

ESTABLISHMENT OF SEVERAL GROUND COVERS IN AN ORCHARD

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ABSTRACT

Ground cover plots consisting of Serra hard fescue (*Festuca longifolia*), Tahora white clover (*Trifolium repens*), hydrocotyle (*Hydrocotyle heteromeria*), cotula (*Leptinella dioica*) and pearlwort (*Sagina procumbens*) were established in an apple orchard in 1993. Mowing and selective herbicides were used to form dense swards of each species. The difficulties which have been experienced so far in keeping the swards pure are discussed. Data show that new weeds have been discouraged from establishing. White clover, hard fescue and cotula are the most promising species to date but further observations are required to confirm this finding.

Keywords: cotula, clover, hard fescue, hydrocotyle, pearlwort

INTRODUCTION

The common management practice for ground under apple trees in New Zealand is to keep the soil bare in the tree rows using herbicides and to mow the vegetation between the rows (Harrington *et al.* 1992). An alternative strategy for managing this ground might be to establish a low growing ground cover species which requires little mowing and which prevents competitive weed species from establishing during the growing season. If the ground cover tolerated herbicides, any weeds which did establish could be killed during tree dormancy, so no herbicides would be necessary during the growing season when fruit could be contaminated by chemical residues.

A number of potential ground cover species have been tested for their tolerance to herbicides which could be used to assist with establishing and maintaining pure swards in orchards (Harrington 1993; Harrington and Grant 1993). The most promising of these species have now been established in an apple orchard. This paper describes how these swards were established, discusses how well they have survived their first 2 years, and studies the influence of sward management on the weed flora of the orchard.

METHODS AND MATERIALS

The trial was established at the Fruit Crops Unit of Massey University at Palmerston North on a Manawatu silt loam soil (pH 6.6, 3.6% organic carbon). Three plots of each ground cover treatment were established under 5 year-old Braeburn and Royal Gala apple trees in 1993 using a randomised block design. In the 6 months prior to establishment, the ground was sprayed several times with glyphosate (Roundup) to ensure all existing perennial weeds had been destroyed. Each plot is 6 x 5 m with one tree in the middle of the plot and a tree between each plot.

The only two species established which had commercially available seeds were Tahora white clover and Serra hard fescue. These were established in June 1993 by raking seeds into the soil. The only herbicide that was applied to the white clover prior to the measurements presented in Tables 1-3 was haloxyfop (Gallant) applied at 0.3 kg/ha in September 1993 and 0.35 kg/ha in June 1994. The clover was mown to 3.5 cm in November 1993 to control tall-growing annual weeds, and to 8 cm in December 1994 to remove flowers prior to insecticide spraying. The hard fescue was mown only once, to 3.5 cm in November 1993. Invading grass weeds were removed using

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haloxyfop in December 1993 at 0.25 kg/ha and in June 1994 at 0.35 kg/ha. Broad-leaved weeds were removed in January 1994 and August 1994 with a mixture of dichlorprop, MCPA, ioxynil and bromoxynil (Proturf) applied at rates of 1.6, 0.7, 0.2 and 0.2 kg/ha respectively.

Plugs of hydrocotyle 6 cm in diameter were transplanted from a lawn into plots in May 1993 at 40 cm spacings. These plots were treated with 1.5 kg/ha of oxadiazon (Foresite) in July 1993, with haloxyfop at 0.3 kg/ha in September 1993, mown to 3.5 cm in November 1993 and to 2.5 cm in December 1993, spot-sprayed with amitrole (Amitrole ATA) at 0.92 g/litre in December 1993, then sprayed with 0.35 kg/ha of haloxyfop in June 1994, 11 g/ha of tribenuron in August 1994, and 1.5 kg/ha of oxadiazon in September 1994 immediately after being mown to 3.5 cm.

