Different Types of Mulching and It’s Effect on Crop Growth and Soil Health

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ABSTRACT

In India, agriculture is the most important sector. Approximately 18% gross domestic product (GDP) is getting from agriculture. Not only that, also 50% employment is providing by agriculture. But the main problem is erosion and water scarcity in India. Due to erosion every year India loss about 5334 million tones of soil. The best solution for erosion and water scarcity is mulching. Which can be both organic and inorganic mulching. In this review paper I have discussed about effects and types of organic and inorganic mulching. Mulching acts as a barrier for different factor like insect-pest, erosion, weed etc. Organic mulching reduces the growth of weed. It is also maintain soil temperature by preventing direct entry of sunlight to the soil. It can enhance the activity of micro-organism, which are most important of plant growth. Inorganic mulching also has lots of advantages. It reduces the evaporation of soil water. Inorganic mulching doesn’t allow growing weed in crop field. In other side mulching have some disadvantages. For example in organic mulching, if crop residues will not decompose properly then which can grow on field during crop cultivation? So, here in this review all aspects of mulching have discussed.

Keywords: Mulching, Erosion, Structure, Conservation, Weeds, Insect-pest, Crop yield, Crop growth, Temperature

INTRODUCTION

After the independence, India has made tremendous development in agriculture and food. Before 1965 India was importing food to meet domestic requirements. After the severe drought in 1965 and 1966, India made some changes in its agricultural policy, and that India could not depend on foreign imports for food security. India adopted significant policy reforms focused on the goal of food grain self-sufficiency. These reforms brought India's Green Revolution (Shirish, Tushar, & Satish, 2013). It started with the decision to adopt high yielding and disease resistant wheat varieties with better farming skill to improve the productivity. Development of irrigation schemes, increases the use of fertilizers and pesticides, use of high yielding varieties, which made the green revolution possible (Sharma* & Bhardwaj, 2017).

As population increases, we have realized that the green revolution saved us once but now its dependence on heavy use of fertilizer and pesticides are polluting our environment and degrading our soils. Excessive irrigation is bringing problems of soil erosion and salinity of soils (Shirish, Tushar, & Satish, 2013). So, we thought to adopt mulching in our agricultural fields. 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). Mulch is a protective layer of material that is spread 3-6 inches deep on top of exposed soil between plants. Mulch can be: straw, grass clippings, corn cobs, river stones, pea gravel, and chipped bricks, bark chips, leaves, peat moss, seaweed, wood ashes, sawdust and so on. Similarly, the practice in which mulch materials are used to cover the ground, much like layers of leaves on the forest floor and a method in which any material used or spread at surface or vertically in soil to assist soil and water conservation and soil productivity is called mulching. (Sharma & Binod*, 2018). Mulching is one such process that can help us in producing quality food in quantities. Mulching reduces the deterioration of soil by preventing the runoff and soil loss, minimizes the weed infestation and checks the water evaporation. Thus, it facilitates for more retention of soil moisture and helps in control of temperature fluctuations, improves physical, chemical and biological properties of soil, as it adds nutrients to the soil and ultimately enhances the growth and yield of crops. (Shirish, Tushar, & Satish, 2013). Mulching also controls the insect pest and reduces the rate of evaporation.

Types of mulching
Organic mulching

Use of organic mulching is one of the suitable methods which could help the horticultural crops to increase the production with good quality of produce. Due to the lack of water that arise due to climate change, adoption of organic mulching at large scale by the Indian farmers would help the farmers to overcome several problems considering the advantages of organic mulching (Ranjan, G.T.Patle, Prem, & K.R.Solanke, 371-380). Organic mulches are natural origin like agricultural wastes such as straw, dry leaves, bark etc. These are decomposing easily and increase the water holding capacity of soil. It also provide nutrient to the soil.

Straw mulch

Generally we are using rice and wheat straw as mulch because it has long life in comparison to other. These mulches doesn’t provide more nutrient but after decompose it make soil more fertile. It can apply easily in the field. These are usually use for fruits and vegetable. Straw have great insulation, water retention capacity. It doesn’t allow growing the weed.

Dry leaves

Dry leaves are widely used mulches because leaves are easily available material. Generally dry leaves mulches are using on forest area where the leaves are abundantly available. But in spring season dry leaves are not easily available so, generally this practice is done in winter season. Due to very light weight small branches and wood barks are kept over the dry leaves mulch. The thickness of the dry leaves mulching is about 3-4 inches (Ranjan, G.T.Patle, Prem, & K.R.Solanke, 371-380). Leaves provide nutrient to the soil.

