

ARROWLEAF CLOVER (*Trifolium vesiculosum* Savi): A NEW SPECIES OF ANNUAL LEGUMES FOR HIGH RAINFALL AREAS OF THE MEDITERRANEAN CLIMATE ZONE OF CHILE

Carlos Ovalle M.^{1*}, Alejandro del Pozo², Fernando Fernández³, Jorge Chavarría¹,
and Susana Arredondo¹

ABSTRACT

The present review examines the main attributes and agronomic characteristics of arrowleaf clover (*Trifolium vesiculosum* Savi) and its incorporation into production systems in dryland areas of the Andean foothills of the humid Mediterranean climate zone of Chile. It is a new species of annual legume in Chile for light and medium textured soils. The root system can reach a depth of 1.5 m and its seeds have a high percentage of hardseedness (99.8%). It is an upright plant, with purplish-white flowers. The mature plant has large arrow-shaped leaves up to 50 mm long, often marked with a large white "V". Dry matter and seed production in the Andean foothills is high (3.9-8.8 t DM ha⁻¹ and 700-900 kg ha⁻¹, respectively), surpassing the productivity of sub clover (*Trifolium subterraneum* L.) cv. Mount Barker and crimson clover (*Trifolium incarnatum* L.). However, DM production in the second year was lower, possibly because the high percentage of hardseedness inhibited plant emergence. The phenological records and productive performance suggest that arrowleaf clover could contribute to improving pastoral production in dryland areas with annual rainfall levels of more than 800 mm, such as the Andean foothills in the central-southern region of Chile.

Key words: *Trifolium vesiculosum*, arrowleaf clover, annual legume pastures, dryland Andean foothills, Mediterranean pastures.

INTRODUCTION

Historically, seeding Mediterranean climate pastures in Chile has been characterized by a limited diversity of species and cultivars in the market. From the 1950s until only a few years ago, the subterranean clover (*Trifolium subterraneum* L. *sensu lato*), and the crimson clover (*T. incarnatum* L.) were the most important annual legumes for forage. By the late 1980s work began to domesticate the naturalized Chilean germplasm of burr medic (*Medicago polymorpha* L.) (Ovalle *et al.*, 1997a; 2001; del Pozo *et al.*, 2001; 2002) and seeds were commercially available in Chile from 1995. Later, balansa clover (*T. michelianum* Savi) was introduced in 1997 and sold commercially. This species is highly tolerant to water logging and therefore

suitable for clay soils with problems of inundation during winter (Ovalle *et al.*, 1997b). Diversification of fodder legumes has continued with the introduction of the yellow and pink serradellas (*Ornithopus compressus* L. and *O. sativus* Brot.) (Rojas *et al.*, 2002; Ovalle *et al.*, 2003; 2006) and the biserrula (*Biserrula pelecinus* L.) (Ovalle *et al.*, 2004). Nevertheless, of these last three species, only *O. sativus* cv. Cádiz is available in the national market for mixed fodder.

New species of fodder legumes suitable for environments of high precipitation and low temperatures during late autumn-winter are required for areas like the Andean foothills of Chile. With an altitude between 300 and 600 m.a.s.l, deep trumaos soils, a humid Mediterranean type climate with an annual rainfall of over 1100 mm, the Andean foothills have the strongest potential for livestock of any area in central southern Chile. Despite the natural potential, this advantage has not yet been utilized by livestock producers, because of the low productivity of existing pastures. Systems of calf and sheep-raising are based more on the use of stubble or natural pasture than on self-seeding between the two sequences of cereal crops. Moreover, in intensive

¹Instituto de Investigaciones Agropecuarias INIA, Casilla 426, Chillán, Chile. *Corresponding author (cvalle@inia.cl).

²Universidad de Talca, Facultad de Ciencias Agrarias, Casilla 747, Talca, Chile.

³Instituto de Investigaciones Agropecuarias INIA, Casilla 165, Cauquenes, Chile.

