

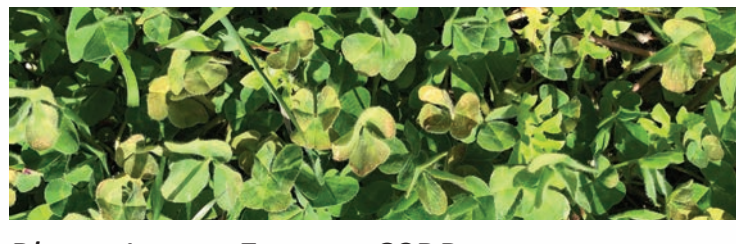















# VISUAL INDICATORS OF SOIL CONDITION PART I

What do you see and when?	What could this indicate?	What test can I do to confirm?
  <p><b>Dark green patches with greater growth of grass or clover, paler green in other areas.</b> Best time to look is late winter and early spring.</p>	<p><b>Pale green areas deficient in nitrogen, potassium, phosphorus or sulphur</b> Dark green areas are urine patches or manure pats. Urine contains high amounts of nitrogen and potassium and some sulphur. Dung affected areas also contain phosphorus.</p> <p><b>Selective grazing</b> Stock avoid pasture near dung while odour remains (up to 3 months).</p>	<ul style="list-style-type: none"> <li>• Soil testing with reference to potassium, nitrogen and sulphur. Avoid sampling the dark green areas.</li> <li>• Test strips of potassium, nitrogen and sulphur fertiliser.</li> </ul>  <p><i>Pictured: Nitrogen response (left) with 25kg/ha applied in May. Photo Lisa Warn Ag Consulting</i></p>
 <p><b>Yellowing or pale green colour in pastures.</b> Seen in late winter to spring.</p>	<p><b>Deficiency in potassium, nitrogen or sulphur or trace elements such as molybdenum</b></p> <p><b>Waterlogging</b>, resulting in transient nitrogen loss.</p> <p><b>Maturing or flowering winter grass (<i>Poa annua</i>)</b></p> <p><b>Dying plants</b> caused by red-headed cockchafer pruning plant roots.</p> <p><i>Pictured: Winter grass (above) and Onion grass (<i>Romulea rosea</i>) (below) infected with yellow brown spots caused by <i>Helminthosporium</i> fungus.</i></p> 	<ul style="list-style-type: none"> <li>• Soil test, with reference to phosphorus, potassium and sulphur. Tissue test for micronutrients, with attention to molybdenum.</li> <li>• Abundance of low fertility weeds and absence of high fertility weeds.</li> <li>• Test strips of nitrogen and / or potassium, sulphur and molybdenum fertiliser.</li> </ul>  <p><i>Pictured: Potassium response in test strip.</i></p>
 <p><b>Grass dominant pasture with little or no legume and slow growth.</b> Best seen late winter to mid spring.</p>	<p><b>Possible phosphorus or molybdenum deficiency</b></p> <p><b>Low soil pH (soil acidity)</b></p> <p><b>Inappropriate sub-clover management</b>, such as leaving too much dry material at the autumn break, long rotations encouraging grass dominance or cutting hay in later maturing clovers.</p>	<ul style="list-style-type: none"> <li>• Soil test, with reference to phosphorus, pH and aluminium.</li> <li>• Plant tissue test for molybdenum.</li> <li>• The dry material litter test in late summer/early autumn.</li> </ul> <p><i>Pictured: Amount of loose litter in late summer. Ideally one to two handfuls in 0.1m<sup>2</sup> quadrat promotes hard seed breakdown of sub-clover.</i></p> 
 <p><b>Increased growth and high fertility indicator weeds growing on stock camps.</b> Seen during the growing season.</p>	<p><b>High soil fertility</b> Stock empty out dung and urine, so nutrients concentrate.</p> <p><b>Bare ground at autumn or overgrazing</b></p> <p><i>Pictured: Bare ground at autumn and false breaks can favour capeweed growth.</i></p> 	<ul style="list-style-type: none"> <li>• Identify if the weeds growing on the camp area thrive under high fertility.</li> <li>• Compare size of fully emerged leaf blades of the same grass species from the stock camp to the rest of paddock.</li> </ul> <p><i>Pictured: Larger yet same number of leaves (right) due to higher fertility.</i></p> 
 <p><b>Areas that stay green during summer but have reduced growth. Bare patches remain damp and white salt crystals may be visible on soil surface.</b> <b>Different plants growing to the rest of the paddock.</b> Best seen in late spring.</p>	<p><b>Salinity</b> Caused by a salty water table less than two metres from the soil surface.</p> <p><b>Freshwater spring</b></p>	<ul style="list-style-type: none"> <li>• Soil test with reference to electrical conductivity (EC).</li> <li>• Identification of individual plant species to confirm their salt tolerance.</li> </ul> <p><i>Pictured: Examples of salinity indicator plants.</i></p>  <p>Buckshorn plantain (<i>Plantago coronopus</i>)      Sea barley grass (<i>Hordeum marinum</i>)      Yellow buttons (<i>Cotula coronopifolia</i>)</p>
 <p><b>Lucerne stunting or patchy poor growth following establishment.</b> Seen in the first three to four months after establishment.</p> <p><i>Photo Malcolm McCaskill, Agriculture Victoria</i></p>	<p><b>Soil acidity with associated high soil aluminium</b> This affects root growth, causing stunting, sideways growth of roots and plant loss.</p> <p><b>Waterlogging</b> may cause a similar effect.</p> <p><i>Pictured: Stunted lucerne with J-shaped roots from poor growth patches (left) compared to healthy plants.</i></p>  <p><i>Photo Neil James, Agriculture Victoria</i></p>	<ul style="list-style-type: none"> <li>• Soil test, with reference to pH and aluminium at 0-10, 10-20 and 20-30cm to detect top and sub soil acidity.</li> </ul>  <p><i>Pictured: Soil pH tested along 30cm soil core using pH kit available from hardware stores or nurseries.</i></p>



