Balansa clover (Trifolium michelianum) - a forage legume for temperate pastures

Craig A.D., Ballard R.A.

in

Sulas L. (ed.).
Legumes for Mediterranean forage crops, pastures and alternative uses

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 45

2000
pages 177-180

Balansa clover (*Trifolium michelianum*) – a forage legume for temperate pastures

A.D. Craig and R.A. Ballard
South Australian Research and Development Institute, GPO Box 397, Adelaide, South Australia, Australia, 5001

Summary - Balansa clover is gaining increasing importance as a pasture legume across southern and eastern Australia. New cultivars are being developed which will broaden the species' adaptation and usage. Research is also being conducted on agronomic issues which impact on the species' performance in the field. This paper presents results from some of this work, details the key attributes of the species, describes the current commercial cultivars and future breeding objectives.

Key-words: balansa, *Trifolium michelianum*, *Trifolium balansae*

Résumé *- Le trèfle balance (Trifolium michelianum) prend actuellement de l'importance dans le sud et l'est de l'Australie. De nouveaux cultivars sont en cours de sélection afin d'élargir les capacités d'adaptation et d'utilisation de cette espèces. Cet article présente les principaux résultats concernant l'amélioration des performances agronomiques et les attributs propres à l'espèce. Il propose également une liste des cultivars disponibles dans le commerce et les futurs objectifs de sélection.*

Mots-clès: Trifolium michelianum, Trifolium balansae

Introduction

Balansa clover (*Trifolium michelianum* Savi syn. *balansae*) is an aerial seeding annual legume, capable of long term persistence in pastures. It is used for a variety of purposes in Australia including rainfed and irrigated pastures or as a hay, silage or green manure crop. It was first released in 1985 (Craig and Beale, 1985) and is now estimated to have been sown on over 1.5 million hectares across southern and eastern Australia.

The development of new cultivars will be reflected in increased utilisation of balansa clover. Two cultivars are commercially available with a third due for release in 2000. This paper documents the key attributes of the species, describes the current cultivars and presents the objectives of the current improvement program.

Species attributes

Balansa clover is a species with broad environmental adaptation. It performs well on a range of soil types and textures. It tolerates a pH range of 5.0 – 8.6 (water basis), although it has been shown to be more sensitive to low pH than subterranean clover cv. Junee (Evans *et al.*, 1990). The species is well adapted to waterlogging and once established, can withstand short periods of inundation. Rogers and West (1993) observed that root growth of balansa clover increased with saline waterlogging, with a significant proportion of new growth occurring as adventitious roots. These roots contained a higher proportion of aerenchyma to facilitate oxygen transport than non-adventitious roots.

Balansa clover possesses moderate salinity tolerance. While balansa clover and subterranean clover cv. Clare seedlings were shown to possess similar salt tolerance at

emergence, established balansa clover plants were far more salt tolerant (Rogers and Noble, 1991). Shoot chloride and sodium concentrations were lower in balansa clover, especially at high salt levels.

Balansa clover is an outcrossing species and populations demonstrate considerable morphological variability, providing the opportunity for the selection of superior cultivars. An experiment which investigated the effects of plant isolation and insect vectors on the seed yield of cv. Paradana demonstrated the importance of both factors in maximising seed production (Table 1). In this experiment six plants were maintained in each of four treatments, either exposed (open) or protected (closed) from pollination by insect vectors while being situated either together (close proximity) or removed from each other by a distance of 20 metres (isolated). Balansa clover flowers are extremely attractive to bees, although it is uncertain if they are an effective pollinator.

Table 1. Effect of plant isolation and insect pollinators on the seed production of cv. Paradana.

Treatment	Mean seed yield (g/plant)
Open + close proximity	13.26
Open + isolated	1.06
Closed + close proximity	0.01
Closed + isolated	0.01
L.S.D. (*P*=0.05)	1.02

Cultivars

Three balansa clover cultivars have been developed in Australia; Frontier, Paradana (Anon., 1990) and Bolta (Craig, 1998). Frontier is the earliest maturing cultivar, flowering 2 –3 weeks earlier than Paradana and four weeks earlier than Bolta in southern Australia. The three cultivars have been developed for low (350 – 500 mm pa), medium (500-600 mm pa) and high rainfall (600 + mm pa) zones respectively. Paradana and Bolta are commercially available while Frontier will be released in early 2000. The advantages of cv. Frontier in a low rainfall district are evident in data presented in Table 2.

Table 2. Early season herbage production, seed yield and regenerative capacity of Frontier, Paradana and Bolta balansa clover at Keith (465mm pa), South Australia. Trial sown 1998.

Cultivar	June - October herbage production (kg/ha) 1998	Seed yield (kg/ha) 1998	Seedling regeneration (plants/m^2) 1999
Frontier	4567	842	3028
Paradana	3067	465	730
Bolta	2834	106	174
L.S.D. (*P*=0.05)	470	187	388

Frontier's early maturity should also prove advantageous in saline environments. Despite the existence of adequate moisture, late maturing cultivars are often disadvantaged in saline areas as their flowering coincides with high soil and ambient temperatures, and an associated escalation in soil salinity. This severely limits the seed production of annual species. Frontier

will partially avoid this problem by setting seed prior to the rapid increase in salt levels. Subsequent regeneration should be significantly enhanced.

All three cultivars are capable of excellent seed yields under favourable conditions. They produce very small seeds ($8.5 \times 10^5 - 1.2 \times 10^6$/kg) and have a high level of hard seeds (av. 98%) at maturity, falling to approximately 50% by mid-April. Squella and Carter (1996) have demonstrated that balansa clover seed has the ability to survive ingestion by sheep by virtue of its small size and hardseeded nature.

