. Reed, US National Arboretum, McMinville

1. Seed stored at 68 degrees F (20 degrees C) rapidly lost viability, regardless of seed moisture.
2. Seed viability remained high after 3 years in storage for seed dried to 6% or 10% moisture and stored at -4 degrees F (-20 degrees C).
3. Storage temperature appeared to be more important than seed moisture level in maintaining viability and seedling vigor.
4. Producers can save seed for future use by allowing seed to dry in a low humidity environment for a few days after cleaning. The seed should be packaged in moisture proof-containers and stored in a household type freezer.
5. from poster 2-05
6. 10-05 Attempting to learn best type of container to store hundreds of pounds of seed in, must be air tight. Tim at Hillis uses 15 yr old 55 gal barrels that paint had come in. The barrels have the resealable rings that can be tightened with a screw. Tim uses a 55 gal poly bag as a liner. He puts no more than 25 lbs of seed in multiple smaller bags. All bags are tightly closed.

Site Selection

Dogwoods are extremely demanding for a very well drained soil; like hemlock, white pine and peach. Select a site without a fragi-pan; where water never stands. Look for native dogwoods in the fence rows as an indication of suitability.

Well drained soils in Warren County suitable for dogwoods are Allen, Cumberland,

Etowah, Hartsells, Jefferson, Minvale, Mountview, Sequatchie, and Waynesboro. Huntington and Staser are okay if the actual spot does not flood.

Additional information on the best soils for other areas may be available.

Planting

Exercise caution to not plant too deep. Dogwood, like hemlock and white pine are very sensitive and will not tolerate being too deep. It is also critical not to allow cultivation to throw additional soil over the roots. Some producers replace the disc blade that throws the soil with a smaller diameter blade.

Field Spacing

Spacing of dogwood liners in the field depends upon the size expected to be harvested and the width of the equipment that will be used to perform various maintenance tasks.

Plant a minimum of 4-5 feet apart within the row to harvest a 1.5 - 2 inch caliper tree. Middles should be at least (width of widest tractor or implement used in middles plus 2 feet per side = 3' implement + 4' = 7' middle).

Spacing examples of trees on 1 solid acre with no roadways:

5 x 4 = 2,178	4.5 x 4 = 2,420	4 x 4 = 2,723
5 x 5 = 1,742	4.5 x 5 = 1,936	4 x 5 = 2,178
5 x 6 = 1,452	4.5 x 6 = 1,613	4 x 6 = 1,815
5 x 7 = 1,245	4.5 x 7 = 1,383	4 x 7 = 1,556
5 x 8 = 1,089	4.5 x 8 = 1,210	4 x 8 = 1,361

Remember to skip a row or leave a 10-12 foot roadway to spray, dig, and load from. Consider 6-8 rows per block. An air blast sprayer is essential for accurate and timely pest control. An air blast sprayer should be able to penetrate the foliage on 6-8 rows of dogwood tree foliage. A tree spade will also require space to maneuver without damaging adjacent plants. A 4 row block offers 50 percent of its plants immediately accessible to a spade.

"It's not how many trees you plant per acre that will make you money; it's how many trees you sell per acre that is important." -Dr. Carl Whitcomb, in McMinnville, Tenn., Oct, 1991, speaking to the MTNA trade show educational audience.

Insect Control

Refer to UT Ext. pub. 1589, "Commercial Insect and Mite Control for Trees, Shrubs and Flowers", for a complete list of potential insects and the recommended controls.

Dogwood Borer - Spray late April and mid-July Dursban 4E -- 2 tsp/gal; 1 fl oz/3 gal; 3.2 fl oz/ 10 gallons; 16 fl oz or 1 pint/ 50 gallons; 32 ounces (1 quart)/100 gallons of spray

water.

Spray the lower limb crotches, down the trunk to the soil from two sides. A back-pack or handgun is the preferred method, in order to wet the bark nearly to run-off. An air blast sprayer does not usually do an adequate job.

Dursban 2E would require twice as much since it is half as strong as the 4E. The 4E formulation is usually a better buy. There is less carrier and less chance of burn with the 4E.

Disease Control

Powdery Mildew

Based on 1999 research performed in Warren County at a nursery by UT researchers; Banner MAXX , Systhane and Rubigan AS provided the best control. Cleary's 3336F or WP, Bayleton 25WP, & Zyban 25WP were less effective, but still effective enough to rotate with. It is beginning to be suspected that different strains of the mildew exist; explaining why a fungicide is more or less effective in different locations.

