

## Arrowleaf clover

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### MAJOR ATTRIBUTES

- Late maturity – extends grazing period into summer.
- Deep rooting ability – exploits deep subsoil moisture.
- High dry matter yield.
- Suppression of summer weed species.
- High proportion of hard seed for persistence.
- Seed production – simple and economic.

### INTRODUCTION

Arrowleaf clover, *Trifolium vesiculosum*, is a temperate annual legume with semi-winter-dormant growth habit. Growth is most active in spring and early summer. Arrowleaf clover is recommended as a mix component with sub clovers or annual medics, rather than as a pure sward.

This species has a wide range in Europe and western Asia. It is native to Italy, Greece, Turkey, the Balkan Peninsula, the Ukraine, the western Caucasus and southern Russia.

Arrowleaf clover was included in NSW pasture evaluation trials in the early 1960's but the varieties tested lacked strong autumn-winter



growth and were very late maturing. They were discarded and the research focused on annual medics, sub clovers and lucerne.

In the mid 1980's Agriculture Western Australia began to research annual legumes for pasture land with underlying perched water tables. The interest in arrowleaf clover arose from this work and the first significant broadacre plantings of arrowleaf took place around Esperance in 1988.

In 1993, arrowleaf was included in a forage legume trial series across southern NSW. Arrowleaf clover was considered inferior to the Persian and Berseem clovers for hay or silage due to its winter-dormant habit and its thicker stems significantly increasing the dry down period for hay. However, growth from October to January made this cultivar a useful addition to pasture stands in the central west areas of NSW.

The new role for arrowleaf clover in a sub clover or medic pasture is to produce a bulk of high quality feed from moisture which is beyond the rooting depth of sub clovers, or from rain falling after the sub clovers have senesced.

Arrowleaf clover extended the grazing phase beyond that of traditional sub clover pastures by some 4 to 8 weeks into summer. This extended growth into summer provides high quality grazing and suppresses growth of summer weeds (e.g. Bathurst burr, melons and heliotrope).

Arrowleaf clover has proved useful for farmers in the western wheatbelt of NSW, who wean lambs in October-November and do not have access to lucerne to provide a fresh green pick. Between 1999 and 2001, some 60,000 ha of sub clover pasture in the Central West of NSW incorporated arrowleaf clover.

In northern NSW arrowleaf is successfully utilised as a companion legume with native and naturalised summer grass pastures. This is also how arrowleaf is utilised in the USA.

Very few annual legumes can persist in the northwestern grasslands of NSW. The persistence of arrowleaf clover in these grasslands is based on its ability to grow tall, its deep taproot, high seed set and high level of hard seed.

## ADAPTATION

Arrowleaf clovers are suited to temperate districts receiving at least 350 mm of annual rainfall, with a minimum of 200 mm falling between May and November. For arrowleaf clover to be a productive component of a pasture it requires a plentiful

supply of moisture in late spring. So there must be useful storm rains from October to mid January or alternately moisture stored in the sub soil.

Arrowleaf clovers have grown best on loamy soils but they are adapted to sands, red-brown earths, red clays and grey clays. As clay content increases growth may be retarded to varying degrees. Preferred soil pH ( $\text{CaCl}_2$ ) range is from 4.5 to 6.5. A pH ( $\text{CaCl}_2$ ) greater than 7.5 may impede growth.

Heavy clay soils that are frequently inundated and remain waterlogged for prolonged periods are not suitable for arrowleaf clover.

Arrowleaf clover is predominantly a hard seeded species like rose clovers and serradellas, consequently regeneration in the second year may be low if the pasture is not grazed after the sward 'hays-off'. Consumption of the mature seed heads by livestock often improves sward regeneration in subsequent years.

## DESCRIPTION

Arrowleaf clover is an erect growing, temperate annual legume, commonly reaching one metre in height. It is semi-winter dormant, with most active growth occurring in spring and early summer.

Arrowleaf clover has a strong stem which is not prone to lodging. Its leaves are large, with distinctly arrow-shaped white markings in the middle of the mid rib (see Figure 2). The leaves contain a significant quantity of tannin which gives them a bitter taste. Sheep will frequently graze out weed seedlings before eating the arrowleaf. Insect pests also prefer to feed upon weed species. The tannin in the leaf may also reduce the incidence of bloating.

