

Just add water; increases in organic carbon over 6 years under pastures in southern Australia

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Well-managed perennial pastures are thought to represent the maximum opportunity for agricultural soils to accumulate organic carbon (OC), but in southern Australia does climate variability override this potential? Despite the considerable efforts over the past decade to collect field information on the influence of land management on OC stocks, few studies have monitored temporal changes in OC stocks under permanent pastures. A field survey of 31 permanent pastures (mean age 31 years) in the Monaro region of south-eastern Australia compared the influence of recent climate on the stock of OC and soil properties to 0.70 m. Baseline samples were collected in 2009, during the Millennium Drought that southern Australia experienced from late 1996 to mid-2010. Sites were resampled in 2012 and 2015 following record high annual rainfall as a consequence of La Niña. There was a significant ($P < 0.05$) increase in the stock of OC in the 0 to 0.30 m soil layer (based on an equivalent mass of soil) when the 2012 and 2015 survey data were compared with the 2009 baseline, and mean carbon (C) sequestration rates of over 2 Mg C/ha/yr. While the increase in OC stocks from 2009 to 2015 corresponded with an increase in annual rainfall, the concentration of OC was also positively and significantly ($P < 0.05$) correlated with total nitrogen (N) and available sulfur (S). Similar to other studies, there was a positive trend between the concentration of OC and available phosphorus (P), however this was not significant. These results highlight the importance of soil nutrition for OC accumulation through increased biomass production and OM stabilisation. Importantly, these results demonstrated an increase in soil C sequestration as a consequence of higher than average rainfall that is beyond that reported for management of temperate pastures in southern Australia.