Soil Aggregate Dynamics, Particulate Organic Matter and Phosphate under Dryland and Irrigated Pasture

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Introduction Soil aggregate formation and turnover affects the rate of occlusion or release of soil organic matter and therefore the availability for mineralisation or stabilisation of soil carbon (C) and phosphorus (P). Furthermore, differences in soil type, management and the quantity and quality of organic inputs can affect aggregate turnover rates (Six *et al*., 2000). Under pastoral farming the ratio of coarse particulate organic matter (inter-POM) inside macroaggregates but outside microaggregates to fine POM (intra-POM) within microaggregates may provide an indication of physical processes influencing mineralisation and stabilisation of soil C and organic P (Po). Our aim was to determine the coarse and fine POM and associated C and P contents in water stable macro and microaggregates under long term irrigated and dryland pasture grazed by sheep.

Materials and methods Soil to 75 mm depth was collected from irrigated and dryland pasture under sheep grazing at a long term irrigation trial site at Winchmore in New Zealand. Field moist soil was gently sieved to <2 mm, air dried then wet sieved by hand to obtain water stable 2000 - 2500 μm macroaggregates. Macroaggregates were broken up by using the method of Six *et al*. (2000) to obtain inter-POM and intra-POM and to determine the sand free content of both macro and microaggregates. Respective soil aggregate and POM fraction weights, total P (TP), inorganic P (Pi), Po and C content were determined.

Results Greater sand free microaggregate weight was obtained in irrigated than unirrigated soils. Olsen P levels were not significantly different at 31 μg/ml in complete soils under the two treatments. The similar proportion of microaggregates in macroaggregates under irrigated and dryland pastures suggests a similar aggregate turnover rate and therefore exposure of POM to mineralisation. However, the ratio of intra- to inter-POM (Table 1) was almost three times greater in irrigated than dryland which suggests slower macroaggregate turnover under irrigation. Irrigated pasture supports a greater worm biomass than dryland and earthworms have been shown to provide protection of soil C in microaggregates explaining the greater proportion of protected POM under irrigation. The greater inter-POM under dryland with a concomitant greater quantity of TP, Pi and Po than under irrigation (Table 1) indicates more POM and P potentially available for plant uptake.

Table 1 Particulate organic matter (POM) and aggregate relationships under dryland and irrigation conditions

Treatment	Intra-/inter-POM	Microaggregates in macroaggregates (%)	Inter-microaggregate POM (g C/ kg macroaggregates)	Intra-microaggregate POM (g C/kg macroaggregates)
dryland	4.81	64.5	1.45	5.47
irrigated	13.63	69.7	0.79	4.37
$LSD_{0.05}$	3.65	6.0 ns	0.66	1.40 ns

Table 2 Phosphorus content of inter-microaggregate POM under dryland and irrigation

Treatment	Total P within inter-POM (μg P/g inter-POM)	Pi within inter-POM (μg P/g inter-POM)	Po within inter-POM (μg P/g inter-POM)
dryland	1465	659	807
irrigated	1239	439	799
$LSD_{0.05}$	173	70	175 ns

Conclusions Although an apparent similar aggregate turnover rate with and without irrigation, the greater intra- to inter-POM ratio and TP, Pi and Po without irrigation indicates more POM and P not being utilised or mineralised because of a lack of biological activity through insufficient moisture.

References

Six, J., E. T. Elliot & K. Paustian (2000). Soil macroaggregate turnover and microaggregate formation: a mechanism for C sequestration under no-tillage agriculture. *Soil Biology and Biochemistry*, 32, 2099-2103.