Considerations for Conditioning Seeds of Native Plants[1]

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INTRODUCTION

The conditioning of seeds of native plants can be seen as having three main components: biological, physical, and administrative. These three interact and at different stages one can be more prominent than the others. However, each must be given its appropriate consideration if quality seed is to be available for native plant regeneration. The biological component is most important because it is the care and direction given this biological component that will determine regeneration success. Seed supplies with high viability and high vigor are indispensable. Therefore, compromises in the biological component should be minimized as seeds are conditioned. This point is often overlooked when time or money are in limited supply. This paper traces the conditioning of seed beginning with harvest, to extraction and cleaning, to storage, and ending with a brief discussion on quality control, quality assurance, and seed certification.

SEED COLLECTIONS

How much to collect is determined by how much is needed. This is determined by the annual amount needed to supply nursery and direct seeding requirements and how many years' supply is needed. Availability and ease of collection in any particular year may also modify these amounts. During good seed crops, extra amounts of seed might be collected if the collection can be made economically.

Where to collect is of course determined by where seed will be planted. It is critical to use adapted material. When genetic studies are not available to define seed transfer zones, then the use of local sources is the best consideration. The definition of local is often a point of debate. The closer the collection site is to the planting site the better the adaptation one could assume. However, other realities might determine the collection site. For example, the most local source could well have been totally destroyed by a large fire or too many years of land use that excluded the desired species. Extrapolating from decades of provenance research on forest trees, which are native plants, too, in the broad sense of the word, maximum boundaries for local source could be defined as no more than 500 feet change in elevation and no more than 100 miles north or south of the planting area. Genetic studies may demonstrate broader or narrower bands of adaptation. Local conditions need to be kept in mind. Changes in soil types and hardiness zone can occur over shorter distances than those mentioned above and would require different definitions of local.

When to collect is the question of maturity index. What are the changes in color, moisture content, and seed morphology that tell when a seed is mature? These indices almost always involve knowledge of the seed structures. Consultation with a reference such as Agricultural Handbook 450 (Schopmeyer, 1974) or careful study of unfamiliar species will show where the essential seed structures are for evaluating maturity.

POST HARVEST STORAGE

Temperature and seed moisture are the critical factors in post harvest storage when seeds are in long term storage. Seeds collected dry need to be kept dry and cool. Good air circulation is important for dry seeds so they can continue to dry. In drier areas of the west, air circulation might not be necessary, but this should be verified. Cool temperatures are here defined as those temperatures not above the ambient temperature. Do not put seed in unventilated sheds, or closed vehicles in the sun. Seeds collected moist need to be kept in cool moist conditions. Cool moist conditions would be anywhere from ambient to near freezing temperatures. The critical point to watch in storing moist fruits is to avoid heating from high seed respiration rates or fruit fermentation. Length of post harvest storage will be species dependent. Some species like cottonwoods and willows need to be processed in the shortest possible time as their life is short if not dried to storage moisture contents rapidly. Ideally, the faster a species can be put into permanent storage the better the viability and vigor. Realistically, most species can be kept for several months if not at high moisture with little or no measurable loss of quality.

CONDITIONING STEPS AND EQUIPMENT

Drying is often a first step in conditioning seeds and is mandatory if seeds are moistened in any step. The most effective and efficient method of drying is in pressurized driers where air is uniformly forced through the seed lot. These can be very simply made from an open topped box that serves as a plenum and mesh bottom trays with solid sides that can be placed on top of the plenum and each other. The trays need to fit together tightly enough to prevent significant air leaks between them. When multiple stacks of trays are used, it is simplest to have a separate fan for each stack in order to eliminate the air balancing problems of multiple stack driers. Without the use of pressurized driers, the seed will only dry at the surface. Drying at the surface only necessitates spreading the seed one or two seeds deep, or frequently turning the seed to bring the moist seed to the surface to dry. Both options take more space and time to accomplish the drying.

