



SOILpak – northern wheat belt - Readers' Note

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Appendix 1:

Acknowledgements



Appendix 1 Acknowledgements

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John Bailey	'The Watermark', Breeza. Farming practices.
Tony Barrett	'Yera Homestead', Edgeroi. Farming practices.
BCRI staff	Use of information in: Vimpany, I.A., Holford, I.C.R., Milham, P.J. and Abbott, T.S. (1985). 'Soil Testing Service: Methods and Interpretation.' Biological & Chemical Research Institute, Rydalmere. NSW Agriculture. <i>(Note: NSW Agriculture no longer offers a free soil testing service.)</i>
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Bruce Cameron	'Woolondoon', Rowena. Farming practices.
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Pip Commins	New South Wales Agriculture, Trangie. Aggregate stability, slaking test, hard-setting.
Peter Cory	'Belara', North Star. Farming practices.
Hamish Cresswell	CSIRO Division of Soils, Canberra. Crop rotation, biological drilling, erosion control.
Graham Crocker	New South Wales Agriculture, Tamworth. Pasture fertiliser recommendations.
Bruce Crosby	'Wallambah', Moree. Farming practices.
Doug Cush	'Saltwells', Bellata. Farming practices.
Ram Dalal	Queensland Wheat Research Institute, Toowoomba. Organic matter decline, chemical and physical fertility, restoration of fertility.
Bruce Danson	'Mentone', Narrabri. Farming practices.
David Doyle	New South Wales Agriculture, Tamworth. Crop fertiliser recommendations, comments on whole manual.
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Ted Gardner	Queensland Department of Primary Industries, Indooroopilly. Plant available water capacity, infiltration, opportunity cropping, erosion control.
Guy Geeves	CaLM (incorporating the Soil Conservation Service of NSW), Canberra. Raindrop impact, erosion control, surface sealing, surface cover.
Neville Gett	'Apsley', Bohena. Farming practices.
Judy Glasby	Queensland Wheat Research Institute, Toowoomba. Cropping and pasture effects on organic matter.
Neville Gould	New South Wales Agriculture, Trangie. Sowing equipment, alternative uses for stubble.
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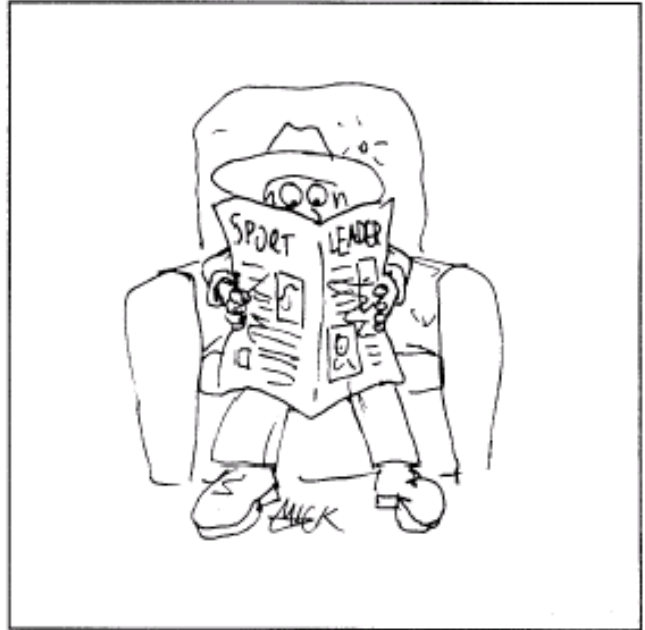
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David Herridge	New South Wales Agriculture, Tamworth. Effective use of rain, nitrogen fixation, fertiliser recommendations.
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Tom Lane	'Nullamanna Station', Nullamanna. Farming practices.
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Mark Littleboy	Queensland Department of Primary Industries, Indooroopilly. Modelling probabilities of rainfall, run-off, yield, drainage, erosion.
Rob Loch	Queensland Department of Primary Industries, Toowoomba. Structural stability, surface cover, erosion control.
Stuart Longworth	'Roundhay', Weemalah. Farming practices.

