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Twin sowing and summer sowing: Alternative techniques to introduce legumes into pastures

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Abstract. Twin sowing and summer sowing are two techniques that are being evaluated as a means to introduce legume species into pastures. Both methods utilise in the first instance legume seed dormancy to prevent undesirable germination and secondly the breakdown of this dormancy to provide an adequate number of germinating seed under favourable conditions. They are being developed to enable a cost effective and convenient means to improve pasture production and quality using low cost seed produced on farm. Twin sowing refers to sowing legume seed with a cereal or oilseed crop in a dormant form so that little germination occurs under the crop. With field exposure over the following summer and autumn, the hard-seed dormancy will breakdown and produce germinating seeds. Summer sowing is similar but requires a sowing operation in the summer or autumn following crop harvesting and uses the same principle of hard-seed breakdown for legume establishment. In both cases the pasture legume will establish as regenerating pasture using full use of the growing season. These two techniques have the potential to reduce the cost of the pasture legume establishment, particularly for species such as serradella where seed processing to enhance germination is difficult and costly.

Keywords. Twin sowing – Hard seed – Pasture legumes – Serradella.

Le semis sous couvert et le semis estival : Des techniques alternatives pour l'introduction des légumineuses dans les parcours

Résumé. *Le semis sous couvert et le semis estival sont deux techniques qui ont été évaluées comme étant un moyen efficace pour introduire les légumineuses dans les parcours. Les deux méthodes utilisent en premier lieu, la dormance des graines pour empêcher toute germination indésirable et en deuxième lieu, la levée de la dormance dans le but de permettre une meilleure germination des graines dans des conditions favorables. Ces techniques ont été développées pour réduire les coûts d'installation des légumineuses et permettre d'améliorer la production et la qualité des parcours en utilisant des semences à faible coût. Le semis sous couvert ou "twin sowing" implique le semis d'une légumineuse avec une céréale ou une culture industrielle sur une même ligne "sous forme dormante" ce qui permet une faible germination sous couvert végétal. Avec l'exposition de la culture aux températures estivales et automnales, la dormance des graines sera levée et la germination des graines aura lieu. Le semis estival ou "summer sowing" est similaire au semis sous couvert sauf qu'il nécessite une opération de semis en été ou en automne après la récolte de la culture précédente et utilise le même principe de levée de la dormance pour l'établissement de la légumineuse. Dans les deux cas, la légumineuse pastorale va s'installer comme une espèce à auto-régénération en utilisant toute la saison de culture. Ces deux techniques ont l'avantage de réduire les coûts d'installation des parcours à base de légumineuses en particulier ceux à base d'Ornithopus dont le processus pour lever la dormance des graines et activer la germination est difficile et coûteux.*

Mots-clés. *Semis sous couvert – Semences dures – Légumineuses de parcours – Ornithopus.*

I – Introduction

In the last decade, pasture legumes markets have benefited from the domestication of new pasture legume species such as French serradella (*Ornithopus sativus*), yellow serradella (*Ornithopus compressus*), gland clover (*Trifolium glanduliferum*) and bladder clover (*Trifolium*

spumosum). These species can be directly harvested with standard grain harvesters allowing seed to be produced at relatively lower cost than species requiring specialist harvesting, such as subterranean clover and annual medics (Loi *et al.*, 2005). These species have also created the opportunity to think creatively about new pasture establishment systems using low cost sources of unprocessed, dormant (hard) seed. They are particularly targeted at species with high levels of hard-seed when harvested but are difficult to process to the high level of germination required for typical establishment techniques.

A good example where this approach could be useful are hard-seeded forms of French serradella where large amounts of podded seed can be easily produced on-farm with conventional multi-crop machinery. With available cultivars, this seed can have less than 10% germination unless the surrounding pod is removed and the seed coat scarified. To avoid these extra processing steps, dormant podded seed can be sown either with a preceding weed free crop or soon after crop harvest. During the following summer and autumn (under the crop stubble), the hard-seed of the legume will gradually breakdown and become able to germinate with rains over late autumn and winter. In this way a legume component can be introduced into a pasture in a cost efficient manner, which utilises the full seasonal rainfall, improves pasture quality, and maximises rotational benefits into the future.

This paper reports the initial results of the twin and summer sowing techniques and the potential benefits to farmers when compared to the traditional sowing method are discussed.

II – Materials and methods

The field study was conducted over two years at the Western Australian No-Tillage Farmers Association trial site, Meckering (150 km east of Perth). The site has a typical Mediterranean climate (average annual rainfall of 380 mm) and is on an acidic sandy soil with a pH (H_2O) of 5.0. Monthly rainfall for the site is shown in Table 1.

Table 1. Monthly average rainfall (mm) and minimum and maximum temperatures (C°) monthly averages for the site of Meckering (2009) in Western Australia

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Temp Min	17	17	14	12	9	6	6	6	5	8	11	
Temp Max	34	32	28	26	21	16	13.5	16	16	24	28	
Rainfall	7.0	25.8	11.2	8.2	18.4	46.6	68.4	53.8	24.0	20.8	25.0	309.2

The same commercial seed lots were used at all time of sowing treatments. The cultivar treatments consisted of two yellow serradellas cv Santorini and genotype GEH72.1a (separately), bladder clover cv AGWEST®Bartolo and a mix of two hard seed French serradellas, cvs. Erica and Margurita. Whole pods (serradella) or unscarified seed (bladder clover) were used for the twin sowing and summer sowing treatments and germination was 20% for Santorini and 9% for GEH72.1a, 18% for the Margurita-Erica mix and 18% for AGWEST®Bartolo. For the normal sowing, seed was passed through an abrasive spinning disc to enhance germination to commercially expected standards (>75%). This seed was first extracted from the pod for serradella treatments. Treatment plots were 10 by 2.4 m, arranged in randomized complete block split-plot design with 6 replicates. The sowing treatments were the main plots and the cultivars the subplots. Data were transformed and analysed with Genstat (11th Edition).

