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Session 5: Conservation Agriculture: Climate Change Impacts

ORAL ABSTRACTS

Presenter	Abstract Title	Page
Jerry Hatfield	Conservation Impacts on Climate Resilience	2
ML Jat	Adaptation to and Mitigation of Climate Change Effects for Future Food Security in South Asia: Is Precision-Conservation Agriculture a Way Forward?	5
Tadesse Birhanu	Seasonal Climate Variability Dependent Effects of Conservation Agriculture Practices Across Different Agroecologies in Ethiopia	8
Ram A. Jat	Climate change Mitigation and Adaptation Potential of Conservation Agriculture: Effects on Rainwater Use Efficiency, Runoff, Soil Moisture, Soil Organic Carbon and Energy Use	11
Stefano Brenna	Environmental Outcomes of Conservation Agriculture in North Italy	13

Climate Change Mitigation and Adaptation Potential of Conservation Agriculture: Effects on Rainwater Use Efficiency, Runoff, Soil Moisture, Soil Organic Carbon and Energy Use

Ram A. Jat, P. Pathak, Suhas P. Wani, R. Sudi, Kanwar L. Sahrawat, K. Srinivas and Girish Chander
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Patancheru 502 324 Andhra Pradesh, India
rajatagron@gmail.com

As climate change will likely have adverse effects on agricultural productivity and food security in much of the semi-arid tropics ((SAT, IPCC, 2007), there is need to develop and disseminate production technologies that provide a layer of resilience against such climate change effects on food security. A long-term experiment was initiated at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) farm in Patancheru, India in 2009 rainy season to assess the potential of conservation agriculture (CA) as an alternative and resilient production technology for sustainable crop intensification under rainfed situations in the SAT of southern India. Two tillage treatments -- , normal tillage (NT) minimum tillage (MT), and residue management practices -- residue removal (RR) and residue retention (RT) were tested in maize-chickpea sequence and maize/pigeonpea intercropping systems with four replications. The soil of experimental field was Vertic Inceptisol, which according to USDA is classified as a member of the fine, montmorillonite, isohyperthermic family of paralithic Vertic Ustopepts (Vertic cambisol as per FAO classification); slightly alkaline (pH 7.91) with EC 0.22, medium in organic C (0.42 %) and available P (10.61 $kgha^{-1}$). Here we present effects of tillage and residue management practices on rainwater use efficiency (RWUE), runoff, soil moisture content and soil organic carbon (SOC) during 2010-11 and 2011-12 seasons. Data from integrated digital runoff and soil loss monitoring unit (IDRSMU, Pathak et al., 2011) were analyzed to estimate runoff in different treatment plots in maize-chickpea system. Soil moisture content was measured using the neutron probe (Troxler model 4302) calibrated under same soil.

Improving RWUE is vital to increase agricultural production and productivity under rainfed conditions in SAT. MT-RT had RWUE at par with NT-RR during 2010-11 but during 2011-12 as weeds could not be controlled timely in MT-RT due to incessant rainfall, which made herbicide applications ineffective, RWUE was lower in MT-RT compared to that in NT-RR in both the maize-based cropping systems. However, effective weeding was possible in NT-RR with tropicultor mounted hoe drawn by bullocks. Therefore, to improve RWUE under CA timely and effective weed control along with proper nutrient management is must. MT-RT reduced total seasonal runoff by 28.62 and 80.22% compared to NT-RR during 2010-11 and 2011-12, respectively. These results imply that higher rainwater infiltrated into the soil to add to the green water. Similarly, peak rate of runoff, which indicates erosive capacity of runoff water was decreased by 25.13 and 72.72% under MT-RT compared to NT-RR during 2010-11 and 2011- 12, respectively. Only 17.41 and 1.11% of total rainwater was lost as runoff under MT-RT compared to 24.40 and 5.62% under NT-RR during 2010-11 and 2011-12, respectively. During 2010-11, MT-RT had
2.25 and 5.49% higher total soil moisture (v/v) in 0-90 cm soil depth in sole maize (in maize-chickpea sequence) and intercropped maize respectively, compared to NT-RR (Fig. 1). During 2011-12, MT-RT had 1.95% higher total soil moisture (v/v) in 0-90 cm depth in sole maize, but in intercropped maize it had 1.31% less total soil moisture compared to NT-RR. MT-RT had higher SOC in 0-15 cm soil depth compared to NT-RR in both the maize-legume cropping systems but SOC was only slightly higher or equal in 15-30 cm soil depth compared to NT-RR. This indicates MT-RT is capable of sequestering more carbon in soil compared to NT-RR. As in MT tillage operations like chisel plowing, mould board plowing, cultivator and blade harrowing and

mechanical interculturing were not done it saved energy equivalent to 41.49 liters of diesel per hectare. As one liter of diesel emits 2.67 kg CO_2 (Environmental Protection Agency, 2009) MT emitted 110.79 kg less CO_2 annually on per hectare basis compared to NT. Besides, with gradual improvement in soil fertility under CA fertilizer requirement is expected to come down in medium to long-term which would help to reduce emission of green house gases (GHGs) both at the level of fertilizer production and post field application stage.

With positive effects on RWUE, runoff, soil moisture content, SOC and energy use which are expected to be more clear in medium to long-term and lesser emission of GHGs CA could be one of the potential climate change mitigation and adaptation production technologies in the SAT.

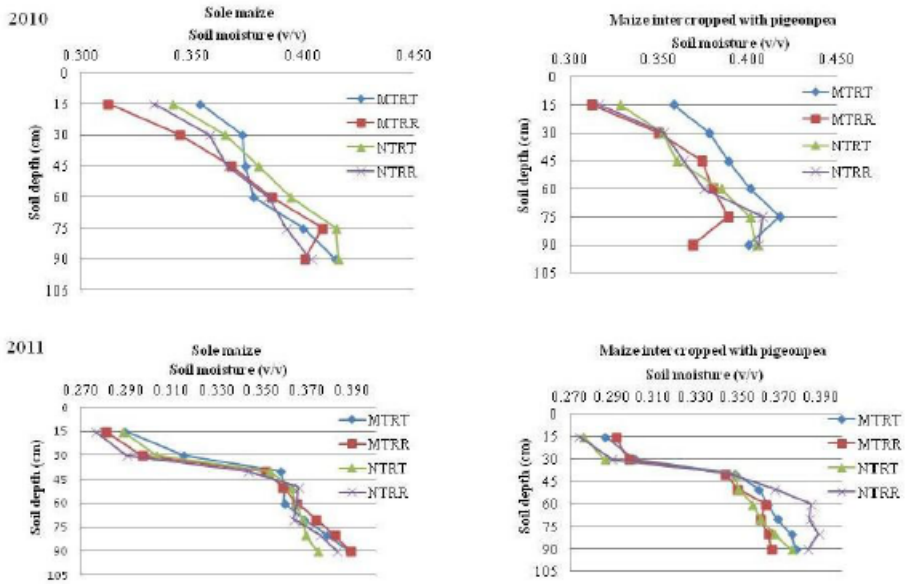

Fig. 1 Effect of tillage and residue management practices on total soil moisture (v/v) averaged over different dates during maize growing period in 0-90 cm depth.

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