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New yellow serradella varieties for low rainfall pastures

By Clinton Revell, Pasture Research Officer, Dryland Research Institute, Merredin

Large areas of acidic, sandy soils in Western Australia’s low and medium rainfall, wheat-sheep areas are suited to the pasture legume, yellow serradella.

In the past, a lack of varieties with suitable maturity has limited the use of this species.

New varieties developed in Western Australia and significantly earlier in maturity than traditional types can now extend the use of yellow serradella into these regions.

About serradella

Yellow serradella (*Ornithopus compressus*) is an annual pasture legume that is well-adapted to acidic, infertile soils. Its deep root system allows it to persist on deep, sandy soils where subterranean clover frequently fails because it cannot exploit subsoil water and nutrient reserves.
Entire recommendations can now be made for low rainfall wheatbelt areas. For most general pasture situations, an equal mixture of Paros and Madeira is preferred. Exceptions are for the eastern margins with less than 325 mm annual rainfall, and for very acidic soils, when Paros should be the dominant variety.

A knowledge of soil pH, both at the surface and at depth (15 to 20 cm), will be useful in determining which varieties should be used. In the eastern wheatbelt, the aluminium status of the subsoil of yellow sandplain soils and its likely effect on plant production can also be assessed, using the Department of Agriculture's recently developed Aluminium Quick Test.

Given that establishment of serradella is an expensive operation, the risk of failure must be minimised. For seed production, concentrate on the best soil types available and on pre-seeding weed control. The best lupin growing soils should be targeted in the first instance, to produce as much seed as possible. Weeds can be controlled by establishing the serradella after one or more cereal crops together with a pre-sowing knockdown herbicide.

Establishment following a lupin:wheat or lupin:wheat:wheat rotation also eliminates the need for inoculation. Once larger quantities of seed are obtained, the serradella can then be sown as a general pasture on the poorer soil types.

Yellow serradella's contribution to pastures on these poorer soils in the 250 to 450 mm rainfall zone comes from improved early season production, through:

- an increase in the density of pasture legume, and
- increasing soil nitrogen levels, which benefit the non-legumes in the pasture.

Winter growth of individual serradella plants is slow, so pastures need to be well grazed to prevent excessive competition from weeds.

Early sowings of serradella in Western Australia were confined to the south coast and small areas of the west Midlands. These were based on the variety Pitman, a late flowering and relatively winter dormant variety. Field testing programs to find agronomically elite yellow serradella varieties with a range of flowering dates started in the early 1980s.

The species is unknown in commerce outside Australia and virtually unknown to overseas researchers. As a result, wild material had to be collected from natural pastures and roadsides in its native Mediterranean habitat. Dr J.S. Gladstones and Dr W.A. Cowling have made major collections, in 1976 and 1984 respectively. The map shows the areas where serradella has been collected.

National field testing of the Gladstones' collection has led to the registration and release of five new lines - Avila, Elgara, Tauro, Madeira and Paros. The last three are recommended for sowing in Western Australia.

Characteristics of new varieties

The agronomic characteristics of these new varieties differ considerably and highlight the variation that exists within the species. Important differences are: time to flowering, degree of segmentation of the pod and tolerance to aluminium toxicity, a key element of acidity stress (see Table 1).

Time to flowering

Early flowering is desirable for varieties targeted to environments with a short growing season. It confers more reliable seed production, which is essential for persistence.

Early maturing varieties are also needed in the high rainfall areas, since they are often grown on deep, sandy soils that dry out in spring much earlier than other soils with higher clay contents.

Paros is the earliest flowering variety available commercially, flowering three to seven days earlier than Madeira. It also has a faster rate of pod maturation. However, compared to other pasture legume species used in low rainfall areas, its maturity is still relatively late - for example, it is two to three weeks later than Santiago burr medic. Selection of a variety earlier in maturity than Paros is still a high priority.

Pod type

Pods of yellow serradella are similar in form to those of wild radish, although much flatter. Varieties differ in the extent to which individual segments break up when mature.
Pods, pod segments and seeds of yellow serradella varieties and accessions.
**Recent research in the eastern wheatbelt**

**Serradella research in the low rainfall wheatbelt** (less than 350 mm) has concentrated on the highly acidic, yellow sandplain soils, which occupy about 25 per cent of farm land. Some of these soils can sustain a wheat:lupin rotation. However, many are too acidic for wheat and are managed as continuous unimproved pasture.

