*Proceedings* of *the* New Zealand Grassland *Association 50:* 175-l 79 (1989)

# WHITE CLOVER OPTIONS FOR SHEEPFARMING IN SOUTHERN REGIONS OF NEW ZEALAND

D.L Ryan
Grasslands *Division. DSIR, Gore*

Abstract

Four white clover cultivars 'Grasslands Huia', 'Grasslands Tahora', 'Grasslands Kopu' and 'Grasslands Pitau' were evaluated at Grasslands Division, Gore, for 4 years, under 2 grazing managements. Year round rotational grazing was compared with rotational grazing incorporating a 1 P-week period of set stocking during spring.

Huia was the best cultivar under both grazing managements. Tahora yields were comparable with those of Huia in spring and summer, and ryegrass yields were best in Tahora swards. The larger leaved and less stoloniferous Kopu and Pitau were not suited to the climatic conditions or the intensive sheep grazing practices of the region.

Keywords: *Trifolium repens*, Huia, Tahora, Pitau. Kopu, grazing management, stolon morphology, persistence, sheepfarming

## INTRODUCTION

Otago/Southland is an area of intensive pastoral farming in which animal performance is high on perennial ryegrass/white clover pastures. High clover yields are essential to ensure high quality feed and to provide high levels of nitrogen (N) for grass production.

'Grasslands Huia' is most productive and persistent in the medium to high fertility zones and where pastures are set stocked periodically. The new white clover cuftivar 'Grasslands Tahora', a small-leaved, densely branched clover, bred for persistence and productivity under moist North island hard hill country conditions, may also be suitable. Williams et *a/.* (1982) showed that Huia, even with adequate fertiliser applications, did not persist in sheep grazed hill country. As large areas of the southern region are similar in climate and soil fertility to North Island hill country, Tahora may be an attractive alternative to Huia.

A pre-release cultivar 'Grasslands Kopu' which has very large leaves, long petioles and thick fleshy stolons, has been bred for extending the growth season of intensively farmed lowland pastures. Extensive trials carried out in the North Island have shown Kopu to be higher yielding than either Huia or 'Grasslands Pitau' under sheep grazing, particularly under lax rotational grazing (Van den Bosch et *a/.* 1986). Pitau, in Southland, was reported to be an improvement only on Huia when lax rotational grazing practices are used all year round (Widdup & Turner 1983).

This paper reports the results from the first 4 years of a study to determine whether Kopu and/or Tahora were superior to Huia and Pitau in Southland.

## METHODS

This experiment was conducted at Grasslands Division, Gore, on a Waimumu silt loam. The 4 white clovers were sown at 4 kg/ha, on an area previously fallowed for 12 months, as monocultures in the autumn of 1983. Nui ryegrass was drilled at 12 kg/ha into the resultant swards 6 months later. Grazing management was common to all swards until February 1984 when the established swards were individually fenced. The trial was a split-plot design of 3 replicates with grazing managements as main plots and 4 clover cultivars as subplots.

The 2 grazing management treatments were:

1. Rotational grazing at 28-day intervals in spring, followed by 42-day intervals in summer and autumn with one winter grazing (RG).
2. A 12-week period of set stocking during spring (September to December), followed by rotational grazing at 42-day intervals during summer and autumn and one winter grazing (SS/RG).

An initial dressing of 250 kg/ha of molybdic potassic superphosphate (O-6-1 6-7) and further annual dressings of 100-200 kg/ha of either potassic superphosphate (O-7-7 3) or straight superphosphate (O-Q-O-1 1) maintained soil Olsen P levels at 14 to 18 µg/g and exchangeable K at 11. Soil pH was 5.8.

Herbage dry matter (DM) was measured in the RG paddocks immediately before each grazing. Four (0.5 $m^2$) quadrets were harvested to a height of 2cm at each sampling. The accumulation of DM during set stocking was assessed from randomly placed exclusion cages which were cut and shifted weekly to new pretrimmed sites. Botanical composition of the pastures was determined from dissection of subsamples. In August and mid December of each year, 60 50-mm diameter pasture cores were removed from each pasture. The number of clover stolon growing tips, stolon length and the DM weight of stolon were measured.