	<u>per 100 gal.</u>	<u>per 3 gal.</u>
Banner MAXX	8 fl oz	1.5 teaspoons
Rubigan AS	8 fl oz	1.5 teaspoons
Systhane 40WP	4 oz	(A)
Cleary's 3336F	10 to 20 fl oz	2.25 to 3.75 teaspoons
Cleary's 3336WP	12 to 24 oz.	(A)
Bayleton 25WP	2 to 4 oz.	3/8 teaspoon
Zyban 25WP	1.5 lbs.	7.5 teaspoons or 2.5 Tablespoons

Their price per container may seem high; but they are concentrated. Compare cost per spray tank, not the price per container.

Rotate between 2 or 3 proven fungicides every 14 days; beginning about mid-May; through Sept.

We are recommending that they be sprayed at least 6 hours prior to a rain. We are also recommending that you spray prior to a rain, rather than after the rain. Here's why.

Powdery mildew produces thousands of spores per square inch on a dogwood leaf. Spores are spread by the impact of the raindrop. Protection is needed during this period of spread and infection.

We observed up to a 50 percent increase in caliper and height where these fungicides were sprayed every 2 weeks, May 28--August 19, in 1998. The fungicides also prevented leaf scorch that was observed on the unsprayed control plants.

Banner, Bayleton and Systhane are in the same chemical class. Zyban contains Cleary's and Mancozeb. It accomplishes nothing to rotate between fungicides that are in the same chemical class.

(A) Systhane and Cleary's 3336WP is not recommended for backpack spraying because they are in water soluble packets designed for larger volumes of water.

Frequent sprays of Banner, Bayleton or Systhane at high rates can cause short internodes, thereby stunting growth.

Banner MAXX, Rubigan, Bayleton, Cleary's and Systhane are systemic fungicides. A good quality spreader should be added to the tank; but a sticker is not required for the systemics. The fungicides above are also effective on Dogwood Anthracnose (*Discula*) and Spot Anthracnose, except Rubigan. Banner 1.1E has been replaced with Banner MAXX.

Use the lower rates as preventative and the higher rate after the disease is found. Spray every 7 days when the disease is severe.

It is also recommended that container dogwoods not be watered overhead to avoid Dogwood Anthracnose and lessen the severity of Powdery Mildew. A drip system using a spray stake in each pot would keep the foliage dry. Watering overhead at 5am would be the best time of day until the conversion to drip can be made.

Refer to all labels prior to use. Always follow label directions.

Dogwood Canker

Dogwood Canker makes them unsalable for a grower with a conscience. We observe less canker on dogwoods planted on good soil, with proper moisture and nutrients; where they grow continually through the growing season without being stopped by droughts, etc. It is thought that any stress that slows growth is likely to increase the likelihood of canker.

While extensively researched by several, man still does not know if Dogwood Canker is caused by a fungus, bacteria or virus; spread by wind, water or nematodes. It's not been proven or disproved to be weather related. Drip irrigation is suggested.

Dogwood Anthracnose (*Distula*)

Fortunately the recommended fungicides above for the prevention of Powdery Mildew will also prevent *Distula*, except Rubigan and are acceptable to the Tennessee Dept. of Agriculture (TDA); but the sprays must begin with new growth. Keep spray date records and receipts showing purchases for TDA inspections.

Spot Anthracnose or Crinkle leaf Refer to UT pub. 1234.

Refer to **UT Ext. pub. 1234** for a complete list of potential diseases and the recommended controls. Phytophthora Root Rot can be a problem if the site is poorly

drained or during very wet periods. Strive to select a well drained site.

Irrigation

An even rate of growth, without stopping and restarting has been proven to reduce canker. Irrigation (drip) should pay for itself in dogwoods, by not losing small seedlings and liners in brief droughts, continued growth, reduced canker, increased plant growth, reduced borer and less death of the salable trees during droughts.

It is also recommended that container dogwoods not be watered overhead to avoid Dogwood Anthracnose and lessen the severity of Powdery Mildew. A drip system using a spray stake in each pot would keep the foliage dry. Watering overhead at 5am would be best until the conversion to drip is made.

