Proceedings of the New Zealand Grassland Association 46: 203-207 *(1985)*

BREEDING A WHITE CLOVER ADAPTED TO SOUTHERN LOWLAND REGIONS OF NEW ZEALAND

K.H. WIDDUP
Grasslands Division, DSIR, Gore

Abstract

White clover populations from Europe and New Zealand together with ecotypes collected from old pastures in Southland-Otago were evaluated as spaced plants at Gore. Plants were screened for herbage production and morphological and flowering characteristics.

The Southland ecotypes and North Island hill country material are adapted to active growth in spring and summer. Their dense growth habit ensures continued production of branched stolons from nodal meristems which is necessary for high clover yield and persistence under intensive sheep grazing. In this region flowering characteristics are unimportant in relation to agronomic performance. Some larger-leaved Huia and French lines have high-yielding features which are evident during autumn under lenient grazing.

Hybrids between superior plants showing adaptive and high yielding features are being screened in order to select new types with the desired characteristics.

Keywords: White clover, *Trifolium repens* L., plant breeding, southern region, ecotypes, growth, morphology.

INTRODUCTION

Plant breeding in recent years has focused on development of plants for specific regions and environments (Corkill *et* a/., 1981). The recently released cultivar of white clover *(Trifolium repens* L.), 'Grasslands Tahora' was bred to improve legume production and persistence in moist hill country regions and comprised mainly material collected from the North Island hill country (Williams *et al.,* 1982).

Breeding objectives for southern lowland regions of New Zealand have concentrated on early spring production followed by improved summer performance, when climatic conditions are optimum, to increase N fixation and herbage quality. Initial screenings emphasised germplasm from Europe and southern New Zealand as this material had the desired plant habit and seasonal pattern of growth, and could sustain high yields (Widdup &Williams, 1982). The cool-season-active Mediterranean material was considered unsuitable for cool temperate regions because improved performance in autumn and winter did not significantly increase annual production.

Only a few lines screened showed the adaptive features desired; therefore, to extend the genetic range, further material from Europe and New Zealand together with southern ecotypes was included for assessment.

MATERIALS AND METHODS

Two trials were conducted at Grasslands Division, DSIR regional station, Gore, between 1980 and 1983. Trial 1 contained 155 lines in 6 major groupings (Fig. 1). Each line consisted of 2 rows of 5 plants at 75 cm spacing replicated 6 times. Trial 2 contained 28 ecotype populations collected from old pastures in the Southland-Otago region. Each population consisted of 90 genotypes planted in 3 replications, each with 6 rows of 5 plants at 75 cm spacing.

Periodically plants were visually scored on a O-5 scale for herbage production and growth habit (large leaves, few stolons scoring low; small leaves, many stolons

scoring high). The date when five flower heads had appeared and final intensity of flowering was scored in Trial 2 only. Immediately after each assessment, plants were grazed, with up to 6 grazings annually.

