Mulching

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1. Introduction

1.2. Definition/s of a Mulch? / Mulching?

The word ‘Mulch’ has its roots in Germany. It comes from the word ‘molsch’ which means ‘beginning to decay’. This is probably used with reference to the mulches which are biodegradable. A mulch is a layer of material applied to the surface of soil. Reasons for applying mulch include conservation of soil moisture, improving fertility and health of the soil, reducing weed growth and enhancing the visual appeal of the area.

A mulch is usually, but not exclusively, organic in nature. It may be permanent (e.g. plastic sheeting) or temporary (e.g. bark chips). It may be applied to bare soil or around existing plants. Mulches of manure or compost will be incorporated naturally into the soil by the activity of worms and other organisms. (Wikipedia).

Figure 1. Aged Compost mulch on a flower bed

Figure 2. Spring daffodils push through shredded wood mulch

Mulching is a simple process of using leftovers such as leaves, grass clippings, straws and shredded trees or synthetic materials like polythene, to cover any bare soil in an
agricultural land. The process is used both in commercial crop production and in gardening, and when applied correctly, can dramatically improve soil productivity.

2. Materials Used for Mulching
2.1. Organic residues: grass clippings, leaves, hay, straw, kitchen scraps comfrey, shredded bark, whole bark nuggets, sawdust, shells, woodchips, shredded newspaper, cardboard, wool, animal manure, and etc.

Many of these materials also act as a direct composting system, such as the mulched clippings of a mulching lawn mower, or other organics applied as sheet composting (Figures 3-7).

Rubber mulch: The white fibers are nylon cords, which are present in the tires from which the mulch is made.

Figure 3. Rubber Mulch

Shredded wood mulch: This type of mulch is often dyed to improve its appearance in the landscape.

Figure 4. Shredded wood mulch
Pine needles used as mulch. Also called "pine straw" in the southern US.

Figure 5. Pine Needles

Aged Compost mulch on a flower bed

Figure 6. Compost

Crushed stone mulch

Figure 7. Crushed stone mulch
3. **Compost**: Fully composted materials are used to avoid possible phytotoxicity problems. Materials that are free of seeds are ideally used, to prevent weeds being introduced by the mulch.

4. **Old carpet (synthetic or natural)**: Makes a free, readily available mulch.

5. **Rubber mulch**: Made from recycled tire rubber.

6. **Plastic mulch**: Crops grow through slits or holes in thin plastic sheeting. This method is predominant in large-scale vegetable growing in developing countries, with millions of acres cultivated under plastic mulch worldwide each year (disposal of plastic mulch is cited as an environmental problem).

7. **Rock and gravel**: Can also be used as a mulch. This mulch is most suitable for cold climatic countries. In cooler climates the heat retained by rocks may extend the growing season.

### 2.2. Factors Affecting in Selecting Materials for a Mulch

Materials used as mulches vary and depend on a number of factors such as:

1. **Availability** (This depends on the location, geography; Ex- in Sri Lanka, areas such as Jaffna, Batticaloa (Figure 8) uses Palm (*Thal*) leaves, as the mulching material). And also, in Kalpitiya area, they practice their cultivation with the use of living mulches. In urban areas most of the places it can be evidenced crushed rock mulches in many countries.

2. **Affordability/Cost** - As an example establishing plastic mulches for a large land extent may be costly. (For some areas, because of lack/ minimum precipitation, micro irrigation practices have being practicing. In case of that, those irrigation...
pipelines are establishing lateral to those plastic mulches, plastic mulch will be the best in the case of resistance for the weed and predators, which will block those irrigation channels.)

3. **Appearance**- This factor affects more in landscaping. In designing landscape layouts for places where the attraction should gain by visitors, it is better to use attractive mulching materials. As an example for a location where there is a waterfall inside a restaurant, for a mulching purpose “rock mulch” can be used. Also, in public parks, the “green colored” mulches, and other colored mulches where the user can differ the color according to the color of the building for more attraction can be used.

4. **The effect it has on the soil** (Chemical reactions and pH, durability, combustibility, rate of decomposition) – This factor relates more with the “sour mulches”. Because the chemical reactions occur in sour mulch, can be harm to the soil condition and also sometimes the tender leaves of the trees can be burnt. Different mulches have variable effects on soil physical properties and plant growth (Table 1).

