1-1-1998

Success with Serradella in the wheatbelt

Clinton Revell
Bradley Nutt
Michael Ewing

Follow this and additional works at: http://researchlibrary.agric.wa.gov.au/journal_agriculture4
Part of the Agronomy and Crop Sciences Commons, Plant Breeding and Genetics Commons, and the Soil Science Commons

Recommended Citation
Available at: http://researchlibrary.agric.wa.gov.au/journal_agriculture4/vol39/iss1/6

This article is brought to you for free and open access by Research Library. It has been accepted for inclusion in Journal of the Department of Agriculture, Western Australia, Series 4 by an authorized administrator of Research Library. For more information, please contact jennifer.heathcote@agric.wa.gov.au, sandra.papenfus@agric.wa.gov.au.
IMPORTANT DISCLAIMER

This document has been obtained from DAFWA's research library website (researchlibrary.agric.wa.gov.au) which hosts DAFWA's archival research publications. Although reasonable care was taken to make the information in the document accurate at the time it was first published, DAFWA does not make any representations or warranties about its accuracy, reliability, currency, completeness or suitability for any particular purpose. It may be out of date, inaccurate or misleading or conflict with current laws, polices or practices. DAFWA has not reviewed or revised the information before making the document available from its research library website. Before using the information, you should carefully evaluate its accuracy, currency, completeness and relevance for your purposes. We recommend you also search for more recent information on DAFWA's research library website, DAFWA's main website (https://www.agric.wa.gov.au) and other appropriate websites and sources.

Information in, or referred to in, documents on DAFWA's research library website is not tailored to the circumstances of individual farms, people or businesses, and does not constitute legal, business, scientific, agricultural or farm management advice. We recommend before making any significant decisions, you obtain advice from appropriate professionals who have taken into account your individual circumstances and objectives.

The Chief Executive Officer of the Department of Agriculture and Food and the State of Western Australia and their employees and agents (collectively and individually referred to below as DAFWA) accept no liability whatsoever, by reason of negligence or otherwise, arising from any use or release of information in, or referred to in, this document, or any error, inaccuracy or omission in the information.
Clinton Revell, Bradley Nutt and Michael Ewing review the latest developments with new varieties of French serradella and yellow serradella that should provide the basis for productive legume pastures on acidic, sandy soils throughout the wheatbelt of Western Australia.

Serradella (*Ornitopus*) is a genus of annual pasture legumes native to the Mediterranean region and central and north-west Europe. There are five main species of serradella, three of which have been commercialised in Australia: yellow serradella, slender serradella and French serradella. Yellow serradella is the most common and widespread of all the species of serradella in the wild.

Serradella is adapted to deep sandy soils which are often highly acidic and infertile. It also has a deep root system which can extend to depths of up to 2 metres. These characteristics make serradella potentially suited to over 5 million hectares of sandplain soils in southern Australia for which there are few other pasture legume alternatives.

This article reviews some of the more recent advances in species/varietal selection, management of serradella pastures and discusses the emerging roles for serradella in farming systems of the wheatbelt.

Historically, the lack of a commercial process to extract the seed from the pod of yellow serradella resulted in limited supplies of high cost seed. This has proved to be a major disincentive to the adoption of serradella pastures in recent times, particularly when combined with low wool prices.

Only small areas of serradella have been established throughout the wheatbelt of Western Australia but we expect the area to rapidly increase as a consequence of three important influences:

- the emergence of herbicide resistance in lupin/wheat rotations which is forcing farmers to reconsider pastures as part of an integrated weed control strategy;
- the development of Cadiz®, a soft-seeded variety of French serradella which is much easier to establish and harvest than earlier varieties of yellow serradella;
- the development of Santorini® and Charano®, two new varieties of yellow serradella which can be harvested with cereal harvesters.

**Latest developments in varieties**

**Cadiz® French serradella**

Cadiz® is the first variety of French serradella to be developed in Australia and was released to farmers in 1996. It is a medium maturing variety with a variable date to flower: 80 days in Geraldton, 105 days in Perth and 140 days in Manjimup.

The release of Cadiz® has created great interest because it offers new opportunities to lift production and improve livestock management while increasing soil fertility and fixing nitrogen.

Farmers have reported more than doubling production from infertile, deep sandy soils, a result of increased pasture quality and an extended supply of green feed due to the deep rooting ability of the species.

A major advantage of Cadiz® is its potential for high seed production which can be harvested with cereal harvesting equipment. The resultant pods require no further processing other than cleaning to remove weed seeds ensuring a low cost product which can then be sown at high density.

