

Introduction to Seed Collection, Processing, and Storage

Course Outline



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Learning objectives for the course

1. Understand the role of seed banking in contributing to climate change adaptation strategies, land restoration projects, local practices and initiatives, and scientific research
2. Develop ability to interpret seed collection and storage protocols for different plant species
3. Understand the concept of seed forecasting, participate in a forecasting field trip, and fill in the appropriate form fields
4. Participate in field collection and follow appropriate field safety measures and protocols
5. Develop abilities to use appropriate seed cleaning equipment and techniques, and assess individual seed types for which cleaning method is appropriate
6. Describe ideal conditions for long term storage of seeds
7. Construct simple and economical seed drying unit
8. Engage with elders and other community specialists in related learning activities

Instructional Style

The course is intended to minimize formal lecture-style content, and rely instead on a conversational and participatory style which is more active and engaging for the participants. Course content focuses on discussion, question and answer, field activities, and lab or desk activities. The instructor can talk through examples and diagrams to explore them with participants. With this style of instruction, the instructor must be very familiar and comfortable with the material and also able to tailor the content to local species and contexts. This course package is intended as a guide for leading the course, with space to adjust for local content, locations, and circumstance. The course can be presented in one, four-day session, or broken up into two or more sessions. The material is presented here in the most logical order, but could be adjusted to allow for scheduling needs and availability of resources. Considerable preparation will be required prior to holding a course, as the instructor must plan locations, materials, local species, local content and guests, as well as any other arrangements associated with holding a course.

Course Content

The course has both 'generic' and customizable content. The generic content, which should apply regardless of where the course is held, consists of topics such as basic botany, and theory or purpose behind seed banking. Customized content is tailored to the community where the course is held and is seen in the particular purpose for the course, local species for collection, locations for field activities, and presentations or sharing from local knowledge holders. The instructor will be able to largely use the generic content in the course package as is, and use the customizable content provided as a basis for their own content.

There is space in the course for the inclusion of local practices, such as opening and closing remarks or prayers, giving thanks before harvesting or other ways of honoring the plants and the land, circles to share thoughts on the course and experience. These are options for the organizers to include, and should reflect the interests of the participants. Participants can be asked beforehand, at the beginning of the course, or as the course progresses if there are practices of inclusions that they would like to have. This is particularly important if the organizer and/or instructor is not a community member.

Assessment

There are no formal assessments for the course material. A participant's abilities will be observed by the instructor with potential for correction throughout the activities of the course. Course content will familiarize participants with the

concepts and techniques that can be applied to seed collection and storage in the future. A certificate of completion can be given at the end of the course if desired.

Session Scheduling

Spacing of the course material reflects the seasonality of different species. In the pilot of the course, two, two-day sessions were held to cover the course material one month apart and allow for the different phases of seed collection (i.e. forecasting significantly prior to collection and drying for the same species). This was found to be too long a gap as the interest waned and momentum was lost. It is recommended to have a shorter space between sessions, hold it all in one go, or split it into more frequent sections (such as once day a week for four weeks). This keeps the material fresh in participants' minds. Species selection will need to be adjusted to reflect the time of year and what is available in different stages. The course must also be held at a time when the activities are possible to carry out, which is generally between mid-summer and fall.