Weed Control

Apply pre-emergence herbicides in Feb-March, mid-summer, and Sept-Oct 15; or anytime that the soil is freshly cultivated and weed-free. Banding is recommended over broadcasting. Casoron, Barricade, Gallery, Kerb, Pendulum, Pennant, Princep (Simazine), Surflan and Treflan are labeled for dogwood. (OH 2, Pendulum 2G, Ronstar, Rout, and Snapshot are labeled for containers.) Pendulum applied over small plants and 1st year buds had caused extensive stunting and deformity.

Wait for a settling rain before spraying new transplants, unless the label states something different. Envoy, Fusilade T/O, and Vantage are labeled to go overtop to kill young green grass.

Weeds, especially grass, can really stunt dogwoods, and pull needed moisture away from the crop. Even Crimson Red Clover should be removed during exceptionally dry springs.

Fertility for Dogwoods spaced to Ball

Sidedress liners and plants spaced to ball mid to late February and late June with no more than 50 lbs of actual nitrogen per acre, annually. Refer to Table 1 for amounts.

Use 13-13-13 or 15-15-15 if Phosphate (P) and Potash (K) was not broadcast pre-plant, or if a soil test indicates that the P and K levels are still low. Never fertilize after August 1st, except liquid. Stop liquid fertilization by Sept 15.

Harvesting

Two inch caliper dogwoods are probably a 5-6 year crop when lining out 18-24 inch liners; depending on soil type, fertility, moisture, growth rate, pruning, etc; with harvesting occurring the last 2-3 years. Dogwoods can be either hand or machine dug.

The use of a wire basket is good insurance for the ball.

Digging the Correct Size Ball

The **American Standard for Nursery Stock** was written by the American Nursery & Landscape Assoc. (ANLA) (formerly the American Assoc. of Nurserymen, AAN). It establishes techniques for measuring plants and rootball size for particular plant sizes and different plant types. A copy of the Standards may be obtained by contacting the ANLA at 202-789-5980 ext 3019 for a few dollars.

A 2" dogwood would require a minimum of a 24 inch ball, according to Table 5 on page 7 of the 1996 revision of the Standards, in Section 1: Shade and Flowering Tree. A portion of Table 5 is reproduced below. The minimum ball size is stated based on the caliper. These specifications are for hand dug or machine dug balls.

Producers are not legally bound to follow the ANLA Standards.

Table 5

Caliper	Minimum Ball Diameter
1	18 inches
1.5	20 inches
1.75	22 inches
2	24 inches
2.5	28 inches
3	32 inches
3.5	38 inches
4	42 inches

Revenues (figures from 2000)

24" bareroot liners sold for \$5.75 to \$9.50 in 2000; depending on cultivar and volume.

5' B&B trees sold for \$30 to \$40 in 2000; depending on cultivar and volume.

1.5" B&B trees sold for \$55 to \$65 in 2000; depending on cultivar and volume.

Potential Problems with Dogwood Production:

Seed may never germinate after being planted and that would be that. The seedling could be killed by frost, damping-off, a wet spring or a dry summer.

There's the possibility of root damage from grubs or close cultivation or becoming a runt and not being budded. The bud may not take. The first year bud may be blown off the

stump during the spring of the second year. It could develop too much of a dog leg, get canker, receive hail damage, receive mechanical damage and be culled. If dug, the roots could freeze or dry out while left unprotected . It could be dropped and the rootball could bust.

References:

- "American Standard for Nursery Stock", American Association of Nurserymen, ANSI Z60.1-1996, approved Nov. 6, 1996, Section 1: Shade and Flowering Trees.
- Dirr, Michael A. 1998. Manual of Woody Landscape Plants, Stipes Publishing, Champaign, IL. 5th ed.
- TNLA Buyer's Guide, 2000-2001.
- Dogwood Research Group within the Tenn. Agr. Exp. Station; Drs. Mark Windham, Bob Trigiano and Will Witte, 2000,
- Shadow, Hoskins. 1959. "The Budding of Dogwood in the Field", Proceedings of the Ninth Plant Propagators Society, pg. 54-57.
- Windham, Mark T. and Robert N. Trigiano. Sept. 1998. "Are 'Barton' and 'Cloud 9' the same Cultivar of *Cornus florida* L.?", J. Environ. Hort. 16(3):163-166.
- Witte, Will. 1989. "Handling Dogwood Seed for best Germination", Proceedings of Tenn Nsy Short Course, pg 302-305.

"The Budding of Dogwood in the Field" - By Hoskins A. Shadow, Tennessee Valley Nursery. Mr. Shadow gave this talk in 1959 in Pennsylvania to the Ninth Annual Plant Propagators Society meeting. It is reprinted here out of respect for the man that Mr. Hubert A. Nicholson named the "Dean of Dogwood Growers", but also for its utter simplicity.

