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

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Summary. Development and selection of early to midseason cultivars of *Trifolium subterraneum* 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 will have burr 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.

INTRODUCTION

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 and southern Queensland (1, 2). The potential area of use is 5 million hectares of neutral to alkaline red-brown soils. Rosedale is currently the earliest maturity cultivar available. Subspecies *brachycalycinum* is a relatively under-developed group compared to the other subspecies of subterranean clover (ssp. *subterraneum* and *yanninicum*). The selection criteria for ssp. *brachycalycinum* lines in South Australia are earlier flowering, more hardseeded, persistent, disease resistant, 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 (3), while early flowering is of less importance.

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. This method of selection is different to the previous selection technique (Pedigree selection), which was labour intensive and involved plants grown as undefoliated spaced plants (5). The ssp. *brachycalycinum* program is comparing the pedigree and F2-progeny methods, and in addition, the use of the F2-bulk method (5). Both F2-progeny and F2-bulk involve growing plants in swards under realistic farming systems where they will be influenced by natural selection pressures (eg. grazing, cropping and competition).

MATERIALS AND 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.

Selection and evaluation procedures

Seed multiplication of 1988 and 1989 crosses (4) were made in 1991 and 1992 respectively. The three selection methods have been described in detail (4).

In 1992, the 1988 crossbred lines were sown into selection nursery swards at TRC (Turretfield Research Centre) and Gomersal. The 1989 crossbreds were sown into selection nursery swards at Spalding and Point Pass in 1993. A sowing rate of 20 kg/ha was used at all four sites. Trials were unreplicated, but checkplots were positioned every 6th plot throughout. The checkplot cultivar was Clare. Clare was chosen since it is still widely grown. There are 88 checkplots and 396 treatment plots. Treatment plots

comprised of crossbred lines, parents of the crosses and commercial subclover cultivars. At Spalding and Point Pass, three commercial *Medicago* spp. (annual medic) cultivars (cvv. Caliph, Santiago and Parabinga) were included. Treatment plots were randomly distributed using *PBSYS* (Statistical package developed by Rod Kenyon - SARDI, South Australian Research and Development Institute). Each site had a total of 484 plots, each plot was surrounded by 2 m pathways. Plots measured 1.5x2 m and were sown using a cone seeder.

Due to the exceptional season during 1992 the TRC and Gomersal site 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.

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, the checkplots provide an indication to any across site trends and the analysis adjusts the treatment plot means accordingly. The analysis indicates which crossbred lines performed better than the check plot cultivar.

All trials are in their final year of sward evaluation. The top twenty plots at each site will be identified at the end of 1995 and burrs will be sampled at random from within the selected plots. Initially each burr will be treated as a individual line. Seed from the burrs will be grown under row conditions in 1996 for the final selection phase of early generation material. The Pedigree method and F2-bulk methods have progressed in the mean time, only 1988 crossbreds being used. F2-bulks were sown in swards at TRC and Gomersal in 1992 and pedigree selection has proceeded at TRC each year since 1991.

Hard-seededness checks were made on the 1989 crossbred F2-progeny trials at the end of the first pasture sward year, 1993. Due to the numbers involved not all crossbred line plots were sampled, 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 $60^{o}C/15^{o}C$ for four months.

RESULTS AND DISCUSSION

In this paper we will present the percentage of lines that have out-performed the checkplot cultivar (Tables 1, 2). Hard-seededness data will be presented for the 1989 crosses series (Table 3).

There is a contrast between TRC and Gomersal (Table 1). The TRC site generally had a higher proportion of lines which out-performed Clare with time, except for regeneration in 1994. A high percentage of lines out-performed Clare at TRC for regeneration 1995, this may reflect that those lines flowered much earlier than 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) retained more moisture than the sandy loam at the TRC site, enabling Clare to complete seed set in 1994.

Table 1. The percentage of 1988 crossbred lines that out-performed the checkplot cultivar.

	Sites	
Measurement	Turretfield R. C.	Gomersal
1. Spring Production, October 1992	30%	13%

2. Clover scorch (*Kabatiella caulivora*), 18.11.92	35%	No Scorch
3. Regeneration before crop, July 1993	17%	0.5%
4. Regeneration/early winter production score, after crop, early August 1994	7%	5%
5. Spring production, 17.10.94	29%	11%
6. Regeneration, late April early May 1995	69%	20%

Results for Spalding and Point Pass (Table 2) also reflect a contrast between sites for the percentage of lines that out-performed Clare. Point Pass during the drought year of 1994 missed many of the showers of rain 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).

Table 2. The percentage of 1989 crossbred lines that out-performed the checkplot cultivar.

	Sites	
Measurement	Spalding	Point Pass
1. Spring production, Mid September 1993	53%	24%
2. Spring Production, Mid October 1993	33%	31%
3. Regeneration/early winter production, late July 1994	9%	14%
4. Spring Production, Mid October 1994	6%	51%
5. Regeneration, late May 1995	3%	54%

Hard-seededness has been incorporated into many of the 1989 crossbreds (Table 3). Cross 1 had the lowest level of hard-seed at both sites (55% and 45%, Spalding and Point Pass respectively). Eighty-eight percent was the highest average level of hardseed for Cross 8 at Spalding. 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.

Table 3. Average hard-seed levels (percentage after 4 months storage 60°C/15°C) 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

Results reflect at this stage that there will be no difficulty in selecting the top 20 plots from each F2-progeny site. Hard-seededness has also been successfully incorporated.

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