RESEARCH

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PRODUCTIVITY AND PERSISTENCE OF YELLOW SERRADELA (*Ornithopus compressus* L.) AND BISERRULA (*Biserrula pelecinus* L.) IN THE MEDITERRANEAN CLIMATE REGION OF CENTRAL CHILE

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ABSTRACT

The production and sustainability of non-irrigated pastures in the Mediterranean climate region of central Chile is currently limited by the low diversity of valuable species and cultivars of annual forage legumes, able to persist in zones with highly variable annual rainfall, and low fertility or poorly drained soils. In this work, DM production, seed yield, hardseededness and pasture persistence were evaluated for cultivars of yellow serradella (*Ornithopus compressus* L.) and biserrula (*Biserrula pelecinus* L.), in field experiments conducted in the subhumid portion of the Mediterranean climate region of Chile. Burr medic (*Medicago polymorpha* L.) and sub clover (*Trifolium subterraneum* L.) were used as a reference plants. A remarkable DM production and seed yield were observed in biserrula (cvs. Mor96 and Casbah), and in some cultivars of yellow serradella (e.g. Madeira, Santorini); biserrula produced by far the largest number of seeds per m^2. As was expected for species that produce very high levels of hard-seeds, the regeneration of biserrula and serradella was low in second growing season, but plant density and productivity were high in the third growing season. The use of biserrula and serradela in monoculture or in mixture with other annual legumes, either in pasture-crop rotation or permanent pasture, would contribute to the improvement of the prevailing productive systems in the Mediterranean climate region of central Chile.

Key words: annual legumes, hard-seed, espinal, plant density, seed yield.

INTRODUCTION

Pastures in the Mediterranean climate region of central Chile are dominated by annual composite and grass species and their productivity is generally low (Ovalle *et al*., 2006a). The abundance of annual legumes is also very low, being *Trifolium glomeratum* L. and two species of *Medicago* (*Medicago polymorpha* L. and *Medicago arabica* (L.) Huds.) the most common species (Ovalle *et al*., 1996). The land use system is based on two basic models, pasture rotated with annual crops (mainly wheat, *Triticum aestivum* L.) and continuous grazing. The crop-pasture rotation is mainly used on well-drained hillsides whereas the continuous grazing by sheep and cattle is practiced mainly on flatlands, which are not suitable for cropping because of the frequent and prolonged water logging in winter.

To improve pasture and cereal production in the Mediterranean region, an intensive research program has been developed in bur medic (*Medicago polymorpha* L.) in order to collect and characterize accessions (del Pozo *et al*., 2002a; 2002b; Paredes *et al*., 2002), and to select Chilean cultivars (Ovalle *et al*., 2001; del Pozo *et al*., 2001) and rhizobium. However, the persistence of bur medic on degraded soils is inconsistent. Therefore, there is a need of insuring pasture persistence as well increasing the diversity of annual legumes, particularly with species producing small and hard-seeds, and have vegetative and reproductive phenology that will ensure persistence in zones with highly variable and unpredictable annual rainfall.

Cultivars of various annual legume species have been developed in Australia during recent years (Dear *et al*., 2002; Loi *et al*., 2005); since 1991, 49 new pasture legume cultivars have been developed by public institutions (Nichols *et al*., 2006). Among these are a number of cultivars of yellow serradella and biserrula. Both species are apparently well adapted to soils of light texture and low phosphorus availability (Paynter, 1990), produce forage of high quality (Freebairn, 1994; Howieson *et al*., 1995), and have smaller seeds than burr medic (Loi *et al*., 1999; Ovalle *et al*., 2003).

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In environments with highly variable and unpredictable annual rainfall, and prolonged dry periods, like the Mediterranean climate region of Chile, vegetative and reproductive phenology, seed production and hardseededness are important traits to ensure pasture persistence. This paper reports results of two field experiments where cultivars of yellow serradella (*Ornithopus compressus* L.) and biserrula (*Biserrula pelecinus* L.) were compared with bur medic and sub clover, in the interior dryland of the Mediterranean climate region of Chile. The objective was to evaluate dry matter (DM) production, seed yield, hardseededness and pasture persistence of these annual legumes, and to discuss their possible role in Chilean farming systems.

