

# SOIL ASSESSMENT

W055AC:35061



**sawma** Soil and Water Management Association

A D A S 

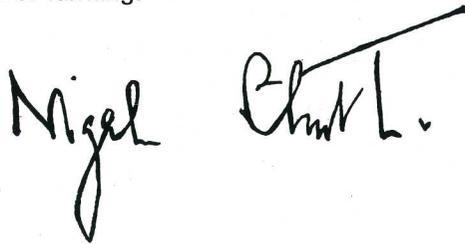
 **British Petroleum**

## FOREWORD

In almost every sphere of activity attention is often misdirected and the wrong priorities given to the use of time. Farming is no exception, and during this half-century, when such enormous developments have taken place in the mechanisation of husbandry, there has been too much neglect of the soil itself. For a farmer, knowledge of the soil and how to succour and exploit it is completely fundamental and should come before everything else. I like to think now that there is something of a "fundamentalist revival" and that more and more soil assessment will take its rightful place as the first and senior priority in the annual planning of each and every farmer.

Soil and water go together: hence the title, "Soil and Water Management Association." This booklet, revised in a second edition by ADAS Soil Scientist John Archer, and SAWMA, and provided for the NFYFC Competition, is designed to be a simple Bible for the assessment of different types of soils and their very varying interactions with water, and as such I commend it. It should have a wider potential use beyond its specific purpose of the competition; young farmers could do worse than give a copy to their fathers for Christmas, and I fancy it would prove interesting and intriguing to employees equally.

We are greatly indebted to B.P. for their sponsorship and to the Young Farmers Clubs for organising this competition. It is to be hoped both will continue their enthusiasm for the first and most important aspect of farming.



Sir Nigel Strutt, T.D., D.L., F.R.Ags.  
President of SAWMA

March 1982

## SOIL ASSESSMENT

There is a wide range of soils in England and Wales. Some are developed by the weathering of underlying rocks, but many are formed in materials that have been moved by the action of ice, water and wind, or affected by extremes of climate when ice caps extended over much of the country. Material accumulating today as sand dunes and in river floodplains, estuaries and coastal marshes are examples of new soils being formed:

Each type of soil has characteristic physical, chemical and biological properties. The major differences in soil management requirements are related to physical properties many of which can be assessed in the field. The Young Farmers Competition and this booklet is primarily concerned with these physical aspects of soil.

### 1. SOIL EXAMINATION

Most fields will contain some variation in soil and in order to characterise any particular field, it is important to ensure that the points at which soils are examined represent the kinds of soil present. Breaks of slope are commonly associated with significant differences in soil and should be investigated before selecting the representative sites. Headlands should be avoided since they will have been trafficked much more than the rest of the field.

Preliminary examination of the soils within a field can be made using a soil auger. For detailed assessment of properties including structure a small hole should be dug to reveal the soil profile and the soil examined to a depth of about 1m or bedrock, whichever is the shallower.

The water content of the soil at the time of examination will influence the assessment of soil properties. Ideally soil should be moist, neither too wet nor too dry. In practice soil moisture varies down the profile. Spring is the best time of the year to examine soils and, wherever possible, freshly dug profiles should be assessed.

## 1.1 Soil Profile

The first step in soil examination is to identify the layers or horizons that comprise the soil profile. Most profiles show a clearly defined topsoil which is commonly darker in colour due to its larger organic matter content. On land that has been ploughed, topsoils usually have a clear lower boundary at 20 - 30cm. (8 - 12 ins.) depth. Land in permanent grass can have a less obvious and shallower topsoil. The subsoil below can be divided into further layers based on differences in properties such as texture, structure or colour.

It is usually instructive to assess the number of roots under a well established crop and note the depth to which they extend. Where crop roots are common at 1m. it can be assumed that there is no major barrier to root growth to that depth. Some crops root considerably deeper than this especially in soils with light or medium textured subsoils. Care should be taken however in interpreting the absence of roots since this may simply reflect the growth stage or rooting habit of a particular crop.



