

Seedling Production in the Northern Plains

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Lincoln-Oakes Nurseries is an association-owned nursery producing woody plant conservation materials for the Northern and Central Plains and surrounding states. Our production sites are located in Bismarck and Oakes, North Dakota and have been in production for nearly 50 years. Customers consist of soil conservation districts, public agencies, and other conservation nurseries.

We are located in the North Central U.S. and so are heavily influenced by an inland continental climate. The growing season is 125 days on average and can vary from about 115 to 145 days. The average frost free days are probably our greatest limiting factor in seedling production in North Dakota.

Climate is rated as USDA Zone 3 with winter lows below -30°F in at least 7 out of 10 years, occasional lows dip below -40°F . Moisture averages 16 inches annually in Bismarck to 20 inches at our nursery in Oakes. Snow cover may range from heavy to nearly non-existent in some years, typical of the plains environment.

The nurseries' production mix consists of approximately 70 deciduous species and cultivars of trees and shrubs hardy in our distribution area that ranges from climatic Zones 3 through 6. To ensure hardiness of the stock produced, we maintain our own seed production belts and orchards and also collect from established plants in the area. Very little seed is purchased from non-regional collectors or companies. Examples of species produced include *Acer*, *Crataegus*, *Cornus*, *Fraxinus*, *Prunus*, *Populus*, *Quercus*, *Rhus*, *Rosa*, and others.

Stock is grown as 1-0, 2-0, 2-1, and 3-0 seedlings and 1-yr rooted hardwood cuttings.

Seedling propagation requires high-quality, cleaned seed as a starting point. Fleshy fruits such as *Prunus*, *Malus*, and *Amelanchier* require de-pulping, drying, and fanning to remove all pulp and fruit skins. We have built a Dybvig type mascerator with a four-cylinder engine and three-speed transmission to accomplish the de-pulping of large fruit lots. Seed is bagged after cleaning and stored at 35°F until use. We can normally store seed for up to 3 years in advance of use to insure yearly crops of required species.

Seeding of nursery crops is undertaken using stratified or non-stratified seed depending upon treatment required to initiate germination. Seeding takes place in the months May through October. Warm stratification requirements are met by summer and early fall planting of dry seed in mulched moist beds, cold stratification occurs over the winter months. Examples of summer seeded crops are *Crataegus*, *Cotoneaster*, and *Rosa*, most *Prunus* species are early fall planted for a short-warm stratification. Several species are given warm and cold stratification treatments artificially in plastic bags for 8 to 10 months before summer or fall planting to simulate a years treatment in outside conditions, examples include *Viburnum* spp., *Fraxinus nigra*, and *Symphoricarpos occidentalis*. Many crops can simply be given a cold stratification treatment in a cooler to initiate germination, this may range from 30 to 120 days in a damp media.

Winged seeds, acorns, nuts, and large *Prunus* seeds are seeded using a tractor drawn 2 row belt seeder which is ground driven. Metering to obtain the desired

seeding rate per linear foot is done by adjustable gates. Rows are planted on a 32 inch spacing and hilled with soil to maintain moisture and provide protection over the winter.

Many small-seeded shrub species are planted in four row beds on a 12 inch spacing between the rows. The four seeding units have adjustable planting plates which allows use for a wide range of seed sizes. Seeded beds are sanded to lesson soil crusting and then may be mulched with rye straw.

Seed germination and seedling emergence takes place in late April and early May; damaging freezes can occur at this time and some night irrigation may be required for crop protection.

Cultural inputs during the growing season include chemical applications for disease and insect control, cultivation, weeding, fertilization, and irrigation. Our irrigation water source at Bismarck is the Missouri river about 2½ miles west of the nursery. This high quality irrigation water is pumped through a 16-inch underground pipeline and utilized by the nursery and two additional cooperators.

The previous nursery water supply was well water that was very high in sodium. Sodium gradually accumulated in the soil and by 1990 it was very difficult to grow a number of salt-sensitive plant species at the Bismarck site. Several water supply alternatives were considered to address the problem, the plan chosen was to run a pipeline from the Missouri River to bring in fresh water and begin gradually to leach the accumulated sodium below the root zone. Heavy irrigation of soil building crops and fallow fields was suggested as a way to begin the leaching process. The irrigation system was completed in 1991 with river water making a tremendous difference.

