EARLY FLOWERING BALANSA CLOVERS FOR THE CEREAL-LIVESTOCK ZONE

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Abstract

The development of small, aerial-seeding annual pasture legumes presents a major opportunity to improve the productivity and profitability of the cropping and livestock industries in the cereal-livestock zone. One component of this work involves a nationally coordinated effort to develop a new early flowering balansa clover cultivar/s which flowers 2-3 weeks earlier than the current commercial cultivar, Paradana. Results to date indicate that 30 early flowering selections are flowering between 103 and 106 days after sowing, compared with Paradana (121 days), Prolific Persian clover (123 days) and Nitro Plus Persian clover (124 days). The early flowering selections appear to be producing as much or more dry herbage as Paradana, while containing low levels of formononetin. The lines appear more tolerant to *Pythium* than Paradana. Seed yields are as good or better than those of Paradana. Hardseed levels of the lines range from 35%-66% hard in mid-April. Evidence from field trials also indicates that the early flowering selections possess good waterlogging and salinity tolerance. There are also indications that they possess better grazing tolerance that Paraggio barrel medic.

Key words: Early flowering, balansa clover, pasture legumes.

Paradana balansa clover (*Trifolium michelianum*) was first registered in 1984. Since its release it has made a significant contribution to Australian agriculture and is now estimated to have been sown on at least one million hectares across south eastern Australia. It is presently used for a variety of purposes in both rainfed and irrigated pastures, either as a component of perman-ent pastures, or as a hay, silage or green manure crop. Paradana has proven to be one of temperate Australia's most adaptable pasture legumes, having the capacity to perform on a wide range of soil types and soil conditions.? Paradana grows well on heavy and light textured soils and can tolerate a pH range of 4.8 - 8.3 (H_2O). It is well adapted to waterlogged and saline situations. In addit-ion, it is extremely easy to establish and demonstrates a propensity to spread in established pastures. Paradana has provided producers with a valuable alternative on soil types where traditional legumes fail.

The full potential of balansa clover will be fully realised when a suitable range of maturities exists. Presently only one cultivar is available, Paradana (1), a mid-season variety suited to the 500-600 mm rainfall zone. In 1998 a new late maturing cultivar, Bolta, will become available for use in districts with longer seasons.? However, the need remains to offer producers in low rainfall areas (less than 450 mm p.a.) a cultivar with the ability to regenerate reliably and persist through cropp-ing rotations. The objective of the current program is to develop an early flowering cultivar(s) that flowers 2-3 weeks earlier than Paradana and which is adapted to the 350-450 mm rainfall zone. This has the potential to:

• provide much needed diversification in our pastures;

• increase the utilisation of waterlogged and/or saline soils; and,

• provide a more "grazing tolerant" option than medics (*Medicago* spp.) currently provide.

Materials and methods

The development of an early flowering balansa clover cultivar commenced at Kybybolite Research Centre, South Australia in 1990. Vigorous, early flowering plants from within Paradana were identified and removed so as to minimise cross pollination with the parent. Seed was harvested from these individual plants and resown the following year. Vigorous, early flower-ing plants were again selected from each of these "populations". Two, or in some cases, three further generations of single plant selection subsequently saw the original plants culminate in the development of 55 early flowering lines. These lines were grown in the field in 1995 at Pinnaroo, SA (339 mm pa) and Lameroo, SA (390 mm pa) and screened for flowering date and dry matter production. Thirty of the 55 lines were subsequently selected for further evaluation on the basis of the 1995 data.

Field trials were established in 1996 in Western Australia (2 sites), South Australia (3 sites), Victoria (3 sites) and New South Wales (3 sites). All trials consisted of 3 replicates and were designed to maximise the efficiency of spatial and multi-environment analysis. Trials were sown as pure legume stands. 30 early flowering balansa clover lines were sown with Paradana balansa clover, Nitro Plus Persian clover (*Trifolium resupinatum*) , Prolific Persian clover and, in some instances, appropriate subclover (*Trifolium subterraneum*) and medic controls. All sites were dryland. Measurements collected during 1996 included dry matter production, isoflavone content, flowering date, seed yield, hardseed content, and observations on disease susceptibility, waterlogging and salinity tolerance.

Results

A summary of the 1996 trial data for herbage production, tolerance to *Pythium*, flowering date and seed yield is presented in Table 1. Lines have been compared for herbage production, *Pythium* tolerance and seed yield on a "percentage of maximum" basis. This process allocates a value of 100% to the best performed line at each site. Flowering dates are present-ed as the number of days from sowing. Data from the 11 sites has been pooled to produce this table. An equal weighting has been allocated to each parameter in deriving the "% of maximum" and "relative ranking" columns. This process allows direct comparison across lines, although it should be stressed that none of this data has been analysed.

Dry matter production data presented in Table 1 represents the relative levels of available pasture of the legume component only. It appears that almost all of the early-maturing lines are performing as well if not better than Paradana balansa clover, Nitro Plus Persian clover and Prolific Persian clover. In some situations the early flowering balansa clover lines also outperformed the medic and subclover cultivars (data not presented).

The early flowering lines were susceptible to *Pythium* spp. in South Australian trials in 1996. They appear more tolerant to *Pythium* than Paradana but more susceptible than Nitro Plus or Prolific Persian clover. Conditions at the time of sowing in South Australia were conducive to the onset of *Pythium* (cold and wet). However, despite the incidence of *Pythium*, stands recovered by early spring and proceeded to make good growth and set seed. There has been no reported incidence of *Pythium* in South Australia, or in any other State, during 1997.

