Environment-friendly mulch mats from paddy straw

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ABSTRACT

Mulch is commonly used for weed control in crop cultivation. The non-degradable mulch mats are environmentally unfriendly, toxic and expensive. Potentially it is urgent to come up with alternative organic materials from the accessible surrounding environment to be made for organic mulch for the farming field with simple technology. Organic mulch requires modification into more effective and efficient forms in usage by modifying it into sheet forms. In the present study an attempt has been made to develop ecofriendly mulch mats. The purpose of the developed mulch mats was to curb the growth of weeds to get better yield and to suggest another means for productive utilization of unutilized paddy straw. These techniques if made available, the benefits may be multifold.

Keywords: Management; mats; mulch; paddy; straw; weed

INTRODUCTION

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 (Patil et al 2013). 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 in producing quality food in quantities. In the days to come farmers need such innovative techniques that help them conserve moisture, avoid weeds and improve soil health tremendously while producing more. Environment-friendly mulch can help in achieving food production with less use of weedicides.

The role of mulching in weed management is multifold. The germination and nourishment of many weeds can be controlled by mulch treatment. The mulches can cover the soil surface or work like a physical barrier and prevent the germination of weeds or physically control seedling appearance. The less weed intensity is recorded in polythene and straw mulch plots compared to the chemical and unmulched (Ramakrishna et al 2006). Daisley et al (1988) and Ossom et al (2001) observed that in the mulch and unmulched treatment, control of weeds recorded large differences in plots of eggplant, cow pea and sweet potato. The combination of drip and sugarcane trash mulch is best treatment that saves about 44 per cent water and produces higher fruit yield (about 51 MT/ ha) (Ranjan et al 2017).

There are many types of mulch materials like natural, synthetic, petroleum, conventional, inorganic and organic. But generally they are classified as organic and inorganic mulches. Organic mulches are found in nature and can be broken down by soil organisms due to decomposition whereas inorganic mulches are made of man-made material or include concrete, granules, stones etc that cannot be broken down by soil organisms. Organic mulches are more beneficial than inorganic mulches. Choice of organic or inorganic mulch mainly depends on the user but using an organic mulch means utilizing a material available in the field which might degrade and break down into organic matter. Organic mulch adds the nutrients in the soil and increases soil fertility. Inorganic mulches like plastic sheets are easy for handling and good choice due to their durability but are non-recyclable and are not environment-friendly.

However the plastic mulches prove to be costlier to use in commercial production as compared to organic mulches. There is a probability of burning or scorching of the young plants due to high temperature of black film. There also occurs difficulty in application of top-dressed fertilizers; the incidence of reptile and rodent movement is experienced at some places and there is more overflow of water. The movement of machine plucking weeds is also very difficult. Plastic sheet mulches cannot be used for more than one season as weeds penetrate through these thin sheets. Another important aspect is that these mulches are toxic to livestock. They reflect solar radiation as a result creating a very hot soil environment during summer. Toxic gases from these sheets may affect the health of the workers in a closed compartment as in polyhouses.

Farmers' operational landholdings, extension contacts and innovativeness were the significant factors contributing to their decision to burn the paddy straw. Socio-economic, personal and psychological variables such as annual income, extension contacts, risk orientation, innovativeness, mass media exposure and ecological consciousness were significantly different among the farmers managing paddy straw and those using alternative techniques other than burning (Roy et al 2018). The studies have shown that wheat and paddy straw is scattered in the fields to control weeds. Scattering of straw in fields leads to reptile movement and difficulty in managing the straw used as mulch. It is estimated that in Punjab over 15 million tonnes of paddy straw is burnt in the open fields to clear the land for sowing wheat or other crops (Vasudeva 2019). In light of this an effort was made to develop organic mulch mats using paddy straw to cater to these problems and to control weeds in the fields.

METHODOLOGY

Paddy straw was selected from Punjab for the present study. Three variants of mulch mats were designed and developed. These variants were tested under control conditions. The development of mulch mats was done in the Department of Apparel and Textile Science, College of Community Science, Punjab Agricultural University, Ludhiana, Punjab.

RESULTS and DISCUSSION

Mulch mats were designed and developed in three variations using paddy straw. These designed and developed variants of mulch mats were of paddy/cotton woven (T_1), paddy/paddy woven (T_2) and paddy non-woven (T_3) (Plate 1).

Woven mats: The woven mulch mats were developed in two variations. The first variation was prepared using paddy straw in both warp and weft and the second variation using cotton as warp and paddy straw in weft.

Non-woven mats: The non-woven sheets were developed in two thicknesses (4 and 8 mm).

The CIE lab values were examined. It was observed that the L-value was maximum with T_1 which was lesser in T_2 and T_3 (Table 1).