MATERIALS AND METHODS

The study site was located at the El Boldo farm of the Experimental Center Cauquenes (35°58’ S, 72º17’ W; 140 m.a.s.l.), Instituto de Investigaciones Agropecuarias (INIA) in the interior dryland of the Mediterranean climate region of Chile. Long term average of the minimum temperatures of the coldest month (July) is 4.8 °C and of the maximum temperatures of the warmest month (January) is 29 °C. Mean annual precipitation is 657 mm, concentrated in the seven coldest months of the year. The soil is granitic (fine, kaolinitic, mesic Typic Palexeralfs), sandy clay loam in texture, with low organic matter content (2.6%), and slightly acid (pH 5.9 in water), with low P (5 mg kg^{-1}), and N (19.8 mg kg^{-1}) levels and medium K level (128 mg kg^{-1}).

In the first experiment (Experiment 1), 11 cultivars of four species of annual legumes (Table 1) were tested. A preliminary report was presented in Ovalle *et al.* (2000). Seed rate was 20 kg ha^{-1} for bur medic and sub clover and 8 kg ha^{-1} for serradella and biserrula of viable seeds (percentage of germination > 85%), and were broadcast sowed on 27 May 1997. Seeds were inoculated with the specific rhizobium (obtained from Centre for Legumes in Mediterranean Agriculture-CLIMA, Australia) for each species at the rate of 10 g of inoculant per kilogram of seeds, using as adherent methyl cellulose (1%), and then covered with lime. The experimental design was a randomized complete block with four replicates. Plot size was 2 x 6 m in size. Fertilization was applied annually and consisted of 90 kg P_2O_5 ha^{-1}, 50 kg K_2O ha^{-1} and 20 kg boron calcite ha^{-1}. More prominent weeds were removed by hand but no herbicide was applied.

In the second experiment (Experiment 2) 12 cultivars of four species of annual legumes were evaluated (Table 1). Sowing date was 6 June 2000. Seeding rate was equivalent to 16 kg ha^{-1} for bur medic and sub clover, and 9 kg ha^{-1} for serradella and biserrula seeds. Seeds were sowed using a manual drill machine (Planet Junior, USA). The experimental design was a randomized complete block with four replicates. Plot size was 2 x 5 m. Fertilization consisted of 92 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} at sowing, and then 45 kg P_2O_5 ha^{-1}, 2.2 kg B ha^{-1} as boron calcite, and 500 kg ha^{-1} of calcium sulphate in autumn 2001 and 2002. More information is in Ovalle *et al.* (2005).

Evaluations and statistic analyses

The evaluations carried out were: a) number of seedlings in winter using a cylinder of 10 cm in diameter and taking five samples per plot (between 2000 and 2002); b) DM production at the end of the growing season (November) using quadrants of 0.5 m^2 (two samples per plot and 5 cm of cutting height) and then separating the sown species from others; c) pods (new plus the residual from previous years) and seed production (g m^{-2}) at the end of each growing season using two quadrants of 20 x 20 cm per plot; seeds were removed from pods by hand; d) percentage of hard-seeds in autumn (April), by testing germination of 50 seeds from each plot in Petri dishes at 20 °C in an incubator. Days to first flower were obtained from a previous experiment conducted in microplots in rise beds (Ovalle *et al.*, 2003).

ANOVAs and multiple comparison test (least significant difference, LSD) were performed to pasture production and seed yield data using SPSS 12.0 statistical packages (SPSS, 2003).

Table 1. Cultivars of the different species of annual legumes tested in two experiments in the subhumid Mediterranean climate zone of central Chile.

Species	Cultivars	
	Experiment 1: 1997-1999	**Experiment 2: 2000-2002**
Medicago polymorpha	Cauquenes-INIA	Cauquenes-INIA
Biserrulla pelecinus	Mor96, Casbah	Mor96, Casbah
Ornithopus compressus	Eneabba, Madeira, Paros, Pitman, Santorini, Tauro	Avila, Charano, Madeira, Paros, Pitman, Santorini, Tauro
Trifolium subterraneum	Seaton Park, Clare	Seaton Park, Clare

RESULTS

Climatic conditions during the experimental period

A large variation in annual rainfall was registered during the studied period; in the first experiment (1997-1999) the annual rainfall ranged between 229 and 986 mm, and in the second experiment (2000-2002) between 741 and 982 mm (Table 2). Both 1997 and 2002 were under the influence of "El Niño" stream and were "humid" years, whereas 1998 was a "dry" year, with respect to long-term rainfall data for the area.