Topsoil

Subsoil

The Soil Profile  
(Soil Survey of England & Wales)

Having identified the different soil layers, the next step is to describe them. You are being asked in this competition simply to assess the topsoil and then to make a broad assessment of the subsoil characteristics.

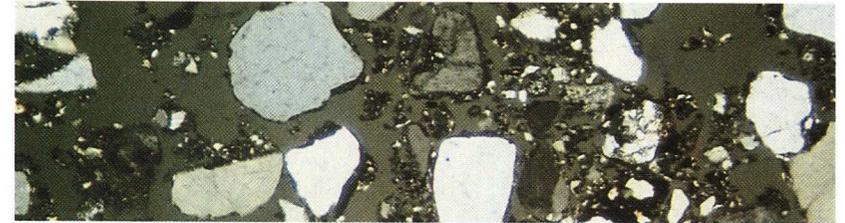
## 1.2 Texture Q1

Soil texture is the single most important physical property and most aspects of soil management are related to it, so it is important that an accurate assessment is made. Texture is the relative proportions of sand, silt and clay particles in the soil together with the amount of organic matter or humus. Soil texture is estimated in the field by rubbing moist soil between finger and thumb. It may be necessary to moisten the soil before making an assessment.



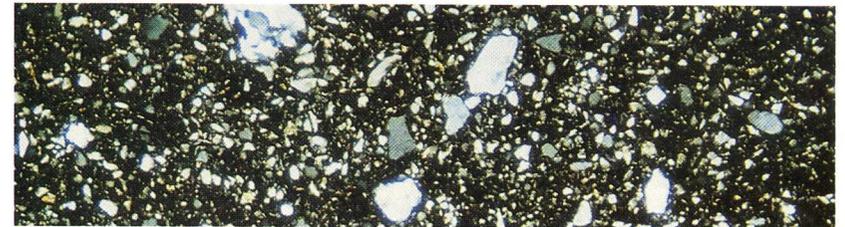
Hand Texturing  
(MAFF, ADAS Crown Copyright)

Below are some thin sections of soils, as seen under a microscope; the characteristic feel of the soils texture is given underneath each appropriate photograph. (scale  $\times 150$ ).



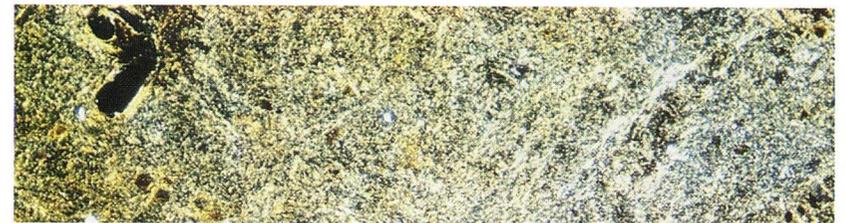
Sandy Soil

**Sand** has a gritty feel — When moulded into a ball it is very easily deformed.



Silty Soil

**Silt** has a very smooth silky or floury feel.



Clayey Soil

(Soil Survey of England & Wales)

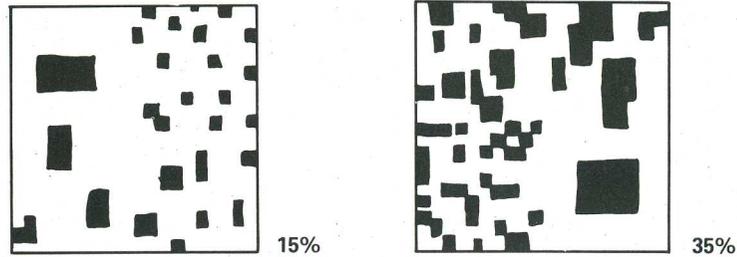
**Clay** is sticky when wet and takes a polish when rubbed with the thumb; it is difficult to mould.

Intermediate textures are described as loams. Loams contain roughly equal proportions of sand, silt or clay.

Peaty soils with large amounts of organic matter feel silty but can generally be distinguished by their dark brown/black colour when moist.

