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GRAZING MANAGEMENT OF AGROFORESTS ON HILL COUNTRY

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Abstract

The successful management of livestock grazing pasture under a tree canopy requires an understanding of the interaction between the trees and pasture. Because of the constraints with the trees there are a number of agricultural management factors requiring special consideration. Details are given on the potential for early grazing soon after tree planting, as well as special requirements in the management of both livestock and pasture.

Keywords: *Pinus radiata;* **agroforestrv; forest farming; early grazing; weed control; livestock production.**

INTRODUCTION

Agroforestry is an alternative land use that offers the potential to substantially improve profitability of lower production hill country (Percival & Knowles, 1983a). Although adoption of agroforestry is not yet widespread throughout New Zealand, in some districts significant land areas are being managed for combined agricultural and forestry production. These include, Hawkes Bay, East Coast and Bay of Plenty. The predominant tree species is *Pinus radiata*, which is suited to a wide range of soil and climatic conditions in New Zealand.

Agroforestry is taken here to mean the management of livestock under trees planted onto existing farmland, rather than the grazing of existing forests. This paper details the grazing policies for agroforests. The information is largely from the tree establishment grazing trials in the Waikato and Bay of Plenty, the Tikitere Forest Farming Research Area near Rotorua and also from visits to commercial agroforestry areas throughout New Zealand.

TREE ESTABLISHMENT AND EARLY GRAZING

The aim is to maximise growth of the seedlings and pasture utilisation without excessive browsing damage to the seedlings. The area to be planted should be hard grazed with a large mob of stock prior to planting, to provide a short sward for planting into. Unless pasture competition is controlled, early tree growth is reduced (Tustin et a/, 1979). The most successful method is to reduce competition by application of herbicides. These are preferably applied prior to tree planting but may also be used to release the young trees after planting (Tustin *eta/, 1979).* A number of suitable herbicides are available, the choice of which depends on the type of pasture to be suppressed.

Early grazing practices vary widely. Because it is critical to get the tree crop established a high degree of grazing control is necessary if unacceptable tree damage is to be avoided. If the trees are repeatedly browsed their early growth is substantially reduced, and some may be killed (Gillingham et *a/ 1976).* It is essential to have good fences around tree blocks to prevent both unplanned break-ins, and also to provide the necessary level of grazing control. In general, the greatest danger period is in the spring and summer immediately following tree planting. The manager must resist the temptation to utilise all available forage until the tree leaders are above browsing height (about 1.2 m).

Browsing damage to *young* trees *is closely* related to the stock pressure. High stocking rates invariably result in tree damage (Gillingham et *al,* 1976). Light stocking in the first two years prevents pastures from becoming rank. This may be achieved by set stocking with sheep at a low stocking rate from soon after tree planting (a fifth of normal stocking rate), or by using larger mobs for a short period. Thus it is not correct that any grazing is undesirable in the first two years. However, the tree requirements are paramount until their leaders are beyond browsing height.

Sheep are generally better suited in younger plantations because they cause less damage to the trees. Dairy stock generally do greater damage than beef cattle, and mature sheep are better than hoggets. The class and breed of stock are of less importance than using stock that are used to grazing amongst trees. The greatest tree damage often occurs with stock being grazed in a planted block for the first time. It is important to check the trees and stock regularly. If stock have eaten more than 10% of the tree leaders, and/or debarked more than 10% of the trees they should be removed. Once tree browsing or bark chewing commences, stock generally continue with these habits if given the opportunity.

Some areas should not be planted. It is important to keep areas such as gateways, fences, troughs, dams and roadways free of trees, with a border of at least 10 m suggested. Trees planted on stock camps are more likely to be browsed, so it is illogical to plant these areas. Tree rows should be spaced at least 7 m apart. This is much wider than in conventional forests, but is important to facilitate livestock movement.

LIVESTOCK MANAGEMENT

It is important for managers to understand that the interaction between the trees and the pasture understorey results in a long term decline in the numbersof livestock that can be carried. Failure to recognise this is usually manifest as lower livestock performance, due to underfeeding. It is important not to overestimate the amount of feed available under the tree canopy. This is more difficult than on open pasture, as pasture under trees is often elongated and deceptive.