1. Twin sowing

Plots of the twin sowing treatment were established on the 1th May 2008 by spreading onto the

uncultivated soil surface at 50 kg/ha of either unthreshed pods (serradella) or unscarified seed (bladder clover). Along with the seed 10 kg/ha of Group S (for serradella) and Group C (for clover) of ALOSCA® granules (Carr *et al*., 2006) were also applied. The entire site was then direct drilled with wheat at 80 kg/ha with 85 kg/ha MacroPro Extra (9.7%N, 11.2%P, 11.2%K 9.8%S, 0.10%Zn) on the 11th May 2009. The wheat was sprayed in July with Dicamba (200 g/L) to control broadleaf weeds and a very small percentage of germinated pasture legumes. For experimental purposes and inability to harvest the grain, the wheat was sprayed with 1.5 L/ha of Glyphosate (450 g/L) at the anthesis stage (in spring) to avoid seed set. After senescence, the wheat was slashed and excess stubble material removed by raking to simulate summer grazing.

2. Summer sowing

The summer sowing treatments were sown on the 20th January 2009 in the same way and at the same rate as the twin sowing treatment. The pods or unscarified seed along with ALOSCA granules were spread onto the plots and incorporated into the soil using a light harrow.

3. Normal sowing

At the break of the season a knock-down herbicide (glyphosate 1.5 l/ha) was applied to control emergent weeds, and plots were sown on the 3rd June 2009 using a disc drill seeder. Treatments were sown using scarified seed at 10 kg/ha along with 10 kg/ha of Group S and C ALOSCA® granules.

4. Sward agronomy and measurements

The twin sowing and summer sowing plots were allowed to regenerate naturally in 2009. The overall site was fertilised with 200 kg ha^{-1} of superphosphate and 70 kg ha^{-1} of murate of potash on the 4th of June. On the same date insecticide (Talstar – a.i. bifenthrin 100 g/l at 120 ml/ha) was applied to protect against damage from red-legged earthmites (*Halotydeus destructor* Tucker). The plots were not grazed. There were several waves of germination in the twin sowing and summer sowing treatments, therefore percentage of ground cover in August was used as a measure of plant establishment. Spring herbage production was measured when all treatments where at full flower on the 21th September by cutting all green material with knives from two randomly placed open quadrats (0.1 m^2) in each plot and weighed after drying at 60℃ for 3 days. Two quadrat samples (0.1 m^2) of mature pods per plot were harvested after sward senescence and threshed to assess seed yield.

III – Results and discussion

Spring dry matter yield and seed yield for the four species are summarized in Table 2. A few plants emerged and became established in early March on the twin sowing and summer sowing treatments. These survived to become large plants by June when the majority of seedlings emerged. The normal sowing treatment could not be sown until after the first significant rainfalls in May/June and this delayed the growth of sward dry matter although producing good even ground cover (Table 1). The presence of the large early established plants and a slightly earlier emergence of the majority of seedlings, generated a large difference (and variability) in early production on the twin and summer sowing compared to the normal sowing. This difference continued throughout the growing season and is reflected in dry matter production (Table 2). The twin sowing and summer sowing treatment were also the highest seed yielding plots compared to normal sowing across the three species although all treatments produced adequate seed for the long term introduction of the legumes. At this site the treatments were under minimal weed challenge and possible weed burden may be a critical consideration when applying twin or summer sowing in any particular paddock.

Table 2. Dry matter production at full flowering and seed yield of 4 annual pasture legumes sown at different times: at the break of the season (normal), at the start of summer and the year before with a crop (twin sowing)

Sowing method	Cultivars			
	AGWEST®Bartolo Bladder clover	**Margurita/Erica mix† French serradella**	**GEH72.1a† Yellow serradella**	**Santorini† Yellow serradella**
Dry matter (kg/ha)				
Normal	319 a	208 a	290 a	109 a
Summer	1485 b	2013 b	3026 b	916 b
Twin	1047b	1782 b	3303 b	608 b
Seed yield (kg/ha)				
Normal	490 a	315 a	893 a	710 a
Summer	1129 b	556 a	1384 a	459 a
Twin	633 ab	467 a	816 a	625 a

†Seed yield expressed as pods.

IV – Conclusion

The preliminary results presented suggest that twin sowing and summer sowing are effective techniques to introduce hard-seeded pasture legumes into a crop-pasture ley-rotation. These techniques have several advantages compared to the traditional systems and some have been shown by the trial. Firstly, the twin sowing does not require a separate sowing operation and avoids conflict with the cropping programs in terms of the timing of sowing. The summer sowing whilst requires a sowing operation, is usually implemented during a not busy time for farmers and sometimes it can be associated to operation such as top dressing lime or fertilizer. Secondly, the establishment of the pasture in the twin sowing and summer sowing clearly take the advantage of early rains (April or May) and this is reflected in a better growth during the year and a better yields at the end of the season compared to traditional sowing methods. In crop dominated farms, pasture sowing is often delayed because of farming operation or not always optimal sowing condition (particularly on sandy soils).

The results from this experiment are promising and encourage further research into seeding rates, herbicide manipulation, rhizobial inoculation requirements and cost:benefit analysis and support the release of GEH72.1a as an alternative soft seeded yellow serradella.

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