

Trophy white clover – a new cultivar for dryland pastures

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Introduction

White clover (*Trifolium repens* L.) is a warm season perennial legume but sensitivity to summer moisture stress is the major factor limiting its persistence in dryland environments in NSW. A national breeding program, run by NSW DPI and based at Glen Innes began in 1990. The first white clover cultivar developed in this program is 'Trophy'.

Species description

White clover (*Trifolium repens* L.) is a warm season perennial legume. While white clover is most typically regarded as a perennial, it has two complementary systems of regeneration: by vegetative regeneration of the stolon system and by reproduction for seed bank development and seedling recruitment.

White clover has a prostrate stoloniferous growth habit – the stems form runners (stolons) for plant spread and rooting down at the nodes along the stolons. The aerial part of the plant comprises petiole, trifoliate leaves, peduncle and flowers. Petioles and leaves are generally hairless and white crescent markings normally occur on the leaves. Flowers are white to pale pink.

Under NSW conditions of extensive grazing, legume-based pastures are the most important feed resource supporting the grazing industries. Inclusion of white clover in the sward:

- increases livestock production by providing forage of high quality



Figure 1. Trophy – a white clover cultivar locally adapted to cope with summer moisture stress

- increases total pasture yield and extends the seasonal distribution of pasture growth
- improves soil fertility by nitrogen fixation.

White clover is the main perennial legume in temperate regions with high average annual rainfall (AAR) of 750–1000 mm due to broad adaptation. The white clover zone in Australia covers about six million hectares but there is potential to expand to 16 million hectares with the development of locally adapted cultivars.

Limitations of imported cultivars

Sensitivity to summer moisture stress is the major factor limiting persistence of white clover in dryland environments in NSW. Stolon survival through periods of soil moisture stress (rather than annual regeneration from seedling recruitment) is a pre-requisite of local adaptation because white clover is slow to recover full production from new seedlings.

Imported cultivars are vulnerable to seasonal drought (due to summer moisture stress) and severe episodic drought. The lack of year-to-year reliability of imported cultivars impacts negatively



on the level of clover content in the sward, the persistence of clover in pasture and grazing value.

For these reasons, a national breeding program, run by NSW DPI and based at Glen Innes, began in 1990. This subsequently evolved into an Australasian program through collaborative breeding with AgResearch Ltd. The aim has been to develop locally adapted white clover cultivars that have improved persistence and agronomic performance under the conditions of close grazing, grass competition and summer moisture stress that are characteristic of NSW dryland pastures.

Breeding for local adaptation

The central breeding objective of the national program is for genetic gain of stolon characteristics that improves vegetative regeneration and longevity, rather than breeding for the 'annual habit' of early maturity and seed set.

The breeding strategy employed by the national program is an *in situ* breeding cycle for:

- selecting superior genotypes
- crossing elite germ plasm
- progeny-testing derived breeding lines for the expression of the target traits early vigour, herbage yield, persistence and seed production capability.

The strategy is based on accessing, breeding and evaluation of medium to large leaf size and mid-season maturity germ plasm from Mediterranean environments, and develops breeding lines with tolerance of moisture stress combined with cool season growth potential.

'Trophy' white clover

The first white clover cultivar developed by this strategy is 'Trophy', which is medium to large in leaf size, combines medium stolon density with medium stolon thickness, and has high stolon survival and strong autumn regrowth following summer moisture stress.

Table 1. Plant characteristics of Trophy (compared with Haifa and Prestige)

	Haifa	Trophy	Prestige
Leaf size (mm ²)	200	188	103
Maturity (days)	51	54	54
Stolon size (mm)	2.6	2.4	1.8
Stolon density (No/m ²)	380	560	767

Herbage production and nutritive quality

Agronomic results from summer rainfall and winter rainfall sites show that Trophy has broad adaptation, high spring growth and high yield stability across summer and winter rainfall environments and is persistent for at least four years.