### 1.3 Stoniness Q2

Particles larger than 2mm are described as stones. The stoniness of a particular soil layer may be judged using the diagrams and limits shown below. Each quarter of either square has the same area of black; this represents stone content and can be compared with the vertical face of a soil profile.



Percentage Occurrence Charts (*Soil Survey of England & Wales*)

0 - 15% — **Stoneless to slightly stony** — will not hinder machinery use.

16 - 35% — **Moderately stony** — establishment and harvesting of some crops will be affected.

36% and over — **Very stony** — cropping and/or machinery use restricted.

### 1.4 Structure Q3

Roots grow, and water and air move through soil along pores and fissures between natural aggregates or peds. The size and development of peds is referred to as the soil structure. The amount, direction and continuity of pores and fissures is one of the most important aspects of a soil's physical condition.

Structure is closely related to texture. In general sandy and peaty soils have weak structure comprising peds that easily break down into individual particles. Soils with more clay have stronger and more obvious peds; very clayey soils can shrink and swell with changes in water content during the year and fissures evident in summer are closed in winter.

Good soil structure in which root development, and water and air movement are unhindered is characterised by well formed small porous aggregates with rounded edges which can be broken between the fingers when moist. Soils with poor structure can be compact and have few fissures, they have well formed but large dense peds with angular edges and smooth faces, or consist of platy peds with few vertical cracks.

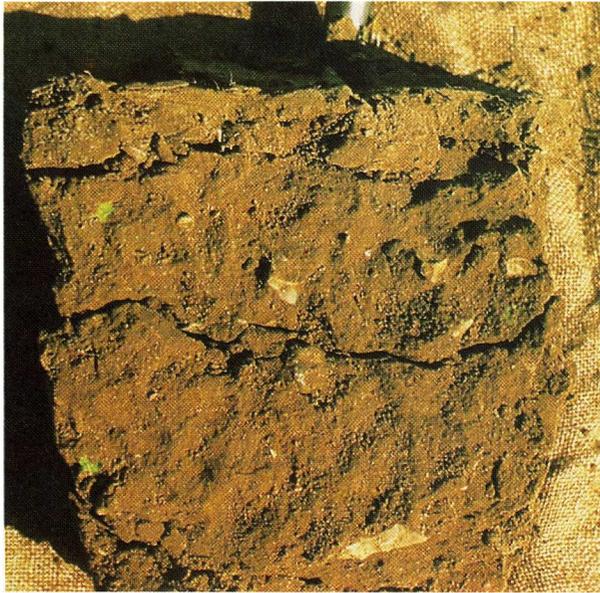


Clay Soil — Poor structure



Clay Soil — Good structure

(MAFF, ADAS Crown Copyright)



Sandy Soil — Poor structure



Sandy Soil — Good structure (MAFF, ADAS Crown Copyright)

Topsoil structure is largely dependent on recent cultivations and management. Poor soil structure can develop in a single season or gradually over a number of years. If land has been mismanaged compact, dense, poorly structured layers or pans with no or few vertical fissures are often found just below the depth of previous cultivations. Pans can often be detected by inserting a knife or trowel into the soil face. The denser and stronger pan will be more resistant than the layers above or below. Poor structure on direct drilled land and permanent grassland is likely to occur just below the surface.

You should assess topsoil structure by taking spadefuls of soil and breaking the material gently by hand. If the soil is moist, it will break down into its natural structural units or peds. Care should be taken to avoid making unnatural breaks particularly in very moist clay soils.

Structure can be described as:—

**Good** — *the soil breaks down almost entirely into well formed small peds and there are no large angular blocky or platy peds or compact material which cannot be broken easily.*

**Moderate** — *a mixture of small well formed peds and loose unaggregated material, or with some large angular or platy peds.*

**Poor** — *mainly large or dense angular or platy peds, or compact material with few vertical fissures.*

## 1.5 Acidity Q4

For satisfactory crop production the following minimum pH levels should be maintained by liming as necessary.

	Arable	Grass
Mineral soils	6.5	6.0
Peaty soils	5.8	5.5

Many soils in England and Wales are naturally alkaline and never need liming. Soil acidity may be assessed approximately in the field using soil pH indicator, following the method outlined below.