Threshing can be done with machinery or by hand. A hammer mill is one machine that can be used but might lead to heavy damage (Young, 1983). A grist mill can be used, especially if the grinding plates are modified to minimize damage. In a grist mill two plates rub over each other and the distance between them is adjustable. When the distance is set at the thickness of the seed but less than the thickness of the fruit, the plates will cut or rub away the fruit while the seeds pass out usually unharmed. The plates can be replaced or covered with cloth, carpet, sand paper or other suitable material. Such a grinder can be obtained for a few hundred dollars (Dalpiaz, 1993). A brush machine is very effective at singularizing, extracting and dewinging many dry seeds and fruits (Karrfalt, 1992). The action of the brush machine is to rub fruits or seeds against a wire shell until the seed is extracted from the fruit or a wing is removed. Dust from the extraction is completely confined by the machine's vacuum dust control. In a trial where winterfat utricles were hand rubbed with a scrub brush on both a round wire screen and a square wire screen, the square wire screen was determined to be more effective in extracting the seeds. More seeds were removed from the fruit in the same amount of time. Therefore, it is believed that a square wire shell is best for the brush machine.

The brush machine can be mimicked by rubbing the fruit on a screen by hand with a brush. This hand method might be suitable for the very smallest of lots but too time consuming on larger lots. Dust can also be a problem for the worker in hand rubbing the seed. Good ventilation or dust removal should be provided.

For very small seeds with hairy appendages, such as anemone, a filament thresher can be used. This machine is a column aspirator with monofilament strings spinning on a central axle. As seeds are fed into the machine, they are carried upward by the air column. As the monofilament lines cut the hairs from the seeds, they become less buoyant and fall out of the air column. The seeds without hairy appendages are collected at the bottom of the column.

Basic Cleaning is usually done with aspirators, blowers, screen machines or air-screen machines. Except for the smallest of lots, continuous flow machines are more productive. To make maintaining lot integrity easiest, machinery should be the type where all surfaces can be seen. Air and small screens usually remove all the dust and fine particles while larger screens are good at removing larger particles.

Round and flat particles can be separated with an inclined draper. The draper is a flat conveyor belt that is held at an adjustable pitch. The steeper the pitch the more easily round objects roll down the belt while the flatter objects are carried up the belt to a collection container. Juniper berries and leaf particles are easily separated with a draper. A board covered with a cloth can accomplish the same separation.

Long and short particles can be separated with an indent cylinder. This is frequently needed because many native plant seed lots contain pieces of stems (long particles) because stems are often threshed with the seeds (short particles). In this device an indented horizontal cylinder is rotated with the seeds inside. The seeds are caught by indents in the cylinder and carried upward until they finally drop from the indents into a collection trough. The stem particles are either not caught in the indents or fall out quickly because their centers of gravity are outside of the indent. The separation can be made by hand, by using the cylinder by itself, or having a board or piece of plastic with indents.

Heavy and light particles can be separated by water in some cases and by the specific gravity table or precisely controlled air columns. Both air columns and specific gravity tables are more effective if the seed has been sized with screens. The air column simply lifts the lighter particles up to a collection point. The specific gravity table uses air to stratify light and heavy particles and then oscillation of the table to push the heavy particles of seeds out from under the lighter seeds. This action pushes the heavier particles up the slope of the table, while the lighter particles flow down the slope of the table. Air pressure gauges and tachometers on both of these devices make them easier to adjust.

Rapid evaluations of seed quality are important for making adjustments to the equipment and for determining when the work is done. Cutting tests have been used for generations and provide some quick answers. X-ray is the most effective because of the great amount of detail that is available almost instantly. Tetrazolium tests are sometimes possible in about 30 minutes and could be useful. At other times they can take a few days and are, therefore, not as useful in conditioning seed. Rapid evaluations of seed moisture content are very necessary to good seed management. Electronic moisture testers can be calibrated to test seed moisture instantly. A minimum of 3 to 8 ounces of seed is required to use most electronic meters and, therefore, the meters may not work with very small lots.