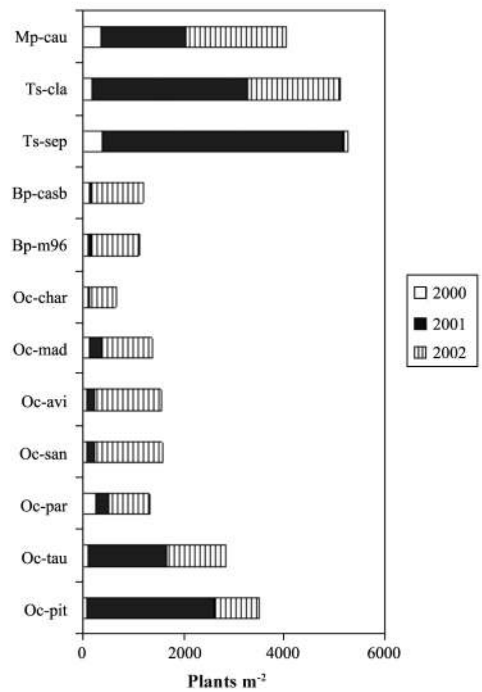
Plant density

Plant density was measured in Experiment 2; in the first growing season (2000) plant density was lower than 400 plants m^{-2}. The regeneration of the annual legume pasture in the second growing season was highly variable depending on hardseededness and the seed yield during the first growing season. For instance, plant density was very low in biserrula cultivars (19-44 plants m^{-2}), had a wide range in serradella cultivars (26-2500 plants m^{-2}) and was high in bur medic (1670 plants m^{-2}) and sub clover (3100-4800 plants m^{-2}) (Figure 1). In the third growing season a great increase was observed in both cultivars of biserrulla (≈ 1000 plants m^{-2}) and in some serradela cultivars (Santorini, Avila and Madeira); sub clover cv. Seaton Park had a great reduction in plant density but not cv. Clare, which reached 1800 plants m^{-2} (Figure 1). Bur medic showed a large plant population in winter (2000 plants m^{-2}) but very few plants survived to maturity.

Flowering time, pasture productivity and persistence

Bur medic cv. Cauquenes-INIA was the most precocious (early-flowering), while yellow serradella cv. Avila was the last to flower (Table 3). A large range in flowering time was observed among cultivars of yellow serradella (106-143 d). Biserrula flowered later than the cultivars of subterranean clover.

Pasture productivity showed large variations among cultivars and years (Table 3). In both experiments, the year x cultivar interactions on DM production and seed yield were highly significant ($P < 0.001$) (Table 4). In the year of pasture seeding, DM production and seed yield of annual legumes were far superior in Experiment 1 than in Experiment 2 (Figures 2 and 3). This was a consequence of the heavy rains, particularly in October-November, occasioned by the "El Niño" effect in 1997 (Table 2). The DM production in the first year was significantly ($P < 0.05$) different among cultivars in Experiment 1, being



Medicago polymorpha cv. Cauquenes (Mp-cau), *Trifolium subterraneum* cvs. Clare (Ts-cla) and Seaton Park (Ts-sep), *Biserrula pelecinus* cvs. Casbah (Bp-casb) and Mor96 (Bp-m96), and *Ornithopus compressus* cvs. Avila (Oc-avi), Charano (Oc-char), Madeira (Oc-mad), Paros (Oc-par), Pitman (Oc-pit), Santorini (Oc-san) and Tauro (Oc-tau).

Figure 1. Plant density measured in July-August of 16 annual legumes grown on hillside during the period 2000-2002 (Experiment 2).

Table 2. Monthly precipitation at Cauquenes-INIA Research Station (35°58' S, 72°17' W; 140 m.a.s.l.).

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
	mm												
1997	1.3	7.0	0.6	127.7	145.6	302.1	60.2	71.6	63.0	125.0	62.2	19.7	986.0
1998	0.0	0.0	2.8	24.3	66.6	54.7	15.4	30.5	31.9	0.0	2.4	0.0	228.6
1999	0.4	0.0	23.8	0.6	67.3	130.4	74.5	72.3	164.1	7.1	0.4	7.0	547.9
2000	0.0	42.5	0.0	4.5	44.7	457.1	26.6	20.4	135.4	2.6	5.0	2.1	740.9
2001	11.8	0.0	1.1	26.0	204.6	95.2	250.7	94.4	40.9	11.8	10.7	0.0	747.2
2002	0.0	68.8	57.4	32.3	136.9	174.8	72.6	256.4	53.2	86.1	31.6	0.0	970.1
$X_{1959-2002}$	6.5	6.3	11.7	38.8	120.4	157.2	130.1	83.7	55.4	27.4	16.2	8.7	657.0

Table 3. Days to first flower (in the year of establishment) and mean (± standard error) dry matter of annual legumes growing in the subhumid Mediterranean climate zone of central Chile. Values for each year are mean of the two experiments.