At that same time we wanted to address the soil condition and what could be done to improve water permeability, alleviate crusting, reduce soil pH, and increase organic matter. The city of Bismarck was looking for an alternative to burying lawn waste which accounted for up to 40% of the materials deposited at the city landfill during the summer months. In cooperation with the city, we opened a stockpiling area for thatch, lawn clippings, and leaves. These were spread heavily on open production fields several times during the summer and fall months and disced into the top growing layer of the soil. No plowing is done, this eliminates bringing salts back up to the soil surface.

Fields may be applied with organic material for 1 or 2 years depending upon field condition. Rye is fall planted after spreading is completed and grown as a cover crop. The rye crop is either chopped for use as mulch the next summer or disced under.

Improvement in our soil has been rapid and noticeable in improved seedling growth, water permeability, and root system quality.

Propagation of poplars, cottonwood, and willows is accomplished by growing cutting material in stooling blocks, harvesting after defoliation, and processing into 7-inch cuttings over the winter months for spring planting. We utilize a fabricated four-row mechanical planter for placement of the cuttings at planting time in late May.

Growth is rapid during the growing season and 1-year-old rooted cuttings are 3 to 6 ft in height at season's end.

Plains cottonwood, *Populus deltoides* subsp. *monilifera* (syn. *P. deltoides* var. *occidentalis*), often roots in poor percentages from hardwood cuttings in the field, due to this most of our cottonwood is grown from seed as a 2-0 crop.

Cottonwood seed is dispersed in June from native stands along the Missouri River. Seed is collected by using a shop vacuum type cleaner that removes the hairs from the small seeds as they are vacuumed into the cleaner. The seed is very short-lived and after some preliminary cleaning to remove debris, is seeded directly onto the surface of raised, packed beds.

Under natural conditions, cottonwood seed lands on the bare surface of sub-irrigated soil or sand along riparian areas. To successfully germinate the seed under nursery conditions, a continually moist soil surface must be maintained for the first 5 to 7 days after seeding for germination and root development to occur. To maintain this moist soil surface under our low humidity conditions, erosion mats are rolled onto the beds and pinned down to prevent removal by winds. Irrigation is applied two to three times daily and germination begins at 2 to 3 days. It is complete at 7 days after planting. The mats are removed from the beds at approximately 10 to 14 days after seeding.

Cultural inputs for cottonwood seedlings after mat removal are the same as for other seedling crops. Plains cottonwood is initially slow-growing as measured by seedling top growth, but much of the first year plant growth is in the deep taproot. Height at the end of the first season is 10 to 24 inches, but reaches 5 to 8 ft at the end of the second season.

Harvest of our nursery crops begins around the first of October after several hard frosts have initiated defoliation of species such as green ash and caragana that drop leaves fairly early in the fall. Most crops of seedlings are topped with a modified forage chopper to a height of approximately 20 inches to provide a uniform seedling size and a top to root ratio of about 2 to 1 to 3 to 1.

Undercutting and lifting is accomplished by a single row lifter used on our 32-inch row spacing and a Lundebly plant lifter for our four-row beds. As stock is lifted, it is quickly placed in wooden field boxes, misted, and transported to our grading facility with a fabricated box carrier.

Our lifting season lasts until soil freeze up halts digging that occurs on the average about the second to third week of November. About 65% of our stock is fall lifted with the remainder dug after thaw in spring.

Seedlings are graded, bundled, and then placed in cooler crates with a poly bag liner. Grading is for the most part based on a conservation grade seedling of 12 to 20 inches in height and corresponding caliper. Additional sizing is done for customers with specific size needs.

Storage of graded stock overwinter is accomplished by the use of two cooler/freezer units. Units freeze stock at 25 to 27°F during the winter months and act as coolers in the spring at 35°F. Stock is pulled for orders as needed and shipped by nursery or customer truck and by United Parcel Service.