Harvest yields in recent years have generally been in the vicinity of 400 to 700 kilograms per hectare of pod with at least one report of 1400 kilograms per hectare. Cereal harvesters commonly collect about 60 per
cent of the pod, leaving sufficient seed for dense regeneration in the following year.

Other strengths of Cadiz® include an ability to grow well on acidic soils and an adaptation to a wide range of rainfall conditions (350 to 700 millimetres annual rainfall).

Cadiz® will continue to flower and set pods over an extended period allowing it to exploit good seasonal conditions when spring rainfall is extended. In rainfall zones between 350 and 400 millimetres the seed set of Cadiz® will be low in below average seasons but probably adequate to allow regeneration in the following year.

**Santorini® and Charano® yellow sarradella**

Santorini® and Charano® were collected in 1987 from the Greek islands of Santorini and Mykonos, respectively, by Dr John Howieson and Dr Mike Ewing. Both sites of collection were characterised as acidic sandy loams with a climate and annual rainfall similar to that of the Western Australian wheatbelt.

Whilst their agronomic performance is similar or slightly better than existing varieties, their main advantage is associated with commercial seed production.

Both Santorini® and Charano® are better suited to the dehulling process than the older varieties of yellow sarradella such as Paros and Madeira. The pods of both new varieties do not break into individual segments readily. When the pods are passed through a dehuller they tend to break at a position past the segment wall which exposes, and often releases, the seed.

Commercial seed of Santorini® is available for sowing in 1998 while seed of Charano® should be generally available in 1999.

Charano® is an early maturing variety similar to Paros (Table 1). It is more upright than Paros when ungrazed making it more suitable for header harvesting, particularly in medium and high rainfall areas. It also has greater tolerance than Paros to the high levels of aluminium in the root zone which are often associated with very acidic subsols.

Santorini® is an early to mid-season maturing variety similar to Madeira and Elgara (Table 1). It has a similar growth habit to both.
Mike Ewing (left) and Clinton Revell (right) talk to Stuart Rogers of Cunderdin about his stand of Santorini® yellow serradella.

Madeira and Elgara but it has a much higher level of pod retention after the pasture hay off which increases the opportunity for header harvesting. Santorini® has greater tolerance to redlegged earth mite at the seedling stage than either Madeira or Elgara and it is also very tolerant of high levels of subsoil aluminium.

The main pest of both Santorini® and Charano® serradella and also of Cadiz® serradella is the native budworm (Heliothis sp.) which feeds on immature pods and can reduce seed production. Control with insecticides may be required in some years.

Santorini® and Charano® have been productive in trials on the highly acidic ‘wodjill’ soils of the eastern wheatbelt and the deep yellow and grey sandplain soils common throughout the medium and high rainfall zones of WA. Both varieties are very hardseeded and complete hard seed breakdown (when seeds become germinable) may take five to six years.

Charano® is suited to areas with as low as 300 millimetres of annual rainfall, whilst Santorini® is recommended for areas receiving more than 350 millimetres.

Sowing a mixture of these new varieties with later maturing varieties such as Tauro or Avila is

---

**Table 1. Maturity, pod type and tolerances of yellow serradella varieties.**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Days to flower (Perth)</th>
<th>Pod type</th>
<th>RLEM® tolerance (1-9)</th>
<th>BGA® tolerance (1-9)</th>
<th>Aluminium tolerance (1-9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paros</td>
<td>85</td>
<td>non-seg</td>
<td>5</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Charano®</td>
<td>85</td>
<td>non-seg</td>
<td>6</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Santorini®</td>
<td>95</td>
<td>non-seg</td>
<td>6</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Madeira</td>
<td>97</td>
<td>seg</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Elgara</td>
<td>100</td>
<td>non-seg</td>
<td>2</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Tauro</td>
<td>115</td>
<td>seg</td>
<td>5</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Avila</td>
<td>125</td>
<td>seg</td>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Pitman</td>
<td>130</td>
<td>seg</td>
<td>4</td>
<td>8</td>
<td>-</td>
</tr>
</tbody>
</table>

* non-seg = non-segmented, seg = segmented
* red-legged earth mite tolerance (1 = low, 9 = high)
* blue green aphid tolerance (1 = low, 9 = high)
recommended in areas receiving more than 550 millimetres.

A commercial stand of Santorini® serradella established north-east of Cunderdin in 1997, with below average growing season rainfall, yielded 2.5 tonnes per hectare of pod. This equates to about 800 kilograms per hectare of seed.

