‘Summer sowing’ of hard-seeded serradella pod into perennial grasses, Badgingarra & Lancelin

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Purpose:	To evaluate effectiveness of ‘summer sowing’ hard-seeded serradella pod into established perennial grass pastures
Locations:	Badgingarra and Lancelin
Soil Type:	Mainly pale deep sands (depending on site)
Rotation:	Permanent pasture (All perennial grass-based pasture for more than 3 years)

BACKGROUND

There is increasing interest among producers in getting more out of their perennial grass-based pasture paddocks during the growing season, whether that is by improving the composition of the annual pasture or by adding the flexibility of pasture cropping.

Perennial grasses require plenty of nitrogen (N) and the cheapest source of N is to fix atmospheric N with a legume. On the deep sands the two options are blue lupins (sandplain lupins) and serradella. Blue lupins are well adapted to the soils, but are essentially unpalatable during the growing season and can be associated with livestock disorders (lupinosis), while serradella has high feed quality, but requires specific management to build-up a large seed bank.

The focus in this project is to identify companion annual legumes for perennial grass based pastures and to develop reliable, low cost methods of establishment. The objectives are:

(i) to evaluate the potential of a range of annual legumes (varieties, lines) to establish, set-seed and regenerate under established perennial grass pastures;

(ii) to evaluate different establishment methods including summer sowing, twin sowing and conventional direct drilling after the break of the season.

‘Summer sowing’ is an innovative method of establishing annual legumes by sowing seed or pod in an unscarified, dormant form. This has the advantage of reducing the need for further seed processing to enhance germination and in the case of serradella by avoiding the need for de-hulling.

The concept is that pods of hard-seed producing serradella are sown in late summer (February – March) allowing the hard-seed dormancy to breakdown in response to large diurnal changes in soil temperature over the summer – early autumn period (e.g. high soil temperatures 40-60°C during the day followed by mild temperatures at night).

Most success to date has been achieved with hard-seeded French serradella (cvs. Margurita and Erica). These cultivars have a hard-seed breakdown pattern suitable for summer sowing as about 50-60% of the seed softens each year. Commercial varieties of yellow serradella have a slower rate of hard-seed breakdown as only 20-30% of the seed softens each year and have a protracted germination pattern which is less suited to summer sowing. An experimental line of yellow serradella 72.1A has a similar softening pattern to hard-seeded French serradella and is being explored as a possible hardier alternative to French serradella. Some soil coverage is desirable to achieve seed softening.

There are not only differences in the proportion of seed softening between species but also in the typical hard-seed breakdown pattern (Figure 1). For example, in subterranean clover almost all the hard-seed breakdown for that year has occurred by mid-March and the seed is then ready to germinate.

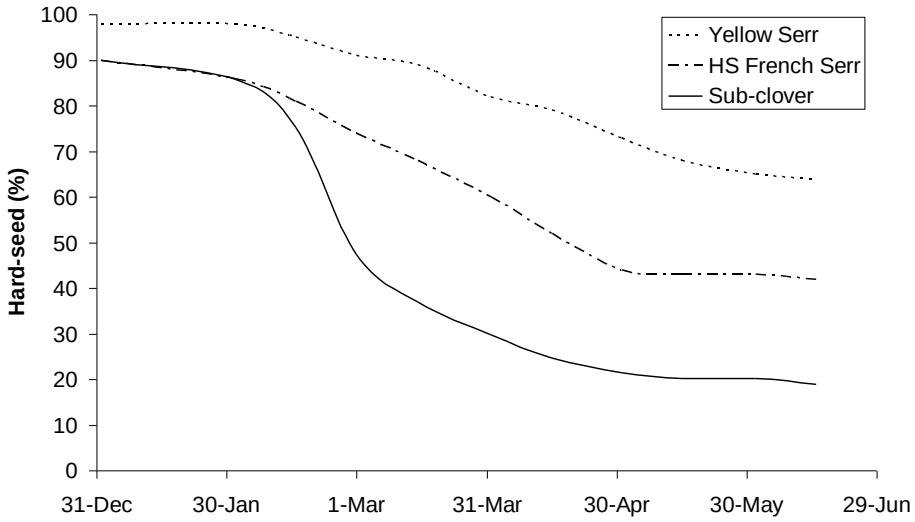

Figure 1: *Typical hard-seed breakdown pattern for commercial yellow serradella, hard-seeded French serradella and subterranean clover*

TRIAL DESIGN AND RESULTS

The first 'summer sowing trials' into paddocks of established perennial grasses were undertaken in 2010 at Badgingarra (T. Alston) and at Dongara (K. Tunney) and these sites were continued in 2011 to assess regeneration. A further two summer sowing trials were established in 2011 at Badgingarra (T. Alston - broadcasting) and Lancelin (B. & A. Wilson).