## RESULTS

### Annual herbage production

Pastures based on Huia produced significantly more total herbage than Tahora or Pitau pastures; Kopu pastures produced significantly the lowest yields (Table 1). Tahora pastures produced significantly more ryegrass than pastures containing the other clovers. The annual legume contributions from each pasture were significantly different: Huia gave the highest yields, then Tahora, Pitau and Kopu.

Spring set stocked and year-round rotational grazed pastures produced a similar annual pasture yield. Although ryegrass yields were greater from year-round rotational grazing, spring set stocked pasture treatment produced 60% more clover.

### Seasonal distribution

All clovers had significantly better summer growth rates after spring set stocking than after spring rotational grazing (Fig. 1). Grazing management had little affect for the remainder of the year on clover production. Huia was the most productive throughout the year. Tahora had similar growth rates to Huia during late spring and summer under RG, but only in spring under SS/RG. The summer growth rate of Tahora after spring set stocking was inferior to that of Huia. The autumn production for Tahora fell off rapidly under both grazing managements. Pitau and Kopu were both inferior to Huia in spring and summer (except Pitau under rotational

**Table 1: Mean annual yield (kg DM/ha) of pastures based on 4 white clover cultivars (values are means for a 4 year period 1984-87)**

| Cultivar | Total herbage | Ryegrass | Clover |
|---|---|---|---|
| Huia | 16350 | 9300 | 4350 |
| Tahora | 15650 | 9800 | 3550 |
| Pitau | 15050 | 8750 | 3500 |
| Kopu | 14450 | 9000 | 2900 |
| LSD (p<05) | 400 | 450 | 300 |
| **Grazing management** | | | |
| RG | 15350 | 10900 | 2800 |
| SS/RG | 15600 | 7550 | 4400 |
| LSD (p<05) | n.s. | 300 | 300 |

Table 2: Mean seasonal daily growth rate (kg DM/ha) of ryegrass with each clover cultivar.

| | Spring | Summer | Autumn/Winter |
|---|---|---|---|
| Cultivar | | | |
| Huia | 30.6 | 35.0 | 19.3 |
| Tahora | 31.3 | 35.5 | 21.0 |
| Pitau | 27.7 | 32.2 | 18.4 |
| Kopu | 30.4 | 31.9 | 18.7 |
| LSD (P<05) | 1.2 | 2.8 | 1.2 |
| Grazing management | | | |
| RG | 41.7 | 39.6 | 20.2 |
| SS/RG | 18.3 | 27.9 | 18.5 |
| LSD (P<05) | 2.5 | 1.9 | 0.6 |

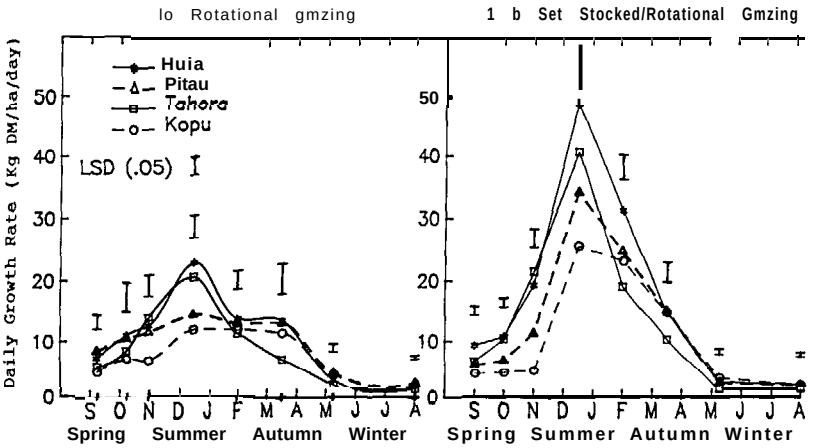


Figure 1: Growth rate (kg DM/ha/day) of four white clover cultivars during each growth period (meaned over years) in RG and SS/RG grazing managements.

