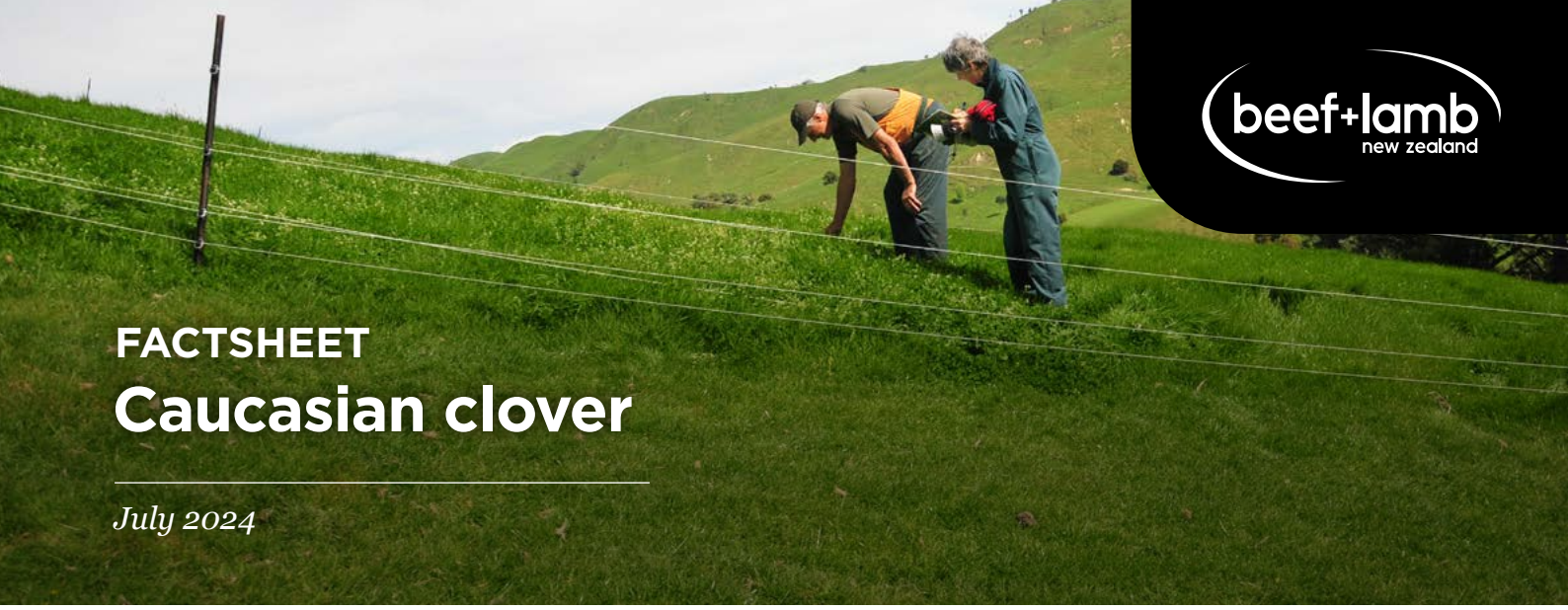

FACTSHEET

Caucasian clover

July 2024

This Factsheet outlines how to establish and manage Caucasian clover over a range of environments for livestock, a food source for pollinating insects and erosion control.

Key message

Caucasian clover is slow to establish but, once established, it is persistent and can produce more dry matter than white clover. This means it can fix more nitrogen than white clover as both species fix about 30 kg N per ton of herbage dry matter produced. Caucasian establishes best on low nitrogen sites, where grasses are less competitive. This allows it to rapidly develop its deep, extensive root and rhizome system for long-term persistence and production.

About Caucasian clover

Caucasian clover (*Trifolium ambiguum*) is a perennial legume that fixes about 30 kg of nitrogen per ton of clover herbage grown. This is the same as white clover. Compared with the huge breeding effort that has been invested into white clover (*T. repens*), Caucasian clover has considerable genetic diversity yet to be exploited.

Caucasian clover (Cc) has hairless blue-green leaves (Figure 1) similar in size and shape to hairy red clover (*T. pratense*). Leaves are normally three times the length of white clover (Wc) leaflets in the same grazed pasture. Leaves from Cc growing points emerge directly from the soil surface rather than from stolons on the soil surface like white clover. Cc has white to pink flowers about the same size as red clover flowers.

Why sow Caucasian clover?

Higher dry matter (DM) production

Field trials by Lincoln University have shown that, over three years, irrigated ryegrass/Caucasian clover/white clover pastures produced 10% more hogget liveweight gain than ryegrass/white clover pastures. This was due to more total clover production (18% vs. 11%).