Trials established in 2010

There was excellent seedling regeneration in the 2010 summer sowing trial at Badgingarra with all of the Margurita French serradella treatments having >270 serradella seedlings per square metre, except for the treatment where the serradella pod was broadcast at 20 kg/ha which had a much lower pod yield in November 2010 (Table 1). In 2011 fertiliser cross-strips with super:potash 3:1 @ 0, 100 and 200 kg/ha were applied in early July.

The herbage dry matter was measured in early August and varied from controls with 700 kg/ha to 1980 kg/ha with the serradella comprising from 17 to 62% of the total biomass. There was extra dry matter production from the applied Fertiliser of 200 – 700 kg/ha. Samples are currently being processed to measure pod yields.

At Dongara, the regeneration in 2011 was promising considering the dry seasonal conditions in spring 2010 and the subsequent low pod yields. The seedling numbers were in general slightly higher than in 2010, although much lower than at the Badgingarra site (Table 2). Importantly the reduced grazing pressure for the paddock over the 2010 season while the serradella was establishing allowed the perennial grasses to recover strongly as they were highly stressed when the trial was sown in March 2010.

Table 1. *Pod yields in 2010 and seedling regeneration in June '11 for the 2010 Summer sowing trial at Badgingarra (T. Alston). Note: seed weight is about 55-60% pod weight for Margurita and 35% pod weight for yellow serradella.*

Treatment	**Av. clean pod weight (kg/ha)**	**Av. sown serradella (plants/m^2)**	**Av. clover seedlings (plants/m^2)**	**Av. lupin seedlings (plants/m^2)**
Margurita @ 20 kg/ha broadcast + animals	130	117	39	8.5
Margurita @ 20 kg/ha drilled	342	300	59	12.2
Margurita @ 40 kg/ha broadcast + animals	234	275	48	1.7
Margurita @ 40 kg/ha drilled	414	508	19	17.2
Margurita @ 80 kg/ha drilled	541	399	121	3.6
Yellow serradella 72.1A @ 40 kg/ha drilled	98	130	77	3.9

Table 2. *Pod yields in 2010 and seedling regeneration in July 2011 for the 2010 Summer sowing trial at Dongara (K. Tunney)*

Variety and treatment	**Av. clean pod weight (kg/ha)**	**Average sown serradella (plants/m^2)**	**Av lupin seedlings (plants/m^2)**	**Av other legume* seedlings (plants/m^2)**
Margurita 50 kg/ha broadcast animals	67	134	4.4	0.1
Margurita 30 kg/ha broadcast animals	59	63	3.7	0.0
Margurita 50 kg/ha drilled	74	101	4.4	0.1
Yellow serradella 72.1A 50 kg/ha drilled	16	29	4.5	0.4
Margurita 30 kg/ha drilled	50	78	4.1	0.4
Margurita 100 kg/ha drilled	115	166	4.4	0.1

* Includes both clover and medic seedlings

Summer sowing 2011 trials

Two large summer sowing experiments were established with producers in early 2011.

<u>Tom Alston (Badgingarra)</u>

This trial evaluated the effectiveness of broadcasting serradella pod and then using animals to trample the pod into the soil surface which was a priority identified by a producer focus group on companion annual legumes.

A replicated large plot experiment was established using four rates of broadcasting Margurita French serradella with 13, 22, 44 and 66 kg pod /ha at Tom Alston's near Badgingarra on a pale grey sandy soil. The trial was established on the 9th of February using a commercial fertiliser spreader with plots 60 m long x 28 m wide with 3 replicates.

The site received an intense, localised summer thunderstorm with 37 mm in 20 minutes on the 16th February. All of the organic matter on the soil surface was washed into lines about 0.5 to 1 m apart parallel with the slope.

The seedling counts in June were comparatively low and patchy with the serradella seedlings germinating in the lines of organic matter as described above. The seedling density was approximately in proportion to the rate of serradella pod broadcast with an average of 6.3, 10, 24 and 27 plants/m^2 for the 13, 22, 44 and 66 kg of serradella pod per hectare respectively. The results were adversely affected by the summer thunderstorm which washed the pod in with the other organic material and did not allow good contact with the soil, which may have reduced seed softening.

