PINES DO NOT DAMAGE SOILS

It is commonly thought that pine trees increase spoil acidity and deplete the soil of nutrients thus making the soil poorer. This is a misconception.

The following information is a summary of scientific facts.

The Facts:

- **Radiata pine plantations do not destroy the land.**
- **They do not acidify or adversely affect nutrient status or chemical properties of soils.**
- **Some changes in nutrient status may occur but the soils will remain suitable for agriculture.**
- **Plantations improve water infiltration and reduce run-off.**
- **Well managed pine plantations planted on pasture are not likely to significantly deplete soil nutrients even after several rotations and generally the land is still good, if not better, for agriculture.**
- **It is a public misconception that pines destroy the land!**

Information supporting these statements is detailed below.

Forests create soil

Most agricultural soils were once under forest cover and trees played a key role in soil development. Tree roots penetrated deep into the ground to improve aeration, water infiltration and storage, and to recycle nutrients from deep in the ground. Trees protected the soil from erosion and roots and litter enhanced biological and soil organism activity. Removal of trees and conversion to agriculture often results in changes to soil structure and fertility in the long term.

Forest soils

Many people believe pine acidify soils and thus reduce soil fertility. This is based on experience in northern Europe where deciduous hardwood forests were replaced with plantations of conifers. As a result soil fertility declined because the biological activity in the soil decreased and nutrients were leached. Australian studies have found no such evidence.

Agricultural Soils

Agriculture almost always changes soil properties. Soil organic matter and nutrient levels increase through application of fertiliser. In particular the level of available phosphorus increases as a result of regular applications of superphosphate.

In some areas, long-term pasture improvement with legumes increases nitrogen levels and acidity due to accumulation and rapid turn over of organic matter and high rates of nitrogen mineralisation and nitrate (NO_3) production. These processes acidify the soil, promote leaching of exchangeable cations, and thus reduce soil fertility. Soluble aluminium and manganese also increase and may reach levels harmful to plants.

Fertility problems in agricultural soils have resulted from increased soil acidity following the introduction of clover in the 1950's and use of fertiliser. Soil acidification of agricultural land is an important environmental problem in Australia.

Pasture improvement increases soil fertility well above the needs of pine. Tree roots explore much larger volumes of soil and reach nutrients not available to shallow rooted pastures and crops. Pines efficiently recycle nutrients after the canopy closes and nutrient cycling under pine would slowly reverse nitrogen mineralisation and nitrate production caused by pasture improvement and reverse soil acidification. The availability of nitrogen, phosphorous and sulphur in the top 10 cm of soil is usually increased by pines. Evidence shows yields of grass and clover have been greater in soils from under pines than adjacent grassland.

Agriculture can damage soils

In addition to increasing acidity, agricultural soils are often compacted by animals and machinery and plough layers can develop on some regularly cultivated soils. Water infiltration and hydraulic conductivity are reduced and run-off increased. Tree roots improve infiltration and reduce run-off. Soil compaction is likely to be less under well managed pines.

Plantation fertility

Research shows soil organic matter can be increased by addition of fertilisers early in the rotation.

CHART 1 - One study showed the application of superphosphate to young pines increased litter and organic matter by time of final harvest.

Pines aren't hungry

In New Zealand, as early as 1914, it was recognised that radiata pine "instead of weakening soil fertility had the opposite effect".

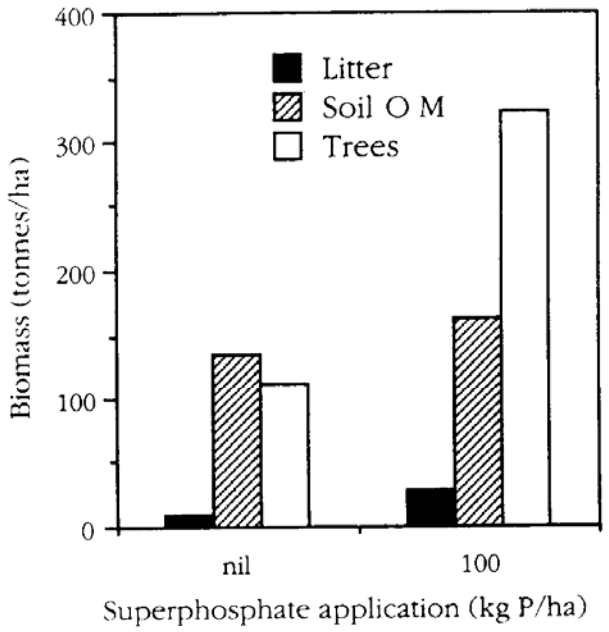
Soil fertility is affected by nutrient cycling and management practices. Established trees rely on the cycling of nutrients for growth. However, nutrient cycling patterns vary between tree species, so in the long term where eucalypts are replaced by pine levels of some nutrients will increase and others decrease, the size of the change depending on the initial level of soil fertility.

CHART 2 – shows nutrient removal during one 30 year rotation of pine is small compared to nutrients removed in agricultural crops.

