KNOW YOUR SOILS

Part 2 Assessing Your Soils

Natural Resources and Environment

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KNOW YOUR SOILS

Part 2 **Assessing Your Soils**

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Centre for Land Protection Research

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PREFACE

The soil is the lifeblood of your crop or pasture. This important asset supplies nutrients, water and oxygen to plants, supports machinery and animal traffic, and provides a medium for the decomposition of crop and pasture residues.

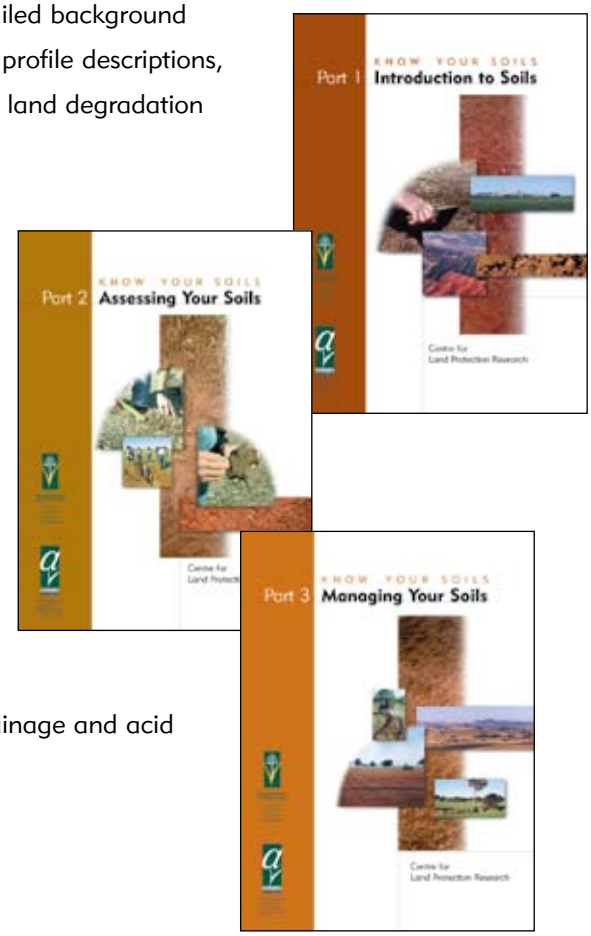
Soil management will affect land productivity and environmental sustainability. Maintaining the health of your soil to maximise productivity will require an awareness of soil characteristics and how they should be managed.

Farms may have a variety of soil types that require specialised management to optimise productivity and prevent land degradation. Different soil types occur for a variety of reasons, such as different geology, position in the landscape and drainage.

This booklet is the second in a series of three booklets called 'Know Your Soils'. The three booklets provide an easy and informative way for you, the farmer, to assess and understand your soil.

All three booklets are inter-linked and should be used together to achieve an understanding of the way your soil behaves and how it should be managed.

Part 1: Introduction to Soils - This booklet provides detailed background information on soil, including soil forming processes, soil profile descriptions, physical characteristics of soil, and soil management and land degradation issues.



Part 2: Assessing Your Soils - This booklet details eight exercises for you to carry out to assess some characteristics of your soil. The topics covered include: soil classing, the hole, soil colour and depth, stone size and percentage, soil texture, friability, soil slaking/ dispersion and soil pH.

Part 3: Managing Your Soils - This booklet allows you to use the information you have collected in Part 2, to interpret the behaviour and physical characteristics of your soil. Part 3 also provides management options for some limitations such as poor structure, poor internal drainage and acid soils.

When used together, all three booklets provide you with a logical way of assessing the characteristics of your soil, and most importantly, enable you to gain an understanding of your soil and how to manage it better.

You can use the 'Know Your Soils' booklets to monitor changes in the condition of your soil over time. Part 1 will help you understand your soil and Part 3 will assist you in understanding and managing your soil.

It is recommended that you do not use this series as a 'one off'. The routine use of 'Know Your Soils' every three to five years will allow you to observe patterns and changes.

By assessing two or three paddocks each year you can develop baseline information for each paddock and then re-sample to start the monitoring process. If you intend to monitor paddocks, it is important to re-sample as close as possible to the original sampling point. Early detection of changes through regular monitoring will enable problems to be managed and even prevented. This will reduce the detrimental effects of soil degradation on productivity and the environment.

It is also a good idea to independently monitor the chemical conditions of your soil in conjunction with this series. This will help you manage the application of fertilisers and allow you to work out if you have any chemical problems.

In Part 3 you will identify limitations that can be managed. Limitations, such as subsoil acidification, are likely to change over time and are costly and difficult to treat. Monitoring pH, particularly at depth, will enable the early detection of subsoil acidification and provide an opportunity for prevention.

Recording sheets are located at the back of this booklet. These sheets will allow you to record the information you collect so you can refer to them when you re-sample. You can independently do the same with your chemical analysis.

Cross referencing between booklets

Each of the three booklets in the 'Know Your Soils' Series is numbered for ease of reference. All sections found in Part 1 have the prefix '1'. For example, 1.1 Introduction to Soil and 1.5.5 Wind Erosion. Whereas 2.7 Soil Slaking/Dispersion Exercise is a practical activity found in Part 2; and Section 3.6 Determining Soil Drainage can be found in Part 3.

