

Root Turnover and Microbial Activity in Cotton Farming Systems

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Abstract

Soil organic carbon levels have been declining in the cotton producing regions of Australia ever since the introduction of cultivation. In response, cotton growers must modify cotton farming systems to slow this decline, or ideally reverse it. A study was carried out at Myall Vale near Narrabri, NSW, Australia to compare cotton-based rotations in relation to root production and turnover, soil microbial biomass, and soil microbial activity. The long-term rotations started in 2002 and were; (CV) cotton-vetch, (CC) continuous cotton, (CW) cotton- wheat (with tillage), (CWV) cotton- wheat- vetch (minimum-tillage). Cotton root dynamics and below ground carbon production were measured using the minirhizotron, core break and root washing methods during the 2004/2005 growing season. The fumigation-extraction (FE) method and Ninhydrin reactive N were used to measure microbial biomass. Microbial activity was measured by soil respiration (CO₂) using the NaOH trap method. Root growth rates, root numbers and root length were all highest at 72 days after sowing (DAS) in the CW rotation. Microbial biomass at this time was also highest in the CW rotation (10-20cm) indicating that high cotton root growth and possibly root exudations, and incorporation of wheat residues was most favourable to microbial populations. Both cotton-based rotations including a wheat phase (CW and CWV) produced the highest root mass throughout the season and hence, the largest amounts of carbon (27% w/w carbon in roots) in their root systems. There were no significant differences in microbial activity between rotations throughout the season, suggesting that soil carbon losses through CO₂ respiration could be similar for all treatments. Therefore, the two cotton-based rotations incorporating a wheat phase (CW and CWV) may return the largest amount of carbon into the soil through their

roots. Lint yields were also highest in rotations CWV (2.58 t/ha) and CW (2.37 t/ha) suggesting that the inclusion of a wheat phase in the rotation may also improve cotton yield.