Developing Well Adapted Early to Midseason Cultivars of Trifoiloum subterraneum ssp. Brachycalycinum

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DEVELOPING WELL ADAPTED EARLY TO MIDSEASON CULTIVARS OF *TRIFOLIUM SUBTERRANEUM* SSP. *BRACHYCALYCINUM*

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ABSTRACT

Development and selection of early to midseason cultivars of subterranean clover (*Trifolium subterraneum* L.) ssp. *brachycalycinum* has mostly involved the use of early generation selection nursery swards (F2-progeny method). Four sites were sown in the mid-North region of South Australia. At the end of 1995, the top 20 lines from each site had burrs (seed pods) sampled at random. The burr will proceed into the final early generation selection phase (1 - 2 years). Dependent on the site, many lines have out-performed the standard checkplot cultivar, Clare. High hardseed levels have also been incorporated into 1989 crossbreds.

KEYWORDS

Trifolium subterraneum, subspecie *brachycalycinum*, hardseed, F2-progeny and crossbreds

INTRODUCTION

Subspecies *brachycalycinum* is a relatively under-developed group compared to the other subspecies of subterranean clover (ssp. *subterraneum* and *yanninicum*). Well-adapted early flowering cultivars of *Trifolium subterraneum* ssp. *brachycalycinum* could provide a major pasture legume in cereal-livestock farming systems of the Mid-north region of South Australia and the long-term pastures of New South Wales (Archer, 1987 a, b) and southern Queensland, Australia. The potential area of use is 5 million hectares of neutral to alkaline red-brown soils. The selection criteria for ssp. *brachycalycinum* lines in South Australia are earlier flowering, more hardseeded, persistent, disease/insect resistant and vigorous lines than Rosedale, Clare and Nuba. In northern NSW, seedling vigour, dry matter production and seed production are considered the most important criteria.

ASCALIP (Australasian Subterranean Clover and Alternative Legume Improvement Program) has implemented the use of early generation selection nurseries (F2-progeny method) to aid the selection of superior crossbred material (Nichols, 1993). The method involves growing plants as swards in realistic farming systems under the influence of natural selection pressures (eg. grazing, cropping and competition). This paper outlines the progress made in South Australian trials since 1993 (de Koning *et al.*, 1993).

METHODS

Approximately 800 crossbred lines have been produced. These are the result of two series of crosses made in 1988 (8 crosses) and 1989 (9 crosses). Parents used in the crossing program had good herbage production, seed production, early flowering, hardseededness and strong winter vigour.

The F2-progeny method involves growing crossbred material in swards for 3 - 4 years (F4 - F6). During that time crossbreds are segregating. The most successful genotype will produce the greatest proportion of seed. Burrs are randomly collected from the top 20 plots at the end of the sward phase. Seed from burrs are sown in rows as spaced plants for 2 years for final selection.

In 1992, the 1988 crossbred lines were sown into selection nursery swards at TRC (Turretfield Research Centre) and Gomersal. 1989 crossbreds were sown at Spalding and Point Pass in 1993. A sowing rate of 20kg ha^{-1} was used at all four sites. Trials were unreplicated, but checkplots (cv. Clare) were positioned every 6th plot throughout. There are 88 checkplots and 396 treatment plots (Total = 484 plots). Treatment plots comprised of crossbred lines, parents of the crosses, commercial subterranean clover cultivars and commercial annual *Medicago* spp. cultivars (Caliph, Santiago and Parabinga). Treatment plots were randomly distributed using PBSYS (Statistical package developed by Rod Kenyon - SARDI, South Australian Research and Development Institute). Plots measured 1.5x2 m with 2 m pathways and were sown using a cone seeder.

TRC and Gomersal sites were cropped in 1993 to barley. Spalding and Point Pass have not been cropped due to poor seasonal conditions at the end of 1993 and the drought in 1994. All sites have been extensively grazed by sheep.

Regeneration, winter production and spring production were scored visually. Results were analysed using *PBSYS.tab* (developed by Rod Kenyon - SARDI). *PBSYS.tab* is a nearest neighbour type analysis and indicates which crossbred lines performed better than the check plot cultivar.