As evident from Table 2, T_2 had the maximum thickness followed by T_1. The third treatment was developed in two thicknesses viz 4 and 8 mm. T_3 had maximum moisture absorption followed by T_1 and T_2. The texture of all the mats was found to be rough (T_1 and T_3) to very rough (T_2). T_1 remained intact for a period of more than one year. All the three treatments were reported to be effective to

Table 1. CIE lab values of the mulch mats

Treatment	Lightness (L)	Chromacity dimension (understandable designations of the colour)	
		a	b
T_1: Paddy/cotton (woven)	63.78	6.14	24.72
T_2: Paddy/paddy (woven)	54.23	5.67	25.33
T_3: Paddy (non-woven)	55.45	5.62	25.44

Lightness L: Varied from 100 for perfect whiteness and zero for perfect black, Chromacity dimension a: Measures redness when positive, grey when 0, greenness when negative, Chromacity dimension b: Measures yellowness when positive, grey when zero and blueness when negative

Plate 1. Variants of developed mulch mats and their application in the field

Table 2. Physical properties of developed mulch mats

Characteristic	T_1: Paddy/ cotton (woven)	T_2: Paddy/ paddy (woven)	T_3: Paddy (non-woven)
Thickness (mm)	12	14	4/8
Moisture absorption (water holding capacity) (%)	53.93	48.01	89.03
Texture	Rough	Very rough	Rough
Durability	Very Good (1-1.5 years)	Fair (3-5 months)	Good (6-10 months)

control diverse weed flora for a long time. The degradation of all the developed mulch mats was depending upon the type of crop and irrigation practices used by the farmers.

The benefits of organic mulching have been documented in various studies. Straw mulch conserved higher soil moisture to an extent of 55 per cent more compared to control (Patil et al 2013).

Organic mulches induced earliness in flowering, less days to fruit set and days to harvest and increased number of flowers and fruit set in tomato crop over control. Black plastic mulch triggers plant growth and development (vegetative growth) while straw mulch encourages flower production both qualitatively and quantitatively in freesia plants (Younis et al 2012).

In another study by Bons et al (2018) it was found that the paddy mulch treatment resulted in increase in fruit diameter, fruit weight, rind weight, yield and it had higher productivity due to better availability of nutrients and soil moisture as compared to other mulch treatments.

CONCLUSION

Use of organic mulching is one of the suitable methods which can help the horticultural growers to increase the production with good quality of produce. Looking to the water scarcity and the challenges that arise due to climate change, adoption of organic mulching at large scale by the Indian farmers would help them to overcome several problems considering the advantages of organic mulching.

Findings of several studies have shown that mulching with organic materials increases the soil nutrients, maintains the optimum soil temperature, restricts the rate of evaporation from the soil surface, restricts the weed growth and prevents the soil erosion. It also helps to improve the soil health. Organic mulches are cheap materials therefore the cost of mulching is also economical.

REFERENCES

Bons HK, Rattanpal HS and Brar AS 2018. Influence of different mulches on growth and productivity of kinnow mandarin. Agricultural Research Journal **55(4):** 765-767

Daisley LEA, Chong SK, Olsen FJ, Singh L and George C 1988. Effects of surface-applied grass mulch on soil water content and yields of cowpea and eggplant in Antigua. Tropical Agriculture (Trinidad) **65:** 300-304.

Ossom EM, Pace PF, Rhykerd RL and Rhykerd CL 2001. Effect of mulch on weed infestation, soil temperature, nutrient concentration and tuber yield in *Ipomoea batatas* (L) Lam in Papua New Guinea. Tropical Agriculture (Trinidad) **78:** 144-151.

Patil SS, Kelkar TS and Bhalerao SA 2013. Mulching: a soil and water conservation practice. Research Journal of Agriculture and Forestry Sciences **1(3):** 26-29.

Ramakrishna A, Tam HM, Wani SP and Long TD 2006. Effect of mulch on soil temperature, moisture, weed infestation and yield of groundnut in northern Vietnam. Field Crops Research **95(2):** 115-125.

Ranjan P, Patle GT, Prem M and Solanke KR 2017. Organic mulching: a water saving technique to increase the production of fruits and vegetables. Current Agriculture Research Journal **5(3):** 371-380.

Roy P, Kaur M, Burman RR, Sharma JP and Roy TN 2018. Determinants of paddy straw management decision of farmers in Punjab. Journal of Community Mobilization and Sustainable Development **13(2):** 203-210.

Vasudeva V 2019. Rise in stubble burning cases in Punjab. The Hindu, Chandigarh, 23 Oct 2019.

Younis A, Bhatti MZM, Riaz A, Tariq U, Arfan M, Nadeem M and Ahsan M 2012. Effect of different types of mulching on growth and flowering of *Freesia alba* cv Aurora. Pakistan Journal of Agricultural Sciences **49(4):** 429-433.