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rotations of wheat (*Triticum aestivum* L.) and oats (*Avena sativa* L.), or wheat and rapeseed (*Brassica napus* L.), there is no space for good pastures capable of sustaining productive and profitable livestock (Rodríguez *et al.*, 1992). Consequently, alternative grasslands are required and the arrowleaf clover (*Trifolium vesiculosum* Savi), recently introduced to the country, could be an interesting option for integration into productive systems in the humid Mediterranean zone.

The present review describes the main attributes and agronomic characteristics of the arrowleaf clover and analyzes the productivity and persistence of this species in volcanic and slightly acidic soils in the humid Mediterranean zone of Chile.

CHARACTERISTICS OF THE PLANT AND ITS IMPORTANCE AS A CROP

The arrowleaf clover is an annual legume, originating from the Balkan Peninsula, the Crimea and the Caucas (Duke, 1981; Oram, 1990; Evans, 2006). It is currently distributed over a much wider area in Europe and western Asia, in countries such as Greece, Turkey, the Ukraine and southern Russia (Thompson, 2005). The plant is semi-erect with hollow stems of up to 1.5 cm in diameter and large trifoliate leaves, arrow-shaped, with a large V-shaped white mark. The flowers are purplish-white. Flowering period is extended for 1-2 months. Reproduction is by cross-pollination by bees. The seeds are brown, yellow or green and weigh around 1.2 mg, which is slightly more than the seeds of the balansa or Persian clovers, but less than those of *T. incarnatum*, *T. subterraneum* or

T. hirtum All. One of its main characteristics is a taproot system (1.5 m) which allows to extract nutrients and water from deeper soil layers, extending its growth period and allowing it to remain green for longer than any other annual pasture species or traditional legumes (Oram, 1990; Thompson, 2005; Loi *et al.*, 2005; Evans, 2006). The roots of the arrowleaf clover extend 20 to 25% deeper than the roots of the subterranean clover, reaching a depth of 0.8 to 1.5 m (Loi *et al.*, 2005).

The arrowleaf is adapted to a wide range of soils. However, the best results have been obtained in well drained soils that are neutral or acidic, with a pH of 6.0 to 7.0 (Caddel and Redmon, 1995; Evans, 2006). Nevertheless, there are cultivars that withstand up to pH 4.5 (Oram, 1990; Snowball *et al.*, 2005; Evans, 2006). When it is planted in calcareous soils it presents chlorosis, which is a symptom of Fe deficiency (Frame, 2007). It does not tolerate soils with poor drainage (Gibberd *et al.*, 2001) and is extremely sensitive to edaphic salinity (Rogers *et al.*, 2007).

It is the most important annual clover cultivated in the USA, covered 2.5 times as many hectares as the crimson clover, which is the second most important species in the country (Evans, 2006; Frame, 2007). It is used there mainly as winter pasture and cover crop. It is also an important species in western Australia, as well as countries in Mediterranean Europe (Rizzo, 1995; Restle *et al.*, 2000; Snowball *et al.*, 2005), Uruguay, Brazil and Portugal. Its importance and advantage against subterranean clover lies in the fact that flowers and seeds are developed on the top of the canopy facilitating seed harvest by combine harvester (Evans, 2006).

Table 1. Phenology of *Trifolium vesiculosum* cv. Seelu in comparison to other Mediterranean fodder legume species studied in Chile.

