



Application of Mulching in Agriculture: A Review

Bikash Bhattarai* and Kabita Gurung

Dept. of Horticulture, Sikkim University, Tadong, Gangtok, Sikkim (737 102), India

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Corresponding Author

Bikash Bhattarai

✉: bikashflori@gmail.com

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Abstract

The agricultural land is currently diminishing and experiencing a number of problems. The use of massive amounts of inorganic fertilizers and chemicals has completely degraded the quality of soil and ground water, which is just one of the numerous causes. A rise in global temperature brought on by climate change over time has an impact on energy and water use, particularly in dryland areas. Mulching has the potential to achieve the desired outcomes by preserving moisture, reducing soil evaporation, maintaining optimal soil temperature, suppressing weed growth, and promoting enhanced microbial activity. Thus, in this article an attempt was made to collect information about the application of mulching in agriculture.

Keywords: Mulching, Organic, Soil health, Soil moisture

Introduction

The agriculture sector in India plays a significant role in driving the country's economy, supporting the livelihoods of half of the population. Farming sustains many Indian households, enabling them to meet their daily needs. However, the agricultural land is currently facing depletion and numerous challenges. One major cause is the excessive use of inorganic fertilizers and chemicals, which have severely degraded the quality of soil and groundwater. In an attempt to boost crop yields, farmers have been applying excessive amounts of these substances, resulting in detrimental effects on soil health. Agriculture is one of the world's largest consumers of water, accounting for 70% of total water usage (Qin *et al.*, 2015). Considering the water scarcity issues arising from global climate change, rain-fed cultivation plays a vital role in ensuring proper crop growth and yield across the country (Sun *et al.*, 2012). Moreover, India primarily relies on groundwater-based irrigation systems, which further exacerbates the negative impact of inorganic fertilizers on both soil health and groundwater reserves. Reports indicate that groundwater levels have dropped by 0.5 to 1 m below the ground surface in many parts of the country in recent years. Additionally, the rising human and industrial population has led to reduced irrigation availability. Consequently, there is a pressing need to conserve water resources. Water management has become a major concern in agricultural

lands, and with the increasing water shortage, water-saving technologies are being implemented, particularly in dryland farming. Efficient water use has been practiced worldwide for several years with varying degrees of success, aiming to maximize yield while minimizing water usage. Proper irrigation management during crop growth stages is crucial for achieving optimal yields. Various technologies and practices have been adopted for water conservation, among which mulching for soil moisture conservation proves to be an effective approach. The term "mulch" is derived from the German word "molsch," meaning "soft to decay," referring to the practice of spreading straw and leaves over the garden (Jacks *et al.*, 1995). Mulches serve different purposes on the farm, but their main objective is to conserve soil moisture and prevent erosion. Mulching involves covering the soil to create favorable conditions for crop growth and maximize production. Mulching materials can be categorized as natural or synthetic. Natural mulches include dried leaves, straw, compost, bark chippings, and paper, while synthetic mulches are made of plastic. The use of natural/organic mulches helps prevent soil erosion, improves soil temperature, provides slow-release nutrients to plants through decomposition, and inhibits pathogens. Additionally, mulches offer economic benefits, ease of handling, and reduced weed growth for farmers. They are particularly advantageous during dry spells, especially in arid and semi-arid regions. Mulching

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materials act as insulators, maintaining soil temperature, enhancing microbial interactions, and minimizing soil evaporation.

Prospectus of Mulching

Maintenances and Regulation of Soil Moisture

There are numerous factors, particularly abiotic ones, which contribute to the loss of soil moisture and render the soil unproductive. These factors include temperature fluctuations, high wind velocities, and the presence of a significant weed population. Therefore, the weed population in the farming land could be a major threat to the moisture loss from the soil. So, it is advised to use the mulches to reduce the potential weed threat and the unnecessary evaporation. By implementing mulching techniques, the percolation and retention capacity of the soil are significantly improved. Organic mulches are generally preferred over inorganic ones due to their superior percolation qualities. There are several reports that have stated that the mulches are more beneficial than cover crops. Mulches offer several advantages over cover crops, primarily because cover crops can compete with the main crops in the field. Thus, it has a more chance that the manure along with the water is taken by the cover crops as it will compete with the main crop.

Prevention of the Soil Erosion and Reduces the Compaction of Soil

Moreover, mulches not only possess knowledge about soil moisture but also play a crucial role in mitigating soil erosion and reducing soil compaction. By implementing mulching techniques, the soil becomes shielded from both the wind and the water erosion, facilitating improved soil aeration and porosity. These factors collectively contribute to the overall growth and development of crops. Numerous studies have documented the positive effects of various mulching materials, such as straw, living crops, wood chips, and plant residues, in significantly reducing soil erosion by approximately 70% (Tanavud *et al.*, 2001). To effectively combat soil erosion, pine leaves or debris from pine trees can serve as highly effective mulch, particularly in hilly regions where runoff losses are a concern. As modern agriculture increasingly relies on heavy machinery, soil compaction has become a prominent issue. Organic mulches, such as bark, offer a solution by aiding in the alleviation of soil compaction.

