7

Harvesting

Understand how to treat the harvested material.

If you have harvested all plant growth simply to compare total yields between treatments, then the samples can be dried in an oven or in the sun after harvest. If you are harvesting seed and want to test its quality (see Partridge, 1996) or if you want to test the chemical composition of the harvested material, you may have to treat the samples differently (for example, there may be specific drying requirements or specific plant parts needed for analysis).

Do not harvest edge plants.

Do not harvest plants on the edge of plots as they often grow differently than the plants in the centre of plots because there is either less or more competition with plants in adjacent areas.

Avoid harvesting plots immediately after rain.

High moisture content in samples can cause errors in yield measurement and soil contamination of leaf samples after heavy rain can cause errors in chemical analysis.

Harvested samples should be representative of the whole plot.

If your plots are small, you can harvest the whole plot, apart from a strip (30–50 cm wide) around the edge. However, if your plots are large, you will need to choose small areas to harvest.

It can be difficult to decide where you should harvest samples to be representative of the whole plot, especially if your plots are growing unevenly. Make sure you use a sampling method that ensures your samples are representative of the whole plot. There are many methods, depending on the uniformity and size of your plots. One is to walk twice across the plot diagonally, taking a metre square sample every few metres (the number of metres depends on the size of the plots). Plan the method of sampling beforehand and follow the same method for all plots.

Cut back all plots after sampling.

If your plots are large enough that you had to harvest sample areas, the entire plot should then be cut back to ensure even regrowth.

Account for weeds in harvested samples.

If your harvest sample contains weeds as well as your sown species, separate them out or, at least, estimate their percentage composition by weight.

Use a simple unbiased method for taking subsamples of harvested material.

The simplest method of sampling harvested material is the 'quartering method'. Divide all the harvested material in half and then divide these two piles in half again. Discard the two diagonally opposite piles. Combine the remaining two piles and repeat the process as many times as is necessary to give you a sample of the size that you need.

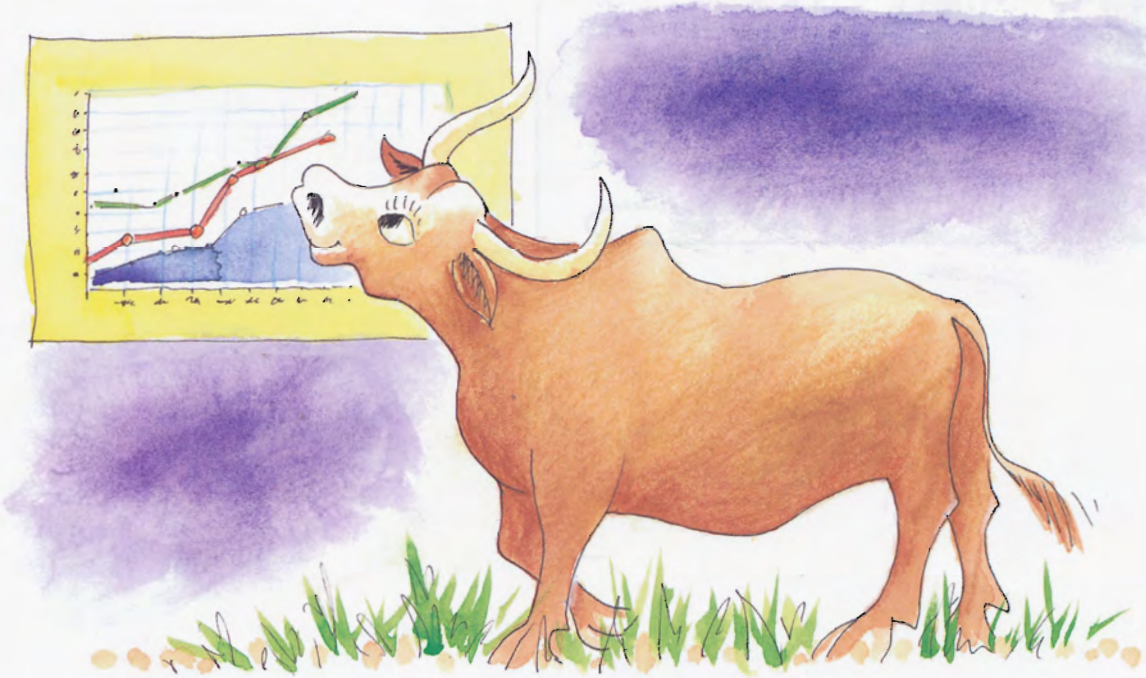
Weigh fresh subsamples in the field at the time of harvest.

