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Boosting plantation growth using organic wastes

Forests Resources Research, Science and Research Division

Forests NSW is continually looking for innovative methods to improve plantation establishment and boost tree growth.

Since the early 1990s, Forest NSW researchers have embarked on a number of trials using organic wastes such as biosolids to assess the impacts such soil ameliorants may have on tree survival and growth.

The earlier period of research was focused on the use of biosolids on pine plantations in the central west and southern highlands of NSW. More recently, research efforts have turned to using biosolids and other soil amendments such as recycled organics (greenwaste and composts) on low rainfall hardwood plantations in the Upper Hunter Valley. This fact sheet gives an outline of biosolids and other amendments, the trials and the results.

What are biosolids?

Biosolids is the nutrient-rich organic material resulting from the treatment of wastewater. After treatment and being spun in a centrifuge to extract excess water, dewatered biosolids are produced. The biosolids must comply with NSW Environmental Protection Authority (EPA) Guidelines before it can be used. The result is a product that has the appearance of damp soil.

What are recycled organics?

Recycled organics is a generic term used to describe compostable organic materials, including garden organics, food organics, residual wood and timber, biosolids and agricultural residues (ROU, 2001). Kerbside collections generate significant quantities or garden organics which could provide significant organic matter, and therefore benefit, to poorer soils.

Using biosolids in forestry

Biosolids contain large amounts of moist organic matter. When added to soil, biosolids act as a soil conditioner, similar to the addition of mulch in a garden.

Biosolids are rich in nitrogen and phosphorous. These nutrients are released into the soil very slowly. Approximately 15–30% of the nutrients in biosolids is released in the first year, with declining rates over the next two to four years. This is particularly advantageous in poor soil conditions where a newly established plantation can greatly benefit from the ongoing boost given by the amendment of the soil with biosolids.

Where are biosolids being used?

Currently, NSW DPI researchers and plantation staff are undertaking a number of trials on hardwood plantations on mine sites and buffer lands in the Upper Hunter Valley. During the 1990s, a number of trials were undertaken in radiata pine plantations.

Before application on any plantation, biosolids are tested for contaminants such as heavy metals and pesticides, to ensure they do not exceed NSW EPA Guidelines.

On the pines

In 1991, Forests NSW began applying biosolids to 120 hectares of plantations in eleven sites across the southern tablelands and central west.

Initially, biosolids were added to the surface of existing pine plantations to promote growth. Researchers were encouraged when increased growth rates of 30 per cent were achieved.

Building on this success, in 1995 biosolids were incorporated into the soil prior to establishing the plantation. After five years of monitoring, it was

found that tree height was improved by as much as 50 per cent and tree diameter by 85 per cent. A decade later there was still a 46% increase in growth due to biosolids.

Additionally, researchers found that the extra growth achieved with biosolids had not impacted on timber density – an important characteristic of timber quality and use.

On the mines

In August 1999, biosolids were spread over an area at the Bulga open cut coal mine near Broke. Seedlings of spotted gum, river red gum, two eucalypt hybrids and a wattle were planted three months later.

The site receives an average rainfall of 600 mm/year. This relatively low rainfall, coupled with poor soil condition, makes for an environment traditionally considered too harsh for plantation establishment.

However, with best-practice site preparation and treatments including the addition of biosolids, the trees continue to grow well. In some cases, growth is comparable to trees in higher rainfall zones.

In 2000, in conjunction with Macquarie Generation and the Natural Heritage Trust, a 40 hectare plantation was established at the Bayswater Power Station near Muswellbrook to trial a variety of soil amendments including fly ash, biosolids and greenwaste (vegetation resulting from clearing for power lines).

Species planted included spotted gum, Chinchilla white gum and Ironbark – species chosen for their drought and salt tolerance.

Researchers believe that this trial could be vital to the viability of plantations in the area, and also demonstrate that organic wastes can be used beneficially instead of going to landfill.

Meanwhile at Coal & Allied's Hunter Valley Operations, a research program has been completed looking at the processes affecting the successful establishment, survival and growth of trees on rehabilitated mine and buffer lands.

The five-year program was funded by the mine operator, Coal and Allied, the Australian Coal Association Research Program and Forests NSW. Various combinations of bottom ash (a by-product of coal-fired power generation) and biosolids were added to the soil and the results compared to the use of conventional chemical fertilisers.

The trial was planted with river red gum/flooded gum hybrids (*E. camaldulensis grandis*) and spotted gums.

Five years later, the trees are growing well, with hybrids established in soils treated with bottom ash and biosolids having the best growth. Whilst slow to start, the now five year old spotted gum (*C. maculata*) are showing the benefits of the biosolids applications.

Researchers believe that the biosolids are providing nutrients and organic matter while the granular, alkaline bottom ash is assisting the soil structure.

In 2004 a 5-hectare site was established at XStrata's Ravensworth Operations, Narama Mine. This trial (funded by the Department of Environment and Climate Change) seeks to quantify the role that recycled organics (soil conditioners and mulches made from green waste) play in the establishment of plantations on mine site rehabilitation areas.

It is hoped that by demonstrating the benefits of recycled organics, a new market for these products can be established, together with improved rehabilitation outcomes.

Current research

Loss of soil organic matter is associated with widespread land degradation resulting in declining plant productivity and increased greenhouse gas emissions. Whilst the application of recycled organics can reverse this decline, understanding the changes in soil organic carbon components over time is necessary to determine the long term role that recycled organics have in the mitigation or sequestration of greenhouse gas emissions.

This project aims to build on previous work by analysing existing soil samples from pine and eucalypt plantations for organic matter and assessing the percentage rate of change. The soil archive includes organic soil applications such as green waste derived soil conditioner, woody mulch, biosolids, municipal waste compost and bottom ash, together with controls and fertiliser treatments. Older sites (> 10 years) will be re-sampled to assess the nature of the organic matter in the longer term.

Understanding the fate of the organic matter added to the soil will allow us to quantify the benefits of recycled organics in the long-term enhancement of soil carbon. This has implications for soil health, tree growth and carbon sequestration.

The future

Forests NSW will continue to work with Hunter Valley mining and power companies, local councils and the community on plantation establishment in the area. Some 30,000 hectares of mining, power station and buffer land in the Upper Hunter has been identified as having potential for plantation establishment.

Our researchers are focused on finding environmentally beneficial uses for treated wastes. Ocean disposal is simply no longer an acceptable option and landfill sites are becoming scarce and costly. With each person estimated to produce 30 kilograms of biosolids each year, exploring opportunities to recycle this waste in a sustainable industry is vital.

Further information

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