Mike Lucy	Queensland Department of Primary Industries, Pittsworth. Bed farming, farming systems.
Elizabeth Madden	Landcare Officer, Trangie. Salinity symptoms and control measures.
Don Mack	'Mitiamo', Bingara. Farming practices.
John Marshall	Queensland Department of Primary Industries. Dryland cotton, farming strategies.
Peter Marshall	'Melita', Gowrie. Farming practices
Rick Mason	'Talana', Weemelah. Farming practices.
Doug McCollum	Queensland Department of Primary Industries, St George. Soil types and farming systems in southern Queensland.
David McDonald	'Beverly', Loomberah. Farming practices.
Don McDonald	'Hibernia', North Star. Farming practices.
Warwick McDonald	CSIRO Division of Soils, Canberra. Reference soil sites, soil survey.
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Jim Morgan	New South Wales Agriculture, Tamworth. Water use efficiency.
Col Mullen	New South Wales Agriculture, Dubbo. Presentation and promotion of manual, demonstrations of soil examination to farmers.
Brian Murphy	CaLM (incorporating the Soil Conservation Service of NSW), Cowra. Hard-setting, soil description, erosion control, interpretation of soil tests.

John Murphy	'Thorndale', Mungindi. Farming practices.
Kevin Overton	'Kiaora', Gravesend. Farming practices.
Alan Palmer	New South Wales Agriculture, Trangie. Shallow leading tines, critical depth for deep tillage, measuring plastic limit.
Rowan Pearse	'Richmond', Moree. Farming practices.
Mark Pfitzner	'Thornleigh', Gravesend. Farming practices.
Mark Porter	University of Southern Queensland, Toowoomba. Controlled traffic, machinery guidance systems, surface roughness.
Bernie Powell	Queensland Department of Primary Industries, Dalby. Soil types in the northern wheat-belt.
Joe Rickman	Queensland Department of Primary Industries, Dalby. Compaction by wheels.
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Joe Robinson	'Claremont', Mungindi. Farming practices.
Ian Rochester	CSIRO Division of Plant Industries, Canberra. Nitrogen losses (denitrification, leaching).
John Ross	Queensland Department of Primary Industries. Soil survey, soil and land limitations for dryland cropping.
Greg Salmond	Queensland Department of Primary Industries, Goondiwindi. Farming strategies, presentation of manual.
Bill Saunders	'Talana', Blackville. Farming practices.
Roger Shaw	Queensland Department of Primary Industries, Indooroopilly. Salinity, effect on crops, leaching.
Ian Slack-Smith	'Goroka', Merah North. Farming practices.
Jeff Smith	'Wyangarie', Warialda. Farming practices.
John Standley	Queensland Wheat Research Institute, Toowoomba. Cropping and pasture effects on organic matter.
Maarten Stapper	CSIRO Division of Plant Industries, Canberra. Farming strategies.
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Cliff Taylor	'The Peak', Delungra. Farming practices.
Terry Taylor	'Cooranga', Yetman. Farming practices.
Greg Thomas	Queensland Wheat Research Institute, Toowoomba. Fallowing for efficient soil water storage; stubble, fertility level and disease.
John Thompson	Queensland Wheat Research Institute, Toowoomba. VAM, nematodes, long fallow disorder, leaching and denitrification.
Ross Tomlinson	'Myall Plain', Moree. Farming practices.
Triticum of the QWRI	Queensland Wheat Research Institute, Toowoomba. Heaps.
Hamilton Trotter	'Scotia', Cobbadah. Farming practices.
Jill Turpin	Queensland Wheat Research Institute, Toowoomba. VAM, nematodes, long fallow disorder, leaching and denitrification.
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Les Wrench	'Strathfield', Manilla. Farming practices.

