

Role of Mulch in Agriculture

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SUMMARY

Mulches are used for various reasons in agriculture but water conservation and erosion control are the most important objectives particularly in arid and semi-arid regions. Mulching is the process or practice of covering the soil/ground to make more favorable conditions for plant growth, development and efficient crop production. Mulch technical term means 'covering of soil'.

INTRODUCTION

India has made immense development in agriculture and food security. It began with the decision to adopt superior yielding, disease resistant varieties in combination with better farming knowledge to improve productivity. Development of irrigation schemes, copious use of fertilizers and pesticides, use of high yielding varieties made the green revolution possible. The word mulch has been probably derived from the German word "molsch" means soft to decay, which apparently referred to the use of straw and leaves by gardeners as a spread over the ground as mulch (Jacks et al., 1955). Mulches are used for various reasons in agriculture but water conservation and erosion control are the most important objectives particularly in arid and semi-arid regions. Mulching is the process or practice of covering the soil/ground to make more favorable conditions for plant growth, development and efficient crop production. Mulch technical term means 'covering of soil'. While natural mulches such as leaf, straw, dead leaves and compost have been used for centuries, during the last 60 years the advent of synthetic materials has altered the methods and benefits of mulching.

Types of Mulches

1.Organic Mulches 2.Inorganic Mulches

Organic Mulch

Organic Mulches Organic mulch material includes grass, straw, dry leaves, bark, saw dust and compost. These has capacity to easy degradable due to attract of insects, slugs and cutworms that eat them and it will help to degraded rapidly and it add some amount of organic matter and nutrient in soil. The example of organic mulches and their uses are given below:

1.Grass Clipping:

This is one of the most abundantly and easily available mulch materials across the country. If incorporated fresh in soil, it added some amount of nitrogen to the soil. It also provides some organic matter in the soil. However, if we added green grass material it has capacity to develop its root system it will harm to crops growth and development. Therefore, use of dry grass as mulch material is suggested.

2.Newspaper:

Newspaper mulching helps to control weeds and also add little organic matter in soil. One to two cm thick sheet of newspaper should be used and edges should be fastened with materials like pebbles gravels etc. The application of newspaper mulch should be avoided on a windy day and avoid the color ink newspaper because it will hazardous.

3.Straw:

Paddy and wheat straw and other crop residues like stubbles, groundnut shells, cotton shells etc.; are the commonest mulching materials used as mulches on soil surface for moisture conservation. Though straw is poor in nutrient value but after decomposition, it makes soil more fertile. Straw mulches reduce both the amount of energy absorbed by the soil and its movement above the soil and hence reduce evaporation.

4.Compost:

The compost is one of the best mulch materials. It increases microbial population, improves the soil health and adds some amount of nutrients. Compost tends to be slightly acidic, so it's an especially great addition to a soil with alkaline nature. However, compost has one drawback. It is very fine and full of nutrients, so it doesn't have much weed suppressing capability.

5. Bark Clippings:

These are good mulch materials as they are long lasting and allow proper aeration to the soil underneath. Wood bark has capacity to hold more water and bark mulch material is used in both the region very dry and very wet because if rain is too much the bark will be absorbed excess water and reduce waterlogged condition. When it rains too little, the wood chips will release the water they've been holding, providing your plants with water even in dry times. Hardwood bark clippings contain more nutrients than soft wood but bark clippings are not easily and abundantly available, and some bark products may cause phytotoxicity.

6. Saw Dust:

Saw dust, obtained during finishing operation of wood and furniture is very poor in nutritive value as it contains only half the nutrients of straw. It decomposes slowly. Being acidic in nature, it should not be used in acidic soils.

7. Dry Leaves:

Leaves, an easily and abundantly available material, are good for mulching. Though leaves are good for protecting dormant plants during winter by keeping them warm and it help to initiate germination during cold season but dry but due to light weight they may be blown away even by light wind. To reduce these problems to used stone, bark or any other material that help to reduce wind problem.

Benefits of Organic Mulching

- Organic mulch plays very important role to reflect solar radiation. This keeps soil cooler and help to prevent evaporation.
- If organic mulch covered with soil suppressed the weed germination because they do not get light that need to germination and growth.
- It also reduces the soil erosion, as the wind or running water does not directly come in its contact and does not blow or wash it away.
- Mulches spread over soil, slow down rainwater run-off and increase the amount of water that soaks into the soil. And more water in the soil means more water for the crops.

Limitation of Organic Mulching

- Mulches can keep the soil too moist, restricting oxygen in the root zone on poorly drained soils.
- If mulch is applied close to or in contact with the stem, trapped moisture creates an environment conducive to development of diseases and pests.
- Certain types of mulches such as hay and straw contain seeds that may become weeds.

Inorganic Mulch Material

Gravel, Pebbles and Crushed Stones:

These materials are used successful for dryland fruit crops. 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. But they reflect solar radiation and can create a very hot soil environment during summer.