Harvested plant material is often dried to calculate the dry matter yield. However, there is often too much harvested material to dry, so it is necessary to weigh all the harvested material in the field and then take a subsample for drying. However, plant water content can change rapidly after harvesting. Therefore, weigh your fresh subsamples at the same time as you weigh the total harvested material. It is useful to write harvest data (such as sample fresh weight) on the sample bags to reduce errors later when analysing the results.

Separate out the unwanted material (such as weeds, stems and dead leaves) from the subsample. It may be useful to weigh each of these separately.

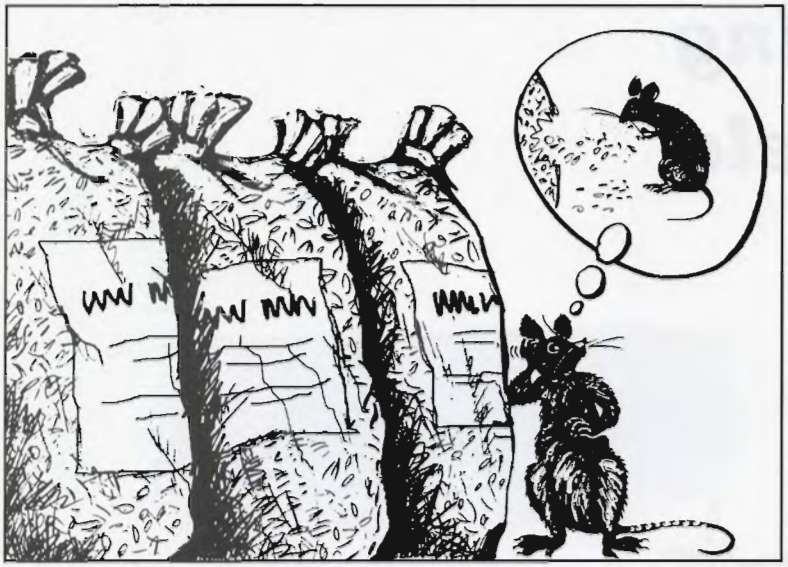
8

After Returning from the Field



Do not leave fresh samples lying around.

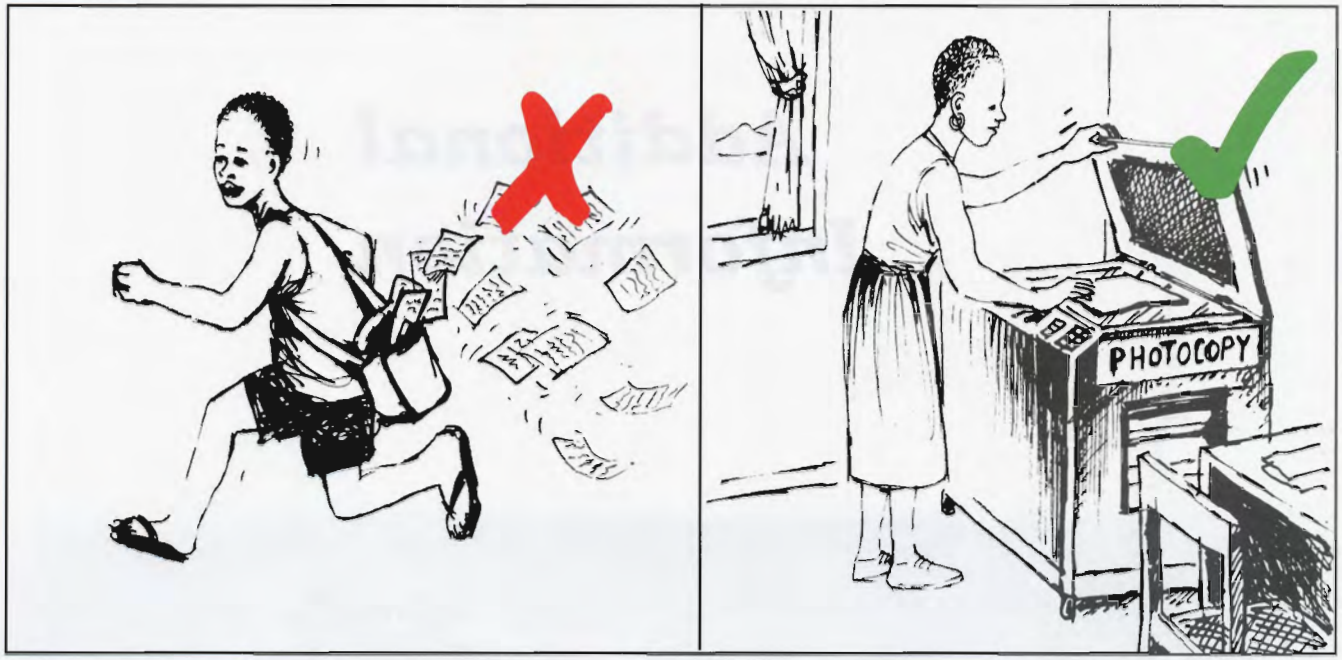
Dry your samples as soon as possible in the sun or in an oven before weighing. If the samples need to be analysed chemically the temperature of the oven should not be higher than 70°C. Do not pack the ovens too full because drying will be slow and the chemical composition of the sample can change. Samples should be left in the oven for 72 hours.



