Seed Production Training Manual

Rural Village Seed Production Project

Seed Production Training Manual

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Cover: A stand of Beach wildrye, *Leymus mollis,* and a handful of cleaned seeds.
Photo by Brianne Blackburn, Composition by Brennan Low

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Site Preparation

Site Selection

The selected site should be clear of all existing vegetation, including trees, shrubs, and unwanted plants. If the objective is to produce certified seed and meet seed certification standards, the field must be isolated from other cultivars or native plants of the same species. The field should also not have produced a seed crop of the same species during the past two years.

Soil Requirements

The appropriate type of soil is a mixture of sand, clay, and/or silt. Different proportions of these three parts are called sandy loams, loams, or silt loams; all of which allow for easy cultivation and the maintenance of optimal soil moisture conditions. Regardless of the soil type, it should be well drained. If the soil is consistently observed to be too dry, consider irrigation.

Soil testing is advised before choosing which plants to cultivate. Based on the results, the best crops can be chosen for your area.

Soil Testing & Amendments (fertilization)

Once a site is selected, soil testing is recommended to know if your soil lacks any nutrients required for plant growth. Soil scientists from the Plant Materials Center will test the soil in your area. The results of this soil test will show the percentage composition of nutrients.

Based on the results of the soil test, recommendations can be made to correct imbalances. If there is a need, fertilizers will be recommended, and a fertilization schedule will be provided.

Photo: Brennan Low (PMC)

A soil horizon shows different layers of soil and is dug with a soil probe

Tillage

The selected site is prepared for planting through a practice called 'tillage'. The purpose is to transform the hard, crusted soil into a soft bed for planting seeds. Before practicing tillage, all of the existing vegetation on the site needs to be removed.

Purpose: To reduce or eliminate undesirable vegetation.

Once the land has been cleared, the soil needs to be tilled using cultivators or other tillage tools, such as rolling cultivators with tines mounted to an ATV or tractor. Tilling essentially loosens up the soil and breaks clods, creating optimum conditions for the seeds to germinate and grow. If there is not much existing vegetation, till the soil 2 or 3 times. If there are a lot of weeds, then repeat the process a few more times. Next, the land should be leveled. Based on the crop species chosen, rows are then laid out on the field using a rope and a measuring tape. Planting will be done in these rows.

An untilled, wild planting site

Tillage

A tilled site ready for planting

Archive Photos: PMC

The same site, after 4 –6 weeks growth

Planting

Planting Season

The ideal time to plant is in early spring.

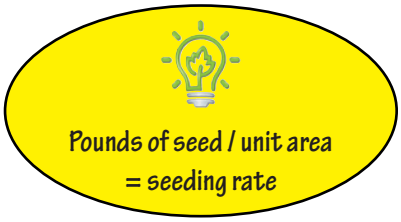
For cool season native grasses: before May 15
Required soil temperature for germination: 39 - 45 ^{0}F

Planting may be delayed if there are weeds on the site. Till the land to remove these weeds before planting.

In extreme environments, planting should be delayed until all snow is melted in and around the planting site.

Seeding Rate

The amount of seed (in lbs.) required to plant a given amount of land is called the seeding rate. This rate depends on the species chosen and the size of seed. The germination percentage and pure live seed contained in your seed material will affect the seeding rate.



Seeding Depth

Seeding depth refers to how deep a seed needs to be placed in the soil to germinate quickly. Proper seeding depth is usually 1/4 inch to 1 inch, depending on the type of soil. Seeds planted in clay soils should be planted closer to the surface

Row Spacing

Row spacing refers to the space between two rows. This space should be large enough to allow passage of mechanical implements, such as an ATV. Commonly, rows are spaced at least 2 feet apart.

In this photo, rows are spaced to accommodate the tires of the tuff-bilt tractor used for cultivation

Planting Equipment

The Planet Jr. Planter is the equipment used for small-scale planting. The Planet Jr. planters are available in tow-behind and ATV-mountable versions, either of which can be used for planting. In the photograph below, a tow-behind Planet Jr. planter is shown attached to a tractor at the Plant Materials Center.

This planter ensures regular spacing between seeds as they are planted. Before operating this equipment in the field, each hopper needs to be calibrated to drop a certain number of seeds over a given distance. The distance between planted seeds depends on the crop and the desired density of the crop. This calibration is set with the help of a disc located under the hopper, containing holes of different sizes.

Photos: Sobhan Sajja (PMC)

Planting bluegrass in the fields of Alaska Plant Materials Center using Planet Jr.

Crop Maintenance

What is Crop Maintenance

Between planting and harvesting, plant health should be monitored. The enemies of crops are mainly weeds, insects, diseases, and predators. These are commonly referred to as agricultural pests. The following chart gives an idea of the common pest groups and various management methods available.

Pest Groups	Management Methods

• Weeds (undesirable plants)
• Insects (aphids, mites, leaf miners)
• Diseases (fungal, bacterial, viral)
• Predators (birds, rodents)
	• Natural Controls (wind, rain, temperature)
	• Applied Controls
	  • Biological (parasites)
	  • Mechanical (removal)
	  • Cultural (tillage, fertilization)
	  • Physical / Environmental Modification (mulching, traps, planting unpalatable species around target crop)

Among the enemies of a crop, weeds are *the* major concern. The following section deals with how to best manage weeds.

Weed Management

Many methods are available to manage weeds. We discuss three methods in this document. They are

1. Mechanical (cutting weeds using specialized implements)
2. Cultural (tilling the soil)
3. Physical / Environmental Modification (mulching).

