Part 1 - Summary Details

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Part 2 – Contact Details

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TRAVEL REPORT

David McKenzie is chairman of a Working Group ("Visual Soil Examination and Evaluation") within International Soil and Tillage Research Organisation (ISTRO).

In late-May 2005, this group held a "Visual soil structure assessment" field meeting near Peronne in the Somme Valley, north-east France. The workshop was sponsored by the National Institute for Agronomic Research (INRA), Estrées-Mons, and ISTRO.

The aims of the meeting were as follows:

- Ten soil structure assessment methods from UK, France, Australia, Denmark, New Zealand and Switzerland were compared in the field under maize, sugar beet and pea crops in a long term tillage experiment on loess-derived soil. Three of the procedures were based on assessment of the whole soil profile to a depth of one metre. Seven were based on spade inspections of the topsoil.
- Possible improvements for each of the methods were discussed.
- Consideration was given to amalgamation of some of the techniques.

David McKenzie demonstrated the SOILpak "compaction severity" assessment procedures to the group. This method was developed by the Australian cotton industry approximately 15 years ago, and is part of the 'Land and Water Management' module in the Best Management Practices Manual. The workshop provided an opportunity to see how well the SOILpak assessment procedures compare with the best available practices in other countries, and allowed possible improvements to be explored.

2. What were the:
   a) major findings and outcomes
   b) other highlights

See next page.

3. Detail the persons and institutions visited, giving full title, position details, location, duration of visit and purpose of visit to these people/places. (NB:- Please provide full names of institutions, not just acronyms.)

See attached list of attendees.

4. a) Are there any potential areas worth following up as a result of the travel?
   b) Any relevance or possible impact on the Australian Cotton Industry?

The workshop participants still have much to learn from each other. At the next ISTRO conference (in Kiel, Germany) in late-2006, results collated so far will be presented and discussed. Future research and possible training courses will be planned.

It is hoped that a follow-up meeting of the Working Group can be held to complete unfinished method comparisons and refinement of procedures (hopefully in France again where excellent facilities exist within INRA, and where a broad range of soil types exist close together). Further R&D is needed to refine the SOILpak procedures (see next page).

5. How do you intend to share the knowledge you have gained with other people in the cotton industry?

Article in 'The Australian Cottongrower'.

Recent trends in the rapid assessment of soil structure in the field

Introduction

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1. Ten soil structure assessment methods from UK, France, Australia, Denmark, New Zealand and Switzerland were compared in the field under maize, sugar beet and pea crops in a long term tillage experiment on loess-derived soil. Three of the procedures were based on assessment of the whole soil profile to a depth of one metre. Seven were based on spade inspections of the topsoil.
2. Possible improvements for each of the methods were discussed.
3. Consideration was given to amalgamation of some of the techniques.

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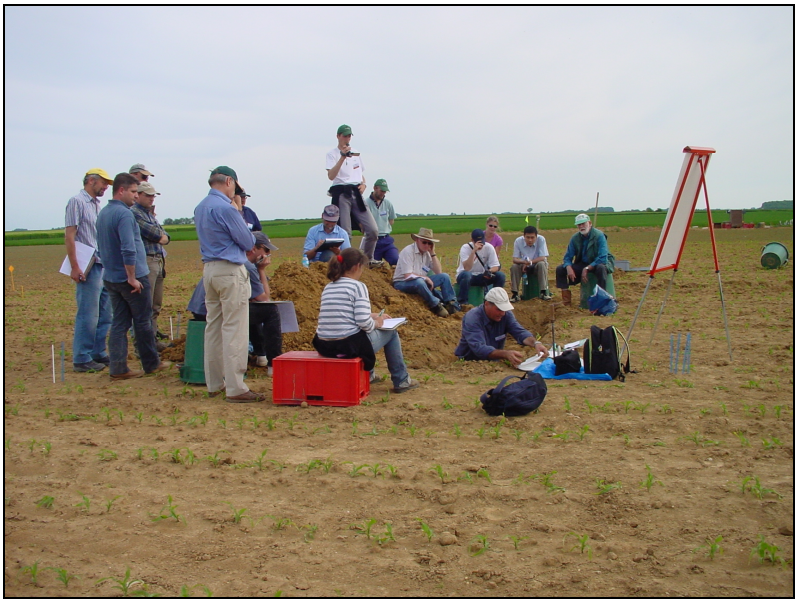

Figure 1. Critical evaluation of the SOILpak scoring procedure at Estrées-Mons (photo courtesy of INRA).