Frontier, Paradana and Bolta contain low levels (av. 0.02 – 0.08 % DM) of the isoflavone formononetin, while genistein and biochanin A have not been observed. No cases of infertility have been reported from sheep or cattle grazing balansa clover. All three cultivars are susceptible to redlegged earth mite (*Halotydeus destructor* Tucker) and lucerne flea (*Sminthurus viridis* L.) while being highly tolerant to clover scorch (*Kabatiella caulivora* [Kirchn. (Karak)]) disease.

Balansa clover nodulates effectively with a range of commercial clover inoculants (*Rhizobium leguminosarum* bv. *trifolii*). An assessment of the effectiveness of three commercial strains (Group C, Group CS and Group B) indicated little difference in their performance on the three cultivars (Table 3). Where inoculation is required, commercial Group CS (WSM 409) is recommended.

Table 3. Effect of inoculation treatment on shoot dry weight (mg/plant) of Frontier, Paradana and Bolta balansa clover.

Inoculation treatment	Cultivar		
	Frontier	Paradana	Bolta
Nil	6	8	6
Nitrogen	366	322	344
Group C (WU 95)	152	159	186
Group CS (WSM 409)	160	175	175
Group B (TA 1)	158	166	191
WSM 1328	155	200	206
CC 4334	143	166	193
LSD (P=0.05) = 31			

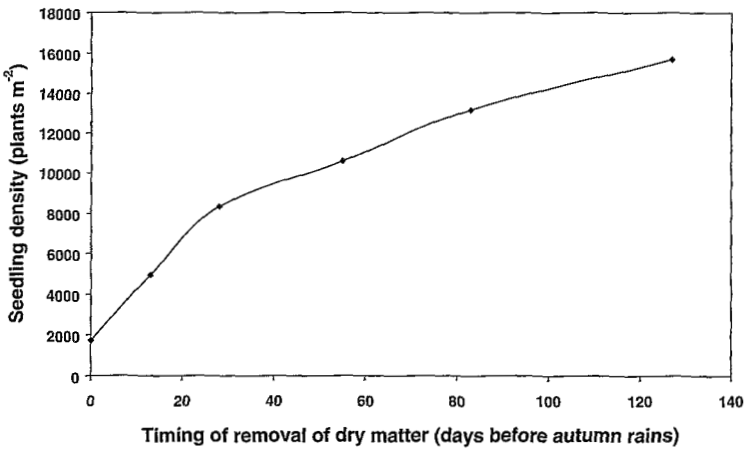

Figure 1. Effect of timing of removal of dry matter on the subsequent regeneration of Paradana balansa clover seedlings.

Appropriate grazing management of balansa clover is pivotal to its success. Of particular importance is the requirement to remove excess dry matter from the pasture by grazing over summer, and prior to the opening autumn rains in the following season. Seedling establishment is enhanced when residual dry matter is removed soon after seed maturity (Figure 1). Removal of dry residue may be increasing the proportion of soft seeds by exposing seed to greater extremes of temperature. It is also possible that removing the dry balansa clover may be minimising possible allelopathic effects. Halsall et al. (1995) have observed reductions in the germination rates of balansa clover when exposed to extracts of wheat and phalaris residues.

Conclusions

The development of new cultivars and a better understanding of the factors which influence their performance should result in greater use of balansa clover in Australia. The current improvement program is seeking to further exploit the species' potential by developing new cultivars which alleviate existing deficiencies or are better adapted to environmental conditions. Present objectives include the development of later maturing lines, softer seeded cultivars, earlier maturing cultivars for areas receiving less than 350 mm rainfall per annum, and cultivars with increased winter vigour. Where possible, sources of pest and disease tolerance will also be identified.

Despite the relatively low number of accessions held in Australian Genetic Resource Centres, the majority of lines appear extremely diverse, presenting an opportunity for the selection of superior types. Significant progress has already been made toward achieving some of the stated objectives and new cultivars can be anticipated within the next few years. Further plant collection missions are planned to extend the existing collection of balansa clovers.

References

Anon. (1990). Paradana balansa clover. In "Register of Australian Herbage Plant Cultivars". Ed. R.N.Oram, CSIRO Australia: Melbourne.

Craig, A.D. (1998). Bolta balansa clover. *Austr. J. of Exp. Agric.* 38, 531-2.

Craig, A.D., Beale, P.E. (1985). Balansa clover – a new pasture species. In: *Proc. of 3rd Australian Agronomy Conference*, Hobart, Australia, 201.

Evans, J., Dear, B., O'Connor, G.E. (1990). Influence of an acid soil on the herbage yield and nodulation of five annual pasture legumes. *Austr. J. of Exp. Agric.* 30, 55-60.

Halsall, D.M., Leigh, J.H., Gollasch, S.E., Holgate, M. (1995). The role of allelopathy in legume decline in pastures. II. Comparative effects of pasture, crop and weed residues on germination, nodulation and root growth. *Austr. J. of Agric. Res.* 46, 189-207.

Rogers, M.E., Noble, C.L. (1991). The effect of NaCl on the establishment and growth of balansa clover (*Trifolium michelianum* Savi Var. *balansae* Boiss.). *Austr. J. of Agric. Res.* 42, 847-857.

Rogers, M.E., West, D.W. (1993). The effects of rootzone salinity and hypoxia on shoot and root growth in *Trifolium* species. *Ann. of Bot.* 72, 503-509.

Squella, F., Carter. E.D. (1996). The significance of seed size on survival of some annual clover seeds in sheep pastures in South Australia. In: *Proc. of 8th Australian Agronomy Conference,* Toowoomba, Australia, 510-513.