INTRODUCTION

This booklet will guide you through a series of soil assessments. It is aimed at giving you a better understanding of your soils attributes and identifies limitations that may result in reduced productivity or environmental degradation. You will conduct eight tests: soil classing, the hole, soil colour and depth, stone size and percentage, soil texture, friability, soil slaking/dispersion and soil pH. All these exercises are designed to assess the physical properties of the soil (things that you can see and touch) with the exception of the pH exercise, which is a chemical assessment. At a depth of around 60 cm you will have access to information that will help you understand why your soil behaves as it does and what plant roots have to contend with. This information will help you to manage your farming system to make the best use of your soil.

You may already be quite familiar with the physical appearance of your topsoil because it is exposed during cultivation, but it is also important to know what the soil below this (the subsoil) looks like. The characteristics of the subsoil often determine the success of various crops and pastures in different areas of the farm. Crop growth may be stunted in one area compared with another, even though the soils appear, on the surface, to be the same. Chemical or physical barriers at depth may restrict plant growth. The exercises in this booklet will help you identify barriers and understand the impact they may have on productivity.

It is important to follow the soil assessments in this booklet with the 'Managing Your Soils' exercises in Part 3. Part 3 will help you integrate the information you have gathered in Part 2 and describe your soil as a whole. It also provides management options to help you overcome any soil limitations. Part 1 (Introduction to Soils) will be an important source of reference throughout your investigation for more detailed information about the properties you investigate in Parts 2 and 3.

GETTING STARTED

You will need:

- An aerial photograph or map of your property or a whole farm plan
- Shovel
- Large paper or plastic bags e.g. shopping bags or freezer bags
- Ruler or tape measure
- Trowel or knife
- Water bottle with distilled water or rain water (approx 250 ml)
- Flat bottomed containers e.g. saucers or transparent plastic cups
- Photocopied Soil Description Recording Sheet and Soil Dispersion Recording Sheet located on pages 23 and 24 of this booklet
- Pen or pencil
- Thin permanent marker
- pH kit available at most nurseries (refer to 2.8 Soil pH Exercise for further information)

The exercises

1. Soil Classing
2. The Hole
3. Soil Colour and Depth
4. Stone Size and Percentage
5. Soil Texture
6. Friability
7. Soil Slaking/Dispersion
8. Soil pH

These exercises require you to dig a hole and assess certain characteristics of the soil. Some tests can be conducted in the paddock, and some are easier to do in the home or shed.

2.1 SOIL CLASSING

Conducted in the paddock and completed in the home/shed.

You will need:

- Aerial photograph or map of your property with property boundary and paddocks outlined
- Permanent markers
- Geology map (optional)

The first activity requires you to identify the different soil types on your property. You may already know that your soils are different due to obvious differences in colour, texture, drainage and workability. If you are not sure whether the soils differ from one paddock to another, it is a good idea to dig at least one hole in each paddock. This allows you to describe as many different soils on your property as possible.

You can identify different soil types in a number of ways by:

- Using your knowledge and experience.
- Identifying different geological types - this can be established from your knowledge, local knowledge or geological maps.
- Dividing the topography into different areas - crests, upper slope, lower slope, flats, drainage depressions.
- Dividing areas by observation, i.e. noting changes in soil types from postholes, dams, ploughed paddocks, roots from overturned trees. (This method is particularly useful on flatter land where landscape and geology may be difficult to separate).
- Noting areas of uneven production. This is often linked to different soil types.
- Noting changes in drainage.
- Referring to different land classes if you have completed a whole farm plan or land classing exercise. (A Land Classing Kit for Farmers, similar to this Series, has been produced by the Department of Natural Resources and Environment, which leads you through the steps of land classing).

EXERCISE 2.1: SOIL CLASSING

1. You will need an aerial photograph or map of your property so that you can record where the different soil types are and where your holes will be located.
2. Using one or more of the methods outlined above, decide where you would like to dig holes to assess the soil, now and in the future.
3. Cross on your map where you want to dig holes. Allocate a number to the holes. Avoid areas that are not common or have been disturbed e.g. sheep camps, tracks.

You do not have to sample all the holes in one go if this is not convenient. You can conduct these exercises over a number of years, but you need to start with a plan of where you want to test now and in the future.

2.2 THE HOLE

Conducted in the paddock.

Note: The holes should be dug when the soil is not too wet or too dry. Spring is usually a good time of the year to conduct these tests.

The first step to understanding your soil is describing its specific characteristics. The most practical way of doing this is to dig a hole (outlined below). Another alternative, although not as effective, is to auger a hole. This booklet assumes that a hole has been dug.

You will need:

- Shovel or auger
- Ruler or tape measure
- Plan with the location of where you want to dig your holes
- Spray paint or coloured tape
- Soil Description Recording Sheet (located on page 23 of this booklet)
- Compass (optional)

EXERCISE 2.2: THE HOLE

1. Locate the area on the ground that you marked on your map. You should mark this site for future re-sampling with a fixed point (fence post, tree etc) with a unique marker that will last a number of years (e.g. spray paint or coloured tape). Measure the distance and direction (compass is useful) to the sample point. Record any information on the plan of your property and on the Soil Description Recording Sheet at the back of this booklet.

2. Dig a hole 50-60 cm deep (20-24 inches) or until you hit rock. This allows you to look at the soil that is most important for the plant roots. The hole should be wide enough for you to get a good look at the soil (eg. 60 cm x 60 cm).

3. If you are hand augering, lay each head-full of the auger on a piece of tarpaulin in a sequential line, so that you can clearly see any vertical changes. When there is an obvious change in colour or texture, measure and record the depth of this change by placing a ruler down the hole.