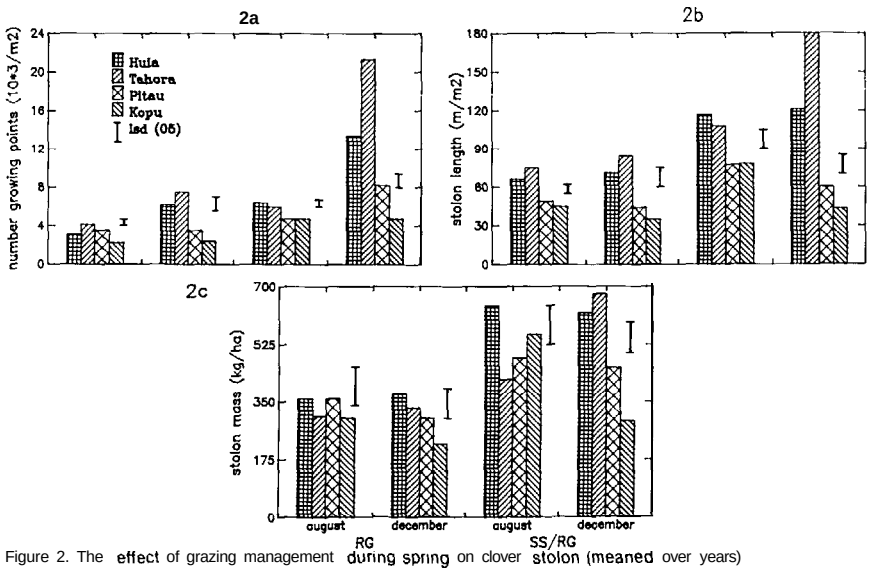


Figure 2. The effect of grazing management during spring on clover stolon (meaned over years)

grazing in early spring), but had similar growth rates to Huia in autumn under both managements.

Tahora pastures had significantly highest ryegrass growth rates only in autumn/winter (Table 2). Pitau and Kopu pastures had lower and similar ryegrass growth rates during summer and autumn/winter. SS/RG reduced ryegrass growth rate during spring and summer by 56% and 30% respectively compared with RG. During autumn/winter ryegrass growth rate differed by only 10%.

Stolon morphology

The number of growing points increased through spring for Huia and Tahora under both grazing managements; set stocking produced greater increases than rotational grazing (Fig. 2). The increase was proportionally greatest for Tahora, then Huia (Fig. 2a). Pitau and Kopu did not increase in the number of growing points under RG during spring and only Pitau responded with a small increment in growing point numbers under set stocking.

The only significant improvement in the development of new stolon material occurred in Tahora under set stocking (Fig. 2b, 2c). Stolon length declined in Pitau and Kopu in both managements, the losses being largest with SS/RG (Fig 2b). Pitau lost more stolon tissue under rotational grazing than under set stocking, whereas Kopu lost significantly the most stolon tissue (Fig 2c).

## DISCUSSION

The superior yield responses of the medium- to small-leaved Huia and Tahora cultivars over the large-leaved Kopu and Pitau confirm Widdup's view (1985) that clovers active in spring and summer, with dense stolons, are better adapted to this region than large-leaved open types with better cool-season activity. The growth pattern is well suited to this region as it occurs when climate is best for clover growth and when high quality feed is needed for conservation and lamb-fattening.

The spring/summer clover yields from Huia and Tahora were associated with increases in the number of stolon growing points and stolon length over spring. Tahora produced 20% more growing points than Huia under rotational grazing, but this was more than compensated for by the larger stolons and leaf size of Huia, which outyielded Tahora. Set stocking favoured Tahora development more, resulting in similar spring clover production from both Huia and Tahora, but in the following summer the superiority of Huia was re-established with the change back to rotational grazing.

The inferiority of both Pitau and Kopu may be because the winters are too cold (5°C) to enable these clovers to express their genetic potential for cool-season growth. Similarly the cool summers (15°C) would limit stolon development and spread throughout the sward by Kopu, whose genetic material is half Ladino which has a high optimum summer temperature of 24°C. for active stolon development (Beinhart 1963).

