

ESTABLISHMENT OF HILL COUNTRY WHITE CLOVER SELECTIONS FROM OVERSOWING

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Abstract

The establishment characteristics of three hill country white clover selections were compared with 'Grasslands Huia' and Kent white clover after oversowing in spring and autumn on a low fertility, summer-dry hill country site near Palmerston North.

The hill country selections gave 15-16% establishment of sown seed in spring, whereas in autumn two of the hill country selections established much higher seedling numbers than other clovers, one-third surviving at 6 weeks. Less than 5% of Huia seed established in autumn.

Less than one-quarter of spring-sown seedlings survived dry summer conditions. Plant survival at one year after autumn oversowing was markedly better and at this stage, two of the hill country selections had developed 6 times the stolon density of Huia and they were giving at least 3 times the herbage content in the pasture.

Keywords: Legume establishment, white clover, hill country, seedling establishment, plant survival, slugs, oversowing, stolon density, nematodes.

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INTRODUCTION

White clover (*Trifolium repens* L.) is a valuable herbage plant in New Zealand's hill country pastures, contributing high quality herbage for grazing livestock, and nitrogen for herbage growth (Levy 1970; Suckling 1976). However, cultivars oversown into hill country have been bred for high fertility lowland pastures (Williams *et al.* 1982), and are now known not to persist long under hill country conditions, even with good management and adequate fertiliser applications (Charlton, unpubl. data).

Dense, small-leaved white clover selections have been developed specifically for use in hill country from populations collected from hill country farms. One of these selections has been evaluated in moist hill country and has performed markedly better than the established cultivar 'Grasslands Huia' (Williams *et al.* 1982).

The only practical method of introducing such selections into clover deficient hill country is by oversowing. Seedling establishment from oversowing is usually poor, often with under 10% of seeds sown establishing (Suckling 1950; Cullen 1970; Dowling *et al.* 1971; Campbell & Swain 1973; Charlton 1978). The weeks following oversowing are the most critical for seedling establishment, whereas survival of established plants largely depends upon grazing management and summer moisture during the first growing season (Suckling 1959, 1965).

This paper reports a comparison of seedling establishment and plant survival of three prerelease selections of hill country white clover with two existing cultivars during 1980-81.

MATERIALS AND METHODS

The site was a north-facing hillside of 20° slope on a farm near the Pahiatua Track which joins Manawatu and Wairarapa. Soil type was a Raumai hill soil, a moderately leached intergrade between yellow-grey and yellow-brown earths derived from sandstone and loess (G. Shepherd, pers. comm.) with a pH of 4.8 and phosphate level of 5 ppm (Olsen).

Vegetation was dominated by browntop (*Agrostis tenuis* Sibth.) with moss and dead matter prevalent during autumn and suckling clover (*Trifolium dubium* Sibth.) during spring. The site was sprayed with herbicides dicamba (0.28 kg/ha active ingredient) and 2,4-D (1.1 kg/ha a.i.) to remove resident white clover, at 3 months before spring sowing and during early summer before autumn sowing. The clovers were oversown by hand in spring 1980 (2 October) and again in autumn 1981 (29 April). The following white clovers were used:

- (1) Hill country selection V — from 34 plants consistently high-yielding at Palmerston North.
- (2) Hill country selection WY — from 66 moderately yielding plants.
- (3) Hill country selection X — from 26 plants less productive than other lines.
- (4) 'Grasslands Huia' — the standard cultivar normally used for hill country oversowing (Suckling 1965).
- (5) Kent wild white clover — a small-leaved introduction from Britain.

Selection V was the line used by Williams et al. (1982) in their evaluation of the type.

Seeds were sown in plots and in rows with 4 replications of each treatment. Plots measured 25 x 25 cm each, divided into 5 x 5 cm grids, 2 seeds being sown into each grid, a total of 50 seeds per plot, equivalent to a seeding rate of 5 kg/ha. The rows were 2 m in length and were sown at 400 seeds per metre. Seeds were inoculated and tested for germination at sowing, data being corrected for viability. All seed lines used were over 90% in germination capacity.

