Food Forest Nursery

Nursery; the most appropriate nursery includes bareroot and container.

A plant nursery is a place to nurture young trees, flowers and other plants to take life. Plants in nurseries usually receive extra care and attention to help them grow large and healthy enough to be transplanted in various locations.A nursery is a dedicated surface to forest speciecs and other beneficial plant breeding intended to be used in restocking forests.

Concepts

To grow plants well, it is important to understand what limits growth. Ecologists refer to this as the concept of limiting factors and it can be helpful in starting a native plant nursery. It states that, although a biological process such as growth is affected by several factors, the rate of that process is controlled by the factor that is most limiting.

Possible Limiting Factors :

Atmosphere;

Light,Temperature,Carbon Dioxide,Humidity,Pathogenic Fungi, Insect Pests,Weeds and Cryptogams.

Soil ;

Water, Mineral Nuterients, Pathogenic Fungi and Lack of Mycorrhizal Fungi.

By managing growth-limiting factors we can develop an environment suitable for growing plants, our “propagation environment”; this is any location that has been modified for the purpose of growing plants.

The Importance of Quality and Access to Water

Good access and quality water is critical for growing native plants , and the concentration and composition of dissolved minerals, often referred to as “soluble salts,” are the major concern. Young plants can be damaged by moderate salt levels, so get water tested.

Drip irrigation is a highly efficient system that uses low water volume and low pressure

to deliver water directly to the root zone. With drip irrigation, water is applied within rows, directly to the soil surface, and gradually over extended periods of time (e.g., 1, 2, or 5 gallons per hour). Drip irrigation results in less water lost to evaporation or run off. In addition, weed seeds are not irrigated by water distributed over large areas, which results in fewer weeds in the nursery.

Nursery Site Selection

Develop the current site of the animal/chicken house.

Bareroot Nurseries

How big a nursery site ? Well, it depends on how many seedlings we plan to grow. Plan on growing about 25 seedlings per square foot using beds 4 feet wide (so you we reach the centers). Therefore, each lineal foot of nursery bed will yield 100 seedlings. For example, if you want to grow 1,000 seedlings, the length of bed required would be 1,000 divided by 100 = 10 feet. So a 4 x 10 foot bed would be sufficient. Plan on adding about 50% more space for walkways between beds.

For the germination percentage of our seedlot, and assuming we sow 10% extra for losses and that our rows are 6 inches apart, this table provides an estimate of how many seeds to sow per square foot and how far apart those seeds should be in each row.

Germination Percentage	Seeds to sow per square foot	Seeds to sow assuming a 10% loss during the first year	Inches between seeds in row
80 to 100	32 to 25	35 to 27	1 to 1¼
60 to 80	42 to 32	46 to 35	¾ to 1
40 to 60	62 to 42	68 to 46	½ to ¾
20 to 40	125 to 62	138 to 68	¼ to ½

Water is the most important chemical for growing native plants. Deep, infrequent irrigations promotes a strong,well-developed root system . We will need to check our soil to determine when irrigation is necessary and, if using a sprinkler system, check water distribution with a grid of small cans or jars.

Container Nurseries

Container nurseries can be located on land with low agricultural value that would be unsuitable for bareroot seedling production.Because container seedlings are grown at high densities, considerably less land is required than would be needed to produce a similar number of bareroot seedlings. Container plants can have high growth rates, especially in fully controlled environments, and so many crops can be produced in one growing season.

Factor	***Container Nursery***	***Bareroot Nursery***
Land Requirement	Less land needed	More land needed
Soil quality	Not important because artificial growing media are used	Critical – sandy loams are preferred
Water quality	Lesser amounts required	Greater amounts required
Propogation structures	Depends on location, size and complexity of the nursery	None
Equipment	Depends on size and complexity of the nursery	Tractors and specialised equipment for sowing and harvesting.
Duration of Crop Cycle	4 – 12 month to several years depending on container size	1 to 3 years
Crop Storage and Transportation	Greater volume required	Lesser Volume required
Plant Handling	Roots are protected in plug	Roots are exposed and are often treated for additional protection
Season Seedlings Can Be Outplanted	Year-round if soil moisture is good	Spring or sometimes Autumn

Many factors should be considered when deciding whether to start a bareroot or container nursery.

These plants must have conditions mophological very strict and are produced in a significant amount, by which apply specific cultivation techniques: bare-root; container ; cuttings.