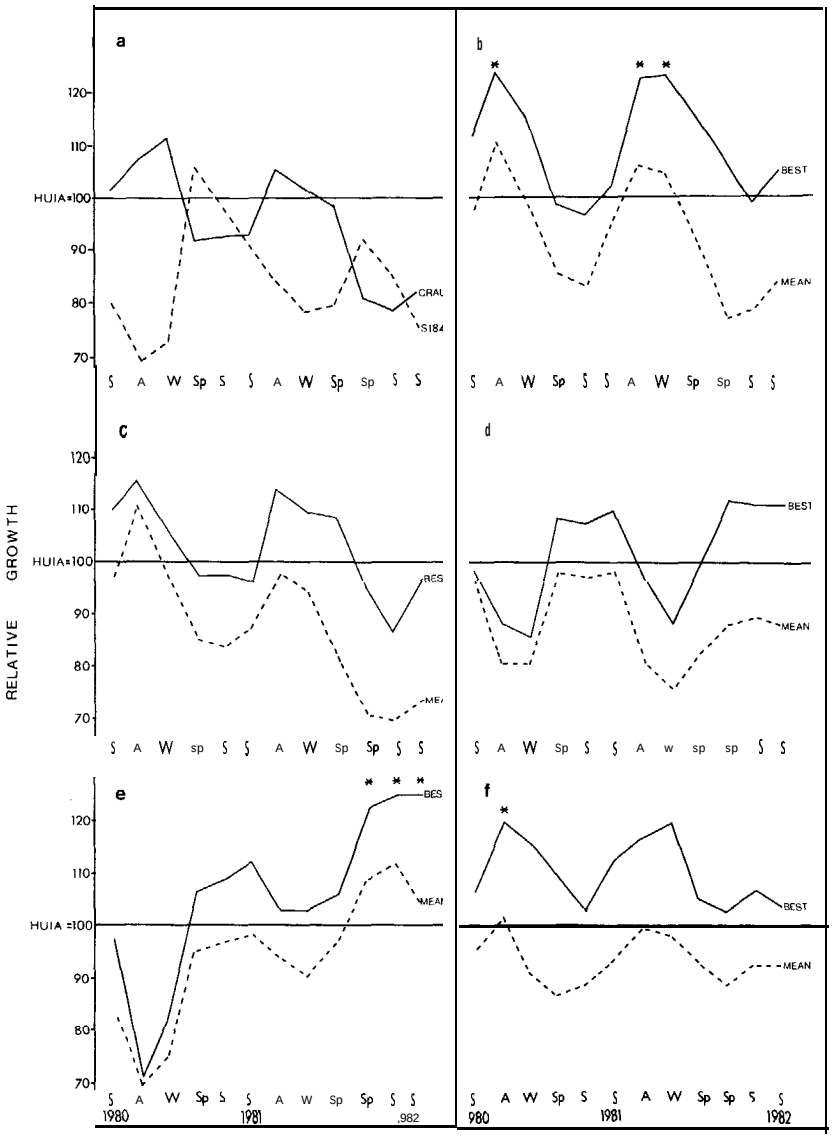

Figure 1: Seasonal Herbage Production relative to Grasslands Huia (= 100) in Trial 1.
(a) Europe (42 lines) *(b) Huia reselection (32 lines)*
(c) Gene Pool (22 lines) *(d) Southland (8 lines)*
(e) Hill Country (37 lines) *(f) Huia x Hill Country (10 lines)*
**Means significantly better than Huia at $P<0.05$*
S = Summer; A = *Autumn;* W = *Winter; Sp = Spring.*

RESULTS

The seasonal production and persistence of the white clovers relative to 'Grasslands Huia' is shown in Fig. 1. The European material (Fig. la) ranged from the autumn-active French type 'Crau' to the winter-dormant Swedish line 'Robusta'. S184, a cultivar used in the upland regions of Britain showed the greatest spring growth. None of the European lines exceeded the growth of Huia during spring-summer. This was a disappointment as these lines were expected to provide at least one genetic source for improved spring production.

The best lines from the reselected Huia and gene pool (overseas x Huia hybrid) material (Fig. lb and lc) showed better cool-season growth than Huia but a more open growth habit.

Uncertified Southland lines (Fig. Id) displayed the desired seasonal pattern of production but at best were only 10% superior to Huia in spring-summer. The ecotype collection in Trial 2 showed greater potential in that the best population was 17 and 43% superior to Huia in spring and summer respectively (Table 1).

Table 1: COMPARISON OF SEASONAL HERBAGE PRODUCTION FOR SOUTHLAND ECOTYPES RELATIVE TO 'GRASSLANDS HUIA' (= 100) IN TRIAL2 IN THE SECOND YEAR.

	Jan	Feb	June	Sep	Nov
Mean of 28 lines	119	100	82	94	104
Best ecotype line	143	116	96	110	117

The North Island Hill Country material (Fig. le) consisted of 'W' and 'V' lines selected by W.M. Williams. These lines established slowly but their production improved with time and they showed good persistence. They were active in spring-summer and the best line was 25% better than Huia by the third spring. Hybrids between Huia and hill country plants (Fig. If) indicated high yield potential.

Both the Southland ecotype and Huia plants began flowering in late November and most plants had flowered by late December. However, a greater percentage of ecotypes had a lower intensity of flowering than Huia (Table 2).

Table 2: COMPARISON OF SOUTHLAND ECOTYPES AND 'GRASSLANDS HUIA' FOR PERCENTAGE OF PLANTS ON A FLOWERING INTENSITY SCALE OF O-4 (TRIAL 2, YEAR 2).

	0	1	2	3	4
Ecotypes	3	32	48	15	2
Huia	2	20	61	17	0

DISCUSSION

Southland ecotype and hill country material appear to be the best for southern regions of New Zealand. Their active growth during spring-summer is an important adaptive feature. These clovers are best when climatic conditions are optimum for growth (November to March), a time when 80% of the annual clover production and N fixation occurs (Carran, 1979; Widdup & Turner, 1983).

