ANNUAL MEDIC CULTIVAR MIXTURES IN SEMI-ARID FARMING SYSTEMS

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Summary. This paper compares the effects of chemical grass control and stocking rate treatments imposed on two medic cultivars of differing maturity (Harbinger AR and Paraggio) during plant development and seed maturation period. The cultivars relative seed production and seed persistence (longevity) were measured over a three year pasture-pasture-wheat rotation.

INTRODUCTION

The development of annual medic cultivars adapted to the semi-arid regions of south-eastern Australia has been an important component in the evolution of the ley farming system. Bluegreen aphid (*Acyrthosiphon kondoi* Shinji) resistant lines *Medicago truncatula* cv. Paraggio and *M. littoralis* cv. Harbinger AR were first recommended for sowing in the Victorian Mallee in 1984 and 1991 respectively.

Paraggio has inherently higher percentages of water permeable seed (up to 30%) at the seasonal break than the previously recommended cultivars, *M. truncatula* cv. Jemalong and *M. littoralis* cv. Harbinger (approximately 10%). This causes increased seed losses as a result of summer rains (5, 8). Harbinger AR was considered agronomically similar to Harbinger (10). Cultivars with less hard-seedeedness at the seasonal break increase the plant density and thus the competitiveness and productivity of the medic-based pasture (6). The most persistent medic cultivars for the semi-arid zones of south-eastern Australia flower during late winter (3, 4). Harbinger flowered after 81 days and Paraggio after 114 days at Walpeup, following a mid-April sowing (7).

Harbinger AR has significantly smaller seed than Paraggio (10). Carter *et al*. (2)measured a direct relationship between seed size and survival after ingestion with small, hard-seeded pasture legumes better suited for survival in self-regenerating stocked pastures.

Medic seed reserves of 200 kg/ha following a cropping sequence was considered the critical minimum seed reserve required to maintain the stability of self-generating medic pastures in the ley farming system (1).

This paper describes an experiment to establish the persistence and productivity of two agronomically diverse medic cultivars when treated with grass selective and broad-spectrum herbicides combined with grazing by sheep .

MATERIALS AND METHODS

The experiment was conducted at the Mallee Research Station, Walpeup, Victoria, (Lat. 35.8^0 S, Long. 142^0 E, Alt. 50 m). The soil was calcareous earth (9) with pH in top 10 cm being 7.7 (H_2O). A mixture of *Medicago truncatula* cv. Paraggio (4 kg/ha) and *Medicago littoralis* cv. Harbinger AR (3 kg/ha) was sown on 22 April 1991. The 10 ha site was fenced into paddocks for grazing with sheep at high (Hsr) and low (Lsr) stocking rates over the 2-year pasture phase of the experiment (1991 and 1992).

The stocking rates were:

(i) 1 DSE/ha in 1991, 2.5 DSE/ha in 1992 (Lsr).

(ii) 2 DSE/ha in 1991, 5 DSE/ha in 1992 (Hsr).

Three pasture herbicide treatments were applied in 1991, one further herbicide treatment was applied in 1992. The stocking rate paddocks were replicated twice, the herbicide treatments were randomised twice within each paddock making four replicates.

The herbicide treatments were as follows:

• Pasture topping with 330 ml/ha of glyphosate, 360 g a.i./L, at grass anthesis on 26 September 1991, to inhibit seed set (Pt).

• Winter cleaning with 330 ml/ha of glyphosate, 360 g a.i./L, at the 6 to 8 leaf stage of the medic on 31 Ju1y 1991, to restrict annual grass development (Wc).

• Selective grass control with 500 ml/ha of Fusilade (fluazifop, 212 g a.i./L), at the 6 to 8 leaf stage of the medic on 1 August 1991, to eradicate annual grasses (Sel).

• Winter cleaning with 330 ml/ha of glyphosate, 360 g a.i./L, at the 6-8 leaf stage of the medic on 2 Ju1y 1992, to restrict annual grass development (Wc92).

Wheat (cv. Meering) was sown at 50 kg/ha with 50 kg/ha of Pivot Double Super + Zinc (15.8% phosphorus, 4% sulphur and 2.5% zinc) on 1 July 1993 into a moist seed-bed. Fertiliser was not applied during 1991 or 1992.

In December 1991 and 1992, the effects of the stocking and herbicide treatments on the medic seed yield was measured by collecting seed pods from each plot, separated into species and threshing, cleaning and weighing seed. In July 1993 and February 1994, prior to the opening seasonal rains, the medic seed reserves present were measured from soil cores (0-5 cm) taken from each plot. The seedpods were removed from the soil and the species separation made in a 5.6 mm sieve. The seedpods were threshed and the seed cleaned and weighed.