**Table 1: Behavior of different soil properties over mulch**

<table>
<thead>
<tr>
<th>Type of Mulch</th>
<th>Moisture (%)</th>
<th>Bulk density (g·cm⁻³)</th>
<th>pH</th>
<th>STN (g·kg⁻¹)</th>
<th>SAN (g·kg⁻¹)</th>
<th>SOM (g·kg⁻¹)</th>
<th>C/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood chips</td>
<td>16.0 ± 0.5a</td>
<td>1.29 ± 0.08a</td>
<td>5.9 ± 0.2a</td>
<td>0.48 ± 0.07a</td>
<td>43.9 ± 5.5a</td>
<td>13.6 ± 0.5a</td>
<td>15.1 ± 0.5a</td>
</tr>
<tr>
<td>Manila turf grass</td>
<td>15.8 ± 0.6a</td>
<td>1.29 ± 0.10a</td>
<td>5.8 ± 0.2a</td>
<td>0.51 ± 0.03a</td>
<td>28.4 ± 5.9b</td>
<td>11.1 ± 1.2b</td>
<td>12.5 ± 1.7a</td>
</tr>
</tbody>
</table>

STN: soil total nitrogen; SOM: soil organic matter; SAN: soil available nitrogen; C/N: carbon to nitrogen ratio

Source: Ni X et al., 2016
5. **Purity of the ingredients** (Some can contain weed seeds or plant pathogens)

Specially the living mulches and organic mulches contain pathogens in itself. So when it is in cooperated to the land, those pathogens will grow well by extracting the nutrients in the mulch and, the tree also. Also those organic mulches sometimes will have weed seeds and also they will grow well in the mulch and it will be a competitive situation for the tree, because the weed itself take all the resources which the tree also requiring.

![Figure 8. Palm Leaves Mulch at Batticaloa, Sri Lanka](image)

**[Extra Facts to know]**: In some areas of the United States, such as central Pennsylvania and northern California, mulch is often referred to as "tanbark", even by manufacturers and distributors. In these areas, the word "mulch" is used specifically to refer to very fine tanbark or peat moss].
3. Types of Mulches

3.1. Organic Mulches

Organic mulches decay over time and are temporary. The way a particular organic mulch decomposes and reacts to wetting by rain and dew affects its usefulness.

Some mulches such as straw, peat, sawdust and other wood products may for a while negatively affect plant growth because of their wide carbon to nitrogen ratio, because bacteria and fungi that decompose the materials remove nitrogen from the surrounding soil for growth (Figure 9). However, whether this effect has any practical impact on gardens is disputed by researchers and the experience of gardeners. Organic mulches can mat down, forming a barrier that blocks water and air flow between the soil and the atmosphere. Vertically applied organic mulches can wick water from the soil to the surface, which can dry out the soil. Mulch made with wood can contain or feed termites, so care must be taken about not placing mulch too close to houses or building that can be damaged by those insects. Some mulch manufacturers recommend putting mulch several inches away from buildings.
Commonly available organic mulches include;

3.1.1. Leaves
Leaves from deciduous trees, which drop their foliage in the autumn/fall (Figure 10). They tend to be dry and blow around in the wind, so are often chopped or shredded before application. As they decompose, they adhere to each other but also allow water and moisture to seep down to the soil surface. Thick layers of entire leaves, especially of maples and oaks, can form a soggy mat in winter and spring which can impede the new growth lawn grass and other plants. Dry leaves are used as winter mulches to protect plants from freezing and thawing in areas with cold winters, they are normally removed during spring.

![Figure 10: Dried leaves as a mulch](image)

3.1.2. Grass Clippings
Grass clippings, from mowed lawns are sometimes collected and used elsewhere as mulch (Figure 11). Grass clippings are dense and tend to mat down, so are mixed with tree leaves or rough compost to provide aeration and to facilitate their decomposition without smelly putrefaction. Rotting fresh grass clippings can damage plants; their
rotting often produces a damaging buildup of trapped heat. Grass clippings are often dried thoroughly before application, which mediates against rapid decomposition and excessive heat generation. Fresh green grass clippings are relatively high in nitrate content, and when used as a mulch, much of the nitrate is returned to the soil, conversely the routine removal of grass clippings from the lawn results in nitrogen deficiency for the lawn.

![Figure 11: Grass clipping as a mulch](image)

3.1.3. Peat Moss
Peat moss, or sphagnum peat, is long lasting and packaged, making it convenient and popular as a mulch (Figure 12). When wetted and dried, it can form a dense crust that does not allow water to soak in. When dry it can also burn, producing a smoldering fire. It is sometimes mixed with pine needles to produce a mulch that is friable. It can also lower the pH of the soil surface, making it useful as a mulch under acid loving plants.
However peat bogs are a valuable wildlife habitat, and peat is also one of the largest stores of carbon (in Britain, out of a total estimated 9952 million tons of carbon in British vegetation and soils, 6948 million tons carbon are estimated to be in Scottish, mostly peatland, soils, so gardeners who wish to protect the environment will choose more sustainable alternatives.