Formononetin levels of some early-maturing lines were higher than those for Paradana (0.01% dry matter), although well within acceptable levels so as to ensure no risk of infertility in sheep. Neither genistein nor biochanin A were detected in the balansa clover selections.

The balansa clover selections flowered between 103 and 106 days after sowing. This compares with Paradana (av. 121 days), Prolific (av. 123 days) and Nitro Plus (av. 124 days).

Table 1. Relative performance of the early flowering balansa clover lines during 1996

Line	Dry matter	*Pythium* tolerance	Flowering date	Seed yield	%of maximum	Relative ranking
EBAL 11	80%	76%	103	65%	79%	1
EBAL 05	85%	76%	104	64%	79%	2
EBAL 02	84%	72%	104	57%	77%	3
EBAL 18	79%	72%	104	58%	76%	4
EBAL 21	80%	69%	105	62%	75%	5
EBAL 24	78%	72%	105	60%	75%	6
EBAL 04	81%	67%	105	60%	75%	7
EBAL 30	80%	69%	105	58%	74%	8
EBAL 13	78%	67%	104	52%	73%	9
EBAL 26	81%	65%	105	57%	73%	10
EBAL 19	75%	61%	104	59%	73%	11
EBAL 06	81%	67%	106	57%	73%	12
EBAL 12	76%	59%	103	58%	72%	13
EBAL 17	78%	57%	105	62%	72%	14
EBAL 10	73%	59%	103	56%	72%	15
EBAL 25	73%	59%	105	64%	72%	16
EBAL 29	76%	57%	106	69%	72%	17
EBAL 07	76%	65%	105	56%	72%	18
EBAL 01	77%	57%	104	58%	71%	19
EBAL 09	74%	63%	104	53%	71%	20
EBAL 14	73%	61%	104	54%	71%	21
EBAL 28	80%	59%	106	61%	71%	22
EBAL 23	77%	59%	104	54%	71%	23
EBAL 22	80%	50%	106	67%	70%	24
EBAL 03	72%	59%	105	55%	69%	25
EBAL 20	73%	67%	105	49%	69%	26
EBAL 08	73%	59%	105	50%	69%	27
EBAL 16	75%	56%	104	48%	68%	28
EBAL 27	75%	56%	106	57%	68%	29
EBAL 15	66%	57%	104	52%	67%	30
Prolific	73%	94%	123	32%	52%	31
Paradana	69%	53%	121	51%	47%	32
Nitro Plus	71%	81%	124	30%	46%	33

Data presented in Table 1 suggests that the early flowering lines produced as much or more seed that Paradana. Seed yields were determined at 9 sites during 1996 with one line (EBAL 29) producing an average of 627 kg/ha, while Paradana averaged 515 kg/ha. Nitro Plus and Prolific Persian clover produced poor seed yields.

Hardseed content was determined over the period December 1996 - April 1997. The early flowering selections had initial hardseed levels of between 91% - 99% (mid December), with Paradana being 95% hard. By mid-April hardseed levels of the experimental lines had fallen to between 35% - 66%. This compared with Paradana (51%) and Rivoli disc medic (77%).

Evidence from Western Australian trials indicates that the early flowering lines possess excellent water-logging tolerance. At one site, established plants were able to withstand a period of 8 weeks of soil conditions described as "above moisture holding capacity". These lines have also been grown successfully in situations described as "mildly saline" and where salt sensitive plants have their yield affected.

Limited trial results suggest that the balansa clover selections may have a greater capacity to tolerate hard grazing than medics. At Birchip in Victoria, spelling following hard grazing saw strong recovery from the early maturing selections while barrel medic cv. Paraggio recovered poorly.

Discussion

Balansa clover is recognised as a pasture legume adapted to waterlogged and saline environments. While indications are that the early flowering lines will behave similarly, one of the most pleasing aspects

of the present study is that the experimental lines are also performing well in a number of traditional medic and subclover growing areas. Winter-waterlogging does not appear to be a precursor for their success. Early indications are that other valuable attributes of these lines include the ability to tolerate heavy grazing and an ability to regenerate reliably in the pasture phase of cropping rotations. The latter conclusion has been drawn from observations made on regenerating South Australian trials during 1997 where the medic cultivar Rivoli regenerated poorly relative to the early flowering lines. One issue yet to be resolved relates to the aphid tolerance of the early flowering selections. Aphids have been observed in South Australian trials, however, damage to date has been minimal. This observation contrasts with glasshouse trials which demonstrate the susceptibility of these lines to aphid attack.

The relatively poor performance of the two new Persian clover cultivars, Nitro Plus and Prolific, should be noted. These lines do not appear to flower sufficiently early to be considered contenders to fill the 350-450 mm rainfall niche that the early flowering balansa clover lines are designed to fit. Flowering data suggests that the Persian clover cultivars are better adapted to500 mm+ rainfall environments.

At the conclusion of the evaluation process decisions will be made on:

• the number of lines required to form a commerc-ial release; and,

• the number of cultivars to be released from the program.

With regard to the first matter, consideration will be given to combining more than one line in an effort to overcome any inbreeding depression that may have occurred through the selection process. In regard to the second point, a dual cultivar release will only occur if distinctly different agronomic types are identified.

Conclusion

The 30 early flowering lines are meeting the major objective of being 2-3 weeks earlier than Paradana. A number of these lines appear to be out-performing Para-dana in other important agronomic characteristics.

Acknowledgments

Financial support for the development of the early flowering balansa clover lines has been provided by the South Australian Research and Development Institute, the International Wool Secretariat and the Grains Research and Development Corporation. The technical assistance of all personnel involved in the research program is greatly appreciated.

Reference

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