Applications of visual soil assessment procedures in modern agriculture

Ian Bradley from UK National Soil Resources Institute gave a presentation describing how English farmers in the near future will have to demonstrate achievement of a minimum standard for soil management before receiving their single farm payments and then payments under agri-environmental schemes. Rapid field procedures for soil assessment are being developed to support this scheme, with an emphasis on soil structural condition.

The soil management component of the 'Good Agricultural and Environmental Condition' initiative in England is very ambitious. All farmers receiving subsidies will have to draw up a simple risk-based soil management plan during 2006, then put it into practice from 2007 onwards. The overall aim of the program is to provide farmers with the opportunity to enhance the environment on their farms and to reward them for doing so. Also, it is anticipated that farm productivity will improve.

The French soil scientists from INRA (Hubert Boizard, Guy Richard and Jean Roger-Estrade) described their long tradition of using visual-tactile soil assessment in pits as a research tool. Their novel excavation and description techniques allow more complex procedures such as image analysis to be targeted accurately.

Tom Batey, a very experienced commercial soil scientist from Scotland, emphasised that visual-tactile soil assessment – either by spade inspections or via backhoe pits – is a central component of all his field investigations.

The methods

A. Methods based on soil profile evaluation.

1. Whole profile assessment, T Batey, Scotland.

This method had two objectives, first, to determine the inherent capability of the soil and second, to identify any limitations as a result of the management of the soil. Key criteria were soil texture by hand assessment, soil colour; development, strength and stability of structure; soil compaction, degree of fissuring and the presence of roots.

2. SOILpak method, DC McKenzie, Australia.

The SOILpak scoring procedure was originally designed to assess compaction under irrigated Vertisols but has been adapted for use on a wide range of soil types and cropping systems in a semi-arid climate in Australia. Structural form is assessed using a systematic and detailed scoring procedure. Key criteria include the size, shape, strength and internal porosity of primary clods and aggregates. The factors are weighted and a score between 0.0 (poor) and 2.0 (good) is calculated at a number of critical depths on the face of a soil pit, down to at least 90 cm. Over-ride factors can be applied to allow for the presence of smeared layers and inter-connected vertical macropores. The SOILpak score is used to develop tillage recommendations for each study site.

3. Le profil cultural, H Boizard, G Richard, J Roger-Estrade, France.

A comprehensive and detailed method widely used in France for the field assessment of soil structure. An observation face (Figure 2) is prepared using a knife and bellows in a pit 3 m wide, 0.6 m deep cut across the direction of tillage and traffic. Key criteria include the transition between the tilled layers; internal structural state of clods or zones (no visible porosity, no visible porosity with cracks, or visible porosity); type of structural state

(continuous, formed with clods > 10 cm diameter, or porous without clods > 10 cm diameter). Field observations are complemented with photographs and image analysis.

Figure 2. 'Le profil cultural' method, demonstrated by Hubert Boizard in a field that had recently been mouldboard ploughed.

B Methods based on topsoil examination.

4. Peerlkamp score, T Batey, Scotland.

The Peerlkamp procedure is a long-established Dutch procedure for assessing topsoil structure. It is based on the manipulation of a spadeful of soil. A score is assigned using a key from 1 (worst) to 9 (best). The method is rapid, flexible and low-cost; the results can be validated statistically. Key criteria are size, shape and porosity of clods and aggregates; stability and dispersion on the surface; actual or potential root development.

5. A guide to tillage management based on surface soil types, B Murphy, Australia.

The Central West Surface Soil Classification (CWSSC) applies to the soil surface and the top 10 cm of soil. Key criteria are a careful and systematic assessment of the texture and the stability and resilience of structure (including an in-field assessment of aggregate stability and dispersion). The method is used to give guidance to assess the most appropriate land management practices for a particular soil.