First rinse the dish with distilled water or indicator. Then place a few soil fragments in the dish and add sufficient indicator to cover them. The dish is then gently rocked and the colour change around the soil fragments observed. The following scale is used to assess the soil pH.



4.0 4.5 5.0 5.5 5.8 6.0 6.2 6.5 6.8 7.2 7.5

### A.D.A.S. pH COLOUR CHART (MAFF, ADAS Crown Copyright)

Red	Below pH 5.0	Very acid
Orange	pH 5.0 - 5.8	Moderately acid
Yellow	pH 5.8 - 6.5	Slightly acid
Green/Blue	Above pH 6.5	Not acid

The results can be misleading on some peats since the indicator colour may be altered by absorption of one of the dye constituents. The yellow colour of some silty soils and the reddish colour of some soils with large iron contents may mask the colour changes, particularly if shaken too much.

## 1.6 Colour Q5

Soil colour varies for several reasons. It can be related to soil wetness: brown soils are commonly dry, soils with rusty and grey mottling suggest intermittent waterlogging, whereas wholly grey soils can be wet for long periods in winter. Great care is needed in interpreting soil colour, however, since some soils, for example, those developed from chalk or Keuper marl, inherit their colour from their parent material and then wetness effects are masked and much less evident. Topsoil colour depends mainly on the organic matter or humus content of the soil. The largest organic matter levels occur in naturally peaty soils. Moderate levels are generally found under permanent grass or in soils recently ploughed out of long term grass. The lowest levels are found on long term arable soils. The following scale can be used to assess this topsoil property.

**High** — organic or peaty topsoil — moist soil is dark brown/black.

**Medium** — moist soil is dark in colour but composed primarily of mineral material.

**Low** — moist soil is grey/brown in colour.

## 2. SOIL MANAGEMENT

Assessment of soil properties can be used to guide soil management though they should always be considered in conjunction with slope and climate, particularly rainfall.

### 2.1 Workability Q6

The ease with which soils can be cultivated/worked and the number of days when land can be grazed or traversed by machinery without damage, is principally related to topsoil texture and wetness. Relative workability declines as silt plus clay content increases and the period over which the surface is wet depends on drainage and rainfall. There are a large number of days when cultivation or grazing can be carried out on sandy soil in dry eastern England, but fewer suitable days on clayey land in the high rainfall area of south-west England.

Soil strength is related to texture and moisture content and is an important factor in determining the power needed to achieve a particular tilth or soil condition; sandy soils usually need less power to cultivate than clayey soils. The quality of seedbed that can be achieved on a particular soil type will have a major effect on the establishment of small seeded crops in dry seasons. Soils with large organic matter contents are more easily cultivated than those with smaller amounts.

Use your assessment of soil texture and organic matter content to place the soil in one of the following categories.

Ease of cultivation for cereal seedbeds.

- Easy** — only small amount of levelling and consolidation needed.  
— can cultivate soon after rain and reliably achieve good seedbeds.
- Moderate** — can cultivate after few drying days in spring and achieve good seedbed in most seasons.  
— fine tilth difficult to achieve in some seasons.
- Difficult** — few days in year when soil suitable for cultivation.  
— seedbeds cloddy in dry autumn.  
— late drilling common in spring.

## 2.2 Available Water and Droughtiness Q7

Once water loss by soil drainage has ceased in the spring, water for crop growth is principally that stored in the soil plus any further rainfall; this can be augmented when soils have ground water within rooting depth. The amount of water stored in a soil depends mainly on texture, porosity and organic matter content. Deep peaty and silty soils retain the greatest amounts of available water. Soils with a large proportion of coarse sand or non-porous stones hold the least. Clayey soils hold less than deep loams but considerably more than coarse sands.

In areas of similar rainfall, susceptibility of a particular soil to droughtiness depends on its capacity to store water for use by crops during the summer.