Bob Wilson (Lancelin)

A summer sowing experiment was established at Bob Wilson's property at Lancelin on an established perennial grass paddock on a deep sandy soil in early 2011.

The experiment consisted of six treatments:

- Margurita French serradella 25 kg/ha pod drilled
- Margurita French serradella 50 kg/ha pod drilled
- Margurita French serradella 25 kg/ha pod broadcast (dropped on top)
- Margurita French serradella 25 kg/ha pod + 25 kg/ha oats drilled
- Margurita French serradella 25 kg/ha pod + 50 kg/ha oats drilled
- Margurita French serradella 25 kg/ha pod drilled (deeper and in to a bigger furrow)

The experiment was sown with a combine (5 m wide with a row spacing of 35 cm) with plots 60 m long x 20 m wide (4 passes of the combine) with 3 replicates on February 23rd 2011.

Seedling numbers were counted on the 13th June. Where the Margurita French serradella was drilled into the soil the seedling numbers varied from 28.3 to 59.5 plants/m^2. The treatments with oats had 25.6 to 35.1 oat plants/m^2. The treatment sowing into large furrows was the most effective treatment with an average of 46.5 serradella seedlings per square metre, with 6 large seedlings, while a high rate of oats (50 kg/ha) appears to suppress the serradella. Broadcasting the serradella pod and then trampling with animals resulted in a low seedling density of 7.5 plants/m^2 (Table 3).

The oats and the serradella seedlings appeared to be either nutrient deficient and/or moisture stressed when the seedling counts were taken. Subsequently the trial design was modified to have split-plots with two 20 m wide fertiliser treatments across the plots: (i) single application in early July of super-potash 3:1 @ 100 kg/ha; (ii) two applications of super-potash 3:1 @ 100 kg/ha, first in early July with a second application in early September plus (iii) controls with no fertiliser applied.

Table 3. *The average number of seedlings for sown serradella and oats plus background blue lupins and clover (plants/m^2) for the 2011 Summer sowing trial at Lancelin (B. Wilson)*

Treatment	Av. large serradella*	Av. small serradella	Av. total serradella	Av. oats	Av. clover	Av. lupins
French serradella 25 kg/ha + oats 25 kg/ha drilled	1.8	39.1	41.0	25.6	32.2	5.2
French serradella 25 kg/ha + oats 50 kg/ha drilled	2.1	26.2	28.3	35.1	20.6	6.3
French serradella 25 kg/ha broadcast	0.1	7.4	7.5	0	18.8	4.7
French serradella 25 kg/ha drilled	6.1	32.3	38.4	0	23.7	8.3
French serradella 25 kg/ha with large furrows	6.1	46.5	52.6	0	9.8	4.6
French serradella 50 kg/ha drilled	5.5	54.0	59.5	0	12.1	6.4

** Large serradella plants were those with 5 or more leaves, while conversely small seedlings were those with 4 or less leaves.*

In late July the total dry matter varied from 540 to 970 kg/ha with only a proportion of this biomass from the serradella. Overall, the results to date have seen modest growth of oats

and the Margurita French serradella, while there was a good stand of rose clover which had regenerated. Samples are currently being processed to measure pod yields.

DISCUSSION

Summer sowing into perennial grasses is showing some promise, but the results are inconsistent. We need to develop guidelines for the required soil conditions (including soil fertility) and there is a need to reduce weed competition by controlling the seed-set of annual pasture weeds in the preceding year.

Results from these trials plus a range of other summer sowing sites demonstrate that serradella pods need to be drilled for successful establishment. Broadcasting pod is not a reliable alternative.

The experimental line of yellow serradella (72.1A) was slow to establish in the first year at Badgingarra but has has really gone ahead in the second year. This yellow serradella is unique in having a very different hard seed breakdown pattern compared with the commercial yellow serradella varieties (i.e. Yelbini, Charano, Santorini) and is suitable for 'summer sowing'. It is earlier flowering (80 to 90 days compared to 105 to 115 for Margurita) and yellow serradella is hardier than French serradella.

Summer sowing using pod avoids the need for de-hulling, so seed is cheaper, but higher sowing rates are required. Consequently the concept relies to a large extent on farmers being able to source or to produce their own hard-seeded serradella pod at low cost

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