Figure 1 *Dig a hole 50-60 cm deep.*

4. In the Position in the Landscape section on the Soil Description Recording Sheet, record the position in the landscape that the hole is located. You could use descriptions such as: crest, upper slope, mid slope, lower slope, drainage depression or flat. It will also be useful to record if the hole is on a steep slope, moderate slope or gentle slope.

5. In the sections provided on the Soil Description Recording Sheet, name the paddock, allocate a unique number to the hole, and enter the date you dug the hole so that you can re-sample and compare results at a later date.

Table 1 *In this exercise you will name the paddock and number the hole and write the date you tested the soil. You will also record the position in the landscape the hole was located.*

SOIL DESCRIPTION RECORDING SHEET

Example Only

PADDOCK: Top Paddock **HOLE No.: 1**
DATE: 12/05/2001

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH

Position in the landscape: Lower slope (gentle slope).

Rooting depth:

Notes:

The exercises you will conduct at the hole are:

- Soil Colour and Depth
- Stone Size and Percentage
- Soil Texture (optional)
- Friability
- Soil pH (optional)

2.3 SOIL COLOUR AND DEPTH EXERCISE

Conducted at the hole.

You will need:

- Colour chart located on page 25 of this booklet
- Ruler
- Trowel or knife
- Bags
- Permanent marker
- Soil Description Recording Sheet
- Additional information - refer to 1.2.1 Soil Structure, 1.2.1 Soil Colour and 1.3.1 What is a soil profile?

What does the soil colour tell me?

Soil colour is an important indicator of internal drainage characteristics. Soil colour may also help you distinguish different layers (horizons).

For the purpose of this exercise there are six colour classes you will use to describe your soil:

- Red
- Yellow
- Black
- Brown
- Grey
- Pale

You will also determine whether there are any 'mottles' in the soil. Mottles are usually bright patches of red, orange or yellow on a yellow, brown or grey background found at depth and are an indication of insufficient drainage (refer to 1.2.1 Soil Colour and 1.3.1 Soil Colour).

EXERCISE 2.3: SOIL COLOUR AND DEPTH

In this exercise you will fill in the Colour and Depth columns of the recording sheet. You will also collect soil samples to be tested in the home or shed after you have identified the different layers of the soil.

1. Look for any change in colour down the hole. If the colour difference is obvious work through steps 2 to 5. If there is no obvious colour difference work through steps 6 to 7. Everyone will then work through steps 8 to 13.

Obvious differences in colour

2. Using a ruler or tape measure, measure the depth from the surface where the soil colour changes. Sometimes these layers are not even, so record the depth as the average.
3. Record the depth from the surface (to the nearest 5 cm) of the different colours in the Depth column on the Soil Description Recording Sheet.
4. Using the colour chart on page 25 of this booklet as a guide, describe the colour of the soil, using the following colour classes:
   - Red
   - Yellow
   - Black
   - Brown
   - Grey
   - Pale

   Also record the presence of mottles.

5. Record the colour in the Colour column at the appropriate depths on the Soil Description Record Sheet and move onto step 8.

Similar colour throughout

6. If the colours are similar down the hole, you need to use another method of recording the depth of the layers. One way is to observe any obvious changes that are visibly different or feel different. These should be immediately obvious and you probably would have noticed these when you were digging the hole (e.g. if it became harder to dig, this would be a change of some sort and the depth should be recorded). Measure the depth where changes occur and record the depths in the Depth column on the Soil Description Recording Sheet. If there is no obvious difference, record the depth in 10 cm intervals, i.e. 0-10 cm, 10-20 cm, 20-30 cm etc.

7. Using the colour chart on page 25 of this booklet as a guide, record the colour in the Colour column at the appropriate depths on the Soil Description Recording Sheet.

Figure 2 *Record the depth where the colour changes down the hole. Note the presence of mottles.*

Figure 3 *The soil has a similar colour to about 80 cm but the structure of the soil changes at 20 cm and again at 60 cm, therefore you would identify these depths as the different layers.*

Figure 4 *The soil has similar colour throughout and there is no obvious difference in texture or structure, therefore you will record the depths at 10 cm intervals.*

8. You will need to record the presence of solid rock in your hole (i.e. rock that cannot be dug out). It is sometimes difficult to know whether you have hit solid rock or just floating rock, so look at road cuttings to give you an idea of the depth of the soil in your area. As a general guide, you have more chance of hitting rock if you are on or near the crest of the hill or on steep land. The lower you are in the landscape, the more likely you are to have a soil depth of greater than 60 cm.

9. Write 'solid rock' at the appropriate depth in the Stone column of the Soil Description Recording Sheet, or leave it blank if you did not hit rock.

Figure 5 *On the Soil Description Recording sheet you will write solid rock at 60 cm. You will write the majority of the roots are at 40 cm. Since there is no obvious colour difference you will record the depths at 10 cm intervals.*

10. In this exercise you are also required to note the presence of roots in the soil. Do most of the roots stay in the top 30 cm of the soil or have they gone deep into the soil? Record this information in your own words in the section provided on the Soil Description Recording Sheet. You should also note what type of plant the roots are from. For instance, if they are perennial plants and the roots are only going down 40 cm, it is more than likely there is a barrier of some sort (either physical or chemical) that is preventing the roots from growing deeper.