Much of the research was conducted at the light land annexe of the Merredin Research Station, located at South Carrabin, 60 km east of Merredin (see Table 3). Most of the early agronomic work was carried out with the variety Madeira, for which large quantities of seed were readily available. However, the new variety Paros has been shown to be more productive and is likely to be a better alternative in most situations (see Figure 1).

### Table 1. Important characteristics of yellow serradella varieties recommended in Western Australia

<table>
<thead>
<tr>
<th>Variety</th>
<th>Days to flower (Perth)</th>
<th>Pod type</th>
<th>Aluminium tolerance</th>
<th>Hardseed level</th>
<th>Seed size (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paros</td>
<td>92</td>
<td>non-segmented</td>
<td>high</td>
<td>high</td>
<td>2.8</td>
</tr>
<tr>
<td>Madeira</td>
<td>95</td>
<td>mod. segmented</td>
<td>low</td>
<td>medium-high</td>
<td>1.8</td>
</tr>
<tr>
<td>Tauro</td>
<td>115</td>
<td>mod. segmented</td>
<td>medium</td>
<td>medium</td>
<td>2.2</td>
</tr>
<tr>
<td>Pitman</td>
<td>130</td>
<td>segmented</td>
<td>medium</td>
<td>low</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Highly segmented pods that readily break on contact have an advantage in the field. They are less liable to be eaten by grazing animals and the pods contact the soil better when seeds are beginning to germinate.

The segmented pod type, however, poses a problem for harvesting because seed cannot be threshed out of the small, individual segments with conventional machinery. Varieties with non-segmented pods thresh better, but the process is still not entirely satisfactory.

**Tolerance of aluminium**

Tolerance to high levels of aluminium in the subsoil is particularly important for growth and persistence on very acidic soils such as the wodgil soils in the eastern wheatbelt. In these situations, the level of exchangeable aluminium can rise dramatically and retard root growth.

Studies in New South Wales have ranked varieties for tolerance to high aluminium levels (Scott, Drew and Michalk, 1991). The order of ranking is Paros (best), Tauro, and Madeira (poorest). Paros was up to four times more tolerant than Madeira.

**Hard seeds**

In the pod form, all the new varieties are considerably more hardseeded than Pitman. Softening the seed by exposing the pods to the sun over summer in a thin layer, as sometimes practised with Pitman, is of doubtful value. The best way to obtain germinable seed for new sowings is to mechanically dehull the pods.

Despite the high levels of hard seed, regeneration in the field has generally been adequate, probably because of high and reliable seed production. Paros is the most hardseeded variety and second-year stands are sometimes sparse. Densities are much higher in the third and fourth years (see Table 1).

### Growth habit

Varieties also differ in vegetative growth habit, varying from the erect forms of Madeira and Tauro to the relatively prostrate form of Paros. Paros is likely to be more tolerant of hard grazing than the other varieties, although it tends to produce less leaf material.

**Recent research in the eastern wheatbelt**

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Much of the research was conducted at the light land annexe of the Merredin Research Station, located at South Carrabin, 60 km east of Merredin (see Table 3). Most of the early agronomic work was carried out with the variety Madeira, for which large quantities of seed were readily available. However, the new variety Paros has been shown to be more productive and is likely to be a better alternative in most situations (see Figure 1).
Unsowing pods in a cereal crop is an alternative, especially if a paddock has been cropped with lupins, since serradella has the same rhizobial requirements. Inoculation is therefore not necessary. Few serradella plants emerge under the crop, but some seed softens over the following summer, which provides the basis for the pasture.

Results have shown that undersowing is not the best establishment technique. Low regenerating densities and strong competition from broad-leaved weeds frequently result in low serradella seed reserves.

The use of dehulled seed is the preferred approach for establishment. However, research into the use of whole pods was needed because dehulled seed was expensive and scarce.

The target density for serradella established on its own with dehulled seed is about 150 plants/sq. m for Madeira and about 100 plants/sq. m for Paros. This should be achieved with seeding rates between 3 and 4 kg/ha. However, final seed production depends heavily on seasonal conditions during spring (see Figure 2). With the varieties available now, early seeding is essential provided there is good weed control.

