Sheep growth rates under Pinus Radiata

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ABSTRACT

This paper summarises a series of experiments near Rotorua in which the liveweight changes of sheep grazed on pasture under Pinus radiata was measured. In general terms sheep performance was lower as the tree stocking increased. Long term experiments have shown that under continuous grazing, sheep performance declines with increased tree stocking from as early as tree age 5 years. Feed allowance experiments indicated there may be a general decline in the feed value of pasture growing under Pinus radiata. The effects were minor at tree stockings up to 100 stems per hectare. The effects would be minimised by offering higher allowances, to provide greater feed selection for the stock.

Key words Sheep, performance, liveweight, Pinus Radiata, pasture, pine needles, agroforestry.

INTRODUCTION

Grazing sheep under stands of *Pinus Radiata* (D Don) is now a comparatively common sight through much of New Zealand. Most recent plantings of *Pinus radiata* have been on agricultural land (Vaughan pers. comm.) and there are predictions for an increase of at least one million hectares (Sutton, 1991), as a consequence of investment and economic opportunities (Cumberland, 1991). The competition between trees and pasture has resulted in reduced pasture production (Percival and Knowles 1986; Hawke, 1991) and lower livestock carrying capacities (Percival *et al.*, 1986).

This paper summarises several experiments conducted to measure sheep performance grazed on pasture under *Pinus radiata.*

METHOD

The experiments were conducted at the Tikitere Forest Farming Research area (near Rotorua) between 1979 - 1988. In the first set of experiments (1979 - 1985), 'basic core flocks' of Romney ewes were run in each tree stocking treatment (0, 50, 100, and 200 stems per hectare). The ewes spent their whole breeding life in a tree stocking treatment of 4 x 2 hectare plots and the size of the core flock ranged from an average of 118 ewes in Open Pasture to 45 ewes in 200 stems per hectare. The trials were reviewed annually and livestock numbers adjusted to equate stocking rates with pasture allowances and residual dry matter. Additional sheep (and sometimes dry cattle) were used during periods of very rapid pasture growth.

The objective was to achieve similar pasture utilisation in all treatments (assessed visually) and measured in terms of ewe liveweight change and lamb growth rates.

The second set of experiments, commencing in 1986 were set up to measure lamb growth at a range of feed allowances and tree stockings, and to compare seasonal variations. There were six experiment runs, in which groups of twenty New Zealand Romney lambs randomised on a liveweight basis were each offered a range of feed allowances for a 30 day period within a tree stocking. In trial No.4, only 10 lambs were able to be grazed in the 200 stems per hectare treatment.

Specific experiments were also conducted to investigate:

a) The effect of feeding decaying pine needles on sheep liveweights.
b) The effect of grazing under *Pinus radiata* on meat flavour.

In a), 16 mixed age, dry Romney ewes were randomised into each of four treatments and pen fed rations made up of 0, 10, 20 and 30% of decaying pine needles, and the balance pasture. The experiment was run for four weeks, during September and October 1983 (Hawke *et al.*, 1984). Dry matter intakes were the same for each group, being at or slightly above 'maintenance'.

In experiment b) groups of six Romney wether lambs were grazed on open pasture or under 12 year old *Pinus radiata* at 100 or 200 stems per hectare, for seven weeks (Percival *et al.*, 1988). The groups grazing under the trees had access to decaying needles at the rates of 0.4 and 0.7 kg dry matter per day for the 100 and 200 stems per hectare respectively. All three groups were offered an allowance of 3 kg of green dry matter (DM) per day with a fresh paddock weekly. Liveweights were recorded weekly.

All livestock data was statistically analysed using an analysis of variance method.

RESULTS

In the first set of experiments ewe liveweights and lamb growth rates were generally lower with increasing tree stocking but there were some exceptions, viz. lamb growth rates in years 7 and 9 were similar across all treatments (Table 1).

In the second set of experiments, sheep liveweight gain was usually lower with increasing tree stocking at any given feed allowance (Table 2), but the effects were somewhat variable between experiments. For example, in Trial 3 there was no significant effect of tree stocking on lamb growth and in Trial 2, sheep on open pasture grew less than those at 100 stems per hectare except at the highest allowance level. Sheep tended to perform relatively better under the trees in Autumn than in the Spring trials (Table 2).

The pine needle feeding experiment showed no significant liveweight differences between rations (Table 3). In the latter part

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TABLE 1 Effects of tree stocking on ewe liveweight change and lamb growth rates

	Tree Age (years)	Final Tree Stocking (stems/ha) Nil	50	100	200	S.E.D.
Liveweight	5	38	26	25	17	4[2]
Changes	6	63	56	47	40	4[2]
(g/ewe/day)[1]	7	27	29	26	15	3[2]
	8	18	11	11	-7	4[3]
	9	24	4	12	19	2[3]
	10	15	13	-5	-16	2[3]
Lamb Growth	7	219	217	220	237	5[2]
Rates	8	189	189	189	160	5[3]
(g/lamb/day)	9	182	175	170	167	8[3]
	10	185	164	151	157	6[3]

[1] Over 12 months from a common starting weight

[2] Analysis based on plot to plot variation

[3] Analysis based on animal to animal variation.

of the experiment, ewes fed pasture alone gained weight while those on mixed needle rations maintained weight.

The liveweights of lambs in the meat flavour experiment showed no significant differences between the open pasture and the trees (Table 4). There was considerable variation between individual weeks.

DISCUSSION

Most of the liveweight data suggest there is lower performance of sheep grazed under *Pinus radiata*. There have been some exceptions, notably the short-term needle feeding and meat flavour experiments in which there were no significant weight differences.