| Species | Cultivar or accession | Days to first bloom | Days to first fruit | Days to maturation |
|---|-----------------------|---------------------|---------------------|--------------------|
| <i>Medicago polymorpha</i> | Cauquenes INIA | 111 ± 2.3 P | 129 ± 2.3 | 174 ± 4.4 |
| <i>Ornithopus compressus</i> | Madeira | 124 ± 4.0 I | 136 ± 0.6 | 179 ± 6.4 |
| <i>O. compressus</i> | Ávila | 143 ± 6.4 T | 156 ± 2.0 | 190 ± 2.3 |
| <i>O. sativus</i> | Cádiz | 135 ± 1.7 T | 147 ± 0.0 | 182 ± 0.0 |
| <i>Trifolium michelianum</i> | Paradana | 136 ± 2.3 T | 150 ± 2.3 | 172 ± 0.6 |
| <i>T. resupinatum</i> | Kymbro | 153 ± 2.3 MT | 162 ± 2.0 | 185 ± 3.5 |
| <i>T. subterraneum</i> | Seaton Park | 111 ± 2.3 P | 125 ± 2.3 | 189 ± 4.0 |
| <i>T. subterraneum</i> var. <i>yanninicum</i> | Gosse | 127 ± 2.3 I | 136 ± 0.6 | 187 ± 5.7 |
| <i>T. subterraneum</i> var. <i>brachycalcynum</i> | Clare | 130 ± 2.3 I | 154 ± 3.5 | 188 ± 2.3 |
| <i>T. subterraneum</i> | Mount Barker | 140 ± 9.1 T | 152 ± 4.0 | 195 ± 3.5 |
| <i>T. vesiculosum</i> | Seelu | 160 ± 4.6 MT | 175 ± 3.0 | 200 ± 2.3 |

Values are averages of three replicates ± standard deviation.

¹Precocity classification (days to blooming): MP: very early (< 101); P: early (102-117); I: intermediate (118-133); T: late (134-149); MT: very late (150-165).

Source: Ovalle *et al.* (2003).

AGRONOMIC CHARACTERISTICS

Phenology

The arrowleaf is one of the most recent clovers introduced in Mediterranean Chilean environments by the Instituto de Investigaciones Agropecuarias, INIA (Ovalle *et al.*, 2003). Assessments made in the sub-humid Mediterranean zone around Cauquenes (35°58' S; 72°17' W; mean precipitation 657 mm) showed 160 days from emergence to flowering for cv. Seelu, which is 20 days longer than the subterranean clover cv. Mount Barker (Ovalle *et al.*, 2003) (Table 1). Another cultivar, Zulu II, has similar phenology to cv. Seelu. According to evaluation conducted in Australia, cv. Cefalu emergences 20 days before the two cultivars mentioned above (Snowball *et al.*, 2005).

Growth and phytomass production

Seedlings vigor during establishment is high however winter growth is lower compared with other species of the genus *Trifolium* (Caradus, 1994; Evers, 1999). In Australia, arrowleaf clover has lower winter production than the subterranean clover, balansa clover and Persian clover (*T. resupinatum* L.), however spring production is higher (Evans, 2006). Also in Australia, dry matter production of arrowleaf clover cv. Arrotas (between September 15th and November 25th) was 9.6 t MS ha⁻¹, which was significantly higher than that of balansa clover cv. Bolta (6.1 t MS ha⁻¹), Persian clover cv. Nitro (6.4 t MS ha⁻¹) or subterranean clover cv. Leura (1.1 t MS ha⁻¹) (Riffkin *et al.*, 2001).

Evaluations conducted in the Andean foothills of Chile (36°49' S, 71°45' W, 340 m.a.s.l., mean precipitation of 1100 mm) between 2000 and 2003, arrowleaf clover cv. Seelu produced 3.9 t DM ha⁻¹ in the year of establishment, being significantly higher ($P \leq 0.05$) than

that of subterranean clover cv. Mount Barker (Table 2). Production in the second season was lower because its high percentage of hard seeds, but in the third growing season production increased to 4.9 t MS ha⁻¹, similar to that of the yellow serradella cv. Ávila, and much higher than that of Mount Barker (Table 2). In another trial in the same area, the average dry matter production of arrowleaf clover cv. Zulu II on two consecutive years (2005 and 2006) was 8.2 t dry matter ha⁻¹, surpassing the production of subterranean and crimson clover (Table 3). The frost tolerance is apparently high since only 10% of the plants exhibited frost damage, which was slightly superior to the 3% observed in subclover cv. Mount Barker (Ovalle *et al.*, 2005).

