



Mulching: As a Sustainable Agriculture Technique

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In present situation, rapid industrialization and urbanization have resulted in the global warming and raising temperature. Looking to the limited rainfall or water scarcity, these challenges arise due to climate change. Due to these reasons, natural resources like soil, water and nutrients are being constantly under pressure. So, we have to adopt some means of sustaining agricultural growth through conservation farming. Mulching is one of the conservation practices by which these goals can be achieved. And it has become an important practice due to benefits such as moisture conservation, regulate soil temperature, efficient use of soil nutrient and also improves the organic matter content. Mulch act as a barrier against soil pathogens and repel certain insects-pest/disease and suppress the weed growth. Mulching is an effective method of manipulating the crop growing environment to increase crop yield and improving product quality.

Mulch: Any covering material including either organic or inorganic applied on the soil surface. Waggoner (1960) coined the term 'mulch' which derived from the German word "molsch". Mulching is the process or practice of covering of soil/ground to make more favourable conditions for plant growth, development and efficient crop production.

Type of mulches

1. Organic mulch

Organic mulches are natural origin materials which can decompose naturally like agricultural wastes, bark chips, grass clippings, wheat or paddy straw, plant leaves, compost, rice hulls, sawdust, etc. Among the organic mulches, there is a wide range of choices each with different characteristics and suitability for different growing conditions. Organic mulch is a source of nutrients for soil microorganisms and their activity. Organic residues used for mulching are decomposed to available plant nutrients and a very important substance in soil humas.

Dry grass: Dry grass add nitrogen and organic matter in the soil. Fresh grass clipping is decomposed easily and increase nitrogen percentage, but it is not used in rainy season because it may be chance to develop root system, it will harm to crops growth and development.

Paddy straw: Paddy straw has unique property of not being able to absorb water, so it is easily available to plants. Straw is poor in nutrient value but after decomposition, it makes soil more fertile.

Newspaper: One to two cm thick sheet of newspaper should be used and edges should be fastened with materials like pebbles and gravels. This should be avoided on a windy day and avoid color ink newspaper because its hazardous.

Dry leaves: It is good for protecting dormant plants to keep them



warm during winter. Help to initiate germination during cold season.

Saw dust: It is very poor in nutritive value as it contains only half of the nutrients of straw material. It decomposes slowly and acidic in nature.

Bark: Long lasting and allow proper aeration to the soil. Wood bark has capacity to hold more water and used in very dry and wet regions. Because of heavy rainfall, it absorbs excess water and reduce water logging condition. When rain is too scarce, wood chip release water they have been holding. Some bark products may cause phytotoxicity

Compost: Compost is good mulch and soil conditioner. It improves soil properties and enhance the carbon content. Use in nutrient loving plants but it contain weed seeds.

Cocoa Shell: It is an excellent mulching material to increase soil fertility and acidic in nature. Cocoa shell use in landscape because of sweet smell and attractive appearances.

Straw: It is an ideal for mulching because it can be easily applied in field and long lasting in place. It does not contain any weed seed.

Benefits of organic mulches

- Organic mulch increase availability of nutrients, add organic matter, encourage growth of earth worm and other soil organisms that helps to improve soil health
- It maintains soil temperature and protect roots from extreme heat and cold
- Prevent soil erosion and reduce the need of water
- Restrict the rate of evaporation and retains soil moisture
- Slowly percolate water into the soil through mulch, this slow process of water movement causes less leaching of nutrients and improve plant growth
- Provide a physical barrier against weed seed germination
- Soil born disease spores are splash on plant, it can be prevented by mulch cover to keep plant healthy
- Gardeners use mulch for its appearance. An attractive covering is certainly pleasing to the eye and acts as an excellent foil to plants, it proved uniformity and colorfulness

Limitations of organic mulches

- Organic mulches keep the moist condition for prolonged time which restricts oxygen in the root zone
- Chances of high incidence of pest-insects
- Keep mulch away from direct contact with plants, it may cause stem or root rot
- Organic mulches have allelopathic effects on crops
- Carbon rich materials create risk of N- immobilisation
- It may carry seeds of pernicious weeds which may spread with mulch

2. Inorganic mulch

Inorganic mulch include stone, rubber mulch, textile fabrics, plastic sheets *etc.*

Gravel, Pebbles and Crushed stones

These materials are used successful for tree and shrubs. Small rock or stone layer of 3-4 cm place on soil surface to provides good weed control, reduced evaporation and facilitate infiltration of rain water into the soil. It very popular in xeriscaping. But they reflect solar radiation and can create a very hot soil environment during summer.



Polyethylene mulches

Polyethylene film was first used as mulch in the late 1950's in USA for high value crops. LDPE and LLDPE mulch use in commercial crop production.



Types of polyethylene

- I. Clear or transparent mulches:** This mulch increases the soil temperature more than black plastic. It will allow sunlight to pass through and weeds are grown, by using of herbicide coating on the inner side of film weed growth can be

checked. All UV, visible and infrared go transmutation to soil, but absorbs very little solar radiation, water droplets that condense on the underside of clear plastic allow solar light (short wave radiation) in, but block outgoing, long wave infrared radiation. Clear plastic mulch absorbs little solar radiation but transmits 85% to 95% of incoming solar radiation. The transparent film is quite successful as soil solarization.