3.1.4. Wood Chips
Wood chips are a byproduct of the pruning of trees by arborists, utilities and parks; they are used to dispose of bulky waste. Tree branches and large stems are rather coarse after chipping and tend to be used as a mulch at least three inches thick (Figure 13). The chips are used to conserve soil moisture, moderate soil temperature and suppress weed growth. The decay of freshly produced chips from recently living woody plants, consumes nitrate; this is often off set with a light application of a high-nitrate fertilizer. Wood chips are most often used under trees and shrubs. When used around soft stemmed plants, an un mulched zone is left around the plant stems to prevent stem rot or other possible diseases. They are often used to mulch trails, because they are readily produced with little additional cost outside of the normal disposal cost of tree maintenance. Wood chips come in various colors.
3.1.5. Bark Chips

Bark chips of various grades are produced from the outer corky bark layer of timber trees (Figure 14). Sizes vary from thin shredded strands to large coarse blocks. The finer types are very attractive but have a large exposed surface area that leads to
quicker decay. Layers two or three inches deep are usually used, bark is relativity inert and its decay does not demand soil nitrates. Bark chips are also available in various colors.

3.1.6. Straw mulch/Field hay /Salt hay

Straw mulch or field hay or salt hay are lightweight and normally sold in compressed bales. They have an unkempt look and are used in vegetable gardens and as a winter covering. They are biodegradable and neutral in pH. They have good moisture retention and weed controlling properties but also are more likely to be contaminated with weed seeds. Salt hay is less likely to have weed seeds than field hay. Straw mulch is also available in various colors (Figure 15).

3.1.7. Cardboard/Newspaper
Cardboard or newspaper can be used as mulches (Figure 16). These are best used as a base layer upon which a heavier mulch such as compost is placed to prevent the lighter cardboard/newspaper layer from blowing away. By incorporating a layer of
cardboard/newspaper into a mulch, the quantity of heavier mulch can be reduced, whilst improving the weed suppressant and moisture retaining properties of the mulch. However, additional labour is expended when planting through a mulch containing a cardboard/newspaper layer, as holes must be cut for each plant. Sowing seed through mulches containing a cardboard/newspaper layer is impractical. Application of newspaper mulch in windy weather can be facilitated by briefly pre-soaking the newspaper in water to increase its weight.

Figure 16: Card board as a mulch

3.1.8. Discarded Carpets
Synthetic carpet that is composed of artificial fibers may be removed after planting to prevent fibers taking a long time to decompose, whereas carpet made from natural fibers may be kept in place, blocking competition from weeds (Figure 17). Rain is absorbed by carpet and then slowly released into the soil, reducing watering needs.
3.2. Colored Mulches
Some organic mulches are colored red, brown, black, and other colors. *Isopropanol amine*, specifically *1-Amino-2-propanol* or DOW™ monoisopropanol-amine, may be used as a pigment dispersant and color fastener in these mulches. Types of mulch which can be dyed include: wood chips, bark chips (bark dust) and pine straw. Colored mulch is made by dyeing the mulch in a water-based solution of colorant and chemical binder. When colored mulch first entered the market, most formulas were suspected to contain toxic, heavy metals and other contaminants. Today, “current investigations indicate that mulch colorants pose no threat to people, pets or the environment. The dyes currently used by the mulch and soil industry are similar to those used in the cosmetic and other manufacturing industries (i.e., iron oxide),” as stated by the Mulch and Soil Council. Colored mulch can be applied anywhere non-colored mulch is used (such as large bedded areas or around plants) and features many of the same gardening benefits as traditional mulch, such as improving soil productivity and retaining moisture. As mulch decomposes, just as with non-colored mulch, more mulch may need to be added to continue providing benefits to the soil and plants. However, if mulch is faded,
spraying dye to previously spread mulch in order to restore color is an option (Figure 18).

![Figure 18. Colored Mulch](image)

### 3.3. Anaerobic (sour) Mulch
Mulch normally smells like freshly cut wood, but sometimes develops a toxicity that causes it to smell like vinegar, ammonia, sulfur or silage. This happens when material with ample nitrogen content is not rotated often enough and it forms pockets of increased decomposition. When this occurs, the process may become anaerobic and produce these phytotoxic materials in small quantities. Once exposed to the air, the process quickly reverts to an aerobic process, but these toxic materials may be present for a period of time. If the mulch is placed around plants before the toxicity has had a chance to dissipate, then the plants could very likely be damaged or killed depending on their hardiness (Figure 19). Plants that are predominantly low to the ground or freshly planted are the most susceptible, and the phytotoxicity may prevent germination of some seeds.

If sour mulch is applied and there is plant kill, the best thing to do is to water the mulch heavily. Water dissipates the chemicals faster and refreshes the plants. Removing the offending mulch may have little effect, because by the time plant kill is
noticed, most of the toxicity is already dissipated. While testing after plant kill will not likely turn up anything, a simple pH check may reveal high acidity, in the range of 3.8 to 5.6 instead of the normal range of 6.0 to 7.2. Finally, placing a bit of the offending mulch around another plant to check for plant kill will verify if the toxicity has departed. If the new plant is also killed, then sour mulch is probably not the problem.