Pearlwort was also established at 40 cm spacings using 6 cm plugs transplanted from a plot of pearlwort in May 1993. These plots were mown to 2.5 cm in December 1993, June 1994 and September 1994. Herbicide treatments were oxadiazon applied at 1.5 kg/ha in July 1993 and September 1994, haloxyfop at 0.3 kg/ha in September 1993 and June 1994, and clopyralid (Versatill) at 0.3 kg/ha in January 1994 and August 1994.

Cotula was transplanted at 40 cm spacings in August 1993 using 6 cm plugs from planter bags of well established plants. Plots were mowed to 3.5 cm in November 1993, December 1993 and June 1994. Herbicides applied were terbacil (Sinbar) at 1.0 kg/ha in December 1993, haloxyfop at 0.3 kg/ha in June 1994, mecoprop-P (Duplosan KV) at 0.5 kg/ha in August 1994 and oxadiazon at 1.5 kg/ha in September 1994.

Another treatment included in the trial was completely bare soil to which herbicides were applied periodically to remove weeds which established. This was to act as a comparison with plots covered in ground covers, though efforts were made to encourage growth of moss on these plots through use of herbicides found to be relatively harmless to mosses (Harrington, unpub data). These plots were sprayed with a paraquat/diquat mixture (Preeglone) at 0.62/0.37 kg/ha in July 1993, November 1993, December 1993, July 1994 and September 1994, with oryzalin (Surflan Flo) at 3.5 kg/ha in September 1994 and with glyphosate at 2.2 kg/ha in January 1995.

A point analysis technique was used to quantify the percentage ground cover in each plot (100 points/plot) in March 1994, November 1994 and March 1995. The height of swards was measured at 20 positions in each plot underneath the trees and at another 20 positions per plot in the alley between tree rows in November 1994. The density of new weed seedlings was measured in March 1995 by counting the number of seedlings in 10 randomly selected quadrats (20 x 50 cm) per plot.

RESULTS AND DISCUSSION

The primary objective of this trial was to investigate the performance of ground covers once they were established. Thus a number of techniques were used such as transplanting plugs of plant material which would not be practical for a large scale planting. At the conclusion of the present trial, more practical techniques for establishing the most promising ground cover species will be investigated. The present trial showed that establishment from seed was preferable to establishment from transplanted plugs. Apart from the time-consuming nature of transplanting operations, weed ingress was more of a problem between transplanted plugs from which it took longer to achieve total ground coverage, compared with seed.

Establishment from seed was also difficult in an established orchard. Cultivation of the soil was not attempted because of tree roots, so it was difficult to bury the seeds. Leaf fall from the trees and movement of tractors down the rows as part of normal management practices also affected seedling survival. Ground cover establishment would be best achieved by planting into the loose soil between tree rows immediately after planting trees. As young trees are presumably more susceptible to competition from ground covers than larger trees, plants would only be allowed to spread under the trees several years later.

White clover and hard fescue had achieved the best ground covers by March 1994 (Table 1), mainly because they were established from seeds. However the white clover

grew aggressively enough to make it unnecessary to apply herbicides to remove weeds apart from applications of haloxyfop for control of grasses. White clover was the tallest sward when measured in November 1994 which helped with weed control, though it potentially made it more competitive with the trees as well. Weeds which established in the white clover initially and which will need controlling include broad-leaved dock (*Rumex obtusifolius*) and fireweed (*Senecio* spp.). Chickweed (*Stellaria media*) also invaded in winter when frost damaged the sward.

Hard fescue has remained dense and weed control has been possible with haloxyfop for grass weeds and turf herbicides during tree dormancy for broad-leaved weeds. However seedlings were killed in the wheel marks through hard fescue plots in the first winter, and the lack of lateral growth by this species has resulted in the wheel marks remaining bare, allowing weed ingress. The hard fescue produced seed for the first time in December 1994, so fescue seedling establishment in autumn 1995 may allow these gaps to be filled. Gaps also appeared in the sward from leaf fall in autumn 1994 killing plants underneath.

