Trees in focus
Practical Care and Management

APN 2

Arboricultural Practice Notes

Compost from Woody Wastes

based on a paper prepared by

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Summary

Increasing quantities of woody waste material, particularly prunings, are being produced by tree surgery, landscape management and gardening. Disposal of these and woody materials from other sources (e.g. construction/building sites, demolition operations and sawmill residues) to landfill sites is becoming increasingly difficult and costly. Alternatives to disposal which are environmentally friendly need to be found. Returning this biodegradable material to the soil as a mulch or soil conditioner in landscape and garden situations is one solution which imitates natural processes. However, before large quantities of woody materials are used in this way they should first be composted. The reasons for composting woody materials are outlined in this Note and advice is given on the method of composting.

Converting Waste into a Useful Product

Pruning and felling amenity trees, or even routine shrub pruning can generate large quantities of waste (branches, twigs and leaves) which may have little weight but considerable bulk. As a result transportation and disposal costs can be high - unless the bulk can be reduced. Even after crushing or chipping, getting rid of the material can be a problem because waste disposal including the transport of waste has to be licenced and many tips do not accept biodegradable organic material. Where tipping is permitted, the imposition of a landfill tax could make disposal even more expensive. Burning on-site is also unacceptable in many instances. It is attractive therefore to make use of the waste, whether in a raw or processed state.

In natural conditions dead wood (tree trunks, branches and shrubs) falls to the ground and rots eventually releasing nutrients back into the soil for use by the next generation of plants. However, since it would be unacceptable in most amenity situations to simply leave large piles of branches lying on the ground to rot, the material must be treated in some way. Chipping to reduce the volume is a necessary first step. The chipped material can be used without further treatment for some applications, for example, equestrian centres, for animal bedding and childrens play areas. However, to be acceptable for horticultural uses chips usually need to be composted (Webber and Gee, 1994).

Farmers and gardeners when they compost organic materials and return them to the soil as a fertiliser and soil conditioner have exploited the decay process. A similar practice could easily be adopted for woody waste materials before returning them, for example, to areas of land that are intensively managed but do not benefit from recycling of raw materials. Reclamation sites where there may be little soil organic matter could also benefit.

Why Not Apply Chips Direct to Soil?

The term 'wood chips' may be used to encompass a whole range of woody materials, from sawmill residues and sawdust to chipped whole plants (including leaves). Such woody or wood-based materials consist mainly of carbon compounds (lignin and cellulose) which are broken down by bacteria and fungi into simpler compounds, primarily carbohydrates. The fungi and bacteria use the carbohydrates as a food so they can grow and reproduce. But nitrogen is also required by the decay organisms to grow, and woody wastes contain relatively small quantities of nitrogen (about 2 kg per tonne in air dried sawdust). Therefore, if fresh wood chips are added to soil the

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decay organisms tend to take nitrogen from the soil. This can result in plants becoming starved of nitrogen and may lead to deficiency symptoms being expressed - typically yellowing of foliage - or even plant death. Wood chips therefore need to be composted to improve the nitrogen content before using them as a mulch or soil amendment. Chipped material containing bark and leaves or needles is likely to have a higher nitrogen content and it will therefore make a smaller demand for soil nitrogen, but composting may still be necessary to reduce the nitrogen depleting effect and to break down toxic substances which may be present. Fresh conifer bark contains monoterpenes, chemicals which are toxic or inhibitory to plant growth but these are broken down or rendered non-toxic during composting (Aaron, 1982).

During composting the organisms which decay the chipped wastes break down carbon compounds and release carbon dioxide. In this way the carbon to nitrogen ratio of the heap gradually decreases from about 150:1 to about 40:1. As composting progresses the decay organisms exhaust the available carbohydrate resources and die. As they in turn decompose nitrogen is released and becomes available to plants.

Composting generates heat, and depending on the rate of composting, temperatures of 50-60 °C can be reached which are high enough to kill most weed seeds and eliminate most pests and diseases harmful to plants [1].

Wood Chips in Horticulture

The benefits of mulching soils around growing plants should be well known to gardeners, horticulturists, arboriculturists and landscape managers. They include suppression of weeds, conservation of soil moisture, regulation of soil temperature and the creation of a more pleasing appearance. Many materials, both natural and manufactured have been used for mulching (e.g. bark, gravel, vermiculite, plastic film and even carpets and cardboard) but composted wood chips have proved to be cheap and effective. They may also be incorporated into the soil to improve its structure and to increase retention of moisture (although not all soil types will benefit), or used as a transplanting or potting medium. The literature on the use of wood chips in horticulture is reviewed in Webber and Gee (1994).

Composting Woody Wastes

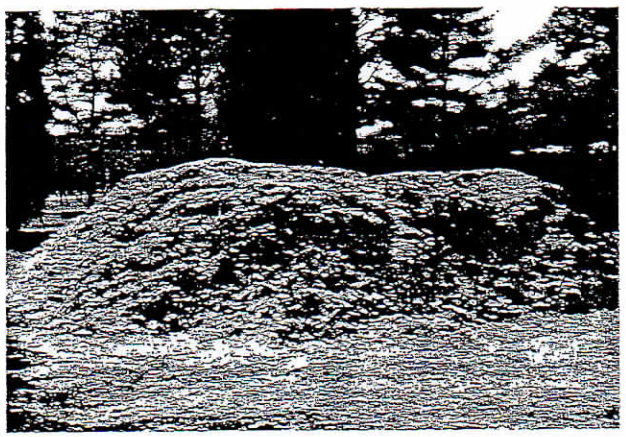
Composting uses natural processes to break down organic matter into its basic constituents. The components necessary for successful composting are:

- organic wastes e.g. wood chips, bark, leaves
- micro-organisms (fungi, bacteria) which are naturally occurring
- oxygen (present in air)
- water

Adding nitrogen, whilst not essential, speeds up the composting process and increases the temperature of the pile thus improving sterilisation of the material.