In northern NSW, Trophy has exceptional spring growth while summer and winter growth is comparable to the industry standard cultivar Haifa (see Table 2).

Table 2. Seasonal growth of Trophy at Armidale (compared with Haifa and Prestige)

	Haifa	Trophy	Prestige
Spring			
– kg DM/ha	464 b	854 a	721 a
– % of Haifa	100	184	155
Summer			
– kg DM/ha	176 a	226 a	43 b
– % of Haifa	100	129	24
Winter			
– kg DM/ha	244 a	231 a	106 b
– % of Haifa	100	94	43

Letters indicate significant difference ($P \leq 0.05$)

Trophy has high digestibility while vegetative and declines slightly in digestibility with the onset of maturity (Table 3). This is a general characteristic of white clover.

Trophy is moderately high in hydrogen cyanide (HCN), which potentially confers pest tolerance without limiting livestock performance. The level is comparable with contemporary New Zealand cultivars such as Prestige.

Figure 3. The characteristic stolon structure and leaf markings of Trophy white clover



Table 3. Nutritive value of Trophy (compared with Haifa and Prestige)

	Haifa	Trophy	Prestige
Digestibility			
– Vegetative	82.5	82.2	81.7
– Full flower	78.8	79.3	78.6
– Ripe seed	77.6	77.3	76.1
HCN	677	1219	1326

Digestibility: % of DM, dry matter

HCN: µg HCN/g DM

Adaptation

White clover is mainly used as a perennial legume in temperate environments for dryland grazing with sheep and cattle. However, irrigation may be used to maintain white clover in marginal environments or for intensive dairying applications. Adaptation and use in each of the major agro-geographic regions in NSW is described below.

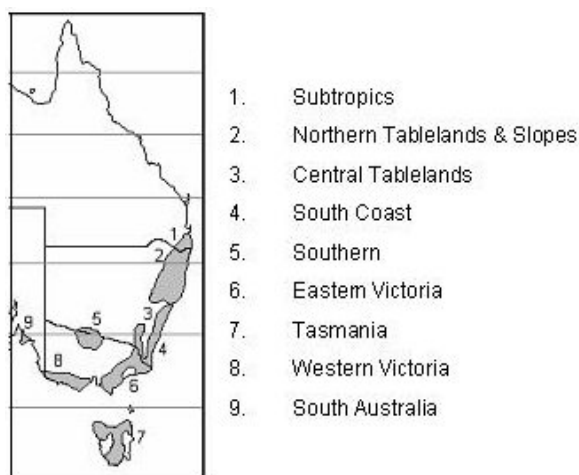
Northern Tablelands

The Northern Tablelands is a cool temperate highlands region where climate is characterised by high rainfall (775–1000 mm AAR) with marked summer incidence, a long frost interval and cold winter conditions. White clover is the legume base of perennial pastures in this region and has naturalised extensively through the 2.2 million hectares of farm area. The main requirement from new cultivars for this region is improved persistence through summer moisture stress.

North-West Slopes

The Northern Tablelands and North-West Slopes are adjoining but contrasting pasture environments. Whereas the Northern Tablelands is a high rainfall hilly landscape where low fertility acidic soils predominate, the North-West Slopes (3 million ha) receives lower rainfall (600–775 mm AAR) and is hotter and drier.

Figure 2. Agro-geographic regions of the white clover zone in eastern Australia



Central and Southern NSW

White clover on the Central Tablelands is currently restricted to areas above 700 m elevation where rainfall exceeds 700 mm AAR. White clover is an alternative to sub clover only where AAR > 800 mm.

For successful adaptation on the Central Tablelands (where there is less summer rainfall), white clover requires tolerance of soil moisture stress, competitiveness with grass, and persistence under close grazing. White clover is also used in southern NSW along the Murray and Murrumbidgee Rivers for prime lamb production – usually in monoculture (and under irrigation) for maximum production.