Method	How performed	Tools	Advantage	Concerns
Mechanical	Cutting weeds	Weed eater	Good for short-term results. Low cost, ease of operation.	Does not kill the weeds. Roots are still alive and weeds can grow back.
Cultural	Cutting, uprooting and incorporating into soil through tillage	Rolling cultivators with tines, Roto tiller	Kills majority of the weeds. Good for long-term results. Adds organic matter to the soil by recycling the cut weeds back into the soil. Tilling promotes plant growth by aerating the roots.	Requires a tractor or ATV and a skilled operator.
Physical / Environmental Modification	Covering soil surface between target plants	Mulching	Suppresses weed growth by depriving them of sunlight required for growth.	Needs to be carefully monitored for gaps and rodents.

Several factors determine which weed control method to use. Availability of resources and your objective should be considered. If the objective is short-term, cost-effective control, the mechanical method is recommended. For long-term weed suppression, cultural methods are most effective. Besides controlling the weeds, cultural methods also improve crop growth by providing aeration to the roots and reducing moisture loss. Mulching is best suited for crops that are widely spaced (Wild Iris, for example).

Mechanical Control

In the mechanical control method, weeds are cut as close to the soil surface as possible. The weed eater is a handy instrument for controlling unwanted plants (weeds). A string at the distant end of the instrument spins at high speed, cutting weeds at the point of contact. This tool can be effectively used to clear weeds on the borders of a field and in between crop plants.

Inert organic matter (cut weeds) recycled back into the soil provides nutrients for the growing plants.

Weed management with handheld Weed Eater along the borders of the field

A row of crop, before Weed Eater is used

Same row of crop, after Weed Eater is used

Photos: Sobhan Sajja (PMC)

Cultural Control with Rolling Cultivators & tines

Tilling or cultivating the soil using rolling cultivators controls weeds and promotes crop growth. Rolling cultivators, mounted to a small tractor or ATV, cut the weeds and incorporate these cut portions back into soil. Cut weeds will decompose and provide nutrients to the crop plants. The tines behind will subsequently turn over the soil.

Photos: Sobhan Sajja (PMC)

Rolling cultivators and tines mounted to a Tuff-Built tractor.

Cultural Control with Roto tiller

The Roto tiller is a convenient piece of equipment that serves two purposes:

i) weed control
ii) turning over the soil

Rotating blades cut the weeds and recycle them back into soil. Operating the Roto tiller also delays moisture loss from evaporation. This machine is used infrequently (approximately once a month).

Photos: Sobhan Sajja (PMC)

Weed control using a Roto tiller

Mulching (Physical / Environmental Modification)

One of the ways to manage weeds without using chemicals is mulching. Straw (dry stems left over after harvest) is spread evenly on the ground between the crop plants, covering the soil. This will deprive weeds of essential sunlight. Weeds that do not receive sunlight will die. Mulching changes the micro-environment underneath.

Mulching works well for forbs and herbs as they are planted with wider spacing compared to grass crops. Since no chemicals are involved in this process, it is easy and environmentally friendly. Further, mulching reduces erosion of topsoil due to wind and rain.

Mulching can promote other pests including rodents. Insects can lay eggs in the much also. Monitoring for these pests in important when mulching. Regularly check the mulch for presence of weeds, and to assure that the mulch is covering the soil completely.

Mulching with barley straw

Insect and Disease Management

Insects and diseases could affect your crop. Small instances on a limited scale are not cause for concern. If you observe these conditions for more than 10-15 plants, however, report the matter to the Rural Village Seed Production Project (RVSPP).

Signs to look for which may indicate presence of insects or disease:

- Wilting of leaves
- Discoloration of leaves or stems
- Visible presence of insects
- Molds
- Stunted growth

If you see any of these warning signs, consult with the RVSPP staff. If an infestation is found, RVSPP staff will assist in selecting an appropriate treatment for the crop.

Dead seed-heads (white) in a field of Brome grass (*Bromus sp.*)

Diseased Kentucky bluegrass (*Poa pratensis*)

Closeup of stem borer insect inside grass stem

Harvesting

Mechanical Harvesting with Seed Stripper

A Seed Stripper is an easy-to-use piece of equipment that can be pulled behind an ATV to harvest seeds in both level and rugged field conditions. It has a small engine that operates rotating brushes. These brushes strip the seeds off of standing plants, and create an airflow which sucks them into the hopper.

Mechanical harvesting is economical, in terms of both money and labor, when relatively large areas need to be harvested. Another reason to opt for mechanical harvesting is the weather. When seeds are ripe, there may only be a small window of optimal weather conditions, followed by wind, rain or snow. Mechanical harvesting can finish the job quickly. The machines are designed to minimize loss of seed while harvesting.

Seed Stripper mounted to an ATV

Harvesting with the Seed Stripper

Photos: Sobhan Sajja (PMC)

Hand Harvesting

Hand-harvesting is easy and efficient, when dealing with small fields and wild collections. Harvesting can be done using various tools like sickles, scissors, and clippers. The advantage of this method is the inherent control over the harvest of unwanted inert material. Only the seed-head (inflorescence) of the target crop is harvested and bagged immediately.