Temperature and rainfall were recorded on site during the 6 week period after each sowing. The pasture was set-stocked during spring with dry ewes at 8/ha. On-off grazing took place through summer, autumn, and winter mainly with ewes at stocking rates varying from 10 to 190/ha. Herbage height during seedling establishment in spring and autumn averaged 2-5 cm.

Seedling Establishment

Seedling establishment refers to the period from germination until the young plants lose their cotyledons and/or unifoliate leaf and thus become indistinguishable from resident white clover.

Seedlings emerging after spring oversowing were counted and their growth stage noted weekly from 2-6 weeks after sowing, in the plots only, using relocation grids. At 6 weeks the rows were sampled using a spade-like scoop which removed a turf along each row measuring 33 x 8 x 8 cm. Clover seedlings were extracted carefully, examined for abnormalities, measured for shoot and root characteristics and a sub-sample was dried and weighed.

As the scoop technique proved easier and gave more information than the plots, the rows were scoop-sampled at weekly intervals after the autumn oversowing, up to 6 weeks. The plots were only counted at 6 weeks after sowing.

Botanical analysis of the pasture was made at 3 and 6 weeks by random clipping with hand shears to within 1 cm of ground level.

Plant Survival

Plant-survival is a measurement of establishment success after the first growing season. Only the plots were used for plant survival measurements. After spring sowing, counts were made at 3 and 7 months, before and after the dry summer. After the autumn sowing, clover plants were counted at 4 months, before summer. As plants had spread into each other after 1 year, *stolon* density was measured using a grid to estimate number of growing points per unit area. Contribution to pasture yield by the clovers was measured in May 1982 by cutting plots to 1 cm using an electric shearing handpiece, samples being submitted for botanical analysis.

RESULTS

Weather Conditions

Records made during seedling establishment indicated similar weather patterns in spring and autumn, with rain at sowing giving way to a short dry spell, followed by around 2 weeks of showery conditions. However in spring, weeks 3 and 4 were very windy and sunny which dried the pasture and soil surface, whereas in autumn temperatures fell sharply at this stage, producing cool moist

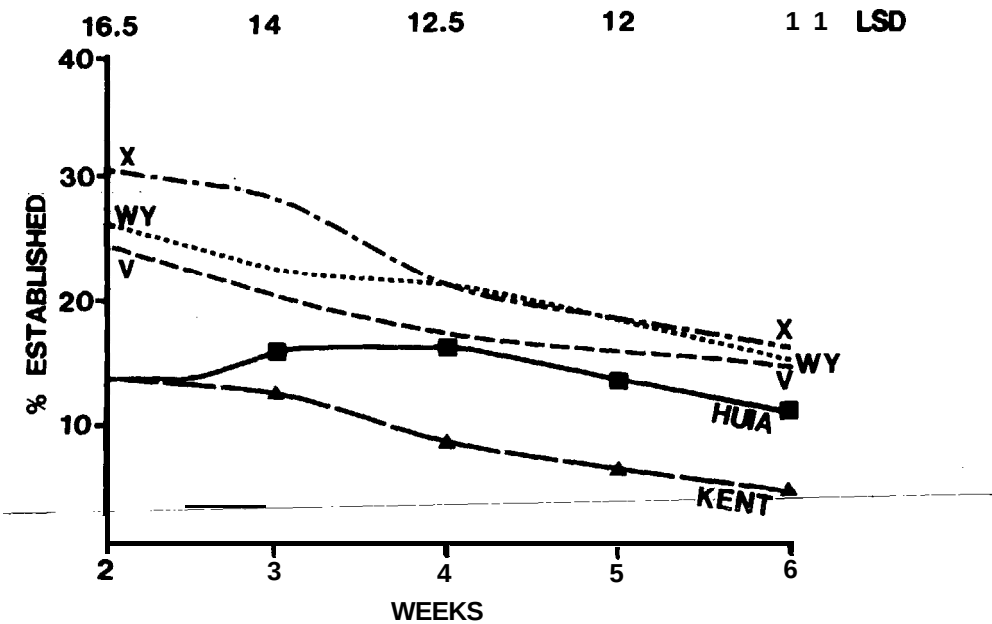


Fig. 1 Establishment of the white clovers oversown in plots, spring 1980 (% of viable seeds so wn).

conditions. Both summers following each oversowing produced dry conditions that prevailed well into the autumn.