"How good is good enough?" is a question sometimes not asked or answered. To answer this question intelligently requires knowing how the seed will be used. No fine trash is tolerable when vacuum sowing is done as the vacuum holes will likely become clogged with trash requiring down time to clean the sower. More trash is tolerable if the seed is to be broadcast seeded in flats or nursery beds. Stem particles need to be removed if a drill type sower is used but maybe can remain if hydroseeding is done. Container growing usually requires higher standards of seed quality than direct seeding or nursery beds. Weed seeds are usually intolerable in all seed lots for conservation uses because of the danger of introducing weeds into a natural system. Maybe it is not known how the seed will be handled and a very thorough upgrading is needed to cover all eventualities.

QUALITY CONTROL

Quality control is the process of watching out for mistakes. It requires an excellent tracking system with unambiguous seed lot identification. The Seed Regulatory and Testing Branch of the USDA Agricultural Marketing Service administers the Federal Seed Act. It is the opinion of the branch that many native plants come under the act and that the way sources of material are named can be misleading. For example, to refer to bitterbrush collected in Ada county Idaho as "Ada County Bitterbrush" is to imply it is a named variety and, therefore, misleading. They prefer a fixed term, such as "germplasm" be used in naming source collections to differentiate them from named varieties. This has been proposed to the Association of Official Seed Certifying Agencies and will likely be adopted by AOSCA as a recommendation to the individual states. Under this proposal the Ada county bitterbrush would be bitterbrush of "Ada county germplasm." Other identifying numbers and letters on the seed lots need to be used in ways that clearly are unique. Simplicity in defining lot numbers is also important to avoid mistakes.

Good quality control requires constant monitoring for damage and quality. Every step in the process should be checked for any possible deleterious effect on viability. This requires periodic checks before and after each step in handling. Steps to be particularly concerned with are conveying steps and threshing or dewinging steps. In the author's experience, most seed damage occurs at these steps. Vacuum is a very nice way to sometimes collect or transfer seeds. However, vacuum moves seeds very rapidly and if they are stopped too suddenly against a hard surface, fatal damage can occur.

High quality and regular training and supervision for all workers is indispensable. They should be a regular part of the seed program.

QUALITY ASSURANCE

Quality assurance is a growing concern throughout the world. It is showing up in most manufacturing and service industries. It is related to quality control but is broader in scope. Quality assurance has to do with the confidence that others have in your competence. It is not necessarily complicated but usually quite detailed. Simply put, it is to plan what to do, do what is planned, and prove it was done. Seed certification has these elements of quality assurance. A plan is made to collect seed from a certain location, the collection is made, and by relying on inspection by the crop improvement agency, third party verification is provided that the work has been done correctly.

Why should we be concerned about quality assurance for seeds of native plants? First there are many publics who feel they have a right and an obligation to speak out on the management of public and private land. Highly effective and verifiable documentation can demonstrate to these concerned parties and legal authorities that artificial regeneration is as good as or possibly better at maintaining biodiversity and adaptability of plant populations.

A second part of quality assurance programs is communication with the customer. Recent studies have shown that the number of owners of rural lands is increasing, that the parcels are becoming smaller, and the owners increasingly are absentees living in urban areas. These factors all add up to a public that is not knowledgeable enough to ask the important questions about seed source. An attitude of not telling about seed sources and propagation procedures until the buyer asks is likely to leave the uninitiated buyer making mistakes. It may leave the landowners purchasing plants or seeds not suited to their lands which is bad for the environment on the whole and puts artificial regeneration in a bad light because of planting failures. The International Organization for Standardization, nicknamed ISO, has developed model standards, ISO 9000, that are used or serve as a pattern for quality assurance programs in many service and manufacturing enterprises (Kantner, 1994). There is also an ISO 14000 that deals with environmental management standards (Cascio et. al., 1996).

How and who would develop quality assurance programs for nurseries and the native plant seed sector? The Association of Official Seed Certifying Agencies is already familiar with this type of work and has an active Tree, Shrub and Native Plants committee. The American Seed Trade Association also has an active Tree, Shrub and Native Species committee. These two groups would, therefore, be natural participants. Nursery associations and conservation groups would necessarily also be involved in developing standards. An effective accreditation program would simply formalize and standardize, in an easily communicated format, all the steps that a responsible conscientious nursery manager or seed supplier would want to do. By careful planning, the cost of the program will be negligible and the dividends substantial.

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