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Changing Facets of Mulching Materials

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Opinion

Mulch is a covering material produced using either organic or inorganic substances, applied on the soil surface, in cultivation of various crops. Mulching is carried out for varieties of reasons including soil moisture retention, reducing soil evaporation, heat trapping, reducing run-off losses, increasing germination, weed prevention and control, protection of roots from temperature fluctuations and control the soil erosion [1,2]. Soil mulching may contribute to closing the yield gap between attainable and actual yields. Soil mulching significantly increases the yields as well as water utilization efficiency and nitrogen utilization efficiency of wheat and maize by 20% and 60%, respectively [3] under regular irrigation system and higher water retention has been reported in the case of sprinkled based irrigation systems [1] and ridge-furrows [4]. Usage of plastic mulch increases the yield of the crops by 18% and 27% respectively for wheat and maize [5]. However, there has been an increase in the greenhouse gas emissions (yield-scaled) while using plastic mulching sheets to the extent of 32% and 10% for these crops. It has been observed [4] that use of plastic mulch in the ridge-furrow plots results in higher crop yield in clay and silt loam soils and both straw mulch and plastic mulch significantly increases maize yields and water utilization efficiency under different humidity and growing-season precipitation, compared to control plots (without mulching).

Majority of the mulching films are made up of PE (a resistant synthetic polymer) which causes a serious environmental drawback consisting of a huge quantity of wastes. Different coloured PE mulches reflect the light rays differently and thereby influence the conditions of cultivation and yield of the crops. Plastic mulches are widely used, and black polyethylene has been an attraction in many situations due to its low cost and the proven results in crop production. Soil temperature is always less in the case of white mulch compared to that of red and black coloured mulch sheets [6]. Mulching film residues are found to be as high as 15.3% of the total quantity of films used, depending upon the film thickness, mulching time and crop type and the highest number of residues are found in the cotton fields [7]. Using black polypropylene nonwoven mulch shows a positive effect on soil temperature and amount of water required during growth stage of potato crops with reduced biomass of weeds by almost 89% [8]. However, use of plastic films is limited by the financial cost, but also by the cost of the collection and recycling of the plastic residues [3]. Some of the biodegradable mulches do not meet the expectations of the farmers and often degrade too quickly or incompletely at the time of harvesting and thereby necessitating the manual removal of mulch sheets [9]. One advantage of paper mulches is that easy disposal of residual material in the soil itself.

Nevertheless, of laying of paper mulches in the field and managing the damages during heavy wind are the challenging tasks [10]. Paper mulches often suffer due to stand-stress in the soil, which could be enhanced by clupak or creping treatment. However, edge-propagated-degradation of paper mulches is faster than the growth rate of the crops. Authors also suggest the reinforcement of paper with polylactic acid fibres and viscose fibres during pulping stage to make it stress-tolerant and withstand longer duration during cultivation [11]. The degradation rate of paper mulches, to a large extent, is controlled by the lignin content and higher lignin content slows down the degradation process and can exhibit the durability up to 3 months also. Paper mulching, by conserving soil-moisture up to the depth of 25 cm and reducing soil temperature, provides better crop growth attributes, while the plastic mulching improved water utilisation efficiency in the case of soybean cultivation. Mulching treatments lowers the soil temperature by 2o to 0.5o depending on the depth of the soil [12]. Interest towards applying biodegradable plastics as a substitution for the conventional plastic is promising and the introduction of biodegradable materials which can be disposed directly into the soil can be a possible solution to the waste accumulation problem [13]. Though use of synthetic mulching films has been advocated by many researchers, plastic residues have become a serious environmental problem in the regions with intensive use of plastic mulching.

Starch-based biodegradable plastic mulch films exhibit strong negative effect on growth of wheat plant during both vegetative and reproductive growth both above-ground and below-ground parts. Nevertheless, presence of earthworms has overall positive effect on growth and eliminate the negative impacts of plastic residues [14]. Biodegradability of mulching films comprising of starch and polybutylene adipate terephthalate under aerobic conditions has been studied [13]. Straw mulching is limited by the availability of straw in the field, which is often being used also for feeding ruminants or as biofuel [3]. Textile based mulching material has been compared with conventional polyethylene mulch, mechanical mowing and chemical controls that are widely used in citrus orchards [15]. Weed control was achieved to the extent of 23.4% in mowing while, chemical control 88.4%, 99.6% and 100% weed control were observed in chemical control, polyethylene mulch and textile mulch respectively. It was determined that soil temperature and moisture are preserved by mulch applications. There is a huge potential available in the utilization of wastes obtained in blow room, carding and spinning preparatory processes through upcycling into mulching sheets.

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