There is a close relationship between the tree density and pasture yields (Percival & Knowles 1983b). The greater the number of trees present at any one time the lower are pasture yields and hence livestock carrying capacity. Successful agroforestry ventures must involve a balance between the two components. The key factor is the tree density. This must be high enough to produce a worthwhile tree crop but low enough to enable sufficient livestock numbers to be carried to sustain normal farm operations such as fence maintenance and weed control. In a number of instances to date, this has not been recognised. The outcome is always to quickly reduce pasture yields, virtually eliminating the agricultural component. This is particularly relevant to hill country where maintaining a farming component is essential to provide income until the tree crop starts generating income. It is not yet possible to predict an optimum tree density for every site. Recent studies show that for straight forestry solid wood regimes, optimum tree densities are below 200 stems/ha (Knowles & Percival 1983). In some circumstances tree densities of 100 stems/ha may be optimal. In most situations with agroforestry, unless tree densities are below 200 stems/ha, the agricultural component will experience a rapid decline as the trees mature. By 1985, an agroforestry model should be developed which will enable optimal tree density to be predicted, provided there are definable profit objectives.

Bark Stripping

Despite the experience and observations of many people, the reason why stock strip and eat bark remains unknown. The greatest damage usually occurs in late winter and early spring. Wet and cold climatic conditionsare often associated with bark stripping. Stock may actually eat the bark, and normally tear a strip up or down the tree until it reaches a branch or pruning occlusion. Trees near gateways, troughs, stockcamps or where hay is repeatedly fed out, suffer the most. Larger plantations generally suffer less damage. Studies have shown that a few animals repeatedly cause most of the damage (Marnane et al 1982). Although bark stripping has been observed in 5-6 year old *Pinus radiata*, sheep generally find the bark too coarse in 4-5 year old trees. However, cattle may damage trees up to 8-9 years old. With both sheep and cattle, stock regularly grazed under the trees tend to cause less damage and are easier to handle than stock unaccustomed to grazing forests. Trials have been conducted with repellents (Knowles & Tahau 1979, Marnane et al 1982). Egg powder and cattle dung have reduced the incidence of browsing and debarking, but farmer application of these on a large scale is not practical. Stock must be removed if serious damage is noticed over a number of trees,

Type of Livestock

There is no experimental evidence to suggest that any one breed of sheep performs better in an agroforest. Fiomneys, Coopworths and Perendales have each been managed successfully under trees, although on hill country with some scrub cover the better foraging ability of Perendales may be an advantage. With cattle, there is general agreement that beef breeds cause less damage than dairy cattle. Cattle utilise pasture growing in slash (thinning and pruning debris) much better than sheep, and speed up its decay by crushing and breaking up small branches. Adult cattle and sheep are preferred to growing stock as their nutritive requirements are less demanding.

Forage Quality

Pasture grown under more mature trees appears to be of lower nutritive value (Percival & Knowles, 1983a). This has not precluded carrying adult ewes under 13 year old trees over twelve months, but their wool and lamb weaning weights were lower. Because of this, it is more difficult to achieve adequate growth rates in young stock under more mature trees. Older trees are more suitable for occasional runoff type grazing. It is also important not to neglect normal trace element supplement programmes. This particularly applies to the requirements for cobolt, which can only be effectively supplied in fertiliser.

There is evidence of abortion problems with cows grazing pine foliage in late pregnancy (Knowles & Dewes 1980). This occurs spasmodically and is usually associated with access to fresh tree foliage, often as thinning and pruning debris. It is recommended that breeding cows are kept out of forests for the last 2-3 months of pregnancy, or at least not given access to fresh foliage.

Handling of Livestock

The tree density has a large effect on routine farm operations. Mustering is very difficult in hill country if fences are poor and where the tree density is high. Data from the Tikitere Forest Farming Research area shows mustering time is increased twofold when 30% of ground area is covered by thinning and pruning debris. At 100 stems per ha with eight year old trees, mustering time was increased by up to 30%. On large blocks at relatively high densities, a straggle muster is

usually required. Remaining stock tend to congregate on ridge tops and open areas. Paddock size is an important factor, with 20 ha being considered the maximum for ease of mustering. Stocking handling problems are less significant where tree densities are low.

Lambing under trees presents no major management problems. Mis-mothering can occur if the ewe has twins and one wanders off behind slash. Weak lambs may crawl under branches and be unable to get out. The presence of trees and/or slash means that a more careful lambing beat is required in order not to miss ewes with lambing problems. Once lambs are eating grass, they tend to forage more under the branches than ewes.

