



On the Surface, What kind of Soil Are You Farming?

in the Central West of NSW.

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INTRODUCTION

Soil classification is a complex and specialised field. It takes into account the entire soil profile and it considers many soil characteristics that are not necessarily relevant to farmers who are sowing their crops and pastures.

This brochure groups those soil surfaces in the Central West of NSW which behave in a similar manner for conservation farming activities. These soils have been categorised into seven types which can be relatively easily identified by farmers and their agronomic and environmental advisers. These seven types are briefly described and some notes about their typical behaviour under conservation farming practices are listed. The suitability or otherwise of certain types of farmers' machinery to each soil type is also discussed. A brief classification system based on surface texture, organic matter content, sodicity, friability and self mulching characteristics is also given.

TYPE 1

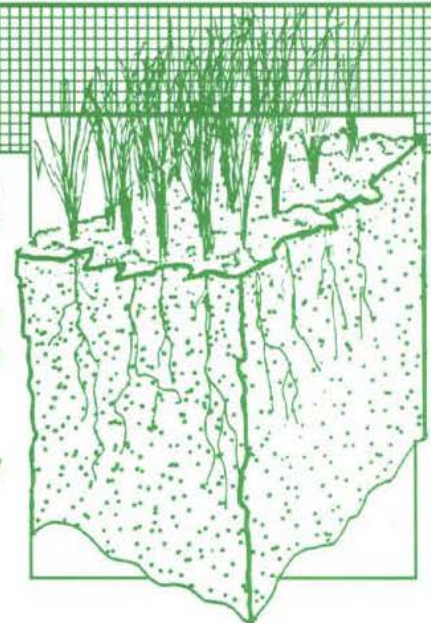
LOOSE SANDS (Siliceous Sands, Earthy Sands, Podzols)
wind deposits, levees, mallee soils and granite and sandstone
derived soils. *Tenosols, Rudosols and Podosols.*

TYPICAL FEATURES: Very sandy soils. Loose sandy appearance. No soil structure (apedal) Pale colour. Often acidic. Poor vegetation growth. May have an organic layer at the surface in natural condition. Hummocky surfaces.

NATIVE VEGETATION: Ironbark, Cypress Pine, Scribbly Gum, Pilliga Box, Fuzzy Box, Baradine Gum.

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING:

- very susceptible to wind erosion without surface cover.
- low water holding capacity, droughty, but crops and weeds respond to light rain.
- usually good surface and internal drainage unless they are non-wetting sands.
- poor fertility and acidity (low buffering capacity) affect plant growth, low organic matter.
- easily tilled even when dry; ideal for zero tillage but narrow window of opportunity for sowing because of low available moisture for seed germination unless dry sowing. Ensure that seed is well covered to prevent seed desiccation.
- can sow deeper than clayey soils.
- high wear on tynes and points but low wear on tyres. Disc openers, closers and rollers work well but diseases like Crown Root Rot and Takeall can result if appropriate rotations are not used and Rhizoctonia sp can still be a problem with good rotations if there is no deep tillage or cultivation below the seed.
- press wheels may be an advantage but not essential.
- easy tyne penetration even when dry, drafts are low, approximately less than 100 kgf for sowing (50-75mm) and up to 200 kgf for deep cultivation (100-150mm).



Subsoils: may be sands, sandy clay loams or sandy clays.

TYPE 2a

FRAGILE COARSE TEXTURED (LIGHT) SURFACES

Podzolic Soils and some Red Earths and Red-brown Earths, Non-calci brown Soils. *Chromosols, Kandosols, Kurosols, Sodosols.*

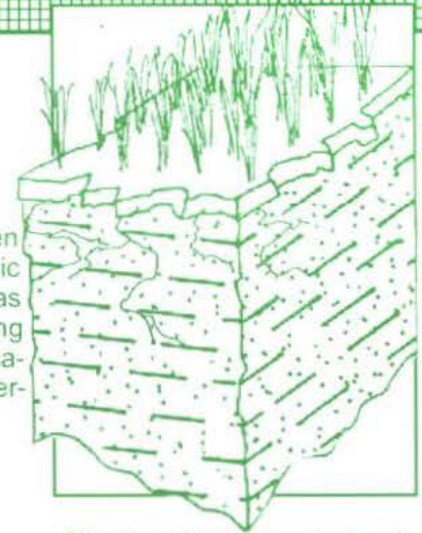
TYPICAL FEATURES:

Sandy loam, loamy sand and fine sandy loam surfaces which have been frequently cultivated for long periods of time and/or heavily grazed. Organic matter levels have declined significantly from their natural condition. This has resulted in surface crusts or seals and massive or weak structures; no strong stable peds are evident. Soils slake on wetting or shatter to dust with application of force when dry. Earthy appearance. Soils often show complete dispersion when worked in a moist condition or subjected to raindrop impact.

NATIVE VEGETATION: Grey Box, Cypress Pine, Yellow Box

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING:

- usually fair to good surface drainage (depending on subsoil). Rarely ponding water except during exceptionally heavy rain or if a plowpan has developed.
- organic matter critical for improving soil structure, surface crusts generally do not prevent seedling emergence
- easily tilled (low tyne pressure for penetration when moist) over a relatively wide range of moisture conditions; produce clods and pulverised soil (shattered peds) if tilled too dry.
- low draught at ideal moisture increasing to moderate when dry approximate draughts of about 100 kgf for sowing (50 - 75mm) and about 200 kgf for deep cultivation (100-150 mm)
- organic matter declines rapidly with tillage and other mechanical disturbance.
- soil structure can only be improved by plant growth and increased organic matter.
- respond best to minimal soil disturbance, stubble retention (encourage biological activity in summer after rain) and judicious stocking (graze only when dry)
- moderate to low water holding capacity.
- moderate to low fertility, susceptible to acidification (poor buffering capacity).
- very susceptible to water erosion in a tilled condition, Very susceptible to wind erosion if there is little surface cover.



Subsoils: earthy loams or structured clays sometimes sandy loams.

TYPE 2b

FRAGILE MEDIUM TEXTURED SURFACES Earths, Red, Brown and Yellow Earths, Non-calci Brown Soils and some Red-brown Earths. *Chromosols, Kandosols, Kurosols, Sodosols.*

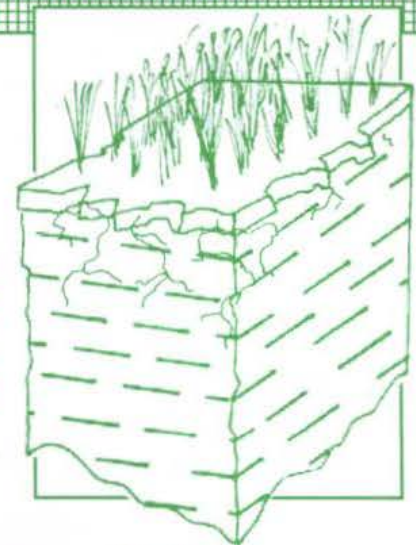
TYPICAL FEATURES

Loams, clay loams, sandy clay loams. Soils frequently cultivated over long periods of time and/or heavily grazed form surface crusts/seals which may be very severe. Weakly structured or massive; no strong stable peds. Soils slake on wetting or shatter to dust when worked dry; soils may be very hard when dry. Earthy appearance. Most soils show complete dispersion when worked in a moist condition or subjected to raindrop impact.

NATIVE VEGETATION Grey Box, Yellow Box, Bimble Box.

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING

- surface crusts can be very severe and prevent seedling emergence.
- very low infiltration and poor surface drainage if soil is structurally degraded (waterlogged due to surface crust or plowpan). Boggy after rain.
- tillage only effective for a narrow range of moisture contents, often difficulties of high resistance to tyne penetration, cloddy after tillage. Easily compacted by traffic, spray irrigation and **stock**. They respond to deep tillage as long as there is no pale sub surface (bleached A2 horizon)
- draft is high to very high outside optimum moisture content. High to very high resistance to tyne penetration outside the optimum moisture content draughts of greater than approximately 100 kgf for sowing (50-75mm) and greater than 200 kgf for deep cultivation (100-150 mm).
- organic matter critical for improving structure, but exchangeable sodium also influences the structural condition. Addition of calcium as gypsum or lime may improve soil structure
- moderate to high water holding capacity.
- moderate fertility and some resistance to acidification.
- susceptible to tunnelling and highly susceptible to rill and gully erosion if a sodic sub-surface is exposed.

