

## **Selection of localised strains of *trifolium subterraneum* var. *brachycalycinum* adapted to a summer rainfall environment**

G.M. Lodge

NSW Agriculture, Agricultural Research Centre, RMB 944, Tamworth NSW 2340

*Summary.* Seed was collected from 19-28 year-old stands of *Trifolium subterraneum* var. *brachycalycinum* cv. Clare in northern NSW. Plants grown from this seed had either higher numbers of seeds per burr than Clare, and seed weights > 6 mg, or hardseed levels > 70% after 6 months storage at 25/25°C, and > 40% after a further 6 months storage at 25/45°C. From the material collected 23 individual strains were selected for further evaluation. Only four selections met all of these criteria and these will be compared in both ley and native pastures at Tamworth in northern NSW in autumn 1993.

### **Introduction**

Farmer experience in northern NSW indicated that soft-seeded subterranean clover cultivars such as *Trifolium subterraneum* var. *subterraneum* Woogenellup and Mount Barker, and *T. subterraneum* var. *brachycalycinum* Clare have good persistence when oversown into native perennial grass pastures. Previous studies (5) showed that the cover provided by such grasses reduced temperature fluctuations, slowing the rate of hardseed breakdown. However, when these legumes were sown into a prepared seedbed without a companion grass, in long-term ley pasture rotations with cereal crops, their seed reserves declined rapidly (2, 3).

A study of plants grown from seed collected in old monoculture stands of Clare (4) found strains that were morphologically indistinguishable from Clare, but differed markedly in ecologically important characters such as number of seeds per burr, seed weight and hardseededness. It was proposed that these divergent strains evolved over a relatively short period of time by natural selection operating on genetic diversity within Clare in a summer rainfall environment that would normally be marginal for the persistence of soft-seeded subterranean clover cultivars. By selecting for desirable ecological characteristics the strains that developed may be better adapted to a summer rainfall zone than Clare, which evolved in a Mediterranean environment. Such strains may also have desirable traits for inclusion in breeding programs.

Seed numbers and seed production are important determinants of a cultivar's ability to persist and maintain adequate seed reserves (7). Differences in seed setting ability could be particularly important in a summer rainfall environment where seed reserves may be depleted as result of unsuccessful summer germination, pathogens and predators, deep soil cracking and high intensity rainfall (3). Hardseededness is also thought to be important (6) in increasing the success of a cultivar in a summer rainfall zone. Larger seeds, with consequent increased seedling vigour (1), could also be an advantage to seedlings establishing in summer and early autumn.

This paper outlines the criteria used to identify superior selections of these locally adapted strains and their seed characteristics. A subset of these lines will be used to assess how much of the measured variation is heritable and to test the hypothesis that selection for the above traits may lead to a Clare type more adapted to a summer rainfall environment.

### **Materials and methods**

Burrs were collected in November 1984 from three properties in northern NSW which had a long history of growing Clare. The property locations and soil types have been described in detail (4). Clare stands were established on "Hillcrest" in 1956 and burrs were collected from four separate paddocks (P1 -P4). The exact year of sowing on "Ripley" was not known, but records indicated that the stands were about 20 years-old. The two paddocks sampled on "Brigalows" were sown in 1965. All stands were established by aerial sowing or surface broadcasting seed into native perennial grass pastures. Burrs were recovered to

a depth of 5 cm at all sites, except "Brigalows" P2 where only fresh pods from the 1984 seed set were collected from the soil surface.

**Table 1. Seed data for plants from each site which met the selection criteria for either number of seeds per burr and seed weight or hardseededness. The mean data for each site are given.**

Paddock	Seeds /burr	Seed weight (mg)	Hardseed (%)	
			6 months	12 months
"Ripley"				
P1	2.8	8.122	72.2	51.5
Mean <sup>a</sup>	<b>2.8</b>	<b>6.134</b>	<b>60.0</b>	<b>43.4</b>
P2	1.8	4.602	83.1	59.1
Mean	<b>2.6</b>	<b>4.406</b>	<b>61.5</b>	<b>52.7</b>
"Hillcrest"				
P1	3.4	8.835	76.0	30.7
	2.9	4.327	75.6	42.8
	2.1	6.037	71.5	43.6
Mean	<b>2.7</b>	<b>5.661</b>	<b>63.0</b>	<b>36.8</b>
P2	2.5	6.562	85.8	52.6
	3.4	6.665	68.6	52.0
	3.7	6.820	85.4	67.0
	3.6	6.265	47.8	54.1
	3.2	4.460	89.3	56.8
Mean	<b>2.9</b>	<b>5.409</b>	<b>68.1</b>	<b>45.0</b>
P3	2.9	6.345	81.9	54.7
	3.2	7.415	57.8	33.2
	3.4	7.745	57.8	53.4
	2.4	3.665	73.5	46.4
	2.8	5.580	73.9	64.5
Mean	<b>2.6</b>	<b>5.589</b>	<b>61.6</b>	<b>39.5</b>
P4	2.8	4.152	70.8	47.3
	2.6	7.632	79.1	44.6
	2.4	6.802	74.9	47.2
	3.0	9.700	79.8	54.1
Mean	<b>2.4</b>	<b>5.776</b>	<b>61.6</b>	<b>39.5</b>
"Brigalows"				
P1	2.9	7.610	84.1	52.0
	2.9 <sup>b</sup>	6.680	62.0	68.2
Mean	<b>2.8</b>	<b>5.502</b>	<b>70.0</b>	<b>37.6</b>
P2	2.9	6.432	82.8	61.4
	3.4	6.345	88.8	42.2
	3.0	6.785	67.0	20.0
Mean	<b>2.6</b>	<b>5.965</b>	<b>70.7</b>	<b>35.9</b>
Certified Clare				
	2.0	5.027	55.8	31.8