The arrowleaf clover presented high nodulation (100% of the plants) in volcanic soils (Ovalle *et al.*, 2005) and probably a high capacity for fixing N. Studies in Australia report production levels of 16.7 kg N t⁻¹ MS (Bowman *et al.*, 2004).

Nutritive value

Arrowleaf clover forage has a high palatability and nutritive value (Tekeli *et al.*, 2005). The crude protein content, especially in full foliation, varies between 15 and 22% in the Australian cultivars Cefalu, Seelu, Zulu II and Arrotas (Riffkin *et al.*, 2001; Snowball *et al.*, 2005). The variation in crude protein content of cv. Arrotas between winter and summer was 29.9 to 15.6%, and the digestibility of dry matter varied between 77.8 and 53.8%, respectively (Riffkin *et al.*, 2001). Digestibility decreased with maturity, associated with increased fiber content and the stem: leaf ratio. Data obtained in the Andean foothills indicate that at flowering the crude protein content is 22.3% crude protein, 22% of acid detergent fiber, and 2.4 Mcal kg⁻¹ of metabolized energy (Hahn, 2007).

Table 2. Phytomass production in arrowleaf clover over three season (2000-2002) in comparison to other clovers, in the Andean foothills of the Bio Bío Region.

| Species | Cultivar | Dry matter | | | |
|-------------------------------|-----------|-------------------------------------|---------------|---------------|---------------|
| | | 2000 | 2001 | 2002 | Total |
| | | t ha ⁻¹ yr ⁻¹ | | | |
| <i>Ornithopus compressus</i> | Ávila | 3.049b ¹ | 1.691bc | 5.190a | 9.930a |
| <i>O. compressus</i> | Madeira | 1.224c | 2.036b | 4.785a | 8.045b |
| <i>O. sativus</i> | Cadiz | 1.555c | 2.537ab | 0.271d | 4.363d |
| <i>Trifolium subterraneum</i> | M. Barker | 2.583b | 2.154ab | 3.280b | 8.017b |
| <i>T. michelianum</i> | Paradana | 1.018c | 2.825a | 1.861c | 5.704c |
| <i>T. resupinatum</i> | Kymbro | 1.661c | 1.229c | 1.169c | 4.059d |
| <i>T. vesiculosum</i> | Seelu | 3.916a | 0.625c | 4.876a | 9.417a |

¹Different letters in the same column indicate differences according to Duncan test ($P \leq 0.05$).
Source: Ovalle *et al.* (2005).

Table 3. Biomass production in arrowleaf clover in comparison to other annual clovers, in the Andean foothills of the Bío Bío Region, during the seasons 2005 and 2006.

| Species | Cultivar | Dry matter | |
|------------------------------|--------------|-------------------------------------|---------|
| | | 2005 | 2006 |
| | | t ha ⁻¹ yr ⁻¹ | |
| <i>Trifolium vesiculosum</i> | Zulu II | 8.830a ¹ | 7.586ab |
| <i>T. incarnatum</i> | Corriente | 3.378c | 3.372d |
| <i>T. subterraneum</i> | Mount Barker | 0.6204b | 4.580cd |
| <i>T. subterraneum</i> | Antas | 7.322ab | 6.298bc |
| <i>T. subterraneum</i> | Denmark | 4.066c | 4.681cd |

¹Different letters in the same column indicate differences according to Duncan test ($P \leq 0.05$).

Source: Hahn (2007).

Seed production and hardseedness

In the Andean foothills seed yield of arrowleaf clover was higher than other annual legume species in seed production, exceeding 700 kg ha⁻¹ in the year of establishment (Table 4), which ensure a seed back for the following years. Because of the high percentage of hardseedness (99%, Ovalle *et al.*, 2003) and persistence after a crop face (Loi *et al.*, 2005; Tonitto *et al.*, 2006; Evans, 2006), the arrowleaf clover is very appropriate for rotation systems with cereals or rapeseed, like the productive systems prevalent in the Andean foothills.