Soil solarization: It is a method of soil disinfection based on its solar heating by mulching with a transparent polyethylene during the hot season, thereby controlling soilborne disease. Successful in protected cultivation and solarising the beds before sowing seeds for nursery raising, which gives better seed germination and disease-free nursery.

II. Black mulches: The black plastic film does not allow sunlight to pass through onto the soil. It absorbs most incident solar radiation, including visible, infrared and ultraviolet light, but it has limited use in warming soil as the incoming solar radiation heat up the upper layer of soil by mean of conduction only. The disadvantage of black plastic is that water and oxygen cannot pass through this material.

III. Two sided mulches: Also known as a wavelength selective/photo selective film. Designed to absorb specific wavelength of sun's radiation which changes the spectrum of sunlight passing through film or being reflected back into the plant canopy. These light changes had a marked effect on plant growth and development, warming of soil temperature and blocking weed growth. Compared to black mulches, wavelength selective mulches re-emit leaf heat, thus maintaining lower leaf temperature.

White-Black mulch: Light reflected back into the atmosphere or the plant canopy from a white plastic mulch, resulting in slightly cooler soil temperature. It can be used to establish crops in the summer when a reduced soil temperature might be beneficial.

Silver-Black mulch: Reflective silver or aluminum mulches also give cooler soil temperature. They tend to repel aphids, which can serve as vector for various viral diseases.

Red-Black mulch: Partially translucent allowing radiation to pass through and warm soil but also reflects radiation back into plant canopy changing ratio of light, which results in changes in plant vegetative, flower development and increased yields in some crops.

Yellow-Black mulch: Attract certain insects and thus acts as a trap for them, which prevent disease.

IV Degradable mulch: An alternative solution for reducing waste from polyethylene mulch is to develop photodegradable or biodegradable mulch. The use of biodegradable or photodegradable mulch films- alternative to petroleum-based products, reduce labor cost to remove the mulch products after use.

Photo-degradable mulch: Gets disintegrated under sunlight over designated mulching period

Bio-degradable mulch: Gets disintegrated under natural environmental condition and get mixed in soil after mulching period

Benefits of inorganic mulches

- Polyethylene is completely impermeable to water so, prevents the direct evaporation of moisture from the soil and thus limits the water losses and conserves moisture
- By evaporation suppression, it prevents the rise of water containing salts
- Mulch can facilitate fertilizer placement and reduce the loss of plant nutrient through leaching
- Opaque mulches prevent germination of annual weeds from receiving light
- Reflective mulches will repel certain insects and provide a barrier to soil pathogens
- Mulches maintain a warm temperature even during nighttime which enables seeds to germinate quickly and for young plants to rapidly establish a strong root growth system.
- Synthetic mulches play a major role in soil solarization process

- Mulches develop a microclimatic underside of the sheet, which is higher in carbon-dioxide due to the higher level of microbial activity

Limitations of plastic mulches

- Probability of ‘burning’ or ‘scorching’ of the young plants due to high temperature of black film
- Difficulty in application of top-dressed fertilizer and difficult in machinery movement
- Environmental pollution
- Cannot be used for more than one season using thin mulches

3. Living Mulch or Cover Crop

Cover crops are interplanted and grown either before or with a main crop throughout the growing season. When used as live vegetative barriers on contour key lines not only serve as effective mulch when cut and spread on ground surface but also supply some nutrients. Plants used as cover crops like grass, legume, subabul, *glyricidia* etc.



Conclusion

Mulching is a boon for horticulture crops not only in increasing growth, development and yield but also for soil and water conservation, check weed growth and provide micro climate to plants by buffering soil temperature. Organic mulching helps to restore soil health with the increase in physical, chemical and biological properties; it creates a suitable atmosphere for earthworms and other beneficial micro-organisms to grow in soil. Polyethylene are most widespread mulching materials and especially, black polyethylene is almost used everywhere because it is inexpensive and shown successful production results.

References

1. Lalitha, M.; Kasthuri, V. T.; Balakrishnan, N. and Mansour, M. (2010). Effect of plastic mulch on soil properties and crop growth – A review. *Agricultural Reviews*. **31**(2): 145-149.
2. Ranjan, P.; Patle, G. T.; Prem, M and Solanke, K. R. (2017). Organic mulching – A water saving technique to increase the production of fruits and vegetables. *Current Agriculture Research Journal*. **5**(3): 371-380.
3. Rashid, I.; Muhammad, A. S. R.; Mohammad, V.; Muhammad, F. S.; Muhammad, S. Z.; Ahmad, S.; Monika, T., Haider, I.; Muhammad, U. A. and Muhammad, A. N. (2020). Potential agricultural and environmental benefits of mulch – A review. *Bulletin of the Nation Research Centre*.
4. Ray, M. and Biswasi, S. (2016). Impact of mulching on crop production: A review. *Trends in Biosciences*. **9**(14): 757-767.
5. Rupali, S. and Bhardwaj, S. (2017). Effect of mulching on soil and water conservation – A review. *Agricultural reviews*. **38**(7): 311-315.