

Applications of Plastic in Agriculture

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ABSTRACT

Plastics have become a key component in modern agriculture, providing solutions that enhance productivity and sustainability. They are used in various applications such as mulching films, irrigation systems, greenhouses, seedling trays, and pest control nets. These plastic materials help conserve water, regulate soil temperature, protect crops from pests, and extend the growing season. Additionally, plastics aid in the packaging and storage of harvested produce, preserving freshness and reducing food waste. Plastics also support soil erosion control and enable efficient fertilizer and pesticide delivery. Despite the numerous benefits, the widespread use of plastics raises environmental concerns, particularly regarding waste and pollution. To mitigate these issues, sustainable practices like using biodegradable plastics, recycling, and minimizing plastic waste are crucial. As the agricultural sector continues to rely on plastics, it is essential to balance the advantages with environmental responsibility. Proper plastic management will ensure that the benefits of plastic in agriculture can be enjoyed while minimizing negative ecological impacts.

INTRODUCTION

In recent decades, plastics have become an essential material in modern agriculture, revolutionizing farming practices and

enhancing productivity. The versatility of plastics has made them invaluable tools for a wide range of agricultural activities, from crop

cultivation to food preservation and irrigation. As the global demand for food grows, plastic materials offer sustainable solutions to address challenges such as water scarcity, soil degradation, and climate change. The applications of plastic in agriculture have led to improved efficiency, better resource management, and increased crop yields. These innovations help farmers optimize growing conditions, protect crops from environmental stress, and manage resources more effectively. As agriculture continues to evolve with technological advancements, plastics play a key role in enabling farmers to meet the increasing food demands of a growing global population.

The use of plastic is seen in diverse forms, including mulching, greenhouse construction, irrigation systems, and packaging materials. The use of various covering materials like polyethylene, polycarbonate (2 mm and 4 mm) maintains temperature and relative humidity in greenhouse; required for plant growth and thus increase yield, quality and productivity (Subin *et al.*, 2020). Nordey *et al.*, (2020) found the ability of plastic mesh nets for complete or partial absorption of solar UV radiation, which interrupts the lifecycle of pathogens and insects and thus controlled the insect -pest population in tomato that ultimately increased the productivity. While plastic offers many advantages, it is important to consider the problem of residual plastic fragments produced from plastic degradation that serve as a major threat to agricultural ecosystems and the food web, leading to the formation of micro and nanoplastics (M/NPs) that can harm crops, microbes, earthworms, and other soil biota and can migrate into groundwater and nearby lakes and streams (Astner *et al.*, 2023). Recently micro and nanoplastics in human brain tissues, liver and kidney samples has been detected as well (Nihart *et al.*, 2025). Nonetheless, plastics in agriculture continue to provide critical solutions for both

small-scale and large-scale farming operations worldwide.

Applications of plastics in agriculture-

The use of plastic in agriculture termed as “plasticulture”, has revolutionized agricultural practices. Various applications of plastics in agriculture are:

1. Mulching Films- Plastic mulch sheets are spread over the soil to retain moisture, control weeds, and regulate soil temperature. Types-

- Black mulch film: Prevents weed growth and conserves soil moisture.
- White mulch film: Reflects sunlight to maintain cooler soil temperatures.
- Biodegradable mulch: Made from plant-based polymers, reducing plastic waste.

Benefits include reduced evaporation, water saving, enhanced soil warmth, improved germination and reduced need for herbicides.

2. Greenhouse Films: Used to cover greenhouses and polyhouses, creating a controlled microclimate for crops.

- Materials: Made of polyethylene (PE) with UV stabilizers.

Benefits include extension of the growing season by protection of the crops from extreme weather, enhanced plant growth by optimization of light transmission, reduced disease risk by prevention of excessive moisture.

3. Drip Irrigation Pipes: Delivers water directly to plant roots through a network of plastic tubes and emitters.

- Materials: Typically made from polyethylene (PE).

Benefits include reduced water wastage by ensured targeted irrigation, prevents weed growth by keeping water confined to crop rows, supports fertilizer application through fertigation.

4. Plastic Nets and Shade Nets: Used for protection of crops from excessive sunlight, pests and birds. Types:

- Shade nets (green, black, or white): Control light intensity.
- Anti-insect nets: Prevent pest infestation in nurseries and greenhouses.

Benefits include reduced heat stress in crops and enhanced crop protection without chemical pesticides.

5. Plastic Seedling Trays: Used in nurseries for raising uniform seedlings before transplanting. Benefits include increased germination rate, reduced seed wastage, and allows easy transportation of seedlings.

6. Plastic Storage and Packaging: Plastic crates, silage bags, and hermetic storage bags help in post-harvest storage and transportation. Benefits include prevention from spoilage and contamination, reduced transportation losses.

Challenges of Plastic Use in Agriculture-

1. **Environmental pollution:** Improper disposal leads to plastic accumulation in soil and water.
2. **Microplastic contamination:** Plastic degradation results in microplastics entering the food chain.
3. **Non-biodegradability:** Conventional plastics take hundreds of years to break down.

CONCLUSION

Plastics have transformed modern agriculture by improving efficiency, reducing resource use, and protecting crops. However, their environmental impact should not be neglected. As agriculture continues to rely on plastics, the focus should shift toward sustainable practices, such as the use of biodegradable plastics, recycling and minimizing plastic waste; thus ensuring that the long-term advantages are not overshadowed by environmental concerns. Proper management of plastics in agriculture will be essential for balancing productivity with environmental responsibility in the future.

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