ESTABLISHMENT AND MANAGEMENT

The species can be established with direct seeding in a level soil with adequate moisture (Overman *et al.*, 1992). Seeding can be from the end of summer, with dry seeding, until early autumn with conventional seeding. The key for a good establishment in the Andean foothills, an area with frequent frosts, is, to sow as early as possible to reduce the risk of dislodging emerging seedlings. The temperature should be at least 15 °C for a good germination and development of seedlings (Evers, 1980). The recommended seed doses, first scarified and inoculated, is 7-11 kg ha⁻¹ (Miller and Wells, 1985; Evans, 2006), which should be planted at a depth of no more than 1 cm. Between 3 and 6 kg ha⁻¹ is also recommended to establish a pasture with a mix of other annual legumes, such as subterranean clover, or in association with grasses. For seed production 5 to 10 kg ha⁻¹ is recommended and 10 to 20 kg ha⁻¹ is recommended for production of hay or silage (Snowball *et al.*, 2005).

If arrowleaf clover is seeded in a mix with short-cycle annual ryegrass (*Lolium multiflorum* Lam.), it is advisable to use a low doses of grass seed to avoid excessive competition for grazing during the winter. In areas with high rainfall it is recommended planting a perennial ryegrass (*Lolium perenne* L.), given that it would be less

competitive. Winter production can be increased by the presence of the grass and the clover makes an excellent late contribution in the spring until the beginning of winter (Evans, 2006).

The plants that best adapt to intensive grazing systems are those with a creeping growth habit, such as subterranean clover (Evers and Newman, 2008; Ovalle *et al.*, 2008), many composite species and those of the genus *Erodium*, as well as stoloniferous and rhizomatous plants (del Pozo *et al.*, 2006). These plants are capable of maintaining a foliar area compatible with photosynthesis requirements, even when they are intensely grazed. Consequently, they are able to grow back rapidly after cutting or grazing. In contrast, fodder plants with erect growth, such as arrowleaf clover, balansa clover, *Trifolium glanduliferum* Boiss. or serradela, are less tolerant of grazing given that the majority of leaves (and stems) are easily consumed by the animals, affecting their capacity to re-grow (Evers and Newman, 2008; Ovalle *et al.*, 2008).

In an experiment comparing the effect of the season and the number of cuttings on phytomass production of different annual legumes, total phytomass production in two subterranean clover cultivars and *T. glanduliferum* did not differ statistically in comparison to a treatment that was cut only once at the end of the season, owing to the relatively high capacity of these species for recuperation (Ovalle *et al.*, 2008). But late cutting did affect the recovery and consequently total phytomass production of erect growing legumes such as the arrowleaf clover, balansa clover and serradela (Ovalle *et al.*, 2008). High seed yield were determined in uncut pastures of arrowleaf clover and balansa clover, but a delay in cutting from 9 September to 24 October had a notable reduction in seed production, particularly in arrowleaf clover, balansa clover and *T. glanduliferum*. These three species have delayed phenology, with respectively 141 and 130 days from seeding to flowering (Ovalle *et al.*, 2003). The least affected by the cutting

Table 4. Seed production of arrowleaf clover, in comparison to other annual clovers, in the Andean foothills of the Bío Bío Region, during the seasons 2000 and 2001, and 2005.

| Species | Cultivar | Seed production | | |
|-------------------------------|----------------|--------------------------------------|--------------|-------------------|
| | | 2000 | 2001 | 2005 |
| | | kg ha ⁻¹ yr ⁻¹ | | |
| <i>Trifolium subterraneum</i> | Mount Barker | 690b | 610a | 352b ¹ |
| <i>Ornithopus compressus</i> | Ávila | 250c | 280b | 682a |
| <i>T. vesiculosum</i> | Zulu II | 890a | 500ab | 734a |
| <i>T. incarnatum</i> | Corriente | - | - | 224b |

¹Different letters in the same column indicate differences according to Duncan test ($P \leq 0.05$).
Source: Hahn (2007).

season were the subterranean clover (cvs. Antas and Seaton Park) and burr medic, which had the same or higher levels of production at 100 g m⁻² when cutting was carried out on September 24th, and approximately 80 g m⁻² when cuttings on October 9th. Similar results were observed in a study in Texas, USA, with arrowleaf phytomass production of 2480 g m⁻² in treatments with only one cutting at the end of the season; production decreased significantly when there were two cuttings, except in the case of subterranean clover, which increased production with the cuttings owing to its habit of prostrate growth (Evers and Newman, 2008).