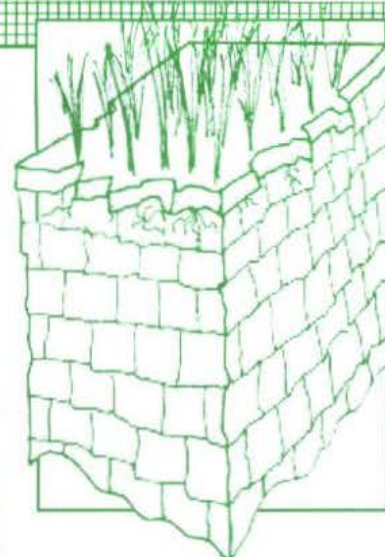


Subsoils: structured clay

TYPE 3a & 3b

3a Acid Topsoil
3b Alkaline Topsoil

SODIC SURFACES Grey Clays, Brown Clays, Red Clays, Red-Brown Earths in the west and some eroded Red-brown Earths in the east, Solodic Soils, Solonized Solonetz. (Note: Solonchaks are usually sodic in the subsoil). *Sodosols*.



Subsoils: Structured medium clay to heavy clay usually strongly alkaline.

TYPICAL FEATURES:

Thick, continuous surface crust; sand grains may be visible on the surface. The surface soils are often shallow (<150mm). Surface soils coarsely structured (>20 mm diameter peds) and very hard when dry, with dense peds. Mostly grey brown and brown surfaces, but some can be reddish brown. Clay loam, light clay; medium clay; sometimes loamy. Exchangeable sodium percentage (ESP) of surfaces is high often greater than 5%. Disperse in water and show complete dispersion after working in moist condition or subjected to raindrop impact.

NATIVE VEGETATION:

Buddah, Grey Box, Eastern Cotton Bush, Bull Oak, Yarran.

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING:

- very low infiltration rates at surface and generally throughout the profile.
- crusts can prevent seedling emergence.
- very sticky when wet and severe smearing can result; problem is worse on compacted soil caused by wheel tracks and from stock trampling.
- very poor surface drainage; waterponding common in wet years with waterlogging deeper in the soil profile. Seeds and seedlings can drown (seed burst). Raised beds are now being trialled in waterlogged areas.
- high runoff potential and highly erodible surface resulting in severe watersheeting erosion. Wind erosion is not generally a problem although some sodic surface soils are probably the result of the loss of the topsoil leaving a sodic subsoil exposed at the surface.
- difficult to till; very narrow range of moisture contents suitable for tillage, **when dry** very high tyre pressures required exceeding 200kgf for sowing (50-75mm) and 400 kgf for deep cultivation (100-150 mm) with narrow points with wings or agrowplow points; cloddy after tillage. **when wet** trafficability, severe smearing and compaction are problems. These soils take a long time to dry out after rain. Disc opener equipment is generally not successful for these soils.
- deep tillage often combined with deep banding of some fertiliser helps reduce anaerobic conditions for early plant establishment
- flexible (semi - pneumatic) presswheels can help seedling establishment
- low wear on tynes and points but moderate wear on tyres.
- because sodic soils are highly susceptible, care is needed to **prevent compaction by stock** and traffic especially when wet. Soil will not readily recover from this but will respond to no till, controlled traffic and increased organic matter from stubble retention.
- responses to additions of calcium as gypsum are expected and as lime for type 3a.
- moderate natural chemical fertility, but often high in magnesium and therefore well buffered against acidification. However they have low levels of organic matter
- alkaline subsoils with high clay content may present some problems for the use of pre emergent herbicides such as sulfonylureas and triazines as these do not break down in alkaline conditions, the clayey surfaces may influence the effectiveness of some herbicides which become attached to the clay particles. Stress caused by waterlogging can influence the effectiveness of some herbicides such as glyphosates, 2-4D amines and MCPA on weeds and also damage stressed crops.
- more difficult to grow summer crops due to lack of available water.
- oats are more tolerant than, wheat and barley. Canola is affected by sodic soils but is very good for them. Faba beans grow well even in sodic soils with more acidic surfaces.
- long fallows are not recommended because of they are susceptible to erosion and soil structure problems and it is better to **leave cropped soils unstocked** if possible.
- plant growth and surface cover critical to maintaining and improving these soils.