Mr. Hoskins Shadow devoted a lifetime to producing quality dogwoods; was a past president of The American Assoc. of Nurserymen, The Southern Assoc. of Nurserymen and The Tennessee Assoc. of Nurserymen. He willingly shared his knowledge and was respected by all. His sons Fred and Don continue in the business.

Production has changed very little over the past 40 years. A lower case letter footnote will be placed where comments will be made as to production changes.

"It is my desire to give you as near as possible the procedure we follow in the field propagation of dogwood on a commercial basis.

Our source of seed is from the native dogwood, which is abundant in our area. These berries are gathered in the early fall and are brought to our packing shed where we buy them, from collectors, by the pound.

We prefer that the berries be well ripened and find that the best test is to press the berries between the thumb and fore finger. If the seed presses out freely, the berries are ripe and ready to be cleaned. We use a Dybvig Seed Cleaner for this process and find it

very satisfactory.

After the seeds are cleaned, they are placed in the open air and sun to dry for a few hours and are then stored in bags in lots of 25 lbs., which is a convenient quantity to handle, since it will not mold, if hung from a rafter.

When weather permits in late October and early November, we plant in a fertile, well prepared seed bed directly in the field. Our standard row is 42 inches, and the seed are placed in a "V"-shaped furrow about 1 to 1.5 inches deep. This furrow is then filled with well decayed hardwood sawdust and firmed with a roller or Cultipacker. We find this desirable, as it prevents, to some degree, the loss of sawdust by wind erosion.

Germination usually takes place between April 1-15. If we have not been able or have not desired to plant all of our dogwood seed in fall and early winter, we will stratify them by Jan 15th.

Our method of stratification uses equal parts by volume of sand and well decayed sawdust. The seeds are poured on this mixture and hand mixed on a concrete floor. The mixture is then placed in steel barrels and stored at a temperature of 40 degrees F. for 60 to 75 days. I might add that our mean average temperature, at the season of the year, is about 40 degrees; consequently we have had good results by storing these barrels outside on the north side of a building.

At planting time the seeds are taken out of this stratification mixture by running it over a 1/4 inch screen which separates the seed from sand and sawdust. These are then planted as previously described. Under favorable conditions, these seed will usually germinate within 2 or 3 weeks.

The little seedlings are very weak when they first emerge and very good care must be taken of them in the early stages of growth. Irrigation is desirable. After the seedlings are well established and the stand can be determined, they are ready to be thinned to a normal stand, which, for us, is about 3 inches apart in the row. This thinning is usually done from the first to the middle of July., or after the seedlings have a fairly well established root system. Our budding operation usually begins between August 1 to 15, or a near to that time as is practical.

You will remember that we have a very tender seedling and consequently we must also have budwood which is in a similar condition. In other words, we have a small, tender seedling; we want a small, tender bud. It takes a great of skill and dexterity to handle the tender buds and seedlings.

I might mention here, that we formally budded our dogwoods on transplanted seedlings. After using both methods, we much prefer the budding of 1 year old seedlings in the field, and root pruning them, to the method of budding transplanted seedlings. The former makes a much stronger union and eliminates the need for staking.

We use the shield or T-Bud methods placing the bud on the seedling as low as is practical and on the southwest side of the seedling. Although this in the direction of our prevailing wind it makes a straighter plant.

In removing the bud from the bud stick, there is a small piece of wood that remains in the bud. We make no attempt to remove this, as more damage is done to the bud by trying to remove it than it causes. The bud is then tied firmly in place with raffia, This is done by wrapping 3 rounds of raffia around the seedling just below the eye or bud, and 4 rounds just above the eye. The raffia is twisted into a rope above the wrap, and tied on the wood of seedling instead of on the raffia itself. This tie will hold the bud firmly. The bud will usually stick immediately. The seedlings should be watched carefully and within 10-14 days, the tie should be cut on back side before it girdles the seedling.

About November 15, or as soon as the plants are dormant, these seedlings, with the live bud in them are root pruned to induce the development of a fibrous root system. The following spring, just before the bud starts growth (about April 1st), the tops of the seedlings are removed by cutting them off just above the bud. All suckers must be removed and the bud given an opportunity to grow. By the end of the first growing season, we will have plants from 12 to 36 inches in height.