Appendix 2: Further reading



Appendix 2 Further reading

The following is a selection of publications which may be useful as further reading. It is not a complete bibliography of soils literature.

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Yo, S.A. and Shaw, R.J. (1990). *Salinity tolerance of various crops*. Information Series QI930020, Queensland Department of Primary Industries.

'Crop Management Notes' by Queensland Department of Primary Industries for various regions. NSW Agriculture's planting guides for winter cereals, grain sorghum, maize hybrids, sunflowers and various winter grain legumes; weed control in winter crops and summer crops; budget handbooks for winter crops and summer crops; and a rotation guide.

AC.10	Improving soil structure with gypsum.	\$1.75
AC.11	Nutrient deficiencies in crops.	\$1.75
AC.14	Boron in agriculture.	\$1.00
AC.15	Liming materials.	\$1.50
AC.16	Zinc deficiency in field crops.	\$ 1.00
AC.17	Soil salinity and how to recognise it.	\$1.00
AC.19	Soil acidity and liming.	\$4.50
E4.17	Broadacre tillage implements.	\$2.00
Pl.E.1	Moisture seeking for sowing winter crops.	\$0.50
P3.M.8	Calculating costs of growing wheat.	\$0.25
P3.2.2.	Oats.	\$2.00
P3.2.3	Barley growing.	\$1.50
P3.4.6	Triticale recommendations for 1986.	\$0.25
P4.2.15	Starting in grain legumes.	\$0.25
P4.2.2	hickpea.	\$3.00
P4.2.9	Field peas.	\$2.00
P5.1.11	Canola (rapeseed) variety and management guide 1989	\$0.75
P5.1.12	Dryland soybean guide for northern NSW.	\$0.50
P5.1.14	New safflower varieties.	\$ 1.00
P5.1.2	Sunflower variety and planting guide 1989-90.	\$0.50
P5.1.7	Irrigated soybean variety and planting guide 1989-90 .	\$0.50
P5.2.1	Rapeseed growing.	\$3.00
P5.2.2	Safflower growing.	\$2.00
P5.2.3	Sunflower growing.	\$3.50
P5.2.6	Soybean Growing.	\$5.00
P5.2.7	Linseed growing.	\$2.50

SOILpak

Glossary of soil terms

A horizon,

Adsorbed,

Aerobic ...



Glossary of soil terms

A, A1, A2 horizon:	see: <i>Soil profile</i> .
Adsorbed:	gathered on a surface; in soil, <i>cations</i> gather on clay surfaces due to a difference in charge between the cations and the surfaces.
Aerobic:	soil conditions in which there is plenty of oxygen; these conditions are suitable for plant roots and (generally) those soil organisms that carry out processes beneficial to plant nutrition and soil structure.
Aggregate:	a unit of soil that contains groups of <i>peds</i> ; the peds within the aggregate are held together more firmly than the aggregate holds to other aggregates (therefore the aggregate is recognisable as a unit).
Aggresizing:	A technique to create 1-4 mm diameter aggregates in moist loam soil which, once dried, are stable on rewetting.
Alfisols:	Loams with clay-rich subsoils (U.S. terminology).
Alluvial soil:	a soil developed from recently deposited <i>alluvium</i> ; usually too young to show the effects of soil forming processes: any layers in the soil profile are successive deposits rather than soil horizons.
Alluvium:	unconsolidated gravel, sand, silt and clay deposited by water flow; typical of floodplains.
Anaerobic:	soil conditions in which there is a lack of oxygen, usually because water has replaced soil air (the soil is waterlogged); substances harmful to plants (for example, ethylene and hydrogen sulphide) may accumulate.
Anion:	an <i>ion</i> with negative charge.
Aquifer:	A water-bearing rock formation capable of yielding useful quantities of water to bores or springs.
B horizon:	see: <i>Soil profile</i> .
Bed:	a raised ridge of soil for planting a row crop.
Biological drilling:	using tap rooted plants to penetrate through a hard soil layer or into a hard subsoil; when the plants die, the root channels are available for subsequent crops.
Biological fertility:	See: <i>Fertility</i> .