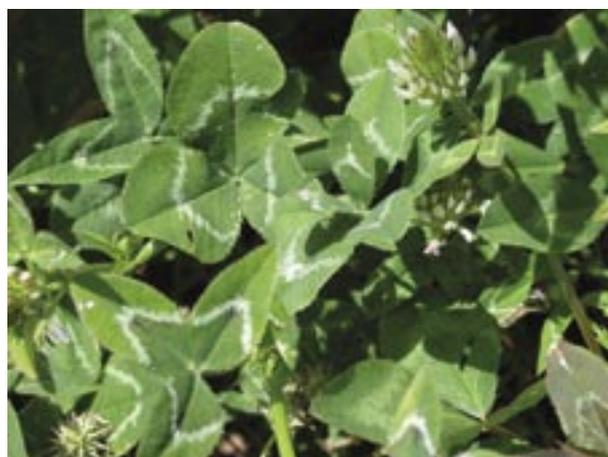


Figure 2. Typical leaf markings of arrowleaf clover

The flower heads are large with many florets being formed on a single stalk. These heads can be up to 10 cm long and 3 cm across. The less mature florets at the top of the head are white, while the more mature florets at the base take on a pink colouring.

Arrowleaf clover seed is brown in colour, slightly larger than balansa clover seed. There are approximately 800,000 seeds per kilogram. It has a high rate of hard seed (> 80%). After cleaning the hard seed level may range from 20% to 90%. A high level of hard seed is desirable for long term persistence but it can reduce short term regeneration.

Arrowleaf clover has a deep, vigorous taproot. This gives the species the ability to exploit moisture stored in the subsoil or water table and thus extends the growing season. On a freely drained, deep gravel soil arrowleaf clover roots have extended beyond 1.5 m. The actual maximum root depth is yet to be established.

## VARIETIES

**Zulu:** Zulu was developed in South Africa, where it out performed the three cultivars developed in the USA. Zulu has a vernalisation or cold requirement and usually flowers after 151 days in a glasshouse, but it is commonly 200 days in the field. Zulu usually flowers from mid November. Plants growing from a spring germination of seed may not flower for 12 months or longer. The plant commonly grows from 70 cm to 80 cm tall; individual plants can exceed one metre in height. Zulu is a public variety and farmers are able to sell seed to other farmers.

**Seelu:** This variety was selected from Zulu by the South Australian Seed Cooperative in 1991. Seelu matured about 2 days earlier than Zulu in glasshouse trials in Perth. Seed lots are uncommon. Seelu is a public variety.

**Cefalu:** It was a single plant selected from a commercial Seelu seed lot by Western Australian Department of Agriculture in 1997. Plants are usually only 50 cm to 60 cm tall and much finer than Zulu. Cefalu matures 20 to 30 days earlier than Zulu. Cefalu tends to senesce by mid November, about four weeks after Dalkeith sub clover and does not continue to grow-on like Zulu in a wet summer. Cefalu is protected by Plant Breeders Rights for Seed Grain and Biotechnology Australia. Farmers can only produce seed for use on their own farm.

**Arrotas:** This variety was bred from an Italian accession by the Tasmanian Department of Primary Industries and Fisheries and registered in late

1996. Arrotas matures 30 days later than Zulu in glasshouse trials. It has a slightly thicker stem than Zulu and is up to 20 cm taller than Zulu in glasshouse evaluation. Arrotas has smaller leaves than Zulu. Arrotas is protected by Plant Breeders Rights for Tas Global Seeds. Farmers can only produce seed for use on their own farm.

## ESTABLISHMENT AND MANAGEMENT

### Sowing

Arrowleaf clover cannot be successfully grown with a cereal cover crop. In most years the spring growth of the arrowleaf will impede the harvesting of the cereal crop.

Arrowleaf is best established by one of three methods – as an elite sward, drilled into existing pasture when that pasture is dormant, or broadcast onto a cover cropped pasture post-harvest and having the seed walked into the soil by sheep as they scavenge for spilt cereal grain.

Elite swards are sown from early April to late June into a well prepared seedbed. Use trifluralin to control wireweed, fumitory, annual grass weeds and volunteer cereals. Arrowleaf is sown with sub clovers or medics. Sow 1 kg/ha of scarified arrowleaf clover seed with 5 kg/ha of sub clover or medic seed into a moist soil with a fine tilth to a depth of no more than 1 cm.

Inoculate arrowleaf seed with rhizobia group C inoculum. Drill at least 10 kg/ha of phosphorus when sowing any clover pasture. In some districts additional sulphur may also be required.

Existing sub clover pastures are usually renovated by direct drilling with arrowleaf, but it is necessary to increase the seeding rate to 2 kg/ha. In southern tablelands and districts with rainfall exceeding 700 mm, arrowleaf clover has been successfully established from aerial seeding.

### Grazing

Grazing may commence when the clover plants are securely anchored. This usually occurs about six weeks after emergence.

