



# PLASTIC MULCHING IN MODERN FARMING: A BOON FOR AGRICULTURE OR A FUTURE THREAT?

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**P**lastic in agriculture, known as “Agri-plastic,” began for the first time in the United States of America in 1948 year. Its application showed clear benefits in improving crop productivity. Dr. Emery M. Emmert (University of Kentucky) is the pioneer of plastic mulching because of his Notable research during the 1950s on the use of polyethylene films in agriculture. His studies demonstrated that plastic mulching is effective in controlling weeds, conserving soil moisture, and regulating soil temperature.

In plastic mulching, a thin plastic sheet is spread over the soil surface. This practice helps retain moisture in the soil, suppresses the growth of weeds, and maintains a suitable soil temperature. As a result, crop yield increases. In India, this technique is widely used on a large scale for many crops, especially vegetables. It also supports water conservation, reduce the losses of nutrients, and helps in the prevent soil erosion. However, if the plastic is not disposed of properly, it can pose a risk to the environment.



Extensive use of plastic in modern agriculture poses a threat to the ecosystems because plastic residues persist in both terrestrial and aquatic environments. When plastic mulch breaks down due to sunlight exposure, microbial activity, and physical abrasion, it fragments into tiny microplastic and nanoplastic particles. Over time, these particles accumulate in the soil, increasing concerns for both land-based and water-based ecosystems.

### PLASTIC MULCHING: TYPES & PROPERTIES

Farmers generally use several types of plastic mulching. The main types are as follows:

- (i) Black plastic mulch
- (ii) Transparent (clear) mulch
- (iii) Silver-black mulch
- (iv) White-black mulch

Farmers use different types of plastic mulching in their fields. The most commonly used materials are Linear Low-Density Polyethylene (LLDPE) and Low-Density Polyethylene (LDPE) because they are durable as well as cost-effective. In addition, High-Density Polyethylene (HDPE) is also used by some farmers. Polyethylene mulch is one of the most popular options due to its UV resistance and long-lasting nature. The mulch films most widely used generally have a thickness ranging from 25 to 30 microns, although products with both lower and higher micron sizes are also available.

### BENEFITS OF PLASTIC MULCHING

**Water Conservation:** Plastic mulching prevents direct evaporation of moisture from the soil, which is especially beneficial in regions facing water scarcity. It also helps in reducing soil erosion.

**Weed Control:** Opaque plastic sheets block sunlight from reaching the soil, which prevents most weeds from germinating and growing.

**Soil Temperature Control:** It helps maintain warmer soil conditions, leading to faster seed germination and improved early root development. Clear (transparent) mulch creates a greenhouse-like effect, allowing the soil

to warm more compared to fields without plastic mulching.

**Nutrient Management:** Plastic mulching reduces nutrient loss caused by leaching and improves the efficient use of fertilizers, especially when combined with drip irrigation systems.

**Pest and Disease Management:** Plastic mulch acts as a protective barrier, helping shield crops from certain soil-borne pests and diseases.

### DISADVANTAGES AND ENVIRONMENTAL IMPACTS OF PLASTIC MULCHING:

Plastic mulching is a helpful technique in modern agriculture for enhancing crop productivity. However, if it is not used properly, it can lead to several adverse effects. Among the soil contamination being one of the most serious concerns. Microplastic and nanoplastic particles present in the soil can move through the food chain, adversely affecting plant growth as well as human and animal health. Some of the disadvantages are discussed below.

**Plastic Waste Increase in Farmer Fields:** Many farmers do not completely remove plastic materials from their fields after harvesting. As a result, small fragments of plastic remain in the soil and gradually accumulate year after year, leading to a growing problem of plastic waste in agricultural land.

**Formation of Microplastics and Nanoplastics from Plastic Fragments:** Plastic pieces that remain in agricultural fields for long periods gradually break down into very small fragments due to exposure to sunlight and heat, the activity of microorganisms, friction (abrasion), and farming practices such as ploughing. These tiny fragments are referred to in scientific terms as microplastics (smaller than 5 mm) and nanoplastics (smaller than 1µm or 1000 nm).

**Release of Harmful Chemicals from Plastic Fragments:** When small plastic particles remain in soil or water for extended periods, they begin to release certain toxic substances. These may include phthalates, bisphenol A (BPA), and various toxic heavy metals.



Over time, such chemicals mix into the soil and are absorbed by plants through their roots. As the plants grow, these substances move into the food chain. Consequently, animals and humans who consume these plants may also take in these chemicals, which can lead to a range of health-related problems in both humans and animals.

#### Impact of Plastics on Soil Microorganisms:

Microplastics can adversely affect soil microorganisms by altering microbial communities and disrupting essential soil functions. Several studies have shown that

toxic substances released during the breakdown of plastics may reduce overall microbial abundance and activity. In addition, these effects can interfere with key processes such as nutrient cycling, decomposition of organic matter, and the emission of greenhouse gases.

**Water Pollution in nearby Water Bodies:** During rainfall, microplastics and nanoplastics are washed away with runoff and enter nearby rivers, streams, and ponds. Their presence contaminates water bodies and can pose serious risks to aquatic organisms, potentially harming ecosystems that depend on clean water.



Figure 1. Plastic fragments in the farm fields after the removal of old plastic mulch

### ECO-FRIENDLY ALTERNATIVES TO PLASTIC MULCHING

**Biodegradable Mulch:** It is an eco-friendly option that naturally breaks down in the environment after use, thereby preventing long-term pollution.

**Biopolymer based Mulch:** These mulches are produced from renewable resources such as polylactic acid (PLA) and starch-based materials. They serve as sustainable alternatives to conventional plastic mulches.

**Crop Residue Mulching:** Natural materials such as rice straw, wheat husk, wood chips, plant leaves, and other crop residues can be used as mulch, offering an eco-friendly and soil-improving option.

### CONCLUSION

Plastic mulching is beneficial for agriculture, but improper use can lead to long-term soil pollution. It helps in conserving soil moisture and suppressing weed growth; however, it can also pose a serious threat to soil health if not used properly. The use of plastic mulch can result in the formation of tiny microplastics and nanoplastics that contaminate the soil. Plastic mulch must be removed and disposed of properly, as leftover material can remain in the soil for decades and easily spread to agricultural lands and nearby water bodies such as rivers, streams, and ponds. Therefore, it is important to consider not only the advantages of plastic mulching but also its long-term environmental impacts, with greater emphasis on adopting biodegradable mulching options.

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