What do you see and when?	What could this indicate?	What test can I do to confirm?
 <p><b>Small, stunted or dark green leaves on sub-clover plants.</b> Observed in early spring when clover is adequately growing.</p>	<p><b>Phosphorus deficiency</b> Only when phosphorus deficiency is extreme do leaf symptoms appear. Slow and poor growth of pasture occurs from "Hidden hunger" of all nutrients before appearance of leaf symptoms. Sub-clover leaves with adequate fertility should be the size of a 20 cent piece.</p>	<ul style="list-style-type: none"> <li>Soil test with reference to phosphorus.</li> <li>Test strips of phosphorus fertiliser.</li> </ul> <p><i>Pictured: Hand-operated soil sampler.</i></p> 
 <p><i>Photo James Easton, CSBP</i></p>  <p><i>Photo Department of Agriculture, Fisheries and Forestry</i></p> <p><b>Bronzing of sub-clover leaf margins which develop into pale grey spots.</b> Seen in late winter and early spring. <i>Pictured left: Sub-clover plants with symptom progression</i></p>	<p><b>Potassium deficiency</b> Avoid confusion with red-legged earth mite feeding damage, which occurs randomly across the leaves (pictured).</p> 	<ul style="list-style-type: none"> <li>Soil test with reference to potassium.</li> <li>Test strips of potassium fertiliser.</li> </ul> <p><i>Pictured: Potassium response in test strip.</i></p> 
 <p><i>Photo Sue Briggs, CSBP</i></p> <p><b>Stunted sub-clover plants, usually pale green in colour. Rapid death of sub-clover plants.</b> Seen in autumn and winter.</p>	<p><b>Soil acidity and associated high soil aluminium</b> <b>Soil borne diseases</b> Caused by four main pathogens (<i>Phytophthora</i>, <i>Pythium</i>, <i>Aphanomyces</i>, <i>Rhizoctonia</i>). <i>Pictured left: Sub-clover with relatively healthy roots on left next to diseased plant with root branch pruning (commonly seen symptom). Pictured right: Extreme diseased roots with tap root pruning and brown lesions on roots.</i></p>  <p><i>Photos Richard Simpson, CSIRO</i></p>	<ul style="list-style-type: none"> <li>Soil test, with reference to pH and aluminium.</li> <li>Test strips with lime. Note, lime responses are often not seen in the first year, especially if lime is not incorporated.</li> <li>Inspect roots. Hostile soil conditions will result in stunted roots with less fine roots.</li> <li>Diseased roots are commonly yellow in colour with reduced or pruned branches and may also have brown/black lesions.</li> <li>Test strips of foliar fungicide such as Phosphorus acid.</li> <li>Predicta B to identify pathogen presence.</li> </ul>
 <p><i>Photo Jo Powell, NSW LSS</i></p> <p><b>Few or whitish nodules on legume roots.</b> Observed 12 weeks after germination to early spring.</p>	<p><b>Inadequate nodulation</b> There could be many reasons for poor nodulation including:</p> <ul style="list-style-type: none"> <li>Soil acidity and high soil aluminium.</li> <li>Insufficient rhizobia in the soil as a result of cropping for many years.</li> <li>Residual herbicide damage.</li> <li>Molybdenum deficiency.</li> <li>Sulphur deficiency.</li> </ul>	 <p><i>Pictured: Healthy pink nodules.</i></p> <ul style="list-style-type: none"> <li>Inspect nodules. Look for many big pinkish coloured nodules rather than small white nodules.</li> <li>Conduct nodulation score.</li> <li>Examine cropping history as soil rhizobia declines after three years without a host.</li> <li>Tissue test clover leaves with reference to molybdenum.</li> <li>Test strips of sulphur and molybdenum fertiliser.</li> </ul>
  <p><b>Milky tea coloured water on soil surface.</b> Best seen after rain.</p> <p><b>Soils form surface crust &amp; set hard when dry.</b> Best seen once soil is dry.</p>	<p><b>Soil dispersion</b> Individual clay particles separate from one another when soil becomes wet due to excessive sodium and insufficient organic matter binding the soil together.</p> <p><b>Slaking</b> Soil crumbs break apart when wet due to low organic matter which results in surface crusting. Often seen around gateways.</p>  <p><i>Pictured: Cloudy water indicating dispersion of soil crumbs; collapsed crumbs indicating slaking.</i></p>	<ul style="list-style-type: none"> <li>Soil test with reference to the amount and proportion of sodium compared to calcium, potassium and magnesium.</li> <li>An aggregate stability test. This involves placing small soil crumbs (sized about 5-10mm) into a dish with distilled water and observing their reaction over time.</li> </ul>
 <p><b>Soil disturbance with lots of soil crumbs on the surface.</b> Best seen in moist soil in winter and spring.</p>	<p><b>Earthworms</b> The disturbed soil is excreted waste called casts. Avoid confusion with blackheaded cockchafer which form mounded tunnels (pictured).</p> 	<ul style="list-style-type: none"> <li>Dig up the soil and check for earthworms.</li> </ul> <p><i>Pictured: Earthworms in soil clod eating decayed roots and microorganisms.</i></p> 