Store dried samples in airtight and pest-proof bags or containers identified with labels on the inside and also with permanent markers on the outside.

Make a copy of the collected data.

It is easy to lose files and offices can burn down. Make at least one copy of your data as soon as possible and keep the original and the copy in separate places. Avoid copying the data by hand, as this introduces more errors.



Analyse your data soon after they are collected.

Mistakes can be quickly detected and corrected if the data are scanned and/or analysed soon after being collected. It is difficult to correct mistakes in the way the data are being collected or recorded if you do not check the data until the end of the trial.

Keep a systematic filing system for the data.

Data sheets are easily lost in the bottom of drawers. Organise your records so information is easily recovered. Simply using paper folders to organise your data can make finding information much easier.

Additional Information

Useful tools in the field

General

- *Ruler*
- *Pens and pencils*
- *Waterproof pens*
- *Clipboard*
- *Paper clips*
- *Sharp knife*
- *Tape*
- *Fencing wire and materials to repair broken fences*
- *Experiment map*
- *Diary*

Laying Out the Plots

- *String (knots tied at every metre is handy for measuring)*
- *Pegs*
- *Labels*
- *Hammer*

Sampling/Harvesting

- *Sickle*
- *Bags—paper, cotton, plastic, net*
- *Tarpaulin for weighing samples*
- *Field balance (spring, beam)*
- *Recording sheets placed in a plastic bag*

Testing seed for germination potential

There are two simple ways to test seed germination potential: a laboratory germination test and an emergence test. Both give only a rough indication of the germination potential of the seed.

1. Laboratory germination test

1. *Wet absorbent paper, such as tissue paper, with clean water and place on a plate. Pour off most excess water.*

2. *Place a known number of seeds (at least 100) on the paper and put a clear lid over it (to prevent moisture loss and to allow some light every day as some species need light for germination). Do not place in full sunlight.*

3. *Check the plate every day and add more water if necessary. The paper should be wet, but not drenched or the seeds will go mouldy. The paper should not be allowed to dry out.*

4. *In the tropics, it is not necessary to put plates in the incubator as a germinating temperature between 25°C and 30°C is quite suitable for most tropical species.*

5. *Count the number of seeds germinated every two or three days, for a total of 14 days for legumes and 21 days for grasses.*

6. *Remove and discard the germinated seeds as you count them so their roots do not get tangled up with each other.*

7. *After you have finished the germination test, add up how many germinated seeds you have removed from the plate, to calculate the percentage germination. For legumes, count the number of hard, unswollen seeds, to calculate the percentage of hard seed.*

2. *Emergence test*

1. *Fill a small tray with moist, fertile, well-structured soil. If you do not have this available, you could mix equal amounts of soil, sand and manure.*

2. *Take a representative sample of seed from your seed lot and sow a known number of these seeds (at least 100) into the soil, just under the surface.*

3. *Place the tray in a shady location with a mild temperature (not too hot or cold). Keep the soil moist but not waterlogged.*

4. *Every two or three days, count the number of seeds emerging for a total of 14 days for legumes and 21 days for grasses. Remove and discard the seedlings as you count them.*

Treating seeds to improve germination

Low germination percentage in seeds can be the result of a high percentage of dead seed or it can be because some of the seed is alive (viable) but is not ready to germinate (dormant).

