Native Plant Trust

Guidelines for Native Plant Seed-Increase (Production) Plots

Site Selection

While seed-increase plots can be installed on almost any tract of arable land, the ideal location will be one that is well matched to the species you plan to grow, is large enough to produce the amount of seed you want, and is capable of supporting any related infrastructure you plan to build or install on site. Whether you want to establish a handful of beds on an existing site or design a comprehensive seed-production facility, you should assess each site within the context of your goals, resources, and capacity, and evaluate options with an eye toward productivity, manageability, and growth potential.

We encourage prospective growers to consider the end use of the seed they will produce before breaking ground. If the plots are intended to support your own projects, you can use historical or forecast data to inform species selection and production scale. If you plan to sell seed and don't currently have a seed-distribution network, you may benefit from connecting with existing suppliers, nursery producers, restoration practitioners, and other seed users in your region. If regional seed partnerships are active in your area, their representatives may be able to recommend species and share their understanding of regional demand.

Growers and labor crews will need to access the site throughout the year. Therefore, it should be accessible, even in inclement weather, and include enough space for parking. If your site includes infrastructure such as greenhouses, seed-processing areas, climate-controlled storage, and multi-purpose workspace, you may need to assess the site's topography, soils, and access to water and electrical connections.

Preliminary research into the site's land-use history and baseline conditions can help identify risk factors that could limit yields or increase production costs. These include poor soils or drainage, a large amount of non-native plant cover, pests and pathogens, and exposure to flooding, erosion, fire, and other environmental disturbance. Sites adjacent to native habitats present the additional risk of weed spread, native seed escape, and cross-pollination with congeners outside of the site. If any of these risk factors are present, additional research into best management practices and risk mitigation may be warranted.

Sub-prime farmland, wet areas, and disturbed soils can be brought into native seed production by identifying native species that are found and thrive in those conditions, creating an additional revenue stream and offering a diversified crop.

Site & Plot Design

Once you have identified a suitable site, you should consider drafting a site plan that designates space for the growing area and any infrastructure and equipment that will be housed on site. If you will be using tractors, UTV's, or other machinery, the plan should also include space for roads and paths that are wide enough for access and turnarounds. Designating space for expansion in the draft layout can help to minimize disruption as the operation grows.

Growing areas are often subdivided into plots. Plot delineation may be influenced by variation in slope, aspect, soil type, and texture, and other factors that can affect how plants get established and perform. You can usually identify these differences by reviewing existing topographic and soil maps, which you can supplement with data from soil tests and personal observations, especially after weather events such as heavy rains.

Traditional plot designs, inspired by fruit and vegetable farms, feature modular blocks of linear beds, with each bed dedicated to a single species. These layouts are appropriate for growing at various scales, especially larger scales that require tractor or UTV-mounted equipment. The modular block design can accommodate most irrigation designs, help simplify planting and crop rotation plans, and make it easier to predict seed yields. The linear beds also provide easy access to labor crews for maintenance and harvesting. Monocultured plots may be more susceptible to pest and pathogen pressure, domestication syndrome (traits that are correlated with cultivation, such as larger fruit set, synchronized flowering, etc.), and loss of genetic diversity(see Section 3), compared to multi-species plots.

Nontraditional plot designs generally feature irregularly shaped beds or areas in which multiple plant species are interplanted. These layouts are more appropriate for small-scale production, as they may limit tractor or UTV access, be more difficult to establish and maintain, and exclude certain irrigation designs. Planting and crop rotation plans may be more challenging to develop on irregularly shaped beds, depending on how many plots are on site and how many species each plot contains. Predicting seed yield also is generally more challenging, due to shifts in species densities over time. While harvesting can be more difficult in a multi-species bed, strategically grouping species (i.e., those with different flowering and ripening times) can help to reduce unintentional mixing. Benefits ofnontraditional plot designs include more desirable aesthetics, improved pest and pathogen resistance, and increased habitat value. Additionally, the chances of genetic diversity loss and domestication syndrome are likely to be lower in multi-species plots.

We encourage growers to map the entire growing area in detail, including plot boundaries, access roads, foot paths, irrigation supply pipelines, and irrigation valve placements. Even a rough sketch can be incredibly useful, providing a reference of

historical layouts when making decisions about plot assignments and crop rotation. Unique identification codes assigned to plots and beds on the map can also be added to field signage, simplifying communication with labor crews.

Ultimately, the best plot design is the one that works for you and your site.

Plot Layout

A plot layout is used to plan how you will allocate space within each plot. In traditional plots this may include details on how each bed within a plot is being used. Whether planning the first layout for a new site or updating an existing layout, it can help to create a layout plan using a spreadsheet, table, or mapping software. For each species, the plan should include details on where plants will be installed (plot ID), the number of individuals to plant, and the planting pattern. For traditional plots with beds, it will also include the number of rows per bed, the spacing between rows, and spacing between individuals (e.g., 2’-3’ between centers). Plans can also be used to capture information on planting amendments used, such as mycorrhizal inoculum, compost, and mulch.