Bark mulch

Barks are good long lasting material. They retain more moisture for long period and used in both dry as well as wet region. It prevents waterlogged condition by absorbing the excess of water in heavy rain and in low rainfall bark will release the absorbing water. These are two types:

Hard wood bark

It is the by-product of paper industries. These are containing more nutrient than soft wood bark. The pH is slightly alkaline and available in various sizes. (Ranjan, G.T.Patle, Prem, & K.R.Solanke, 371-380)

Soft wood bark

It takes more time to decompose and also avail easily than hard wood bark. The pH is slightly acidic. These barks are available in various sizes. (PREM, RANJAN, SETH, & PATLE, 2020).
Grass clipping
Grass clipping is one of the most effectively and richly accessible mulching material in Indian farming. If fresh grass clippings are utilized in the field, it decays effectively and expands the level of nitrogen in the dirt. The various kinds of grass clipping are generally accessible, for example, green or new and dry grass. Ordinarily, green grass clippings are not utilized in the rainy season since it may develop root system which will be harmful to crop growth. Apply of green clippings can warm up a lot and perhaps cause harm to plants. So always we try to use dry grass as mulch. (Ranjan, G.T.Patle, Prem, & K.R.Solanke, 371-380)

Compost/Manure
The compost is good choice as a mulching material. It made by various kinds of waste materials like leaves, straw, grass, plant residue and so on. The accessibility and use of compost in Indian farming is mature age practice. It improves the dirt properties like physical, chemical and biological properties and increases the carbon content which improves the water holding capacity of the dirt. Manure is the acceptable material for improving the soil health. It ought-not be utilized in the vegetable field since they have an excess of nitrogen and it might contain weed seeds. The fantastic utilization of compost is at the time of bed preparation or as ‘top dressing. (PREM, RANJAN, SETH, & PATLE, 2020)
Newspaper
Paper mulching assists with controlling weeds and is promptly accessible. The paper layer biodegrades into the dirt in a short period. The paper can decompose fast than plastic mulching. Paper mulch can save time in fields where weeds are now developed in the past season and dropped seeds will be grow in the coming season. Paper mulching strictly prohibited in high wind areas. We should use 2-3 layers of paper so that and its edges ought to be stuck with other material so that it will not blow away.

![Newspaper mulch](https://www.agardenforthehouse.com/2013/05/how-to-smother-weeds-with-newspaper/)

**Fig.5: Newspaper mulch** (source: https://www.agardenforthehouse.com/2013/05/how-to-smother-weeds-with-newspaper/)

**Advantages of organic mulching**
Mulching prevent the direct entry of sunlight into the soil. So, it maintains the soil temperature. Mulching will not allow growing weed. During heavy rain fall the excess water will absorb by organic mulch and provide water during dry condition. Organic mulching decomposes slowly and provides organic substances to the soil. Ultimately the micro-organism and earthworm activity will increase which helps to increase the soil porosity. Decompose matter act as nutrition for plant. It also increases the water holding capacity of soil (Shirish, Tushar, & Satish, 2013).

**Disadvantages of organic mulching**
Organic mulching can make the soil wet and in poorly drainage area oxygen stresses can be seen. Wet condition can be a suitable environment for diseases and pest development. It may the region of breeding of many pests. Some organic mulch like paddy straw may contain seeds which can develop weed (Ranjan, G.T.Patle, Prem, & K.R.Solanke, 371-380).

**Inorganic mulching**
Inorganic mulching includes plastic, rocks, pebble etc. These mulches are providing lots of benefit to soil as well as crop. It reduces the growth of weed by preventing from direct sunlight and also conserves the soil moisture in soil.

**Gravel, Pebble**
Stones, pebbles are good mulching material for preventing the growth of weed. In this method we have to crushed the stone and spread over the bed in a thin layer. But one demerit is during sunny days the stone reflect solar radiation which can make soil hot.

![Gravel mulch](https://www.superpages.com/em/10-reasons-use-gravel-mulch/)

**Fig.6: Gravel mulch** (source: https://www.superpages.com/em/10-reasons-use-gravel-mulch/)
Plastic mulch
Plastic mulches are helpful in controlling evaporation rate. Water and supplement can't go through plastic film since it is impenetrable in nature. Plastic mulch is most appropriate for vegetable nurseries to raise the temperature of soil in spring season. It isn't good to use for more than one season. So generally it is utilized just for one season since it decays on daylight. Both plastic and transparent is used as mulch.

Fig.7: Plastic mulch (source: https://www.123rf.com/photo_105469674_agriculture-mulching-sheets-plastic-mulch-in-the-field.html)

Types of plastic mulch

Colored mulches
There are different colors of plastic mulch are available, such as black, white, transparent, silver, blue, red etc. According to specific target selection has to be done (Mehan & Singh, 2015).

i. White: It always keep cold to the soil than other color.
ii. Red: It enhances the vegetative growth.
iii. Black: Black helps in moisture conservation. It reduces the weed population.

Transparent
It rises the soil temperature and also use for soil solarization.

Fig.8: Transparent film (source: https://hxycorrine.en.ec21.com/Transparent_Mulch_Film--6403752_6404681.html)

Reflective film
It is use to maintain the root zone temperature.