Biological ripping:	using plants to dry and crack the soil; cycles of swelling and shrinking improve soil structure in cracking clays.
Bleached:	a pale colour (for example, of an A2 horizon); see: <i>Soil profile</i> .
Bulk density:	a measure of compactness; the more compact a soil is, the more soil solids in a given volume; it is calculated as the weight of oven-dry soil divided by the field volume of the sample; compacted soils have high bulk density.
C horizon:	see: <i>Soil profile</i> .
Calcareous	a soil containing significant amounts of naturally occurring calcium carbonate (lime), such as to fizz with dilute acid.
Calcium:	a cation that promotes flocculation; an essential plant nutrient.
Cation exchange capacity:	see: <i>Exchange capacity</i> .
Capillary rise:	the upward movement of water caused by the molecular attraction between soil particles and water; capillary rise causes the wetting of soil above a watertable.
Cation:	an ion with a positive charge; see: <i>Ion</i> .
Chemical fertility:	see: <i>Fertility</i> .
Chiselling:	chisel ploughing (using tined implements).
Clay:	soil particles smaller than 0.002 millimetres (effective diameter); these particles are involved in swelling and shrinking of soils and hold water and exchangeable cations; the term 'clay' also refers to soils with sufficient clay content (more than about 35%) to have clay behaviour.
Clod:	a large, coherent lump of soil produced artificially; see <i>Aggregate</i> and <i>Ped</i> .
Colloid:	material consisting of very finely divided particles that consequently have a large surface area per unit volume and are therefore very reactive; <i>clay</i> and <i>humus</i> are colloids.
Compaction:	compression of a soil or layer into a smaller volume; see: <i>smearing</i> , <i>remoulding</i> , <i>pulverising</i>
Controlled traffic:	The confinement of field traffic wheels to laneways.

Conventional tillage:	describes traditional systems where mechanical tillage is the sole method used for seedbed preparation and weed control. This normally involves 3 to 6 tillage operations; see: <i>No-tillage</i> , <i>Minimum tillage</i> .
Cracking clays:	black, grey or brown (occasionally, but rarely, red) clay soils that are distinguished by seasonal cracking and a lack of distinct <i>horizons</i> ; see: <i>Vertosol</i> .
Crop water use:	the water used by a crop from sowing to harvest. It includes transpiration (through the crop) and evaporation (from the soil). Usually expressed as mm of water.
Crusting:	<p>occurs when the soil surface "melts" together when wet, and then sets hard and impermeable when dried;</p> <p>if a thin (up to 10 mm) surface layer is affected, and can not be readily separated from and lifted off the underlying soil, it is called crusting;</p> <p>if thicker, (particularly when the whole topsoil is affected) it is called <i>Hard-setting</i>; see: <i>Flaking</i>.</p>
Damage:	(to soil structure) <i>compaction</i> , <i>smearing</i> , <i>remoulding</i> , <i>pulverising</i> .
Deep tillage:	any tillage deeper than that needed to produce loose soil for a seedbed, or deeper than that needed to kill weeds; its usual purpose is to loosen a hard subsoil.
Denitrification:	the processes by which soil microbes convert soil nitrate to nitrogen gas and nitrous oxide gas which are unavailable to plants, and eventually return to the atmosphere.
Deposition:	movement of particles to their present location by water and/or wind.
Discharge:	the volume of water flowing in a stream or through an aquifer past a specific point in a given period of time.
Discharge area:	an area where underground water is discharged at the soil surface;
Discharge groundwater:	water which leaves an aquifer by seepage into surface water bodies, by plant water use or evaporation.
Dispersion:	disintegration of micro-aggregates into individual clay, silt and sand grains; it is the opposite of flocculation.
Dryland salinity:	all non-irrigated areas displaying symptoms of salinity.