Nutrient neutral

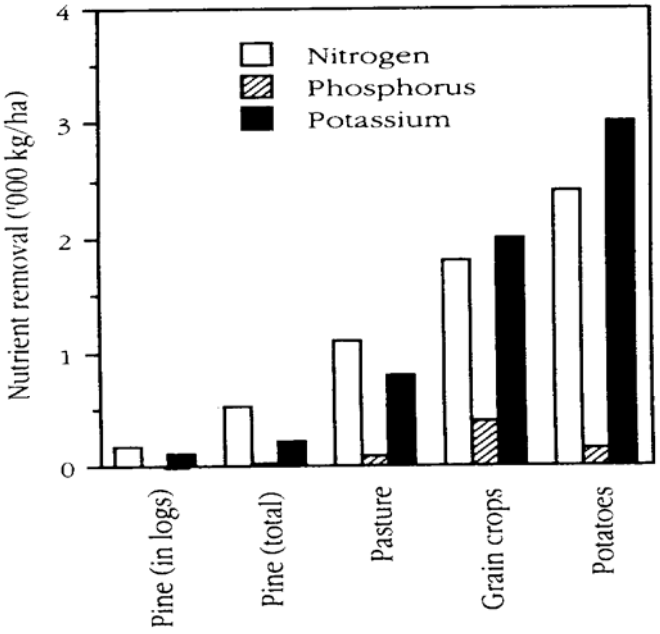
About 70% of the wood in a 30 year old pine is above ground – the rest being in the roots. Most of the nutrients are held in the green needles and litter which is not removed from the site when trees are harvested. Where this is incorporated back into the soil rather than burned little nutrients are lost. Fertilisers are used to maintain productivity especially on infertile soils.

CHART 1



The effect of superphosphate applied in the establishment phase on soil organic matter (O M) and productivity of Radiata Pine over a 30–year rotation

CHART 2



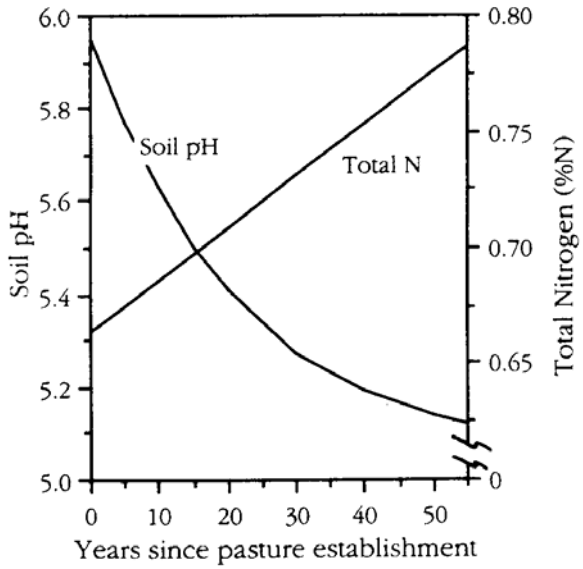
A comparison of the quantities of nutrients accumulated in a Radiata Pine plantation and in agricultural crops over a 30-year period (all quantities in kg/ha).

Legumes, pH and nitrogen

CHART 3 shows the relationship between:

- age of pasture legume establishment
- soil Ph and
- total nitrogen content in the top 10cm of soil.

CHART 3



Generational soil changes

A pine plantation on a well structured red soil in north west Tasmania will not affect the soil properties to any degree but a plantation on sandy soils in a high rainfall area could, over 1,000 – 1,500 years change, but not necessarily degrade, the soil properties to a mor (humus enriched) type soil.

Poor forest practices degrade soils

Today, soil fertility and plantation productivity can be maintained and often improved with sound forest management practices. In the early periods of plantation establishment soil changes were initiated not, by planting pines, but by removal of top soil, burning of both forest and logging debris and compaction of soils by harvesting in wet conditions and use of inappropriate machinery. The major changes to soil, particularly compaction, occurs when plantations are harvested. Even so, with appropriate soil cultivation this has little impact on the productivity of successive plantations. Tasmania has the world's best Codes Of Practice to ensure forestry operations do not cause undue environmental harm.

How nutrient recycling works

During the closed canopy phase litter (needles, branches and cones) is produced until a balance between litter fall and rate of decomposition is reached. Litter contains large amounts of nutrients taken up from the soil in the establishment phase. These nutrients are released as the litter decomposes and leaches into the soil for uptake by roots. Nutrients are also leached by rain from green needles in the tree crowns. This whole process of biological cycling enables pines to use nutrients very efficiently. In the long term pine plantations accumulate less nutrients than agricultural crops.

Nutrient & Biomass in Pines

Percentage distribution of biomass and nutrients in a 30 year old radiata pine plantation.

	Percent distribution (%)			
	Wood	Bark	Crown	Litter
Biomass	73	7	12	8
Nitrogen	23	11	34	32
Phosphorous	23	7	35	35
Potassium	36	16	34	14

Stages of nutrient recycling

Growth Phase	Age	Nutrient Activity
Establishment	0-8 years	Tree crowns expand and trees take up nutrients at rates similar to pastures.
Closed Canopy	8-30+ years	Tree crowns interlock and nutrient recycling operates.

Pines improve water quality

Water Quality

- Levels of nitrogen and phosphorous are often higher in run-off from agricultural land than plantations
- Sedimentation is generally worse with pasture than pines.
- Forestry can have a negative impact at times of roading and harvesting but Codes of Practice minimise environmental damage.

Soil Erosion

- Erosion is less serious under pines than agriculture.

Water Yield

Plantations may increase or decrease annual water yields from catchments. Clearing catchments of natural tree cover increases water yield.

- Long term research indicates that forests will reduce water yield on a catchment basis.
- Substantial increases in water yield occur for about the first 6 years after harvesting.
- Forests in certain situations can smooth flood peaks, but their main benefit here is to reduce sedimentation in flood waters.

References

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