ASSESSING GROUND COVERS IN A NEWLY PLANTED APPLE ORCHARD

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ABSTRACT

Three low growing ground-cover species, dichondra (*Dichondra micrantha*), hydrocotyle (*Hydrocotyle heteromeria*) and a creeping red fescue (*Festuca rubra*)/white clover (*Trifolium repens*) mixture were compared to bark mulch and herbicide in a newly planted apple orchard for their ability to suppress weeds. Dichondra, with the aid of an initial herbicide treatment, established a dense ground cover and provided good weed suppression. Hydrocotyle failed to establish under the dry Hawke's Bay conditions. Creeping red fescue gave moderate weed suppression. Bark required spot treatment with herbicide for complete weed control. All ground covers reduced tree growth and fruit yield in the first year compared to herbicide and bark mulch.

Keywords: Ground covers, mulches, *Dichondra micrantha, Hydrocotyle heteromeria, Festuca rubra.*

INTRODUCTION

With increasing demand worldwide for the reduction or elimination of pesticides in food production, New Zealand must look to ways of reducing pesticide use in orchards. One area in orchard management where pesticide use could be reduced is in weed control or understorey management. In most New Zealand orchards weeds are controlled within the tree rows by various herbicides (Harrington *et al.* 1992). The effects of organic mulches such as straw, sawdust and wooldust on weed control, tree growth and soil bioactivity have been reported previously (Hartley and Rahman 1994; Hartley *et al.* 1996). To develop more sustainable economic means of weed management, the feasibility of establishing ground cover species and their use as "green" mulches has also been investigated (Harrington 1995; Harrington and Rahman 1998). Two species, dichondra (*Dichondra micrantha*) and creeping red fescue (*Festuca rubra*) have given promising results in established orchards (Harrington *et al.* 1999; Hartley and Rahman 1998).

In 1998 a new trial was commenced to establish green mulches in a newly planted apple orchard, and compare them with herbicides and bark mulch for weed control and tree growth. To gain information suitable for full organic production, transition to organics as well as for integrated fruit production, the green mulch establishment was attempted with and without herbicide use. These mulches were also planted in bark covered plots in the second year of the trial.

MATERIALS AND METHODS

The trial was conducted in a newly planted orchard on a HortResearch property in Hawkes Bay. Strips 2 m wide were cultivated by rotary hoeing, leaving 3 m inter-row in grass. One year old apple trees of a new cultivar, A38R2T119 on MM106 rootstock, were planted 3 m apart in the cultivated strips in September 1998. There were six rows of 38 trees. Each plot was 9 m long by 1.8 m wide with two trees within the plot and one guard tree between each plot. The height and trunk diameter of each

tree were measured soon after planting. Trunk diameters were measured at a marked level about 10 cm above the graft.

The green mulches, dichondra, hydrocotyle (*Hydrocotyle heteromeria)* and creeping red fescue cv. Dawson plus white clover (*Trifolium repens* cv. Tahora) as well as a no-ground cover treatment were established with either mowing or herbicide + mowing or planted in the bark mulch. This resulted in 12 treatments which were laid down in a randomised complete block design with three replicates. Pine bark was laid approximately 15 cm deep over corrugated cardboard on 22 September 1998. On the same day the dichondra and hydrocotyle were planted as 5 cm plugs in five rows on each plot, spaced 23 cm apart within and between the rows except for the bark plots where planting was delayed until the following year (3 August 1999). Creeping red fescue (30 kg/ha) and white clover (3 kg coated seed/ha) were sown by hand and raked into strips 50 cm wide on either side of the plots, leaving approximately 80 cm unsown in the centre, on 22 September 1998, except for the bark plots. As the fescue/clover seedings failed to give satisfactory cover, plots were reseeded on 26 April 1999 at double the seeding rate after weeds had been killed by a glyphosate spray 24 days earlier. On this date bark plots were also seeded and Seabreeze cultivar of creeping red fescue was used for this second planting. Seed was raked through the dead vegetation and into the bark.