Dry scald	erosion of topsoil, exposing subsoil which is inhospitable to plants because of high clay content and sodicity; a dry scald is therefore bare. See: <i>Saline scald</i> , <i>Saline seep</i> , <i>Scald</i> .
Duplex soil:	a soil which shows a sharp change in soil texture between the A and B horizons; for example, a loam topsoil overlying a clay subsoil; red-brown earths are duplex; see: <i>Gradational</i> , <i>Uniform</i> .
Electrical conductivity	a measure of the conduction of electricity through water, or a suspension of soil in water, or a water extract of soil; an indicator of the concentration of dissolved salts, and hence salinity; units are decisiemens/metre (dS/m), numerically equal to the old units millisiemens/centimetre (mS/cm) and the even older units millimho/centimetre (mmho/cm).
Electrolyte:	Salty solution.
Entisols:	Loams without clay-rich subsoils (U.S.A. terminology).
Equilibrium (of groundwater):	a condition in which the amount of recharge to an aquifer equals the amount of natural discharge.
ESP:	see: <i>Exchangeable sodium percentage</i> .
Evaporation:	The process by which water passes from the liquid to the vapour state and enters the atmosphere.
Evapotranspiration:	the sum of evaporation and transpiration.
Exchange capacity:	<p>ability of a soil's clay and humus to hold ions on charged surfaces; negatively charged surfaces (cation exchange sites) hold cations, positively charged surfaces (anion exchange sites) hold anions;</p> <p>for cations, the capacity is expressed as centimoles of positive charge per kilogram of soil (cmol (+) kg⁻¹); for anions, the capacity is expressed as centimoles of negative charge per kilogram of soil (cmol (-) kg⁻¹); both are numerically equal to milliequivalents per 100 g of soil (me/100g); see: <i>ion</i>.</p>
Exchangeable cations:	positively charged <i>ions</i> held loosely on negatively charged soil particles, and readily exchanged with other ions in the soil solution; this mechanism reduces the leaching of some plant-available nutrients.
Exchangeable sodium percentage:	the number of exchangeable sodium ions as a percentage of all exchangeable cations held by a soil; high exchangeable sodium percentage promotes dispersion.

Fallow efficiency:	is the percentage of rainfall received during the fallow that is stored in the soil; a common value for fallow efficiency in the northern wheat-belt is 20%; soil management can change that value.
Fertility:	<p>the capacity of a soil to support plant growth; it has three components: chemical, biological, and physical fertility.</p> <p>Chemical fertility is the ability of a soil to supply, to plants, suitable quantities and balance of nutrients.</p> <p>Biological fertility refers to the number and diversity of soil organisms, and their activity in the soil.</p> <p>Physical fertility is the ability of a soil to supply plants with water and oxygen, to protect their roots from temperature stress, and to allow unrestricted root penetration and shoot emergence; it depends largely upon soil texture and structure.</p>
Flaking	Structural condition of topsoils in which the surface layer, usually less than 10 mm thick, is hard and brittle when dry and can be readily separated from and lifted off the underlying soil (see <i>Crusting</i>).
Flocculation:	clustering of clay particles into microaggregates; the opposite of dispersion.
Fractured rocks:	rocks in which spaces are created by fractures, joints and partings. These provide groundwater storage and flowpaths.
Gilgai:	a natural, surface feature of humps and depressions found in some clay soils.
Gradational:	a <i>soil profile</i> with a slight and gradual increase in clay content with depth; krasnozems and prairie soils are gradational; see: <i>Duplex</i> , <i>Uniform</i> .
Gypsum:	Calcium sulphate, used to reduce swelling and dispersion; a naturally mined substance, and a by-product of fertiliser manufacture.
Hard-setting:	occurs when a layer of soil, not necessarily at the surface, "melts" together when wet, and then sets hard and impermeable when dried; generally thicker than a crust; see: <i>Crusting</i> .
Horizon:	a layer of soil in the soil profile different from layers above or below, recognisable by a different colour, texture and/or structure; horizons are formed by soil forming processes, as distinct from strata due to successive deposition; see: <i>Alluvium</i> , <i>Soil profile</i> .

