Agriculture Notes

Fertiliser Use in Farm Forestry

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This Agriculture Note describes the use of fertiliser in farm forestry.

Why apply fertiliser?

Most Australian soils have low fertility. It is often believed that trees occurring naturally in such an infertile environment are well adapted and would not benefit from increasing the site's fertility. In practice, it has been found that this is not the case with most plantation species.

The relationship between the application of fertiliser, weed control and the effect of deep ripping in the establishment of Tasmanian blue gum (*E. globulus*) on a high rainfall (1100 mm) site can be seen in Figure 1

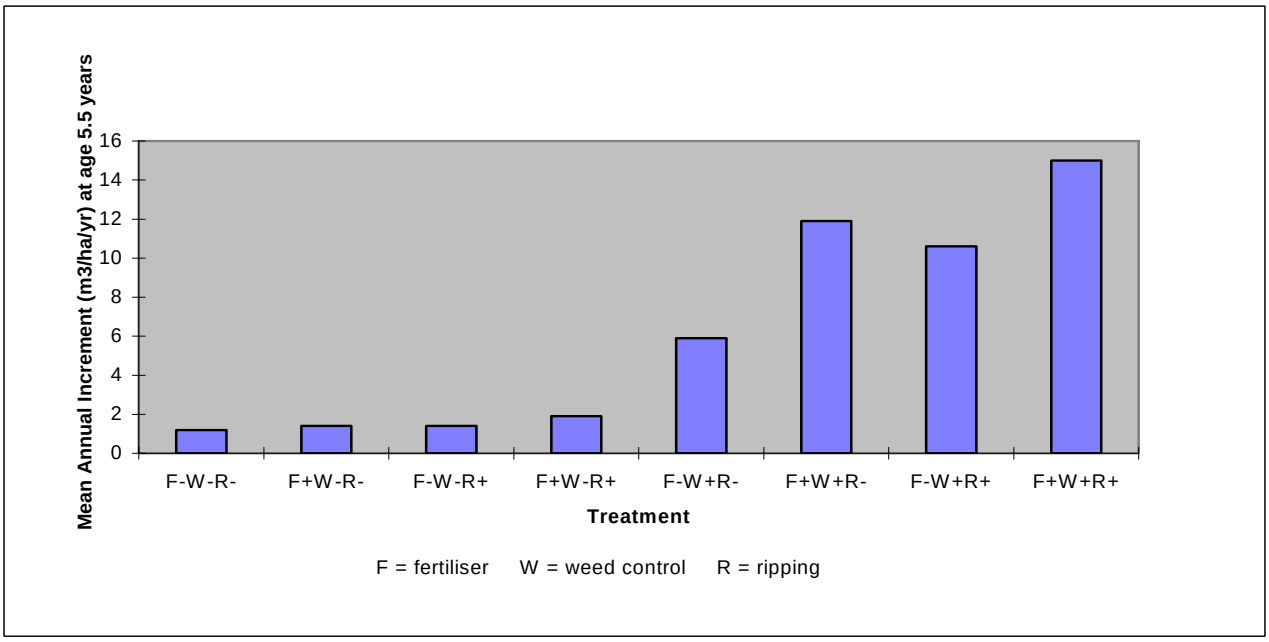

Figure 1. Response of Tasmanian blue gum (E. globulus) *to fertiliser, weed control and ripping at establishment.*

The results of the trial clearly show that fertiliser applied at establishment resulted in an increase in growth of between 17% and 102% (see Table 1). The wide variation in growth rate being dependent upon the site's history of preparation, that is, whether weeds had been controlled and whether it had been ripped.

It should be noted that although the fertiliser only treatment did result in increased growth, where fertiliser was applied in conjunction with other treatments, the response was many times greater.

Table 1. Response of Tasmanian blue gum* (E. globulus) *to fertiliser, weed control & ripping at establishment.

Treatment	Mean Annual Increment (m^3/ha/yr)	% increase in growth above control	% increase due to fertiliser only
F-W-R- (control)	1.2	0	
F+W-R-	1.4	17 %	17 %
F-W-R+	1.4	17 %	
F+W-R+	1.9	58 %	38 %
F-W+R-	5.9	392 %	
F+W+R-	11.9	892 %	102 %
F-W+R+	10.6	783 %	
F+W+R+	15.0	1150 %	42 %

Radiata pine (*Pinus radiata*) has also been shown to benefit from the application of fertiliser. In the establishment phase of a plantation (0 to 8 years), the tree crowns rapidly expand and trees accumulate nutrients.

Recent research in New South Wales has shown that applying fertilisers early in the rotation of radiata pine can improve growth and increase litter and organic matter by the end of the rotation (Figure 2).

