

Approaches for Downscaling the Plastic Usage in Soil

Hiren Das¹, Indrani Debasmita Borah² and Kankana Lahkar³

¹Department of Soil Science, Assam Agricultural University-Jorhat

²Department of Agronomy, Assam Agricultural University-Jorhat

³B.Sc. 4th Semester, Assam Agricultural University-Jorhat

ARTICLE ID: 04

Abstract

Plastic is a polymer created from petrochemical byproducts like crude oil or natural gas. Plastic is widely used in agriculture for weed control, packaging, seed starting, and other purposes due to its being affordable, lightweight, and responsible for much time- and cost-cutting advancement. However, this use of plastic disrupts soil health, resilience, inhibits plant growth, reduced nutrient cycling and causes it to leach into aquatic environments. According to an FAO report, 12.5 million tonnes of plastics are used in agriculture annually, indicating a need for plastic alternatives. In crop production, horticulture, and gardening, there are a number of plastic substitutes that can be utilized, including bioplastics, compostable plastics, biodegradable seed trays, reusable pots, and organic mulches, which can considerably minimize the negative effects of plastic.

Introduction

Plastic is widely used in agriculture for weed suppression, packaging, seed starting, and more. However, studies show that plastic can disrupt soil health, reduce plant growth, and leach from soils into aquatic environments. While marine plastic pollution tends to get the most attention, and for good reason (a recent study of 102 sea turtles in three different oceans found micro plastics in the gut of every single one), a 2021 report on agricultural plastics use by the Food and Agriculture Organization of the United Nations (FAO) revealed that there may actually be more plastics in our soils than in our oceans.

Agricultural activities are one of the most direct pathways for plastics to enter soils, with impacts on both soil and aquatic ecosystems, as plastics in soils can travel downstream to rivers, lakes, and oceans. According to the FAO report, plastics used in agriculture represent 3.5% of total global plastic production. While it might seem like a small percentage, 3.5% of total plastic production amounts to a total of 12.5 million tonnes per

year. (These estimates do not include food packaging, which is responsible for a further estimated 37 million tonnes of plastic per year.)

What is plastic actually made of?

Different kinds of synthetic or semi-synthetic organic chemicals are used to create plastic. Typically, these substances come from petrochemicals like crude oil or natural gas. Polyethylene, polypropylene, polyvinyl chloride, and polystyrene are the most popular kinds of plastic. Based on their characteristics and applications, these plastics can be further categorised into several groups. Thermoplastics, thermosetting plastics, and bioplastics are a few examples.

How exactly do plastics enter soils?

It's vital to keep in mind that plastics, once they've gotten into the soil, can stay there for hundreds of years and can negatively affect the growth of plants, wildlife, and the soil. Plastic can enter the environment through three different pathways, sometimes referred to as the 3Ds: being Damaged (a harvest bin is dropped on the ground and a piece chips off), being Degraded (plastic tarps left out in the elements slowly disintegrate over time), or being Discarded (a drip tape end plug falls out of your pocket in the field). The application of sewage sludge as fertilizer is another way that plastics can enter soils directly. Unfortunately, not all of the micro plastics present in industrial and domestic wastewater and stormwater are removed during wastewater treatment processes. Plastics that enter the environment through any of these pathways eventually break down into micro plastics, which are almost impossible to recover.

Effects of Plastics on Soil Health

It's important to note that effects of plastics can vary depending on the type of plastic, the amount of plastic present in the soil, and the specific properties of the soil. Plastics can have a variety of negative effects on soil health. Some of these effects include in the *figure 1*:

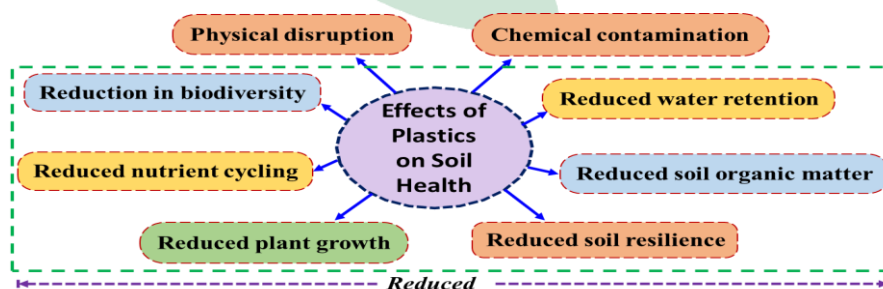


Fig 1: Effects of Plastics on Soil Health

Are there any better plastic alternatives?