Hand-harvesting Bluejoint reedgrass (*Calamagrostis canadensis*) seed with Clipper

Close view of hand harvesting

Bagging the hand-harvested seed

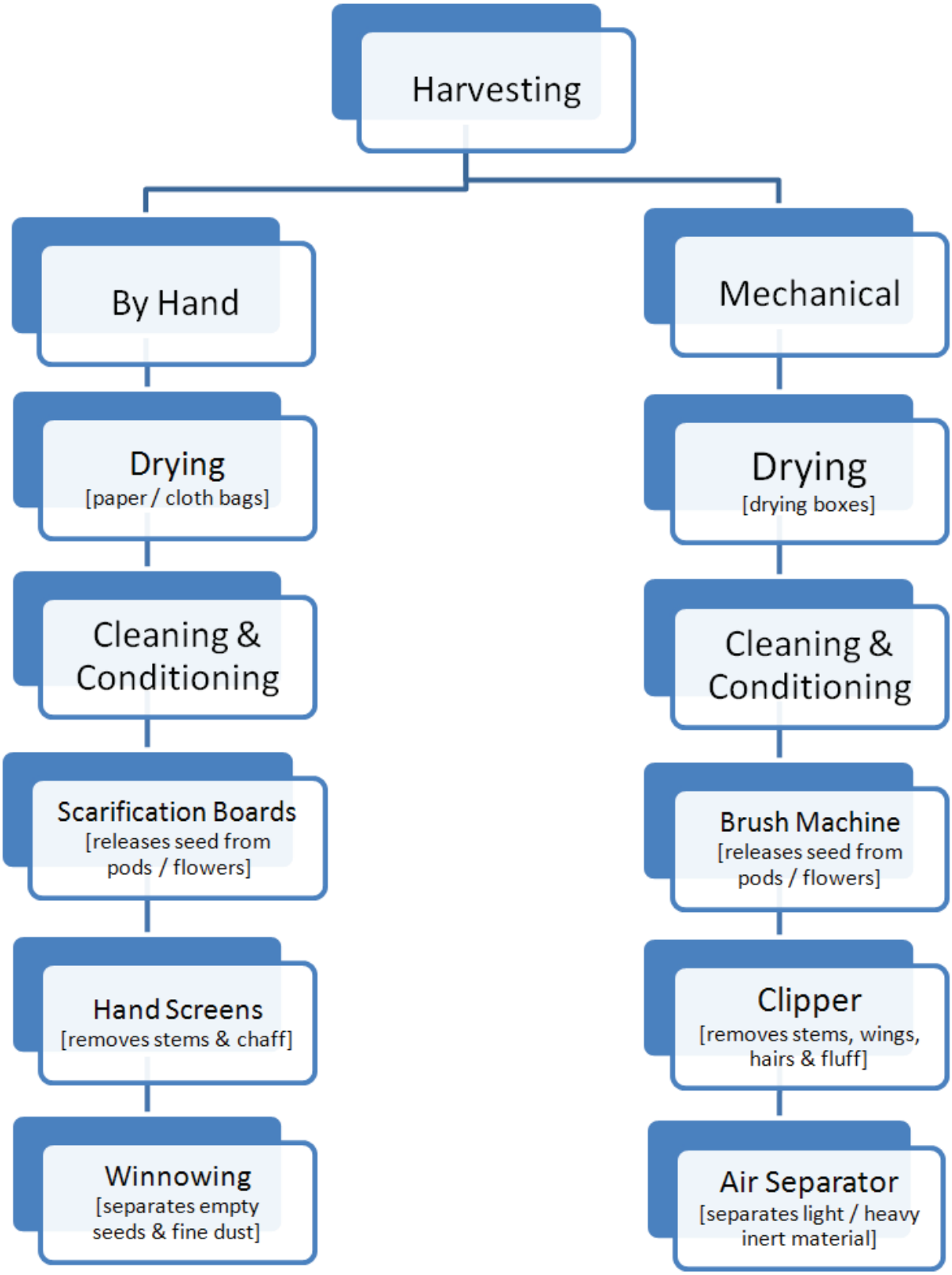
Photos: Sobhan Sajja (PMC)

Residue Management

Once the harvest is complete, considerable plant material will still be on the field, in the form of stems. Stems should be trimmed back, leaving only 2—3 inches above the ground. An instrument like the weed eater can be used for this purpose. It is important not to till the soil after harvest, as this will disturb the root structure of the crop, and affect future yields. Most of the grass species used as crops are perennial, meaning that they grow back year after year.

Trimmed stems and leaves can be spread evenly over the field to recycle the nutrients back to the same field. They can also be gathered and used as bedding for animals or feed / roughage for livestock. Do not leave the chaff in a pile in one part of the field, as it will rot and destroy the plants underneath.

Post-Harvest Activities



Seed Cleaning

Seed Cleaning Overview

If the seed is harvested from the field mechanically, it will contain seed, along with other materials such as stems, leaves, chaff , and seed from other plants. It is important to separate these impurities from the target seed.

Objective: remove chaff, stems, & leaves from target seed

Uncleaned Bluejoint reedgrass (*Calamagrostis canadensis*) seed

Cleaned Bluejoint reedgrass seed, free from all impurities

Photos: Zander Ault (PMC)

Equipment Types

Several machines will be provided for seed cleaning by the Rural Village Seed Production Project. Specific information about the use of these machines follows.

Machines clean seed using physical properties (size, weight)

Equipment	Purpose	Operating Principle
Brush Machine	Strips seeds from pods / flowers, removes appendages like hairs, wings, chaff	Rubbing action or rotating brushes against wire mesh mantle
Clipper	Removes stem & chaff from the seed and progressively grades them	Separation by size through a series of vibrating screens
Air separator	Blows chaff and lightweight materials away from filled seeds	Continuous air supply separates seeds based on weight

Photo: Zander Ault (PMC)

Left tub contains uncleaned seed, right tub contains same seed processed by brush machine

Brush Machine

Harvest contains dry pods or flowers with seeds inside. The brush machine separates seed from these pods or flowers, and removes any appendages (hair, cotton, fluff, etc.) associated with the seeds. This is often the first step in the seed cleaning process. Harvested material needs to be properly dried before being fed to this machine. Seed is fed into the hopper and falls into a wire-mesh cylinder. Rotating brushes inside this cylinder strip the seed from the stems. The seed drops down through a chute into a container placed under the machine. Inert material is ejected through an aperture into a chute where it falls into another container.