Figure 19. Sour mulches sometimes burn the tender leaves of the plant

3.4. Ground Covers (living mulches)

A living mulch is a cover crop inter planted or under sown with a main crop, and intended to serve the purposes of a mulch, such as weed suppression and regulation of soil temperature. Living mulches grow for a long time with the main crops, whereas cover crops are incorporated into the soil or killed with herbicides (Figure 20 and 21).

Other benefits of mulches are slowing the growth of weeds, and protecting soil from water and wind erosion. Some living mulches were found to increase populations of the natural enemies of crop pests. Legumes used as living mulches also provide nitrogen fixation, reducing the need for fertilizer.
3.4.1. Benefits of Living Mulches
When cover crops are turned over into the soil, they contribute nutrients to the main crop so that less chemical fertilizer is required. The amount of the contribution depends on the biomass, which varies over time and depends on rainfall and other factors. The greater the biomass, the greater the nutrient turnover of land. Legume cover crops turn over nitrogen fixed from the atmosphere. (Reports indicate that legumes in general have higher foliar nitrogen contents, from 20 to 45 mg g⁻¹.)
Bare soil resulting from intensive tillage can lead to soil erosion, nutrient losses, and offsite movement of pesticides. In addition, weeds can germinate and grow without competition. Living mulches can reduce water runoff and erosion, and protect waterways from pollution. Living mulches have also been shown to increase the population of organisms which are natural enemies of some crop pests.

Living mulches control weeds in two ways. When they are seeded before weed establishment, they suppress weeds by competition. In some situations, the allelopathic properties of living mulches can be used to control weeds. The allelopathic properties of winter rye (*Secale cereale*), ryegrasses (*Lolium spp*), and subterrain clover (*Trifolium subterraneum*) can be used to control weeds in sweet corn (*Zea mays* var "rugosa") and snap beans (*Phaseolus vulgaris*) (Figure 22).

![Figure 22: Winter rye (left) and sub terrain clover (right)](image)

*(Extra facts to know: Allelopathy)*-

Populations of ground-dwelling predators were greater in a corn and soybean rotation with alfalfa and kura clover living mulches than without a living mulch. This situation was due in part to a change in the composition of vegetation in the agricultural system.
3.4.2. Drawbacks of Living Mulches
Living mulches compete for nutrients and water with the main crop, and this can reduce yields. Elkins et al. (1983) examined the use of tall fescue (*Festuca arundinacea*), smooth bromegrass (*Bromus inermis*), and orchard grass (*Dactylis glomerata*) as such living mulches (Figure 23). They found that herbicides killed 50% to 70% of the mulches but corn yield was reduced 5% to 10% at the end of the harvest.

![Figure 23: Tall fescue (left), bromegrass (middle) and orchard grass (right)](image)

Although leguminous cover crops have large biomass production and turnover, they are not likely to increase soil organic matter. This is because legumes used as living mulches have greater N contents and a low C to N ratio. So, when legume residue decomposes, soil microbes have sufficient N available to enhance their breakdown of organic materials in the soil.

3.4.3. Types of Living Mulches
In the tropics, it is common to seed tree crops with living mulches such as legume covers in oil palm plantations, coconut and rubber (Watson 1989).
In Mexico, legumes used traditionally as living mulches were tested as nematode and weed suppressors. The mulches included velvetbean (*Mucuna pruriens*) jackbean (*Canavalia ensiformis*), jumbiebean (*Leucaena leucocephala*) and wild tamarindo (*Lysiloma latisiliquum*). Aqueous extract of Velvet bean reduced the gall index of *Meloidogyne incognita* in the roots of tomato, but suppressed tomato rooting as well. In addition, Velvet bean suppressed the radical growth of the local weeds Alegria (*Amaranthus hypochondriacus*) by 66% and Barnyardgrass (*Echinochloa crus-galli*) by 26.5%.

Nicholson and Wien (1983) suggested the use of short turf grasses and clovers as living mulches to improve the resistance soil compaction. These authors established Smooth Meadow-grass (*Poa pratensis*) and white clover (*Trifolium repens*) as living mulches since they did not cause reduction of yield corn (the accompanying main crop).

In one study, chewing fescue or red fescue (*Festuca rubra*) and ladino clover (*Trifolium repens*) were effective living mulches for controlling weed growth. Unfortunately, these cover crops also competed with corn for water which was particularly problematic during a dry period. The possibility of using ladino clover (*Trifolium repens*) as a potential living mulch was also mentioned; however, this clover was difficult to kill with herbicides in winter.

### 3.4.4. Management of Living Mulches

Because they compete with the main crop, living mulches may eventually need to be mechanically or chemically killed.

It is important to carefully select the appropriate herbicide rate for burning down a living mulch. In 1989, Echtenkamp and Moomaw found that herbicide rates were
inadequate to suppress all the living mulches. Therefore, the mulches competed with the main crop for resources. In some cases, the clover could not be killed at the first herbicide application, so a second application was needed.