Types of propagules used to grow native plants include fruits; containing seeds, stem cuttings; root sprouts , layers, divisions, bulblets, and stolons.

A successful native plant nursery is based on proper planning and many factors must be considered.

Crop Scheduling

Once the best propagation techniquea are identified, then we must do some planning and consider several different factors. (see above table)

- plants propagated from seeds are always less expensive to produce than those from cuttings.

For nursery planning purposes, plant growth and development during the year can be divided into three consecutive growth phases: **establishment**, **rapid growth**, and **hardening**. Because cultural objectives are different for each phase, the growing environment and perhaps even the type of propagation structure may be different. The amount of time required for each of these growth phases varies depending on species, the propagule collection location (that is, the "seed source"), type of propagation environment, and cultural practices.

Seedling Growth Phases

- **Establishment -** In the case of seed propagation, the establishment phase begins when seeds are sown, continues through seed germination and emergence, and generally ends when the young seedlings develop true leaves. For vegetative propagation, the phase begins when the cuttings are struck into the container and ends when cuttings have rooted.

- **Rapid Growth -** The rapid growth phase is sonamed because it is during this period that young nursery plants increase rapidly in size; in general, most of this increase in biomass is shoot tissue with relatively less root growth—some native plants, especially those adapted to harsh, dry sites, may do just the opposite, growing more roots than shoots . With seedlings, this phase begins after the cotyledon stage when the new shoot begins to grow at an accelerated rate and ends when plants have reached their target size.

- **Hardening -** During the hardening phase, plants divert energy from shoot growth to stem diameter and root growth, and gradually become conditioned to withstand cold temperatures and the rigors of harvesting, transportation, and outplanting.

Crop Production Schedules

The first and most long-term type of growing schedule is the crop production schedule, which is designed to help nursery managers visualize "the big picture." These schedules typically are designed on a month-by-month time scale, cover at least 1 year, and include all phases of nursery production from crop planning to outplanting (see chart below). Many of us fail to appreciate how long it really takes to grow native plants crop, so crop production schedules are particularly useful for explaining all the various steps in the nursery process and the time involved. For example, a crop production schedule will illustrate that it will be necessary to transport seeds to the nursery several months prior to sowing, especially if germination tests and presowing seed treatments are necessary. These growing schedules are also useful in illustrating how different seedling stocktypes are produced, the time required to grow them, and when they would be available for outplanting.

Solar Timing

Because of seasonal changes in the Temperate Zone, native plant crops are usually scheduled around the solar cycle (Figure 1.8). Both light intensity and daylength vary considerably during

the year, so nursery managers plan their crops around the summer solstice to take full advantage of available sunlight. This is particularly critical for container nurseries that grow two crops per season. The first crop must be sown very early so that they can be large enough to move out of the greenhouse in time to allow plenty of sunlight for the second crop. Planning around the solar calendar also ensures that crops perceive the naturally shortening daylengths that queue them to prepare for winter.

The Right Plant for the Right Place

Although many people think that all plants of the same species are alike, they can be very different.
The best nursery stock has the proper morphological characteristics (such as height, stem diameter, and root volume) and physiological characteristics (such as dormancy status and cold hardiness) to have maximum survival and growth for a particular outplanting site. Seedlings being grown for a very dry place need thicker stem diameters, shorter shoots, and more roots than those being grown for a very moist place. Seedlings being grown for a very mountainous site must survive colder temperatures than seedlings being grown for valley locations.

Crop production schedules give a chronological view of the necessary steps to produce a native plant crop, and how long it takes to complete each of those steps. Schedules are useful planning aids.

Native plant crops should be scheduled around the annual solar cycle to take advantage of available sunlight.

Obtaining and Perparing Seeds

Important Seed Concepts

- **Seed Dormancy -** Although native plant seed can be categorized in many ways, its ability to germinate promptly is the most important from our standpoint.
  Non-dormant seeds are those that will sprout in a relatively short time預 few days, weeks, months but generally less than 1 year謠ithout any special treatments. Examples include willow, aspen and aster. Non-dormant seeds do not require any pre-sowing treatment other than soaking in water, and they are usually sown in the nursery soon after collection. Storage and handling of non-dormant seeds is critical because they must be kept moist. Temporary storage should be in a shaded, cool location. Large seeded, non-dormant seeds, such as acorns and nuts, must be kept fully moist by keeping them in trays under damp burlap bags or in plastic bags filled with moist sand or peat moss. Just prior to sowing, seeds are usually soaked in water for a few hours to a few days, depending on species. Dormant seeds require some sort of pre-sowing treatment, but store easily for long periods and can tolerate drying. Most conifers and many other native species fall into this category. Pre-sowing treatments

