

ROLE OF ORGANIC MULCH IN WEED MANAGEMENT

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¹Saikat Biswas* and ²Rupa Das

¹Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

²Department of Seed Science and Technology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Email: sbsaikatbiswas27@gmail.com

Present day agriculture mostly suffers from high yield loss due to various biotic and abiotic factors. Consistent increase in population and low agricultural production creates a disparity between the demand and supply of food. Among various biotic factors affecting agricultural production, the weed problem is one of the key issues pertinent in almost all the crops and agro-climatic zones. Weed, on an average, causes 5%, 10%, and 25% yield losses in developed, developing, and least developing countries (Oerke, 2006). However, it has the potential to cause 100% yield loss if not checked on time. Modern day agriculture mostly relies on limited resources. Weed, being the competitor of the crop, steals the crop's valuable resources viz. land, nutrients, water, and sunlight. It also provides shelters for various pathogens and insects. Besides, it releases toxic chemicals, which hampers crop growth. Weeds provide competition to crop both above and underground. Hence, manual weed control is an uneconomical and temporary approach as the emergence of weeds occurs again after some days. Chemical weed control through herbicide creates residual toxicity to soil and leaves environmental health impact. Besides, repeated application of one herbicide builds up resistance in weeds against it. In this context, farmers are in search of suitable alternatives to chemical and hand weeding options. Organic mulching is one such suitable cultural approach that can be used for weed management in an environmentally safe way.

Organic mulching

It is the application of materials of natural origin on the surface of the soil with the objectives to protect the soil from erosion, conserve soil moisture and fertility status, control weeds, regulate soil temperature etc. Such materials are biodegradable. Hence, they naturally decay over time and improve soil health.

Types of organic mulch

There are so many organic materials which are successfully utilised as mulching options. Some of them are straw, dry leaves, bark (softwood and/or hardwood), sawdust, compost/manure, grass clipping, living mulch, alfalfa, seaweed, coir, cocoa bean hulls, corn cobs, hops(spent), peanut hulls, hay, wood chips, municipal tree waste, pine needles, chopped leaves etc.

Organic mulch as weed management option

- Organic mulches, when applied on the soil surface, block sunlight transmission essential for photosynthesis and thereby check germination of already present weed seeds, especially of the dicot category.
- Organic mulches prevent weed seeds from transmission from outside to reach the soil and emerge.
- Several organic residues release allelopathic chemicals, which possess toxicity to many weeds (Saha *et al.*, 2018). For instance, rye straw releases a toxic chemical that causes more damage to small seeded weeds as compared to large seeded weeds.
- As organic mulches exert a cooling effect on soil, the growth of some weeds such as pigweeds, purslane, Galinsogaetcwhich respond to high soil temperature (85-100⁰ F), are checked.
- Organic mulching, just after the harvest of the crop, controls the later emerging weeds.
- Organic mulches improve the growth and competitiveness of winter growing crops against weeds through modification of soil temperature, improvement of soil organic matter, and conservation of soil moisture.
- Organic mulches limit O₂ availability, which affects the germination of weed seeds. O₂ unavailability is increased with the increase of thickness of the mulch layer (Benvenuti *et al.*, 2001).
- Live mulch (i.e. growing living vegetation before or after crop growth) covers the soil surface in such a way that weeds do not get the space to emerge.

Requisite for application of organic mulch

- ❖ Replenishment of organic matter should be done periodically as decomposition of organic residue occurs easily.
- ❖ Thickness of organic mulching should be decided based on the types, extent of weed dominance etc. Organic mulching at the thickness of 3-5 t/acre suppresses small seeded broadleaf weeds whereas, organic mulching at the thickness of 7-10 t/acre is useful in controlling large seeded broadleaf weeds and grasses. The thin layer of organic mulching (1-2 t/acre) allows weed emergence and growth by conserving soil moisture and supplying essential nutrients.
- ❖ Adequate care should be taken to use mulch materials free from weed seeds admixture before application over the soil surface.
- ❖ Application of suitable mulch at the right time and quantity is important for effective weed control. Untimely application and wrong selection of organic mulches can hamper crop growth. For instance, straw mulch is harmful against tomatoes, melons etc, as it lowers down soil temperature. Besides, straw mulching decomposes quickly, and thereby, its weed control efficiency is confined for a short period of time. However, mulch with high C: N (like sawdust) slows down crop growth by immobilizing nitrogen.
- ❖ Organic mulching should be used after proper crop establishment and removal of existing weed flora from the field to reduce the crop-weed competition for resources.
- ❖ Live mulch should be harvested after the crop-weed competition is over. Otherwise, it will compete with the crop.

Limitations

- Organic mulching is only suitable for small seeded annual weeds. It has no or negligible use against large seeded perennial weeds. Perennial weeds easily penetrate through organic mulches.
- Excessive mulching lowers down the O₂ availability in soil, which ultimately hampers germination and root growth of crops.
- Due to its role in reducing soil temperature, organic mulching is more useful during hot summer over the winter season.
- Organic mulches cannot fully block sunlight creating partial windows for light entry, and thereby, some weeds emerge.

- Organic mulches such as straw, hay, compost, leaves, grass clippings, tree barks etc., carry mature perennial weed seeds, which are very difficult to control if they emerge. It is worthy of mentioning that weeds growing through mulches are more difficult to control than weeds without mulches.
- Manual application of organic mulches is a labor consuming process. Hence, it is economically more feasible for small scale farming than others.
- Organic mulching invites disease, insect (bugs/termites etc) problems in many crops like lettuce, brassicas etc.
- Organic mulching provides effective weed control. However, their bulk amount needs high transportation costs unless they are produced on farm.

Some new and promising organic mulching interventions for weed management

Hydro compacting dust:

Hydro-compacting dust is a new and modified organic mulching option, which holds good promise for weed management. Organic fibers combined with adhesive substance based on polyvinyl alcohol. On adding water, this adhesive substance creates a compacted organic disk (Massa *et al.*, 2019). It effectively blocks sunlight entry and prevents weed emergence. There are several benefits of hydro-compacting organic dust/disk like:

- It is more durable than common organic residues.
- As there is no opening for light penetration through this compact material, it is a highly efficient option in controlling weeds.
- It exerts low or negligible environmental impact.

Newspaper mulching:

2-3 layers of black and white newspapers are laid on the soil surface, followed by hay/leaf/grass clippings. It effectively checks weed emergence. Further, it decomposes subsequently and improves soil health for crop growth. Newspaper can also be applied in shredded form. According to Harrington and Bedford (2004), shredded newspaper glued between two sheets of the brown paper provides better weed control than plastic mulching. However, the use of newspaper is usually avoided in windy areas.

Jute mulching mat:

It is a hairy mulching disc which is laid on the soil surface and contains a central hole through which plant emerge. The size of the hole depends on plant size. It is primarily used in the suppression of weeds and soil moisture conservation. It protects plant root damage by weeds.

Cardboard mulching:

Such kind of mulching includes either layer or shredded form of cardboards. It is placed beneath compost materials or grass clippings. It checks grass and other weeds. It is a 100% biodegradable weed management option.

Conclusion

Although organic mulching cannot fully protect the crop from weeds due to several limitations, it is still a very promising option in effective weed management from the crop field. Considering its role on environmental safety along with some added advantages other than weed management, organic mulching should be given a try through various multi-locational trials, particularly in dryland areas, and possible outcomes should be interpreted for its recommendation as the suitable and environmentally safe option of management of agricultural weeds.

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