DAY 1

Topic	Exercises
MORNING	
1.0 Introductions	<ol style="list-style-type: none">1. Round table introductions<ol style="list-style-type: none">a. Instructor introduces themselves and their background and experienceb. Icebreaker activity: ask participants to introduce themselves and tell the group their personal interest in seed collection, why they are here, or what their desired learning outcomes are
2.0 Introduce course	<ol style="list-style-type: none">2. Run through course objectives and agenda with participants: what will be covered, how the days will be organized, ask participants if they have any questions
3.0 Intro to seed collection	
3.1 Setting the context: Why are we doing this?	<ol style="list-style-type: none">3. Open the discussion by having participants answer the following questions: Why collect native seeds? (seed bank has many applications: restoring damaged or completely wiped out populations, research on plant species for things like assisted migration, restoration with climate hardy species that can resist extreme weather events, providing data for building adaptation strategies in communities, can provide economic opportunities for community, etc.) Why is native seed collection important to you and your community? How can it benefit your community? Have a guest speaker (elder, FN government representative) to discuss why seed banking is important to the area, tell stories about seed collecting/plant use, or go for a walk to talk about different plants or plant use. *Note: This sort of course content is likely being run as part of a larger project – here is a good place to talk about this program, why they are doing, it and how it can benefit the community
4.0 Choosing species to bank	<ol style="list-style-type: none">4. Go through the tolerances of the focal plant species. Ask participants:<ol style="list-style-type: none">a. Why do you think these make good choices for seed banking? (grow in many different locations, have tolerances to flood/drought, have traditional importance to community members, etc.)b. What other characteristics are important to consider when choosing species for seed banking? Why? – Discuss these suggestions – Add any additional reasons that have not been discussed (e.g. species of cultural importance, species that have wide ranges of growth)
5.0 Plant ID	<ol style="list-style-type: none">5. Go for a walk with protocols/plant ID book and find focal species. Use herbarium specimens for species that cannot be found nearby.<ol style="list-style-type: none">a. Work with participants to identify species and discuss how to differentiate from other similar species.b. Look at reproductive structures of focal species (male/female), and how seeds form. Indicate that we will talk about this more tomorrow when discussing seed basics.

AFTERNOON

1.0 Planning for seed collection

1.1 Planning for seed collection

1.2 Field safety

2.0 Mapping collection areas

2.1 Locating and tagging populations

2.2 Suitability of populations

1. Provide protocols for participants.
 - a. Divide participants into pairs. Assign them 1 or 2 focal species and have them read through the harvesting considerations section of protocol. Discuss as a group and write a list of things that collectors need to be aware of before choosing populations and collecting seeds. Add anything that was missed and discuss with participants why this information is important and how it will make things easier for them in the field. Go over seed dispersal mechanisms, method of reproduction, and timing of dispersal for each of the focal species. Stress the importance of timing in seed collection (seed quality increases late in season, but seeds can be dispersed or consumed by animals if you wait too long to collect)
 - b. Go through field safety worksheet, discuss how going into the field for work is different from going out personally, potential hazards, check-in policies, and safety equipment.

2. Go over GPS use with participants.
 - a. Work with participants to locate and tag populations to develop a walking map.

 - b. Walk participants through the process of identifying the makeup and boundaries of a population to determine if the population is appropriate for collection. Tag appropriate populations.

DAY 2

Topic	Exercises
MORNING	
1.0 Morning reflection	1. Discuss the previous day's activities, what worked, what didn't, what needs to be revisited
2.0 Seed Basics	2.
2.1 Storage Behavior	a. Introduce 3 types of seed storage behavior (recalcitrant, intermediate, orthodox). Have participants answer the following questions: How do you think storage behavior affects the ability to store seeds? How would this influence species choice for conventional seed banking? Discuss these suggestions – Add any additional reasons that have not been discussed Examine seed storage behavior of focal species
2.2 Basic Seed Structure	b. Have participants look at a diagram of seed structure and try to find parts of seed in a halved bean/pea seed with a hand lens. Have participants look at pictures of healthy and unhealthy cut seeds and

discuss the differences/indicators of a healthy vs unhealthy seed. Have them perform a cut test (see activity) and look at them with a hand lens
How does the presence of unhealthy seeds affect your seed collection strategy?

Discuss suggestions given by participants– Add any additional information that has been missed

2.3 Types of Fruit

- c. Look at species list and determine what types of fruit are present. Look at examples of different fruit types. Ask participants how they think fruit type affects seed collection and handling. How will they accommodate for this in the field?
- d. Briefly go through the process of how seeds are formed. Refer to discussions yesterday on plant ID walk.

2.4 Plant propagation & reproduction

3.0 Germination & Dormancy

3.1 What is Dormancy

3.
 - a. Introduce the basic concept of dormancy. Ask participants to consider the following:
Why do seeds exhibit dormancy?
What do you think influences dormancy?
Based on this, do you think dormancy is always the same in a species regardless of where the species grows? Different? Why?
Discuss these questions and fill in any information missed by participants answers.
 - b. Take participants through the dormancy breaking activity included in the course package. This will show participants how seeds can be scarified by using sandpaper and a scalpel and how seeds can be cold stratified. Ask participants when they think scarification is necessary and how it breaks dormancy. Introduce other types of scarification (chemical, thermal)
Ask participants how these dormancy breaking techniques mimic what would be happening in nature (seeds under snow, physical abrasion). Refer to protocols to identify types of dormancy present in focal species and how these techniques apply to them.