Species	Cultivar	Days to first flower[1]	Dry matter Year 1	Year 2	Year 3
			g m^{-2}		
Medicago polymorpha	Cauquenes (Mp-cau)	97	285 ± 167	388 ± 115	91 ± 91
Trifolium subterraneum	Clare (Ts-cla)	118	444 ± 257	253 ± 106	285 ± 103
	Seaton Park (Ts-sep)	101	333 ± 187	241 ± 13	197 ± 15
Biserrulla pelecinus	Mor96 (Bp-m96)	123	301 ± 77	81 ± 46	673 ± 201
	Casbah (Bp-casb)	124	363 ± 225	19 ± 1	700 ± 84
Ornithopus compressus	Avila (Oc-avi)[2]	143	149	183	872
	Charano (Oc-cha)[2]	108	193	49	480
	Eneabba (Oc-ene)[2]	111	122	255	469
	Madeira (Oc-mad)	112	214 ± 54	257 ± 29	806 ± 59
	Paros (Oc-par)	106	155 ± 12	110 ± 5	554 ± 112
	Pitman (Oc-pit)	120	188 ± 44	327 ± 20	491 ± 34
	Santorini (Oc-san)	110	228 ± 53	159 ± 35	486 ± 182
	Tauro (Oc-tau)	123	329 ± 141	320 ± 41	356 ± 94

[1] From Ovalle *et al*. (2003).
[2] Data are from one experiment.

Table 4. Analysis of variance (*F* values) for dry matter and seed yield of annual legumes species growing in the subhumid Mediterranean climate zone of central Chile, in the periods 1997-1999 (Experiment 1) and 2000-2002 (Experiment 2).

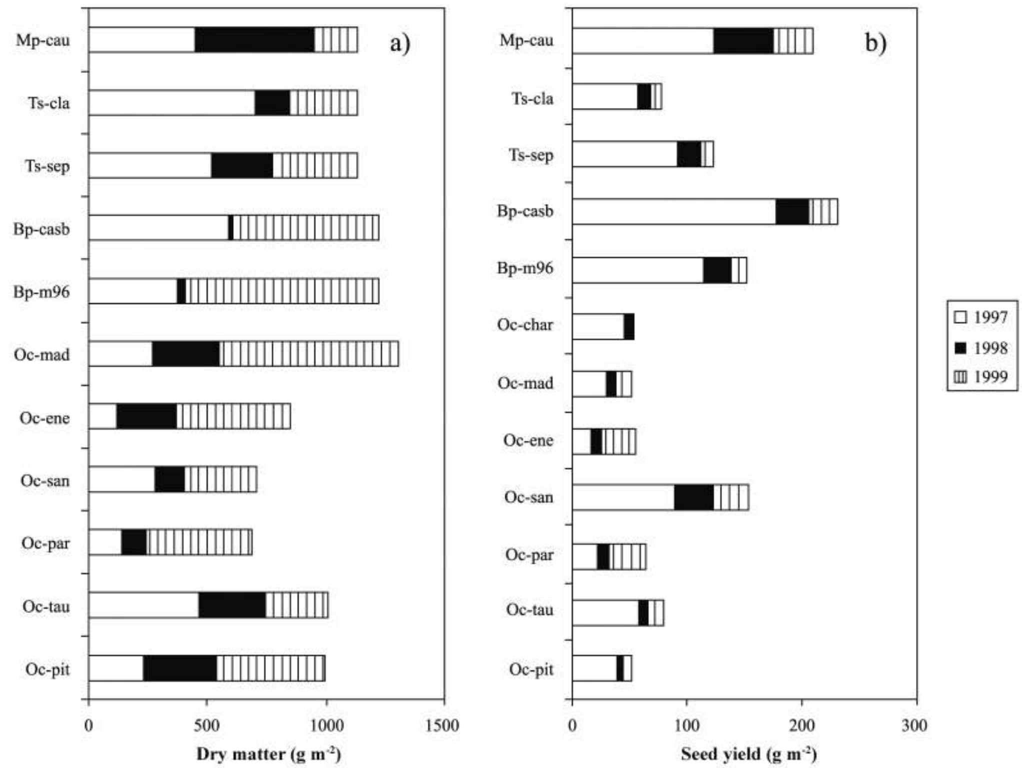
Source	Experiment 1 Dry matter	Experiment 1 Seed yield	Experiment 2 Dry matter	Experiment 2 Seed yiel
	g m^{-2}			
Block	6.6***	3.9*	2.5	1.3
Year	28.3***	146.9***	117.1***	67.5***
Cultivar	3.2***	12.4***	4.4***	6.6***
Year * Cultivar	9.7***	9.7***	7.0***	5.4***