11. Using a permanent marker label each bag with the hole number and the depth (e.g. hole 1: 0-15 cm).

12. Using the trowel or knife collect about three handfuls of soil at the depths you have recorded on the recording sheet. If possible, collect several large clumps of soil. Samples need to be collected from the paddock and carried back to the house or shed with minimum disturbance. Do not crush the samples. Uncrushed soil is required for the dispersion exercise.

13. Bring your samples to the home or shed and allow to dry out if too wet. Keep plastic bags open, as the soil is likely to 'sweat' if sealed.

Table 2 *In this exercise you will fill in the Depth column, the Colour column, the Rooting Depth section, the Stone column if you hit solid rock, and write additional notes as required.*

SOIL DESCRIPTION RECORDING SHEET

PADDOCK: Top Paddock **HOLE No.: 1**

DATE: 12/05/2001

Example Only

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH
0-15	Brown					
15-30	Pale					
30-40	Yellow					
40-50	Yellow					
50-60	Yellow Mottled					
60+	Yellow					

Position in the landscape: Lower slope (gentle slope).

Rooting depth: The main pasture species is an annual Rye grass. Most roots are in the 0-15 cm horizon. About 30% go through to 30 cm and very few go deeper.

Notes: Colour changes at 15 cm to pale layer. Colour changes again at 30 cm. 30+ cm seems clayier.

2.4 STONE SIZE AND PERCENTAGE EXERCISE

Conducted at the hole

You will need:

- Ruler
- Samples from bag (optional)
- Soil Description Recording Sheet
- Additional information - refer to 1.2.1 Stone Content

This test is best conducted at the hole, although you can correct the percentage at home by using the samples collected in the bags.

What does the presence of stone tell me?

Note: For reasons of simplification we have used the term 'stone' in the text to incorporate gravel, stone, rock and buckshot.

You would notice the presence of stone every time you work a paddock, but it is important to record the location, size and percentage of stones in the soil to be able to compare one soil type with another. Stones are not only a limitation for machinery, they are also a problem for plant roots. They may act as a barrier to roots (restricting growth) and can also limit the water and nutrient capacity of the soil. However, stones can facilitate drainage.

Some stones occur in the soil as part of the weathering process. That is, they are remnants of the broken down bedrock. Other stones occur in the soil due to poor drainage of the soil. The common name for these is 'buckshot' (refer to 1.2.1 Stone Content). The presence of buckshot is an indication that there is (or was) a perched watertable and you will often find it in association with the pale horizon (A2 horizon), and yellow or grey subsoil with mottles throughout (refer to 1.2.1 Soil Colour and 1.3 Soil Profile). The presence of buckshot is an important indicator of the internal drainage characteristics of the soil.

EXERCISE 2.4: STONE SIZE AND PERCENTAGE

1. In this exercise you are required to differentiate between gravel, stone, rock and buckshot. The average diameter is used to differentiate and the following definitions should be used:
   Gravel - less than 2 cm
   Stone - 2 cm to 10 cm
   Rock - greater than 10 cm
   Buckshot - any size
   Using a ruler to give an idea of the sizes will help.

For the purpose of this exercise, 'rock' means 'floating rock' i.e. rock that could be dug out. If you did hit solid rock, this would have been recorded in the Soil Colour and Depth Exercise.

Work out the average size of the stony material and name as one of the above. You may have more than one type.

2. When you have determined whether you have gravel, stones or rocks through the soil you must approximate the amount.

You can do this by:

- Estimating the proportion of the soil in each horizon that is made up by stony material by looking down the hole

OR

- Separating out the stony material from a handful of the soil from the bag you collected previously and determining the percentage of stone in that handful of soil.

3. Estimate the percentage and record the following in the Stone column in the Soil Description Recording Sheet:

- Less than 10%: Some rocks / some stone / some gravel / some buckshot;
- 10-20%: Slightly rocky / slightly stony / slightly gravelly / 10-20% buckshot;
- 20-50%: Rocky / stony / gravelly / 20-50% buckshot;
- Greater than 50%: Very rocky / very stony / very gravelly / greater than 50% buckshot.

Figure 6 *In this example you will record very stony at 40-50 cm.*

Table 3 *In this exercise you will fill in the Stone column.*

SOIL DESCRIPTION RECORDING SHEET

Example Only

PADDOCK: Top Paddock **HOLE No.: 1**
DATE: 12/05/2001

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH
0-15	Brown					
15-30	Pale	20-50% buckshot				
30-40	Yellow					
40-50	Yellow					
50-60	Yellow Mottled					
60+	Yellow	Some rocks				

Position in the landscape: Lower slope (gentle slope).

Rooting depth: The main pasture species is an annual Rye grass. Most roots are in the 0-15 cm horizon. About 30% go through to 30 cm and very few go deeper.

Notes: Colour changes at 15 cm to pale layer. Colour changes again at 30 cm. 30+ cm seems clayier.

2.5 SOIL TEXTURE EXERCISE

Conducted at the home or hole.

You will need:

- Soil from the bags (if conducting the tests in the home) or
- Knife or trowel (if conducting the test at the hole)
- Water bottle
- Soil Description Recording Sheet
- Additional information - refer to 1.2.1 Soil Texture and 1.3 Soil Profile
- Cloth to wipe hands

What does the soil texture tell me?

Soil texture is the measure of the relative proportion of sand, silt, clay and organic matter. Every soil consists of sand, silt and clay particles, (with the exception of pure sand) but they occur in different proportions.

