AN INTEGRATED SYSTEM OF SHEEP GRAZING AND SOFTWOOD PRODUCTION

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SUMMARY

Grazing sheep under pines requires stock control to avoid damage to young trees, and a reduction of the number of sheep carried as canopy closure approaches. Planting the pines at lower density, thinning and pruning, all delay canopy closure and increase sheep carrying capacity. Some feed value of pine needles is indicated. Intensive pruning of trees on an individual basis improves timber quality, but the litter decreases pasture availability to sheep. The sheep provide decreasing amounts of income while final timber returns are awaited. There are some labour complementarities and other side benefits.

INTRODUCTION

The greening of Australia by planting more trees is one of the objectives for our bicentennial. CSIRO and the WA Forests Department have been investigating agroforestry in a 750 mm Mediterranean rainfall environment near Perth since 1975. In this paper I will describe firstly the silvicultural, secondly the agricultural, and then, other components of the system, that we have learnt whilst conducting several experiments with Pinus radiata. These have been or will be reported in more detail elsewhere.

OBSERVATIONS

Silvicultural aspects

It is essential when planting pines to eliminate competition from other plants, hence pastures must be sprayed with a suitable herbicide along the proposed tree lines. We planted 380-1140 trees/ha in 1978 and these are being thinned (for no return), as soon as undesirable characteristics are observed, to reach final densities of 76-228 trees/ha in 1985. The distance between the tree rows may be varied to suit the individual but the range of 8-12 m is suggested because final crop trees will be almost equally spaced between and within rows. (A 12 m grid spacing ≅ 70 trees /ha, 8 m'grid ≅ 156 trees/ha.)

Pruning to improve the form of the trees was carried out in the third year. "Form pruning" involves removal of double leaders, branches of greater than 35 mm diameter, and other serious malformations. It increases the proportion of useful trees in the stand for a relatively small labour cost. As the trees reach about 5 m in height, annual lift pruning (pruning all branches, usually to about 50% of the height of each tree) becomes necessary. We are currently assessing the economics of extending the final height pruned from the normal 6 m to 10 m. A vital feature of our pruning regime is to limit the size of the knotty core of the trees. We hope to restrict this low value core to about 15 cm by pruning branches where the main stem exceeds 10 cm in diameter.

These silvicultural practices not only enhance timber quality and maintain good growth rates, they also promote pasture growth by decreasing shading. However, they do create litter which renders some of the pasture inaccessible to sheep. Felling 250 out of 750 trees/ha, at age four years, and pruning the remainder covered 14% of the pasture with debris. This was reduced within 12 months to 7% by sheep consumption and trampling, and by natural breakdown. With only a small labour input the fresh litter can be roughly heaped to about halve the area of pasture covered. We are investigating the value of mulching

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the litter which, though costly, almost eliminates pasture coverage and may accelerate nutrient recycling.

Although the total volume of timber produced in high density stands is larger, low density stands can be more profitable (McKinnell 1979, Knowles and Percival 1983), because there is a greater proportion of high value timber in the large diameter trees that result from properly managed open stands grown in clover-based pastures. The provision of phosphorous, primarily to maintain pasture growth, and of nitrogen through fixation by the clover, also promotes rapid growth of pines. It appears, therefore, that income from timber in an agroforestry system may be similar to that from plantations.

Agricultural aspects

Young pines need protection from sheep for two years or until the apical shoot is out of reach. In this period hay making and cropping between the rows can be practiced out to within 1 m of the trees. Closer cropping may reduce both survival and growth of the trees (Anderson and Batini 1983a). Crash grazing of the crop or hay residues is possible, but requires close supervision as tree damage once started sometimes escalates rapidly.

In the third year set stocking with sheep becomes practicable though frequent inspection of the trees is still advisable. Sheep eat a lot of the lower needles and may also strip bark. Needle consumption does not harm the pines but severe bark stripping will reduce growth rates and may distort and weaken the stem. Sheep are unlikely to damage the bark of P. radiata older than 6 years. When the degree of bark stripping causes concern a fresh flock of sheep should be tried or the paddock spelled and the same flock returned later. The use of repellants applied to the trees has also been effective in some trials.

Crop or hay production per unit area is not affected by the trees in the first two years so yields are proportional to the area sown. With tree rows 12 m apart, 10 m or 83% of the total area may be utilized, 66% with rows 6 m apart. When full grazing commences a small production loss is experienced in agro-forestry pastures due to shading and the residual effects of the initial herbicide treatment. Figure 1 illustrates the suppression of pasture by litter and the sheep stocking rates maintained in five-year-old stands. Sheep management was designed to maintain equivalent bodyweights of sheep on all treatments. Sheep carrying capacities of 91, 82 and 73 per cent of those on open pasture were achieved under 250, 500 and 750 pruned trees/ha respectively. On another site, where a plantation had been thinned, pruned to 6 m, and undersown with clover in the fifteenth year (Anderson and Batini 1983b), pastures under 20 year-old trees at 70 and 120 trees /ha carried 55 and 30 per cent, respectively, of the sheep carried on open pastures. Litter had been removed from these plots and pasture depression was considered to be due mainly to shading.