TYPE 4

COARSE STRUCTURED CLAYEY SURFACES Grey and Brown Clays, Claypans. *Vertosols*.

TYPICAL FEATURES:

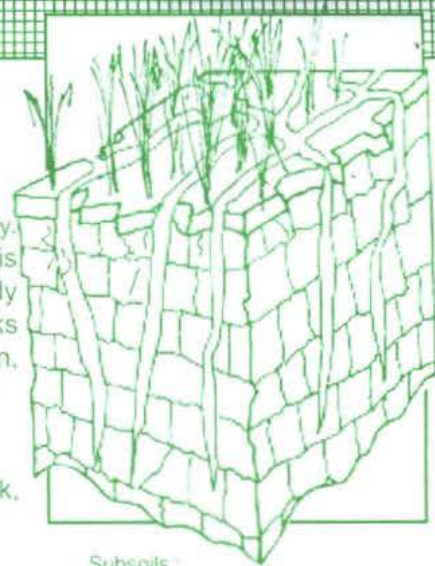
Coarse (>10 mm), blocky clods at surface. Very hard and tough when dry. Surface cracking (10 mm wide and greater than 50 mm deep) and/or gilgais often present. Clayey surfaces, may have a thin veneer (5 mm) of sandy material at surface. Brown, grey and yellow colours frequent. Rust specks (red, orange flecks), often present in surface soil. Peds may show dispersion, especially if worked in a moist condition or subjected to raindrop impact.

NATIVE VEGETATION:

Myall, Grey Box, Coolabah, Bloodwood, Bimble Box, Wilga, Belah, Bull Oak, and Yarran. Rushes and reeds may be present.

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING:

- poor surface drainage and waterlogging; very low surface infiltration and high runoff because of surface crusting. Puddles common in wet years with waterlogging deeper in the soil profile. Seeds and seedlings can drown suffer from seed burst. Raised beds in combination with no-till and controlled traffic can be successfully used in waterlogged areas.
 - cloddiness is a severe problem sometimes, but in some cases, the clods formed by tillage will break down naturally by wetting and drying.
 - very strong crusts; surface crusting can prevent seedling emergence.
 - very sticky when wet and severe smearing can result especially on compacted soil caused by wheel tracks.
 - will respond well to additions of calcium as gypsum or lime. Note: Organic matter is not that effective except with large quantities.
 - surface cover can improve structure by preventing raindrop impact.
 - tillage can be very difficult and restricted to a very narrow moisture range; high tyne pressures required.
 - vegetation does not respond to light rains.
 - very high to extreme drafts and resistance to to tyne penetration outside optimum moisture content, narrow window of opportunity for tillage and sowing exceeding 200kgf for sowing (50-75mm) and 400 kgf for deep cultivation (100-150 mm). Disc opener equipment is generally not successful for these soils.
 - severe smearing can result when sowing too wet.
 - alkaline subsoils with high clay content may present some problems for the use of pre emergent herbicides such as sulfonylureas and triazines as these do not break down in alkaline conditions, the clayey surfaces may influence the effectiveness of some herbicides which become attached to the clay particles. Also waterlogging can influence the effectiveness of some herbicides such as glyphosates, 2-4D amines and MCPA on weeds and damage stressed crop
 - moderate to high water holding capacity.
 - moderate fertility and high resistance to acidification (high buffering capacity).
 - relatively resistant to wind erosion High runoff can lead to severe erosion when these soils occur on sloping ground.
- ***prevention of stock compaction critical!!***



Subsoils :
Coarsely structured heavy clay.

SOME GENERAL NOTES

Rhizoctonia (spear points) is a problem in the alkaline sandy soils of southern Australia - wide range of host plants - fallowing is not effective - need to cultivate at least once before sowing - disturbance beneath the roots optimum fertilizer especially available N.

Other significant factors.