Initial herbicide treatments were oxadiazon (Foresite) at 1.5 kg/ha plus oryzalin (Surflan Flo) at 3.5 kg/ha on the dichondra and no-ground cover plots and oxadiazon at 1.5 kg/ha on the hydrocotyle plots. These were applied in 220 litres/ha water at 200 kPa immediately prior to planting on 22 September 1998. The fescue/clover plots received MCPB at 1.2 kg/ha over the sown strips on 11 December 1998 with glyphosate (Roundup GII) applied over the centre unseeded strip. The no-ground cover herbicide and bark plots were also sprayed with glyphosate to remove emerged weeds. At the same time dichondra and hydrocotyle were treated with haloxyfop (Gallant) at 0.6 kg/ha. Where required, further herbicide applications were made in July 1999 to control the weeds.

Mowing treatments commenced on 12 November 1998 and continued at 2-3 weekly intervals throughout the summer. Mowing was done with a hand pushed rotary mower leaving clippings on the plots. From 21 December 1998 onwards the herbicide plots were also mown. Mowing height commenced at 4.5 cm and reduced to 2.5 cm as plots settled down.

Weed seedlings were counted on 8 October 1998 and 30 October 1998 in six 15 x 15 cm quadrats per plot but the sample number was doubled on plots with low weed densities. Ground cover of weeds and sown species was estimated periodically from December 1998 to December 1999 and fresh weight of clippings from each mown plot measured between October 1999 and February 2000. Mown area was the 9 m plot length by 1.8 m wide. Clippings were returned to the plots after weighing.

At the end of the first growing season the trunk diameter of each tree was remeasured as well as the terminal extension and all the lateral branch lengths. All the data were analysed by ANOVA using initial tree diameter or row position as a covariate.

RESULTS

Seedling numbers for some of the main weeds present in the trial area in October 1998 are shown in Table 1. The site was dominated by black nightshade (*Solanum nigrum*). Fathen (*Chenopodum album*), scrambling speedwell (*Veronica persica),* white clover (*Trifolium repens*), redroot (*Amaranthus* spp.), hawksbeard (*Crepis capillaris*) and creeping mallow (*Modiola caroliniana*) were present in smaller numbers. Most of these weeds were substantially reduced by the herbicide treatments though oxadiazon alone (hydrocotyle plots) did not effectively control scrambling speedwell. It is possible that some weed seedlings escaped through the oxadiazon treatments because the ground was disturbed after spraying when planting the plugs of dichondra and hydrocotyle.

TABLE 1: Main weed species in the trial area (mean seedling number/m^2 in October 1998) as affected by herbicide treatments.

Treatment	Black nightshade	Fathen	Scrambling speedwell	White clover	Hawksbeard[1]	Total
No herbicide	2970	761	383	274	220	5110
Oxadiazon[2]	110	4	502	58	29	755
Oxadiazon and oryzalin[2]	37	4	73	50	7	213

[1]Including other similar composite species.
[2]Oxadiazon only was used for hydrocotyle while oxadiazon and oryzalin was used for dichondra.

The trends in weed cover on the various treatments from December 1998 to December 1999, as assessed by visual estimates, are shown in Fig. 1. In the absence of herbicide, the establishing dichondra and hydrocotyle plants were completely covered by weeds. The addition of herbicide resulted in a substantial reduction of weed cover on the dichondra plots and some reduction in the hydrocotyle plots. As the initial spring establishment of fescue/clover was unsatisfactory and the plots had to be reseeded in autumn 1999, both fescue/clover treatments have been omitted from Fig. 1 to avoid confusion. However, by December 1999 both fescue/clover treatments had reduced weeds to about 45% ground cover.

