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Effects of Conservation Agriculture on Soil Physical Properties and Yield of Lentil in Northern Syria

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Conservation agriculture (CA) aims to achieve sustainable and profitable agriculture and subsequently improve livelihoods of farmers based on three main components, i.e. minimum or no tillage, retention of crop residues and use of crop rotation. However, to promote CA in semi-arid areas where precipitation is erratic, low, and falls over short periods in winter, its effects on soil and crop yield have to be investigated.

The present study was conducted at the main research station of the International Center for Agricultural Research in the Dry Areas (ICARDA), Syria, during the agricultural season of 2010-2011, in the frame of a long term trial (2003-2011), where two treatments; i.e. conservation versus conventional agriculture (replicated twice), and six varieties of lentil (early, medium and late maturity genotypes; 2 each), selected from 100 varieties, were used.

Soil samples were taken (before planting and after harvesting), to determine soil bulk density, particle density and total porosity. Aggregate stability was also determined using dry and wet sieving methods for the 0-15 cm soil depth, and the effective diameter of the aggregate was calculated for both treatments of conservation agriculture (CA) and conventional tillage (CT). Soil moisture was monitored in the top soil layer (0-15 cm) using Time Domain Reflectometry (TDR) on a weekly or two weekly-intervals. Soil moisture release curve was done for disturbed, 2 mm dry sieved soil at 0-15, 15-30, 30-45 and 45-60 cm depth using pressure plate chamber.

Dry plant production (oven dry at 70°C) was estimated at the harvesting stage, and then threshed to estimate grain yield.

CA showed higher ($p = 0.001$) soil moisture values than CT. The difference in volumetric soil moisture content between CA and CT during the studied period ranged from 20 to 30 %. Volumetric water content was higher for, CA compared with CT, at a given soil water potential especially at the lower pressure; this observation was consistent for the four layers (down to 60 cm). This could suggest that more water content could become available for CA compared with CT.

The results showed that soils under CA had slightly lower total porosity compared with CT (about 39 and 45% respectively; although no significant). However, CA improved soil aggregate stability, as compared with CT, by about 20% (no significant). Higher effective diameter in CA as compared with CT (although no significant, but, range of about 10 to 45%, in dry and wet sieving respectively).

Genotypic differences were evident for the chickpea yields (grain and biomass) between early, medium and late genotypes, with the medium maturity genotypes having the highest yield compared with the rest ($p=0.01$). Results also showed that CA produced significant higher grain yields of lentil of 20 to 30%, as compared with CT ($p = 0.05$), especially early and late maturing genotypes.

This study proves the importance of CA in conserving soil moisture, and achieving higher crop productivity after eight years of implementing the CA than CT. The data support indications that CA systems may have the potential to mitigate the impact of climate change on agricultural production.