Humus:	stable, large organic molecules produced by the decomposition of once-living material.
Impermeable:	transmits no water or air.
Infiltration:	movement of water into a soil.
Ion:	atomic or molecular particle carrying an electrical charge.
Leaching:	carrying dissolved materials downwards.
Levee:	recently deposited alluvium beside a river; a levee is higher than the surrounding plains.
Lime:	calcium carbonate, occurring in rocks as limestone or chalk, and in some soils as fine particles or small nodules; finely-ground limestone (aglime) is used to raise soil pH; other forms of lime are hydrated lime (calcium hydroxide) and burnt lime (quicklime, calcium oxide).
Lower plastic limit (LPL):	old name for the <i>Plastic Limit</i> .
Macropore	Large soil <i>pore</i> that is drained at field capacity; (a pore with a diameter greater than 0.03 mm can drain and admit air); includes channels created by cracking, plant roots and soil fauna (for example, earthworms); mainly responsible for transmitting water and allowing exchange of gases in soils; indicative of good structure for plant growth; see: <i>Minipore</i> .
Magnesium:	a cation that promotes dispersion, but less so than sodium; an essential plant nutrient.
Massive:	a coherent or solid mass of soil, largely devoid of natural lines of weakness.
Meander plain:	an alluvial area built up by sediment from a slow moving and winding river.
Microaggregates:	units of soil (smaller than 0.25 mm) that contain particles ranging in size from clay (smallest) through silt to fine sand.
Mineralisation:	the processes by which soil microbes convert organic nitrogen to ammonium; see <i>Nitrification</i> .
Minimum tillage:	or "reduced tillage" describes farming practices which reduce the number of tillage operations compared with <i>conventional tillage</i> . Weeds in the fallow are controlled by herbicides, grazing and some tillage; see: <i>No-tillage</i> .

Minipore:	soil <i>pore</i> with a diameter less than 0.03 mm; mainly responsible for storing water in soils.
Mole drain:	A tubular drain formed beneath the soil surface by pulling an expanding plug through wet soil.
Mottled:	having blotches of soil with a different colour; indicative of past periods of intermittent waterlogging.
Mycorrhiza:	a fungus that associates with plant roots to the benefit of both.
Nitrification:	the processes by which soil microbes convert ammonium to plant available nitrate.
Nitrogen fixation:	the process of converting atmospheric nitrogen into compounds that eventually become available to plants; one such process is the fixation of nitrogen by <i>Rhizobium</i> bacteria associated with the roots of legumes; free-living soil organisms also fix nitrogen; industrial nitrogen fixation produces manufactured nitrogen fertiliser.
Nodule:	an accumulation of a soil material as a discreet, small lump, may be composed of iron or manganese compounds, or calcium carbonate (lime); a swelling on the roots of legumes, containing symbiotic <i>Rhizobium</i> bacteria.
No-tillage:	a form of conservation farming involving no mechanical soil disturbance other than planting, or occasional strategic tillage; see: <i>Conventional tillage</i> , <i>Minimum tillage</i> .
Organic carbon:	one of the chemical elements making up organic matter; organic matter is often expressed as organic carbon because it is carbon that is measured in the laboratory; organic carbon multiplied by 1.75 gives an estimate of organic matter (soil organic matter is approximately 57% carbon).
Organic matter:	plant and animal material, living and dead.
Pan:	a hard soil layer which may restrict the entry of water, air and roots; if caused by tillage, it is referred to as a plough pan.
PAWC	see: <i>Plant available water capacity</i>
Ped:	an individual natural soil aggregate consisting of a cluster of primary particles and separated from adjoining clusters by surfaces of weakness that are recognisable as being natural.
Percolation:	movement of water through a soil.