When well ripened and dormant, we run the digger, with a root pruning blade flat, in order to prevent tilting, under these one year plants. This permits us to remove all the plants we desire to move, leaving well spaced plants 2 feet or more apart in the row for growing on the second year. We are able to produce 3-4 and 4-5 foot plants the second year, usually with bloom buds to be dug B&B. To increase a desirable quantity of bloom buds, we find that irrigation is very helpful.

This method produces a well formed, straight trunk, with perfect compatibility between scion and stock which increases the chances for survival for each plant. Thank you.”

(Editor's note: Mr. Shadow supplemented his discussion with a series of well selected, colored slides. Some of the comments and questions follow).

MR. CASE HOOGENDORN (Newport, R.I.): What is the reason for covering your seeds with sawdust instead of soil?

MR. SHADOW: Well I guess you learn a little bit by experience. We find we get good stands by using sawdust and we don't by using soil. Our budding crew consists of 3 budder, 3 tiers and 1 man preparing the seedling for budding.

MODERATOR LANCASTER: Thank you very much, Mr. Shadow, for a very interesting discussion on the propagation of the dogwood. Since Mr. Shadow did not use his allotted time of 30 minutes we have time for several questions. Mr. Flemer.

MR. WILLIAM FLEMER (Princeton, NJ): I would like to ask if you have tried plastic budding strips on your dogwoods?

MR. SHADOW: No, Bill, I have not. I would be rather reluctant to try them in any quantity since the bud is very, very tender. If it were a larger bud or of the type that you were putting in a transplanted seedling, then I think probably they would be satisfactory. I question the advisability of using them on a tender bud.

MODERATOR LANCASTER: Thank you.

(Applause)

The meeting this afternoon will start on time, since we have now set a precedent for this Society by starting on time this morning. Thank you. (The session recessed as noon.)

Dogwood Liner Production Calendar

Year 1

Obtain aged hardwood sawdust. Soil test. Broadcast recommended lime and fertilizer prior to field preparation.

Sept - Oct Collect, buy and clean seed in fall.

Oct - Nov Plant the seed. Band spray 1.5 qts Princep/acre over row after a settling rain.

Year 2

March-April Plan frost protection

April Seedlings germinate. Apply Damping-off prevention.

May Irrigate and cultivate as needed.

Late May Prevent powdery mildew with applications every 2 weeks.

When 4 inches tall, sidedress lightly and apply pre-emergent herbicide.

Summer Find budders and budwood

Aug, Sept Irrigate, clean out and Bud

Nov Root prune

Nov to March Un-budded seedlings will be barerooted and sold or replanted (spaced) over the winter. Occasionally they may be left til end of second year if the planting is not too dense, especially if not a market.

Year 3

Feb, March Cut and remove the understock top. Apply pre-emergent herb. Sidedress lightly.

March, April Bud begin growth.

April, May Irrigate and cultivate as needed.

Late May Prevent powdery mildew with applications every 2 weeks.

Late July Sidedress lightly.

Summer Irrigate, cultivate and practice good weed control as needed.

Nov- March Bareroot, take up, grade, stored, shipped or replanted (spaced to ball in field or in pots. They will be 18-30 inches tall on average.

Year 4

Budded or seedling liners will grow in field for 2-5 years and be sold when 4 to 6 feet tall, up to 2 or 2.5 inch caliper, normally.

Dogwood Production Calendar for B&B

Practice good weed control and irrigate as needed.

Nov to March	Transplant liners to field
Feb-March	Sidedress Apply pre-emergent herbicide
late April	Apply Dursban for borer prevention
May 15 +-	Begin fungicide sprays for Powdery Mildew Spray every 14 days until new growth stops.
late June	Sidedress
June-July	Apply pre-emergent herbicide
mid-July	Apply Dursban for borer prevention
Nov-Dec	Band spray pre-emergent herbicide (Princep or Gallery alone), primarily to prevent the winter broadleaf weeds; such as thistle. A pre-emergent herbicide (Surflan, Pendulum, Factor) to prevent grass (ryegrass) may be tank mixed, but is optional, and may not needed for all blocks.
Nov-March	Harvest and ship.

Kousa Dogwood Production

Number of Seeds per Pound and Cost

"Seeds of Woody Plants in the US", USDA Agriculture Handbook #450, 1974, page 339, says that there are 7,400 cleaned *Cornus kousa* seed per pound on the average. The range is 6,500-8,300. Kousa seed are approximately \$75 per pound according to Shadow Nursery in 1993.

