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Review Paper

Mulching: A Soil and Water Conservation Practice

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Abstract

India being an agriculture country should have a good respect towards conservation strategies especially of water. Already we are suffering from a great stress of water scarcity. Each and every drop of water is important for us but unfortunately because of carelessness, we often waste huge amount of water. One of such practices is over and excessive irrigation. Mulching is a soil and water conserving and weed management practice through soil solarisation also in which any suitable material is used to spread over the ground between rows of crops or around the tree trunks. This practice helps to retain soil moisture, prevents weed growth and enhances soil structure. There are various types of mulching such as surface mulching, vertical mulching, polythene mulching, pebble mulching, dust mulching live vegetative barriers, straw mulching etc. Mulching proves to be beneficiary though increment in soil moisture, reduction in soil erosion, maintenance of soil temperature etc. It helps in improvise in soil structure, soil fertility and soil biological regime. Though also mulching is having many advantages it shows some limitations as it may harbour some pests and diseases. It is not so appreciable in wet conditions. It is little bit difficult to get even mulching on steep lands. Some grass species used as mulch can root and become a weed problem. The present review deals with the discussion of every aspect of mulching and how it has beneficiary effect.

Keywords: Mulching, conservation, weeds, improvement of soil structure

Introduction

Over 50 years since its independence, India has made immense progress in Agriculture and food security. Prior to the mid-1960s India relied on imports and food aid to meet domestic requirements. However, two years of severe drought in 1965 and 1966 convinced India to reform its agricultural policy, and that India could not rely on foreign aid and foreign imports for food security. India adopted significant policy reforms focused on the goal of foodgrain self-sufficiency. This ushered in India's Green Revolution. It began with the decision to adopt superior yielding, disease resistant wheat 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.

But the population of India continues to rise, and we have realized that this one green revolution will not help. We have to adopt to other means of sustaining our agricultural growth and how can we do that?

We can do it through conservation farming. Organic farming is the answer. 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. Though a lot of irrigation schemes have been developed we still have only 1/3rd of our agriculture under irrigation.

So what is the way out? What do we do to restore the health of our soils? What do we do to add nutrients to our soils? What do we do to maintain a good micro-flora and a fine balance of micro-organisms in the soil? What do we do to conserve the moisture in the soil? What do we do to control the weeds in our fields?

The answer is simple, to adopt the age old practice of Mulching in our agricultural fields. So what is a Mulch? It is a protective covering, usually of organic matter such as leaves, straw, or peat, placed around plants to prevent the evaporation of moisture, and the growth of weeds.

The word mulch has probably derived from the German word “molsch” means soft todecay, which apparently referred to the gardener’s use of straw and leaves as a spread overthe ground as mulch[1].

Mulching reduces the deterioration of soil by way of preventing the runoff and soilloss, minimizes the weed infestation and checks the water evaporation. Thus, it facilitates formore retention of soil moisture and helps in control of temperature fluctuations, improvesphysical, chemical and biological properties of soil, as it adds nutrients to the soil andultimately enhances the growth and yield of crops. Further, reported that mulching boosts theyield by 50-60 per cent over no mulching under rainfed situations [2].

Organic Mulch

An organic mulch is made up of natural substance such as bark, wood chips, pine needles, dry grasses, paddy straw, dry leaves, saw dust, grass clipping, etc. But organic mulch attracts insects, slugs and the cutworms that eat them. They get decomposed easily and need frequent replacements.

Grass Clipping: This is one of the most abundantly and easily available mulch materials across the country. It provides nitrogen to the soil, if incorporated fresh. However, application of green grass in rainy season may result into the development of its own root system which will be detrimental to plant growth. Therefore, use of dry grass as mulch material is suggested.

Straw: Paddy and wheat straw are the commonest mulching materials used for fruit and vegetable production. Though straw is poor in nutrient value but after decomposition, it makes soil more fertile. Among organic mulching materials, straw has a long life in comparison to other mulches (grasses, leaves and leaf mould).

Newspaper: Newspaper mulching helps to control weeds. 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.

Dry leaves: Leaves, an easily available material, are good for mulching. Though leaves are good for protecting dormant plants during winter by keeping them warm and dry but due to lightweight they may be blown away even by light wind. To counter this problem, it requires anchoring which can be done with stones, chipped bark and covering with net or some form of sheet.

Bark clippings: These are good mulch materials as they are long lasting and allow proper aeration to the soil underneath. Hardwood bark clippings contain more nutrients than softwood but bark clippings are not easily and abundantly available, and some bark products may cause phytotoxicity.

Saw dust: Saw dust, obtained during finishing operation of wood, 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.

Compost: The compost is one of the best mulch materials. It increases microbial population, improves the soil structure and provides nutrients. It is the excellent material for improving the health of soil.

