season, MT-ZT. Zero tillage during *kharif* + zero tillage during *rabi* recorded significantly higher OC (0.83 %) than continuous conventional tillage practice (0.71 %), however was at par with rest of the treatments. Similarly OC content in 15-30 cm soil depth also showed similar trend however soil organic matter content in 30-45 cm soil depth remain unaffected due to tillage management practices in *kharif* and *rabi* seasons. In case of summer ploughing treatments, alternate year summer ploughing treatment recorded significantly lower organic carbon content (0.76 %) than no summer ploughing (0.82 %) in the soil layer 0-15 cm.

## CONCLUSION

On the basis results of four years field experimentation it is concluded that for higher net return and B:C ratio and improved soil health under *fodder* sorghum + cowpea – *duram* wheat cropping system, minimum tillage during *kharif* season and minimum or zero tillage during *rabi* season may be recommended.

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# Managing root zone salinity through deficit saline water irrigation and mulching in salt affected soils under limited fresh water irrigation

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Soil salinity has emerged as the most significant problem constraining agriculture in 6.74 mha in different parts of country (CSSRI, 2015). Saline soil and saline groundwater coexist in nature, leaving very limited option for reclamation using fresh water either from rain water harvesting and/or canal water. In many farming situations, the scarcity of fresh water has forced farmers to use saline groundwater, which helps to overcome drought and increase crop yields (Sharma and Minhas, 2005). However, in the absence of proper soil-water-crop management practices use of saline waters also increases the risk of soil salinization and deterioration of soil and environment health. This experiment was conducted to evolve ideal soil and water management strategies for manipulating the root zone salinity and sustaining crop production seems promising in productive utilization of salt-affected lands and use of poor quality water.

## METHODOLOGY

Experiment was laid out in *kharif*-2014 at Nain Experimental Farm, CSSRI, Panipat with three tillage treatments *viz.* zero, conventional and reduced tillage in main plot and six treatments comprising irrigation (100, 80 and 60 % of water requirement) and mulch (0 and 5 t/ha rice straw) combination in subplots. Initial electrical conductivity of the saturation extract ($EC_e$) of the surface soil of the experimental site varies in the range of 4-36 dS/m. Fodder sorghum (*cv*. HSSG-5000)-wheat (cv. KRL-210) cropping system was adopted. *Kharif* season was rainfed and *Rabi* season was irrigated with saline water (8 dS/m) as per the treatment.

## RESULTS

Tillage had no significant effect on wheat grain and fodder sorghum yield (Table 1). Saline soil of experimental plots irrigated with saline water of 8.0 dS/m produced 4.7 Mg/ha wheat. Irrigation with 80% of water requirement (WR) had no significant reduction in the wheat yield. Application of 5 Mg/ha rice straw mulch with 60% WR showed 7.5% increase in wheat yield compared to without mulching (4.0 Mg/ha). *Kharif* rainfed sorghum produced significantly higher green forage yield in the plots irrigated with 60% WR (6.42Mg/ha) in *Rabi* season compared to treatments irrigated with 100% WR. Tillage, irrigation and mulching had no effect on dry matter content of the fodder sorghum. Soil moisture content of the mulched plots in 0-10 cm and 40-50 cm soil layer were 6-

**Table 1.** Effect of tillage, mulching and deficit irrigation on the sorghum and wheat yield (Mg $ha^{-1}$)

| Treatment | Wheat (2014) | Sorghum GFY (2015) | Sorghum DFY | Dry matter (%) |
|---|---|---|---|---|
| *Tillage** | | | | |
| RT-ZT | 4.41a | 550.0a | 137.0a | 25.2a |
| CT-CT | 4.52a | 562.5 a | 132.4a | 23.6 a |
| ZT-ZT | 4.51a | 558.3a | 135.0a | 24.3 a |
| *Irrigation and mulching* | | | | |
| 100 WR#-no mulch | 4.69a | 505.6b | 125.7b | 25.2a |
| 80 WR- no mulch | 4.6ab | 541.8b | 130.7b | 24.1a |
| 60 WR - no mulch | 4.0b | 547.2 b | 137.3ab | 23.9a |
| 100 WR – mulch** | 4.67ab | 563.2b | 136.7ab | 24.2a |
| 80 WR - mulch | 4.62ab | 541.7b | 125.7b | 23.5a |
| 60 WR - mulch | 4.31ab | 641.7a | 152.7a | 25.2a |
| 100WR-G | 4.90a | 658.0a | 158.4a | 24.1a |
| 100WRC | 4.70ab | 508.3b | 126.1b | 24.0a |

*Tillage × irrigation and mulch: NS*
*RT-reduced tillage, ZT-zero tillage, CT-conventional tillage; # WR-water requirement; ** Mulch- rice straw mulch (5 Mg/ha) and different letters within columns are significantly different at P = 0.05 according to Tukeys Test for separation of means.

23% higher than non-mulched plots in entire *Rabi* season. Similar trend was observed for soil salinity. Throughout the year $EC_2$ of the surface soil was lowest in the 60%WR + Mulch (60WRM) treatment (Fig. 1). Soil $pH_2$ was inversely related with change in soil $EC_2$. Maximum increase in soil pH was observed in soil irrigated with good quality water ($EC_{iw}$<1dS/m). Soil $pH_2$ was positively correlated (*r*>0.3-0.6) with soil solution indices like sodium adsorption ratio (SAR), $Na^+/K^+$ (SPR), $Na^+/(Cl^- + SO_4^{2-})$ (NCSR), $Cl^-/SO_4^{2-}$ (CSR)

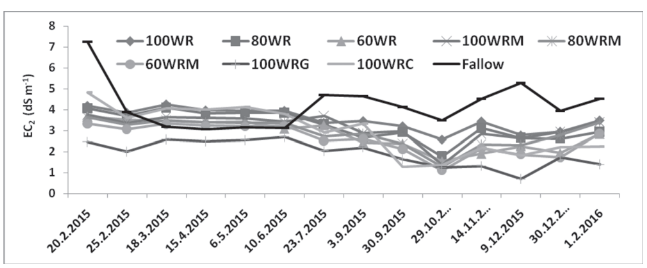


**Fig. 1.** Effect of deficit irrigation and mulching on soil salinity of the surface soil (0-10 cm)

and dissolved organic carbon (DOC). $Ca^{2+}/Mg^{2+}$ (CMR) was negatively correlated with $pH_2$.About 85.6% variability in DOC content of soil solution was explained by $Ca^{2+}$, $Mg^{2+}$, total nitrogen and $Na^+/(Cl^- + SO_4^{2-})$ ratio.

## CONCLUSION

These findings suggest that mulching was effective in increasing root zone soil moisture and reducing the soil salinity. Soil salinity dynamics showed inverse relation with soil pH in root zone. About 85.6% variability in DOC content of soil solution was explained by change in $Ca^{2+}$, $Mg^{2+}$, total nitrogen and $Na^+/(Cl^- + SO_4^{2-})$ ratio of the soil.

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