e-GRO Alert

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Organic Mulching: An Effective Non-chemical Weed Management Strategy

Weed management in enclosed environments like greenhouses, hoop houses, and propagation houses presents unique challenges (Figure 1). Weeds in these settings compete with crops for vital resources such as space, nutrients, water, light, and oxygen, which can significantly reduce crop yield and quality. Additionally, weeds can harbor pests and pathogens, further threatening the health of the plants within these confined spaces.

Figure 1. Ornamental production at an enclosed environment. Photo credits: Debalina Saha, MSU Horticulture.

This makes effective weed control essential for maintaining a healthy and productive growing environment. The use of chemical herbicides in such enclosed environments often makes the problem more critical. The temperature inside the greenhouse or any enclosed structures can get high if not properly controlled. This high temperature can easily cause several herbicides to vaporize within the greenhouse, leading to the accumulation of harmful vapors that can cause severe damage to several sensitive ornamental crops. To mitigate these risks, non-chemical methods of weed control are increasingly preferred for their safety and effectiveness. Non-chemical method inside greenhouses mostly includes hand weeding and organic mulching.

What is organic mulch?

Organic mulch is the application of naturally derived materials on the surface of the soil with the aim of protecting the soil from erosion, conserving moisture, enhancing fertility, controlling weeds, and regulating soil temperature (Figure 2). These materials, being biodegradable, decompose over time, which improves the overall health of the soil. Organic mulches are derived from various sources, each offering unique benefits and drawbacks, depending on how they are used, and the specific requirements of the crop being grown.

Organic mulch primarily works by covering the soil surface, thereby blocking the transmission of sunlight. Sunlight is crucial for the process of photosynthesis, which weed seeds need to germinate and grow. By obstructing sunlight, organic mulch effectively prevents weed seeds, particularly those of the dicotyledonous variety, from germinating. This is especially beneficial for small-seeded weeds, which are more sensitive to light deprivation. Additionally, organic mulch acts as a physical barrier that prevents new weed seeds from reaching the soil and establishing themselves (Figure 3). Beyond this physical blocking action, certain organic residues release allelopathic chemicals—compounds that have natural herbicidal properties. For example, rye straw is known to release chemicals that are toxic to small-seeded weeds, making it particularly effective in suppressing their growth (Saha et al., 2018).

Figure 2. Organic mulching used in container-grown ornamental production for an effective weed control. Photo credits: Debalina Saha, MSU Horticulture.

Figure 3. Layer of organic mulch in the container acts as physical barrier and prevents new weed seeds from reaching the soil and establishing themselves. Photo credits: Debalina Saha, MSU Horticulture.

Figure 4. Hardwood chips organic mulch. Photo credits: Debalina Saha, MSU Horticulture.

Figure 5. Pine bark organic mulch. Photo credits: Debalina Saha, MSU Horticulture.

Figure 6. Rice hull can be used as organic mulch for weed control in container-grown ornamental production. Photo credits: Debalina Saha, MSU Horticulture.

Another key mechanism by which organic mulch controls weeds is by modifying the soil environment. Organic mulches tend to have a cooling effect on the soil, which can inhibit the growth of heat-loving weeds such as pigweed, purslane, and Galinsoga. These weeds typically thrive in soil temperatures ranging from 85 to 100°F, and the cooling effect of organic mulch can significantly reduce their growth. One of the notable effects of organic mulch is its ability to limit the availability of oxygen in the soil, which is crucial for weed seed germination. The thicker the mulch layer, the less oxygen is available to the soil, further inhibiting weed growth. However, this effect must be carefully managed, as excessive mulch thickness can also affect ornamental crop growth by reducing oxygen availability to the crop roots (Benvenuti et al., 2001).

Types of Organic Mulches:

Organic mulches come from a variety of sources, each with specific benefits and considerations. Following are some of the most common types available in market:

Hardwood chips: Hardwood chips (Figure 4), created from mechanically chipping or shredding tree and shrub trimmings, are commonly used as organic mulch in various horticultural settings. They help retain soil moisture, regulate temperature, and suppress weeds. When applied around trees, shrubs, and perennial beds, hardwood chips gradually decompose, enriching the soil with organic matter. However, hardwood chips made from natural tree material are of better quality than those made from old wood products like pallets. The ones made from old wood might contain chemicals or break down too quickly, making them less effective as mulch (Steil, 2022).

Pine bark: Pine bark (Figure 5) is a popular organic mulch derived from the outer bark of pine trees. It decomposes slowly, offering long-lasting benefits such as moisture retention and temperature regulation in garden beds. Pine bark is slightly acidic, making it particularly suitable for acid-loving plants like azaleas and rhododendrons. It also effectively suppresses weeds by creating a barrier that blocks light. As it breaks down, it improves soil structure by adding organic matter. Additionally, its natural and attractive appearance makes it a favored choice for outdoor ornamental landscapes, trees, and shrubs.

Rice hull: Rice hulls (Figure 6), particularly parboiled rice hulls, are used as an organic mulch in horticulture. They are lightweight, decompose slowly, and provide effective weed control by forming a barrier that prevents weed seeds from reaching the soil surface. This mulch is especially useful in container gardening and nursery production, where it has been shown to suppress challenging weeds like liverwort and bittercress. Rice hulls are also low in nutrients, helping to minimize weed growth by creating an inhospitable environment for seed germination. Additionally, they resist decomposition and dry quickly after watering, making them a durable and practical mulch option (Altland, 2014).

Other types of organic mulches can include sawdust, pine straw, grass clippings, shredded cypress, etc.

Advantages of Organic Mulch:

Following are some of the important advantages of using organic mulches:

- *Moisture Retention*: Organic mulch keeps soil moist by reducing water evaporation, which is especially helpful during dry periods.
- *Weed Control*: Mulch blocks sunlight, preventing weed seeds from sprouting, which reduces the need for weeding.
- *Temperature Regulation*: It insulates the soil, keeping it cooler in summer and warmer in winter, protecting plant roots from extreme temperatures.
- *Soil Enrichment*: As mulch decomposes, it adds nutrients to the soil, improving its structure and fertility, leading to healthier plant growth.
- *Microbial Activity*: Mulch supports beneficial soil microbes, which are important for nutrient cycling and overall soil health.

Disadvantages of Organic Mulch:

Despite its numerous benefits, organic mulch has several limitations that must be considered. For instance:

- *Oxygen Limitation*: Thick mulch layers can restrict oxygen to the soil, which helps control weeds but may also hinder crop growth. Balancing mulch thickness is important.
- *Labor and Cost*: Applying organic mulch is labor-intensive and can be costly, especially for large areas, making it more suitable for small-scale farming.
- *Pest and Disease Risks*: Organic mulch can attract pests and increase disease risks in certain crops, so these need to be managed carefully.

- *Weed Seed Contamination*: Some organic mulches may contain weed seeds, making it harder to control weeds that grow in the mulch.
- *Impact on Crop Growth*: Some organic mulches can negatively affect crops, especially if they have a high carbon-to-nitrogen ratio, which can cause nutrient deficiencies.

Research led by Dr. Debalina Saha (Assistant Professor) and her team, at Michigan State University has found that mulch particle size is very important factor which can determine its effectiveness for weed control. Finer or smaller the particle size, more is the moisture retention in its layer and therefore new weed seeds coming on top of the mulch layer can germinate. Whereas larger coarse particle mulch absorbs water like sponge and retains less moisture in its layer and hence providing more effective weed control. Rice hull and pine bark nuggets are good organic mulch options for weed control in greenhouse container production of ornamental plants.

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