

How do I determine why my sub-clover is underperforming?

- The issue:** Many sub-clover pastures fail to perform for a range of reasons. In many of these situations, producers remain either unaware of lost production or they suspect it is underperforming but are not sure why.
- The impact:** Producers are missing the opportunity to maximise livestock production by improving their feedbase. Resources are wasted attempting to improve pastures without identifying the cause of underperformance.
- The opportunity:** Producers can better meet livestock condition targets and create more stable and resilient pastures by identifying and addressing the factors limiting sub-clover growth.

What makes a good sub-clover pasture?

A productive pasture will have around 40% sub-clover content in spring. A sub-clover content consistently less than this over several years would suggest something is limiting growth.

There are many possible reasons for poor sub-clover growth, so it is important to make the correct diagnosis. This guide is designed to help identify what might be limiting sub-clover growth – both common and less common reasons. Diagnosis involves visual observations, some testing and possible field confirmation.



A spring pasture with more than 40% sub-clover content

What could be impacting sub-clover production?

Seasonal conditions

Sub-clover is an annual so relies on an adequate store of seed in the soil and successful establishment to reappear the next season. Unfavourable growing conditions, repeated or late false breaks and early finishes to the season can result in little or no residual seed.

Rarely does one unfavourable season alone exhaust the sub-clover seed bank. More likely it is repeated poor seasons (three or more consecutive years) which will create a problem. Specific management can be applied to rapidly build this seed bank.¹

Soil condition

Soil constraints are a common reason for sparse sub-clover. The main indicators to check are phosphorus and acidity levels. Only when nutrient deficiencies become extreme do leaf symptoms appear, otherwise 'hidden hunger' results in reduced growth and often replacement with annual weeds such as silver grass (*Vulpia* spp) and winter grass (*Poa annua*).

Severe deficiency in phosphorus is evident by small, dark green leaves. Sub-clover will grow under excessive soil acidity (pH[CaCl₂] as low as 4.2) but growth will be reduced by up to 30% and rhizobia survival, and

therefore nodulation and nitrogen fixation, will be poor. Excessive soil acidity, often with elevated levels of aluminium (in excess of 10% exchangeable aluminium), prunes the roots of the plant, restricting water and nutrient uptake and reducing the availability of molybdenum.

Trace elements, such as boron and calcium, can affect growth and seed set. Further information on the diagnosis of soil constraints limiting sub-clover production is available in MLA's *How do I manage soil health to grow good sub-clover?*²



Small sub-clover compared with a 20¢ coin indicating low soil phosphorus impacting growth

Grazing

The influence of grazing can impact sub-clover growth in three ways.

- 1. Long spelling:** Long periods of spelling allow grasses, which grow upright, to shade the flatter-growing sub-clover. If this grazing method is repeated over several years, the pasture will become grass dominant.
- 2. Dry material:** Retaining excessive dry material across the paddock over summer means trash acts as a blanket, preventing fluctuations in soil temperature vital to break the dormancy in sub-clover seed. Seed may be present in the soil but has not germinated.
- 3. Flowering and seed burial:** Grazing during winter and early spring favours flower production, while reducing grazing pressure in late spring avoids the removal of burr when sub-clover is burying its seed. This helps to build the seed bank.³



Grass-dominant pasture with little or no clover



Excessive dry material across the paddock over summer

Pests and diseases

Redlegged earth mites and black field crickets can have a significant impact on the contribution sub-clover makes to a pasture. Redlegged earth mites puncture the leaves, draining the green chlorophyll the plants use to photosynthesise and grow. They also damage seed formation at flowering, resulting in unviable seed.



Redlegged earth mites damaging clover leaves



Black field cricket eating clover seed and seedlings

Black field crickets are most active in late summer and eat the mature sub-clover seed, which then reduces the seed bank for the next growing season.

Root diseases caused by soil-borne pathogens are a major cause of root pruning and poorer plant growth. These can be diagnosed through observation of plant roots or by using a PREDICTA® B test.

In severe cases, insecticides, fungicides, cultivation or herbicides (to remove pest habitats) may be required to diminish pest populations where natural predation will reduce damage to an acceptable level.