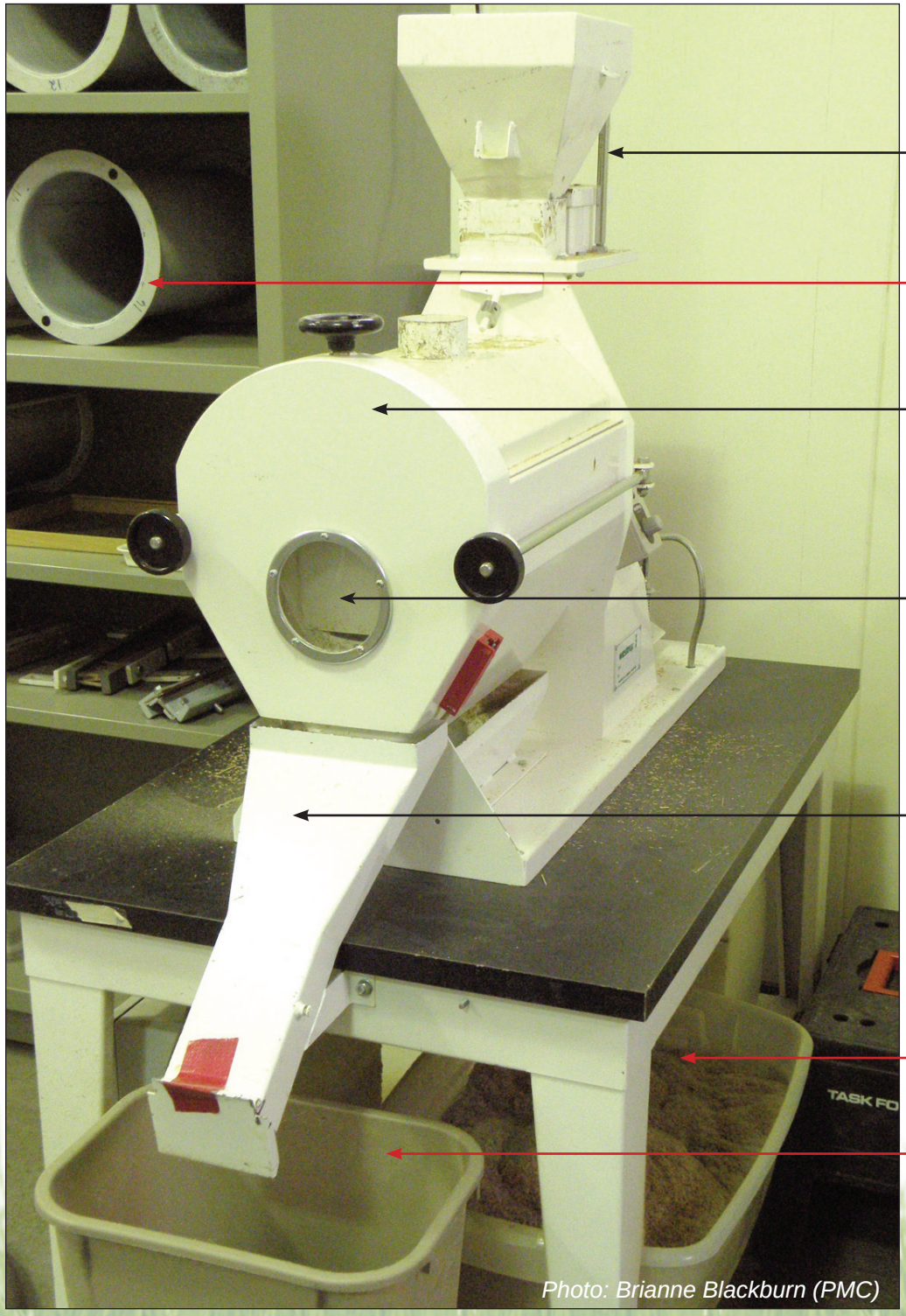
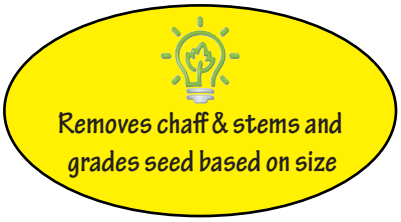


Photo: Brianne Blackburn (PMC)

Clipper Eclipse Seed Separator

Another interesting piece of equipment is the Clipper Eclipse seed separator. This machine separates unwanted material (chaff, inert material, undersized seed, etc.) from the target seed through a series of vibrating screens. Material that has gone through preliminary cleaning is loaded into the hopper. The material falls onto the top screen, which separates stems and larger chaff from the seed. The seed then drops to the next screen, and on to other screens below, each one removing progressively smaller unwanted materials. Stems and chaff are ejected through different chutes. Finally, cleaned seed drops into a container placed underneath the machine.