**Managing serradella pastures**

**Herbicides**

The strategic use of herbicides is an important management tool for weed control in pastures. All grass selective herbicides are safe for use in both yellow and French serradella pastures, though farmers should be mindful of the development of herbicide resistance in grasses such as ryegrass.

Simazine should not be used in any serradella pasture for grass control as all varieties tested to date are very susceptible. Midwinter applications of paraquat can also be quite damaging but could be useful in established pastures where seed production is less important.

Options for broadleaf weed control are much more limited, particularly in serradella pastures grown for seed production. Research is continuing so that recommendations can be improved.

Where pastures are grown for seed production, attention should be paid to weed control in the previous year and to weed control with knockdown herbicides at seeding time. If post-emergence herbicides are required, recent experimental results suggest that Broadstrike and Spinnaker can be used with safety in both yellow and French serradella.

The application of Spinnaker after sowing but before emergence appears very promising and may allow the use of lower rates. Other broadleaf herbicides such as 2,4-DB, Tigrex and Jaguar will damage serradella but they may again be used in established pastures where seed production is less important.

An interesting feature of both Santorini® and Charano® is that seed germination takes place over a much longer period of time than that in varieties such as Paros and Madeira. Germination can be spread over as long as 60 days which may be used to advantage for weed control in regenerating pastures.

The early germination of serradella together with most of the weeds may be killed with a knockdown herbicide. Later germinations of serradella should provide the basis of the pasture.

The timing of spray operations to optimise weed control yet which ensure adequate serradella regeneration needs further research for each variety. The technique is unsuitable for Cadiz® serradella which germinates rapidly.

**Hardseededness**

Breakdown of hard seeds (seed softening) in yellow serradella is accelerated by the shallow burial of pods. Very little (less than 5 per cent) softening occurs over the first summer if seeds are left on the soil surface and this can lead to poor regeneration in the second year.

Santorini® yellow serradella at flowering.

The rate of seed softening appears to increase in the third and fourth year but this is likely to be due to gradual seed burial. The burial response appears to result from a requirement for specific changes in temperature to which the seeds are exposed and which need to occur in conditions of darkness.

Yellow serradella should regenerate particularly well after single crops where tillage will bury the seed. We recommend that newly sown pastures of pure Santorini® and Charano® serradella be cropped in the second year.

In situations where serradella is grown as a permanent pasture regeneration in the early years will be low for most varieties unless there is some shallow burial of the pods.

Dry plant residues are unlikely to be sufficient to produce the required degree of darkness. High seed production may partly compensate for low levels of seed softening but this may not always be achieved in low rainfall environments.

For some soil types sufficient burial may be achieved by the trampling of pods into the top soil by grazing animals, although this procedure has to be balanced against seed losses from animal consumption.

If trampling by animals is not an option, an alternative is the timely...
Suppression of silver grass using Spinnaker® in a stand of Charano® yellow serradella at an experimental site near Geraldton (photo courtesy A. Blake).

Clinton Revell examines some plots of Cadiz® serradella near Meckering which have been green manured.

Direct harvesting mature pods of Santorini® yellow serradella with a cereal harvester.

burial of pods (probably in late February or early March) by light cultivation or harrowing, keeping in mind the risks of soil erosion.

Cadiz® serradella produces about 99 per cent soft seeds at maturity which clearly distinguishes it from varieties of yellow serradella. Nearly all seeds produced in one year will germinate the following season which makes the need for seed production in each pasture year much more important for Cadiz® than for varieties of yellow serradella.

There will be little self-regeneration of Cadiz® after a crop. A drought year will also severely deplete seed reserves making periodic resowing a strong possibility in low rainfall areas.

Cadiz® does appear to have some ability to regulate seed germination over the summer/autumn period so that not all seed will germinate and be lost in the event of summer rain or false breaks of season.

Grazing serradella pastures over summer can deplete seed reserves on the soil surface. Recent research suggests that only 5 per cent of ingested Cadiz® seeds and 10 per cent of ingested Santorini® seeds will survive passage through the digestive tract of sheep. This compares with about 40 per cent in balansa clover.

Place of serradella in farm systems

Permanent pasture

Infertile sandy soils are often unprofitable for cropping and permanent pasture is the best option. Cadiz® French serradella, preferably in mixtures with other species, can now be used to increase productivity of such areas.