Two of the most important considerations when creating the plan are species placement and planting density. If conditions are uniform across the site, you can organize species however you want, including by plant community, life-cycle, mature plant size, fruit type (dehiscent or indehiscent), seed maturation pattern (determinant or indeterminant), harvest method, or pest and disease susceptibility. For example, species with indeterminant (staggered) ripening may be grouped separately from those with determinant ripening to simplify harvesting. If you have multiple plots and conditions vary considerably across the site, it may be most appropriate to group species by soil preference and/or irrigation requirements.

The ideal planting density varies across species. In general, target a density that will optimize for yield without compromising plant health and performance. Aim for a plot density that is relatively high, with ample space for airflow. Individuals can be added or removed if necessary. When planting a species for the first time, consider its growth habit, mature size, and root structure. It should be noted that mature size in a seed-increase setting is often larger than it is in the wild. Also, plot densities for perennial species may be low in the first year and increase over time.

If you are planting your first plot, you may want to leave room in the planting plan for future expansion. In a traditional plot, you can leave fallow beds or rows next to planted rows. For example, a single bed of “species A” may be installed in the first year, with the two adjacent beds left fallow, to be planted in years two and three. In a nontraditional plot, you can leave a portion fallow for future expansion. You should have a plan in place to manage weeds in any uncovered fallow areas.

Over time, the data included in these layout plans can be combined with yield records and used to calculate each species' average yield per unit area. This metric can be used to size future plots so they generate a desired yield. This can be especially helpful if you're growing on contract for a customer that needs a certain amount of seed by a certain date.

Source-Identified Seed

Seed that has been "collected from natural stands or produced in seed-increase fields where no intentional selection or testing of the parent population has been made" is considered "source identified" in the United States, according to the Association of Official Seed Certifying Agencies (https://aosca.org/). If you are interested in producing source-identified seed in the Northeast you will need to document wild seed collection locations and make sure that the origin, or provenance of their seed-increase plots is traceable.

You can map seed collection locations using GPS coordinates. You can link the metadata, including collection date, species, population size, and number of individuals sampled to the geospatial record using a unique identification code, or lot code (e.g., NPT_2025_001). This lot code stays with the seed on labels as it moves through drying, processing, and testing, and it is included on the bag label when the finished lot is packaged.

The lot code of each wild seed generation (aka: generation 0 or G0) used to establish the increase field will need to be added to all digital records associated with the production, including nursery production records for the plants that were used to establish the increase field. In this way, the provenance of the increased lot is traceable throughout the entire production history. The first generation of seed produced from wild-collected seed in an increase (aka: generation 1 or G1 seed) should be assigned its own unique lot code once it's been harvested. The new code also stays with the seed as it moves through drying, processing, and testing and is included on the bag label when the finished lot is packaged.

Sourcing Wild Seed

The wild seed you use to establish seed-increase plots should be genetically diverse and well matched to the conditions of your site, so it will germinate, establish, and reproduce well and yield seed that is representative of the source population(s).

To identify wild collection sites that are well matched to their increase sites, you can reference seed zone maps, which outline the spatial boundaries within which seed can be reasonably moved without high risk of poor performance or maladaptation (https://research.fs.usda.gov/pnw/products/dataandtools/seed-zone-webmap).

Empirical seed zones are the gold standard, as they are defined within the range of a single species and are created using data from genetic studies (i.e., common garden and reciprocal transplant studies, DNA sequencing, etc.). Unfortunately, no empirical seed zone maps exist for the species of the Northeast (that we're aware of). In their absence, you can turn to provisional seed zone maps.

Provisional seed zones are:

- defined for regions
- delineated using environmental data
- meant to guide seed transfer for all species that occur within them
- usually created using variables that influence genetic variation and local adaptation in plants, including climate and soil metrics.

The following seed zone maps are useful references::

- The Eastern Seed Zone Map, produced by the Eastern Seed Zone Forum, combines USDA Plant Hardiness Zones with Bailey's Ecological Provinces to create 245 distinct seed-collection zones across 37 Eastern states. (Eastern Seed Zone Forum includes members of the Reforestation, Nurseries, and Genetic Resources team, the United States Department of Agriculture Forest Service National Forest System Regions 8-9, and USDA Forest Service Southern Research Station; https://research.fs.usda.gov/srs).
- The "generalized seed zones for native plants" (Bowers et. al., 2014), which delineates 64 provisional seed zones for the United States using high-resolution climatic data, and the EPA Level III and IV Ecoregion maps, derived from Omernick (1987).