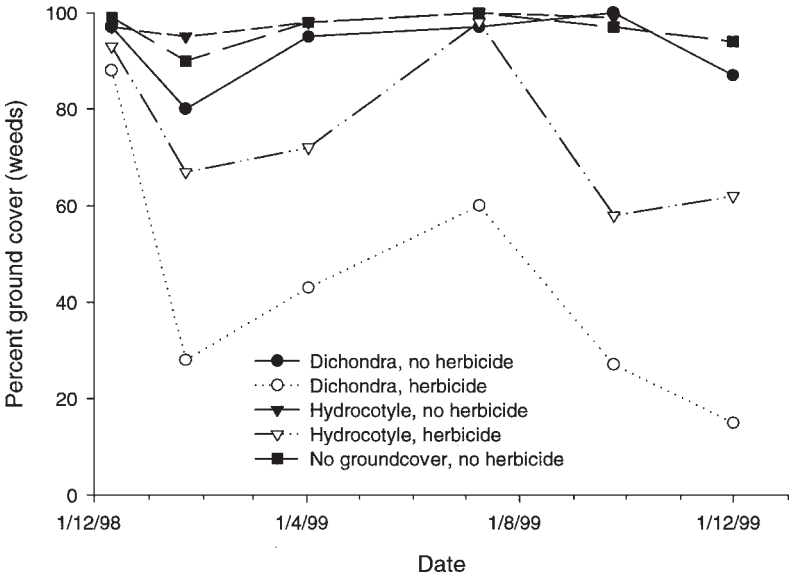

FIGURE 1: Percent ground cover of weeds present in the mown treatments at various dates.

Visual estimates of the percent cover of sown species between January and December 1999 are shown in Fig. 2. Dichondra, with the aid of herbicide, developed almost complete ground cover but without herbicide it dropped to 15% by December 1999. Hydrocotyle without herbicide failed completely and even with herbicide was at a very low density. Fescue/clover establishment with herbicide was slow, as initial

herbicide treatment and mowing did not commence till December 1998, but it was showing good coverage by December 1999 after reseeding in April 1999. Fescue/clover established better initially on mown-only plots as mowing throughout spring 1998 kept the weeds short. However, these plots also required reseeding in autumn. All fescue/clover plots were grass dominant with very little white clover present, and reached 50% ground cover (no herbicide) and 75% ground cover (with herbicide) by December 1999.

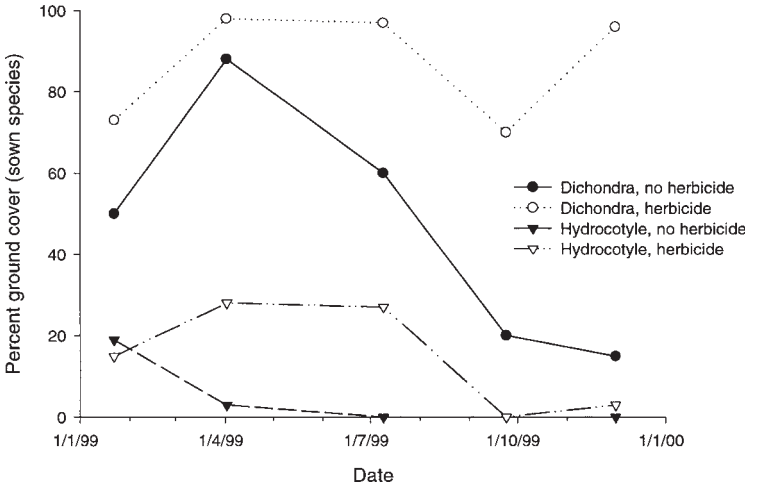

FIGURE 2: Percent ground cover of the sown species at various dates.