Seed Collection

The large raspberry-like fruits are collected in Sept-Oct. by hand. The seeds are removed from the pulp, frequently by hand. Fall plant or provide 3 months of cold, moist stratification.

Planting

It is standard nursery practice to plant the seed in rows and cover them with sawdust. The sawdust prevents soil crusting and allows emergence. The seed population planted per acre varies greatly among producers. Dogwood seed are planted thick to aid each other in emerging (some pull and some push).

Commercial Nursery in Decherd plants 25 pounds per acre; Tennessee Valley Nursery in Winchester plants 17.42 pounds per acre in rows 5 feet apart, striving for 18 seed per foot; and Shadow Nursery in Winchester also strives for 20 seed per foot in rows 6 feet apart. Tennessee Valley expects 60-70% germination. Germination is a long way from market.

Pro-Gro Nursery in McMinnville had two total failures back to back. Seedling root rot killed 100% in a weeks time. Planting purchased seed too late in the spring that apparently had not been properly stratified (to simulate winter conditions) never germinated after the grower waited two years. Buck Springs Nursery of McMinnville had similar results 1 or 2 years.

Marketing

A Kousa seedling is sold as a liner at the end of two growing seasons (occasionally after one year). I believe Krauth Nursery in Cowan plants kousa seed in beds like tobacco plants. The seedlings are also used as understocks, but *C. florida* is used more often.

The New *Cornus kousa* and *Cornus florida* Hybrids from Rutgers

by Don Shadow
Shadow Nursery, Winchester, Tenn.
JUNE 19, 1993

Dr. Elwin Orton, Rutgers University began trying to cross *Cornus kousa chineses* and *C. florida* 25 years ago. His first successful cross required 10 years. He has introduced six hybrids since then:

'Auroro' - They bloom after *C.florida* but before *C.kousa*. They are hybrids and do not produce fruit, like mules. Three bracts overlap and 3 do not. The original plants are 18 feet tall and very vigorous. They are good growers. Received the Styar Award from the Pennsylvania Horticultural Society for 1993.

'Constellation' - Heavy bloomer. The blooms last a little over 3 weeks.

'Galxery' - The flowers are tucked a little bit. The blooms reflex down with age and become whiter. A very nice plant.

'Ruth Ellen' - Received the Styar Award from The Pennsylvania Horticultural Society for 1993.

'Stardust' - The most dwarf one. Due to an incompatibility problem, Shadow Nursery is attempting to root it. Shadow Nursery is not currently producing it and recommends that no one buy budded 'Stardust' plants. It has a good bloom.

'Stellar Pink' - The only pink *C. kousa chinensis* and *C. florida* cross. The shade of pink varies with the amount of spring heat from year to year.

I sent Dr. Orton a *Cornus florida* 'Pymgy' about 20 years ago that Mr. Will Hawksmith found in a block of seedlings. Dr. Orton hybridized it and developed *C. florida* 'Pink Beauty'. It is very compact, but not a true dwarf.

Cornus florida 'Wonderberry' - The berry is the outstanding attribute, being as large as the tip of your index finger. A wonderful flower also.

Dr. Orton has a nuttali kousa hybrid back crossed onto kousa. He feels it is very outstanding, but he has not released it yet. This might suggest that nuttali and kousa is more closely related than florida and kousa. The florida and kousa crosses are sterile, while the nuttali and kousa crosses are not sterile.

Rutgers University has licensed 7 nurseries in America to produce Dr. Orton's *C. florida* and *kousa* hybrids. Four of the seven are Franklin County nurseries, here in Tennessee.

This speaks well for Dr. Orton's opinion of our ability to produce dogwoods.
Comm/Crops/Dogwood-kousa hybrids on-line June,1993

Container Production of Dogwood

Dr. Donna Fare, USDA-ARS, McMinnville, feels dogwoods can be successfully grown in containers, as long as irrigation and fertility are closely monitored. Too much of either will cause problems. She has grown dogwoods in several research projects without a problem. She recommends a low rate of CRF and cyclic irrigation applied with micro spray stakes.

Actually, Dr. Fare recommends that dogwoods be potted in the fall/winter with half of the recommended rate incorporated; the other half topdressed in spring. A commercial container nursery here struggled for 2-3 seasons until they cut their rate in half.

Comm/Crops/Dogwood Rev. 03-2002

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