The top twenty plots at each site had burrs sampled randomly from within each plot at the end of 1995. Each burr will be treated as a individual line. Seed from the burrs will be grown under row conditions in 1996 and 1997.

Hard-seededness checks were made on the 1989 crossbred trials at the end of the first pasture year, 1993. One-third of lines were sampled based on previous good performance. The same lines were taken from both sites (Spalding and Point Pass). Commercial cultivars and parents of the crosses were also sampled. Burrs were gently rubbed out by hand between rubber matting and the seed placed into a alternating temperature cabinet 60°C/15°C for 4 months.

RESULTS AND DISCUSSION

In this paper we have presented the percentage of lines that have out-performed the checkplot cultivar (Table 1). Hard-seededness data is presented for the 1989 crosses series (Table 2).

The TRC site generally had a higher proportion of lines which out-performed Clare with time, except for regeneration from seed in 1994 (Table 1). A high percentage of lines out-performed Clare at TRC for regeneration in 1995, which may reflect the earlier flowering of these lines in comparison to Clare and managed to set some seed compared with Clare during the 1994 drought conditions. At Gomersal far fewer lines out-performed Clare, this may be a reflection of the more favourable soil type (heavy textured deep cracking clay) which retained more moisture than the sandy loam at the TRC site, enabling Clare to complete seed set in 1994.

A high percentage of lines outperformed Clare at Point Pass. During the drought year of 1994 Point Pass missed many of the rain showers Spalding received, thus favouring the earlier maturing lines. Clare

was more likely to set seed under the seasonal conditions at Spalding. Spalding (450 mm annual average) on average receives more rainfall than Point Pass (400-420 mm annual average).

Hard-seededness has been incorporated into the 1989 crossbreds (Table 2). Eighty-eight percent was the highest average level of hardseed for Cross 8 at Spalding. Cross 1 had the lowest level of hard-seed at both sites (55% and 45%, Spalding and Point Pass respectively). The low level of hardseed for Parent 5 at Spalding is unusual, we have no explanation. The hard-seededness results only give an indication of the level since the material within a crossbred line is still segregating.

There was no difficulty in selecting the top 20 plots from each site. Hard-seededness has also been successfully incorporated.

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Table 1
The percentage of 1988 crossbred subterranean clover lines (TRC and Gomersal sites, sown 1992) and 1989 crossbred lines (Spalding and Point Pass sites, sown 1993) that outperformed the checkplot cultivar Clare.

		Sites		
Measurement	TRC	Gomersal	Spalding	Point Pass
1. Spring Production, Oct. 1992	30	13	NA	NA
2. Clover scorch (*Kabatiella caulivora*) 18.11.92	35	no scorch	NA	NA
3. Regeneration before crop, July 1993	17	0.5	NA	NA
4. Spring Production, mid Sept. 1993	NA	NA	53	24
5. Spring Production, mid Oct. 1993	NA	NA	33	31
6. Regeneration, early Aug.1994	7*	5*	9	14
7. Spring Production, mid Oct. 1994	29	11	6	51
8. Regeneration, late May 1995	69	20	3	54
9. Winter Production, mid Aug. 1995	75	14	17	59
10. Spring Production, early Oct. 1995	66	15	5	21

* Regeneration from seed after a one year crop.
NA = Not Applicable

Table 2
Average hard-seed levels (percentage after 4 months storage 60°C/15°C) of subterranean clover for the 1989 crosses and parents to the crosses at the end of the first year grown as swards at Spalding and Point Pass in 1993.

	Sites	
Cross/parents	Spalding	Point Pass
CROSS 1	55.4	44.6
CROSS 2	66.6	75.3
CROSS 3	68.9	71.8
CROSS 4	68.6	80.1
CROSS 5	79.7	80.2
CROSS 6	53.1	49.7
CROSS 7	85.1	79.9
CROSS 8	88.4	84.7
CROSS 9	86.6	79.6
PARENT 1	53.5	48.3
PARENT 2	95.1	94.6
PARENT 3	80.2	76.4
PARENT 4	78.7	67.9
PARENT 5	32.9	79.6
PARENT 6	56.0	74.3
PARENT 7	92.6	97.4
Rosedale	63.9	83.9
Clare	38.7	23.1