Synchronization of Soil Temperature

The main goal of using the mulch is to regulate the soil temperature as it covers the soil surface keeping the soil cool even during the hot and humid climate. The soil temperature is considered to be the important factor affecting the plant growth especially the new growing roots, therefore the temperature needs to be regulated so that the uptake of the nutrients and water by the roots is done smoothly. In case of temperature extremes, a little attention needs to be taken for the proper growth; therefore the use of the mulch in such critical condition is a must. In case of soil temperature regulation, the selection of the mulching material is a must. The mulch that will be used has to be finer one as the coarse mulch could bring the negative impact to the soil. The different mulches have different effect on the

soil temperature as well as such the use of the living mulch absorbs more solar radiation. Organic or living mulches are highly favored for their ability to regulate and maintain soil temperatures, thanks to their evaporative cooling effect. Additionally, thicker mulch layers have a more pronounced positive impact on soil temperature compared to thinner ones. In case of inorganic mulch, the gravel stones are chosen as it has the property to moderate the soil temperature. The use of the plastic mulch or any other synthetic material are not used or preferred as they have been reported to help in increasing the temperatures instead of decreasing.

Improves Soil Fertility

There are many advantages of using the mulches on the soil quality among which the enhancing the soil fertility is considered to be a major one. The choice of mulching material is crucial as it contributes nutrients to the soil. Therefore, it is essential to select mulches carefully and efficiently. Organic mulches are particularly advantageous because they possess decomposition properties, making them more beneficial for the soil compared to inorganic mulches. Organic mulches such as bark chipping, wood chips, straw, residues of plants, green manures provide more nutrients to the soil. However, the management of the living mulches is very necessary as it can affect the sensitive crops and has to be used in intensive way so that the other resources are not hampered by these living mulches. It is always advised to use those mulches which are high in nitrogen content so that it has been beneficial in increasing the yield of the crop. Mulches like bark, straw, saw dust can be applied for increasing the nutrients level in foliage than in soil. In addition to nutrient levels, the application of mulch also has a significant impact on the soil's microbial population.

Suppression of Weed Population

Weeds are the real trouble to the farmers and the farm. If the weed population increases at the rapid rate, the yield of the main crop is decreased massively. Therefore, the control of the weed is a must. Controlling of the weed by using a chemical can be easy and time saving but for the longer period of time, it is not recommended. Moreover, Sikkim being an organic state, the use of weedicides is strictly prohibited. Hence, mulching emerges as a favorable method for managing weed populations in both nursery and field conditions. According to Wilen *et al.* (1999), it has been reported that the weed population has been reduced about 92% in the mulched area in comparison to non-mulched areas. Whenever the mulching material is spread out over the soil surfaces, the chances of the weed growth is zero as there is a barrier for the sunlight to pass in, thus preventing the germination of the weed species. In case of plastic mulches, the black plastic ones are usually preferred over other colors as the light penetration is prohibited in black making the weed growth minimum. In general the mulches act as a barrier for the germination of the weed as the photosynthesis rate is reduced. Moreover the inter-cultural operation is also minimized as the population of the weed is controlled to the maximum.

Conclusion

In the present context, water scarcity being an important issue where the irrigation facility is even difficult, mulching practices adoption will be considered to be the best and eco-friendly practices. It can be adopted to overcome the problem. Mulching is now considered to be an important tool to conserve soil water along with many beneficial characteristics. Mulching is particularly beneficial in regions with low rainfall, as it aids in enhancing agricultural production. It increases the soil's moisture holding capacity, reduces evaporation losses, suppresses weed growth, and moderates soil temperature. Besides, the conservation of soil water, the mulching is used in different areas for the beautification of the landscape, farmlands and garden. The application of various types of mulches offers diverse benefits depending on the field's requirements. Organic mulches, for instance, contribute organic matter to the crops and help regulate temperatures at the root level. The plastic mulches are basically used for the weed suppression and soil moisture conservation especially the black ones and so on. There are certainly the some limitations of the mulches being used but the dominant of the advantages of using mulches is always considered to be more. Therefore, in the near future, farmers will definitely opt for the innovative farming technique for the soil water conservation for the better results. However it can be concluded that the mulches can be contemplative as the cheapest source of soil moisture conservation and weed growth suppression. Further it can be concluded that if the mulching strategies

needs to be managed in a scientific and proper way in order to recompense the water requirement especially in the water deficit areas.

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