* P < 0.05; ** P < 0.01; *** P < 0.001.

higher in sub clover cv. Clare and biserrula cv. Casbah, but no differences (P > 0.05) between cultivars were observed in Experiment 2. Seed yield in the first year was very high in biserrula in both experiments, and in bur medic in Experiment 1 (Figures 2b and 3b).

In the second year, DM production and seed yield of cvs. Casbah and Mor96 biserrula and cvs. Charano, Paros and Santorini yellow serradela were much lower compared to bur medic or sub clover cv. Seaton Park (Figures 2 and 3; Table 3). However, a remarkable DM production was observed in biserrula and in some cultivars of yellow serradella (cv. Madeira) in the third growing season, in both experiments (Figures 2 and 3; Table 3). Biserrula produced also the largest number of seeds per m^2 especially in the first year (data not shown). By contrast, a very low persistence was observed in burr medic after 3 yr.

The relationship between the cumulative DM and seed yield along the three growing seasons of each experiment, showed a clear separation between cultivars. The biserrula cultivars appear in the upper right extreme of the plots, indicating high DM production and high seed yield, and therefore good persistence (Figure 4). Among serradela, cvs. Madeira and Santorini also appear in the upper right part of the plot in the Experiment 2 (Figure 4b) and in the lower right side (cv. Madeira) and the left upper side (cv. Santorini) in Experiment 1 (Figure 4a). Bur medic had



Medicago polymorpha cv. Cauquenes (Mp-cau), *Trifolium subterraneum* cvs. Clare (Ts-cla) and Seaton Park (Ts-sep), *Biserrula pelecinus* cvs. Casbah (Bp-casb) and Mor96 (Bp-m96), and *Ornithopus compressus* cvs. Charano (Oc-char), Madeira (Oc-mad), Paros (Oc-par), Pitman (Oc-pit), Santorini (Oc-san) and Tauro (Oc-tau).

Figure 2. Dry matter production (a) and seed yield (b) of annual legumes grown in the subhumid Mediterranean climate zone of central Chile, in the period 1997-1999 (Experiment 1).

high productivity in Experiment 1 (upper right extreme in Figure 4a) but had a poor performance in Experiment 2 (lower left extreme in Figure 4b). Sub clover had a good performance in the first and second year but fair in the third year (Table 3).