***Figure 1**. Caucasian clover leaves (Photo: K.M. Pollock, Lincoln University).*

Pure irrigated three-year-old stands of Cc produced 12 t DM/ha/yr compared with 9.5 t from irrigated Wc. Dryland stands of Cc produced 9.4 t DM/ha/yr and Wc 7.0 t DM/ha (see Figure 2). More legume means increased nitrogen fixation, giving increased pasture quality and livestock production.

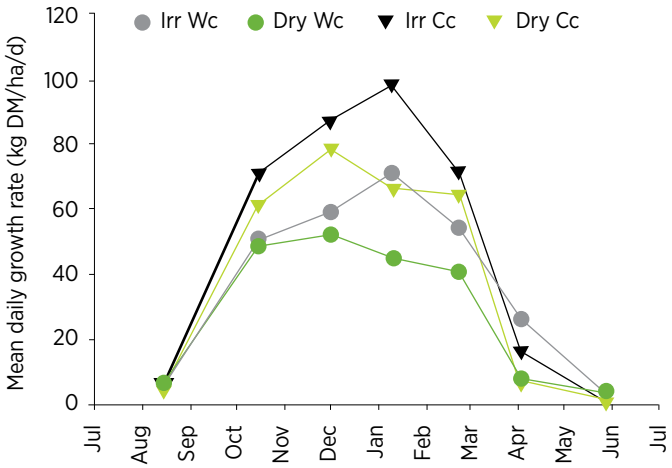

***Figure 2**. Mean daily growth rate (kg DM/ha/d) of established Caucasian and white clover monocultures under irrigated and dryland conditions, July 2001-June 2002, at Lincoln University (Black et al. 2003).*

Same feed energy value

There is no difference between the two clovers in foliar crude protein (around 30%) or energy values (>12 MJ ME/kg DM).

Caucasian is more persistent

Cc produces a large perennial taproot (at least 1.4 m deep in Wakanui silt loam). On the other hand, the smaller Wc taproot dies at between 12 and 18 months, leaving only shallow roots formed from stolon nodes that need frequent rain or irrigation to survive.

Underground stems (rhizomes) of Cc avoid and survive the high (>40 °C) summer surface soil temperatures experienced on dryland farms. In contrast, Wc stolons on the soil surface can get 'cooked', become brittle and die.

Compared with Wc, Cc has greater drought and extreme temperature tolerances (hot and cold), survives in infertile soils and tolerates some insect and nematode pests and viruses better than Wc.

Faster photosynthesis

Cc has a 20% faster leaf photosynthesis rate than Wc at all temperatures within the 7 °C to 30 °C range. Like all temperate perennial herbage legumes, Cc has an optimum temperature range for maximum growth of 20-25°C.

Cc has also shown a 20% faster leaf photosynthesis rate than Wc when water is freely available and over 30% faster rate when soil moisture content was only 50% of soil water holding capacity (Fig 2). This helps Cc produce more than Wc at all stages of water stress.

Understanding Caucasian clover establishment

Cc requires a specific rhizobium strain to form effective N-fixing root nodules

Cc rhizobia are not present in New Zealand soils. Therefore, all seed must be freshly inoculated immediately before sowing with the correct strain of Cc rhizobia. Ideally, seed should be inoculated at greater than 'normal' rates to get over 200,000 rhizobia/seed. This is especially vital if seed is broadcast.

Rhizobium bacteria are sensitive to ultraviolet light, drying out and high temperatures. If sowing is delayed, the inoculated seed should be kept in a dark, cool, dry place and re-inoculate seed prior to sowing.

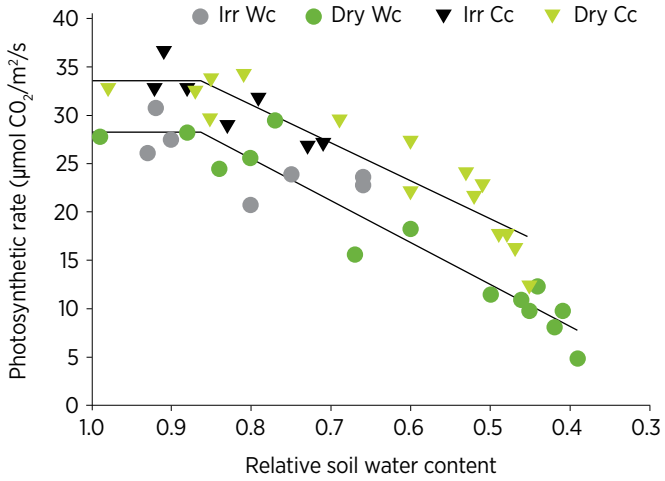

***Figure 3**. Caucasian clover leaf photosynthesis rate was consistently faster than white clover under non-limiting temperature conditions (20–25 °C), regardless of soil moisture status. Photosynthetic rates for both species declined when relative soil water content fell below 0.86. Note: field capacity (relative soil moisture = 1) was 580 mm to 1.7 m depth (Black et al. 2003).*

Takes longer to form a canopy of leaves

Cc has the same rapid rate of germination, emergence and primary shoot development seen in most perennial clover species.