Hopper

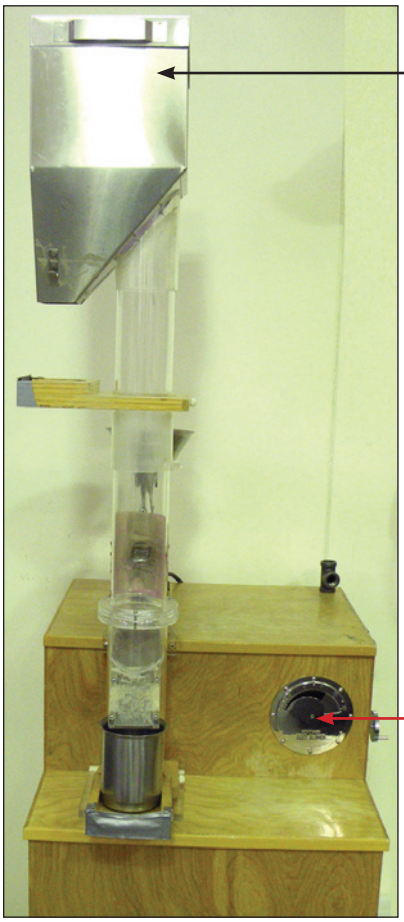
Screens

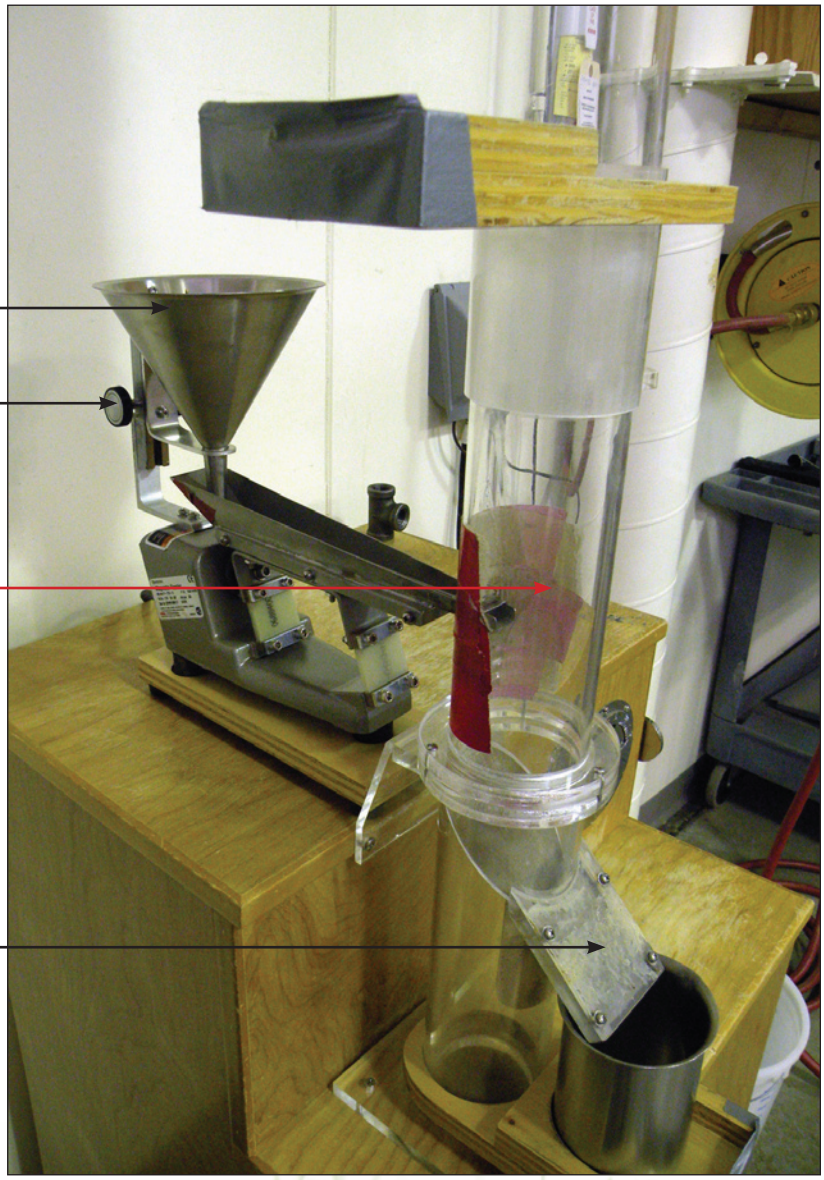
Photos: Brianne Blackburn (PMC)

Continuous Air-Stream Separator

The cleaned product coming from the brush machine will still contain stems and chaff. To remove these remaining materials, a continuous air-stream separator is used. This machine separates the target seed from the inert material using the physical property of weight. The seed, along with inert material, is fed into a hopper and travels into a tube. Air flows from the bottom of the tube, blowing the lighter materials into the upper chute while heavy material (including seed) falls to the lower chute.

The Air Separator blows chaff away from seed





Photos: Brianne Blackburn (PMC)

Fanning or Winnowing

Fanning / Winnowing is a low-cost alternative to the air-stream separator. Generally, the finished product from the seed cleaner / clipper contains inert material (chaff) like hairs, wings, and empty seeds, along with full seeds. To separate these unwanted materials, pour this mixture slowly in front of a small electric fan. The light-weight materials will be blown away and filled seeds will fall near the fan. Observe and collect the full seeds; discard the fluff.