Permanent beds:	a tillage system where the beds and wheel tracks are left in the same place for a number of crops; actually, semi-permanent beds.
Permeability	Ability of a soil to transmit water and gases.
pH:	The acidity or alkalinity of a soil is measured as pH; usually in a thin paste of soil and calcium chloride (CaCl ₂) solution (one part dry soil to five parts CaCl ₂ solution by weight); sometimes pH is measured in a paste of soil and distilled water; in CaCl ₂ , pH values are about 0.5-0.8 units lower; but with less variation, than in water. Whilst most commercial soil testing laboratories use the CaCl ₂ method, most field pH testing kits and some laboratories use the water method.
pH buffering capacity:	the ability of a soil to absorb acid or lime with little or no change to pH.
Physical fertility:	see: <i>Fertility</i> .
Piezometer:	a non-pumping shallow bore, of small diameter, to measure the pressure level of groundwater.
Plant available water capacity (PAWC)	the maximum amount of water that a soil can hold and later release to plant roots; it is expressed as millimetres of water in the whole root zone.
Plantback period:	the waiting period before it is safe to sow a crop after using a herbicide.
Plastic limit (PL):	the moisture content of a soil above which it can be remoulded (is plastic) and below which it cannot be remoulded (is brittle).
Plastic:	capable of being moulded.
Platy clods:	soil aggregates with horizontal dimensions greater than vertical dimensions.
Poaching damage:	damage to soil structure caused by stock trampling wet soil. It occurs when a soil is so soft that the hooves of grazing animals can not be supported on the surface and they press into the soil to leave noticeable depressions. Poaching is sometimes called "puddling".
Pore:	channel or cavity in a soil.
Porosity:	The degree to which a soil is permeated with pores; the fraction of the soil volume made up of pores, but also the size and shape of the pores and the degree of connection between them.

Pulverising:	mechanically destroying soil aggregates; usually refers to crushing dry aggregates; see: <i>compaction</i> , <i>smearing</i> , <i>remoulding</i> .
Recharge area:	where surface water from rain, irrigation or streams infiltrates the soil and adds water to the groundwater system.
Red brown earths:	red coloured soils with hard-setting (fine sand or silt) topsoils over clay-rich subsoils.
Remoulding:	re-organising pore space and natural clay orientation by disturbing a soil when it is wet; see: <i>compaction</i> , <i>smearing</i> , <i>pulverising</i> .
Rhizobium:	bacterium associated symbiotically with legume roots, fixing nitrogen.
Root zone:	that part of a soil where the majority of live plant roots are located.
Saline scald	is a bare, dry, salt affected area, resulting from topsoil loss exposing a naturally saline subsoil.
Saline seep	is a bare, damp, salt affected area, resulting from rising saline ground water.
Salinity:	an excess of water-soluble salts, dominantly sodium chloride in Australia, that restricts plant growth.
Sand:	soil particles between 0.02 mm and 2 mm in diameter; fine sand is 0.02 - 0.2 mm, coarse sand is 0.2 - 2 mm.
Scald:	a bare area, inhospitable to plants because of high clay content and either sodicity or salinity. See <i>Dry scald</i> , <i>Saline scald</i> , <i>Saline seep</i> .
Sedimentary rocks:	ancient soil particles carried by water or wind that have been turned into rock by pressure and chemical bonding over time.
Sediments:	particles of clay, silt and sand carried by water or wind and deposited.
Self-mulching:	refers to cracking clay surfaces that develop a shallow layer of loose, small aggregates after wetting and drying.
Shattering:	fracturing of soil aggregates or a hard layer of soil by tillage.
Silt:	soil particles between 0.002 mm and 0.02 mm in size; intermediate between clay and sand.
Slaking:	collapse of aggregates to microaggregates in water due to the swelling of clay and expulsion of air.

