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Enhancing crop productivity: The art of mulching in agriculture

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Abstract

Mulching is a vital practice in agriculture that involves covering the soil surface with a layer of organic or inorganic materials. This article explores the art and science of mulching, discussing its benefits, various types of mulch, application techniques, and considerations for successful implementation. Mulching helps conserve soil moisture, suppress weeds, regulate soil temperature, enhance soil health, and prevent erosion. Understanding the proper use of mulch allows farmers to maximize its potential and contribute to sustainable and productive crop production.

Keywords: Mulching, weed management, organic and inorganic mulch

Introduction

Mulching is the process or practice of covering the soil/ground to make more favorable conditions for plant growth, development and efficient crop production. While natural mulches such as leaf, straw, dead leaves and compost have been used for centuries, during the last 60 years the advent of synthetic materials has altered the methods and benefits of mulching (Sharma and Bhardwaj, 2017) [7].

Mulch is a general term for a protective ground cover that can include manure, wood chips, seaweed, leaves, straw, grasses, sands, stones (boulders), synthetic plastics and other natural products. While the term mulching may be defined as a practice of covering the surface of soil with these materials to reduce evaporation and also to moderate wide fluctuations in diurnal soil temperatures, especially in the root zone environment. It controls external evaporability and also reduces energy supply to the evaporating site by cutting off solar radiation falling on the ground. Its main function is limited to controlling first stage of drying which helps in improved moisture status, reduced soil temperature, besides checking seedling mortality and improving crop stand (Loy and Wells, 1975) [3].

The Role of Mulching in Agriculture

Mulching in agriculture involves covering the soil around crops with a layer of organic or inorganic material. This practice has several key objectives:

- 1. Water use efficiency:** Water use efficiency is critical in agricultural production and should be promoted (Unger, 1995) [5]. One way to achieve this is through mulching, which involves covering the soil surface with crop residue or other materials such as paper or polyethylene film. Straw mulch helps to retain soil moisture, control weeds, reduce temperature, and conserve soil, ultimately increasing soil fertility. Mulching also increases soil moisture in the root zone and significantly reduces soil temperature, providing a stable environment for seedling growth and establishment compared to non-mulched soil. Furthermore, mulching enhances water infiltration and storage in the soil, improves soil structure and macro-porosity, and reduces evaporation and runoff losses (Osuiji, 2007) [4].
- 2. Weed Management:** Mulches can be used to cover the soil surface or act as a physical barrier to prevent weed germination and control seedling growth. Polythene and straw mulching have been found to reduce weed intensity compared to chemical and unmulched plots for various crops. The difference in weed control between mulched and unmulched treatments is significant. The combination of drip irrigation and sugarcane trash mulching is the best treatment for saving water (up to 44%) and achieving the highest crop yield. This treatment reduces weed intensity by 95%, increases crop yield by 53%, and saves up to 44% of irrigation water compared to flood irrigation without mulching (Boomika *et al.*, 2022) [1].
- 3. Soil Temperature Regulation:** Mulching helps to regulate soil temperature by preventing extreme temperature changes. It reduces soil temperature during summer and increases it during winter.

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The use of wheat straw mulch can increase soil temperature by 2-3 degrees Celsius in peak winter season (Sarolia and Bhardwaj, 2012) ^[6]. At night, mulching helps to increase soil temperature by absorbing longwave radiation emitted by the soil, which slows down the cooling of the soil (Lamont, 2005) ^[2].

4. **Erosion Prevention:** Mulching provides protection to soil from wind, water, traffic-induced erosion, and compaction, which can be a direct cause of root stress and poor plant health. Adding even a thin layer of organic mulch can help protect the soil. For example, using straw mulch, fallen pine needles, or wood chips can reduce erosion and overland flow. The use of bark or jute on compacted urban soils can restore soil aggregation and porosity. It is better to apply mulch before compaction occurs, as it is difficult to reverse. Proactive mulching can protect soil integrity (Telkar *et al.*, 2017) ^[8].
5. **Enhanced Soil Health:** The effect of organic mulching on nutrient levels can vary depending on the type of mulch, soil chemistry, and the specific nutrients of interest. Mulches that have a relatively high nitrogen content often result in higher yields. However, low-nitrogen mulches, such as straw, sawdust, and bark, can also increase soil fertility and plant nutrition (Telkar *et al.*, 2017) ^[8].

Types of Mulches in Agriculture

Farmers can choose from various types of mulch, each with its unique characteristics and advantages:

1. **Organic Mulch:** Made from natural materials that decompose over time, organic mulch materials include:
 - Straw
 - Crop residues
 - Compost
 - Wood chips
 - Grass clippings
2. **Inorganic Mulch:** These materials do not break down and are often used for long-term weed control. Common inorganic mulches include:
 - Plastic sheeting
 - Landscape fabric
 - Gravel or stone mulch

Best Practices for Agricultural Mulching

To make the most of mulching in agriculture, farmers should adhere to best practices:

1. **Proper Timing:** Apply mulch when the soil is moist and at the right temperature for crop planting. This ensures that the soil is well-prepared for mulch coverage.
2. **Adequate Depth:** Apply a layer of mulch at a depth of 2 to 4 inches. This depth offers effective weed control, moisture retention, and temperature regulation.
3. **Avoid Mulch Contact with Stems:** Ensure that the mulch does not come into direct contact with the stems of plants, as this can promote disease and rot.
4. **Replenish as Needed:** Regularly monitor the mulch layer and replenish it as it breaks down, usually on an annual basis.
5. **Choose the Right Mulch:** Select the type of mulch that suits your crop, climate, and soil conditions. Consider factors like cost, availability, and sustainability.

Conclusion

Mulching is a versatile and sustainable practice in agriculture that offers numerous benefits, ranging from water

conservation and weed control to soil health improvement and temperature regulation. As the world faces challenges like climate change and diminishing water resources, farmers can adopt mulching as a valuable tool to enhance crop productivity while promoting eco-friendly farming practices. By understanding the art of mulching, agriculture can move closer to a more sustainable and productive future.

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