For another treatment, rates that were so high that they caused the cover crop to be killed too rapidly, so that broadleaf weeds invaded the corn. This study suggested that the timing and dosage of herbicide should be carefully considered.

3.4.5. Plant Nutrition Contribution by Living Mulches
Legume cover crops have important positive effects on the nutrient cycling of tree crops. Leguminous living mulches work in three ways:

- Fixing the atmospheric N\textsubscript{2} that is important for the main crop
- Recycling soil nutrients
- Enhancing soil nutrient availability for the main crop

3.4.6. Control of Erosion by Living Mulches
Vegetative cover as living mulches protect soil against wind and water erosion. Plants should form a mantle or thick mulch that protect soil from detachment. Living mulches intercept raindrops and reduce runoff. The protection that such vegetation provides against wind is influenced mainly by the amount of biomass that covers the ground (differs with each spp), plant geometry and row orientation.

3.5. Inorganic Mulches
3.5.1. Plastic Mulch
To apply plastic mulching, a lot of knowhow is required. It depends on the crop, climate, soil, precipitation, and water quality what kind of plastic mulch is used. The colour influences temperature of the soil and airflow around the plants. Deteriorated
plastic mulch might be difficult to remove if it has fallen apart in little pieces and is mixed with the soil.

Figure 24. Lateral pipelines for irrigation are laid under the mulch covering

Source: TNAU, Undated

In case the mulch film needs to be used for more than one season (thicker film) the plant is cut at its base near the film and the film is removed and reused (for more detailed information please check TNAU, Undated). In the table (Table 02) below, find some general instructions for selecting the correct plastic mulch (TNAU, Undated).

<table>
<thead>
<tr>
<th>Condition/situation</th>
<th>Preferred mulch type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainy season</td>
<td>Perforated mulch</td>
</tr>
<tr>
<td>Orchard and plantation</td>
<td>Thicker mulch</td>
</tr>
<tr>
<td>Soil solarization (ELMORE et al. 1997)</td>
<td>Thin transparent film</td>
</tr>
<tr>
<td>Weed control through solarization</td>
<td>Transparent film</td>
</tr>
<tr>
<td>Weed control in cropped land</td>
<td>Black film</td>
</tr>
<tr>
<td>Sandy soil</td>
<td>Black film</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Saline water use</td>
<td>Black film</td>
</tr>
<tr>
<td>Summer cropped land</td>
<td>White film</td>
</tr>
<tr>
<td>Insect repellent</td>
<td>Silver colour film</td>
</tr>
<tr>
<td>Early germination</td>
<td>Thinner film</td>
</tr>
</tbody>
</table>

Source: TNAU, Undated

The selection of mulches depends on the ecological situation. A common practice to irrigate plastic mulched fields is the drip irrigation system where the laterals are laid under the mulch (Figure 24). With this technique the water can be distributed without moving the plastic mulch. Furthermore, there is no evaporation or water loss.

### 3.5.2. Fabric Mulches

There are different kinds of fabrics that are used. Some people use synthetic carpets, others just use the landscape fabric. Unlike the plastic mulch, the landscape fabric is meant for long periods of time. This means that these types of mulch can be used across different seasons (Figure 24).

The advantages of the fabric include the fact that it does not allow the growth of weeds. Since it is porous, it allows both water and air to circulate to the soil below. Landscape fabrics can be used on their own or they can be combined with organic mulches.
3.5.3. Rubber Mulch

Another popular inorganic mulch is Rubber mulch (Figure 25). It is made up of rubber generated from recycled tires. A lot of research has been done in this area and people are still studying how rubber mulches can affect our lives. The studies show that rubber can remain in the soil for indefinite amounts of time. They also indicate possible toxicity levels that can be found in the soil post use.

Figure 24: Use of rubber mulch in gardening

4. Importance of Mulching

Studies conducted at the Morton Arboretum in Chicago have shown that applying organic mulch increases the organic matter in the soil (Figure 25). Microorganisms that are naturally present in the soil degrade the mulch depositing decomposed organic material at the plants’ roots. This organic material provides necessary nutrients and holds moisture in the soil for the plants. Access to these nutrients and
moisture is visible above ground in the healthy growth and appearance of the plant. It is the microbial degradation of the mulch that necessitates reapplication every two – three years (Scharenbroch, Bryant & Watson, Gary, 2014).

Wood and compost improve soil quality and improve growth of *Acer rubrum* and *Betula nigra* in Compacted Urban Soil (Scharenbroch, Bryant & Watson, Gary, 2014).