The extent to which these effects develop may depend on many factors. These are discussed below.

While there is no doubt from the feed allowance experiments that the effect of increasing tree stockings was to lower sheep growth, there were always problems in grooming the pastures under 100 and 200 stems per hectare to provide similar feed allowances as on open pasture. It is thus unclear to what extent these differences were the result of there being lower green pasture mass with increasing tree stocking or lower quality of feed per se. The effects of green pasture mass on lamb growth rates are well established (Rattray *et al.*, 1987).

Nevertheless, the difficulties encountered in the experiments of providing high pasture masses under trees are real effects, and these alone indicate that if livestock grazed under trees are to achieve adequate growth rates, rotation lengths will always need to be longer to allow for the reduced rates of pasture growth under *Pinus radiata*.

An important management factor may be a tendency to overestimate the amount of feed on offer under trees. This is due to the etiolated nature of pasture growing under the trees. Sheep and cattle stocking rates should be adjusted accordingly. The physical inability to grow sufficient green pasture mass of 1500 - 2000 kg dry matter in tree stockings of 200 stems per hectare aged 14 - 15 may limit sheep performance (Hawke *et al.*, unpubl.).

A number of other factors have been previously advanced to explain lower growth rates of livestock grazed under radiata pine (Percival *et al.*, 1986).

Ingestion of decaying pine needles could be an important factor. Two short term experiments have failed to reveal any effect of up to 30% decaying needles in the diet, despite the presence of needles in the rumen of slaughtered sheep. Their effect will be related to the total level of intake, the proportion of needles and possibly the length of time over which they are fed. For instance, a diet containing 30% needles on a restricted intake would have more effect than with ad lib feeding.

With canopy closure, the lower branches senesce and needle fall increases (Hawke, unpub). At this stage, the needles directly reduce the pasture available to the animal (Percival and Hawke, 1986).

TABLE 2 Liveweight Gain (g/sheep/day) Per Feed Allowance

Trial	Season	Treatment	Feed allowance level (kg DM/sheep/day) 1	2	3	4	5	SED's
1	Spring	Open Pasture	114	202	246	251	264	
		50 sph	55	176	218	246	253	
		100 sph	42	100	168	190	200	9
2	Spring	Open Pasture	30	114	173	170	228	
		100 sph	38	141	180	191	170	
		200 sph	-3	49	103	116	117	10
3	Autumn	Open Pasture	51	105	148	173	178	
		50 sph	47	128	130	173	168	
		100 sph	38	108	112	156	180	11
4	Spring	Open Pasture	93	213	264	255	245	13*
		100 sph	76	143	206	231	226	16
		200 sph	77	107	167	173	195	19
5	Spring	Open Pasture	68	160	200	223	220	
		50 sph	19	147	173	168	194	
		100 sph	23	110	133	174	155	10
6	Autumn	Open Pasture	108	139	160	159	169	
		50 sph	90	130	130	142	168	
		100 sph	71	127	123	130	146	11

* 13 for comparing groups of 20 sheep

16 for comparing groups of 20 sheep with 10 sheep

19 for comparing groups of 10 sheep with 10 sheep

TABLE 3 Liveweight (kg)* of ewes fed decaying pine needles

	Pasture	10% Needles	20% Needles	30% Needles	SED
Initial L.W.	46.3	46.3	46.3	46.3	
After 1 week	44.9	45.1	45.0	45.2	0.4
After 2 weeks	44.7	44.6	44.8	44.7	0.4
After 3 weeks	45.5	45.0	45.1	45.1	0.4
After 4 weeks	45.8	45.0	44.8	45.2	0.7

* Figures adjusted by covariance to give equal starting weight.

TABLE 4 The effect of *in situ* grazing under trees on lamb liveweight gain (g/day)

Week:	1	2	3	4	5	6	7	Mean
Treatment:								
Nil sph	-86	+243	+129	+129	+200	-86	+100	+90
100 sph	-171	+171	+157	+171	+157	-14	+43	+73
200 sph	-71	+129	+200	+129	+29	+129	-43	+76
SED								14

There is clear evidence of higher concentrations of infective trichostrongyle larvae on pasture growing under *Pinus radiata* (Jackson *et al.*, 1986). Sheep in all of the short-term feeding experiments were treated with anthelmintic drenches and so these are unlikely to be a significant factor in the results. In a commercial situation, more attention may need to be paid to ensure that lambs in particular are not unduly affected.

There is a gradual decline in ryegrass and white clover with increasing tree stocking and tree age (Hawke, 1991) though the extent to which this has occurred has varied between years. These are the highest feed value components of pasture and their decline is also likely to be implicated. In the pen feeding experiment, the pasture component was from an 'open pasture' area. If the pasture component was from under trees, the result could have been different.

The rate at which any changes in stock performance under trees develop will depend on the rate of tree growth. This is usually measured by site index, which is an index of tree height (Goulding, 1986). In the central and northern half of the North Island, the site indices are generally high with canopy closure usually occurring at age 12 to 13 years at 200 stems per hectare. On lower site index locations, canopy closure occurs more slowly, thus tree competition has a later effect on pasture production (Cossens, 1991). Most South Island locations have lower site indices.

CONCLUSIONS

The presence of *Pinus radiata* planted onto pasture affects sheep performance. As the tree stocking increases, sheep performance is reduced and this may be due to a variety of factors. While none have been proven beyond doubt, it is likely that the inability to eat sufficient green pasture mass caused by the tree/pasture competition is a major factor. Over short periods of time grazing under trees, there is minimal effect on sheep performance. However, where sheep spend their lives under agroforestry systems, there is a cumulative reduction in sheep performance.

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