RESULTS AND DISCUSSION

The seasonal rainfall over the course of the study contrasted markedly. In 1991 there was a dry autumn and spring but a wet winter (Table 1). In 1992 there was a wet autumn and spring but a drier period during winter. In 1993 there was a dry autumn but a wet spring.

Table 1. Growing season rainfall (mm) for 1991, 1992, 1993 and the long-term mean (1911-1993).

	Apr.	May	June	July	Aug.	Sep.	Oct.	Annual Total
1991	18	0	68	54	32	26	0	303
1992	43	82	23	15	44	88	53	520
1993	1	6	13	51	22	78	44	361
Long-term mean	21	33	31	32	35	33	36	337

Differences in seed yield occurred between the 2 pasture years due to differences in growing season rain (170 mm 1991; 300 mm 1992).

Table 2. The effect of grazing and herbicide treatments applied during 1991 and 1992 on seed yields (kg/ha) of Harbinger AR and Paraggio.

Stocking rate	Herbicide treatment	Seed yield			
		1991		1992	
		Harbinger AR	Paraggio	Harbinger AR	Paraggio
Lsr	Pt	10	14	119	214
	Wc	57	92	138	255
	Sel	122	77	222	333
	Wc92	71	48	135	182
Hsr	Pt	22	14	109	181
	Wc	65	46	176	219
	Sel	92	53	264	217
	Wc 92	70	41	146	120
l.s.d.(*P*=0.05)		43.8		62.4	

The 1991 high stocking rate (Hsr) did not reduce seed yields. Harbinger AR had higher seed yields than Paraggio when glyphosate was not used in 1991. However, the Paraggio seed yield tended to be lower as a result of the Hsr**.** In 1992, Paraggio produced more seed than Harbinger AR at the Lsr. However, the Hsr reduced the seed yield of Paraggio**.** The selective grass control (Sel) produced similar or more seed and pasture topping (Pt) generally reduced seed yields in both years irrespective of cultivar or stocking rate (Table 2).

Table 3. Seed reserves (kg/ha) of Harbinger AR and Paraggio prior to the seasonal break in 1993 and 1994 in response to grazing and herbicide treatments applied in 1991 and 1992.

Stocking rate	Herbicide treatment	Seed reserves			
		1993		1994	
		Harbinger AR	Paraggio	Harbinger AR	Paraggio

	Pt	171	213	93	180
Lsr	Wc	198	249	81	202
	Sel	275	311	123	204
	Wc92	150	239	48	162
	Pt	113	186	81	154
Hsr	Wc	215	176	96	131
	Sel	316	226	114	141
	Wc92	201	152	62	74
l.s.d.(*P*=0.05)		108.3		62.4	

In 1993 Harbinger AR at Lsr tended to have lower seed reserves than Paraggio after the first 2 years of the pasture-pasture-cereal-pasture rotation (Table 3). However, with the Hsr imposed seed reserves were comparable. The Harbinger AR seed reserve reduced at a greater rate in comparison to Paraggio during the 1993/94 crop year. This may have been due to high mouse numbers, and their ability to extract seeds from the Harbinger AR seedpod relative to the spinier Paraggio seedpod (Latta, observations).

With a growing season of four months in 1991 and below average rain, Harbinger AR seed yields were generally higher than Paraggio. The increased seed yield of Harbinger AR compared to Paraggio was not reduced by the higher stocking rate. In 1992, Paraggio produced a higher seed yield than Harbinger AR under both low and high stocking rates. Paraggio better utilised the longer, seven month growing season of 1992 and above average rain. A total seed reserve of approximately 250 kg/ha (Paraggio and Harbinger AR seed) was available to regenerate in the 1994 pasture phase. Assuming a 50% establishment rate, a density of at least 350 medic plants/m^2 should ensure.

CONCLUSIONS

Findings of consequence to semi-arid ley farming systems include:

• The value of mixing cultivars with differing maturity and agronomic characteristics, an early maturing small-seeded cultivar (Harbinger AR) with a mid-season larger-soft-seeded (Paraggio), to maximise seed production and subsequent regeneration over a range of seasons has been established.

• Smaller-seeded cultivars help ensure seed persistence due to seed yield and seed reserve reduction in larger-seeded cultivars when stocking rates are increased.

• The reduction of the medic seed yield as a result of the non-selective herbicide applied at grass anthesis; the inherent tolerance of Paraggio to the glyphosate applied as a winter cleaning treatment.

• Medic pastures can be established and maintained with a low grass component at plant densities of about 400 plants/m^2. This will support a substantial increase in farm productivity through an increased

legume component, resulting in more livestock, greater nitrogen accumulation, decreased root diseases, notably Take-all and Cereal cyst nematode leading to higher livestock and cereal returns.

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