6. Visual soil assessment (VSA), G Shepherd, New Zealand.

VSA was developed to provide land managers (regulatory authorities, consultants and farmers) with a simple standardized method to assess and monitor soil quality quickly and cheaply on land in arable or grassland. It is based on the manipulation of a spadeful of soil from the topsoil, and if desired, from lower horizons to examine the subsoil. Key criteria are

the identification and sorting of aggregates by size, shape and abundance, aggregate porosity, colour, mottles, erosion and earthworm count. Nine indicators are assessed on a scale from 0.0 to 2.0 by comparison with photographs in the Field Guide. An undisturbed reference sample is taken from under a fence or scrub cover nearby.

Figure 3. Graham Shepherd showed workshop participants how to apply the New Zealand VSA system.

7. Soil quality scoring procedure, BC Ball, Scotland.

This is a rapid, cheap and holistic method based on the extraction, manipulation and evaluation of a spadeful of soil. Key criteria include the identification of horizontal layers, their depth and thickness; structure, consistence, macropores, roots and fauna. Separate scores are given for each criterion on a scale of 1 (worst) to 5 (best).

8. Visual soil assessment - spade analysis, LJ Munkholm, Denmark.

The Danish VSA method describes the present status of the soil tilth and to relates it to past management practices. It is based on German techniques developed during the 1920s. Key criteria include soil texture, structure (layering, units, density, colour), compaction, anaerobism, root growth, soil fauna and decomposition of organic matter. A record form describing each property is completed. A heavy duty 'Gorbing Spade' and an assessment frame (Figure 3) are used to extract and examine the 30 cm long mini-profiles.

9. Assessment of soil structure by visual classification of soil aggregates, G Hasinger and J Nievergelt, Switzerland.

The Swiss method is based on the assessment of soil extracted using a strong spade with a blade of 45 cm. The soil is divided into layers and after fracture of the soil by a drop-test, aggregates in each layer are separated and classified according to size and type. The diameter of big aggregates is measured directly in cm, the smaller ones are sieved into 5 fractions with mesh sizes between 0.2 and 20 mm. The clods and aggregates are classified with the help of a

comprehensive set of pictures and key codes into 12 different types and put on a scale ranging from 1 (worst) to 14 (best). Each fraction of aggregates is weighed and the mean weight diameter (MDW) and the mean weight score (MWS) are calculated for each layer.

Figure 3. Lars Munkolm used a 'Gorbing spade' to demonstrate topsoil structure and root growth.

10. A guide to better soil structure, I Bradley, England.

This method is principally aimed at farmers and is based on a spadeful of soil dug out to a depth of 30 cm and laid on the ground. A second spadeful may be taken from below plough depth to examine the subsoil. Alternatively, the test can be done by removing soil from the side of trench. Soil structures are identified by reference to a photographic guide describing good, moderate and poor structures, compaction, impeded drainage, root behaviour and other signs of structure damage.

Do the soil structure assessment procedures in SOILpak require improvement?

Better photographic standards are needed by users of the SOILpak system, particularly on loam soil. Recent booklets from UK (Bradley) and New Zealand (Shepherd) provide good examples of what is possible with eye-catching illustrations.

A limitation of the SOILpak scoring procedure is that it becomes more difficult to use as the sand content of the soil increases. Dr Paul Blackwell (WA Department of Agriculture) is developing rapid diagnostic procedures for the assessment of compaction (via the use of penetrometers) and water repellence in sandy soil.

The application of "moderate" hand pressure to a soil sample prior to assessment of aggregate/clod size and shape is a poorly defined concept for novices, particularly in situations where the soil is dry and extra pressure needs to be exerted on a sample. Rather than break soil samples apart by hand pressure prior to clod/aggregate assessment, it is recommended that a moist sample be dropped onto a wooden board in a plastic crate (as per the NZ VSA system) from a standard height of one metre. Dry samples perhaps should be dropped from a height of 1.5 metres – research is needed to improve this recommendation..

The over-ride factor definitions need to be refined, for example via the use of reference images that can be compared with the paint-impregnated soil.

Soil processes other than root growth – such as water movement and greenhouse gas emission – need to be correlated with the SOILpak scores.

Acknowledgements

The method descriptions outlined above were collated by Dr Tom Batey.

Participant list

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