Plastic Mulch:

Plastic mulches are very effective as mulches for evaporation controls provided cost is not limiting factors. Both, black and transparent films are generally used for mulching. Advancement in plastic chemistry has

resulted in development of films with optical properties that are ideal for a specific crop in a given location (Steinmetz et al., 2016).

Advantages of Inorganic Mulching

Moisture conservation, Soil Conservation, Soil Temperature, Soil Solarization (With Transparent Plastic Mulch Controls disease pest) and Weed Control.

Apart from the above classification there is another way of classifying Methods in Mulching:

Vertical Mulching:

It involves opening of trenches of 30 cm depth and 15 cm width across the slope at vertical interval of 2-4m interval and fill with the some organic material such as straw, stubbles, grass or organic matter at a layer of 10cm above the ground layer it will help to reduce runoff losses and increase infiltration rate of water.

Surface Mulching:

Mulches are spread on surface to reduce evaporation and increase soil moisture.

Live Vegetative Barriers:

Subabul and Glyricidia 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 nitrogen to the extent of 25 to 30 kg per ha, besides improving soil moisture status.

Polythene Mulching:

Sheets of plastic are spread on the soil surface between the crop rows or around tree trunks. It helps to reduce evaporation and weed growth and increase the germination percentage of crop.

Effect of Mulching on Soil Environment

1. Soil temperature:

The effects of mulches on soil temperature are highly variable and depend up on the type of mulch material. White or reflective type of plastic mulches generally decreases soil temperature, while black plastic mulches may increase soil temperature. Crop residues moderate temperature by decreasing it in summer and by increasing in winter season. This is due to combined effect of radiation interception and evaporative cooling. The sugarcane trash mulch will enhance the germination of sugarcane setts during summer by temperature reduction.

2. Improved soil moisture:

Using mulches, the soil has greater water retention, reduced evaporation and reduced weeds. One study documented a 35% reduction in evaporation when straw mulch was applied. There is a wide variety of permeable mulching materials. Organic mulches conserve water more effectively and do not limit soil water infiltration and retention. Appropriate mulch can reduce the need for irrigation and in some landscapes can eliminate irrigation all together. Coarse organic mulches protect soil water reserves holding water for later release and prevent runoff. Mulch can also protect trees and shrubs from drought stress and cold injury.

3. Reduced soil erosion and compaction:

Mulches protect soils from wind water, traffic induced erosion and compaction that directly contribute to root stress and poor plant health. Even adding thin organic mulch will protect soils. For instance, using straw mulch, fallen pine needles or wood chips can reduce erosion and overland flow. Using bark or jute on compacted urban soils restores soil aggregation and porosity. It is better to apply mulch before compaction occurs as it is difficult to reverse. Proactive mulching will protect soil integrity.

4. Maintenance of optimal soil temperatures:

Mulches have shown to lower soil temperatures in summer months. Extreme temperatures can kill fine plant roots which can cause stress and root rot. Mulches protect soils from extreme temperatures, either cold or hot. Coarse mulches are more temperature moderating and allow for better water and gas transfer than thick layers of finely textured mulches. There is an effect of mulch type on surface temperature. Some mulches heat the soil as a function of solar radiation absorption more than bare soils. Increased surface temperature due to pine bark mulch has been shown to cause nearby leaves to lose more water.

5. Increased soil nutrition:

Organic mulches can increase, decrease or have no effect upon nutrient levels depending on mulch type, soil chemistry and particular nutrients of interest. Mulches with relatively high nitrogen content often result in higher yields, but low nitrogen mulches, such as straw, sawdust and bark, can also increase soil fertility and plant nutrition.

6. Reduction of salt and pesticide contamination:

In arid landscapes, evaporating water leaves behind salt crusts. Because mulches reduce evaporation, water is left in the soil and salts are diluted. Organic mulches can actively accelerate soil desalinization and help degrade pesticides and other contaminants. Plastic mulches cannot bind ions as organic mulches can and are not effective in this regard.

7. Improved plant establishment and growth:

Mulches are used to enhance the establishment of many woody and herbaceous species. Mulches improve seed germination and seed survival, enhance root establishment, transplant survival and increase plant performance. The improved water retention created by mulch allows roots to extend and establish farther beyond the trunk compared to bare soil. Plants thus become more stabilized. Root development is greatest under organic mulches compared to plastic or bare soil. Sheet and film mulches encourage root growth on top of the mulch, injuring plants when removed. Plastic mulches can lead to increased mortality of transplanted material and cause extensive damage to fine root systems. Roots tend to grow into organic mulch layers, and it does not appear to injure the plant to have roots exploring a mulch layer.

CONCLUSION

From above information, it is concluded that mulching can significantly increase crop yields, WUE and NUE, and thereby may contribute to closing the yield gap between attainable and actual yields, especially in dryland and low nutrient input agriculture.

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