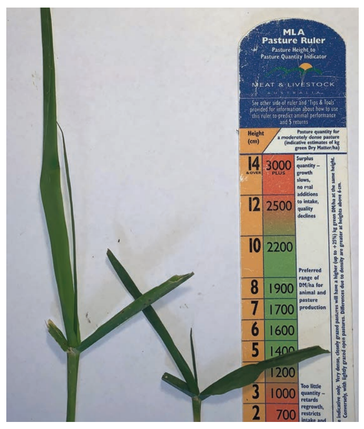
VISUAL INDICATORS OF SOIL CONDITION PART I

MEAT & LIVESTOCK AUSTRALIA

What do you see and when?	What could this indicate?	What test can I do to confirm?
 **Dark green patches with greater growth of grass or clover, paler green in other areas.** Best time to look is late winter and early spring.	**Pale green areas deficient in nitrogen, potassium, phosphorus or sulphur** 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. **Selective grazing** Stock avoid pasture near dung while odour remains (up to 3 months).	• Soil testing with reference to potassium, nitrogen and sulphur. Avoid sampling the dark green areas. • Test strips of potassium, nitrogen and sulphur fertiliser.  *Pictured: Nitrogen response (left) with 25kg/ha applied in May.* *Photo Lisa Warn Ag Consulting*
 **Yellowing or pale green colour in pastures.** Seen in late winter to spring.	**Deficiency in potassium, nitrogen or sulphur or trace elements such as molybdenum** **Waterlogging,** resulting in transient nitrogen loss. **Maturing or flowering winter grass (*Poa annua*)** **Dying plants** caused by red-headed cockchafer pruning plant roots. *Pictured: Winter grass (above) and Onion grass (Romulea rosea) (below) infected with yellow brown spots caused by Helminthosporium fungus.*  	• Soil test, with reference to phosphorus, potassium and sulphur. Tissue test for micronutrients, with attention to molybdenum. • Abundance of low fertility weeds and absence of high fertility weeds. • Test strips of nitrogen and / or potassium, sulphur and molybdenum fertiliser.  *Pictured: Potassium response in test strip.*
 **Grass dominant pasture with little or no legume and slow growth.** Best seen late winter to mid spring.	**Possible phosphorus or molybdenum deficiency** **Low soil pH (soil acidity)** **Inappropriate sub-clover management**, such as leaving too much dry material at the autumn break, long rotations encouraging grass dominance or cutting hay in later maturing clovers.	• Soil test, with reference to phosphorus, pH and aluminium. • Plant tissue test for molybdenum. • The dry material litter test in late summer/early autumn. *Pictured: Amount of loose litter in late summer. Ideally one to two handfuls in 0.1m² quadrat promotes hard seed breakdown of sub-clover.* 
 **Increased growth and high fertility indicator weeds growing on stock camps.** Seen during the growing season.	**High soil fertility** Stock empty out dung and urine, so nutrients concentrate. **Bare ground at autumn or overgrazing** *Pictured: Bare ground at autumn and false breaks can favour capeweed growth.* 	• Identify if the weeds growing on the camp area thrive under high fertility. • Compare size of fully emerged leaf blades of the same grass species from the stock camp to the rest of paddock. *Pictured: Larger yet same number of leaves (right) due to higher fertility.* 
 **Areas that stay green during summer but have reduced growth. Bare patches remain damp and white salt crystals may be visible on soil surface.** **Different plants growing to the rest of the paddock.** Best seen in late spring.	**Salinity** Caused by a salty water table less than two metres from the soil surface. **Freshwater spring**	• Soil test with reference to electrical conductivity (EC). • Identification of individual plant species to confirm their salt tolerance. *Pictured: Examples of salinity indicator plants.*  Buckshorn plantain *(Plantago coronopus)*  Sea barley grass *(Hordeum marinum)*  Yellow buttons *(Cotula coronopifolia)*
 *Photo Malcolm McCaskill, Agriculture Victoria* **Lucerne stunting or patchy poor growth following establishment.** Seen in the first three to four months after establishment.	**Soil acidity with associated high soil aluminium** This affects root growth, causing stunting, sideways growth of roots and plant loss. **Waterlogging** may cause a similar effect. *Pictured: Stunted lucerne with J-shaped roots from poor growth patches (left) compared to healthy plants.*  *Photo Neil James, Agriculture Victoria*	• Soil test, with reference to pH and aluminium at 0-10, 10-20 and 20-30cm to detect top and sub soil acidity.  *Pictured: Soil pH tested along 30cm soil core using pH kit available from hardware stores or nurseries.*