The soils you examine may be classified for their water holding capacity by using the following scale:

- High** — peaty or silty to 1m.
- Medium** — loamy or clayey to 1m.
- Low** — sandy to 1m.
- Very low** — sandy over coarse sand or gravel.  
— shallow soils over non-porous rock.

## 2.3 Wetness and Drainage Need Q8

Soil wetness limits crop production and utilisation particularly in areas receiving high rainfall. Crop roots cannot grow in saturated soil and the number of days in autumn and spring when animals can graze or machinery work on wet land is limited. Artificial drainage can often improve such land but clay soils continue to retain water and are always slow to dry in the spring.

Waterlogging occurs when soils are unable to dispose of excess water. Three principal situations can be identified. The first concerns land with impermeable clay subsoils; excess water cannot pass through the soil and the upper layers become waterlogged for long periods. The condition is usually alleviated by pipe drainage schemes often assisted by moling and with permeable fill over the pipes. A second major problem affects low lying land where groundwater levels are high in winter. To improve such

land an efficient arterial drainage system is needed to provide sufficient free-board for pipe systems in individual fields. Of more local significance are springlines where water-bearing rocks or sediments outcrop on slopes. These sites need pipe drainage schemes tailored to suit the particular individual location.

The degree and duration of waterlogging is difficult to interpret accurately from the soil profile. Texture, structure and colour all provide some evidence from which to judge. Soils subject to surface wetness commonly have profiles with clayey, coarse structured subsoils and grey and ochreous mottles above 40cm. (18 ins.). The incidence of high ground water is most easily detected by the low position of affected fields in the landscape and the presence of an arterial drainage system; soils at such sites often have a zone of ochreous mottling above a grey subsoil or are wholly grey.

Drainage of wet land is usually based on a pipe system. Pipes at an appropriate depth and spacing are adequate in permeable soils but because water movement is slow in clayey subsoils, pipes need to be spaced closer together for effective drainage. In such areas pipe systems are supplemented by mole drains connected to the pipes by permeable backfill.

Each soil should be put into one of the following categories of artificial drainage need, assuming the cropping is to be intensive grass or mainly cereals. Any existing drainage system should be ignored.

*Artificial drainage not needed*

*Pipe drains only needed*

*Pipe drains plus moling needed*

## 2.4 Rooting Depth and Subsoiling Q9

The depth to which plant roots can penetrate substantially influences crop production. Barriers to root growth include rock and pans of dense, compact soil. Where rock occurs at shallow depth, rooting is severely restricted, soils are droughty, stony and difficult to plough.

Pans can be natural or cultivation induced and often there is rootable soil below them. In such situations the pan can be broken by subsoiling to improve root development and vertical water movement; care should be taken to ensure that impermeable subsoils are adequately drained beforehand.

To determine the need for subsoiling, the upper subsoil layer should be inspected for the presence of a poorly structured, compact and dense layer, often comprising platy peds but with better structured, less compact soil below.

Severe pans form most frequently in fine sandy and silty loams where ploughing has been undertaken in wet conditions. Pans are less common in clayey subsoils because natural swelling and shrinking helps maintain good structure.

You should attempt to assess the need for subsoiling using the following categories:

*Subsoiling not needed*

*Slight plough pan — subsoiling worthwhile*

*Severe plough pan — subsoiling essential*

## 2.5 Stability Q10

The stability of topsoil which is subject to waterlogging or exposed to rainbeat or strong wind is related to texture and organic matter content. Peaty soils and mineral soils with a large fine sand and small clay content are most susceptible to serious wind erosion (blowing). Risk of damage to young seedlings or loss of seed before emergence is high in these soils. Most sandy soils can suffer some wind erosion on exposed sites.

Soils with little organic matter and small clay content are unstable when exposed to rainbeat or where surface ponding occurs. The result can be slumping of the plough layer or capping of fine seedbeds following heavy rain leading to a reduction of crop emergence. Soils with large silt or fine sand contents are most susceptible to capping and slumping.