![How mulch works](image)

**Figure 26. The Process of nutrient contribution by mulching** (Caballero, 2015)

As this degraded organic mulch is incorporated into the soil, it reduces compaction significantly. Excessive compaction is a common issue in urban soils that have been stripped, turned, and driven on repeatedly. Compaction reduces air between soil particles, limiting the roots’ ability to breath, causing stress on the plant. “Soil compaction is one of the biggest problems a tree root can have. Compacted soils significantly limit the growth of plants, particularly trees and predispose them to infections. Regular mulching, has been shown to reduce compaction considerably in only a few years.
The importance of mulching can be summarized as increased organic matter, nutrients, water, and reduced compaction, can be realized using a wide range of materials. All of these materials need to be readily compostable organic (carbon containing) substances. Materials that are often used are wood, straw, evergreen needles, seed hulls (cocoa beans, coconut husks), and compost. Some of these materials, such as straw and wood chips take longer to decompose and consume more nitrogen thereby reducing their benefit. Evergreen needles may acidify the soil which can be troublesome for certain plants. Some seed hulls are toxic to pets and decompose completely in the same season reducing their extended benefit (figure 26). Compost does little to prevent weeds but, sometimes encourages them.

![Figure 26: Seed hull compost](image)

**Figure 26: Seed hull compost (left: peanut and right sunflower)**

5. Advantages and Disadvantages in Mulching

5.1. Advantages in Mulching

1. **Conservation of moisture:** A lot of gardeners spend a lot of time watering their gardens. A lot of this water is lost to the surrounding air because of the difference in temperatures. Mulch forms a barrier between the wet cool earth and the hot atmospheric air. This helps the soil retain its moisture content.
2. **Protection against weeds:** Since the mulch forms a protective layer between the sun and the soil, weeds find it very hard to sprout and grow. Even if the weeds manage to sprout, the lack of sunlight causes them to wither and die.

3. **Winter protection:** Mulch doesn’t stop the ground from freezing. During the freeze and thaw cycles, plants find themselves being thrown out of the ground. Mulch prevents this from happening.

4. **Improves the fertility of the soil:** The organic types of mulch decay over time and slowly add to the nutrients in the soil. In addition to this, it also encourages the growth of worms. The movement of these worms helps transport the decomposing matter deeper into the soil.

5. **Prevents soil crusting:** Soil crusting occurs when a water droplet strikes the ground with force. This force of impact causes the soil particles to spray in all different directions. This causes soil crusting. Now this ordinarily shouldn’t be a problem but every gardener knows that soil crusting means that the ground absorbs water more slowly. Mulch on the other hand breaks the force of impact. The water then trickles through it and soaks into the ground.

6. **The aesthetic perspective:** Mulch gives the ground an even and filled out look. The protection against weeds is another reason why it improves the aesthetics. Some inorganic methods of mulching (like stone) can be used in designs that look very trendy.

### 5.2 Disadvantages of Mulching

1. Mulching is labor-intensive.
2. Inorganic mulches are costly.
3. Too much mulch can create rotting of the root zone or provoke pests.
4. Mulch material can introduce new pests and diseases into a field (Figure 27).

![Image of a slug](image)

**Figure 27. Some mulches can be a habitat for the damagers**

5. When plastic mulch starts to break down into non-recyclable bits; it is hard to remove it again.
6. Organic mulches usually need to be applied in a loose or partially-rotted state or the first stages of decomposition, otherwise they can lead to nitrogen being taken from the soil, or anaerobic decomposition which can lead to ‘sour mulch’ which turns acidic and damages the plants it is supposed to be protecting.
7. Some living mulches compete for the resources with the main crop.

5.3.1. Straw Mulch
If layered thickly, straw is a strong mulch option, providing adequate protection from the sun, blocking weeds, and regulating moisture. Its lightness prevents rot from building up at the base. Even more convenient, straw can be tilled into the soil at the end of a growing season (Figure 28), breaking down and releasing nitrogen into the soil in preparation for the following year.

It should ensure that, straw is virtually weed-seed-free or the mulch will lose its ability to suppress new weed growth. It can also be difficult to spread a thick layer over a larger area without a diligent effort. Another disadvantage of straw is its attractiveness to all sorts of creatures, such as rabbits, voles, and mice. Critters won't hesitate to nest in the straw and take advantage of the buffet provided in the garden while they're at it.

5.3.2. Shredded Wood Mulch

Shredded wood mulch is often made from pine shavings or from cypress or cedar. The key benefit of using shredded wood mulch is water retention, both in excessively wet or dry conditions. Wood absorbs excess moisture in the soil during times of heavy rains, taking the burden off the soil. During dry times, wood mulch releases retained moisture into the soil, keeping it hydrated. Depending on how shredded it is, this type
of mulch also decomposes relatively quickly and releases beneficial nutrients into the soil. It’s important to apply at least 4-6 inches for optimal benefits. Note: Shredded wood mulch is not be confused with wood chips or bark chunks which do not absorb water as well.

It is important to keep in mind that wood mulch consumes nitrogen as it breaks down, and eventually will also become part of the soil (Figure 29). However, it also consumes nitrogen – an important element for plant growth – in that process. To help keep nitrogen from being depleted from the soil, sprinkle a slow release non-burning nitrogen fertilizer like Milorganite on to the beds before adding mulch to help retain or supplement the nitrogen in the soil.