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VISUAL INDICATORS OF SOIL CONDITION PART II

MEAT & LIVESTOCK AUSTRALIA

What do you see and when?	What could this indicate?	What test can I do to confirm?
 **Small, stunted or dark green leaves on sub-clover plants.** Observed in early spring when clover is adequately growing.	**Phosphorus deficiency** 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.	• Soil test with reference to phosphorus. • Test strips of phosphorus fertiliser. *Pictured: Hand-operated soil sampler.* 
 *Photo James Easton, CSBP*  *Photo Department of Agriculture, Fisheries and Forestry* **Bronzing of sub-clover leaf margins which develop into pale grey spots.** Seen in late winter and early spring. *Pictured left: Sub-clover plants with symptom progression*	**Potassium deficiency** Avoid confusion with red-legged earth mite feeding damage, which occurs randomly across the leaves (pictured). 	• Soil test with reference to potassium. • Test strips of potassium fertiliser. *Pictured: Potassium response in test strip.* 
 *Photo Sue Briggs, CSBP* **Stunted sub-clover plants, usually pale green in colour.** **Rapid death of sub-clover plants.** Seen in autumn and winter.	**Soil acidity and associated high soil aluminium** **Soil borne diseases** Caused by four main pathogens (*Phytophthora, Pythium, Aphanomyces, Rhizoctonia*). *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.*  *Photos Richard Simpson, CSIRO*	• Soil test, with reference to pH and aluminium. • Test strips with lime. Note, lime responses are often not seen in the first year, especially if lime is not incorporated. • Inspect roots. Hostile soil conditions will result in stunted roots with less fine roots. • Diseased roots are commonly yellow in colour with reduced or pruned branches and may also have brown/ black lesions. • Test strips of foliar fungicide such as Phosphorus acid. • Predicta B to identify pathogen presence.
 *Photo Jo Powell, NSW LSS* **Few or whitish nodules on legume roots.** Observed 12 weeks after germination to early spring.	**Inadequate nodulation** There could be many reasons for poor nodulation including: • Soil acidity and high soil aluminium. • Insufficient rhizobia in the soil as a result of cropping for many years. • Residual herbicide damage. • Molybdenum deficiency. • Sulphur deficiency.  *Pictured: Healthy pink nodules.*	• Inspect nodules. Look for many big pinkish coloured nodules rather than small white nodules. • Conduct nodulation score. • Examine cropping history as soil rhizobia declines after three years without a host. • Tissue test clover leaves with reference to molybdenum. • Test strips of sulphur and molybdenum fertiliser.
 **Milky tea coloured water on soil surface.** Best seen after rain.  **Soils form surface crust & set hard when dry.** Best seen once soil is dry.	**Soil dispersion** Individual clay particles separate from one another when soil becomes wet due to excessive sodium and insufficient organic matter binding the soil together. **Slaking** Soil crumbs break apart when wet due to low organic matter which results in surface crusting. Often seen around gateways.  *Pictured: Cloudy water indicating dispersion of soil crumbs; collapsed crumbs indicating slaking.*	• Soil test with reference to the amount and proportion of sodium compared to calcium, potassium and magnesium. • 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.
 **Soil disturbance with lots of soil crumbs on the surface.** Best seen in moist soil in winter and spring.	**Earthworms** The disturbed soil is excreted waste called casts. Avoid confusion with blackheaded cockchafer which form mounded tunnels (pictured). 	• Dig up the soil and check for earthworms. *Pictured: Earthworms in soil clod eating decayed roots and microorganisms.* 

High fertility indicators

What weeds do you see and when?	What could this indicate?	What test can I do to confirm?
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.  **Capeweed** *(Arctotheca calendula)*  **Barley grass** *(Hordeum leporinum)*  **Thistles** *(Cirsium vulgare)*  **Marshmallow** *(Malva parviflora)*	**High fertility, particularly nitrogen** Presence of barley grass also indicates high phosphorus levels. **Overgrazing in late summer** This provides ideal conditions for germination.	• Soil test with reference to nitrogen and phosphorus. • Note location where the weeds are most dominant.

Low fertility indicators

 **Flatweed** *(Hypochaeris radicata)*  **Sweet vernal grass** *(Anthoxanthum odoratum)*  **Bent grass** *(Agrostis spp)*  **Fog grass** *(Holcus lanatus)*  **Silver grass** *(Vulpia bromoides)*  **Onion grass** *(Romulea rosea)*  **Sorrel** *(Rumex vulgaris)*	**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. **Low fertility** Bent grass and fog grass are general indicators of low fertility, especially nitrogen and also phosphorus, potassium, sulphur and soil acidity. **Low nitrogen –** Silver grass **Low phosphorus –** Onion grass **Low potassium –** Flatweed, sorrel and sweet vernal grass Common on light textured soils (as potassium leaches) and on paddocks repeatedly cut for hay or silage. **Soil acidity** – Sorrel Also favours silver grass, bent grass and fog grass growth as nitrogen fixation of legumes declines.	• Soil test with reference to nitrogen, phosphorus, potassium and soil pH.  *Pictured: Sorrel becomes obvious during spring due to red seed heads.*

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