Plastic alternatives are growing in popularity as global tolerance for plastics (especially single-use plastics) decreases. The single-use plastics ban, which could come into effect as early as the end of 2023, would eliminate six of the worst offenders: checkout bags, cutlery, foodservice wares, ring carriers, stir sticks, and straws. These are all products that are either difficult to recycle or often end up as litter in the environment.

Today there are reusable or biodegradable alternatives for many common plastic products, from stainless steel straws to fabric shopping bags and packaging made from mushrooms. Critics often cite the increased financial costs and carbon footprint of manufacturing and transporting plastic alternatives, which can be heavier, more resource-intensive to produce, or involve chemicals that are just as harsh and toxic as those used to make plastic. These criticisms highlight the need to move away from single-use products in general and to consider the environmental impacts at all stages of a product's life cycle, from design to production, transportation, use, and disposal.

The good news is that there are some alternatives available for farmers looking to reduce their dependence on plastic products, although usually it's not as simple as replacing a plastic product with a comparable non-plastic one. As the awareness of soil plastic pollution increases, hopefully we will see more substitutes available for plastic farm products in the future. Until then, moving away from plastics on the farm involves the requisite creativity, sacrifice, ingenuity, and trial and error inherent in ecological farming.

Alternatives to Plastic Seeding and Propagation Equipment

It's important to note that alternatives to plastic seed trays and propagation equipment may have different properties and require different care and maintenance than traditional plastic equipment. Some examples include in the *figure 2*. Apart from the figure Natural materials and Recycled materials are also used.



Fig 2: Uses of different Alternatives to Plastic Seeding and Propagation Equipment

Natural materials such as peat pots, coconut husk, and paper pulp can be used to make seed trays and pots. Recycled materials such as plastic bottles, old tires, or recycled paper can be used to make seed trays and pots. It's also worth noting that the use of some alternatives may have an impact on the environment, depending on the sourcing and disposal of the materials used.

Alternatives to Plastic Mulches

Plastic mulches may have different properties and require different care and maintenance than traditional plastic mulches. For example, organic mulches may need to be replenished more often than plastic mulches, and some alternatives may not provide the same level of weed control or moisture

retention. It's also worth noting that the sourcing and disposal of materials used for the alternatives may also have an impact on the environment. There are several alternatives to plastic mulches that can be used in horticulture and gardening. Some examples include in the figure 3:



Fig 3: Uses of different alternatives to plastic mulches

Alternatives to Plastic Packaging

Plastics packaging alternatives may have reduced environmental impacts compared to traditional plastics, they are not a panacea and have their own environmental concerns. For example, bioplastics may not be biodegradable in marine environments, and not all paper packaging is recycled.



Fig 4: Alternatives to plastic packaging

It's also worth noting that many alternatives to plastics can be more expensive than traditional plastics, which may make them less accessible for certain applications. There are several alternatives to plastic packaging that can be used in various industries. Some examples include in the figure 4:

Conclusion

Although using plastic has allowed farmers to produce more food with less resources, the substance poses a serious environmental problem. Plastic mulches, plastic drip irrigation, greenhouse poly, silage wrap, and plastic bins and crates are just a few of the time and money-saving innovations in agriculture made possible by this economical, lightweight material. However, excessive usage of this material has a negative impact on the environment, which encourages the adoption of plastic replacements. Bioplastics and compostable plastics are created from renewable plant resources that can decompose through the action of microorganisms, minimizing their adverse effects on the environment. Materials like peat, coir, or paper pulp, which may be reused numerous times, are utilized to make biodegradable and reusable seed trays. For weed prevention or moisture retention in a crop field, several possibilities include organic, living, and rock mulches instead of plastic mulching. Similarly, to cut back on waste and the demand for single-use packaging, packaging materials made of glass, paper, cardboard, and bioplastics can be implemented. The "Refuse, Redesign, Reduce, Reuse, Recycle, and Recover" approach is the foundation for various solutions to curb the rising plastic effects.

Reference

Joos, L., & De Tender, C. (2022). Soil under stress: The importance of soil life and how it is influenced by (micro) plastic pollution. Computational and structural biotechnology journal.

<https://youngagrarians.org/how-to-reduce-plastic-in-agriculture/>