

Meanwhile the additional organic matter added to a dry sandy soil will help retain water near the surface and reduce the loss of valuable nutrients through leaching.

Improved Availability of Nutrients

The nutrient released as the mulch decays will depend entirely on its origin and what organic matter may be within it. Mulches with a high C : N ratio (high in carbon - C and low in nitrogen - N) such as forest bark, sawdust, hay and straw can cause nitrogen deficiencies in the soil if they are dug into the surface.

This occurs because the decay organisms need nitrogen to grow and during the process of decomposition they absorb more than they release. When this type of material is used as a surface mulch the process is much slower and the associated short term nitrogen loss is less of an issue.

When poorly decomposed woodchip are applied, as a mulch, additional nitrogen can be added in the form of animal manure (chicken manure is particularly good). However, the application of soil fertilisers must be undertaken with great care, as it can damage the delicate balance of soil ecosystems by changing the soil chemical integrity and altering the pH.

Relatively small changes in soil pH can dramatically affect the availability of nutrients, because they become chemically locked within the soil or dissolve into soil water and quickly leach away before the plant roots have a chance to absorb them.

Mulch pH will vary considerably depending on the origin of the organic matter for instance, wood chippings from conifers may have a relatively low pH (6 or less). However, research work at the Royal Horticultural Gardens at Wisley indicated that mulch pH does not affect the soil on which it is spread.

Meanwhile, the decomposition process appears to produce neutral pH readings of around 7.5. This does not reduce the importance of regular monitoring of soil pH as this is very important, and should be combined with a good record system. These records will help with plant selection.

Soil Nitrogen Availability

Nitrogen (N) is one of the elements that is essential for all living organisms, but despite forming the largest proportion of the atmosphere around the earth as N², it is not always readily available. Plants cannot absorb N from the air, it has to be converted to a form that they can take up through their roots.

Fungi and bacteria decompose the carbon compounds within the woody plant tissues of the organic mulch, (lignin and cellulose) which are broken down into simpler carbohydrates (basic carbon C compounds). The fungi and bacteria use these carbohydrates as 'food' so they can grow and reproduce. But nitrogen is also required by the decay organisms to grow, and wood chippings (especially from winter pruning) often have a very high C:N ratio.

If the mulch has a high C:N ratio (eg. 150 : 1) and does not contain enough nitrogen, the fungi will absorb it from the surrounding soil. This can cause a temporary soil nitrogen deficiency, especially if the mulch is mixed into the soil and is finely textured.

Fortunately this is a temporarily problem because, as the mulch is decomposed by the fungi and bacteria, the nutrients are released back into the soil and nitrogen is released again when the decay organisms die and decompose themselves. The C:N ratio can be reduced by composting the mulch first and even mixing in more green leafy material like grass cuttings. After composting the C:N ratio can be reduced to around 40:1.

Wood chippings containing high proportions of leaves needles or bark, are likely to be higher in nitrogen and will have less impact on the available soil C:N ratio. However, this high content of soft plant tissue will also decompose quicker and may increase the temperature of a fresh mulch. It is still better to leave the mulch to compost for a short period before application.

It is also important to be aware that bacteria release nitrogen in the form of nitrate which is easily leached from the soil and therefore lost to surface roots, whereas the fungi that break down the organic mulch release nitrogen into the soil in a form of ammonia nitrate which is less mobile. Fungi are particularly beneficial to plants and should be encouraged.

Encourage Beneficial Fungi

Fungi are an intrinsic part of almost all terrestrial ecosystems and are essential to maintain a healthy soil environment and encourage root growth. The fruiting bodies of fungi (mushrooms) often appear on organic mulches, frequently appearing after rain. Such fungi are not harmful to plants and are rarely poisonous.

Some fungi combine with fine plant root hairs to form mycorrhizal associations, (Mycorrhiza means "fungus-root"), which work as an extension of the plant's root system and improve their ability to absorb soil nutrients and water. In return for this the fungi are provided with sugars from the plant, which have been produced in the leaves by photosynthesis (which is a process that uses the sun's energy to produce carbohydrates from water H₂O and carbon dioxide CO₂). The association of these fungi with both young and established trees and woody shrubs can vastly improve their growth and development.

Research studies have shown that these partnership help plants survive stress, absorb more water and essential elements, and increase resistance to root disease pathogens and pests. In nature, mycorrhizae are readily available to plants. However, in residential gardens, natural levels of endomycorrhizal fungi, that live inside the plant's roots, and ectomycorrhizal fungi, which reside on the outside of roots, can be extremely low. This is especially true when soils are distressed by compaction, fertiliser imbalance or other problems associated with urban landscapes.

