Mulches for Small Farms and Gardens Overview

Purpose

Mulches are plant residues or other suitable materials that are applied to the soil surface. Mulches can be used to:

- Improve the efficiency of moisture management
- Improve irrigation water and energy efficiency
- Reduce erosion
- Improve plant productivity and health
- Maintain or increase soil organic matter
- Reduce emissions of particulate matter

Mulches protect soil in and around crop beds.

Mulches Applied to Small Farms

Many urban and small farms use multiple types of mulch. This may be a combination of natural and/or synthetic mulches. Mulching can increase soil health over time by protecting the soil and increasing soil organic matter. Mulches are effective alone, but when used with other practices such as cover cropping and reduced tillage, overall soil health will improve more rapidly. Mulches applied to the soil surface will help retain soil moisture and improve irrigation water use efficiency. Mulches are effective at weed suppression and can improve overall plant productivity and health.

Types of Mulch: Natural vs. Synthetic

Natural

Natural mulches commonly include straw, hay, compost, composted leaves, woodchips, and cover crop residue. Other biodegradable natural materials such as grass clippings, wool, sawdust, paper, newsprint, and cardboard may also be used as mulches. A range of natural mulches have diverse uses in production and non-production areas on any size farm and are widely applicable.

Synthetic

The two most common synthetic materials used in farm settings are plastic mulch and landscaping fabric. Plastic mulch is a thin, non-permeable material that only lasts one season. Landscaping fabric is a permeable, durable, woven material that is reusable for up to 5 years *(See Table 3)*.

Natural mulches (clockwise top left to bottom right): alfalfa hay, cereal rye cover crop residue, woodchips, composted leaf mulch

Location

Mulch materials are widely applied throughout farms and gardens on growing beds, pathways, and non-production areas. Consider C:N ratio, residue management, and mulch duration when choosing mulch materials for various areas.

C:N Ratios

The carbon to nitrogen ratio compares the mass of carbon to the mass of nitrogen in a particular material *(See Table 1)*. The C:N ratio of mulches affects the decomposition rate and crop nutrient cycling. The

optimum C:N ratio for soil microbes is 24:1. A mulch in this range will feed soil microbes and increase soil organic matter.

The higher the C:N ratio, the longer it takes for the material to decompose. High carbon residues such as wheat straw have low nutritional quality for microbes and will take longer to break down.

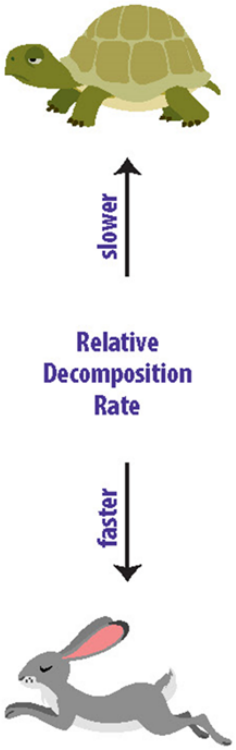
Mulches with a C:N ratio greater than 30:1 may immobilize soil nitrogen and additional nitrogen may be needed as the mulch breaks down. Mulches with a C:N ratio less than 20:1 will release plant available nitrogen.

The smaller the C:N ratio, the more rapidly the material will decompose. Low carbon mulches, such as hairy vetch cover crop residue, will likely need to be re-applied throughout the growing season.

Apply a mulch with a higher C:N ratio (at least 20:1) in concentrated flow areas to avoid negative water quality impacts.

Table 1. C:N Ratios

Material	C:N Ratio
rye straw	82:1
wheat straw	80:1
oat straw	70:1
corn stover	57:1
rye cover crop (anthesis)	37:1
pea straw	29:1
rye cover crop (vegetative)	26:1
mature alfalfa hay	25:1
Ideal Microbial Diet	**24:1**
rotted barnyard manure	20:1
legume hay	17:1
beef manure	17:1
young alfalfa hay	13:1
hairy vetch cover crop	11:1
soil microbes (average)	8:1



C:N Ratios of crop residues and natural materials. Source: Carbon to Nitrogen Ratios in Cropping Systems, USDA-NRCS 2011

(Clockwise top left to bottom right): Walkways/Pathways, Bed/Pathways, Planting Bed, Non-Production

Temperature

Compared to bare soil, mulched soil has significantly lower temperatures and more moisture retention, due to reduced evaporation. Root function ceases to develop at temperatures higher than 85° F. Maintaining an optimum temperature in the root zone will allow for maximum nutrient uptake and growth. Mulch can help reduce moisture loss and maintain an optimal soil temperature.

