A review of arrowleaf clover performance on the North-West Slopes of NSW

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Abstract: *Arrowleaf clover (*Trifolium vesiculosum*) is grown in pasture mixtures on the North–West Slopes of NSW because of its ability to produce large quantities of high-quality feed and at the same time extend the legume growing season well into spring and summer. Its ability to provide high quality feed every year is limited by its hard seed content of ~80% and its break down. There is also a question about its annual regeneration, whether it is totally the hard seed content limiting yearly regeneration or if there is a dormancy factor adding to the issue, and grazing management has a strong influence on hard seed break down and annual regeneration. Good germinations of arrowleaf clover usually follow an extended dry season followed by good autumn and winter rainfall and in mixed pastures arrowleaf clover can swamp and dominate tropical perennial grass stands. This paper will further explore the introduction of arrowleaf clover, the current varieties and management options to achieve more consistent production.*

Key words: hardseededness, nitrogen fixation, condensed tannins, kilograms of dry matter per hectare (kg DM/ha)

Introduction

Arrowleaf clover was included in pasture trials in NSW as early as the 1960's, but early cultivars were poor winter–spring performers so other legumes gained attention such as subterranean clover (*Trifolium subterraneum* spp. *subterraneum* and *brachycalycinum*). Research by the Department of Agriculture, Western Australia, to find a legume to manage perched water tables, saw a renewed interest in arrowleaf clover. The mid-1980s saw a renewed interest in arrowleaf clover in NSW and it was formally included in forage legume trials in 1993 (Thompson 2005).

Arrowleaf clover has been used on the North-West Slopes of NSW since the mid-1990's. The main cultivar used was Zulu. Arrowleaf clover has always been viewed as a fair-weather friend and only in wet winters and springs following a dry period has it contributed greatly to feed supply.

This species has a wide range of adaptation in Europe and western Asia. It is native to the Mediterranean region, the Balkan Peninsula, the Ukraine, the western Caucasus, Crimea and southern Russia. Recent information paints an interesting picture on its elusive behaviour, whether it is the hardseededness or if are there dormancy factors involved (Smith *et al.* 2026).

Pasture varieties and classifications

Arrowleaf clover varieties are classified by maturity, based on days to flowering, as being either early, late or very late maturing (Table 1), following the information provided at https://www.dpird.nsw.gov.au/agriculture/pastures-and-rangelands/species-varieties/pf/factsheets/arrowleaf-clover-399 (accessed July 2026). Days to flowering, based on work conducted at the Tamworth Agricultural Institute, were 140 days for Cefalu and 146 days for Zulu.

Table 1. Arrowleaf clover maturity classifications based on days to flowering.

Maturity	Cultivar
Early maturing	Cefalu (*140 days at Tamworth*) Zulumax
Late maturing	Zulu (*146 days at Tamworth*) Seelu Zulu II
Very late maturing	Arrotas

Pasture productivity and quality indicators

Arrowleaf clover can continue growing into late spring and even early summer giving it a significant dry matter production advantage over subterranean clover. This advantage is also carried

forward in feed quality. Crude protein in arrowleaf clover can exceed 30% during the vegetative stage of growth (Thompson 2005). Depending on late spring-early summer rainfall, arrowleaf clover can provide an extra 4 to 12 weeks of high-quality dry matter. Arrowleaf clover has been observed growing in mid-January during a wet summer.

In earlier trials as part of the NAPLIP program, arrowleaf clover when grown as a monoculture achieved 13,397 kg DM/ha at Tamworth (Table 2) and, on a site with 20% aluminium saturation at Turrawan, 3,568 kg DM/ha was produced (Table 3) (Crocker and Sanson 2004, 2005). On the North–West Slopes, in good seasons arrowleaf clover has exceeded 14 t DM/ha (Table 4) (SP Boschma and M Brennan, pers. comm.).

Management practices and innovations

Establishing pastures containing arrowleaf clover

As with the sowing of any pasture, it is critical that there has been at least two and preferably three years of total weed control prior to sowing of a new pasture. Weed incursion remains the main cause of pasture establishment failure. Generally, when sowing arrowleaf clover, you will be buying seed that has been scarified to achieve more than 90% germination. If sowing a standalone pasture (monoculture), rates of 7–10 kg/ha are suggested. If it is a component of a mixture, then rates of 2–5 kg/ha are suggested depending on other components in the mixture. Scarified seed is best sown in mid to late autumn after the danger of a false break has passed. It is also important to ensure that a viable source of Group C inoculum is used to optimise opportunity for nodulation and nitrogen fixation.