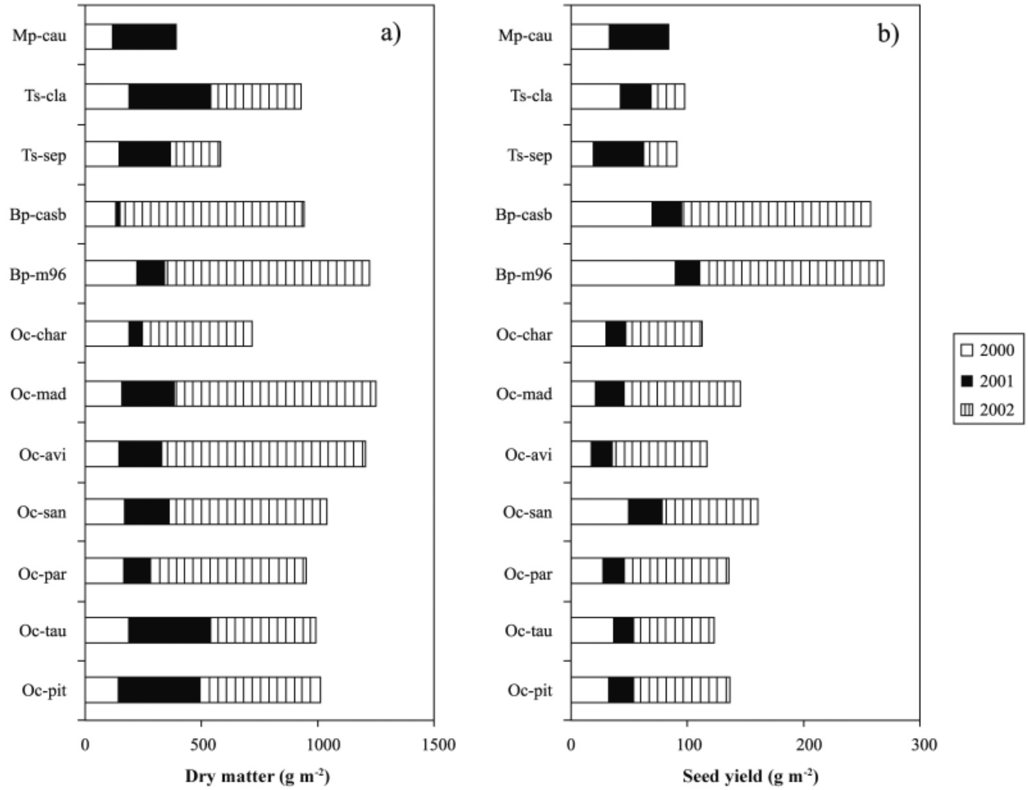
Hard-seeds

The percentage of hard-seeds was higher in biserrula and lower in sub clover (Table 4). Among serradela cvs. Paros and Santorini showed higher percentage of hard-seeds, similar to biserrula, but others (cv. Eneabba) had much lower percentage. Bur medic had high percentage of hard-seeds in the first year but it declined in the following years due to the process of seed softening (Table 5).

DISCUSSION

Cultivars of biserrula and yellow serradella evaluated in this study appear very promising for pasture-crop rotation in hillsides. Both serradella and biserrula have a semi-erect growth habit and it seems that they can achieve larger plant size compared to sub clover, which has a more creeping growth habit. Biserrula is a prolific seed producer with small seed and a high level of hardseededness (Loi *et al*., 1997; 1999); cvs. Mor96 and Casbah were able to develop a large seed bank over the three growing seasons of the two experiments. This was achieved when seeded in a favorable year like 1997 in Experiment 1 or in a normal year like 2000 in Experiment 2. Despite being later flowering compared with the reference bur medic, both cultivars showed greater than average seed production in a ‘dry’ year (1998); this result is consistent with the relatively deep rooting patterns observed for this species (Loi *et al*., 2005). The natural re-establishment in the second year was low; however, in the third year self seeding was optimal, assuring the longer term persistence of biserrula. This performance has been described in biserrula by several authors and it is explained by the high amount of hard-seeds produced by this species (Howieson *et al*., 1995; Loi *et al*., 1999; Ovalle *et al*., 2004).

Hardseededness, or impermeability of the seed coat to water, is the most important long-term dormancy mechanism in Mediterranean legumes. Both genetic and environmental factors control hardseededness. In



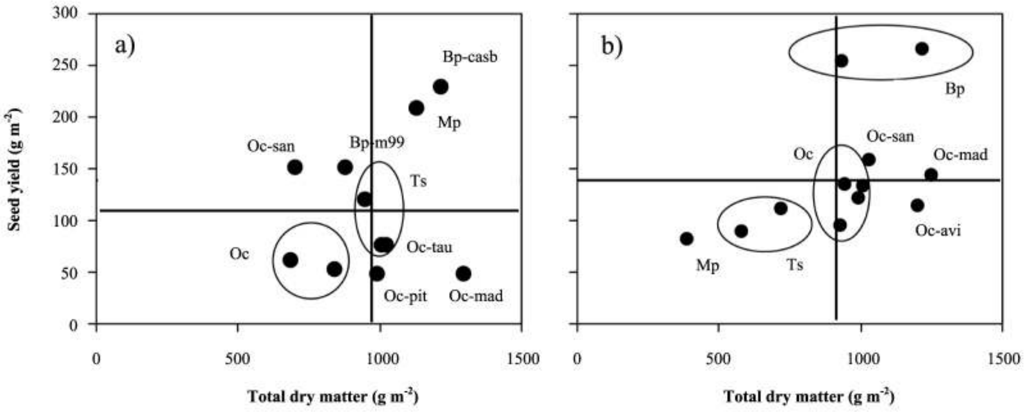
Medicago polymorpha cv. Cauquenes (Mp-cau), *Trifolium subterraneum* cvs. Clare (Ts-cla) and Seaton Park (Ts-sep), *Biserrula pelecinus* cvs. Casbah (Bp-casb) and Mor96 (Bp-m96), and *Ornithopus compressus* cvs. Avila (Oc-avi), Charano (Oc-char), Madeira (Oc-mad), Paros (Oc-par), Pitman (Oc-pit), Santorini (Oc-san) and Tauro (Oc-tau).