Dark mulch materials such as black synthetics and compost will warm the soil and promote spring crop germination. Light mulch materials such as white plastic and straw will cool the soil and reduce the scorching of young plants. Straw, hay and wool can help insulate young transplants from frost.

How much to apply

It is important to apply enough mulch to fully cover the soil to reduce erosion, suppress weeds, retain moisture and buffer temperatures (*see Table 2*). Woodchip mulch should be at least 2" thick. All other mulches should be 100% bed or walkway coverage. For straw and hay mulch a final depth of 2" (after settling) is recommended, which would be an initial application of about 6" of mulch.

To determine how much mulch is needed, calculate:

Area (sq ft) = Bed length (feet) x bed width (feet)

Determine the desired final depth of mulch. Compost and other bulk materials are typically calculated in

cubic yards. Straw and hay are by bale. Use estimates for the area that will be covered per cubic yard and per bale using the final desired depth for each area and material.

Table 2. Estimated coverage at 1" depth* for various mulch materials. Use Mulch Calculator to determine quantities.

Mulch Material	Area (sq. ft.)	Final Depth (inches)	Quantity	Units
Compost	100	1	0.31	Cubic yards
Composted leaf mulch	100	1	8.33	Cubic yards
Grass clippings	100	1	0.31	Cubic yards
Hay (square bales)*	100	1	1	Bales
Landscape Fabric	Area = linear ft. X product width			
Plastic Mulch				
Newspaper	Area = (linear ft. X product width) X # of layers			
Straw (square bales)*	120	1	1	Bales
Woodchips	100	1	0.31	Cubic yards
Wool	100	1	10	Pounds

** A final 1" depth is approximately 3" of material initially applied.*

Planting into Mulch

Planting before or after mulching will depend on the type of crop that is being planted, and whether it is direct seeded or transplanted. For most transplanted crops, and direct-seeded crops spaced 12+" apart, it is best to mulch and then plant. It will take additional time to plant directly into straw and hay mulch.

Transplanting into newsprint and straw mulch.

This time can often be made up by reduced weeding over the season. For direct-seeded crops that have a tight spacing, it is best to mulch with compost and then seed. Or, plant and then mulch up with straw or hay after the crop is established for additional coverage.

Keep mulch 3-6" away from plant stems to prevent disease. Before mulching crops with natural or synthetic materials, make sure the soil is moist.

Mulch and Crop Compatibility

Knowing what crop is planned and how it will be planted, weeded, and harvested will help determine what mulch material is the best option (see Table 4). For example, direct-seeded crops that are tightly spaced are typically planted with equipment that requires a fine and loose planting medium. Compost that is well broken down and applied to the soil surface will be best suited. Chunky mulch materials like leaves, straw, and cover crop residue can get in the way of common seeding and harvesting equipment for direct-seeded and low-lying crops like greens mixes.

Alternately, crops that are transplanted or direct seeded farther apart can be planted into deeper, thick residues like straw and leaf mulch, or into landscaping fabric with pre-cut holes. Also consider how long the crop will be in the ground and how it will be weeded. For a long-season crop, like tomatoes, use a deep straw, hay or wool mulch that will last throughout the crop harvestable period.

Table 4. Examples of common crops and most suitable mulch options based on likely planting method and spacing.

Crop	Planting Method	Mulch
Tomato/Pepper	Transplant	Straw, leaf mulch, wool, or landscaping fabric
Watermelon/Zucchini	Transplant or Seed	Straw, leaf mulch, wool, or landscaping fabric
Head lettuce	Transplant	Compost, leaf mulch, straw, or landscaping fabric
Carrots/Beets/Spinach	Direct Seed	Compost

Mulch Duration and Management

Over time, mulches need to be re-applied to maintain good soil cover due to quick decomposition, compaction from walking, wind, and erosion from heavy rainfall events. If the area does not have adequate depth or coverage of mulch, weeds will appear and likely require hand weeding.