In summary, for the appropriate grazing management, there should be a balance between the efficient use of forage and seed production, given that the latter is the basis for regenerating and persistence of the pasture. In order to maximize the seed bank it is necessary, overall in the first year, not to graze the clover pasture from the beginning of flowering until the end of spring. Close to maturity, when the nutritive value is still high (end of January-February) the pasture should be grazed when the seeds are already dry. The optimal level of residual forage should be near to zero at the beginning of the first autumn rains in order to achieve better regeneration. Heavy summer grazing should not affect the seed bank given that a high percentage of the seeds survive passage through the digestive tracks of the animals and consequently return intact to the soil. The species is highly palatable as pasture forage, hay or silage (Evans, 2006).

Forage conservation

Its rapid growth in spring and the beginning of summer, its habit of erect growth, its good recovery after cutting and its high digestibility, all make the arrowleaf clover appropriate for hay and silage. In zones with high precipitation and long growing seasons, growth is sufficient for two cuttings without severely affecting the seed bank. The arrowleaf clover has good growth after cutting for hay or silage (Evans, 2006).

DESCRIPTION OF CULTIVARS

Four cultivars are currently being marketed in Australia, of which Cefalu is early flowering, Seelu and Zulu II are late flowering, and Arrotas is classified as very late flowering. In the USA the cultivar Yuchi is early flowering, Amclo is intermediate, and Meechee late (Hoveland, 1995). Here we only describe briefly the Australian cultivars that eventually can be available in Chile. Three of these (Seelu, Zulu II and Cefalu) have been assessed in the INIA Mediterranean forage program.

Cefalu

Cefalu grows around Perth in Western Australia (31°96' S; 115°84' W). It flowers 135 days after seeding, approximately two weeks before 'Seelu' and 'Zulu II' and six weeks before cv Arrotas, (Snowball *et al.*, 2005). Phenological assessments of this cultivar in Chile indicate a similar behavior to that in Australia, with 140 days between emergence and flowering (Ovalle *et al.*, 2007). It has an early prostrate growth, but is erect during the spring; reaching a height of 1.2 m. Cefalu produces thick stems and large leaves. It has deep roots that extend to a depth of 1.5 m, which results in it producing forage for much longer than other grasses, giving it an added value. It has a high level of seed production and a high percentage of hard seeds, which makes it an excellent alternative for rotation with other crops. Cefalu is adapted to zones with more than 400 mm of precipitation annually. It is highly tolerant to acidic soils (pH 4.5) but is not tolerant of prolonged conditions of water-logging or heavy soils. Cefalu can be used as hay, silage or green manure (Seedmark, 2005a; Snowball *et al.*, 2005).

Seelu

Seelu is a late maturing cultivar. It flowers in Cauquenes, in the dry interior of Chile, 160 days after seeding. It shows good growth during the spring and beginning

of the summer, providing excellent forage production. Seelu grows erect with heights of 50 to 100 cm and is appropriated for association with perennial grasses. It is easily harvested either as forage or for its seeds. Seelu adapts to zones with annual precipitation levels of over 800 mm (Evans, 2006).

Zulu II

Zulu II is a semi-late cultivar that is very similar to Seelu. It flowers in Perth (Western Australia) 162 days after seeding. It has a prostrated early growth, beginning to be erect in the spring and reaching a height of 1.2 m. Zulu II has deep roots that can reach a depth of 1.5 m, which allows it to extend its growth period during the summer. It has a high level of seed production and a high percentage of hard seeds, so that it can be used in rotation with other crop. It can adapt to areas with more than 450 mm of precipitation annually. Zulu II has excellent tolerance to acidic soils (pH 4.5 to 7.0) but is intolerant of water-logging conditions and heavy soils. It can be used as hay, silage or green manure, with a crude protein content of 18-22% (Seedmark, 2005b; Thompson, 2005).