Seedling Establishment

Within the plots there was a highly significant interaction between the clover lines and season of oversowing. All 3 hill country selections established 15-16% of seeds sown by 6 weeks after spring oversowing, with Huia similar at 11% but Kent only establishing 5%. In autumn, however, selections V and WY had around 30% establishment, significantly better than the other lines which established less than 10% of seeds sown after 6 weeks.

Seedling establishment levels were not recorded in the rows after spring oversowing as these had been intended for determinations of seedling size, but after autumn oversowing, WY and V established 45 and 29% of seeds sown, whereas X had 12%. Kent 16% and Huia only 4%, though these 3 lines were not significantly different from each other.

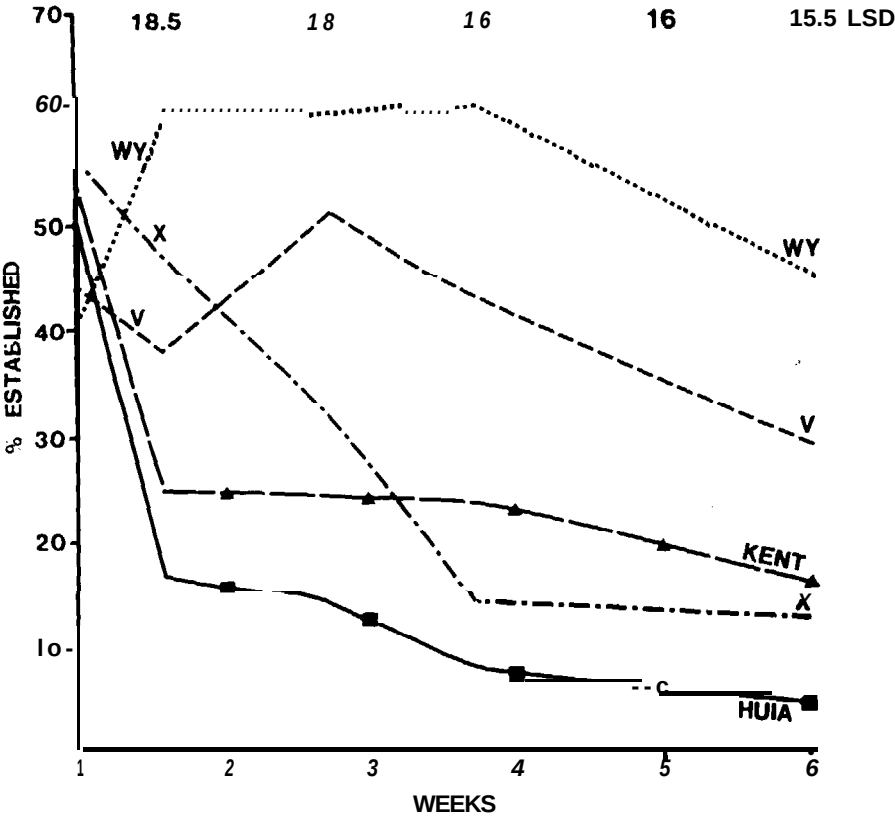


Fig. 2 Establishment of the white clovers oversown in rows, autumn 1981 (% of viable seeds sown).

After spring oversowing, establishment levels did not decline excessively between weeks 2 and 6 (Fig. 1). In autumn (Fig. 2) WY and V maintained high seedling numbers throughout the first 6 weeks, whereas X, Huia and Kent started well then declined sharply through the first 4 weeks before stabilising. Huia and Kent showed a rapid decline during the second week but maintained seedling numbers thereafter.

All lines grew better in spring than in autumn. Although there were no marked differences between lines in terms of growth stage, seedling dry weights of the hill country selections were about 50% greater than Huia at 6 weeks after spring sowing, and they had 2-3 lateral roots developed, Huia only having one root. In autumn, the hill country selections were 20-34% heavier than Huia but no further advanced.

Seedling Damage

Spring-sown seedlings were infected with clover cyst nematode (*Heterodera trifolii*) when examined at 6 weeks. Huia seedlings were also infected with root-knot nematode (*Meloidogyne hapla*). No nematode infection was recorded on autumn-sown seedlings at 6 weeks but signs of fungal root rot were evident.