In the closed canopy phase the tree crowns interlock and stabilise, and nutrient cycling commences.

Where the growth rates for radiata pine are less than 25 m^3/ha/year, there is a likelihood of significant improvement following the use of an appropriate fertiliser, and a reasonable likelihood that this improvement will lift the growth rates up to 20-25 m^3/ha/year. Fertiliser responses are possible even if growth rates are greater than 25 m^3/ha/year, but may be limited by the amount of local rainfall or other soil water factors.

As the fertility of a site has a large impact on the amount and type of nutrient that may need to be applied, pasture sites that have established legumes or a history of fertiliser application are more likely to provide conditions for good tree growth. On high fertility pastured sites, radiata pines may respond to the fertility and develop “speed wobbles”. This condition can be overcome by planting cuttings selected for high fertility sites. On sites with low fertility, an application of superphosphate at 180 grams (16 grams phosphorus) per tree immediately after planting has proven to be beneficial.

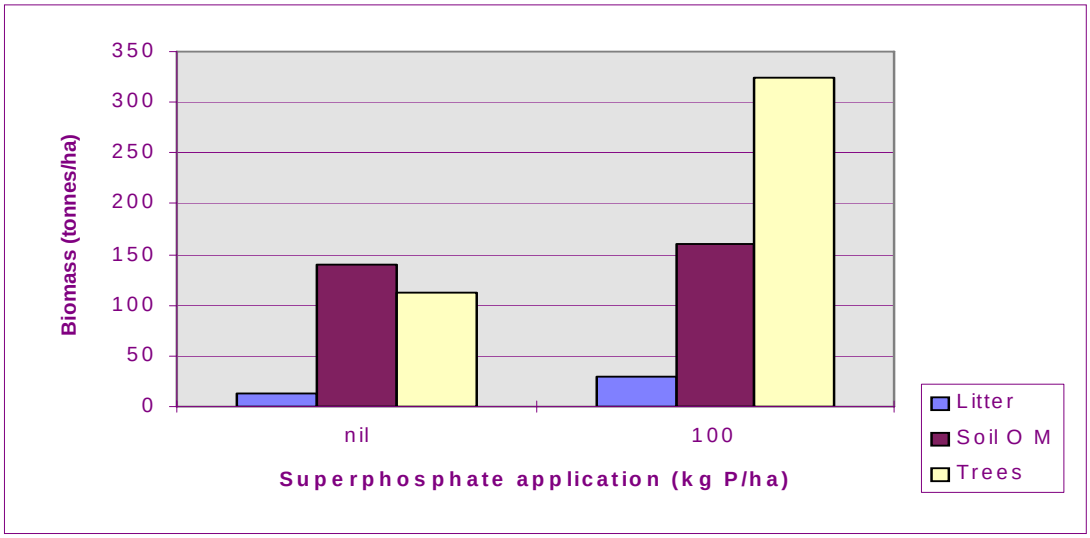

Figure 2. The effect of phosphorous (P) applied at establishment, on soil organic matter (OM) and productivity of radiata pine over a 30-year rotation.

On sites irrigated with nutrient loaded effluent, young eucalypt plantations have the opportunity to access unlimited nitrogen, which they remove from the soil and store mostly within their leaves. At two to five years of age, when canopy closure occurs and the leaves are able to intercept most of the available light, the uptake of nitrogen slows. Nitrogen cycling begins as the trees lower leaves die off and drop to the ground where the nutrients contained within them are returned to the soil. Once the leaf litter builds up beneath the trees it can supply most of the trees nutrient requirements. Optimum wood growth may require some additional nutrients, but the quantities are small.

How much fertiliser should be applied and when?

Soil testing for nutrient deficiencies is of limited use in forestry because tree roots explore large volumes of soil that are not easily or economically sampled. Of greater benefit and a more precise technique for predicting nutrient deficiency is that of foliage sampling. Soil sampling may still have a role in some circumstances.

The main deficiencies likely to occur in plantations are usually phosphorus, nitrogen, potassium, magnesium and boron while in localised areas manganese, copper, zinc and molybdenum may create problems.

Compared to pastures and crops, there has been relatively little research done on determining the response of trees to the application of fertiliser. Where research has been carried out, the response obtained has varied with the site and the treatment applied to it. Recommendations for the application of fertilisers are therefore based on small amounts of research and "best bet" options for given circumstances. Response will vary depending upon prior site management such as stocking rates and thinning regimes.