Take a test

PREDICTA® B is a rapid diagnostic test used in cropping to identify diseases such as Pythium, Phytophthora, Aphanomyces and Rhizoctonia. Similar testing in pastures is still in the developmental stage, but currently the test can detect high, medium and low population densities of these major soil-borne diseases.

The testing is conducted by the South Australian Research and Development Institute (SARDI). Contact SARDI to discuss test options and to locate accredited agronomists who can take samples.

pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b



Late winter spray-grazing treatment. Herbicide (Agritone®750 900mL/ha) was applied on 3 September. Photo on left is before grazing (12 September) and photo on the right is post-grazing (17 September). Post-grazing management will affect sub-clover recovery and seed set.

Less common reasons

Two other reasons for poor sub-clover growth are herbicide damage and unsuitable cultivar selection.

Sub-clover is susceptible to damage from the common pasture manipulation techniques of spray-grazing and spray-topping if the timing and/or the rate of application is wrong (see images above and below). Key times to avoid are before the three true leaf stage with spray-grazing and using glyphosate at flowering with spray-topping. Maximum rates are specified on the herbicide label.

There has also been reported damage to sub-clover nitrogen fixation from residual levels of Group B

herbicides, most commonly after a cropping phase.

Breakdown of Group B herbicides is influenced by soil pH and biological activity – trace levels can remain a problem for up to 18 months after application.⁴ Be aware of the prior pasture history before introducing new sub-clover cultivars.

Selecting cultivars that suit the soil and growing season is critical for the ongoing regeneration of sub-clover.⁵

There are three main subspecies of sub-clover which vary in their tolerance to pH, time to flowering, capacity to bury their seed and level of hardseededness. Ensure the variety chosen matches the growing environment.⁶



Spray-topping causes yellowing of sub-clover and, when it coincides with flowering, reduces seed production

The rule in/rule out diagnosis chart

This flow chart provides simple steps for diagnosing the cause of poor sub-clover content. It has been created in order of most common to least common reasons. Users simply need to answer yes or no at each question. If the response to the question is yes, then further methods of investigation are suggested.

		FURTHER DIAGNOSIS
SEASONAL CONDITIONS (observation required)		
Has there been repeated :		
<ul style="list-style-type: none"> poor spring finishes? years of false or late autumn breaks? 	YES	<p>Search for residual surface and buried burr in the top 1cm at the end of summer and check for plump seeds. Want more than 50 burrs/0.1m².</p> <p>Oversow additional sub-clover seed and observe its response.</p>
NO		
SOIL CONDITION (based on the results of soil/tissue tests)		
Is the:		
<ul style="list-style-type: none"> Olsen P less than 8mg/kg or the Colwell P less than 19mg/kg (moderate PBI=190)? pH (CaCl₂) less than 4.3? 	YES	<p>Observe sub-clover leaf area in high-fertility areas. Should be larger than a five cent coin.</p> <p>Observe nodulation on plant roots. Want more than twenty small or three large pink coloured nodules.</p> <p>Apply test strips of phosphorus and lime, individually and in combination, and observe growth.</p>
NO		
Is the:		
<ul style="list-style-type: none"> molybdenum less than 0.5mg/kg? 	YES	<p>Observe nodulation on plant roots. Want more than twenty small or three large pink nodules.</p> <p>Apply test strips of trace elements, individually and in combination, and observe growth.</p>
NO		
Is the:		
<ul style="list-style-type: none"> Colwell K less than 120mg/kg (sand) or 160mg/kg (clay)? KCl sulphur less than 6mg/kg? 	YES	<p>Observe sub-clover leaf area in high-fertility areas. Should be larger than a five cent coin.</p> <p>Apply test strips of trace elements, individually and in combination, and observe growth.</p>
NO		
Is the:		
<ul style="list-style-type: none"> boron (hot CaCl₂) less than 15mg/kg? exchangeable calcium less than 3meq/100g? 	YES	<p>Collect seed and conduct germination test. 80% or higher germination is desired.</p>
NO		
GRAZING (observation required)		
Is the pasture consistently lightly grazed and more than 15cm (2,500kgDM/ha) in winter/early spring?	YES	<p>Apply harder grazing (3cm, 1,000kg–1,400kg DM/ha) over winter, observe sub-clover content in spring. Should be more than 30%.</p>
NO		
Is the pasture grazed less than 5cm or regularly cut for hay in late spring?	YES	<p>Apply lighter grazing (8–9cm, approximately 2,000kg DM/ha) in late spring, avoid hay cutting. Observe sub-clover response next winter.</p>
NO		
Is the dry material covering the ground at the end of summer more than 2,000kg DM/ha (more than two handfuls of litter/0.1 m ² scraped up)?	YES	<p>Increase summer grazing to leave 1,000–2,000kg DM/ha at the autumn break. Observe sub-clover next winter.</p>
NO		