Newly sown paddocks should be destocked from the onset of flowering to maximise seed set. Stock may be reintroduced 6 to 8 weeks later, once the seed is well developed, at half the normal stocking rate. Once the pasture has dried off, increase the stocking rate to consume the seed heads and to remove as much residue as practical.

Observations suggest that a reasonable proportion (>80%) of the seed consumed by sheep will pass through the gut undamaged and is therefore capable of germinating.

Second year pastures should be grazed normally at standard stocking rates. Avoid crash grazing with high stocking rates particularly when the arrowleaf clover is running up to flower as it can reduce productivity over summer as seen in figures 4 and 5. These plots were harvested using a lawn mower which simulates crash grazing. The unmown Zulu plants outside the plots continued to grow through to late December.

## NUTRITIONAL QUALITY AND ANIMAL PRODUCTION

Arrowleaf clover produces abundant herbage which is high in protein (up to 30%), and remains highly digestible for a long time relative to other legumes as seen in Figure 3. This is due to its late maturity and deeper rooting habit and its ability to respond to later spring and summer rain.

Dry matter production from arrowleaf clover varies widely depending on variety (see Figure 4), soil type, available nutrients, prevailing warm conditions and early summer rains.

Sub clover pastures incorporating Zulu in the southwest wheatbelt (see Figure 5), have been capable of producing over 6,000 kg/ha of feed (dry wt.) in a typical year receiving 40 mm of rain per month. In comparison a typical sub clover pasture produced around 5,000 kg/ha. In this trial the arrowleaf fortified pasture plots trade off some early autumn growth but have additional forage in October and November. The Zulu outside the harvested plots produced approximately another 1,000 kg of feed/ha during December.

In the higher rainfall districts of the southern slopes forage yields have been reportedly as high as 9.0 t/ha in good seasons.

## Regeneration

Poor regeneration rates in the second year have been reported as a limiting factor for arrowleaf clover. Grazing should be managed to maximise seed set and regeneration in the following season.

The grazing strategy should aim to maximise seed set in new swards. Consumption of the seed heads by livestock aids subsequent germinations.

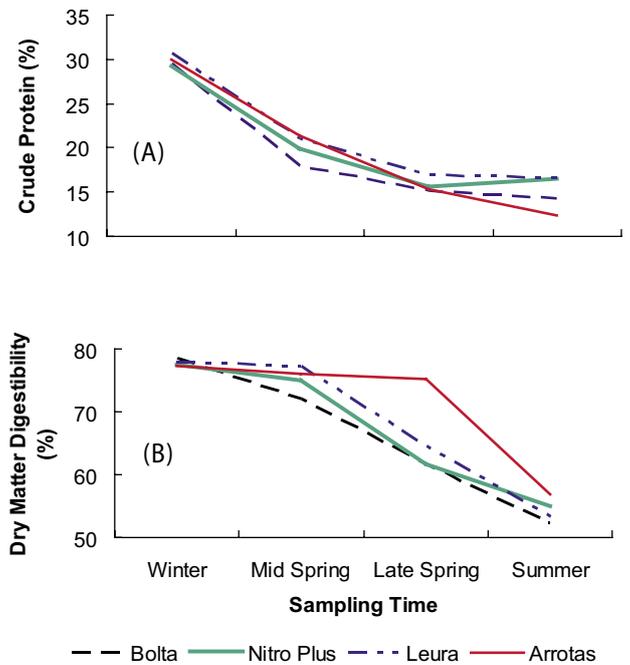


Figure 3. Percentage crude protein (A) and dry matter digestibility (B), of arrowleaf clover (cv. Arrotas), persian clover (cv. Nitro), balansa clover (cv. Bolta) and subterranean clover (cv. Leura) at 4 sampling times at Streatham, south western Victoria 'Extending pasture quality later into the season.' P.A Riffkin et al Proceedings of the Australian Agronomy Conference 2001.

It is worth noting that the drier the conditions are during seed set and seed fill the greater the hard seed percentage.

Some farmers have harvested small quantities of their own arrowleaf seed, they then scarify the seed and then broadcast it onto pastures in late summer to ensure satisfactory regeneration in the following autumn.