Slickenside:	natural shiny surface found on clay aggregates; formed by the parallel orientation of clay particles during swelling and shrinking cycles.
Smearing:	aligning of clay particles when mechanically disturbed under moist conditions, producing a thin, shiny, impenetrable surface; see: <i>compaction, remoulding, pulverising</i> .
Sodic:	an excess of exchangeable sodium (exchangeable sodium percentage greater than 5) and low salinity, making a soil prone to dispersion.
Soil evaporation:	water evaporated from the soil, not from plants; it is usually high when the soil is wet and slows greatly as the soil surface dries.
Soil profile:	<p>the vertical sequence of layers in a soil; the three main horizons are A (generally referred to as topsoil), B (generally referred to as subsoil) and C (the parent rock).</p> <p>The A horizon is the zone of leaching; it may consist of an A1 horizon (true topsoil: higher in organic matter, darker in colour and richer in biological activity than other horizons) and an A2 horizon (similar to A1 but often paler in colour, poorer in structure, lower in clay content and less fertile); the A2 horizon does not always occur.</p> <p>The B horizon is the zone of accumulation of materials from above: clay, iron, aluminium and organic matter (although the organic matter content is never as high as in the A horizon); structure is different from that of A or C horizons and colour is typically stronger.</p> <p>The C horizon consists of weathered rock, little affected by soil forming processes; soils which have developed on alluvium do not have a C horizon: the rock below is not related to the soil and would be termed the D horizon.</p>
Soil water:	water contained in, or in transit by drainage through, the soil.
Splay:	fan of alluvial material deposited during floods.
Stubble mulching:	involves the use of tillage machinery such as blade ploughs, chisel ploughs and rod weeders which, compared with other implements, leave more crop stubble on the soil surface.
Structural form:	the arrangement of soil material (sand, silt and clay particles and organic matter) into larger units (peds or aggregates), and the pore spaces between. It includes the shape and size of peds, the nature of their faces, their porosity and their friability.

Structural resiliency:	the ability of a soil to restore a good structural form after damage.
Structural stability:	the ability of a soil to retain its structural form under the influence of disruptive forces (raindrop impact, tillage, trampling).
Structure:	(of soil) the form in which soil material is arranged into larger units, the stability of that arrangement, and its resiliency (ability to restore a good arrangement). Often 'structure' refers only to structural form.
Symbiosis:	two species of organism living closely together in a mutual association that benefits both species; for example, <i>Rhizobium</i> bacteria form nodules in legume roots; the bacteria fix nitrogen and the plant supplies sugars.
Texture:	the behaviour of a small handful of soil when moistened and kneaded into a ball and then pressed out between thumb and forefinger. It depends mainly upon the proportions of gravel, coarse sand, fine sand, silt and clay in the soil.
Texture contrast:	see: <i>Duplex</i> .
Transpiration:	the process by which plants give off water vapour through their leaves.
Uniform soil:	a soil in which texture changes very little down the <i>soil profile</i> ; horizons may be distinguished by differences in organic matter content, structure or colour; cracking clays are uniform soils see: <i>Duplex</i> , <i>Gradational</i> .
Vertisol:	old name for a <i>Vertosol</i> .
Vertosol:	a soil which 'turns' (tills) itself (Latin <i>verto</i> : to turn); surface soil that falls down cracks eventually returns to the surface after many cycles of wetting and drying; <i>cracking clays</i> are Vertosols and are distinguished by seasonal cracking and a lack of distinct horizons.
Watertable:	upper surface of groundwater, below which the layers of soil, rock, sand or gravel are saturated with water.
Waterlogged:	a soil which is saturated with water and air has been displaced to the point where there is insufficient oxygen for full root activity; see: <i>Anaerobic</i> .
Water use efficiency:	is a measure of the conversion of water into plant products.

Weathering: the process whereby rock is broken down by water, wind, temperature changes and chemical attack to small particles, perhaps eventually to form soil; note: weathering continues after the particles have formed soil, and this process slowly changes the soil minerals and releases plant nutrients.

Zero tillage: See: *No-tillage*.

SOILpak