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RESEARCH PAPER

Effect of various organic mulches on the content of organic carbon in soil of NA '7' aonla (*Emblica officinalis* Gaertn.) under rainfed condition of Shiwalik foothills of Himalayas

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Abstract : Organic mulch eventually breaks down and adds organic material to the soil. The increase of the amount of soil organic carbon (SOC) is regarded as the main advantage of organic mulches. The aim of our investigation was to evaluate the effect of different organic mulches on the content of SOC. The treatments applied : were without mulch, bajra straw, maize straw, palah leaves (*Butea monosperma*), brankad (*Adhotada vassica*) and farmyard manure. The influence of organic mulch was investigated in 2006-2009 and their residual effect in 2011-2012. In the article the data of 2009-2012 are presented. A higher content of SOC was established in all mulched experimental tree compared with the unmulched tree. A significant influence of farmyard manure observed during the whole period. The influence of bajra straw, maize straw, palah leaves (*Butea monosperma*), brankad (*Adhotada vassica*) and FYM mulches on the content of SOC was significant in 2009-2010 but residual effect of bajra straw, maize straw, palah leaves and brankad was not significant.

Key Words : Mulching, Soil organic carbon, Aonla

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INTRODUCTION

Aonla or Indian gooseberry (*Emblica officinalis* Gaertn.) is one of the important fruits from Ayurvedic consideration as well as nutritional point of view. Now, it is gaining popularity rapidly in the rainfed regions of the country owing to its hardiness, high productivity, suitability for growing in varied agro-climatic conditions and its utilizations in cosmetic, pharmaceutical and processing industry, which attract the growers for its cultivation under arid and semi-arid conditions, where growth and development of plants depend upon rain received during rainy season, mulching plays an important role in such region. Jammu and Kashmir is the northern most state of the country divided into three regions Jammu, Kashmir and Ladakh. Jammu region comprises of sub-tropical, intermediate and temperate areas. Maximum area under sub-tropical belt is rainfed locally known as kandi belt. Most of the terrain of kandi is undulated and affected by vagaries of unpredictable weather further aggravated to prolonged dry spell. The ability of aonla to grow in rainfed wasteland area of Jammu and Kashmir state with minimum water and attention, with an ability to give reasonable returns, propagation and establishment of new orchard is increasing day-by day in subtropics rainfed (kandi areas) of Jammu province. In these kandi soils, the major constraint is shortage of water which is a serious problem in this country and inherently poor soil

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fertility. The content of organic carbon has long been recognized as a key component of soil quality and thus maintenance of soil organic carbon (SOC) in cropland soils is a major determinant of the productivity and long-term stability of agricultural systems (Carter, 2002). Soil organic matter (SOM) is composed of plant, animal, and microbial residues at varying stages of decomposition and amorphous humic substances (Jenkinson *et al*., 1992). An increase in the total content of SOC in organic farming was established by Marinari *et al*. (2010). Natural organic mulch eventually breaks down and becomes a part of the soil and a source of plant nutrients (Gruber *et al*., 2008). Increasing the amount of SOC is regarded as the main advantage of organic mulch (Saroa and Lal, 2003). The influence of mulch on soil agrochemical properties depends on the chemical composition of mulch.

It is recommended that in ecological farming, soil should be covered with composts, chopped straw, and other organic residues to provide crops with nutrients, especially nitrogen (Relf, 2009). During the mineralization process of the mulch, small amounts of nutrients become available for plants. However, it is not a sufficient supply of plant nutrients. Organic mulch is a source of nutrients for soil microorganisms, and as a result of their activity organic residues used for mulching are decomposed to available plant nutrients and a very important substance in soil humus (Blanchart *et al*., 2006). Different opinions on the influence of organic mulches on SOM exist. A significant increase of SOC was observed in plots mulched with organic mulches (Relf, 2009). According to Blanco-Canqui and Lal (2007), mulching with straw during 10 years increased SOC by 33 per cent. Mulching even has the potential of reducing greenhouse gas emissions from soil by increasing its SOM content (Mulumba and Lal, 2008; Jordán *et al*., 2010). Our hypothesis was that the influence of organic mulch of different chemical compositions on SOC will be unequal. The aim of the investigation was to evaluate the effect of various organic mulches layer on the SOC content.