Arrotas

Arrotas is a new late cultivar developed in Tasmania, Australia, originating from collections in Italy. Its main characteristic is that it takes better advantage of the long growing season in humid Mediterranean areas than any other leguminous species. Arrotas flowers six weeks after cv. Cefalu. It is highly productive until the end of summer and can produce over 10 t MS ha⁻¹ yr⁻¹ in Hamilton (37°73' S; 142°02' W), Victoria, Australia. It does not produce meteorism in animals. It is moderately tolerant of the cold, sustaining temperatures to -5 °C. It is not tolerant to salinity or poor drainage. The seeds are relatively small, the weight of 1,000 seeds is 1.42 g. Seminal hardness is 96%, because of which scarification is necessary before seeding (Riffkin *et al.*, 2001; Thompson, 2005).

CONCLUSIONS

The arrowleaf clover presents characteristics of tolerance to cold, delayed phenology, high level of seed and phytomass production, small seeds with a high hardseedness, and a strong capacity for fixing nitrogen. All of these are very appropriate attributes that suggest the arrowleaf clover can be successfully integrated into cattle production systems in humid Mediterranean areas. In particular, it could become an important support in areas of the Andean foothills in the central south and south of Chile, where in

five years of assessment it has shown superiority in terms of phytomass and seed production compared to subterranean clover and crimson clover. Arrowleaf clover is more productive and persistent than crimson clover. It is also considered appropriate for both cutting and grazing. However, its erect habit with flowers and seeds developing at the top of the canopy, and its incapacity to bury the seeds, makes it more vulnerable to grazing than subterranean clover, requiring to prevent grazing during the flowering period. Consequently, it seems advisable to integrate it into grazing system in a mix and not as the only species in the pasture. The data available to date on phytomass and seed production make it suitable in Mediterranean climates with annual precipitation levels above 800 mm. Another relevant trait is hardseedness so it can be incorporated as an annual pasture in rotation with cereal or oleaginous crops. It can also be incorporated in association with annual or perennial grasses and other legumes as permanent pasture.

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RESUMEN

Trébol vesiculoso (*Trifolium vesiculosum* Savi): Una nueva especie de leguminosa anual para áreas de alta precipitación en la zona mediterránea de Chile. En la presente revisión se examinan los principales atributos y características agronómicas del trébol vesiculoso (*Trifolium vesiculosum* Savi) y su eventual incorporación a sistemas de producción en la precordillera andina de la zona de clima mediterráneo húmedo de Chile. Se trata de una nueva especie de leguminosa forrajera anual para suelos de textura liviana y media. El sistema radical puede alcanzar 1,5 m de profundidad y las semillas tienen un alto porcentaje de dureza seminal (99,8%). Es una planta de crecimiento erecto, flores de color blanco con una leve coloración púrpura. Las plantas adultas tienen grandes hojas con forma de flecha de más de 50 mm de largo, a menudo muestran una marca blanca en forma de "V". La producción de materia seca y de semillas en precordillera andina es alta (3,9-8,8 t MS ha⁻¹ año⁻¹), superando el rendimiento alcanzado por el trébol subterráneo (*Trifolium subterraneum* L.) cv. Mount Barker y el trébol encarnado (*T. incarnatum* L.). Sin embargo, la producción del segundo año puede ser inferior dado que el alto porcentaje de dureza seminal inhibe la emergencia de plantas ese año. Los antecedentes de fenología y comportamiento productivo sugieren que el trébol vesiculoso podría contribuir al

mejoramiento de la producción pastoral en zonas de secano con precipitaciones anuales superiores a 800 mm, como en la precordillera andina de la zona centro-sur de Chile.

Palabras clave: *Trifolium vesiculosum*, trébol vesiculoso, praderas de leguminosas anuales, secano de precordillera andina.

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