An alternative mechanism for the establishment of arrowleaf clover-based pastures is the use of unscarified seed. Arrowleaf clover can be harvested on farm using a conventional header and some farmers grow small nursery areas to harvest their own seed where yields of 300–800 kg seed/ha can be obtained. Seed harvested in this way retains high levels of hard seed and, rather than sending seed for scarification, the seed can be sown well ahead of anticipated germination (i.e. in

Table 2. Herbage yields (kg DM/ha) from legume evaluation trials at the Tamworth Agricultural Institute (TAI), Calala NSW in 2003 and 2004 where soil pH_{Ca} 6.0

Cultivar	2003			2004		
Cefalu	8618			13937		
Zulu	8963			13045		
Cool season rainfall*	A	W	S	A	W	S
	126.2	152.4	191.0	69.0	104.2	184.8

*Note: cool season rainfall autumn (A), winter (W) and spring (S)

Table 3: Herbage yields (kg DM/ha) from legume evaluation trials at Turrawan, NSW over three years where soil pH_{Ca} 4.3

Cultivar	2003			2004			2005		
Cefalu	3568			2815			1540		
Zulu	3467			1915			875		
Cool season rainfall*	A	W	S	A	W	S	A	W	S
	137.0	167.0	104.7	99.0	83.4	214.6	30.0	226.6	242.4

*Note: cool season rainfall autumn (A), winter (W) and spring (S)

Table 4. Herbage yields (kg DM/ha) for Cefalu arrowleaf clover grown at the Tamworth Agricultural Institute (TAI), Calala NSW and total rainfall (mm) for each period.

Winter 2016	Summer 2016/17	Winter 2017	Summer 2017/18	Winter 2018	Summer 2018/19	Winter 2019
14455	1519	11174	0	511	0	3407
280.8	240.6	89.0	100.0	49.8	95.2	37.6

summer) with variation in temperature and moisture breaking sown a percentage of the hard seed so that it can germinate on opening autumn rain. Seeding rates using unscarified seed need to be higher (10–15 kg/ha) but the cost of seed is significantly lower than purchased seed. It should also be remembered that arrowleaf clover has a deep and rapidly forming root system achieving a depth of 1.3 m compared to 90 cm for subterranean clover and annual medics and therefore is more tolerant of autumn and spring moisture stress (Hackney *et. al.* 2023).

Grazing management

Regeneration in the second year is usually poor, because the seed is held tightly in the seedhead and does not readily shed. However, if the trash is removed by heavy grazing before the break of the season, then germination should be better despite 80% hard seed, provided there is good seed set in the first year (Wiley *et al.* 1994). This heavy grazing ensures the seed comes in contact with the soil. Temperature and moisture variation once the seed is in contact with the soil drives hard seed breakdown.

Anecdotal reports indicate cattle do not voluntarily consume arrowleaf clover until flowering. In trials at Manilla NSW, it was observed sheep would heavily graze other clovers but would only trim arrowleaf clover plots before flowering and I concluded it was because of a compound that appears to be like condensed tannins (Campbell 2008). Plants containing condensed tannins benefit the general health of grazing animals in many ways, including bloat prevention and parasite infection (Kiwi Seed Co. 2024). Arrowleaf clover seed is much smaller than subterranean clover seed and, as with other small-seeded species, this means a high proportion can survive ingestion by grazing ruminants (Wiley *et al.* 1993; Norman *et al.* 2026). This mechanism can be a useful means to spread seed and establish arrowleaf clover across the farm. However, care needs to be taken to ensure that seed has fully formed prior to attempting to spread seed in this way.

Future research directions

Legumes have always been important in pasture systems for nitrogen, but looking into the future their role will increase as producers struggle with increased nitrogen supply issues and prices. In our pasture systems, if we back off on nitrogen and the carbon to nitrogen ratio falls below 10 to 1, then the soil biological system ceases to function (M Peoples, pers. comm.).

It is hard to recommend future research directions when so much of our pasture research is being wound back, but clearly with a dynamic legume such as arrowleaf clover, research could investigate the strategic integration of arrowleaf clover with tropical grasses using the twin sowing method of including unscarified arrowleaf clover seed and granular inoculant with a late spring early summer sowing of tropical grasses.

Conclusions

Arrowleaf clover remains a viable pasture legume for inclusion in pasture mixes on the North–West Slopes of NSW. It extends the growing season by 4 to 12 weeks over the more traditional clovers and provides a large quantity of high-quality herbage in grazing systems.

Management must consider different options to improve reliability and grazing management that also protects the tropical grass function that is now so important on the North–West Slopes of NSW.

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