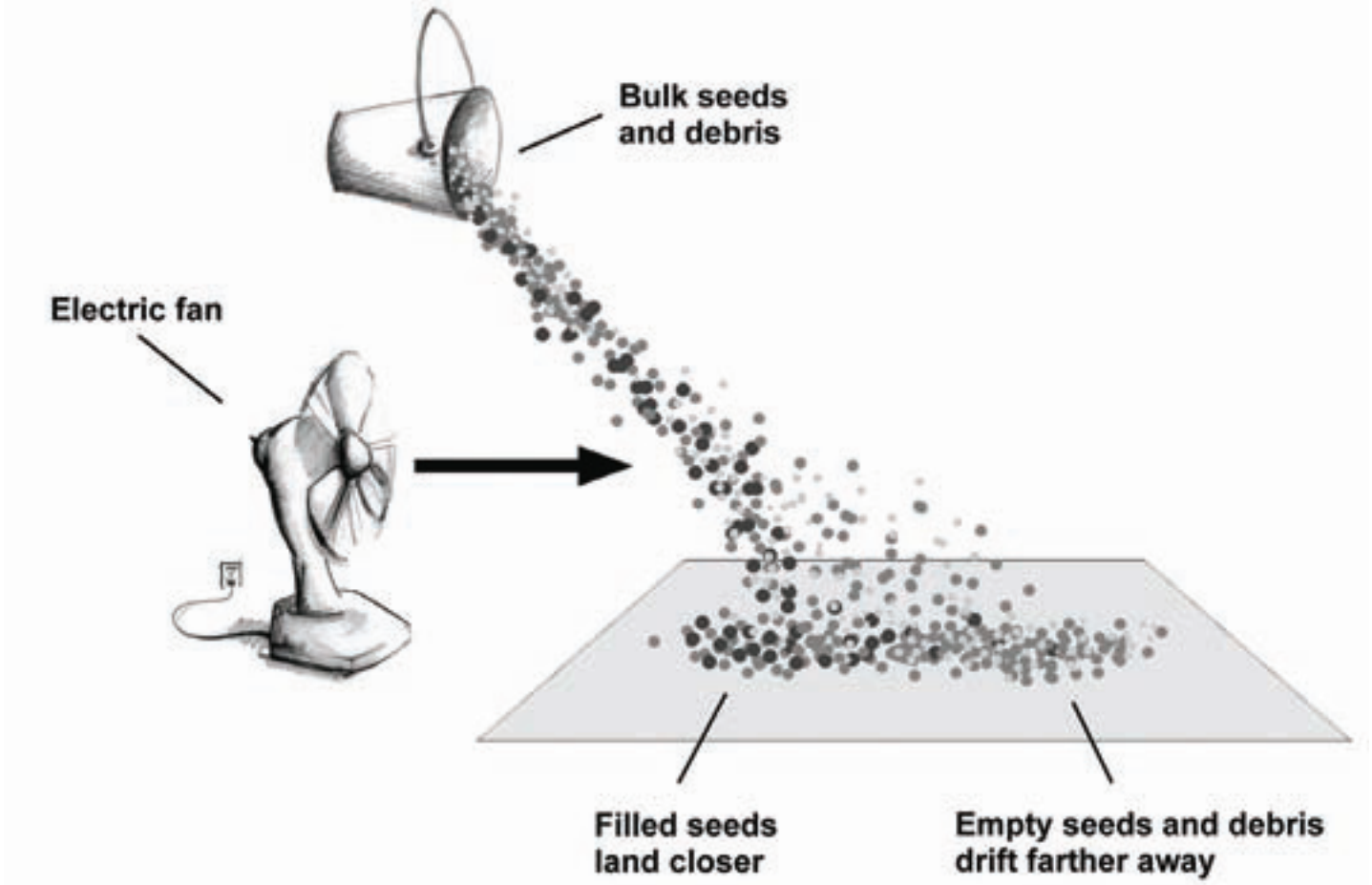
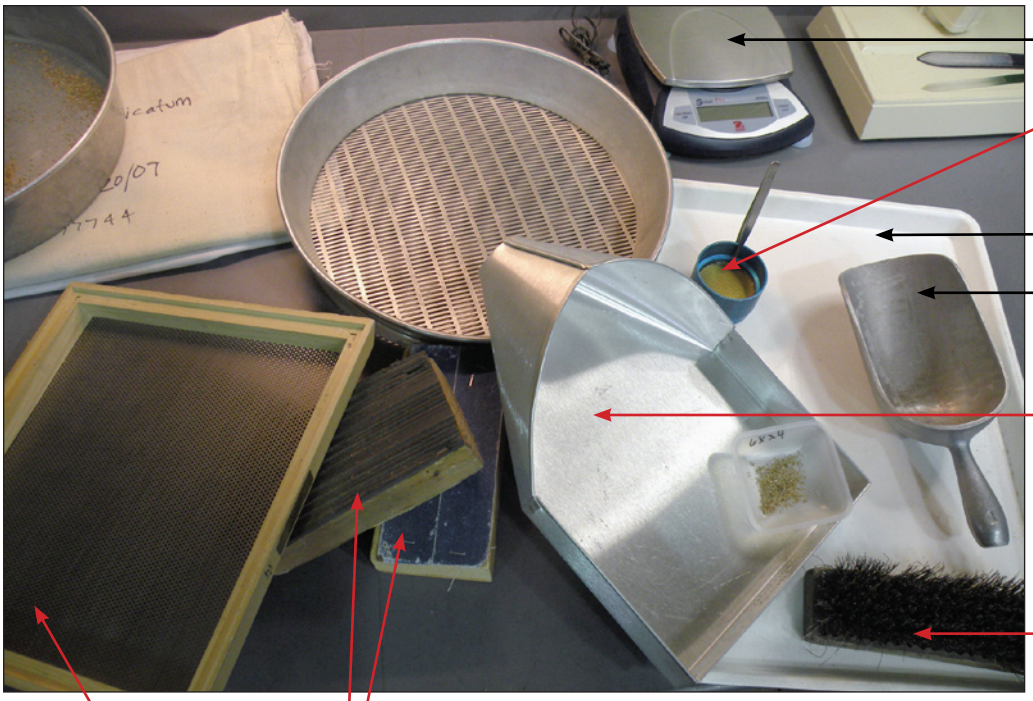