Seedling damage by slugs during spring was greatest at 3-4 weeks after sowing. Huia had 25% of seedlings damaged (usually cotyledons eaten off) whereas other lines suffered less than 10% damage. In autumn, slug damage was also seen at 3 weeks with 29% of Huia damaged but only 12-18% of hill country seedlings damaged ($P > 0.05$). About one-third of surviving seedlings had cotyledons removed and over half had radicles eaten off. Damping-off symptoms were noted on about 10% of seedlings extracted from turf samples and about one-third of imbibed seeds showed fungal growth, some being soft and dead.

Plant Survival

After 'spring oversowing mean seedling numbers declined from 12% at 6 weeks to 6% at 3 months (December), and to 3% after summer (Table 1). Spring-sown plants had not developed stolons by the end of their first growing season, but remained individual units. After autumn oversowing, plant numbers were maintained between 6 weeks and 4 months.

Table 1: PLANT SURVIVAL (% of viable seeds sown) IN THE PLOTS

Clovers	Spring Oversown		Autumn oversown
	3 months	7 months	4 Months
HC-V	8 a*	3 ab	28 a
HC-WY	8 a	5 a	26 a
HC:X	6 a	3 ab	4 b
Huia	6 a	4 ab	3 b
Kent	3 a	0 b	7 b
Mean	6	3	14

* Within columns, values followed by different letters are significantly different at the 5% level.

Table 2: THE CONTRIBUTION OF WHITE CLOVER TO PASTURE YIELD (%) AND STOLON DENSITY (no. growing points/m²) AT 1 YEAR AFTER AUTUMN OVERSOWING, IN THE PLOTS.

Clovers	%DM	Stolon Density
HC-V	8.7 a	1240 a
HC-WY	8.3 a	1161 a
HC-X	3.9 b	729 b
Huia	2.8 b	198c
Kent	4.0 b	651 b

At one year after autumn oversowing (Table 2) the selections V and WY were contributing twice the **herbage** DM to pasture yield of X and Kent and 3 times that of Huia. Outside the sprayed area white clover yield of pasture DM was less than 1% at this time. Stolon densities showed a similar trend, V and WY having 6 times the number of growing points of Huia, whereas X and Kent had 3 times as many.

DISCUSSION

Seedling establishment of the individual lines of white clover differed markedly, the most outstanding performances being those of V and WY after autumn **over-**sowing relative to Huia, the cultivar usually used for hill country oversowing (Suckling 1965). The inability of larger-leaved forms of white clover, such as Huia, to withstand low fertility harsh conditions is well documented (Davies & Levy 1931; Davies 1962; Levy 1970).

Figure 2 showed that during the first 2 weeks after autumn oversowing, **Huia** and Kent lost around 80% of seeds sown compared with 50% for the hill country selections. The apparent preference of slugs for Huia seedlings, observed during weeks 3 and 4, may also have been responsible for these early differential losses. It is known that slugs do selectively graze cyanogenic white clover (Angseesing 1974) and in this experiment Huia was more cyanogenic than the hill country selections (Williams et al. 1982). Some loss at this stage by drying-off of germinating seeds was also possible but this would have been similar in all lines.

Previous trials on timing of oversowing clovers in the North Island have shown that, apart from areas, where summer rainfall is regular, highest levels of seedling establishment and subsequent plant survival were obtained by oversowing in autumn (Suckling 1950, 1959; Charlton 1978). Mean levels of seedling establishment in this experiment were similar in autumn and spring but subsequent plant survival differed considerably.

The rapid decline in seedling numbers between 6 weeks and 3 months and again between 3 and 7 months after spring oversowing indicates the effect of dry summer weather and grazing pressure on these young plants, which were still separate units without stolons at the end of summer. In contrast, the **autumn-**sown clovers declined only 2% through the cooler months and by the following autumn had developed a network of stolons and were contributing significantly to **herbage** production. The final selection of hill country white clover,

which has been recommended for commercial release, is based on 26 parent plants, 18 from WY, 4 from V and 4 from X (W.M.Williams, pers. comm.). The results from these trials and the previous evaluation by Williams *et al.* (1982) indicate that it should establish satisfactorily from oversowing and perform well thereafter.

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