You can apply one of these zone systems to the designation of your wild-collection area or overlay multiple maps to identify a zone that is common to all systems. In either case, you can be reasonably confident that **wild seed sourced from the same zone as your increase site will perform well there**. If a species cannot be found in the same zone as the increase site, you may need to evaluate other options and associated risks.

You can also partner with reputable ecological and conservation organizations, nurseries, botanists, and wild seed collectors in your area to procure genetically appropriate and diverse wild seed.

Managing Genetic Diversity in Seed Production

One of the main goals when growing seed for ecological restoration, horticulture, and landscaping is to capture a representation of the genetic diversity in wild source populations and maintain it throughout the seed-production process (Pedrini, 2020). The sections below include information on how to source wild seed that is genetically diverse and minimize the loss of genetic diversity throughout nursery production and seed increase, processing, and storage.

Wild Seed Collection

Wild seed that you use to grow plants for the purpose of establishing seed-increase plots should contain genetic diversity that is representative of the wild source populations. You can accomplish this by:

- Collecting from large populations with many individuals
- Collecting a minimum of 50 individuals and as many more as possible within each source population, while observing the collection limits set by the land managers.
- Collecting from individuals with a variety of plant morphologies (forms): large, small, robust, spindly, prolific, scant, etc.
- Collecting from plants in all microhabitats at a site
- Collecting from the same stand multiple times per collection year
- Avoiding collecting in previously seeded sites such as restoration polygons

**Please note that the guidelines above are only a subset of the standards and protocols that should inform wild seed collection. Additional measures are necessary to protect wild plant populations from overharvesting and minimize ecological impacts.* [MG1]

Nursery Production

In the Northeast, where seed production is primarily focused on perennial species, it is common for increase plots to be established using container plants grown from wild seed. When producing nursery containers, you can maintain genetic diversity by:

- Producing container plants in the same seed zone that the wild source material was collected from
- Breaking seed dormancy before sowing

- Sowing wild collections separately, with labels that include the unique seed lot code
- Diversifying germination conditions to germinate the highest fraction of wild seed (if possible)
- Keeping germination flats for as long as possible to capture late germinating individuals (consider multiple cycles of stratification)
- Using all healthy seedlings to establish increase plots, including those of varying morphology (small, large, spindly, robust, etc.)

Plot Establishment

Whether increase plots are established with source-identified wild seed (G0) or plants grown from source-identified wild seed (G1), the material should be well adapted to the site. This will optimize plant performance while minimizing selection pressures known to reduce genetic diversity. To establish plots with well-adapted material, growers can:

- Use source-identified wild material from the same seed zone as the increase site.
- Use source-identified plants grown from wild G0 seed whenever possible. If necessary, use G1 seed to produce nursery plants. Avoid using G2 and above.
- Include as many individuals as possible in each increase plot, and no less than 50

While in some cases it may be most appropriate to establish a plot using wild material from a single plant population, you often may need to mix multiple wild collections, especially when there's not enough material in any single one to produce the minimum number of individuals required for the plot (i.e., 50). When mixing wild collections for seed increase, you should:

- Mix only collections from populations within the same seed zone, aka: creating a "regional admixture"
- Review available literature to identify genetic risks that may result from mixing populations
- Include an equal number of individuals from each source population

To minimize unintended hybridization of related crops, growers can:

- Use temporal or spatial separation (note that isolation distance varies by species and pollination mechanism)

Maintenance

Once increase plots have been established using genetically diverse wild material, growers can maintain that diversity by adopting best practices that reduce the risk of artificial selection and domestication syndrome during maintenance:

- Managing (i.e., culling) clonal growth and self-sowing
- Minimizing losses to pests, pathogens, and natural disturbance
- Minimizing irrigation and fertilization
- Minimizing the number of years that the plot stays in production (diversity may be lost with each year)
- Rotating crops when replanting

Harvest

Likewise, during maintenance and harvest of genetically diverse wild material, you can maintain genetic diversity by adopting best practices that reduce the risk of artificial selection and domestication syndrome:

- Varying the timing of seed harvests (early-mid-late)
- Modifying harvest techniques to capture the most seeds
- Identifying and anticipating sources of selection during the increase process (severe weather, wind, etc.)

Seed Processing & Storage

Once seed has been harvested from an increase plot, it must be dried, processed, and stored. Genetic diversity can still be lost during these steps; therefore, growers should consider methods that minimize loss, including:

- Drying seed in a covered area and turning it frequently to prevent mold
- Cleaning populations separately
- Retaining all seed sizes during processing
- Storing seeds under optimal conditions (cool and dry)
- Storing wild collections from different populations separately (if possible)
- Minimizing fluctuations in storage conditions
- Minimizing storage duration

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