Figure 3. Dry matter production (a) and seed yield (b) of annual legumes grown in the subhumid Mediterranean climate zone of central Chile, in the period 2000-2002 (Experiment 2).

field conditions, seed impermeability is broken by the influence of diurnal fluctuating temperatures and other natural or artificial processes that scarify the seed coat to produce 'soft' seed (Lodge *et al*., 1990). Hard-seeds are necessary to develop a seed bank from which the legumes will spontaneously re-establish each season (Cocks, 1988; Taylor *et al*., 1991; Loi *et al*., 1999). In general, newly ripened seeds of annual legumes have high levels of hard-seeds, but the rate of seed softening under field conditions differs greatly among accessions and between species. For example, seed softening occurs very rapidly in *Trifolium subterraneum* and *T. isthmocarpum*, but the opposite is true in *Ornithopus compressus* and *Biserrula pelecinus* (Table 5; Revell *et al*., 1998; Norman *et al*., 1998; Loi *et al*., 1999). Furthermore, in annual medics (*Medicago* spp.) and *T. subterraneum*, the rate of seed softening decreases as depth of burial increases (Taylor and Ewing, 1996), whereas in *O. compresus* and *B. pelecinus* softening occurs more rapidly at 2 cm depth than at 6 cm (Revell *et al*., 1998; Loi *et al*., 1999). An experiment conducted in Chile (at the same experimental site of the present work) showed that pods of bur medic placed in soil surface had 97% of hard-seeds after the first summer and reached 17% after 5 years (Avendaño *et al*., 1997).

Among yellow serradella cvs. Madeira and Santorini have similar precocity (110-112 d to first flower) and both are highly productive; 'Madeira' produced more DM but 'Santorini' more seeds. In a "humid" year (2002), serradella and biserrula produced about two times more DM than sub clover cv. Clare (~ 800 vs. 400 g m^{-2}) and with lower number of plants per m^2 (1000-1500 plants m^{-2} in the formers and 2500 plants m^{-2} in sub clover).

Seed size of yellow serradella is about two times greater than of biserrula (Ovalle *et al*., 2003), and seed recovery is low (~ 10%) after being ingested by sheep (Edward *et al*., 1998). These seed characteristics suggest a more careful management of serradella pastures during summer, in terms of grazing pressure may be required. In biserrula the small seed size of provide a further advantage when the pasture is grazed because seed viability is less affected after being ingested by sheep (Squella, 1992; Edward *et al*., 1998).



Medicago polymorpha cv. Cauquenes (Mp-cau), *Trifolium subterraneum* cvs. Clare (Ts-cla) and Seaton Park (Ts-sep), *Biserrula pelecinus* cvs. Casbah (Bp-casb) and Mor96 (Bp-m96), and *Ornithopus compressus* cvs. Avila (Oc-avi), Charano (Oc-char), Madeira (Oc-mad), Paros (Oc-par), Pitman (Oc-pit), Santorini (Oc-san) and Tauro (Oc-tau).

Figure 4. Relationships between dry matter production and seed yield of annual legumes over three growing seasons, 1997-1999 (a) and 2000-2002 (b). Lines represent the average values for all cultivars.

According to Nichols *et al*. (2006) the preferred texture of serradella and biserulla range from sand to loam soils, however in these experiments both species performed well in a more heavy soil texture (sandy clay loam) and imperfect drainage. Sandy loam textures are common in volcanic soils (Andisol) in Chile where yellow serradela has been naturalized (Ovalle *et al*., 2006c). Also, both yellow serradela and biserrula can tolerate a wide range of soil pH, including acid soils (Nichols *et al*., 2006), which is another important trait to ensure adaptation and persistence of annual legume pastures in the Mediterranean region of Chile, where soil pH is 5-6.

Soil characteristics and rizhobia strains are important factors for N fixation and annual legume persistence. The four species studies in this work differ in nodulating species (Temprano *et al*., 2008); biserrula is nodulated by *Mesorhizobium ciceri* bv. *biserrula* (Nandasena *et al*., 2006; 2007; Temprano *et al.*, 2008), serradella bv.