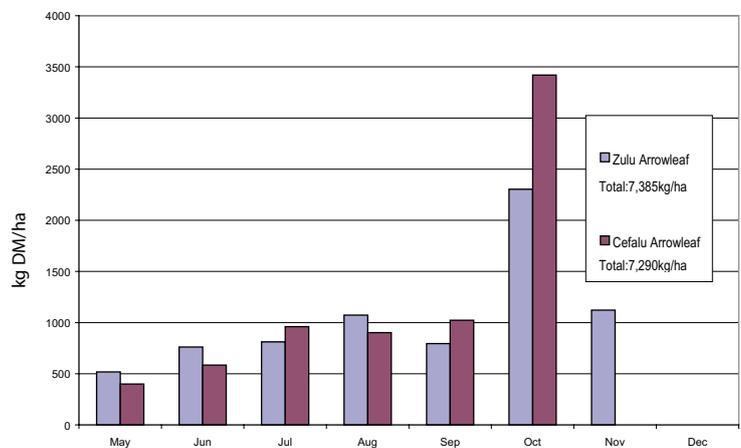


Figure 4. Zulu arrowleaf versus Cefalu arrowleaf, Racecourse Farm, West Wyalong 2001

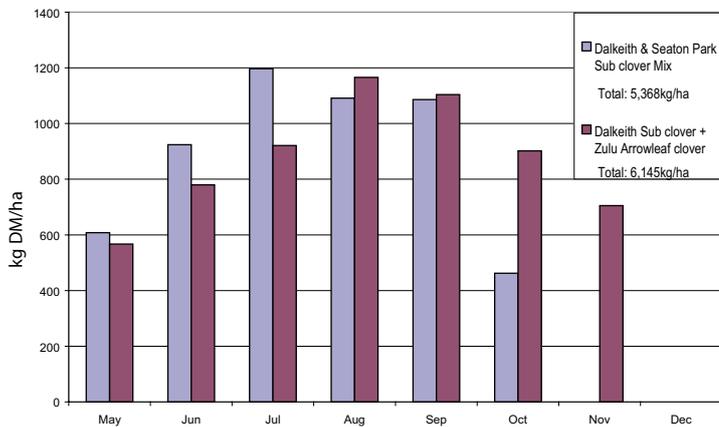


Figure 5. Subclover mix versus Subclover plus Zulu arrowleaf clover, Racecourse Farm, West Wyalong 2001

Red Leaf Virus has also been identified in arrowleaf plants in Western Australia.

## WEED CONTROL

Sub clover based pastures are commonly sprayed with MCPA 500 amine\* to control broadleaf weeds. Like most Trifolium species arrowleaf will tolerate MCPA amine.

Do not use herbicides or mixtures containing bromoxynil, terbutryn, diflufenican and 2,4-D amine as significant injury to the arrowleaf clover (dry matter reduced by 70% or greater) can be sustained.

## ANIMAL HEALTH

Arrowleaf is not sown as a pure sward by farmers, it is usually mixed with sub clovers or medics. Therefore it is prudent that farmers observe the usual management protocols for sub clover and medics to minimise livestock disorders like bloat, red gut, foot scald and clover/kidney stones.

While arrowleaf foliage contains tannins that reduce the incidence of bloat it would be unwise to depend on that potential in a mixed sward.

## INSECT PESTS

Red legged earthmites and lucerne flea can cause significant injury to seedling plants, although once arrowleaf clover is well established it appears to have reasonable tolerance or lack of appeal to these pests because of the tannins contained in its leaves.

Bluegreen aphids have been found in arrowleaf clover in Western Australia but have only caused minor damage. In the USA cowpea aphid, pea aphid, potato aphid and the green peach aphid have been found feeding on the flowers of arrowleaf clover.

## DISEASES

Arrowleaf appears to be resistant to clover scorch disease, but may be susceptible to Phytophthora root rot under waterlogged conditions.

Bean Yellow Mosaic Virus is a significant disease that affects most legume species and arrowleaf is no exception. USA reports have also noted Pepper spot and powdery mildew but their instance is uncommon. Cercospora leaf spot has also been suspected in the USA.

\*In NSW only Generex MCPA 500® and AH Marks Agroxone MCPA 500® are registered for use in sub clover pastures.

## SEED POTENTIAL

This species lends itself well to seed production, particularly where seed is required for use on the same property. Surplus seed of the public variety Zulu may be sold to other farmers, but all other varieties are protected by Plant Breeders Rights in Australia.

Areas intended for seed production should be closed up in spring. Arrowleaf can be readily harvested with an open fronted header. The stand should be harvested as soon as the majority of the seed is mature. Some seed may shed if harvesting is delayed. Seed yields have ranged from 200 kg/ha to 400 kg/ha from pasture stands in NSW but specialist seed producers in South Australia have recorded consistent seed yields of 1,000 kg/ha. The highest seed yield recorded to date was 1,400 kg/ha of seed on a farm to the north of Perth.

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## 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. Management may need to be modified to minimise risk. Consult your veterinarian or adviser 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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