to overcomeseed dormancy will be discussed later. Dormant seeds retain viability for periods longer than a year and can be dried to low seed moisture levels and stored under lower temperatures.It is important to remember that dormant seeds need to be spread evenly and dried completely before storage, while non-dormant seeds need to be kept moist and in a high humidity environment until they are sown.
Controlling moisture content is the most critical aspect of seed storage, so place seeds in airtight bottles or in zip-lock-type plastic bags in a protective box. Make sure all storage containers are properly labeled.

- **Seed Source -** Beneficial Insect Attractors, Companion Plants, Compost Activators, Culinary & Medicinal Herbs, Dye Plants, Edible Flowers, Edible Seeds, Fruit and Nuts, Ground Cover, Nitrogen Fixing Plants, Perennial Vegetables, Trees,Shrubs and Vines.The process of growing any native plant begins with procuring a supply of high quality seeds or other propagules.Collecting seeds from a wide genetic base fosters a more diverse gene pool at the outplanting site. This can protect a planting against unforeseen biological and environmental stresses, and it also protects a**g**gainst potential genetic problems in future generations. For restoration and conservation projects, maintaining genetic diversity is a key project objective. Plants are genetically adapted to their environment, and this adaptation is known as 都eed source�in nursery jargon. If and when we plan to collect seeds locally, grow plants, and outplant them in the same climatic region, then our plants will be adapted and seed source isn稚 critically important.If we need a small quantity of seeds or don稚 have the time or resources to spend collecting all types purchasing from a local seed dealer may be more appropriate.

- **Collecting Native Plant Seeds -** Collecting seeds may be appropriate when we want seeds from a specific location or from specific plants. Just like people, plants of a particular species come in different shapes and sizes and, young plants usually resemble their parents. Therefore, only collect seeds from healthy and vigorous plants—ones that look like we want our plants to look. Some seeds are large and easy to collect while others will require special procedures or equipment. Annual plants, and perennial grasses and forbs, produce some seeds every year but the seed crops of perennial woody plants, such as shrubs and trees, can vary considerably from year to year. For example, trees like aspen produce seeds in 1 year, but others like pines and oaks can take 2 years or more to produce seeds.

Collecting Seeds and Fruits -

Native plants produce a wide variety of seeds and fruits that often need to be cleaned and processed before sowing.

- **Conifer Cones -** Conifer fruits are woody cones that contain many hard-coated, winged seeds, can take 2 – 11 years for crop cycle.Based on the number of filled seeds per cone, we can determine how many cones we will need to collect. Cones can be collected with

pole pruners or by climbing the trees. Place cones in burlap or nylon screen sacks, and don’t contaminate the cones with needles, branches, and dirt that could introduce damaging molds. Cones have a high moisture content so fill sacks only half full to allow for air circulation and cone expansion during drying. Never toss or drop a bag of cones. Label each sack immediately with species, elevation, collection location, date, and any other pertinent information. Store sacks on open racks in dry, well-ventilated shelters, such as open-sided sheds or well-ventilated barn lofts. We can also hang sacks from rafters. Either way, sacks should be separated to permit good air circulation. Stored this way, cones will dry gradually with a minimum of overheating and mold damage. Check cones often and inspect them for mold. If mold is present, rearrange sacks to improve air circulation. If we picked cones with mature seeds, cones should dry satisfactorily in a few days, depending on the weather. If we picked green cones, it may take a few weeks or months for seeds to finally mature.

- **Dry and Fleshy Fruits -** **Dry and Fleshy Fruits**—Dry fruits are those that are woody or papery at maturity and examples are hazel nuts and capsules. Some dry fruits will split open at maturity. We will need to harvest these just before the fruits begin to split open and seeds disperse. Other dry fruits have structures where both the fruit and seed are fused together and do not split open at maturity. Dry fruits can be collected like cones. Nuts and acorns can be harvested after they drop from the tree as long as they are handled and cleaned immediately after collection (described later). Fleshy fruits are those usually comprised of three layers: the skin, the often fleshy middle, and the membranous or stony inner layer. Depending on species, fleshy fruits can contain many seeds per fruit or they can bear a tough, stony pit that encloses only one seed. Therefore, the amount of fruits we have to harvest to obtain a desired number of seeds will vary greatly from species to species. When collecting and handling fleshy fruits, it is important to keep them cool and out of direct sun. Heat buildup and subsequent fermentation can damage the seeds inside the fruits. It is also important not to let the fruits dry out, because this can make cleaning more difficult. Collect fleshy fruits in white plastic bags, and store them in a cool place or a refrigerator until they are cleaned.