MATERIAL AND METHODS

A study was carried out on 12 years old plants of 'NA-7' aonla which were planted in 1997 at a spacing of 8m × 8m. These plants were treated with different mulches at Rainfed Research Sub-station for sub-tropical fruits, Raya, Sher-e-Kashmir University of Agricultural Sciences and Technology Jammu during 2009 to 2010. The experiment was laid out in a Randomized Block Design with 6 treatments and four replications. Different organic mulches *viz.*, bajra straw, maize straw, palah leaves (*Butea monosperma*), brankad (*Adhotada vassica*) and farmyard manure were imposed uniformly on the basin (10 cm thickness) during April. Mulch was not applied in control plots. Other cultural practices adopted were similar for all treatments. Nutrient management and other horticultural operations were carried out as per standard practices under rainfed conditions. The surface (0-15 cm) soil samples were analyzed for the organic carbon content. Organic carbon in soil was determined by Walkley and Black's rapid titration methods as suggested by Piper (1966).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Soil organic carbon (2009) :

The SOM content is the result of equilibrium between the processes supplying new organic inputs and the rate of mineralization of the existing SOM (Stockdale *et al*., 2002). Lal and Kimble (1997) pointed out that the addition of organic amendments can increase the accumulation of total organic carbon in the soil. As remains of mulch were returned into the soil by ploughing after harvest in autumn, quite large amounts of organic residues of different levels of decomposition accumulated in the soil. A significant increase of SOC was observed in the tree basin mulched with farmyard manure followed by brankad (*Adhotada vassica*), maize straw, bajra straw and palah leaves (*Butea monosperma*) compared with the unmulched plots in 2009 (Fig. 1).

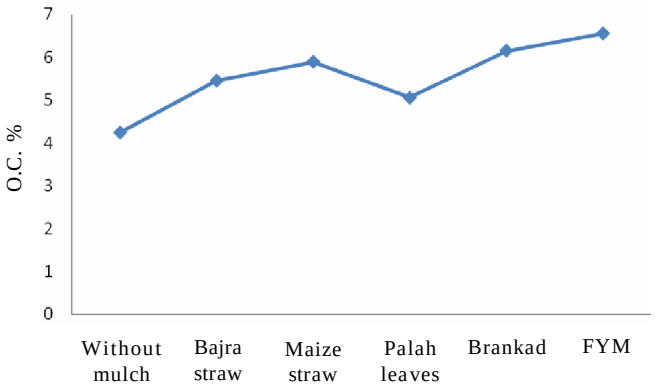

Fig. 1 : Influence of organic mulches on the content of SOC in 2009. Significant at (P=0.05)

Soil organic carbon (2010) :

An increased amount of SOC was established in the tree basin covered with leaves and straw mulch. The influence of the thickness of the mulch layer on SOC was significant in 2009. Increases in SOM occurred when carbon inputs exceeded the rate of oxidation (Sheperd *et al*., 2002). The highest SOC content was established in the farmyard manure mulched tree basin during both the year 2009 and 2010. Farmyard manure and brankad (*Adhotada vassica*) mulch had a positive influence on the SOC content. Same trend of increase in SOC content was observed in farmyard manure followed by brankad (*Adhotada vassica*), maize straw, bajra straw and palah leaves (*Butea monosperma*) as compared with the unmulched plots in 2010 (Fig. 2).

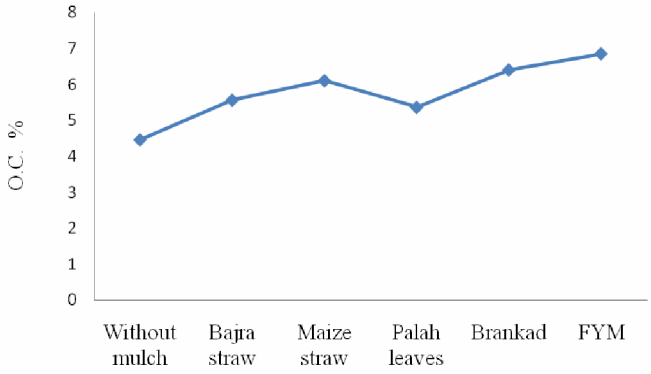

Fig. 2 : Influence of organic mulches on the content of SOC in 2010. Significant at (P=0.05)