Pine needles are eaten from trees throughout the year and consumption rates to 260 g/head/day have been estimated. Needles on pruned branches and felled trees are also eaten for at least six months after these are cut. In pen feeding experiments, sheep, with free choice between freshly stripped needles and oaten chaff with a digestibility of 56%, ate 45 g less chaff than control sheep offered only chaff ad lib, but compensated for this by eating 140 g needles (digestibility c 35%) and maintained liveweight, as did the control group. Sheep on a restricted chaff intake, of 409 g/day, ate 230 g/day of needles and lost weight at the rate of 100 g/day.

Wool production per head and liveweight trends, at the different stocking rates used, have not been affected by the presence of trees. Fleece weights and yield have been measured and were found to be correlated, not with tree density,

but with bodyweights which in turn strongly reflected pasture availability. Incidence of tenderness, fleece rot and mycotic dermatitis have been low and not affected by our treatments.

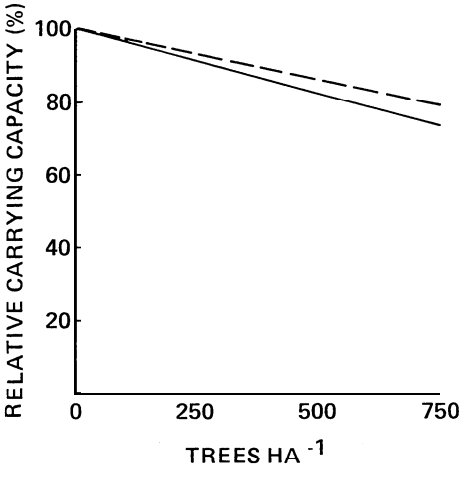

Fig. 1 Regressions of sheep carrying capacity(———), and of pasture free of litter (------), on tree density, with 4-5 year old P. radiata.

Economics

In softwood production systems the major costs are incurred at establishment and in silvicultural treatments during the first half of the rotation. In plantation forestry these costs are largely offset by the sale of thinnings, however these are often over supplied in some areas and do not always have sufficient value to warrant transportation in some other cases. In most situations, the accrual over many years of interest on the initial capital outlay means that profit is only taken following final harvest. In agroforestry, income can be derived annually throughout the rotation from sale of hay, livestock or wool. Such returns should compensate for the lack of thinning sales in this system. The end of the rotation is quite flexible. The trees will continue to grow and become more valuable for several years beyond the prescribed rotation length so this option may be exercised if income from other sources is satisfactory. Hence harvest of the timber can be timed to stabilise income to a considerable degree. We are delaying detailed economic analysis of the systems in our project until we have more data.

Integration of agroforestry and other enterprises on the farm

Agroforestry on up to fifty per cent of a grazing property appears to fit in quite well with other farm activities. In young agroforestry areas pastures or crops can supply hay or grain for use on the farm or for sale. In later years there is enough flexibility to allow for the practice of rotational grazing which should reduce serious damage by bark stripping. Later again in the rotation heavy grazing pressure can be applied to the pastures under the trees in early summer. This practice can reduce the fire hazard to the equivalent of that of a normal pasture situation.

Tending the trees can be concentrated in the autumn when labour requirements for other activities are normally low. This is also a period when consumption of needles could be of value. Silvicultural techniques are easily learned and can be practised with relatively inexpensive equipment. Logging and on-farm milling of the logs could also be handled by farm labour if available.

A final consideration is that an area of agroforestry on a farm can provide shelter which can be of value for lambing ewes and for freshly shorn sheep. In areas of light soils prone to strong winds the presence of trees should also be helpful in reducing wind speeds thus reducing soil erosion.

DISCUSSION

Our experience in managing an agroforestry system and our data on tree growth rates and sheep production suggest that in suitable areas agroforestry may be a viable compromise between agriculture and forestry. It appears to be compatible with farming and has potential to both diversify and stabilise income in the long term. In some areas side benefits of agroforesty may also appeal to landholders. In Western Australia we are hoping that agroforestry will stabilise groundwater salt which causes problems of land and stream salinity when areas are fully cleared to agriculture.

Pine needles have some feed value for sheep. This may be greatest in autumn while dry herbage is scarce and of poor quality, in drought periods, or even in winter as a source of roughage. The recycling of nutrients in the needles should be accelerated by their passage through the sheep.

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