- **Grasses and Forbs -** Seeds of native grasses and forbs (herbaceous plants) are not contained in dry or fleshy fruits, and they can be collected directly from the plants. Grass seed heads form at the top of the plants and the seeds are contained in a papery sheath. Forb seed heads form directly from the flowers; seed heads are therefore variable in size and shape and the seeds can be handcollected.

Handling Seeds and Fruits After Collection

After harvest, begin drying cones, fruits, and seed heads as soon as possible. Freshly collected

fruits, whether they are dry or fleshy, have high moisture content and will mold if stored inappropriately even for a few days. Drying reduces the moisture content of the seeds, helps open dry fruits, and prepares seeds for further cleaning.

- **Seed Cleaning and Extraction –** Seed cleaning is necessary so that seeds can be sown or stored properly. In some cases, seeds will fail to germinate if they are not removed from their fruits. The seed cleaning area should be well ventilated because some fruits can cause allergic reactions and fine dust can irritate eyes and lungs.It is important to remember that dormant seeds need to be spread evenly and dried completely before storage, while non-dormant seeds need to be kept moist and in a high humidity environment until they are sown.

- ***Cleaning Non-Dormant Seeds* -** Large seeded, non-dormant seeds are typically cleaned from other debris by floating them in water immediately after collection for example nuts and acorns, soak large seeds in water overnight to allow enough time for good seeds to hydrate and sink.

- ***Cleaning Dry Fruits, Capsules, and Seed Heads* -** The first step in cleaning seeds is to remove them from the cones, capsules, or seed heads. We can extract small quantities of seeds and clean them reasonably well with simple, low-cost equipment. As cones and capsules dry, they open and seeds fall out. Properly dried fruits will partially open inside the sacks and some seeds will fall out. To remove all the seeds, however, they may need further drying.They will dry best if placed in window screen-bottomed trays, which are placed in warm locations with good air circulation. Adding wooden spacers at each corner allows the boxes to be stacked, and fans will accelerate drying.The next step is to separate seeds from cones, fruits, and other debris. Separation is typically accomplished with a combination of screening and air separation. Move the dry fruits and seeds to another screen box with a mesh size large enough to permit the seeds to fall through. Repeat the screening process again with a mesh size that retains seeds but allows the smallest debris to pass through.The final step in the seed cleaning process is fanning or winnowing, which separates detached wings, hollow seeds, and seed-sized impurities from good seeds. Winnowing can be done outside on a breezy day or, for smaller batches, just cup the seeds in our hands and blow through them while gently bouncing the mixture.For larger batches, winnow in front of an electric fan, which separates seedsfrom the lighter debris. Most heavy, sound seeds will come to rest near the base of the fan, and hollow seeds, wings, and lighter impurities will tend to blow farther away.

- ***Cleaning Fleshy Fruits* -** Fleshy fruits should be processed soon after collection to avoid fermentation, mummification, heat buildup, or microbial damage. Just before cleaning, soak fleshy fruits in water to soften the pulp. Fruits can be soaked for a few hours to a few days, depending on the species.

- **Storing Seeds** – Most seeds can be sown immediately after cleaning. Fleshy fruits should be processed soon after collection to avoid fermentation, mummification, heat

buildup, or microbial damage. To properly store seeds, they must be mature and free of mechanical injury. The key to good seed storage of non-dormant is to control moisture content and temperature(up to 1year unless frozen then upto 10 years) . Dormant seeds, however, can be dried, which increases the amount of time they can be stored..

Transplanting emergents: □ Small or fragile seeds □ Good growing space □ Transplanting requires utilization skill and is laborSeeds are sown into trays □ Seeds of unknown

or pots filled with medium; quality or low purity □ Efficient use of seeds □ Difficult to control density
a few days or weeks after in seed trays so disease
germination and when leaves □ Valuable or scarce seed □ Can adjust for unknown potential can be high
are present, seedlings are lots seed quality
transplanted into growth □ Root deformation possible
containers (“pricking out”) □ More uniform crop if poorly transplanted