Residual effect of soil organic carbon (2011) :

The residual effect of organic mulches on SOC was studied in 2011 and 2012. In 2011 the content of SOC in the tree basin previously mulched with farmyard manure was higher compared with the unmulched plots (Fig. 3). The residual effect of other examined mulches was not significant. The content of SOC decreased largely compared with 2010 in the basin previously mulched with leaves and straw but less in the tree basin mulched with farmyard manure and branker mulches. Because of its quick decomposition process grass mulch had no significant influence on the SOC content as the previous year (2010) of the experiment either.

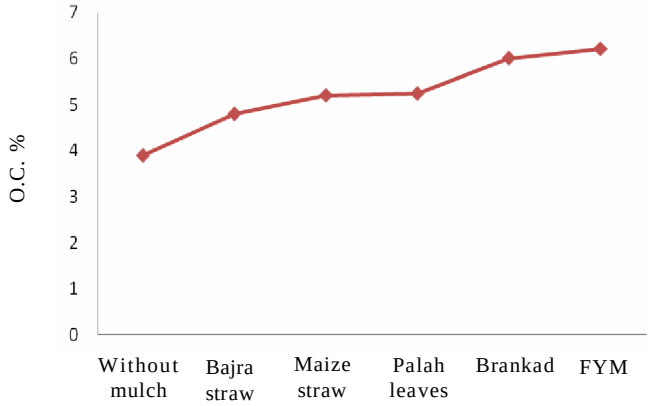

Fig. 3 : Residual effect of organic mulches on the content of SOC in 2011

Residual effect of soil organic carbon (2012) :

Similar tendencies were established in 2012. The significant effect of farmyard manure mulch on SOC persisted (Fig. 4). The content of SOC in the basin previously mulched with farmyard manure was higher compared with the unmulched plots. Annual incorporation of farmyard manure and brankad (*Adhotada vassica*) into the soil from 2006 to 2010 caused the highest content of SOC. Basin previously mulched with farmyard manure, straw, and leaves still showed a higher content of SOC than the unmulched plots.

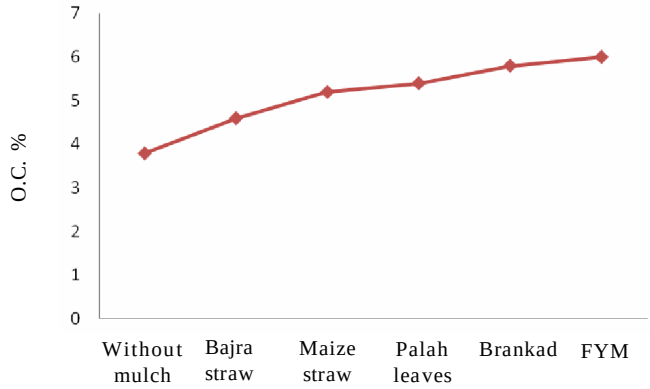

Fig. 4 : Residual effect of organic mulches on the content of SOC in 2012

Although farmyard manure and branker mulch high nutrient status decomposed, the amount of SOM in the tree basin previously mulched with manure and leaves which was higher compared with the unmulched plots. The results of many studies confirm that long-term organic farming positively influences the amount of SOM (Schjønning *et al*., 2002; Tu *et al*., 2006; Lagomarsino *et al*., 2009). Like in 2011, the residual effect of the thickness of the mulch layer on the SOC content was significant also in 2012. All the examined organic mulches increased the content of SOC.

Conclusion :

The influence of various organic mulches layer on the content of organic C in the soil was evaluated. A higher content of SOC was established in all mulched experimental tree basin compared with the unmulched plots. A significant influence of farmyard manure mulch was observed during the experimental period of 2009 to 2012. Brankad (*Adhotada vassica*) and straw mulch significantly increased the content of SOC in the years of treatment (2009 to 2010) but its residual effect (2011 to 2012) was not significant. The influence of straw mulch on the content of SOC was significant only in 2010.

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