A quantitative measure of vegetative competition was obtained during the second summer when the fresh weight of clippings was recorded (Table 2). The no-ground cover mown plots and the dichondra mown plots produced significantly more vegetation than other treatments. The mown fescue/clover plots produced about half the vegetation of the no-ground cover mown plots and this was unaffected by herbicide treatment. Hydrocotyle with herbicide produced similar vegetation weight as fescue/clover plots. Hydrocotyle mown-only is not included in Table 2 as the hydrocotyle failed to establish and the treatment was abandoned. Dichondra with herbicide produced a very thick low growing mat with very little weed penetration as reflected by the significant reduction in vegetation cut.

TABLE 2: Total fresh weight of clippings from six cuts between October 1999 and February 2000.

Treatment	Total fresh weight (kg/m^2)
No ground cover, mown	3.3
Dichondra, mown	3.7
Fescue/clover, mown	1.6
Dichondra + herbicide	0.4
Hydrocotyle + herbicide	1.6
Fescue/clover + herbicide	1.5
LSD (P<0.05)	0.37

Tree growth over the first season from planting, September 1998 to May 1999, is shown in Table 3. Growth over this period was greatest on the bark (all plots combined) and no-ground cover with herbicide treatments with trunk extension, lateral extension

and trunk diameter all responding similarly. There was little difference in tree growth on any other treatment. Fruit yield in March 2000 (second season) was also highest on the herbicide and bark treatments (Table 3).

TABLE 3: Tree growth over the first season and fruit yield in March 2000 as affected by treatments.

Treatment	Trunk extension (cm)	Total branch growth (cm)	Trunk diameter increase (mm)	Fruit Yield per tree	
				wt (kg)	No.
No-ground cover	42.5	319	5.4	0.08	0.5
Dichondra	43.2	279	4.8	0.28	1.7
Hydrocotyle	22.1	199	3.6	0.31	2.0
Fescue/clover	38.9	190	4.5	0.50	3.8
Herbicide	73.7	560	9.9	2.55	15.7
Dichondra + H[1]	43.2	240	5.4	0.18	1.7
Hydrocotyle + H	49.2	314	6.8	0.72	4.8
Fescue/clover + H	40.7	379	7.0	0.30	2.0
Bark[2]	80.8	628	10.8	1.70	10.9
LSD (P<0.05)	28.10	193.7	3.07	1.288	7.78

[1]H =herbicide.
[2]mean of all bark plots.

DISCUSSION

Dichondra showed good promise as a low growing ground cover species capable of reducing weed growth but only if assisted by herbicide during establishment and mown afterwards. Its long term sustainability without the aid of a herbicide treatment is yet to be determined. Hydrocotyle was unable to establish under the dry Hawke's Bay conditions even with herbicide assistance and irrigation. Creeping red fescue establishment was poor in the spring but autumn sowing established well. White clover establishment was poor and it appears that the creeping red fescue reduced the white clover establishment since natural clover had established on all the other mown plots. Attempts to establish dichondra and hydrocotyle plugs into the bark after 1 year were also unsatisfactory. Much of the bark was still too thick for the plugs to make adequate contact through the bark to the soil and some plugs were scratched out by birds. The bark alone allowed some weed growth (especially creeping mallow which came in from mown strips) which required spot treatment with herbicide. Had this not been done the plots would have been completely covered by weeds by the second year as has been observed in another trial in the same orchard (M.J. Hartley, unpubl. data).

Tree growth was reduced by all vegetation treatments including dichondra with herbicide, which had the least amount of weeds present. The competition affected all aspects of tree growth in the first year and fruit yield in the second year but this could have been influenced by tree size in the second year. It would appear from the results of this trial that even if low growing ground covers could be established to give satisfactory control of larger weeds in organic orchards it is probable that some reduction in tree growth and loss of yield will occur. Dichondra ground covers have been shown to cause no decrease in fruit yields when grown under well established apple trees (Harrington *et al.* 1999). Ground covers should probably be kept away from the base of trees for the first years, and would do better in systems where occasional use of herbicides in winter is permitted to remove weeds that do establish.

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