Advantages of inorganic mulching
Inorganic mulching is less costly than organic mulching. Life spans also more of inorganic mulching. It decreases the moisture evaporation. Also prevent the weed growth. It enhances the water holding capacity of soil. Inorganic mulching doesn’t allow growing pest and disease. It improves the soil health and reduces the soil runoff (PREM, RANJAN, SETH, & PATLE, 2020).

Disadvantages of inorganic mulching
Inorganic mulches don’t decompose on soil. So, they don’t provide any organic matter or nutrient to the soil. In large area the plastic mulches can heat the soil. Sometime the plastic mulches can damage by sun. Some mulches like rubber may release toxic substances which harm the plant.
RESULT

Effect of mulching on crops

Crop growth
The impacts of mulches on plants are usable through the impacts of mulches on soil water, soil temperature, structure (Sharma & Binod*, 2018). As per Mahadeen (2014) on utilizing polyethylene plastic mulch delivered prior seedling emergence, more growth plant and better return than non-mulched treatment. Lang et al. (2001) reported that by using black polythene mulch, the root system can grow more actively. They announced that mulch enhance the root growth and help to the plant to produce 1.5times more nutrition taking root. Devi Dayal et al. (1991) noticed prior seedling on groundnut due to mulch. Loy and Wells (1990) observed that due to using of black plastic mulch crop harvested 7-14 prior and in case of clear plastic mulch, it propel the harvest date by 21 days.

Improve yield and Quality
By using mulching, fruit can be safe and clean from contacting the ground, fruit cracking and soil rot. It also reduces the grading time. Due to using of mulching the yield of tomato, eggplant, cucumber found to be increased. Straw mulching can improved the keeping quality of vegetables (Ray* & Biswasi, 2016). Using of straw mulch at the rate of 6t/ha yield of tomato will increase (Gupta and Gupta, 1987). The yield of fruit is more on mulch soil than the bare soil. According to Gollifer (1993) by using organic mulching at the rate of 40t/ha produced 2.5t/ha of chili.

Weed management
Mulching helps to reduce the weed population (Raju Lal Bhardwaj, 2013). The mulching activity favors in the decrease of weed seed germination, weeds development and keeps the weed leveled out (Vander Zaag et al., 1986). Mulching can suppress the weed seed emergence. Materials like straw, bark and decompose green waste can give powerful weed control (Merwin et al., 1995). Saw dust is a soil improver and weed suppressor as it conserve soil water, reduces erosion, increases permeability, furthermore, weed development can be considerable under clear mulch (Waterer, 2000).

Pest and diseases management
Polyethylene mulches have been utilized which helps to reduce pest and diseases (Lamont, 1993). Mulch can reduces the growth of whitefly, aphids and viruses in comparison to bare soil (Nameth et al., 1986).

Effect of mulching on Soil

Soil water conservation
The dark polythene prevents soil water evaporation and increase the soil water quantity. Improvement of the water use efficiency by better use of soil water gives off an impression of being the most ideal approach to build grain yield in the semiarid regions (Zhao et al., 1995). The plastic polythene mulch was advanced root development and that more roots were distributed in mid-and deep soil, so that the plant would be able to uptake water from the deep soil and increase the grain yield (Kwabiah, 2004).

Soil Structure
Organic mulching increases the infiltration rate of soil. It can also improve soil aggregation capacity. Mulch can reduce the soil erosion. By using plastic mulches, increase soil porosity and decrease bulk density (Mbah et al. 2010).

Soil Temperature
Mulching manage the temperature in root zone of plant (Koski & Jacobi, 2004). In inorganic mulches, at 10 cm depth soil temperature is 2.5°C higher than the soil which has depth of 10 cm beneath organic mulches (PREM, RANJAN, SETH, & PATLE, 2020). Organic mulches limit the dissemination of heat energy in to the soil which brings about decreasing soil temperature (Singer & Martin, 2008).

Soil Erosion
Mulching is most important for controlling soil erosion. The factor can be either water or wind. Both can be control by mulching. In dry land the soil aggregation is very low. So, during rainfall soil will erode by rain water and also by wind soil particle will blow away from one place to another place. But by using mulching which act as a barrier, will reduce the erosion and keep the soil fertile. Organic mulching can reduce the velocity of water. Borst and Woodburn (1942) got that by using 1.5 cm layer of straw mulch, it can slow down erosion by 86%.
Soil Nutrient
Mulching can prevent the nutrient loss also can add nutrient to the soil. By using organic mulching, it decompose and provide additional organic matter to the plant while inorganic mulching like dark polythene, will reduced leaching of organic matter. So, that plant can easily uptake that organic matter.

CONCLUSION

In present situation erosion is the most important problem in Indian farming. And for reducing erosion mulching is one of the best ways. Not only erosion it is also effect’s on improvement of soil structure, increase soil fertility, increase soil moisture quantity, maintain soil temperature etc. Also it effect’s on plant like increase the yield and quality of crops, reduce the insect pest growth. Mulching is not more expensive also. So, mulching is necessary for better quality and quantity cultivation.

REFERENCES