From your description of texture and organic matter content place the topsoil in one of the following categories:

*Stable to wind and water*

*Susceptible to wind erosion*

*Susceptible to capping and slumping*

## 2.6 Nutrient Status

The physical characteristics of the soil also influence crop nutrition and fertiliser requirement. Sandy soils are subject to loss of nitrogen and lime by leaching while peaty soils have high levels of available nitrogen and need low rates of nitrogen fertiliser.

Soils with a high clay content are generally well supplied with potash, magnesium and trace elements. Sandy soils often need larger applications of potash and magnesium, but retain high levels of available phosphate.

## 2.7 Soil Borne Pests and Diseases

Many soil borne pests and diseases cause problems on a specific soil type. Free living eelworm problems are most common on coarse sandy soils. Potato cyst nematode is particularly associated with peaty soils.

Many soil borne diseases such as take-all of cereals cause more problems on sandy, peaty or poorly drained soils. Problems are least on well drained, well structured clay soils.

### Recommended Reading

1. **Good Soil** by Graham Brade Birks.  
(Publishers: "Teach Yourself Farming" Series.)
2. **Modern Farming and the Soil** (Agricultural Advisory Council, MAFF, HMSO 1970)
3. **Soil Management** (4 ed) by B. Davies, D. Eagle and B. Finney.  
(Publishers: Farming Press Limited)
4. **Soil Survey Field Handbook** — edited by J.M. Hodgson.
5. **Crop Nutrition and Fertiliser Use** (2ed) by John Archer  
(Publishers: Farming Press Limited)
6. **Soils and their use in . . .** — a series of six Regional Bulletins covering respectively:-  
**South East England; South West England; Eastern England; Midland and Western England; Northern England; Wales.**  
(Publishers: Soil Survey and Land Research Centre)

*For further advice on soils and their management telephone your local MAFF office.*

*The Soil Survey produces maps showing soil distribution; a full list of maps and reports is available from:-*

*The Soil Survey and Land Research Centre  
Silsoe Campus,  
Silsoe  
Bedford MK45 4DT*

## ACKNOWLEDGEMENTS

This booklet has been produced by Agricultural Development and Advisory Service Soil Scientists and the Soil and Water Management Association. We wish to thank the Soil Survey and Land Research Centre (formerly the Soil Survey of England and Wales) for their support in producing this booklet, and British Petroleum for their generous sponsorship.

## SCORECARD

Name .....

Club .....

Profile No. ....

Denote answers by ✓ in appropriate box(es)  
 Questions are cross referenced within the text.

### 1 Soil Examination

#### Q1 Topsoil Texture

A. Sandy	
B. Silty	
C. Clayey	
D. Loamy	
E. Peaty	

(tick one or two boxes as considered appropriate)

#### Q2. Topsoil Stoniness

A. Stoneless to slightly stony	
B. Moderately stony	
C. Very stony	

#### Q3. Topsoil Structure

A. Good	
B. Moderate	
C. Poor	

#### Q4. Acidity Measurement of Topsoil

A. Very acid	
B. Moderately acid	
C. Slightly acid	
D. Not acid	

#### Q5. Topsoil Organic Matter Content

A. High	
B. Medium	
C. Low	

### 2. Soil Management

#### Q6 Ease of Cultivation for Cereal Seedbed

A. Easy	
B. Moderate	
C. Difficult	

#### Q7. Soil Water Holding Capacity of Profile

A. High	
B. Medium	
C. Low	
D. Very low	

#### Q8. Drainage Need

A. Artificial drainage not needed	
B. Pipe drains only needed	
C. Pipe drains plus moling needed	

### Q9. Need for Subsoiling

A. Not needed	
B. Slight plough pan — subsoiling worthwhile	
C. Severe plough pan — subsoiling essential	

### Q10. Stability of Topsoil

A. Stable to wind and water	
B. Susceptible to wind erosion	
C. Susceptible to capping and slumping	

For information on Soils and their Management and further copies of this Booklet, contact:

**SAWMA**  
**22 Edgerton Grove Road**  
**Huddersfield**  
**W. Yorkshire**  
**HD1 5QX**  
**Telephone: (0484) 29417**