However, the thermal time required to start production of the secondary growing points, which are required to rapidly produce a canopy of leaves, is much longer for Cc than perennial ryegrass (RG) or Wc (see Fig 3). For example, ryegrass begins tillering after 400 °Cd (degree days) and Wc grows stolons after 430 °Cd, but Cc takes 1200 °Cd for its first additional crown shoots and about 1600 °Cd (most of a growing season) to initiate secondary shoot production from rhizomes.

As an example, in a North Canterbury climate, it would take about one to two months for white clover to grow stolons but about six months for Cc to grow crown shoots.

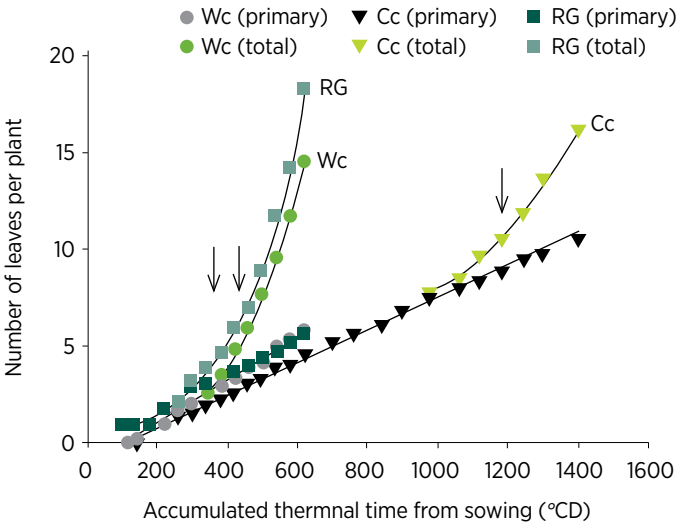

***Figure 4**. Total number of leaves for seedlings grown at 21.5 °C. Arrows indicate the time of initiation of secondary growing points, either ryegrass tillers (RG), white clover stolons (Wc) or Caucasian clover crown shoots (Cc).*

Degree day (°Cd) measurement is simply the amount of accumulated heat over time. The amount of 'heat' each day is calculated by adding together the daily minimum and maximum temperatures and dividing it by two.

Spring sowing best

The aim should be to sow early enough to accumulate 1600 °Cd (degree days) before April. For example, this typically means sowing before 1 November in North Canterbury. This will ensure some crown shoots and rhizome shoots develop before winter. Spring sowing is essential in cool environments.

Autumn sowing is not recommended. Cc seedlings usually suffer severe grass and weed competition through the winter because it is a continental species and therefore it is dormant in winter.

Fertiliser and lime requirements similar

Cc and Wc have similar fertiliser (P,S,K, trace elements) and lime requirements. Maximum clover growth is in soils with a pH above 5.5, Olsen P above 20, and Sulphur test above 8. Molybdenum (Mo) and boron are possible trace element deficiencies best evaluated through herbage tests during active growth.

Caucasian clover seedlings are poor competitors

Because young Cc plants are so slow to develop secondary shoots they do not produce enough leaves to compete for light against most other weed and sown species. Cc establishment therefore requires minimisation of this competition by controlling resident vegetation and weeds, low seeding rates of companion species and, where practical, a reduction in available soil N.

The vigour of non-legume, mainly grass competitors, is driven mainly by the nitrogen fertility of the site. Assess the available N in areas to be sown in Cc from the vigour of the resident vegetation. The amount of soil N can be reduced by sowing an arable crop, making hay or silage, avoiding N fertiliser and by not feeding out supplements on the block. The N-fixing Cc seedlings can compete only when grasses are nitrogen stressed.

Best practice for establishment

Apply the general principles above to your specific situation. To summarise current best practice advice for Cc establishment.

Cultivated seed-beds

i. Incorporate lime and fertiliser (no N) into the soil based on recent soil test results.

ii. Create a weed free, firm, fine seed-bed for sowing in spring, when soil temperatures exceed 10 °C.

iii. Use appropriate herbicides before cultivation and pre and/or post emergence as needed, to limit grass and broadleaf weed competition.

iv. Drill 5 kg/ha of freshly inoculated Cc seed in spring. A roller drill may be best to place seed at a maximum of 10 mm depth, in rows no wider than 15 cm.

v. A pure stand of Cc sown in spring and overdrilled in autumn with low seeding rates of permanent pasture species will give a Cc based permanent pasture. However, if initial Cc establishment is slow, delay overdrilling till spring.