Hand texturing can be used to assess the dominance of any particular particle. If clay is dominant it will feel sticky, if silt is dominant it will feel very smooth, and if sand is dominant it will feel gritty. You can also measure the cohesiveness of the soil, i.e. how strongly it sticks together when you manipulate (ribbon) it. Measuring the amount of cohesion will help you determine how much clay there is in the soil.

EXERCISE 2.5: SOIL TEXTURE

Note: You will end up with dirty hands at the completion of this exercise.

1. Take a small handful of soil from the bag or from each depth if conducting the test at the hole. If you are using samples collected earlier remember to do this for each depth.
2. Remove any coarse organic matter i.e. roots and any stony material (larger than 2 mm diameter). Crumble the soil in your hand, especially if it is clayey.
3. Wet the soil until it is moist enough to mould into a ball. Stop adding water when the ball starts to stick to your hand.
4. To determine the texture class you need to manipulate the ball and feel whether the soil is:
   sandy - feels and sounds very gritty
   silty - feels very smooth and silky
   clayey - feels like plasticine and is sticky.
5. The texture class is also determined by ribboning the soil. Roll the ball into a sausage shape and then press the sausage out between your thumb and forefinger. Measure the length of the ribbon.

Figure 7 *Ribboning between thumb and forefinger.*

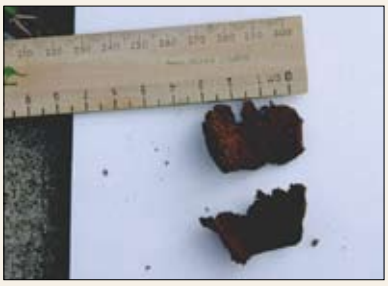


Figure 8 *Measuring the length of the ribbon.*

6. Use the table below to determine the texture.

Table 4 *Determining soil texture.*

Ball	Ribbon	Feel	Texture
Will not form ball		Single grains of sand stick to fingers, note whether it is coarse or fine sand; coarse sand can be seen with the eye	sand (S)
Ball only just holds together	0.5 cm	Gritty	loamy sand (S)
Ball just holds together	0.5-1.3 cm	Sticky, sand grains stick to fingers	clayey sand (S)
Ball just holds together	1.3-2.5 cm	Very sandy to touch, visible sand grains	sandy loam (SL)
Ball holds together	1.3-2.5 cm	Fine sand can be felt	fine sandy loam(SL)
Ball holds strongly together	2-2.5 cm	Sandy to tough, sand grains visible	light sandy clay loam (SL)
Ball holds together	2.5 cm	Spongy, smooth but not gritty or silky	loam (L)
Ball holds together	2.5 cm	Slightly spongy, fine sand can be felt	loam, fine sandy (L)
Ball holds together	2.5 cm	Very smooth to silky	silty loam (L)
Ball holds strongly together	2.5-3.8 cm	Sandy to touch, medium sand grains visible	sandy clay loam (CL)
Ball holds together	3.8-5 cm	Plastic, smooth to manipulate	clay loam (CL)
Ball holds strongly together	>5 cm	Plastic, smooth, handles like plasticine and can be moulded into rods	clay (C) *

* The clay texture group can be further divided into light clay, medium clay and heavy clay. For the purpose of this exercise we are using the term clay to incorporate all three.

7. Record the texture group at each depth in the Texture column on the recording sheet.

Table 5 *In this exercise you will fill in the Texture column.*

SOIL DESCRIPTION RECORDING SHEET

Example Only

PADDOCK: Top Paddock **HOLE No.: 1**
DATE: 12/05/2001

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH
0-15	Brown		SL			
15-30	Pale	20-50% buckshot	SL			
30-40	Yellow		C			
40-50	Yellow		C			
50-60	Yellow Mottled		C			
60+	Yellow	Some rocks	C			

Position in the landscape: Lower slope (gentle slope).

Rooting depth: The main pasture species is an annual Rye grass. Most roots are in the 0-15 cm horizon. About 30% go through to 30 cm and very few go deeper.

Notes: Colour changes at 15 cm to pale layer. Colour changes again at 30 cm. 30+ cm seems clayier.

2.6 FRIABILITY EXERCISE

Conducted at the hole.

You will need:

- Knife or trowel
- Soil Description Recording Sheet
- Additional information - see 1.2.1 Soil Structure and 1.2.1 Porosity

What does the friability of the soil tell me?

Friability is essentially a term used to describe the structure of the soil and refers to the proportion of macropores present in a particular soil sample. Macropores store air and store water (when soil is wet), and plant roots require them to grow freely through the soil (refer to 1.2.1 Porosity). Soils with a large proportion of macropores are likely to have plenty of air available to plants, drain well, and provide the channels through which plant roots grow. A friable soil has many macropores and plant roots are able to grow deep within the soil to tap into the store of water and nutrients held there.

In this exercise you will determine the ease with which the soil breaks apart from which you will infer the friability of the sample.

For the purpose of this exercise, soils that are not friable are referred to as 'hardsetting'. Hardsetting soils have very few macropores and it is difficult for plant roots to grow through this soil. In some situations a soil may have a friable topsoil but the subsoil may become hardsetting. Plant roots may then be confined to the topsoil with limited access to water, air and nutrients. Assessing the change in friability down the soil profile may help you understand why plants in one area grow better than in another.