	What weeds do you see and when?	What could this indicate?	What test can I do to confirm?
<b>High fertility indicators</b>	<p><b>High content of capeweed, barley grass, thistles and/or marshmallow within pasture or in stock camps, gateways or adjacent to tree plantations. Seen from autumn to December.</b></p>  <p><b>Capeweed</b> (<i>Arctotheca calendula</i>)</p>  <p><b>Barley grass</b> (<i>Hordeum leporinum</i>)</p>  <p><b>Thistles</b> (<i>Cirsium vulgare</i>)</p>  <p><b>Marshmallow</b> (<i>Malva parviflora</i>)</p>	<p><b>High fertility, particularly nitrogen</b> Presence of barley grass also indicates high phosphorus levels.</p> <p><b>Overgrazing in late summer</b> This provides ideal conditions for germination.</p>	<ul style="list-style-type: none"> <li>Soil test with reference to nitrogen and phosphorus.</li> <li>Note location where the weeds are most dominant.</li> </ul>
<b>Low fertility indicators</b>	<p><b>High content of bent grass, fog grass, silver grass, onion grass, flatweed, sweet vernal grass and/or sorrel within pasture. Seen from autumn to December.</b></p>  <p><b>Flatweed</b> (<i>Hypochaeris radicata</i>)</p>  <p><b>Sweet vernal grass</b> (<i>Anthoxanthum odoratum</i>)</p>  <p><b>Bent grass</b> (<i>Agrostis spp</i>)</p>  <p><b>Fog grass</b> (<i>Holcus lanatus</i>)</p>  <p><b>Silver grass</b> (<i>Vulpia bromoides</i>)</p>  <p><b>Onion grass</b> (<i>Romulea rosea</i>)</p>  <p><b>Sorrel</b> (<i>Rumex vulgaris</i>)</p>	<p><b>Low fertility</b> Bent grass and fog grass are general indicators of low fertility, especially nitrogen and also phosphorus, potassium, sulphur and soil acidity.</p> <p><b>Low nitrogen</b> – Silver grass</p> <p><b>Low phosphorus</b> – Onion grass</p> <p><b>Low potassium</b> – Flatweed, sorrel and sweet vernal grass Common on light textured soils (as potassium leaches) and on paddocks repeatedly cut for hay or silage.</p> <p><b>Soil acidity</b> – Sorrel Also favours silver grass, bent grass and fog grass growth as nitrogen fixation of legumes declines.</p>	<ul style="list-style-type: none"> <li>Soil test with reference to nitrogen, phosphorus, potassium and soil pH.</li> </ul>  <p><i>Pictured: Sorrel becomes obvious during spring due to red seed heads.</i></p>