Lower seeding rates can be used to reduce costs if the serradella is sown as a mixture with subterranean clover or rose clover. The clover should provide short term feed value until such time as the serradella content builds up.

Establishment

Sandy surfaced soils in low rainfall environments are difficult soils in which to establish small-seeded pasture species. Soil water relations of the topsoil are not always conducive to seed germination at the break of the season. The small seeds need to be sown shallow (one to two centimetres). However, topsoils can dry quickly following cultivation which can result in low plant establishment. Once germinated, serradella seedlings have good drought tolerance.

Paros has larger seeds than Madeira; this should allow slightly deeper seeding depths to be used.

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Insect control

The two major insect problems of serradella in the eastern wheatbelt are red-legged earth mite at the seedling stage and budworm when pods are developing.

Budworm can be a serious threat, because serradella often remains green for longer periods than other, more shallow rooted, pasture components. The early maturing variety Paros suffers less damage than Madeira and it is likely that an even earlier maturing variety will be less susceptible than Paros.

Results from 1990 and 1991 show that the safest option is the unregistered product Pursuit® (AC 263 499) and this product requires further work (see Table 4). The phenoxy chemicals (2,4-D Amine, 2,4-DB) tended to delay maturity and so reduce seed production. The safest of this group was 2,4-DB; low rates could be useful for wild turnip control. Reglone® and Brodal® caused substantial losses in early production but plants eventually recovered. Weed control with low rates of Reglone® was poor.

The best compromise appears to be bromoxynil at 1.0 L/ha sprayed at the three to four leaf stage. This product will reduce early production, delay flowering and reduce seed production. However, it provides the best overall result as far as weed control and crop safety are concerned. Further work with the commercial mix of bromoxynil and Brodal® (Jaguar®) is also warranted, since this mix may give better results than bromoxynil alone.

Management

Weed control

Preliminary research has been conducted on the tolerance of yellow serradella to a range of herbicides for broad-leaved weeds. Problem weeds include wild radish, wild turnip and capeweed.

A safe option for weed control with chemicals will be particularly useful in the establishment year, when grazing management is not always feasible as a control measure.

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Pink cutworm has also caused occasional damage in spring. Bluegreen aphid is often found on serradella in spring, but does not appear to cause significant damage.

Grazing

Moderate grazing is needed over summer to remove some of the dry residue. This ensures good regeneration after the opening rains by exposing the pods fully to the sun, causing a rapid softening of hard seeds. Pods do not have to be buried by cultivation if serradella pastures are grazed over summer (see Figure 5). Care must be taken not to overgraze pastures, since these light textured soils are liable to be eroded by wind.

Pastures grown for seed production need to be harvested with a suction harvester, because plants rarely grow tall enough to be harvested by conventional headers. This may also leave the soil liable to erosion.

Future research

New accessions

Further collections of serradella were made in the Mediterranean region in 1987 and 1988. These have added more than 250 new accessions to the serradella collection maintained at the Genetic Resource Centre in Western Australia. Documentation and preliminary evaluation of the accessions is being carried out by Mr R. Snowball at the Centre.

The most promising collections are those made by Dr M. Ewing and Mr J. Howieson. This material was collected from the Cyclades Islands, in the south of Greece, in regions ranging from 350 to 600 mm rainfall and often from infertile and acidic sites.

Early testing of the yellow serradella accessions has revealed some of the earliest maturing varieties ever evaluated in serradella research programs. A selection of these varieties was tested in the low rainfall wheatbelt for the first time in 1991 (see Table 5). The development of a variety that is earlier in maturity than Paros appears a strong possibility. This will provide added impetus for the use of yellow serradella in the low rainfall wheatbelt.

Harvesting and seed processing

The future of the serradella seed industry in Western Australia depends on the development of a commercial dehulling system. A prototype machine has been constructed by an engineering team at the Trangie Agricultural Research Centre, NSW, as part of a research project funded by the Wool Research and Development Corporation. This machine awaits commercial field testing.

Success is also likely to come from innovations by farmers at the harvesting stage of the seed production system. The future for serradella in the traditional wheat growing areas looks bright if commercially acceptable seed production systems can be developed.

Acknowledgements

This research has been supported by the Wool Research and Development Corporation and the State Wheat Industry Research Committee of Western Australia.