![Figure 29. A Shredded wood mulch](image)

### 5.3.3. Wood Chips

Wood chips, like those generated from tree removal companies, are the roughest kind of mulch (Figure 30). These chips are generally free or inexpensive. They are okay to use in areas where you want to remove/reduce all vegetation but are not appropriate for ornamental or vegetable gardens as they not only use a huge amount of nitrogen as they’re breaking down. In addition, depending on the wood used for the chips, they might also raise the acidity level in the soil.
5.3.4. Rock Mulch

An advantage of rock mulch—medium to large stones—is temperature regulation. Rocks absorb heat during the day and then release it at night, maintaining consistent soil temperatures. This is especially beneficial in cooler climates. Rock mulch is also economical because it doesn’t decompose or require frequent replenishment or replacement. Additionally, rocks can retain moisture underneath which can nourish the underlying soil (Figure 31).

This lack of decomposition, however, can also be a drawback, as it doesn’t allow for the release nutrients into the soil as other organic mulches do. Larger rocks can also be difficult to move around when the need arises. Smaller stones, like pebbles and gravel, do help regulate temperature, but unlike their larger counterparts, pebbles can work themselves into the soil, requiring more maintenance. Pumice rock is a unique rock worth considering; it is light, porous, retains moisture, and is a perfect mulch for flowerbeds housing perennials.
5.3.5. Shredded Rubber

Although on the higher end of the cost spectrum, shredded rubber is quite long-lasting. It provides adequate insulation from both heat and cold. Rubber mulch is also non-porous and doesn’t absorb water, allowing moisture to drain directly into the soil. It’s excellent for preventing weed and fungus growth. Furthermore, it lasts much longer than wood-type mulches and recycles material that could otherwise harm the environment sitting in a landfill (Figure 32).

Even though rubber breaks down extremely slowly, it does break down, and may release toxic chemicals into the soil depending on its origin. It is also flammable and not recommended for areas where wildfires are common. This is a situation in which the gardener must decide for themselves if the benefits outweigh the potential risks. Some landscapers are vehemently against the use of rubber, but there might be certain scenarios where it remains a viable option.
5.3.6. Leaves and Grass Clippings

Mulching leaves and/or grass clippings is a very economical option (Figure 33). As many lawnmowers now come with a mulching feature, creating the own mulch, making use of a resource would otherwise remove, sometimes even paying to do so. Like straw, leaves and grass clippings can be tilled into the soil to add nutrients. Though this might not be the most aesthetically pleasing, leaves and grass clippings are incredibly rich in nutrients that will make the garden.

If it is decided to choose this option, be sure to use clippings that are herbicide-, pesticide-, and fungicide-free. As freshly cut grass clippings can lead to rot, it is best to dry out or compost them first when using them as a top layer. Fresh cuttings can, however, be beneficial when tilled into the soil, as these begin to release nitrogen immediately after cutting.
5.3.7. Pine Needles or Pine Straw

Pine needles or pine straw offer the same nutrient benefits as other organic mulches, but they cannot be used with every type of planting. The acidity of pine needles necessitates using them for plants that thrive in acidic soil. This also means that pine needles should only be used as top layer unless thoroughly composted. Tilling into the soil can throw off the pH balance of the soil (Figure 32).

Pine straw must be applied in a thick layer to provide protection from the sun. Pine straw's benefits increase as it ages, so it might be best to wait until the pine straw has thoroughly been composted or aged. Luckily, pine straw and needles can be quite...
affordable, especially when sourced from nature rather than purchased; they simply require a little more patience.

5.3.8. Newspaper

Either laid flat or shredded, newspaper is a viable mulch option at a very affordable price. They make a great barrier to weeds and act as an insulator, especially if layered at least 6-8 inches. Unfortunately, newspaper mulch is not very pleasing to the eye and usually require another more decorative form of mulch to accompany it. Another biodegradable, organic mulch layered on top of the newspaper helps to hold it in place and retain the moisture, allowing the newspaper to break down while still holding back weeds.

As the ink in newspaper can be hazardous, particularly colored ink, it is best to stick to black carbon-based inks. Glossy pages from inserts should also be avoided, as they may release heavy metals (Figure 33).

Figure 33. Newspapers Mulches
6. Proximate Analysis/ Composition of Different Mulches

The table 03 shows the proximate composition of different mulching materials.