South Coast

White clover along the South Coast is primarily used in combination with kikuyu or perennial ryegrass for dairy pastures. In this high rainfall zone (> 1000 mm AAR), white clover performance is limited by poor competitive ability with rhizomatous grasses such as kikuyu. Better persistence of white clover in this environment requires cultivars with increased tolerance of competition from stoloniferous grasses and the ability to regenerate quickly after periods of moisture stress.

Subtropical North Coast

White clover has a significant presence on approximately 250,000 hectares of dryland pastures in the subtropical region and contributes importantly to dairy and beef cattle production. This region is characterised by high rainfall (> 1000 mm AAR), high temperature and low soil fertility. Adaptation of white clover to this subtropical environment requires tolerance of heat and humidity and the ability to compete with summer-growing grasses.

Establishment and management

An extensive knowledge base of white clover technology from research and practice provides evidence that pasture improvement based on white clover and introduced companion grasses is an effective and profitable means of increasing grazing production. The use of white clover and topdressing with phosphate fertiliser is a stable and productive land use system for improved sheep and cattle production.

Success with pasture improvement rests on the choice of a locally adapted white clover cultivar and compatible companion grasses, suitable cultural practices for successful establishment and the implementation of sound management for the long-term persistence of the component species.

Sowing

White clover can be used to develop legume-based pastures either in a 'replacement pasture' or in 'existing pasture'. (White clover may also be used in 'monoculture' provided that care is taken to safeguard against bloat.)

For replacement pasture, cultural practices should be directed at achieving a weed-free seedbed, and planting to a shallow depth (< 1 cm) with a seeding rate of 1–3 kg clover seed per hectare, depending on clover content sought in the resultant sward.

For establishing white clover into an existing sward, clover seed (inoculated and lime-coated) can be surface broadcast following lead-in practices (grazing, slashing or herbicide) that reduce vegetation cover and foster soil-seed contact for rapid germination.

A desirable practice for maintaining consistently high year-to-year clover presence is to include a low rate of clover seed (1 kg per hectare) with the annual phosphorus topdressing.

Inoculum

White clover requires inoculating with the correct strain of *Rhizobium* bacteria (Group B) immediately prior to planting. The seed should be lime-coated especially where the soil is acidic or where seed is surface broadcast using granular fertiliser as the carrier.

Fertiliser

Fertiliser requirements vary according to soil type, previous fertiliser history and soil phosphate status.

In general, white clover has a relatively high requirement for phosphorus and sulfur that can be met through fertilising with superphosphate. On certain soils, clover may also be responsive to the trace elements molybdenum, boron, zinc or copper. The appropriate fertiliser program is best determined by expert interpretation of a soil test.

Grazing

Pastures based on white clover tolerate close grazing and generally do not have specialised grazing management requirements. However, benefits to the presence and persistence of white clover may accrue from strategic grazing practices.

- Light grazing during early establishment will avoid dislodgement of seedlings.
- Close grazing favours clover dominance, while lax grazing promotes grass dominance.
- Lax grazing in early summer (that retains sward cover) enhances stolon survival over summer for rapid autumn regrowth.

- Where an old clover stand becomes sparse, a spell from grazing over summer (so that the companion grass shades out remnant clover plants) stimulates stolon extension rather than stolon branching for rejuvenation of the clover stand.

Pests and diseases

A range of pathogens, viruses, mites, aphids, nematodes and other insects may predate on white clover but damage levels rarely warrant treatment.

Acknowledgements

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Seed is released by PGG Wrightson Seeds.

Warnings

Pasture improvement may be associated with an increase in the incidence of certain livestock health disorders. Livestock and production losses from some disorders are possible. Cattle grazing pastures with high levels of white clover (early spring and prior to the onset of flowering) may be susceptible to bloat. Management may need to be modified to minimise risk. Consult your veterinarian or advisor when planning pasture improvement.

Legislation covering conservation of native vegetation may regulate some pasture improvement practices where existing pasture contains native species. Inquire through your office of the Department of Natural Resources for further information.

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