GREEN MULCHES

Summary
Although nitrogen fixing white clover provides a good weed suppressant, easy to manage mulch for harvesting clean fruit, it can have a seriously inhibitory effect on young tree growth, especially in dry seasons.

Field Farm legume trial for young trees [93/4.2]

Method

Various legume species and a low maintenance grass were sown onto clean, weed free soil strips under young Ashton Bitter trees in spring in a replicated trial.
Grass: Lisette dwarf ryegrass.
Legumes: *Trifolium repens* cvs. White clovers Huia, S184 and Kent;
Red clover, *T.pratense*;
Crimson clover, *T.incarnatum* ;
Strawberry clover *T. fragiferum*,
Trefoil *Medicago lupulina*
British Seed Houses A17 legume mixture.
Half of the plots were cut each August and in year 2, all plots had a final cut at the end of the season to prepare for harvest.

Results

Year 1

In the absence of chemical control, good weed suppression relies heavily on rapid germination and establishment of the mulch species. All three white clover cultivars, *T repens* Huia, S184 and Kent did this well, forming a dense mat of 10 – 15 cm by the end of June, but all depleted soil moisture and nitrate. They stood out clearly as most suited to the purpose and reasonably priced.

BSH A 17 legume mixture and strawberry clover, were slightly slower to establish but suppressed weeds well. Red clover and trefoil were less competitive but suppressed weeds inadequately. Trefoil, a shade tolerant biennial, could be better managed by mowing early in the summer to prevent flowering. All legumes responded well to mowing twice during the season. The last cut in August left low re-growth suitable for machine harvesting.

The soil under most covers was very dry by late August. It was anticipated that root nodulation would contribute to soil nitrogen supplies. Disappointingly though, most soil samples contained only about 20% of the nitrate found in bare soil. Leaf nitrate in trees with the ground cover was 2.00% compared with 2.38% in trees in bare soil [Guideline level 2.50%]. Soil pH rose slightly under the cultivated plots

The soil nitrate and moisture levels during the first establishment summer are summarised in Table 1 below. Bare soil plots received the normal rate of soil applied nitrate but the rest of the trial received no fertilizer.

Table 1. Soil analysis from samples at 2 depths in June

Cover species	Sample depth	Soil pH	Nitrate ug/g	% soil moisture
Lisette	Upper	6.4	25	18.1
	Lower	6.5	17	16.7
Clover S184	Upper	6.8	14	16.1
	Lower	6.9	16	17.2
A17 legumes	Upper	6.8	13	16.7
	Lower	6.9	17	15.0
Clover Kent	Upper	6.4	14	15.5
	Lower	6.6	16	12.0
Clover Huia	Upper	6.7	22	16.0
	Lower	6.7	18	14.0
Trefoil	Upper	6.8	19	18.0
	Lower	6.7	23	15.3
Crimson clover	Upper	6.9	17	14.5
	Lower	6.9	19	16.2
Strawberry clover	Upper	6.8	5	17.4
	Lower	6.8	15	16.8
Red clover	Upper	6.8	16	15.8
	Lower	6.8	24	15.9
Bare soil	Upper	5.8	110	18.7
	Lower	6.2	72	18.3

Year 2

The changes in soil fertility and soil moisture under the various legume species throughout the summer, are summarised in the tables below.

Soil nitrogen levels under the legume plots before the first cut in June were similar to or better than bare unfertilized soil, notably in the white clover plots . After cutting the legumes responded with good re-growth but, soil nitrate levels dropped to support this. Nitrate under uncut red clover and trefoil continued to rise, but N levels fell slightly in the other plots.

Soil moisture levels throughout the summer were very low and all the legumes were competitive for soil moisture. Trees mulched with legumes showed drought stress symptoms and grew less than control trees.

Table 2: soil samples 31/5/94

Legume sp	**Soil pH**	**Soil nitrate**	**% moisture in soil [w/w]**
Strawberry clover	6.2	53	16.5
White clover [pooled]	5.8	100	16.5
BSH A17 mixture	6.2	38	15.0
Red clover	5.9	26	19.0
Crimson clover	6.1	30	18.0
Trefoil	6.0	38	17.9
Bare soil	6.0	45	20.3

Table 3: Soil samples after cutting half the plots 23/6/94

Legume spp	Cut or Left long	Soil pH	Soil nitrate	Nitrite	% moisture
White clover	Cut	6.1	38	Slight	10.0
	Long	6.0	65	Nil	12.6
A17 legume mixture	Cut	6.1	25	Trace	9.6
	Long	5.9	20	Slight	10.7
Red clover	Cut	5.9	58	Slight	8.6
	Long	5.9	53	Nil	12.3
Strawberry clover	Long	5.7	40	Slight	8.4
Trefoil	Long	5.7	45	Nil	9.9
Bare soil	-	5.4	28	Nil	14.6

Table 4: Soil samples from pooled plots 1/9/94

Ground cover	Soil nitrate	% soil moisture
Mixed legumes	115	15.8
Bare *	95	12.9

* it is not known but likely that late summer nitrogen was applied to the bare plots

Table 5: Final soil samples after a further cut October 94 [pooled samples]

Ground cover	Treatment	Soil nitrate	% soil moisture
Legumes	1 cut	98	13.7
Legumes	2 cuts	45	14.4
Bare soil	-	125	16.5

Conclusions

It was anticipated that as the legume root structure became more established, more free nitrate would be available to the tree roots in the 2nd year. Additional nitrogen should also be available from the breakdown and mineralization of mulch clippings from the last cut, a useful over-winter 'locking-up' of nitrogen in a non-leachable form throughout the dormant season. This seems to have been true for the white clover species where soil nitrate was more than twice the level in bare soil [Table 2].

Legumes make a good weed-free, clean substrate for harvesting fruit, but may be unacceptably competitive for water in dry seasons.
One cut per season is sufficient management for all the species trialled. This helps to avoid severe competition for nitrate.

Germination and establishment of grasses and legumes in this trial was good. Previous attempts to establish legumes have failed where weeds were inadequately controlled prior to sowing. Germination is usually slow and weed seedlings a problem in early summer. A clean seed bed is vital for the relatively slow germinating legume species.

Tree girths at end of first season[Ashton Bitter]

	row 1		row 2		row 3		
TREATMENT	rep 1	rep 2	rep 1	rep 2	rep 1	rep 2	**Means**
Bare	22.0	22.0	23.5	22.5	21.5	21.5	**22.2**
S184	20.0	21.0	22.0	24.5	21.5	22.0	**21.8**
S184+fescue/mustard	25.0	23.0	24.5	24.0	23.0	22.0	**23.6**
S184+legume/ryegrass	21.5	21.5	21.5	22.5	22.0	22.5	**21.9**
Kent	21.0	23.5	22.0	20.5	22.0	22.0	**21.8**
Kent+fescue/mustard	25.5	22.0	22.0	23.5	22.5	23.0	**23.1**
Kent+legume/ryegrass	22.5	24.0	22.5	22.0	21.5	21.5	**22.3**
Huia	24.0	23.0	22.5	17.0	20.5	21.5	**21.4**
Huia+fescue/mustard	23.0	21.0	22.5	22.0	22.5	22.5	**22.3**
Huia+legume/ryegrass	22.0	18.0	22.5	23.0	21.0	22.0	**21.4**
ROW/REP MEANS	22.7	21.9	22.6	22.2	21.8	22.1	**22.2**