Water stress is also likely to occur faster on soils that are 'loose', such as sandy soils. Loose soils have too many macropores and insufficient micropores. The roots can grow freely down the soil, but rainwater often drains too quickly with little water stored for plant use.

EXERCISE 2.6: FRIABILITY

1. Lever out a clump of soil (large handful) and gently try to prise the soil into individual aggregates (refer to 1.2.1 Soil Structure).

Figure 9 *Gently trying to prise the soil into individual aggregates*

2. Decide which of the following definitions best describes the friability of your soil sample:

a) Friable - The soil breaks easily with little force into small individual aggregates. There should be obvious cracks where the soil will naturally break apart.

b) Hardsetting - The soil does not naturally break into individual particles and remains solid unless strong force is applied. The soil does not necessarily have to be 'hard'. When moist a hardsetting soil tends to 'stick' together and it is difficult to break it apart.

c) Loose - The soil is loose and granular like beach sand. There may be some aggregates that are held together with organic matter but the majority of the soil is loose.

Figure 10 *This soil is very sandy (like beach sand) and is described as loose.*

Figure 11 *The soil on the top is friable, i.e. it will fall naturally into individual aggregates. The bottom soil is harsetting i.e. it will not naturally fall apart into individual aggregates.*

4. Record the friability of the soil at the different depths in the Friability column of the Soil Description Recording Sheet.

Table 6 *In this exercise you will fill in the Friability column.*

SOIL DESCRIPTION RECORDING SHEET

Example Only

PADDOCK: Top Paddock **HOLE No.: 1**
DATE: 12/05/2001

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH
0-15	Brown		SL	Friable		
15-30	Pale	20-50% buckshot	SL	Hardsetting		
30-40	Yellow		C	Friable		
40-50	Yellow		C	Friable		
50-60	Yellow Mottled		C	Hardsetting		
60+	Yellow	Some rocks	C	Hardsetting		

Position in the landscape: Lower slope (gentle slope).

Rooting depth: The main pasture species is an annual Rye grass. Most roots are in the 0-15 cm horizon. About 30% go through to 30 cm and very few go deeper.

Notes: Colour changes at 15 cm to pale layer. Colour changes again at 30 cm. 30+ cm seems clayier.

2.7 SOIL SLAKING/DISPERSION EXERCISE

Conducted in the home/shed.

You will need:

- Clumps of soil from the bags
- Flat bottomed dishes e.g. saucers or transparent plastic cups
- Distilled water or rainwater
- Soil Dispersion Recording Sheet located on page 24 of this booklet
- Soil Description Recording Sheet
- Additional information - refer to 1.2.1 Slaking and 1.2.1 Dispersion

What does the slaking and dispersibility of the soil tell me?

Some soils remain stable when in contact with water, others collapse totally and lose structure. Slaking and dispersion tests will give you an idea of how different clay soils will react to rain when dry (e.g. how they will behave when wet after the autumn break) or how they will respond to cultivation when moist.

Slaking and dispersion tests are conducted on dry aggregates to simulate the effect of rainfall on dry soil. If the soil does not disperse in the dry state, tests are conducted on moist reworked aggregates to simulate the effects of cultivation on moist soil.

The following simple test will determine the dispersibility of your soil. You should sample the first layer (topsoil) to determine its susceptibility to surface crusting and the layer where the clay content increases, to determine how the soil will react to cultivation. If this clay is deep, sample to the cultivation depth. Sampling two or three layers will be useful to determine if the soil has differing dispersive characteristics with depth.

Note: You do not have to test the soil if the texture is in the sand texture group as it is the clay particles that disperse in water and sandy soils do not have enough clay to disperse.

EXERCISE 2.7: SOIL SLAKING/DISPERSION

1. Take a clump of soil from the bag.
2. Place this sample in a warm dry place until it is dry. This is very important. Moist soil may need a couple of days to dry.
3. Select three aggregates approximately pea size from each depth (you will need to break off pieces if the soil is hardsetting). You will need at least four flat-bottomed containers (e.g. saucers or transparent plastic cups) and some rainwater or distilled water. Do not use bore, river or dam water as this can alter the results of the tests. Put the containers in a place where they will not be disturbed (by pets or children) for 20 hours. Put enough water in each dish so that it will cover the aggregates (6-10 mm deep). Use a separate dish for each depth you want to sample. Gently place the aggregates into the saucers or gently slide them along the side of the plastic cups.

Figure 12 *Slaking*

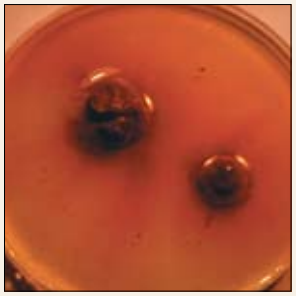


Figure 13 *Complete dispersion (Type 1)*

Figure 14 *Incomplete dispersion (Type 2)*

Figure 15 *No dispersion (move on to step 7)*

4. Watch the aggregates carefully for the first few minutes. If slaking is to occur it normally occurs within the first hour. This is where the aggregates fall apart into smaller micro-aggregates (Figure 12). Small bubbles of air will escape from the aggregate and eventually the entire aggregate may collapse. Note on the Soil Dispersion Recording Sheet if slaking has occurred.
5. Leave the samples for 20 hours before checking for dispersion, which will be indicated by a cloudiness or milkiness around the base of the aggregate. In some soils, it will take this long for dispersion to be visible.