Water repellence can affect the infiltration rates of a soil. It is a major limitation in some sandy soils especially under ironbark trees

Gravel The amount of gravel and rock in the soil can also affect the management of the soil. ie dry sowing of stoney soils can cause damage to points and tynes

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TYPE 5

FRIABLE SURFACES Euchrozems, Krasnozems, Terra Rossa Soils, Chocolate Soils and some Non-calcic Brown Soils. *Ferrosols, Dermosols, Chromosols.*

TYPICAL FEATURES:

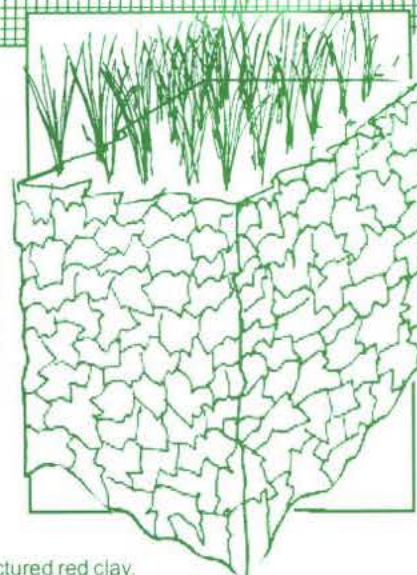
Strongly structured with small (<10 mm diameter) many sided (polyhedral) peds often with shiny faces. Usually dark reddish brown or dark brown. Can set hard at the surface and show some crusting/sealing. Clay loam or light clay, sometimes loamy. Do not disperse, even when worked in a moist condition or subjected to raindrop impact.

NATIVE VEGETATION: White Box, Kurrajong

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING:

- good surface drainage.
- soils are friable over a wide range of moisture contents. When dry can have a high resistance to tyne penetration.
- somewhat resistant to structural breakdown because of high levels of iron and aluminium sesquioxides but they may degrade under long term frequent cultivation but they respond well to deep tillage.
- resistant to acidification (high buffering capacity).
- alkaline subsoils with high clay content may present some problems for the use of pre emergent herbicides such as sulfonylureas and triazines as these do not break down in alkaline conditions, the clayey surfaces may influence the effectiveness of some herbicides which become attached to the clay particles.
- wide window of opportunity for sowing especially if presswheels are used.
- inverted T boots provide excellent tilth.
- drafts moderate to high outside optimum moisture content, drafts of about 150 kgf for sowing into stubble (50 - 75mm) and 330 kgf for deep cultivation (100-150 mm) into stubble and drafts of 200kgf for sowing into pasture and 400 kgf for deep cultivation.
- moderately fertile with good buffering capacity against acidification, but may fix phosphorus at low pH's.
- somewhat resistant to water erosion and very resistant to wind erosion.

Subsoils: Strongly structured red clay.



TYPE 6

SELF MULCHING CLAYS Grey, Brown and Red Clays, Black Earths. *Vertosols.*

TYPICAL FEATURES:

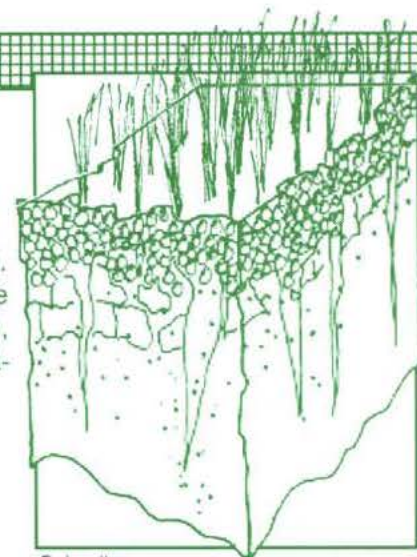
Self mulching. Strongly pedal loose surface mulch; peds commonly < 5 mm. Surface cracks may be present (10 mm wide and > 50 mm deep); these may be hidden by self mulching surface. Gilgai may be present, usually black, dark brown, or grey. A weak surface crust may form after rainfall, but this breaks up on wetting-drying. Light clay to medium clay.

NATIVE VEGETATION: Myall, Belah and Plains Grass.