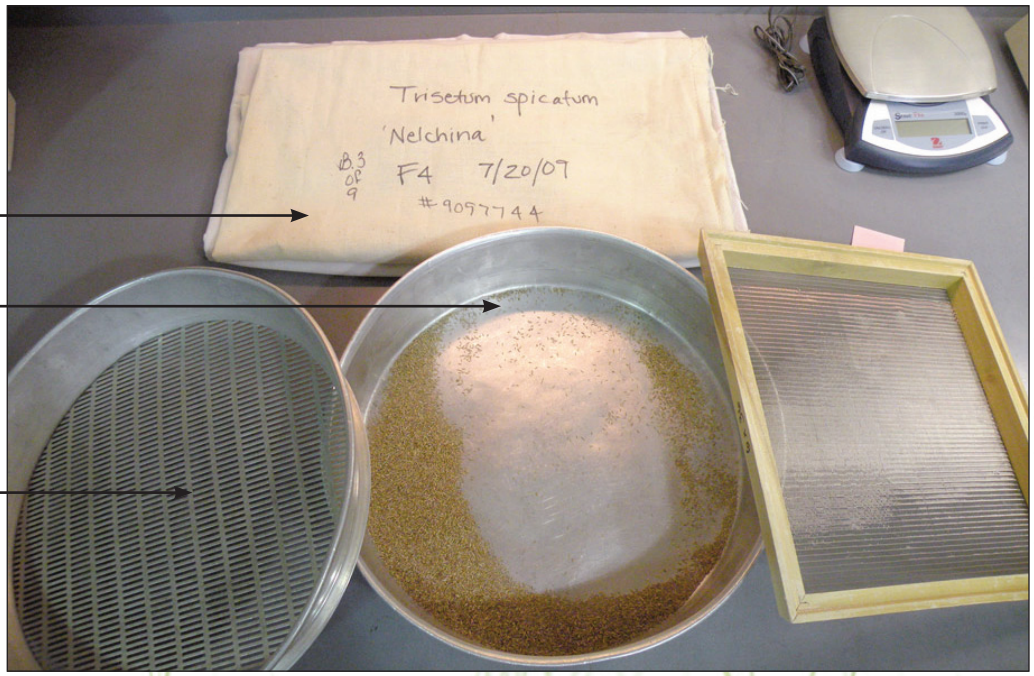
Diagram: Luna, Tara; Wilkinson, Kim M. 2009. 7: Collecting, processing, and storing seeds. In: Dumroese, R. Kasten; Luna, Tara; Landis, Thomas D., editors. Nursery manual for native plants: A guide for tribal nurseries - Volume 1: Nursery management. Agriculture Handbook Washington, D.C.: U.S. Department of Agriculture, Forest Service. p. 113-131.

Hand tools

When machine cleaning is complete, the resultant seed sometimes still needs further cleaning. Also, machine cleaning is not practical for small collections. Hand tools are used in such situations. These tools include a series of hand screens and pans. Pans or screens are selected based on the seed size and the size of the inert material (chaff).

Hand tools can be used to complement machine cleaning





Photos: Brianne Blackburn (PMC)

Seed Storage

Storage of cleaned seed

Cleaned seed needs to be stored properly, with detailed information about the seed that is being stored. Various materials can be used for storage, including paper, cloth or plastic bags, plastic or glass jars, or other suitable containers. The size of container selected will depend on the quantity of the seed to be stored. Bags of seed should be placed within rubbermaid containers with closing lids to keep rodents, insects, and moisture out.

Stored seed needs to be dry!

Heat kills seed. The seed storage area should never be warm. Freezing temperatures are acceptable.

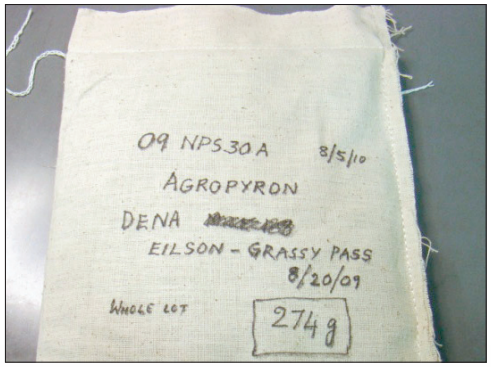
Heat kills seed; Stored seed should be kept cold

Do not forget to mark the details of the seed like lot number, processing date, name of the species, harvesting date and location, and the weight of the seed.