Yellow serradellas are the most important species for mixing with Cadiz® because their seed germination patterns complement each other. The yellow serradellas are slow to establish but once in place will continue to flourish for extended periods irrespective of conditions in any one year.
The variety of yellow serradella best suited to the mix will depend on rainfall zone. Avila and Tauro are best in high rainfall zones (above 550 millimetres). Santorini* in medium rainfall areas (above 350 millimetres) and Charano* for the low rainfall areas (less than 400 millimetres).

Yellow serradella seed, particularly Santorini*, is becoming available in larger quantities and its inclusion in mixes (at rates of 1 to 2 kilograms per hectare) with Cadiz* pod (at 5 to 15 kilograms per hectare) for permanent pastures is highly recommended.

Cadiz* is generally well suited to the soils on which tagasaste is grown and can be sown inter row, especially with a row spacing of 10 metres or more. Mixing of Cadiz with yellow serradella is again desirable for this role.

**Rotations with crops**

The self regeneration of pastures in intensive cropping rotations (such as year-in year-out) requires high levels of hardseededness. Santorini* and Charano* yellow serradella are well suited to such rotations.

Yellow serradella is best sown as seed because of the low germination of seeds which remain encased in their pods. High priced seed of yellow serradella generally represents better value than lower priced pod.

Ideally, seeding rates of 7 to 10 kilograms per hectare are desirable but seed costs are still too high for these rates to be used unless a small ‘nursery’ area is being established.

An alternative is to again use low seeding rates (1-2 kilograms per hectare) in mixtures with Cadiz* pod (as for permanent pastures) and accept establishment over a two to three year period.

Cadiz* will provide the bulk of pasture density and legume content in the early years but once the pasture is cropped, yellow serradella should dominate and provide long-term persistence.

**Phase pastures**

Where alternatives to lupin/wheat rotations are being sought, Cadiz* serradella can be used in short pasture phases (2 to 4 years) between longer sequences of crops. This alternative might be considered because of the emergence or threat of herbicide resistant weeds.

In this role Cadiz* would be sown at the start of the pasture phase but it is not expected to regenerate naturally after the following crop sequence. Resowing would then be needed. Mixing with other species could also be considered for this situation and might include subterranean clover, crimson clover, rose clover or other species depending on the soil type.

In the last year of pasture the choice of management strategies for the seed set control of herbicide resistant weeds can be widened since seed set of Cadiz* or other pasture species is unnecessary. Options such as mowing for silage, green manuring and hay freezing become feasible and research is underway to measure the benefits of such strategies in terms of the whole farm system.

**Conclusions and future prospects**

We believe the future prospects for serradella are bright. We are greatly encouraged by the commercial success of Cadiz* French serradella and more recently of Santorini* yellow serradella. Together, French and yellow serradellas have the potential to cost-effectively improve pasture production on the large area of deep sand soils throughout the Western Australian wheatbelt.

They can be managed to suit farm systems from permanent pasture to intensive cropping rotations and should provide additional strategies for the control of herbicide resistant weeds. Further developments in varieties in the next two to three years may include French serradellas with a greater level of hardseededness and yellow serradellas which soften more rapidly and with pod characteristics for easier dehulling.

**Further reading**

New developments in serradella. Agriculture Western Australia Bulletin 4238.

Cadiz* French serradella – a new pasture variety for deep acid soils. Agriculture Western Australia Farmnote No. 12/97.

Inoculation of Cadiz* French serradella with ‘Serradella Special’ inoculum. Agriculture Western Australia Farmnote No. 15/97.

**Acknowledgments**

This research is jointly supported by farmers through the Grains Research and Development Corporation and the International Wool Secretariat and by Agriculture Western Australia and the CRC for Legumes in Mediterranean Agriculture. We also acknowledge research contributions from Mr G. Taylor (CSIRO Centre for Mediterranean Agriculture), Mr R. Snowball (Curator, Australian *Trifolium* and *Ornithopus* Genetic Resource Centre, Agriculture Western Australia, South Perth), Mr A. Blake, (Agriculture Western Australia, Geraldton) and Ms A. Edward (Agriculture Western Australia, Merredin).

Mention of trade names does not imply endorsement or preference of any company's product by Agriculture Western Australia, and any omission of a trade name in unintentional.

---

*Clinton Revell can be contacted at Agriculture Western Australia, Northam (08 9690 2000), Bradley Nutt is at CRC Legumes in Mediterranean Agriculture (08 9387 7423) and Mike Ewing is at Agriculture Western Australia, South Perth (08 9368 3333).*