3.2 Dormancy Breaking

Afternoon

1.0 Forecasting

1.1 Benefits

1.2 Data collection

1. Practice forecasting at a site with a focal species not yet ready for collection (ideally in bloom so participants can see the benefits of identifying populations while they are in flower).
 - a. Ask participants what they think the benefits of forecasting are, and how they think it can make later collection easier. Discuss participants ideas and go over any additional benefits not covered. (species are easier to identify when in flower, can better forecast harvesting time, save time when collecting, provide useful info for collection strategies, etc.)
 - b. Go over information that can be collected prior to actual seed collection (extent of population, geographic barriers, approximate number of individual plants, environmental variation within population, GPS coordinates, aspect, etc.).

Take participants through the steps of forecasting a population. Have protocols with plant ID section or a plant ID book along to ensure it is the focal species.

Fill out forecasting data sheet.

2.0 Collection strategy

2.1 Site assessment

2. Visit three sites

- a. Take participants through an assessment of a good site for two focal species that are ready for collection and a bad site for one of these species.

The good sites should have relatively large population sizes, be easily accessible, have healthy plants, free of hazards for collection, etc. Have participants describe what they think makes a good site. Discuss these ideas and add any additional information.

The bad site should contain something obvious (e.g. presence of invasive species, very difficult to access, very small population)

Ask participants to describe characteristics that make a site a bad candidate for collection (accessibility, presence of invasive species, size of population, etc.). Discuss these answers and fill in any that have been missed.

Are there areas seed can't/shouldn't be collected? (national parks, Category A settlement land)

This is a good place to stress the foundations of ethical seed collection (gauging what a responsible amount of seed to harvest is, avoiding collection from very small populations)

- b. Take participants through the assessment of seed ripeness (seeds are dispersing naturally, berries are ripe, or species-specific indicators of ripeness are present). If the seeds are ready for collection, perform a cut test on a sample of seeds and revisit healthy vs. unhealthy seeds and how this can affect your collection strategy. Briefly go over required data to collect during forecasting and collection. Participants will write this info on collection bags. Have an example bag to demonstrate. Let participants know we will talk in more detail about why we need this information later. Once again, touch on collection ethics here, i.e. collecting seeds before they are ready means you will likely be collecting unviable seeds, and are therefore are taking seeds from a population without the gain of conserving these seeds for later use in restoration of populations, etc.
- c. Demonstrate collection method and lay out where and how much seed participants should collect. Give participants protocols for reference. Have participants collect for approximately an hour.

2.2 Seed assessment

2.3 Seed collection

DAY 3

Topic

Exercises

Morning

1.0 Introductions

1. Round table introductions

- 2.0 Introduce second half of course**
2. Run through course objectives and agenda with participants, introduce how this session relates to the last
Icebreaker activity: Ask participants what their favorite part of the last course was, what overarching thing they have learned about seed banking, and what they are most excited to learn about in this course
- 3.0 Pre-collection info session**
- 3.1 Collection methodology**
3. Introduce the topic of seed collection methodology
- a. Have each participant look at the collection methodology section in their protocols. Take them through collection methodology outlined in each protocol. This can be tailored to prepare for actual seed collection in afternoon, i.e. focus on species that will be ready for collection.
- 3.2 Materials**
- b. Go over materials list with participants.
Discuss with participants what materials will be required for collecting each species. Why? (go over types of bags for different types of fruit/seed here)
What should you always have with you? (safety equipment)
- 3.3 Data collection**
- c. Take participants through data forms
Why do we need this information?
Fill in these forms with information written on collection bags during collection in session 1.
Have participants fill in a poster sized spreadsheet with data collected to highlight the effect of data gaps in future use.
What problems could arise from not having this data?
What can we do to ensure that our seed collections have as much future use as possible?
(if we don't have data about where the seeds came from we can't choose the seeds that best fit the location we want to restore a population/species in)
- 3.4 Temporary storage**
- d. Go over post-harvest handling strategies in focal species protocols with participants and develop a plan for appropriate storage of seeds/fruit between collection and cleaning. This can be tailored like the seed collection section.
Why is post-harvest handling important?
What types of fruit/seed will we be collecting?
How does this affect post-harvest handling?
- Afternoon**
- 1.0 Planning for collection**
- 1.1 Material preparation**
1. Seed collection
- a. Revisit materials list with participants. Assemble materials required for collection. Double check to ensure everything is present. Do a field safety run through, touching back on forms and discussion in session 1.
- 1.2 Locating populations**
- b. Briefly review GPS use from session 1 day 2. Revisit two sites, one that was forecasted and one that was not.
- 1.3 Site assessment**
- c. Do site assessments of both populations. Fill in pre-collection forms.

