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Grain yield and carbon sequestration potential of post monsoon sorghum cultivation in Vertisols in the semi arid tropics of central India☆

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ABSTRACT

Soil fertility management and water conservation strongly impact soil quality and agronomic production of Vertisols. Thus the data from a 22-year of soil fertility management experiment conducted in semi arid tropical region of central India was used to evaluate the impact of input of crop residue carbon (C) through sorghum (*Sorghum bicolor* L.) cultivation in post monsoon season in Vertisols. In addition, the use of chemical fertilizers and manuring on crop yield sustainability and soil organic carbon (SOC) sequestration was assessed to 1-m depth. Retention of crop residues of sorghum, and application of farmyard manure (FYM) equivalent to 25 kg N ha^{-1} along with 25 kg N ha^{-1} supplied through chemical fertilizers increased and maintained the SOC stock. Green leaf manuring with *Leucaena* clippings along with chemical fertilizers did not increase the SOC stock. However, a conjunctive use of crop residues and *Leucaena* clippings increased the profile SOC stock (68.5 Mg ha^{-1}), an overall SOC build up (39.8%) and a high amount of SOC sequestration (14.4 Mg C ha^{-1}). These parameters were positively correlated with cumulative C input and also reflected in the sustainable yield index (SYI). Higher grain yield (1.19 Mg ha^{-1}) through the application of 25 kg N (CR) + 25 kg N (*Leucaena*) was obtained. For every Mg increase in SOC stock in the root zone there was 0.09 Mg ha^{-1} increase in grain yield of sorghum. Stabilization of the SOC stock (zero change under cropping) requires a minimum input of 1.1 Mg C ha^{-1} $year^{-1}$. Application of 50 kg N ha^{-1} through chemical fertilizer also maintained the SOC stock at the antecedent SOC level. Therefore, a combined use of organic manure (crop residues and FYM) or green leaf manure along with chemical fertilizer is essential to enhancing SOC sequestration in sorghum cultivation in Vertisols during the post monsoon season in central India.