   If dispersion is complete, (Figure 13) then a cloud will cover the bottom of the dish (Type 1 dispersion). If dispersion is incomplete, (Figure 14) the cloud will just surround the aggregate (Type 2 dispersion).

   Note on the recording sheet if complete, incomplete or no dispersion has occurred by ticking the appropriate box.
6. If no dispersion occurred (Figure 15), move on to step 7. Otherwise use the Soil Dispersion Recording Sheet to determine the stability of your soil. Refer to the definitions below of the different types of dispersion.
7. If no dispersion occurred, then the soil requires a further test. Make a moist ball using exactly the same procedure for making the texture ball in the Soil Texture Exercise. Out of this, make three pea size balls and place them in a dish of water prepared as in step 3 above.
8. Leave the samples for 20 hours. Record whether any form of dispersion occurred (Type 3), or if no dispersion occurred (Type 4). Tick the appropriate box on the Soil Dispersion Recording Sheet.
9. Using the information on the Soil Dispersion Recording Sheet, fill in the Dispersion type on the Soil Description Recording Sheet.
10. Refer to the definitions below to interpret the results.

Slaking

Slaking is when the air-dried aggregate breaks into smaller aggregates when suddenly immersed in water. This indicates that the aggregates are not strong enough to withstand pressures involved with wetting and will break up and block the macropores. Some soils are strong enough to withstand this pressure. Increasing the organic matter of the soil may assist in stabilising the soil. Most subsoils will slake. Slaked soils can also disperse (see below).

Table 7 *Soil Dispersion Recording Sheet*

SOIL DISPERSION RECORDING SHEET

Example Only

PADDOCK: Top Paddock **HOLE No.: 1**

DATE: 12/05/2001

Depth	Slaking (Yes/No)	Complete dispersion (Type 1)	Incomplete dispersion (Type 2)	No dispersion	Remoulded Dispersion (Type 3)	Remoulded No dispersion (Type 4)
0-15 cm	Yes	✗	✗	✔	✗	✔
20-30 cm	Yes	✗	✔			
cm	-	-	-	-	-	-

Notes:

Definitions of the types of dispersion

Figure 16 *Severe surface crusting occurs when the topsoil is a Type 1 dispersive soil.*

Type 1 - When an air-dried aggregate completely disperses, a cloud will cover the bottom of the dish in a thin layer. The only thing left of the aggregate may be a small heap of sand grains.

Highly dispersive topsoils may suffer from severe crusting and dispersive subsoils may suffer from poor internal drainage and waterlogging. Dispersive soils are likely to respond to gypsum. A laboratory test will be valuable to determine how much gypsum to apply. Increasing the organic matter of the soil will assist in stabilising the slaking nature of the soil.

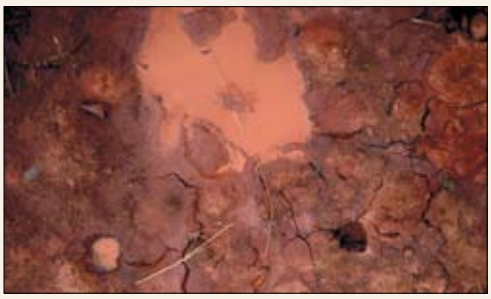


Figure 17 *Type 2 dispersion on the topsoil, still leads to surface crusting, but not as severe as a Type 1 dispersive soil.*

Type 2 - When an air-dried aggregate has incomplete dispersion, a cloud of dispersed clay forms around the aggregate and usually spreads in thin streaks and crescents along the bottom of the container. Some of the aggregate remains.

Type 2 soil will have similar problems as the Type 1 soil but to a lesser degree. The soil is likely to respond to gypsum. A laboratory test will be valuable to determine if gypsum will be beneficial and if so, how much gypsum to apply.

Type 3 - When the air-dried aggregate does not disperse (although it may slake) but the reworked aggregate does disperse. Cultivation of this soil when it is moist will cause dispersion. Gypsum could be useful in promoting this soil from a Type 3 to a Type 4.

Figure 18 *Type 3 dispersion. A plough pan has formed and results in waterlogging.*

Type 4 - When the air-dried aggregate does not disperse (although it may slake) and the reworked aggregate does not disperse. The aggregate structure of this soil is reasonably stable with little or no dispersion. This soil should not crust and should not suffer from significant soil structure problems. Appropriate management will help ensure structural stability.

Figure 19 *Type 4 soil does not disperse and is therefore generally stable to water.*

Note: In some cases the soil may not disperse (Type 4) but you suspect that there is something stopping the roots from growing deep into the soil. This may be caused by high soil salinity, or high levels of aluminium if the soil is strongly acidic, which stops the soil from dispersing. If you suspect that there may be some chemical problem, further tests should be conducted by a laboratory.

Table 8 *In this exercise you will fill in the Dispersion column.*

SOIL DESCRIPTION RECORDING SHEET

PADDOCK: Top Paddock **HOLE No.: 1**
DATE: 12/05/2001

Example Only

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH
0-15	Brown		SL	Friable	Type 4	
15-30	Pale	20-50% buckshot	SL	Hardsetting		
30-40	Yellow		C	Friable	Type 2	
40-50	Yellow		C	Friable		
50-60	Yellow Mottled		C	Hardsetting		
60+	Yellow	Some rocks	C	Hardsetting		

Position in the landscape: Lower slope (gentle slope).

Rooting depth: The main pasture species is an annual Rye grass. Most roots are in the 0-15 cm horizon. About 30% go through to 30 cm and very few go deeper.

