Medics return to favour

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Medics return to favour

Background
Annual medics originated in the Mediterranean region (Heyn 1963). The spiny burrs of many species of annual medic have helped disperse them widely from their centres of origin. Western Australia is one of the many parts of the world where a number of accidentally introduced medic species have become naturalised. It is likely that these arrived early in the agricultural development of the State. They most likely came here from western Europe and the western Mediterranean. The most common naturalised species in Western Australia are burr medic (Medicago polymorpha), Goldfields medic (M. minima) and cut leaf medic (M. laciniata). Other species that have been recorded but are not widespread are M. praecox, M. arabica, M. intertexta and M. orbicularis.

In their natural Mediterranean environment annual medics grow over a wide range of soils, temperature regimes and growing season.

They are found most commonly on alkaline soils but some species are found on mildly acid soils. In Western Australia our soils of light surface texture are generally acid and our heavy soils neutral to alkaline. In the Mediterranean region this is not a general link. Light alkaline soils are common, and medics are spread widely on these soils. Some medic species such as M. truncatula occur more commonly on the more
fertile soils while others are common on less fertile soils. An example is *M. littoralis* which is common on sandy sea shore areas. Other species, particularly *M. polymorpha* are widespread, growing in association with *M. truncatula* on heavy alkaline soils and with species such as *M. arabica*, *M. turbinata* and *M. murex* on infertile and acid soils. (Francis and Gillespie 1977).

The range within species is also great. Flowering times for Mediterranean ecotypes of *M. truncatula* range from 66 to 136 days after sowing, and there is a strong relationship between time from germination to flowering and length of growing season at the sites the material was collected. (Cocks, Mathison and Crawford 1980)

Whereas sub. clovers are rarely found in their natural environment in areas with less than 450 mm annual average rainfall, medics are common in areas with rainfall as low as 100 mm annual average. One species, *M. lacinia* grows in North Africa on sandy soils with rainfall down to 50 mm annual average.

**Commercial Australian medics**

A high proportion of most commercial medic cultivars (varieties) result from direct introductions of material from overseas or by breeding from introduced material. Relatively few of the successful cultivars are Australian ecotypes, or bred from Australian ecotypes. This contrasts with the situation for sub. clovers where most varieties are locally collected ecotypes or have been bred from local ecotypes. Important exceptions amongst medics are Jemalong, Hannaford and, more recently, Circle Valley. The imported material which has been used directly as varieties such as Cyprus and Harbinger, or as parent material for crosses such as Tornafield and Serena comes from geographically diverse sources. (Table 1).

**Commercial varieties in Western Australia**

**Cyprus barrel medic (M. truncatula)**

‘Cyprus’ was collected in 1951 in Cyprus and tested first in South Australia. It was released in Western Australia in 1959 following testing here. Cyprus is now sown widely on the alkaline soils of the wheatbelt where its early maturity... flowering about 80 days after sowing...has fitted well with the short growing season and relatively low and unreliable spring rainfall.

The heavier soil types on which Cyprus has been sown are cropped frequently. Cyprus has demonstrated its ability to regenerate well after crops in intensive rotations, even when seed production has been poor during pasture years because of drought.

**Harbinger strand medic (M. littoralis)**

Harbinger medic was introduced into Western Australia in 1960 and now occupies a distinct niche in the pasture legume field. Experience has shown that although Harbinger grew on the heavier wheatbelt soils it did not outperform Cyprus. However, on the yellow sandplain north and east of Geraldton it has been highly successful. These soils, which carry native pine, grevillea and mallee before clearing are neutral in pH reaction. Another situation in which it has succeeded is on the sand-over-clay mallee soils near Salmon Gums. Again this soil has pH values which are near neutral at the surface, but it becomes alkaline with depth.

**Tornafield (M. tornata)**

Tornafield is the result of a crossing programme conducted at the Western Australian University Institute of Agriculture. It was released to farmers in 1970. It has been tried widely throughout wheatbelt areas but has not shown enough advantage over other species to encourage large-scale plantings. It grows best on the same soils as Harbinger but appears to have some advantage over other species on the better, mildly acid wheatbelt sands and sand-over-clay soils. Stands of fluctuating legume dominance have persisted in the Lakes District of the south eastern wheatbelt.
Serena and Circle Valley (M. polymorpha)

Circle Valley is a naturalised collection from near Coolgardie. It was crossed with an early-maturing Chilean introduction at the University of Western Australia to produce Serena. Both are M. polymorpha var. breuispinia, the subspecies of M. polymorpha with reduced or no spines on the burr. Serena is extremely early maturing... up to a fortnight earlier than Cyprus... while Circle Valley is later than Cyprus by a fortnight or more.

Neither species has as yet been sown widely but experimental results indicate a wider range of soil type adaptation than Cyprus. Results of trials on transitional soils in the wheatbelt between the heavy, valley-bottom soils and the deep sands have been promising.

Both species have a specific rhizobial (root bacteria) requirement. The current commercial strain U45 is ineffective but good results have been obtained with the strain NA2290.

Current interest in medics

Today there is strong interest in medics in several areas. In the wheatbelt, especially the drier parts, medics, mainly Cyprus, have survived and are regenerating after crops, even following the series of dry seasons we have experienced, and the intensification of cropping rotations. Under the same set of circumstances, sub. clovers have almost disappeared from most low rainfall wheatbelt pastures on light acid soils. A number of factors contribute to the better performance of medics compared to sub. clovers in these situations.