Table 03: Proximate composition of different mulching material

<table>
<thead>
<tr>
<th>Material</th>
<th>Total C (%)</th>
<th>Total N (%)</th>
<th>C/N ratio</th>
<th>Dry weight(mt/ha-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refuse tea</td>
<td>34.44</td>
<td>3.15</td>
<td>10.93</td>
<td>44.8</td>
</tr>
<tr>
<td>Mana grass</td>
<td>40.32</td>
<td>1.40</td>
<td>28.80</td>
<td>13.9</td>
</tr>
<tr>
<td>Coir dust</td>
<td>34.80</td>
<td>0.84</td>
<td>41.43</td>
<td>16.2</td>
</tr>
<tr>
<td>Sawdust</td>
<td>40.86</td>
<td>0.28</td>
<td>145.93</td>
<td>37.0</td>
</tr>
<tr>
<td>Paddy husk</td>
<td>29.70</td>
<td>0.77</td>
<td>38.57</td>
<td>29.6</td>
</tr>
</tbody>
</table>

Source: Ekanayake, Jayasekara, and Rajapakse, 2003

Rice straw is a highly used mulching material in many agricultural crop productions. The table 04 shows the proximate composition of rice straw.

Table 04. proximate composition of rice straw

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Matter</td>
<td>76.00 %</td>
</tr>
<tr>
<td><strong>Macro nutrients</strong></td>
<td></td>
</tr>
<tr>
<td>Nitrogen (N)</td>
<td>1.05 %</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>1170.00 mg/kg</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>1.50 %</td>
</tr>
<tr>
<td>Calcium (Ca)</td>
<td>470.30 mg/kg</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>321.00 mg/kg</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>0.11 %</td>
</tr>
<tr>
<td>Sulphur (S)</td>
<td>392.40 mg/kg</td>
</tr>
<tr>
<td>Organic carbon (c)</td>
<td>1.06 %</td>
</tr>
<tr>
<td><strong>Micro nutrients</strong></td>
<td></td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>500.75 mg/kg</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>19.25 mg/kg</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>335.25 m/kg</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>115.75 mg/kg</td>
</tr>
<tr>
<td>Boron (B)</td>
<td>4.06 mg/kg</td>
</tr>
</tbody>
</table>

Source: Umar and Obukohwo, 2013
7. Process of Mulching

7.1. Mulch Installation Checklist

Before installing the mulch, user need to ensure;

- **Soil drainage:** Check to see if the soil drainage is sufficient.
- **Plant species:** Check to see if all the plants in the vicinity do well with the types of mulch you are using.
- **Pre-existing mulch:** Check to see if there is any mulch that is already present. Check the depth of the mulch and break up the clumps of mulch.
- **The stems and the tree trunks:** The mulch should not be piled high next to the stems and the tree trunks. On the contrary, ensure that the mulch is pulled away so that the stems have space to breathe.

(Source: https://www.chainsawjournal.com/types-of-mulch/)

7.2. Mulch Installation in Landscape Beds & Planters

- **STEP 1:** Mark the area that to mulch.
- **STEP 2:** Clear all the undesired plants from the vicinity.
- **STEP 3:** Use a weed barrier. A commercial weed cloth or even newspaper will do the trick. Apply this to the soil before putting the mulch.
- **STEP 4:** Spread a layer of mulch that is 3-4 inches thick. Ensure that the layer is not more than 4 inches thick.
- **STEP 5:** Keep the mulch one to two inches away from the stem of the plants.
- **STEP 6:** Build an outer edge for the mulch to ensure that it stays in the location you have placed it. A small trench also works well. Other edgings are made up of wood, plastic, stone or even steel.

(Source: https://www.chainsawjournal.com/types-of-mulch/)
7.3. Installing Mulch Around Trees
Like the landscape beds and planters, the installation of different types of mulch around trees is a simple step by step procedure. Let’s take a look at how it is done.

- **STEP 1:** Make a circle around the tree that has a radius of 3 feet.
- **STEP 2:** Increase the mulch area by 1 foot for every inch of the trunk’s diameter. This rule holds true till 12 inches.
- **STEP 3:** Use a weed barrier just like how you did with the landscape beds and planters.
- **STEP 4:** Apply a layer of mulch that is 3-4 inches deep. This is the gold standard for all types of mulch.
- **STEP 5:** Ensure that a gap is kept between the trunk of the tree and the mulch. The mulch should not pile up on the trunk.
- **STEP 6:** Organic mulch degrades after a period of time. Frequent top ups need to be done as and when required.
- **STEP 7:** Use an edging at the circumference of the mulch.

(Source: [https://www.chainsawjournal.com/types-of-mulch/](https://www.chainsawjournal.com/types-of-mulch/))

7.4. Mulch Calculator | How Much Mulch Do You Need?
Research will tell you that an ideal layer of mulch needs to be 3-4 inches thick. While that does give an idea of how much mulch should be layered on top of the ground, it does not tell that, how much mulch you need to buy for a plot of land. There is a formula that simplifies the whole process.

The cubic yards = the specific area (square x depth (in inches)) x 0.0031
of mulch required of to be covered of the mulch required

(Adopted from [https://www.landscapecalculator.com/calculators/mulch](https://www.landscapecalculator.com/calculators/mulch))
8. Bibliography


Caballero, G., 2015, Five reason why you should apply mulches around your plants. Available online at https://www.yourgreenpal.com/blog/how-does-mulch-work.