The saprophytic fungi, which live on the dead organic matter in the surface mulch, actively compete with parasitic fungi such as Honey Fungus (*Armillaria* sp.) and suppress their development. Some research carried out in Canada found that if stumps of recently felled trees were inoculated with Sulphur Tuft (*Hypholoma* sp.), Honey Fungus could be excluded. Maintaining the diversity of soil organisms and encouraging natural competition all helps to sustain a healthy soil ecosystem

Andrew Cowan, ArborEcology, August 2007



Using Organic / Biodegradable Mulching

The term mulch simply means a covering layer, put on the surface of the ground, which is frequently used as a means of controlling weeds and conserving water by reducing evaporation., but there is so much more to know, as Andrew Cowan explains.

A mulch may be of wood chip, manure, straw and other materials mixed into a 'compost', that will progressively break down into the soil. Such mulches are known as organic, because non-degradable mulches, can also be utilised, like plastic film or even gravel and these products may reduce weed growth or conserve some soil moisture, but do not have the same extent of soil improving benefits as a decomposing natural mulch.

Mulching has several effects on the soil and the plants growing in it, and can be used to;

- suppress weed growth,
 - retain moisture in the soil by reducing surface evaporation,
 - insulate soil from extremes of temperature,
- and in the case of natural mulches they;
- improve soil structure by adding organic matter which increases aeration,
 - enhance nutrient content of the soil, and increasing its availability to roots,
 - encourage the growth of mycorrhizal fungi that enhance the effectiveness of plant roots,
 - improve soil biodiversity and increase the effective balance in microbial communities,

There are many materials that can be called natural biotic or biodegradable mulches: garden compost, woodchip, forest bark, well-rotted manure, hay, straw, peat, leaves and leaf mould are among the most familiar. All will progressively break down into the soil, improving its structure and nutrient content, and as a result will need topping up each year (usually in the spring).

The rate of decomposition will be influenced by soil type and on the 'woody' content of the mulch (i.e. the proportion of lignin and cellulose). Organic matter decomposes slowly in heavy clay soils, in contrast to sandy soils which are sometimes referred to as 'hungry' because mulch can be incorporated quickly into the soil structure.

Wood based compost decomposes more quickly than bark. For example, conifer bark stripped from mature pine, cypress or other softwood trees contains a high proportion of lignin, wax and protected (chemically impregnated) cellulose that resist decay. Meanwhile, wood from these same species (especially from young trees), in contrast, decomposes quickly.

The trunks (heartwood) and bark of some trees such as Oaks, Pines and Sweet Chestnut can also be slow to decay due to the chemicals produced by the tree (phenols, resins, and terpenes) which slow the process of decay.

Controlling Weed Growth

When using mulch primarily to control the growth and spread of weeds, a deep surface layer will be required, which is thick enough to stop some weed seeds from germinating, and those that do appear can be easily removed from the loose surface.

To be effective the organic mulch must also be thick enough to block light from developing weeds and suppress the growth of germinating seeds so they can't reach the surface.

However, application of a deep mulch can smother desirable herbaceous plants and could encourage decay in some woody stems. This can be avoided by hollowing out the area around existing shrubs and limiting the depth of mulch around stems to 10 cm (4 inches) or less.

All mulches will help prevent the evaporation of moisture from the soil, and thereby reducing the need for watering. A layer of organic mulch on the surface also reduces run off during watering, acting like a sponge by soaking up additional water and allowing excess to percolate through.

Because the organic matter within the mulch is combined into the top soil it enables surplus water to be stored in the humus layer rather than just draining straight through away from surface rooting plants and trees. However, deep mulches should be avoided on waterlogged soils, as they slow down evaporation of water from the soil surface and can allow it to increase to damaging levels.

Improved Soil Temperature Regulation

A thick layer of organic mulch on the surface of a soil acts as an insulator, just as loft insulation traps heat in the winter and keeps the house cool in the summer. Applying fresh mulch around newly planted trees and shrubs in autumn can increase soil temperature and reduce heat loss, subsequently improve young root development over winter.

A thick layer of composted mulch applied in autumn can also protect the crowns of tender plants and improve the root growth of fruit bushes. However, very deep layers of fresh wood chips (20cm / 10 inches or more) are liable to compost *in-situ*, and this can result in a considerable temperature increase, which may cause injury to tender plant tissues.

Improving Soil Moisture

The increased soil surface moisture level and more constant temperatures encouraged by organic mulches dramatically improve the environment for soil organisms. The mulch protects the surface soil crust from erosion by heavy rain and reduces the harmful effects of compaction. This allows the development of a good 'crumb' structure as the soil mixes with the decaying organic matter within the lower layers of mulch.

Earthworms are attracted to the moist mulch on the surface and by their burrowing activities help incorporate the organic matter into the soil. Their movements create channels which increase soil aeration and allow excess water to drain away.

A layer of mulch on the surface of a thick clay soil will soon help break up the heavy structure and allow better root penetration and improve drainage.

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