Shelter

The presence of a low density tree crop still provides a significant shelter effect, particularly from wind, Wind run under 9 year old trees at 100 stems/ha on the Tikitere area was 40% lower than that on open pasture. The harsher the climate, the more beneficial are the effects of shelter. It can reduce lambing losses in wet and cold weather and be used for newly shorn sheep. It is important that where an agroforest is primarily used for shelter, adequate feed is available. Overseas studies indicate there is a reduction in the energy requirements of cattle wintered in mature plantations (Cumming 1980).

PASTURE MANAGEMENT

During the period of early tree growth the reduced grazing pressure generally causes changes in pasture composition. There tends to be a greater proportion of erect growing grasses such as cocksfoot and Yorkshire Fog. Once full or near full pasture utilisation is restored these species usually decline. The time for this to occur depends on the extent of pasture composition changes in the period of early tree growth, which in itself is linked to the degree of pasture utilisation in that period.

Pasture composition also changes with increasing tree density and age (Percival & Knowles 1983b). There is a decline of ryegrass and white clover, and an increase in the annual grasses and Yorkshire Fog. It is unlikely there are management techniques to prevent these changes occurring. Up to tree age 10 years on the Tikitere Forest Farming Research Area the changes are comparatively minor at tree densities of 100 stems/ha or less,

Perennial weeds such as blackberry, gorse, Californian thistle and inkweed can become a problem, arising either in slash or from grazing pressures being too low. To maintain grazing it is essential to control these as on a normal farm. This can pose problems especially if access is difficult, and where the range of acceptable herbicides is reduced because of the tree crop. The most important factor in weed control is the maintenance of adequate grazing pressure, particularly later in the tree rotation when the total grazing available is limited.

The annual weeds such as nodding and Scotch thistles, and ragwort tend to flourish in the shelter provided by slash. These may reduce grazing in the earlier part of the rotation but do not constitute any long term problem as they do not survive under the low light intensities present later in the tree rotation. Because most agroforests are in extensive farming situations, herbicide control of annual weeds isgenerally not warranted, though they could be justified where the forested area is only a small proportion of a farm.

Since most weed ingress in agroforests is associated with slash, any practice

to reduce the area it covers should have a corresponding effect on weeds. It is not usually feasible to physically remove slash on hill country. The proportion of ground covered by slash is related to tree density (Hawke et *a/ 1979).* The effects at tree densities of 100 stems/ha are comparatively minor compared to 200 stems/ha or above. Slash ground cover can also be minimised by pruning and thinning as early as possible, by thinning into alternate rows, and sawing the larger stems into smaller sections. Slash usually breaks down in 3-4 years.

Maintenance fertilisers should be applied where major or trace element deficiencies are limiting livestock production. In general the trees do not respond directly to fertiliser, though there are some major exceptions to this such as phosphate responses from radiata pine in parts of Northland. Since stocking rates are related to tree density the chances of a payable fertiliser response decline with increasing tree density. Fertiliser rates should be primarily determined from the soil type, soil test values and the removal of nutrients in livestock production.

CONCLUSIONS

From the experience with livestock systems on the agroforestry trials, plus a number of examples of successful agroforestry ventures on farms, it is clear that the combined use of land for agricultural and forestry production is biologically viable. The most important factor determining productivity of the agricultural component is the tree density. It is essential that this is low enough to maintain a profitable farming component. There are a number of agricultural management factors that are important. These include:

- Grazing in the two years after tree planting is possible providing fences are secure and the stock are closely monitored to avoid excessive tree damage.
- Sheep are generally preferred to cattle in the first six to seven years after planting.
- High tree damage risk areas such as gateways, fencelines, and stock camps should not be planted.
- It is important not to over-estimate the amount of pasture available under the trees.
- There is a risk of cattle abortion in the two-three months before calving.
- Mustering of stock under trees takes longer, particularly where thinning and pruning debris covers more than 30% of the ground.
- Trees even at densities as low as 100 stems/ha provide significant shelter.
- Perennial weed control is essential to provide continued grazing. Control of annual weeds is less important as they are not a long term threat.
- Debris from pruning and thinning adversely effects agriculture, but can be minimised by a number of practices.
- Maintenance fertiliser topdressing is appropriate in some circumstances.

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