In legumes, dormancy is often caused by a hard seed coat which is impermeable to water ('hardseededness'). In grasses, the causes of dormancy are more complex, including both physical and chemical factors.

Hardseededness in legumes can be determined by the percentage of apparently normal, hard seed that has not germinated at the end of a standard germination test. Viability (and hence dormancy) of grass seed can be determined by taking apparently normal seed that has not germinated at the end of a standard germination test and staining it with Tetrazolium (tri-phenyl tetrazolium chloride). Tetrazolium reacts with live cells in the embryo to form a bright red compound.

Low germination and high dormancy percentages in grasses often occur in fresh seed (e.g. Brachiaria *spp.). The simplest way to overcome this is to let the seed age in cool, dry conditions for 4–6 months or more.*

If the germination percentage of a seed lot is low but the viability of the ungerminated seed is high, then germination might be improved by treating the seed before sowing. Some procedures for this are on pages 41 and 42.

Treatment of dormant seed in grasses

1. Acid treatment

Acid treatment of grass seed is not often used unless immature seed is needed for sowing immediately. Brachiaria seed, for example, can be immersed in concentrated sulphuric acid (available from car batteries) for up to 10 minutes using the following procedure:

i. *Mix the seed in concentrated sulphuric acid for up to 10 minutes and stir frequently. BE CAREFUL NOT TO SPLASH ACID ONTO YOUR SKIN OR CLOTHES. IF THIS HAPPENS, WASH IT OFF QUICKLY WITH COLD WATER. The outer parts of the seeds (the 'glumes') will be removed by the acid.*

ii. *Drain the acid and rinse the seeds in water until free from acid. Rinse several times then spread the seeds out thinly to dry.*

iii. *Test the germination of the treated seed. If germination is still low and most of the seed is still hard and not swollen, you can soak the seeds in acid again. Do not soak seeds in acid for more than 30 minutes at any one time.*

2. Pre-drying

Seed is heated up to 7 or more days in hot air at 40°C–60°C.

Treatment of hardseededness in legumes

1. Soaking

Seed is soaked in hot water at 80°C for 2–10 minutes or 100°C for 3–5 seconds. This helps open the hard seed coat in some legumes (e.g. Leucaena).

2. Acid treatment (e.g. Stylosanthes hamata*)*

Mix the seed in sulphuric acid for up to 10 minutes and stir frequently (as for the acid treatment of grass seed).

3. Mechanically remove parts of the seed coat

With small seed lots, this can be done with a scalpel, nail clippers or sand paper. Caution should be used when cutting seeds to avoid damaging the embryo. With large seed lots, hammer mills can be used, but you will need special sieves for your seed type.

A WORD OF CAUTION: *Seed is alive. The methods described above can easily kill your seed if not used properly. Test each method on a small lot of seed first. Confirm that the treatment has been successful by comparing germination test results of both the treated and untreated seed.*

Useful reference

Harty, R.L. (1996). Seed testing. In: TROPICAL PASTURE SEED PRODUCTION — A TRAINING MANUAL. I.J. Partridge (ed.). Department of Primary Industries. Queensland, Australia. 110pp.

Inoculating legume seeds with rhizobia

If it is necessary to inoculate your legume seed, the inoculant can be applied to seeds, in a slurry or as a dry powder.

1. Slurry application

i. *Mix the inoculant and the seed with a little water to make a slurry.*

ii. *The seeds should be thoroughly wet and coated with the slurry, without being too wet. This is best done by swirling the seed around in a beaker, bucket or other container.*

iii. *Dry the seeds in a cool, shaded place before planting.*

iv. *Sow the inoculated seeds within 24 hours. You may choose to inoculate seeds in the evening and dry them overnight before planting the next morning.*

2. Dry application

Mix the dry inoculant with the seed immediately before planting.