Notes: Colour changes at 15 cm to pale layer. Colour changes again at 30 cm. 30+ cm seems clayier.

2.8 SOIL pH EXERCISE

Conducted in the home/shed or at the hole.

You will need.

- pH kit
- Soil from bags (if conducting the test in the home) **or**
- Knife or trowel (if conducting the test at the hole)
- Soil Description Recording Sheet
- Additional information - refer to 1.2.1 Soil pH

What does the pH of the soil tell me?

Soil pH is a measure of the acidity or alkalinity of the soil. Different plants can tolerate different pH levels. Some plants prefer to grow in acid soils (e.g. lupins), others can tolerate a wide pH range (e.g. wheat) but most plants prefer a pH between 6.5 and 7.0 (water). Productive agriculture can change soil pH over time and it is therefore important to develop strategies to prevent irreparable damage.

It is useful to be aware of any change in the pH down the soil profile. Some soils have a strong change in pH from less than 5.0 in the topsoil to greater than 8.0 in the subsoil. The growth of deep-rooted plants that are not suited to alkaline situations could be limited by severe changes in pH. They may not be able to exploit the water and nutrients deeper in the soil profile if the deeper soils have a pH outside of the plant's pH tolerance range.

EXERCISE 2.8: SOIL pH

The use of a soil pH test kit is the most convenient way to conduct your own pH tests. You should be able to buy one from any good nursery. A test kit will measure the pH of your soil to within 0.5 of a pH unit. For more accurate results, you should send samples to a chemical laboratory.

Be aware that the soil pH kit provides a pH measure similar to that measured in water. Laboratories may provide pH results in calcium chloride ($CaCl_2$) and/or water. Take note before comparing results.

1. Conduct the test as per instructions on the kit at different depths.
2. Write your results in the pH column on the Soil Description Recording Sheet.

Table 9 *In this exercise you will fill in the pH column.*

SOIL DESCRIPTION RECORDING SHEET

PADDOCK: Top Paddock **HOLE No.: 1**
DATE: 12/05/2001

Example Only

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH
0-15	Brown		SL	Friable	Type 4	5.0
15-30	Pale	20-50% buckshot	SL	Hardsetting		5.5
30-40	Yellow		C	Friable	Type 2	6.5
40-50	Yellow		C	Friable		6.5
50-60	Yellow Mottled		C	Hardsetting		6.5
60+	Yellow	Some rocks	C	Hardsetting		6.5

Position in the landscape: Lower slope (gentle slope).

Rooting depth: The main pasture species is an annual Rye grass. Most roots are in the 0-15 cm horizon. About 30% go through to 30 cm and very few go deeper.

Notes: Colour changes at 15 cm to pale layer. Colour changes again at 30 cm. 30+ cm seems clayier.

Where to from here?

Congratulations. You have completed the Assessing Your Soils part of 'Know Your Soils'. Part 3 of 'Know Your Soils' will enable you to interpret the information you have collected and develop short and long term management strategies for your soil.

Remember also that soils do change over time. Repeating the exercises in Part 2 every three to five years will help you to refine the management strategies for your soil.

APPENDICES

MASTER COPY

SOIL DESCRIPTION RECORDING SHEET

PADDOCK: HOLE No.:

DATE: / /

Depth (cm)	Colour	Stone	Texture	Friability	Dispersion	pH

Position in the landscape:

Rooting Depth:

Notes:

SUMMARY RECORDING SHEET

PADDOCK: HOLE No.:

DATE: / /

Topsoil Subsoil	Topsoil depth (cm)	Total soil depth	Stone	Structure	Drainage	pH

MASTER COPY

SOIL DISPERSION RECORDING SHEET

PADDOCK: HOLE No.:

DATE: / /

Depth	Slaking (Yes/No)	Complete dispersion (Type 1)	Incomplete dispersion (Type 2)	No dispersion	Remoulded Dispersion (Type 3)	Remoulded No Dispersion (Type 4)

Notes:

SOIL DISPERSION RECORDING SHEET

PADDOCK: HOLE No.:

DATE: / /

Depth	Slaking (Yes/No)	Complete dispersion (Type 1)	Incomplete dispersion (Type 2)	No dispersion	Remoulded Dispersion (Type 3)	Remoulded No Dispersion (Type 4)

Notes:

SOIL COLOUR CHART

Red soils - If any of these colours approximate the soil colour then the soil is considered red.

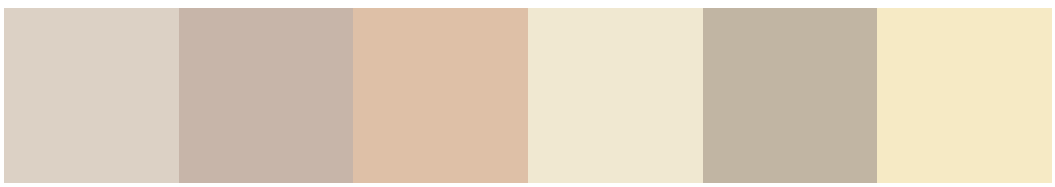
Yellow soils - If any of these colours approximate the soil colour then the soil is considered yellow.

Black soils - If any of these colours approximate the soil colour then the soil is considered black.

Brown soils - If any of these colours approximate the soil colour then the soil is considered brown.

Grey soils - If any of these colours approximate the soil colour then the soil is considered grey.

Pale soils - If any of these colours approximate the soil colour then the soil is considered pale.



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