Seed mix options

- Sowing 5 kg/ha freshly inoculated Cc with 1 kg/ha of plantain or chicory allows the herbs to act as a nurse crop for the slow emerging Cc seedlings.
- Slower establishing grasses (sown at low rates) such as timothy (0.5 kg/ha) or tall fescue (5 kg/ha) have also been used with Cc in spring sowings.
- Grasses sown with Cc will slow the clover development depending on soil N levels. Perennial ryegrass in particular **is not recommended** because it has a highly competitive seedling.
- Other perennial clovers (e.g. red or white) may be sown with Cc in spring. This allows a wider range of herbicides to be used in the establishment year. Both Wc and red clover are fast establishing, compared with Cc, so their seeding rates should be less than half normal amount (Wc 1 kg/ha, red clover 2 kg/ha). However, in most areas Wc seed is often present in the soil and new seed will not be necessary.

***Figure 5**. Caucasian clover in flower (Photo: K.M. Pollock, Lincoln University).*

Direct drilling

i. Follow advice as for cultivated seed-beds.

ii. Double spray to ensure complete kill of resident vegetation and weeds.

iii. Soil N levels will tend to be lower than after cultivation. Companion species are therefore likely to be less competitive than if the same paddock had been cultivated, but sow at 25% of the recommended rate.

iv. Ideally, use a cross-slot drill to place fertiliser in the soil near the seed, but monitor sowing depth (<10 mm).

v. Fertiliser and lime surface broadcast will not increase top-soil nutrient levels as rapidly as from cultivation.

Undeveloped hill and high country

i. Low soil N gives establishing CC a competitive advantage.

ii. Develop smaller areas with optimum input rates to get a dominant clover sward (low input development results in browntop and weed invasion into weak, nutrient deficient clover).

iii. Use double spray and cross-slot drill as in above.

Ensure seed is freshly inoculated or inoculant is provided to the farmer

Management of Caucasian Clover for best persistence and performance

Early management

Graze lightly if grasses or herbs are shading the Cc seedlings.

Herbicides should be applied if necessary to control aggressive perennial and annual weeds when they are at the susceptible seedling stage.

Once established, Cc can be set-stocked in early spring. Prolonged set stocking after tailing or throughout summer and especially in autumn will reduce root reserves. Herbage production and long-term persistence will then be compromised.

Rotational grazing with long spells is crucial in late summer/autumn. Similar to lucerne, this period is when a larger proportion of current 'plant sugars' are prioritized to recharge reserves in taproots and rhizomes, rather than contributing to production of new leaves. These stored nutrients are remobilised six months later to give rapid production in spring.

Can tolerate close grazing once established

Because the vegetative growing points of Cc are underground it can tolerate very intensive defoliation. This characteristic is valuable if grasses such as cocksfoot or browntop require suppression by hoof and tooth. Such treatment should not be prolonged as sheep can get a taste for the rhizomes and show enthusiasm for grazing below ground level!

FOR FURTHER INFORMATION

Black AD, Moot DJ, Lucas RJ. 2002. Seedling development and growth of white clover, Caucasian clover and perennial ryegrass grown in field and controlled environments. *Proceedings of the New Zealand Grassland Association 64*: 197-204.

Black AD, Moot DJ, Lucas RJ. 2006. Development and growth characteristics of Caucasian and white clover seedlings, compared with perennial ryegrass. *Grass and Forage Science 61*: 442-453.

Black AD, Moot DJ, Lucas RJ. 2003. Seasonal growth and development of Caucasian and white clovers under irrigated and dryland conditions. Legumes for Dryland Pastures. Grassland Research & Practice Series 11: 81-90.

Black AD, Lucas RJ. 2018. Dry matter yield of dryland and irrigated mixtures of Caucasian clover, white clover and perennial ryegrass over 5 years at Lincoln University. *Journal of New Zealand Grasslands 80*: 73-80.

Moorhead AJE, White JGH, Jarvis P, Lucas RJ, Sedcole JR. 1994. Effect of sowing method and fertiliser application on establishment and first season growth of Caucasian clover. *Proceedings of the New Zealand Grassland Association 56*: 91-95. https://doi.org/10.33584/jnzg.1994.56.2149.

Stevens DR, Taylor AL. 2022. Profit, productivity, and eco-efficiency of using Caucasian clover/ grass pastures in hill country farms. *Journal of New Zealand Grasslands 84*: 177-188.

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