Table 5. Percentage of hard-seeds of annual legumes growing in the subhumid Mediterranean climate zone of central Chile. Values were measured in April of each year in Experiment 1.

		Hard-seeds[1]		
Species	**Cultivar**	**Year 1**	**Year 2**	**Year 3**
			%	
Medicago polymorpha	Cauquenes	95.4	66.7	68.2
Trifolium subterraneum	Clare	67.4	8.2	39.0
	Seaton Park	39.1	10.8	28.5
Biserrulla pelecinus	Mor96	100	98.2	99.9
	Casbah	99.9	99.2	99.8
Ornithopus compressus	Eneabba	25.1	61.9	92.8
	Madeira	98.9	76.4	96.3
	Paros	99.6	97.5	97.6
	Pitman	93.2	33.3	97.5
	Santorini	99.4	97.8	96.7
	Tauro	33.6	93.9	94.4

[1]In year 1 correspond to freshly produced seeds and in years 2 and 3 to whole seed reserve (seed stock).

Bradyrhizobium sp. strains (Stępkowski *et al*., 2005; Temprano *et al*., 2008), bur medic by *Sinorhizobium meliloti* and *Sinorhizobium medicae* (Charman and Ballard, 2004; Denton *et al*., 2007; Temprano *et al*., 2008), and sub clover by *Rhizobium leguminosarum* bv. *trifolii* (Temprano *et al*., 2008). Observations of nodulating plants in old experimental plots in the same Experimental Center Cauquenes, indicate that the survival and persistence of *Mesorhizobium* and *Bradyrhizobium* in granitic soils is remarkable after 6-8 years of pasture establishment. Also, determination of N fixation using the ^{15}N natural abundance technique showed greater N content in DM and N fixation in yellow serradela cv. Tauro (91 kg N ha^{-1}) compared with bur medic and sub clover (Ovalle *et al*., 2006b). Other study conducted in Australia showed also higher rate of N fixation in yellow serradella than burr medic and sub clover (Sanford *et al*., 1994).

Our results indicate that biserrula and yellow serradela can be used in monoculture or in mixture with other annual legumes, in both pasture-crop rotation and permanent pastures. The use of these species would contribute to the economic and ecological improvement of the prevailing productive systems in the Mediterranean climate region of central Chile (Ovalle *et al.*, 1999).

CONCLUSIONS

The productivity and persistence of serradela and biserrula cultivars are clearly superior to bur medic or sub clover, which are the most common annual legumes seeded in the area. Compared to the reference species, subterranean clover and bur medic, they have higher pasture production, seed yield, hardseededness and persistence. Furthermore, these new species have the advantage that seed harvesting is much easier (and in some species cheaper) compared to bur medic or sub clover, which could facilitate a local production of seeds.

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RESUMEN

Productividad y persistencia de serradela amarilla (*Ornithopus compressus* L.) y biserrula (*Biserrula pelecinus* L.) en la región climática mediterránea de Chile central. La producción y la sostenibilidad de las praderas de secano en la región de clima mediterráneo de Chile central están actualmente limitadas por la baja diversidad de especies valiosas y cultivares de leguminosas forrajeras anuales, capaces de persistir en zonas con precipitaciones anuales sumamente variables, y suelos de baja fertilidad o de mal drenaje. En este trabajo se evaluó la producción de fitomasa, producción de semilla, dureza seminal y la persistencia de cultivares de serradela amarilla (*Ornithopus compressus* L.) y biserrula (*Biserrula pelecinus* L.), en experimentos de campo conducidos en la región mediterránea subhúmeda de Chile. La hualputra (*Medicago polymorpha* L.) y el trébol subterráneo (*Trifolium subterraneum* L.) fueron utilizados como especies de referencia. La producción de fitomasa y de semillas fue considerablemente más alta en biserrula (cvs. Mor96 y Casbah), y en algunos cultivares de serradella amarilla (e.g. Madeira y Santorini); biserrula produjo el mayor número de semillas por m^2. Como era esperable en especies que presentan niveles muy altos de semillas duras, la recuperación de la pradera en el segundo año fue débil, pero la densidad de plantas y productividad fue alta en la tercera temporada de crecimiento. El uso de biserrula y serradela en monocultivo o en mezcla con otras leguminosas anuales, tanto en rotación con cultivos como en praderas permanentes, podrá contribuir al mejoramiento de los sistemas productivos en la región mediterránea de Chile central.

Palabras clave: dureza seminal, densidad de plantas, espinal, leguminosa anual, producción de semillas.

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