'Cooking' the Chips

Good quality compost should result if the following method is adopted:



- Large quantities of wood chips should be stored on a flat area in heaps (windrows) up to 2 m wide, a maximum of 1.5 m high and of convenient length (see above). Smaller quantities can be composted in smaller piles or bins. The top of the heap should be cupped to help retain water and to encourage it to percolate through the heap. It is important not to make the heap too large as this can reduce air circulation within it, especially if the chips are very small, or there is a large proportion of sawdust. (Where the pile is inadequately aerated anaerobic fermentation, may occur resulting in temperatures over 70 °C, and the

[1] Concern has been expressed that Honey fungus (*Armillaria* spp) might be encouraged by spreading wood chips. However, if chips are properly composted any Honey fungus present in chipped material should be killed. Furthermore if chips are fully composted colonisation by Honey fungus will not occur.

danger of spontaneous combustion - compost produced in this way will be of poor quality).

- Initially about 30 litres of water should be added for each cubic metre (m^3) of chips (1 m^3 weighs approximately 1 tonne) to maintain an adequate moisture content (50-70% of the fresh weight).
- The rate of composting of fresh chips can be significantly accelerated by the addition of nitrogen. Nitrogen is available in several forms - Table 1 shows the quantity contained in five different sources. This amount of nitrogen should be mixed into the heap at the start and a repeat application may be made after about four weeks. Organic forms of nitrogen such as poultry manure, dairy slurry and sewage sludge may be used; as a rough guide about one part manure is required to three parts chips. The type of fertilizer added to the wood chips may also influence the final pH of the composted material, for example, poultry manure may raise the pH.
- As the temperature starts to decline from its peak (50-60 °C), the wood chip pile should ideally be turned to ensure adequate aeration and thorough composting of all the chips. In practice this may mean turning the pile about every two weeks - if required additional nitrogen can be mixed in when the heap is being turned.
- The time taken for woody wastes to break down completely varies depending on the type of material (for example bark takes longer than leaves), the size of chip, quantity of chips and environmental conditions; but it usually takes between 3 and 12 months. Composting is complete when turning the heap no longer produces a rise in temperature. Well composted woody material is similar in appearance to peat or leaf mould.

Uses for Composted Chips

The heap of composting chips can be broken up and used whenever the required characteristics have been achieved. If necessary the compost can be screened to obtain a physically homogeneous material of a required particle size. Over-sized chips can then be returned to another heap for further composting or to a pile of fresh wood chips to help inoculate it with the composting organisms. Both fresh and composted chips can be used as:

- a surface for woodland paths, running tracks and childrens play areas as a substitute for bark.
- an heeling-in medium to protect the roots of trees and shrubs during temporary storage. In an experiment in the USA young trees planted temporarily in wood chips with the addition of supplementary nitrogen and water showed excellent root growth (Jacobs, 1959).
- a plunge-bed for containers to protect roots from extremes of temperature.

Partially composted chips (after about 4 weeks) should be suitable for use as:

- a mulch for shrubberies, trees and herbaceous beds. Do not allow composting to become too advanced because the material may then have poor properties for maintaining moisture in the soil and suppressing herbaceous weeds, while at the same time providing an ideal seedbed for weeds.

Well composted chips could be used either screened or unscreened:

- unscreened material could be used as a soil amendment, top dressing or as a component of a potting mix. It could be sold to landscapers,

Table 1. Approximate quantity of various nitrogen sources required to counteract the nitrogen-depleting effect of 1 m^3 of dry sawdust.

Nitrogen source	Nitrogen content (%)	Quantity required (kg)
Ammonium nitrate	35	33
Ammonium sulphate	21	52
Sodium nitrate	16	68
Urea	47	25
Poultry manure	6	340

nurserymen, homeowners or even to landfill operators as a cover material for site restoration.

- screened material could be used as a potting compost or soil conditioner, for example, as a substitute for peat or mushroom compost.

Partially composted chips mixed with soil to improve its properties may need extra nitrogen, depending on the composting time allowed, rate of fertilizer application during composting and the characteristics of the soil. However, varying results can be obtained with some plants reacting much more favourably to soil amended with composted chips than others. Before adding large quantities of compost to the soil a small suitability test should be considered.

Although the composition of woody material available for composting will usually be very variable both physically and chemically, homogeneous material may be available especially where large scale chipping is undertaken in an area of predominantly one species. Where a compost is made from a homogeneous material, then it may be particularly valuable as a potting compost or as a medium for use on specialist sites such as nurseries.

Cash in on Other Wastes

Composting woody wastes utilises natural processes to break down and recycle natural materials. This does not have to be confined to the products of pruning and tree felling. Leaves collected in autumn, straw and shredded waste paper and cardboard, for example, could all be used in the process. Using farm manures, or even sewage sludge, as a source of nitrogen would thus combine wastes that were previously an expensive disposal problem and could turn them into a beneficial and potentially marketable product.

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