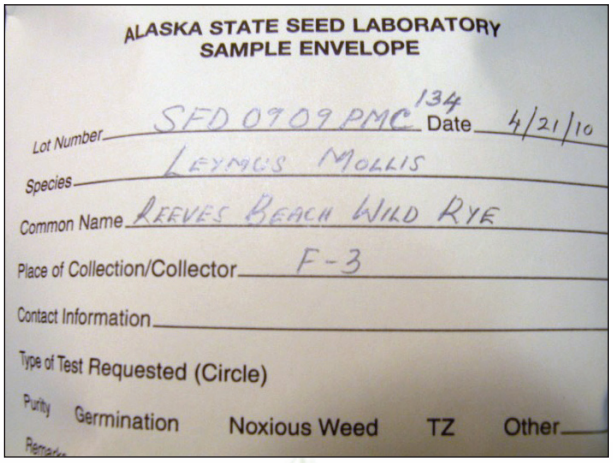
Plastic container

Paper bag

Plastic bag



Cloth bag with seed details



Paper bag labeled with details of the processed seed

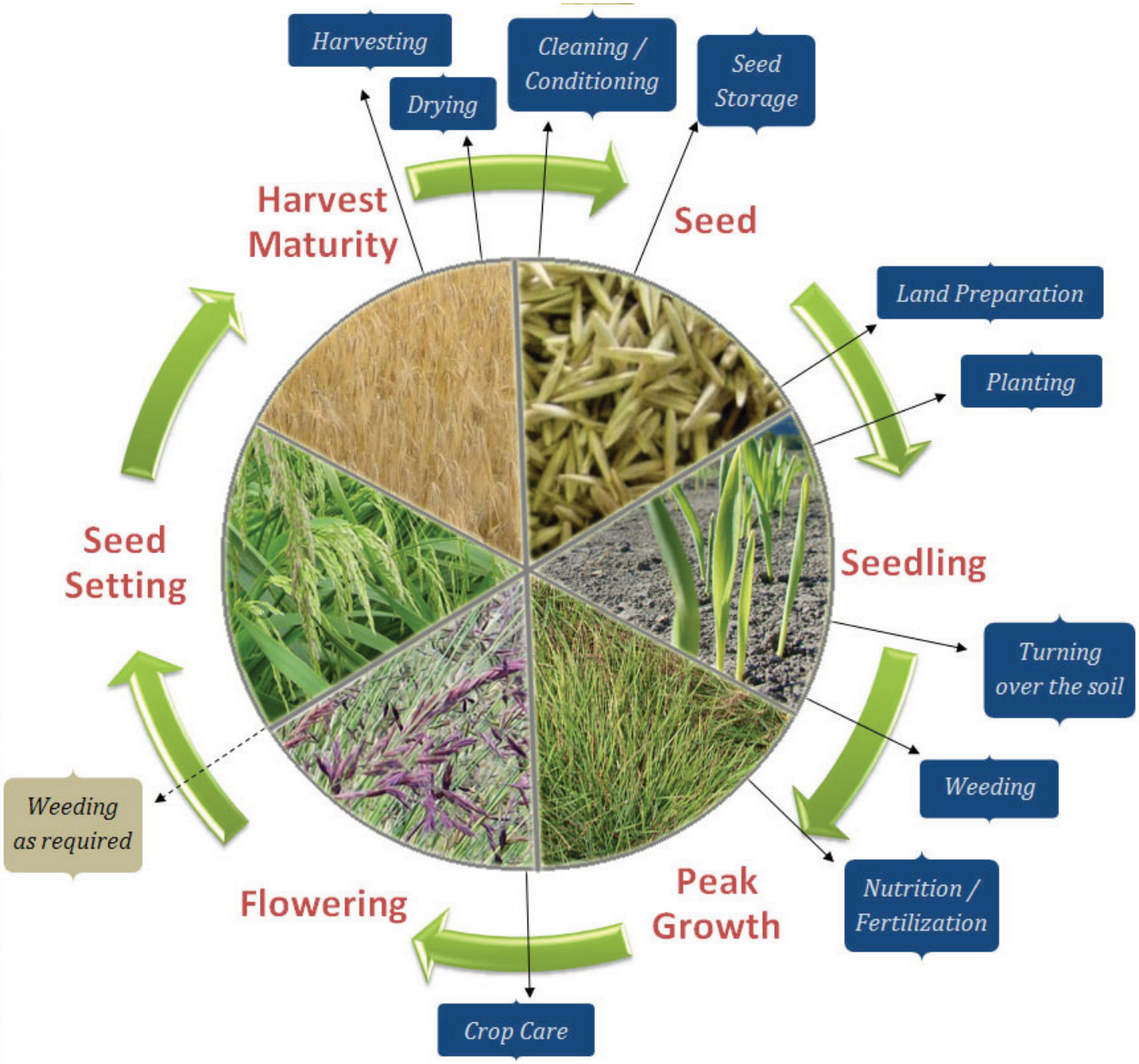
Photos: Brianne Blackburn (PMC)

Additional Information

Crop Growth Timeline

Timeline	Growth Stage	Operation
0 days	Seed	Planting
1 -2 weeks	Germination	
1 month	3 - 5 leaves	
2 months	10 - 15 leaves	Turning up of soil Removal of weeds
3 months	20 leaves Approaching peak growth	Nutrition Weeding
4 months	Peak growth Mature, nearly ready for harvest	Watch for pests and diseases NO WATER
4 $^{1/2}$ months	Harvest maturity	Harvesting
4 $^{1/2}$ months - 5th month	Harvested & either in the field / drying boxes	Drying
5th month	Harvested and dried product	Cleaning & Conditioning
5 $^{1/2}$ months	Seed should be cleaned before storage	Storage

Seed Production Cycle



Glossary of Terms

Certified seed: Seed free of weeds and meeting a minimum germination standard.

Certification standards: Standards for pedigree, purity, and germination of seed.

Chaff: Empty seed husk (shell)

Fertilization: Providing required nutrients (Nitrogen, Phosphorus, Potassium) to the plants.

Fluff: Floral parts of a plant, always removed when cleaning seed

Field Production: Growing/harvesting a plant species using traditional agricultural methods

Inert Material: Any unwanted material other than the seed

Inflorescence: A cluster of flowers on a branch.

Irrigation: Watering the plant stand.

Pure Live Seed (PLS): Percentage of viable seed in a given lot that will germinate.
Pure Live Seed = germination (%) x purity (%)

Seed head: The top of a stalk with seeds.

Sowing: Placing seed in the ground/soil, planting

Revegetation: The process of replanting and rebuilding the soil of disturbed lands

Weed: A plant species which is generally considered unwanted, useless or bothersome

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