<sup>a</sup> Mean of 20 plants tested for each site.

<sup>b</sup> Number of seeds per burr < 3, but high percent hardseed after 12 months.

Seeds were removed from the burrs, germinated in peat moss pellets and transplanted to a field nursery at the Agricultural Research Centre, Tamworth. For each collection site 20 plants were grown as spaced

plants on black plastic. Also 20 plants were grown from certified seed of Clare. Burrs from each plant were harvested individually in November 1985. Seed was removed from the burrs by hand and four subsamples of each were assessed for: (i) the number of seeds per burr, (ii) weight of individual seeds, (iii) hardseed content after storage for six months at 25/25°C, and (iv) hardseed content after storage at 25/45°C for a further six months.

From this material lines were selected using the following criteria:

- Plants that had 3 seeds per burr and a seed weight > 6 mg, or,
- Plants that had a hardseed content after six months of > 70% and a hardseed level > 40 % after 12 months.

Lines that met these criteria were seed increased in 1992.

## Results and discussion

Twenty three Clare types met the above selection criteria (Table I ). Ten of these were selected on number of seeds per burr and seed weight, and 17 on hardseededness. Only four of the strains (two from "Hillcrest" P2, and one each from "Hillcrest" P4 and "Brigalows" P2) met all of the selection criteria. These four strains were markedly different to certified Clare for the characters measured (Table I), ranging from a mean of 3.0-3.7 seeds per burr, 4.460-9.700 mg seed weight, 79.8-88.8% hardseed after six months, and 42.2-67.0% hardseed after 12 months. Three of these four strains were from the oldest Clare stands which were 28 years-old at the time of sampling.

The wide range of values recorded for the measured characters (Table I) may be related to environmental factors such as stress during flowering, the probable effect of position on the peduncle on seed size and the relationship between seed size and hardseed breakdown. On-going studies will determine the contribution of genotype and environment to this variation.

Seed of the 23 superior selections was sent to South Australian and Western Australia for further evaluation in 1992. Preliminary results from South Australia (C.T. de Koning, unpublished data) indicated that some performed well in their first year. Also included in these seed lots were five Woogenellup strains that were collected on "Ripley". These were morphologically distinct from certified Woogenellup and their measured characters ranged from a mean of 2.9-3.5 seeds per burr, 3.895-8.722 mg seed weight, with hardseed levels of 57.8-84.4% (six months) and 30.2-67.1% (12 months). A similar collection was made from five old stands of *T. subterraneum* var. *subterraneum* in 1986. This material was highly variable and morphologically not true to type for any existing cultivar, with plants having similarities to either Woogenellup, Bacchus Marsh or Dwalganup.

Grazed plots of the four elite strains, lines from the Australasian Subterranean Clover Alternative Legume Improvement Program in South Australia, and the commercially available cultivars Clare, Rosedale and Nuba were sown at Tamworth NSW in autumn 1993 to further assess their agronomic potential.

## References

1. Black, J.N. 1957. Aust. J. Agric. Res. 24, 479-95.
2. Hagon, M.W. 1974. Aust. J. Expt. Agric and Anim. Husb. 14, 57-64.
3. Lodge, G.M. 1993. Aust. J. Expt. Agric. 33, (in press).
4. Lodge, G.M. 1994. Aust J. Expt Agric. 34, (in press).
5. Lodge, G.M., Munson, R.D. and Elizabeth, W. 1990. Aust. J. Agric. Res. 41, 941-55.
6. Quinlivan, B.J. 1971. J. Aust. Inst. Agric. Sci. 37, 283-95.

7. Rossiter, R.C. 1966. Aust. J. Agric Sci. 17, 425-46.