The best responses in terms of productivity improvement have been obtained from applications of phosphorus, nitrogen or phosphorus-nitrogen combination fertilisers. The greatest advantage is likely to be gained from applications at planting or at the latest in years 2 or 3, while trees are still in relatively free growth. A foliar analysis after thinning may assist in determining the need for nutrient application to immediately boost growth.

The following recommendations have been used in the past as a standard fertilizer application for eucalypt plantations established on cleared agricultural land in North East Victoria and are typical of a tree's requirement for nutrients.

1. Within one month of planting, an application of 14 grams of phosphorus and 30 grams of nitrogen should be applied in a curved band on the soil surface, between 20-30 centimetres from the base of the seedling, and on the downhill side. Of course this will vary with canopy size, soil type, rainfall, and so on.
2. In the August or September of the year following establishment, 25-50 grams of phosphorus and 100-200 grams of nitrogen should be applied (exact amounts determined by foliar analysis) evenly along the planting line or mound.

In the absence of specific site information such as soil or foliar analysis, the above recommendation could be regarded as the "best bet" option for fertiliser application at plantation establishment.

It must be remembered that weeds will also benefit from applied fertilizer and if weed growth becomes too vigourous, the weeds will use soil moisture which will be detrimental to young seedling growth. For this reason, some growers now prefer to only apply fertilizer one year after planting to minimise the competion from weeds and resultant loss of tree growth.

Reducing fertiliser costs

When purchasing fertilisers it must be remembered that you are paying for the nutrients contained within that fertiliser. There is no point therefore, in buying a fertiliser that contains nutrients that you do not require. The costs associated with applying fertilisers can be kept to a minimum if care is taken in choosing a fertiliser. The chemical analysis of a fertiliser needs to be considered to ensure that you are not getting nutrient that you do not need. The chemical analysis of a fertiliser is usually expressed in terms of the nutrients N-P-K-S and as a percentage of the total fertiliser, for example, Pivot 900 (16-8-9-11). The numbers indicate that Pivot 900 fertiliser contains approximately 16% Nitrogen, 8% Phosphorus, 9% Potassium and 11% Sulphur.

Calculating fertiliser application rates

If we use the previous example for the recommendation of fertiliser applied at establishment, we will want to know how much fertiliser we need to apply to achieve an application of 30 grams of nitrogen and 14 grams of phosphorus for each tree.

To calculate the amount of fertiliser required, simply divide the amount of nutrient required (expressed in grams) by the percentage of that nutrient found in the chemical analysis of the fertiliser. If we use Pivot 900 (16-8-9-11) as the chosen fertiliser, then the calculations are as follows:

30 grams nitrogen required, so 30 grams divided by 16% = 30 divided by 0.16 = 187.5 grams of Pivot 900, and

14 grams of phosphorus is required, so 14 grams divided by 8% = 14 divided by 0.08 = 175 grams of Pivot 900

So, to apply 30 grams of nitrogen and 14 grams of phosphorus to each tree as recommended, Pivot 900 applied at the rate of 187.5 grams per tree will supply sufficient nitrogen and more than meet the phosphorus requirement.

To calculate fertiliser application rates for other nutrients, the same procedure is followed.

To determine the suitability of fertilisers on a nutrient availability basis, Table 2 contains a selection of some fertilisers. Fertiliser suppliers should be able to supply you with a complete list of the fertilisers that they sell and the nutrient analysis of these fertilisers. Using this information, you can fine-tune your fertiliser selection.

Table 2. A selection of some fertilisers and their nutrient analysis.

	Percentage analysis			
Fertilisers	**Nitrogen (N)**	**Phosphorus (P)**	**Potassium (K)**	**Sulphur (S)**
Superphosphate	0	9	0	11
Double Super	0	17	0	4
M.A.P.	10	22	0	1
D.A.P.	18	20	0	1
Pivot 200	12	5	16	11
Pivot 800	8	11	10	7
Pivot 900	16	8	9	11

References

- Borschmann, R. & McCormick, M. (1996). Extracts from a presentation of research results to farm forestry advisers in Benalla.
- Cromer, R.N. (1996). Research to increase and sustain productivity of hardwood plantations in Australia. *Australian Forest Grower*. Vol. 19. No 1.
- Lewis, N.B. & Ferguson, I.S. (1993). *Management of Radiata Pine*. Inkata Press. Melbourne.
- MacLaren, J.P. (1993). Radiata Pine Growers Manual. *FRI Bulletin*. No. 184. New Zealand Forest Research Institute.
- CSIRO (1996). Don't overfeed the trees! *Ecos* **87**. 21-24. CSIRO, East Melbourne.
- Conservation Forests and Lands (1988). The effects of Radiata Pine on soil. *Research and Development Paper No 9*. Lands and Forests Division, Conservation Forests and Lands.

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