IMPORTANT

INOCULANT SHOULD ALWAYS BE KEPT IN A COOL PLACE, NEVER IN SUNLIGHT AND NEVER FROZEN.

☑ Checklists

These checklists are designed to remind you of the practical suggestions mentioned in this guide. Make a copy these checklists to take with you to the field.

Planning the Experiment

- ☐ *Start a diary for the experiment.*
- ☐ *Explain the aims and procedures to everyone involved.*
- ☐ *Keep the experimental design as simple as possible.*
- ☐ *Allow enough time for the experiment to be successfully completed.*
- ☐ *Make sure everyone understands their responsibilities.*
- ☐ *Prepare a timetable for the experiment.*
- ☐ *Check that everything you need will be available on time.*
- ☐ *Store your seeds in a cool, dry place.*
- ☐ *Make sure that the site is typical of the area you are interested in.*
- ☐ *Find out how the site has been used before.*
- ☐ *Make sure that the site is as uniform as possible.*
- ☐ *Avoid sites prone to erosion.*
- ☐ *Make sure that the site will be available for as long as you need it.*
- ☐ *Check that fences around the site will keep unwanted animals out.*
- ☐ *Check that the site will not be affected by other farming activities or experiments.*
- ☐ *Make a description of the site.*

Preparations before starting the Experiment

- ☐ *Prepare a map of the experiment to show the location of the plots.*
- ☐ *Make extra copies of the experiment map.*
- ☐ *Test the germination of your seed. (Consider whether you need to treat your seed.)*
- ☐ *Carefully weigh seed or fertiliser for each plot.*
- ☐ *Choose the appropriate sowing rate for each species.*
- ☐ *Prepare and label as much as you can before going to the field.*
- ☐ *Place all the treatment materials in waterproof bags.*
- ☐ *Consider preparing some backup treatment materials.*
- ☐ *Check whether your legumes need inoculation.*
- ☐ *Calculate the size of the experiment carefully and double-check.*
- ☐ *Mark the experiment site clearly.*
- ☐ *Choose the appropriate plot size to match the aims of the experiment.*
- ☐ *Label the plots clearly and permanently.*
- ☐ *Minimise the risk of erosion.*

Managing the Experiment

- ☐ *Always carry a copy of the experiment map with you in the field.*
- ☐ *Lay all the treatments out on the plots before applying them.*
- ☐ *Check the label on each plot before applying treatments.*
- ☐ *Choose the appropriate sowing method.*
- ☐ *Choose the appropriate weed control measures.*

- ☐ *You may wish to establish a small nursery of seedlings for replanting.*
- ☐ *Apply treatments evenly within plots.*
- ☐ *Keep your methods consistent between plots.*
- ☐ *Apply treatments one block or replication at a time.*
- ☐ *Make sure that one treatment will not affect other treatments.*
- ☐ *Record any mistakes and problems.*

Collecting Data

- ☐ *Make the recording sheets clear and easy to use.*
- ☐ *Provide extra space on the recording sheets for notes and calculations.*
- ☐ *Collect data from one block at a time.*
- ☐ *Be consistent in your data collecting methods.*
- ☐ *Measure establishment success.*
- ☐ *Rate the relative performance of the treatments regularly.*
- ☐ *Measure relevant climatic information throughout the experiment.*
- ☐ *Make regular visits to the site.*

Harvesting

- ☐ *Know how to best treat and dry your harvest samples.*
- ☐ *Collect samples that are representative of the whole plot.*
- ☐ *Cut back the entire plot after harvesting samples.*
- ☐ *Account for weeds in harvested samples.*
- ☐ *Take unbiased subsamples (for example, use the 'quartering method')*
- ☐ *Weigh fresh samples and subsamples as soon as possible after harvest.*

After returning from the field

- ☐ *Dry your subsamples properly before storing.*
- ☐ *Make at least one copy of the collected data.*
- ☐ *Analyse your data soon after collection.*
- ☐ *Keep a systematic filing system for the data.*

Useful references

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