The lack of activity in stolon extension meant few new growing points were developed in the spring in both Pitau and Kopu. Kopu also has fewer rooted nodes per stolon length than Huia, so stolons were vulnerable, to the grazing animal. Consequently the ability of Kopu to survive under both grazing managements was severely lessened. Pitau did develop new growing points under set-stocking, which suggested Pitau could tolerate hard grazing although it was not as productive as Huia or Tahora. The poor yield of Pitau compared with Huia under rotational grazing contrasts with the results of Widdup & Turner (1983). This poor yield may have been a result of shorter regrowth intervals restricting expression of growth potential (Brock 1974).

In each year more ryegrass was grown in Tahora pastures, possibly as a result

of Tahora being less competitive in the sward than Huia, or because Tahora had a better rate of nitrogen cycling through plant decomposition, or both. A large proportion of the network of stolons developed by Tahora is below grazing height. These stolons are much thinner than those of other clovers (0.35 g stolon per m for Tahora; 0.55 g and 0.65 g stolon per m for Hui and Pitau respectively). Tahora clover stolons would be more susceptible to treading damage, which could lead to a high rate of stolon tissue decay during summer and autumn. In Pitau and Kopu stolons are more readily removed by grazing so less stolons are destroyed by tissue decomposition. Field & Ball (1981) showed that N cycling through plant decomposition is more effective than N returned to pasture through animal excreta. Consequently more N may have been available for grass production from Tahora than from the other clovers.

Grazing management can manipulate clover stolon development and thus increase subsequent clover yields in summer. Spring set stocking followed by summer rotational grazing improved summer clover production. Continued set stocking during summer can keep clover yields at theii spring levels (Hay 1984) instead of giving the high summer peaks. Even though clover yields are increased over summer by set stocking, ryegrass yields are reduced. However ryegrass growth rates recover sufficiently during autumn and winter to a level sufficient to maintain the stock feed requirements of this period. If spring growth is limiting then a mixture of set stocking and rotational grazing may be used to maximise the benefits of both.

## CONCLUSION

Of the four clovers evaluated, Huia is the best for Otago/Southland, particularly in soils of good fertility and if rotational grazing is practised.

Tahora is a good alternative to Huia where climatic conditions restrict clover production to late spring/summer. Tahora is better adapted to intensive stocking than either Huia or Pitau and ryegrass growth is better in Tahora pastures.

The climatic conditions of the region restrict the genetic potential for cool-season and summer growth of both Pitau anb Kopu. The limited stolon development in Pitau and Kopu affects their survival and persistence under the intensive sheep grazing practices of the region.

Acknowledgements

The planning and statistical advice of Alan Harris and technical assistance of David Turner

## References

Beinhart, G. 1963. Effects of environment on meristemic development, leaf area and growth of white clover. *crop Science 3.* 209-l 3.

Brock, J.L 1974. Effects of summer grazing managements on the performance of 'Grasslands Huia' and Grasslands 4700 white clovers in pastures. NZ journal of experimental agriculture 2: 365-69.

Field, T.R.O.; Ball, P.R. 1961. Nitrogen balance in an intensively utilised dairyfarm system. *Proceedings* NZ Grassland Associahon 43: 64-69.

Hay, R.J.M. 1984. Spring management of pasture to increase summer white clover growth. *Proceedings Lincoln* Farmers Conference: 132-37.

Van den Bosch, J.; Lancashire, J.A.; Cooper, B.M.; Lyons, T.B.; Williams, W.M. 1986. G18 white clover: a new cultivar for lowland pastures. *Proceedings NZ Grassland Association 47:* 173-77.

Widdup. KH. 1965. Breeding a white clover adapted to Southern lowland regions of *NZ. Proceedings NZ Grassland* Association *46:* 203-207.

Widdup. K.H.; Turner. J.D. 1963. Performance of 4 white clover populations in monoculture and with ryegrass under grazing. *NZ journal of experimental agriculture 11*: 27-31

Williams, W.M.; Lambert, M.G.; Caradus, J.R. 1962. Performance of a hill country white clover selection *Proceedings NZ Grassland* Association 43: 166-95.