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FURTHER DIAGNOSIS

PESTS AND DISEASES (observation required)

Are there large whitish areas on sub-clover leaves?
Are redlegged earth mites present in winter?

NO

YES

Graze hard and re-observe.

Remove pest habitat (especially capeweed) and re-observe.

Search for predatory mites.

Apply insecticide if damage still occurring and re-observe.

Is there an average of 5–7 black field crickets found under hessian bags or 20 crickets found under one bag in summer? (Taken from 10 bag counts across the paddock).

NO

YES

Bait crickets mid-summer, observe sub-clover after autumn break.

Are the roots of the sub-clover pruned with few branches, or have brown lesions?

NO

YES

Conduct PREDICTA® B test.

Apply fungicide and observe response.

FURTHER DIAGNOSIS

OTHER POSSIBILITIES (observation required)

Has pasture been:

- spray-grazed or winter cleaned before three true leaf stage or later than mid-August?
- spray-topped with glyphosate in spring?

NO

YES

Revisit chemical records on timing and application rate.

Has the pasture been exposed to any recent Group B herbicides (from previous cropping or fed-out hay)?

NO

YES

Revisit chemical records on timing and application rate. Check soil pH and if favourable conditions for biological activity.

Observe nodulation on plant roots.

Are the sub-clover cultivars present suitable for the soil conditions and growing season?

YES

Identify sub-clover cultivars and compare to preferred soil and growing conditions.

More information

1. MLA fact sheet: *How do I manage grazing to maximise sub-clover seed set?* Available online at: [mmla.com.au/globalassets/mla-corporate/research-and-development/program-areas/grazing-and-pasture-management/mla599--how-do-i-maximise-sub-clover-establishment-18.2.20.pdf](https://mla.com.au/globalassets/mla-corporate/research-and-development/program-areas/grazing-and-pasture-management/mla599--how-do-i-maximise-sub-clover-establishment-18.2.20.pdf)
2. MLA fact sheet: *How do I manage soil health to grow good sub-clover?* Available online at: mmla.com.au/legumes
3. MLA fact sheet: *How do I optimise sub-clover based pastures?* Available online at: mmla.com.au/globalassets/mla-corporate/research-and-development/program-areas/grazing-and-pasture-management/mla599---how-do-i-optimise-sub-clover-based-pastures--18.2.20.pdf
4. Hackney B (2019) Underperforming legumes? In: *Grassland Society of Southern Australia Inc 60th Annual Conference proceedings* (pp. 42–52), Grassland Society of Southern Australia Inc.
5. NSW DPI (2020) Choosing the right sub clover variety, NSW Government. Available online at: dpi.nsw.gov.au/agriculture/pastures-and-rangelands/establishment-mgmt/establishment/clover/choosing-the-right-sub-clover
6. Nichols P and Dear B (2007) Pastures Australia fact sheets.
Subterranean/sub-clover:
 - ssp. *subterraneum*
 - ssp. *brachycalicinum*
 - ssp. *yanninicum*Available online at: keys.lucidcentral.org/keys/v3/pastures/Html/index.htm#S
7. MLA feedbase hubs – mmla.com.au/controlweeds, mmla.com.au/healthysoils, mmla.com.au/persistentpastures

The herbicide label provides all the critical comments and precautions for the safe and responsible use of herbicides in pasture. Always read the label and only use as directed.

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