Hard seed

Whether annual plants persist in the Mediterranean environment is dependent both on the level of seed production and the efficiency of its subsequent germinations. Both medics and sub. clovers produce a proportion of seeds that do not germinate in the year following their production. These seeds are known as hard seeds, and become capable of germinating over time as a result of being subject to widely fluctuating temperatures on or in the soil during summer (Quinlivan 1961).

The hardest seeded commercial sub. clover cultivar is Nungarin. Very little seed of Nungarin remains unsieved after three summers of exposure in the Perth environment, while softening has been even more rapid inland at Merredin. Although within-and-between species variation occurs, the rate of softening among medics is generally much slower than of sub. clovers, so that after three summers, a substantial reserve of seed of the medics remained ungerminated. (Quinlivan unpublished data). This experimental observation is borne out in the field where Cyprus, grown in a three years pasture: three years crop rotation at both

Merredin and Salmon Gums, can leave adequate seed reserves to produce a legume-dominant pasture when returned to the pasture phase after three years of cropping, with no seed set. (Rowland—pers. comm). In this respect then, medics are better adapted than sub. clovers to a heavy cropping, low rainfall environment.

Drought tolerance

Medics have been shown to be deeper rooted than sub. clover on sandy soils (Ozanne, Asher and Kirton 1965). This may be an explanation for the medics' ability to set seed under adverse moisture conditions so common in spring in low rainfall areas. It also has been demonstrated that time from flowering to pod maturity is reduced by moisture stress in medics. (Clarkson and Russell, 1976).

Another contrasting situation between sub. clovers and medics is the site of seed production. Medics produce their seed above the ground, while sub. clovers, as their name implies, need to bury their seed for efficient seed production. If seed burial is not possible, or is impaired by a hard soil surface layer, then seed yield and quality can be reduced drastically (Collins, Francis and Quinlivan, 1976). Many wheatbelt soils form a hard surface layer as they dry out, and the conditions which will impair seed burial occur often in this environment.

![First year medic after three years of crop.](image)
Can medicos replace subterranean clovers?

Medics have some distinct ecological advantages over sub. clover for growing in drier areas, or where a high proportion of an area is cropped. However, medicos favour alkaline soils while by far the largest portion of the land surface is acid. Minor incursions have been made into mildly acid areas using the varieties Hartinger and Tornafield. Overseas collection data indicate that some medic species are more common on acid and sandy soils. A preliminary review of a narrow range of material has shown good seed yield potential for medicos on mildly acid soils when compared to subterranean clovers (Table 2).

At these sites all species are inoculated and lime pelleted when sown and all nodulated well in the first year. In the second and subsequent years, medic nodulation has been patchy and poor while sub. clovers have nodulated adequately. This indicates that the plant may be capable of growing under mildly acid conditions but is limited by the survival of the symbiotic Rhizobium bacteria. This is in line with the observations of Robson and Loneragan (1970) that "R. meliloti have poor ability to colonise acid soils and that this property is a major factor limiting the growth and persistence of an annual Medicago species on acid soils in the field." They did observe that there were differences in rhizobial strain performance under acid soil conditions.

A programme now under way in Western Australia is exploring the performance of a range of rhizobial strains under acid conditions, hopefully to find a strain with markedly superior performance. This, combined with species of medic tolerant to soil acidity may greatly expand the soil type range over which medicos can persist.

Medicago murex

Medicago murex is a species which research workers have only recently started to evaluate. It has promise as a species for medium and high rainfall areas. The first interest in the species followed a collection trip to Sardinia in 1977 (Francis and Gillespie, 1977). It was found growing in heavily grazed areas over a wide range of soils but was particularly prominent on acid soils with pH levels as low as 5.5. Preliminary evaluation of about 80 lines from this collection has started and 60 additional lines from the national medic collection held by the South Australian Department of Agriculture will start in 1983.

Evaluation of the species so far has been limited but the results have been most encouraging. Winter production has been good. It forms a dense semi-prostrate sward, and recovers well from intensive grazing. Seed production has been excellent compared to existing commercial medicos and to sub. clovers.

There is a range of pod types within the species, many pods having either no spines (c.v. inermis) or short innocuous spines which would cause little or no fleece contamination. Lines with these pod types will be selected where possible.

Hard seed data has been collected for all lines sown in rows in 1981. In common with most medicos, M. murex has proved to have much harder seed than commercial sub. clover cultivars. This high hard seed characteristic will be beneficial where cropping is commonly part of the farming system. However, in mild summer, continuous pasture areas, the high hard seed content may result in poor stands in the year after new sowings of M. murex. In 1982, regeneration at Augusta from 1981 sowings has shown this to be a real problem. The softest seed line was the only one to give reasonable plant density in the second year.

Further testing over a wider range of environments and soil types will give a clearer picture of the areas to which this promising species is suited. Limited testing at Katanning and Merredin has indicated the species may be suited better to drier areas than would be expected on the basis of its flowering date.

As with M. polymorpha the commercial strain of rhizobia, U45, is ineffective. Rhizobia have been collected from the roots of M. murex growing in Sardinia and these, when made into a culture, have provided effective nodulation in field experiments. These are the same strains that are under test for improved ability to grow under acid soil conditions.

References