TABLE 1: The percentage of plot area covered by the planted species and weeds as assessed by point analysis on March and November 1994, and the average height of ground cover swards.

| Ground cover species | % ground cover | | | Sward height (cm) | |
|----------------------|-----------------|-------------|-------|-------------------|----------|
| | Planted species | Bare ground | Weeds | Under trees | In alley |
| March 1994 | | | | | |
| cotula | 60.5 | 29.4 | 10.1 | | |
| hard fescue | 83.7 | 10.1 | 6.2 | | |
| hydrocotyle | 53.0 | 18.9 | 28.1 | | |
| moss | 46.4 | 31.7 | 21.9 | | |
| pearlwort | 67.6 | 15.7 | 16.7 | | |
| white clover | 85.6 | 8.2 | 6.2 | | |
| LSD _{0.05} | 18.7 | 12.4 | 10.4 | | |
| November 1994 | | | | | |
| cotula | 74.2 | 8.5 | 17.3 | 2.8 | 1.2 |
| hard fescue | 79.4 | 5.9 | 14.7 | 19.2 | 10.9 |
| hydrocotyle | 65.6 | 1.0 | 33.4 | 9.8 | 3.2 |
| moss | 50.0 | 44.8 | 5.3 | - | - |
| pearlwort | 41.8 | 2.6 | 55.5 | 2.4 | 1.9 |
| white clover | 79.1 | 0.0 | 20.9 | 22.2 | 17.2 |
| LSD _{0.05} | 16.2 | 9.4 | 11.1 | 3.1 | 2.5 |

TABLE 2: The percentage of plot area covered by the planted species and weeds (new weeds being less than 2 months old) as assessed by point analysis and also counting of seedlings in quadrats in March 1995.

| Species of ground cover | Planted species | % ground cover | | | No. of new seedlings/1000 cm ² |
|-------------------------|-----------------|----------------|-----------|-----------|---|
| | | Bare ground | Old weeds | New weeds | |
| cotula | 71.6 | 14.7 | 13.7 | 0.0 | 34.3 |
| hard fescue | 94.5 | 0.3 | 5.5 | 0.0 | 3.6 |
| hydrocotyle | 33.6 | 1.0 | 65.4 | 0.0 | 19.0 |
| moss | 23.1 | 57.5 | 1.6 | 17.7 | 40.6 |
| pearlwort | 50.5 | 10.6 | 36.7 | 2.3 | 489.1 |
| white clover | 90.3 | 1.3 | 8.3 | 0.0 | 15.1 |
| LSD _{0.05} | 17.6 | 11.5 | 15.8 | - | 144.4 |

The cotula had formed a dense canopy by November 1994, though this canopy was much shorter than that formed by white clover or hard fescue. Many of the weeds recorded in cotula in March 1995 (Table 2) were those which had not been controlled prior to the November 1994 assessment (Table 1) but should be removed by herbicides in winter of 1995. Some bare soil was exposed over the dry summer of 1994/5, but this was mainly from death of weeds in the plots. This species appears to have considerable potential as a ground cover.

The hydrocotyle had formed a dense canopy by November 1994, and sward height was generally intermediate between cotula and white clover. The main weed control problem experienced with hydrocotyle was the difficulty of removing white clover from the swards. Most of the weed recorded at March 1995 was white clover. Tribenuron was more damaging to white clover than hydrocotyle, but the clover still regrew and the hydrocotyle was sufficiently damaged by this herbicide to make higher application rates unsuitable. A trial was initiated in May 1995 to improve weed control in hydrocotyle.

The pearlwort has generally been a less satisfactory ground cover than the other species assessed. Its shallow root system makes it more vulnerable to damage by vehicles and drought. Although it tolerates oxadiazon very well, plots have been invaded by other species which also tolerate oxadiazon, particularly chickweed (*Stellaria media*) and mouse-ear chickweed (*Cerastium fontanum*). There was a high number of new weed seedlings in the pearlwort plots in March 1995 following the first autumn rainfall due to the bare ground present and the number of weeds which had set seeds in these plots in previous months.

The trial will continue for another 2 years to determine whether the ground covers which are now well established can keep the orchard free of more competitive weed species.

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