How was assessing the site that was forecasted and the site that was not different?

What kind of data we can collect in advance? How this can make the job of collection easier?

(see forecasting and collection forms to guide this discussion)

2.0 Collection of seed

2. Take participants through assessment of seed ripeness again. Perform a cut test (see Activity: Cut Test in course package), discuss collection strategy, and follow collection methodology discussed this morning to collect seed into appropriate containers.

DAY 4

Topic	Exercises
Morning	
1.0 Seed drying	1. Introduce importance of drying seeds (need low moisture level for storage, orthodox seeds have increased viability when dry, etc.)
1.1 Conditions that influence drying	a. Ask participants what conditions they think influence seed drying. Go over RH, temp, ventilation, etc. Based on this, what conditions do you think are ideal for drying seed?
1.2 Seed characteristics that influence drying	b. Revisit the discussion of seed structure from session 1. Ask participants how they think seed structure might influence drying. Have participants examine seeds they collected and discuss if they think the seeds collected will have varying drying time based on their structure (diameter of seeds, type of seed coat, etc.).
1.3 Small-scale seed drying methods	How can we tell when seeds are dry? (hygrometer, humidity indicating strips, etc.) c. Introduce different options for small-scale seed drying methods (barrels with desiccant, drying cabinets, etc.). Which would be most appropriate for this situation? (amount of seed, size of operation, etc.) and how to set up. Develop a plan to set up seed drying for species collected
2.0 Native Seed Cleaning	
2.1 Challenges of cleaning native seed	2. Introduce importance of native seed cleaning (reduce bulk for storage, sometimes influences dormancy, etc.) a. Ask participants how they think native seeds are different from those produced in agriculture (not uniform in size, often more delicate, etc.). How might this create challenges when cleaning native seed? (designed for uniform size seeds, need to do a lot by hand, etc.) Why is it important to clean all viable seeds? (genetic diversity!)
2.2 Fleshy Fruit	b. Go over some general techniques for cleaning fleshy fruit, focusing on techniques relevant to focal species (look at seed cleaning section in protocol for specific information on focal species). Set up an interactive demonstration of how fleshy fruit can be cleaned. Blend berries and water in blender with taped or rubber coated blades. Demonstrate how pulp can be floated off the top while heavier seeds sink to the bottom. (If focal species not available, use alternate species ready at this time)
Afternoon	
1.0 Seed drying set up	1. Review seed drying discussion from morning. a. Collect materials required for seed drying. Set up two seed drying stations (see activity: small scale seed drying for instructions). Set out seeds collected during previous day to dry.
2.0 Native Seed cleaning: Dry fruit	2. Review seed cleaning sections of protocols with participants for species collected in session one that are now dry. Set up seed clearing stations based on materials indicated in protocols. Follow instructions in the protocols and take participants through cleaning these seeds. Do an example for each

species so participants can watch and then have them continue cleaning the remainder of the seeds (if time and size of collection permits, otherwise just do a portion). Have participants look at protocols for reference but be available to answer any questions they may have while cleaning.

3.0 Native seed storage

3.1 Storage conditions

3. Introduce the importance of seed storage conditions to participants.
Why are the conditions we store seeds in important?
What do you think influence seed viability during storage? (moisture, temperature, oxygen)
How should we store our seeds?
Is the type of storage dependent on the amount of time seeds are intended to be stored?
Go over types of containers that can be used for seed storage. Develop a plan for the storage of seeds cleaned and collected.
Place cleaned seeds in appropriate containers. Stress the importance of labeling containers!

4.0 Wrap up and Closing

Opportunity for participants to comment on the course, ask questions, discuss future steps.