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING:

- generally good surface drainage.
- very sticky and greasy when wet and severe smearing can result especially on compacted soil caused by wheel tracks. Clay will stick to press wheels and most points at some moisture contents. Flexible (semi-pneumatic) press wheels and spear points which lift the soil attract less clay, presswheels beneficial especially for summer crops. Soils may have a loose pedal surface which is very good for germination and emergence; press wheels may be necessary for good seed/soil contact.
- very easy to till over a wide range of moisture contents; press wheels may be necessary for seed/soil contact. High water holding capacity.
- drafts usually low over a wide range of moisture contents and little resistance to tyne penetration over a wide range of moisture contents, drafts of about 150 kgf for sowing into stubble (50-75mm) and 330kgf for deep cultivation into stubble and drafts of 200kgf for sowing into pasture and 400kgf for deep cultivation (100-150 mm) . Disc opener equipment is generally not successful for these soils.
- very resistant to structural breakdown as wetting and drying cycles can quickly rejuvenate soil structure.
- moderate to high fertility and resistant to acidification (high buffering capacity).
- do not use disc openers unless they provide some sideways scattering, discs can cause smearing.
- very susceptible to water erosion as raindrop impact causes surface sealing and high runoff. Ground cover and stubble retention are essential in areas of erosion risk.

Subsoils: Strongly structured red and brown clay.



TYPE 7

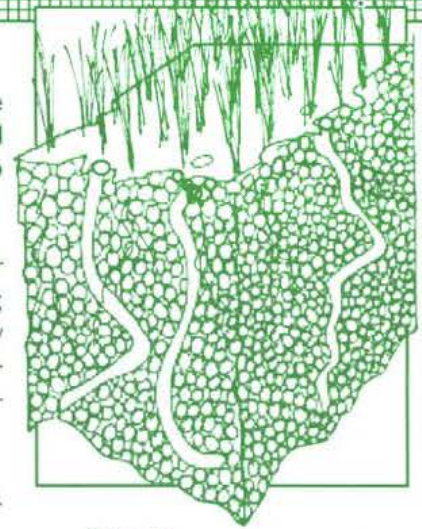
SURFACES HIGH IN ORGANIC MATTER Alpine Humus, and small areas of alluvials in excellent condition. Chernozems and Prairie Soils, most of these soils have been over cultivated and now fit into other types. *Organosols and Dermosols*.

TYPICAL FEATURES: Soft spongy feel, very high organic matter; surface litter or humic horizon at surface. Earthy smell. High biological activity; many roots; worm casts, worms, beetles and larvae. worm tunnels; termite chambers. Sandy loam, fine sandy loam, loam, clay loam; can be clayey. Strong fine crumb structure, friable (5-15 mm diameter) No slaking or dispersion. Sometimes water repellent (hydrophobic). Neutral pH's.

NATIVE VEGETATION: Various, depending on where undisturbed soils are found.

TYPICAL BEHAVIOUR RELEVANT TO CONSERVATION FARMING:

- stable to wind and water erosion.
- supports nitrogen-loving weeds like nettles, thistles etc.
- good surface drainage; high infiltration rates (unless water repellent sands).
- organic matter levels can be run down rapidly with repeated tillage and high grazing rates. When organic matter is lost, these surfaces change to other surfaces, mainly Fragile Coarse Textured (Light) Surfaces and Fragile Medium Textured Surfaces, Types 2a or 2b respectively.
- moderate to high fertility, susceptible to acidity with decline in organic matter.
- easily tilled, even when dry (low tyne pressures even when dry) because of high friability. Ideal for zero tillage. Moderate window of opportunity for available moisture for sowing.
- soft under-foot.
- friable and easy to till, but grass clumps may cause some problems.
- disc openers, closers and rollers work well. Press wheels an advantage but not essential.
- generally low draft, even when dry, easy tyne penetration, approximate drafts of less than 100 kgf for sowing (50-75mm) and up to 200 kgf for deep cultivation (100-150 mm), can sow deeper than for clayey soils. Need to ensure that seed is well covered to prevent seed desiccation.



Subsoils:
Various according to soil type.

Classification of Soil Surfaces (top 10 cm of soil) in Central West NSW