Plant morphology is closely associated with seasonal pattern of growth (Fig. 2). Small-leaved and densely branched clovers are superior in late spring, and the large number of growing points per plant are able to respond to favourable climatic conditions to produce good summer yields. Hay & Baxter (in press) reported a similar

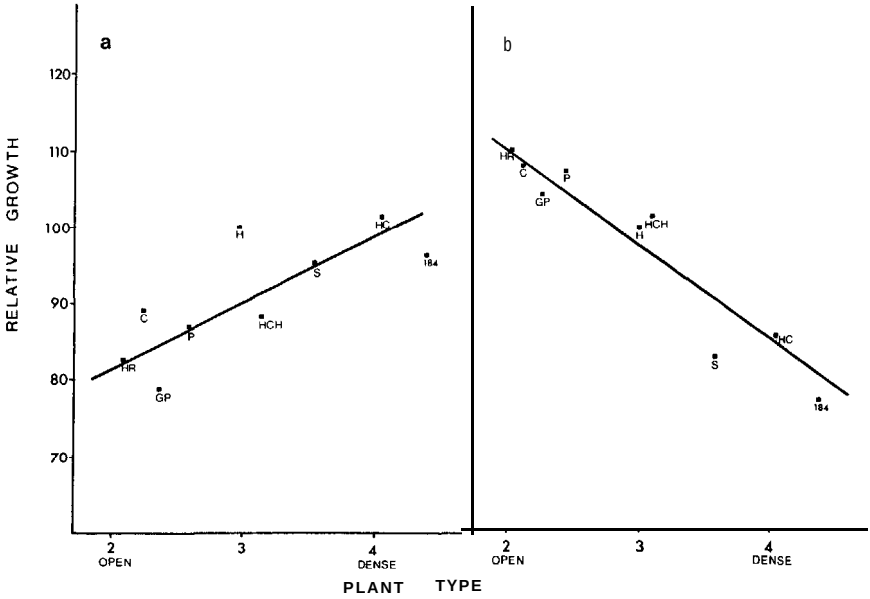

Figure 2: Relationship between Plant type and Seasonal Growth (a) Spring(b) Autumn
H = Huia (Growth = 100, Type = 3) *GP = Gene Pool*
HR = Huia reselection *P = Pitau*
HC = Hill country *C = Crau*
HCH = Huia x Hill country *S = Southland*
184 = S184

effect of clover morphology on production when they set-stocked an old Southland pasture during spring and followed this by rotational grazing in summer. Their grazing management led to a build-up of stolon tissue (increased branching) in spring which then developed into high clover herbage production during summer. This adaptive feature is also necessary for persistence in regions of New Zealand where sheep grazing is intensive (Chapman, 1983; Corkill *et al,* 1981).

The association between spring-summer growth and a dense plant growth habit is fortunate where cultivars adapted to southern regions and sheep grazing are being developed. However, this association is less desirable in northern dairying regions where types with cool-season activity are favoured and their lax, open habit is not ideally suited to sheep grazing.

Flowering and seed-setting characteristics appear to be unimportant for persistence in this moist environment. Southland ecotypes flowered at the same time as Huia and it seemed that environmental pressures caused no genetic shift. However, a lower intensity of flowering by ecotypes reflects the adaptive emphasis on production of branch stolons from nodal meristems rather than flower stems.

Some of the larger-leaved Huia and French types displayed high yielding features which were evident in late summer-autumn under lenient grazing. The large-leaved cultivar 'Grasslands Pitau' showed high annual clover yields under rotational grazing at Gore (Widdup & Turner, 1983). Hybrids between Huia and Hill Country material in this trial indicated high yield potential. For this reason, superior plants from the adapted and persistent ecotype-hill country material were hybridised with plants from high yielding Huia-French material. These hybrids are presently being screened in order to select new types with the desired characters.

ACKNOWLEDGEMENTS

Thanks are due to Mrs Margaret Collins, Mrs Jenny Boleyn and Mr Gordon Baxter for technical assistance.

REFERENCES

Carran, R.A. 1979. *N.Z. J. exp.* Agric. 7: 39-41.

Chapman, D.L. 1983. *J. App. Eco. 20:* 1-13.

Corkill, L.; Williams, W.M.; Lancashire, J.A. 1981. *Proc. N.Z.* Grass/d. *Ass. 42:* 100-122.

Hay, R.J.M.; Baxter, G.S. 1984. N.Z. *J. exp. Agric.:* in press.

Widdup, K.H.; Williams, W.M. 1982. *Ibid 10: 43-47.*

_____; Turner, J.D. 1983. *Ibid 11: 27-31.*

Williams, W.M.; Lambert, M.G.; Caradus, J.R. 1982. *Proc. N.Z. Grass/d Ass. 43:* 188-195.