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SOIL

FACT SHEET TWO

Forest Industry Council

Pines do not harm the soil

Pine plantations have three distinct advantages over most agricultural crops in relation to soils:

- they have a long rotation length of 30 to 35 years and thus provide soil stability
- they are deep feeders within the soil, accumulating nutrients often inaccessible to agricultural crops, and
- they recycle a major proportion of their nutrients after canopy closure (when the trees touch each other) at some six to eight years old.

This can be readily observed when you walk into a pine plantation and kick through the carpet of fallen needles into the rich layer of humus forming below that is being incorporated into the topsoil.

Over the rotation, pines are more efficient in nutrient usage than crops.

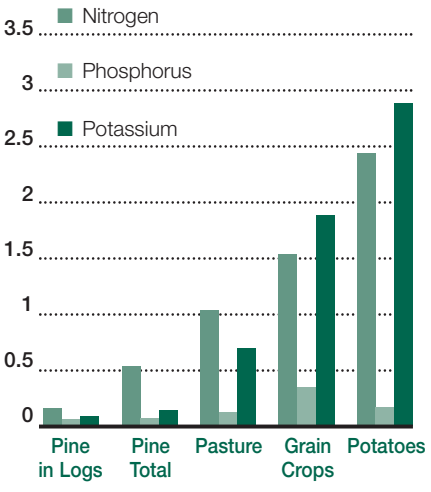
In the long term, this results in radiata pine plantations using less nutrients than agricultural crops (see figure 1). Nutrient cycling under radiata pine may also slowly reverse the pattern of nitrogen mineralisation and nitrate production caused by pasture improvement, and even reverse increased soil acidification.

The location of nutrients within a pine tree is also an important factor to consider (see figure 2). In pines, the component which is harvested (the trunk) typically constitutes around 70 per cent of the aboveground biomass, yet it constitutes only a small proportion of the nutrients. It is made of wood, which is largely cellulose formed from the chemical combination of water and carbon dioxide (photosynthesis).

A highly productive pasture near Tumbarumba which was once a mature pine plantation.

On the other hand, the crown and needle litter components of pine trees, which are not usually removed from the site, contain between 50 and 70 per cent of the total nutrients in the biomass. By contrast, the bulk of nutrients in pastures and crops are removed when they are grazed or harvested.

Figure 1. Nutrients removed during a 30-year period.
Nutrient removal (`000kg/ha)



(Source: DCFL 1988)

Acidity

Critics of radiata argue that coniferous plantations acidify the soil and decrease soil fertility leading to a decline in productivity. This view was based on experience in northern Europe where deciduous hardwoods were replaced with conifers. There soil fertility declined because of a reduction in the biological activity in the soil, and because of leaching of nutrients.

But studies in Australia have found no evidence of soil acidification under radiata pine. Rather, soil tends to become less acidic under pine than under eucalypts (Anon 1988. Turner and Lambert 1988).

Isn't pine humus acidic?

Although pine humus (organic constituent of soil formed by decomposition of plant materials) is acidic, it does not increase soil acidity. The humus is acidic due to organic acid production, but this does not significantly impact on the

soil

Without going too deeply into the chemistry, the ratio of carbon to nitrogen in the humus, is the important determining factor in the rate of decomposition of organic matter and its incorporation into the mineral soil.

Pine needle litter has a high carbon-to-nitrogen ratio and slows down acidification, whereas improved pasture with legumes accelerates the process.

The use of nitrogen-rich fertilisers such as Urea in pasture improvements also contributes to soil acidification. It has been estimated that during one rotation (35 years), the pH under pine may decrease by only one hundredth of the pH decrease under improved pastures. (Low pH values indicated acidity.)

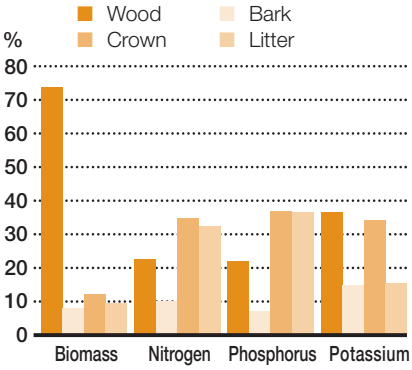
Why doesn't anything grow under the trees?

Once the canopy of a pine plantation closes little or no light reaches the soil, stopping the growth of other photosynthetic plants under the canopy. This situation may lead some people to think that the pine trees have had a detrimental effect on the soil.

However, after thinning or upon clearfelling, other plants quickly re-establish themselves with the increased light availability. Local examples of plantation land reverting to pasture include:

- The Mannus Correctional Centre, Tumbarumba, where after 60 years under pine, 325 hectares was re-established to highly productive pasture.
- The successful re-establishment of a eucalypt plantation following 65 years under pine at Pilot Hill near Batlow, which included the natural regeneration of 16 native shrubs and flowers.
- The regeneration of native wattle and eucalypt forests following the clearfelling of the area behind the golf course at Tumut after 70 years under pine.

Figure 2. Percentage of total biomass and nutrients in various parts of pine trees.



(Source: DCFL 1988)

Is it true that nothing will grow after a crop of pines?

This is far from the case, particularly if you take a look at the Mannus Correctional Centre near Tumbarumba, which has been returned to highly productive pasture after a crop of mature pines were harvested.

Pine stumps break down quickly and then after some clean-up work pasture can be established.

Do pine plantations need more nutrients than agricultural crops?

In the long term, plantations use fewer nutrients than agricultural crops. Figure 1. compares the nutrient utilisation of pine (during a 30-year period) with agricultural crops such as grain. This indicates a lower demand on soil nutrients in pine when compared to agricultural crops.

In addition, pine trees utilise nutrients from lower in the soil profile than most pastures and crops and then recycle the nutrients in the humus and surface layers of the soil.

Harvesting trees, removes very little of the soil nutrients from the site because wood consists almost entirely of carbon, hydrogen and oxygen. However pastoral farming of meat, milk and wool has been found to result in a substantial loss of nitrogen, phosphorus, potassium and sulphur (Hedley et al.1990).

In conclusion radiata pine plantations are likely to reverse soil acidification through nutrient cycling and unlikely to significantly deplete soil nutrient reserves even after several rotations.

Further reading

- Anon (1988), The effects of radiata pine on soil (pamphlet). *Produced for the Victorian Department of Conservation, Forests and Lands - Lands and Forest Division Division*. no. 9.
- Attiwill P, Florence R, Hurditch W E and Hurditch W J (1994), *The Burning Continent - Forest Ecosystems and Fire Management in Australia. Institute of Public Affairs.*
- Hedley M J, Tillman R W, Ball RP (1990), 'Nutrient losses from New Zealand agriculture'. *Proceedings of the 21st Conference of the New Zealand Fertiliser Manufacturers' Research Association.*
- Roberts B R (1992), The Issues of Land Degradation*, in Land care manual*. NSW University Press, pp. 10-21.
- SPIS (State Plantation Impact Study) (1990), *Report and Recommendations*. SPIS Steering Committee, Melbourne.
- Ward S C (1991), 'Processes of Land Degradation and the Role of Plantations in its Amelioration'. *In Productivity in Perspective*. Third Australian Forest Soils and Nutrition. Conference, Melbourne, 7-11 Oct. ed. P J Ryan. Forestry Commission NSW, Sydney, NSW.
- Turner J and Lambert M (1988), Soil properties as affected by Pinus radiata. NZJ ForSci 18: 77-91.

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