Benefits of Organic Mulching: Mulch reflects a lot of the sun that otherwise heats the soil. This keeps the soil cooler and helps prevent evaporation. This is especially important in hot, dry climates. When the soil is covered in mulch, weeds do not grow under it as they do not get the light they need to grow. Mulches prevent 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. Organic mulches also improve the condition of the soil. As these mulches slowly decompose, they provide organic matter which helps keep the soil loose. This organic matter becomes food for the beneficial earthworms and other soil micro-organisms in the soil and create a very good porous soil. This improves root growth, increases the infiltration of water, and also improves the water-holding capacity of the soil. Decaying organic matter also becomes a source of plant nutrients. Maintains a more even soil temperature. Keeps feet clean, allowing access to field even when damp

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 contactwith the stem, trapped moisture creates anenvironment conducive to development ofdiseases and pests. Many organic type ofmulches also encourage and providerefuge or breeding locations for snails,slugs, mice, etc. that may attack the plants. Certain types of mulches such as hay andstraw contain seeds that may becomeweeds

Inorganic Mulch Material

Gravel, Pebbles and Crushed stones: These materials are used for perennial crops. Small rock Layer of 3-4 cm provides good weed control. But they reflect solar radiation and can create a very hot soil environment during summer.

Plastic mulch

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. Horticulturists need to understand the optimum above and below ground environment of a particular crop before the use of plastic mulch. These are two types.

Photo-degradable plastic mulch: This type of plastic mulch film gets destroyed by sun light in a shorter period.
Bio-degradable plastic mulch: This typeof plastic mulch film is easily degraded inthe soil over a period of time.
Colour of film: Soil environment can be managedprecisely by a proper selection of plastic mulchcomposition, colour and thickness. Films areavailable in variety of colours including black,transparent, white, silver, blue red, etc. But theselection of the colour of plastic mulch filmdepends on specific targets. Generally, thefollowing types of plastic mulch films are usedin horticultural crops.

Black plastic film: It helps in conserving moisture, controlling weed and reducing outgoing radiation.
Reflective silver film: It generally maintains the root-zone temperature cooler.
Transparent film: It increases the soil temperature and preferably used for solarization.

Advantages of Inorganic Mulching: Moisture conservation, Soil Conservation, Soil Temperature, Soil Solarization (With Transparent Plastic Mulch Controls disease pest), Weed Control

Apart from the above classification there is another way of classifying Methods in Mulching[3]

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

Vertical Mulching: It involves opening of trenches of 30 cm. depth and 15 cm. width across the slope at vertical interval of 30 cm.

Polythene Mulching: Sheets of plastic are spread on the soil surface between the crop rows or around tree trunks.

Pebble Mulching: Soil is covered with pebbles to prevent transfer of heat from atmosphere.

Dust Mulching: Interculture operation that creates dust that breaks continuous capillaries, and deep and wide cracks thus reducing evaporation from the exposed soil areas.
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.

The benefits of Organic Mulching have been documented in various studies: Straw mulch conserved higher soil moisture to an extent of 55 per cent morecompared to control [4]. Average available soil moisture stored up to1.5 m depth of soil increased significantly by mulching of wheat residue @ 6730 kg/hacompared to bare soil[5].

Okra production was significantly higher under straw mulch followed by dust mulchover control[6]. Similar beneficial effectsof mulching through improvement of soil environment resulting in better plant growth andtuber yield of potato were observed[7]. Application of straw mulch @ 6 t/ ha increased yield of tomato and okra by 100 and 200 per cent, respectively over control[8].

The yield of potato was the highest under paddy straw mulch (27.9%) and also starch content was highest in paddy straw mulch (18.18%) than unmulched plot [9].

Organic mulches induced earliness in flowering, less days tofruit set and days to harvest, also increased number of flowers and per cent fruit set in tomatocrop over control[10].

Table – 1
Increase in Yield of Fruit Crops through Plastic Mulching

Crop	Yield (T/Ha.)		Increase in Yield (%)
	Unmulched	Mulched	
Guava	18.36	23.12	25.93
Mango	4.93	7.16	45.23
Papaya	73.24	120.29	64.24
Ber	7.02	8.92	27.06
Pineapple	10.25	11.75	14.63
Banana	53.99	73.32	33.95
Litchi	111.0	125.0	12.61

Source: NCPAH, New Delhi (National Committee on Plasticulture Applications in Horticulture)

Table- 2
Increase in Yield of Vegetable Crops through Plastic Mulching

Crop	Yield (T/Ha.)		Increase in Yield (%)
	Unmulched	Mulched	
Broccoli	15.64	25.14	60.74
Cauliflower	18.58	25.02	34.66
Brinjal	36.73	47.06	28.12
Tomato	69.10	94.85	37.26
Okra	6.91	8.56	23.88
Bitter Gourd	20.12	25.63	27.39
Chilli	16.79	19.71	17.39
Cabbage	14.3	19.9	39.16

Source: NCPAH, New Delhi (National Committee on Plasticulture Applications in Horticulture)

Conclusion

In the present scenario of globalization and health consciousness demand for horticultural crops has increased world over. Excessive competition has not only compelled us to produce more but also to produce quality fruits for sustaining in the international market. Apart from using high yielding varieties and good agricultural practices, there is a need to utilize environmental/biological energy for higher production. Mulching is one such process that can help us in producing quality food in quantities. In the days to come, farmers will make use of this innovative technique that helps them conserve moisture, avoid weeds and improve soil health tremendously while producing more. This will also go a long way in the world achieving food security sustainably.

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