Straw, hay, grass clippings, leaves, newspaper, and cardboard all last roughly one season. Wool can last up to 2 years. Woodchips will last roughly 2-3 years. Black plastic synthetic mulch will last 1 year, and a more

Table 3. Common natural and synthetic mulch materials, and general pros, cons, and comments for each.

Natural Mulches	Pros	Cons	Comments
Compost Mulch	Can reduce tillage to establish direct-seeded crops, increases soil organic matter	Sources can be high in pH and high in Phosphorus (especially manure-based products), cost	Apply on top of beds without incorporation as a mulch and planting medium for direct seeded crops.
Leaves	Widely available, increases soil organic matter and beneficial soil microbes	High C:N ratio (if not composted), municipal sources may contain trash	2" minimum, uncomposted leaves best for transplants or walkways. Leaves should be shredded to prevent matting.
Newsprint/Cardboard	Added weed suppression in non-production areas, lasagna garden bed prep, or pathways	Newsprint breaks down quickly (need to mulch up), no nutrient value	Cardboard most suited to long-term bed building, walkways, perennial plantings. Combine newsprint with straw or hay to increase weed suppression
Straw/Hay	Good insulator, moisture retention, soil protection, weed suppression. Alfalfa hay = Nitrogen contribution	Easily windblown, re-application throughout the season, weed seeds depending on source, longer planting time, may increase slug pressure if used in the spring	3-4" final depth optimal, 2" minimum. Best for transplants or walkways, or around established seeded crops
Woodchips	Widely applicable, easily sourced, effective weed suppression, lasts over two years	High C:N ratio	Most suited to walkways, non-production areas, perennial plantings
Wool	Low C:N ratio, slow release of nitrogen, weed suppression, water retention, good insulator, slug deterrent, may last up to 2 years	Not suitable for direct seeding, high pH value, not widely available, may not be compatible with all crops (squash)	Wool pellets are easy to apply. Well suited for long lasting transplanted crops such as tomatoes. Nutrient value of 9-0-2
Synthetic Mulches	**Pros**	**Cons**	**Comments**
Landscaping Fabric	Effective weed barrier, warms soil, moisture retention (once soil is wet), permeable, reusable (5+ years)	No organic matter contribution, can burn small plants, may effect soil biology, may impede natural moisture (rain), eventual waste, cost	Use strategically in rotation, only for 1 year in the same location to address long-term soil health via natural mulch materials and cover crops
Plastic Mulch	Weed barrier, warms soil, moisture retention (once soil is wet)	No organic matter contribution, used in tillage system, not permeable, not reusable (1 season), waste and removal difficult, can burn small plants	Can reduce repeated cultivation and soil disturbance throughout the sea-son, but almost requires tilled soil to use mulch layer equipment

sturdy commercial landscape fabric will last over five years.

Consider how mulch residue management will fit into crop rotation, and the next crop's planting, weeding, and harvesting methods. Mulch can be re-applied or raked off into walkways.

Mulch Sources

It is important to consider the source of mulch materials. Hay or straw may have unwanted weed or barley/wheat seeds. A compost nutrient and pH analysis is recommended, and can be obtained from most commercial sources. Municipal compost or woodchips may have trash residues and are typically not screened to be uniform in size. Residual herbicides have become a concern in some mulch feed stocks. Knowing the source and asking questions ahead of time can reduce risks and frustrations with mulch materials.

Mulch Costs

Mulch inputs can represent a significant cost on the farm. However, the benefits include reduced weeding time and the associated labor costs, reduced water costs from avoided irrigation, along with cleaner marketable produce and reduced washing time. The long-term soil health improvement may result in improved organic matter, moisture retention, and erosion control.

Keep the soil covered as much as possible.

More In-Depth Reading

- Carbon to Nitrogen Ratios in Cropping Systems (pdf), USDA-NRCS, 2011
- Missouri Botanical Garden – Mulches for the Home Garden (pdf)