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STABILIZATION OF SOIL AGGREGATES BY PLANT ROOTS

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CONTENTS

SUMMARY

Red-brown earths are used extensively for agriculture in Australia including horticulture in the Goulburn Valley Irrigation Area. Problems of structural stability are widespread. Thus the effects of plant roots and crop rotation on the stability of aggregates of red-brown earths were studied.

The root system of ryegrass was more efficient than that of white clover in stabilizing aggregates of Lemnos loam because the root system of ryegrass was longer and supported a larger population of vesicular-arbuscular (VA) mycorrhizal hyphae in the soil. Electron micrographs show that the hyphae were covered with a layer of amorphous material, probably polysaccharide, to which clay particles appear firmly attached.

The effect of management of the ryegrass on the stability of aggregates was related to the growth of these hyphae in soil. The quickest way to stabilize aggregates was to grow the ryegrass with ample water and to clip the tops at monthly intervals. Stressing the plants by allowing them to wilt reduced the growth of the plants and the stability of aggregates. The results show that provided there has been sufficient growth of roots, VA mycorrhizal hyphae can persist in soil for at least several months after the plants die, although the hyphae may no longer be viable.

The effect of crop rotation on the stability of aggregates was measured in another red-brown earth, the Urrbrae fine sandy loam. Fifty years of crop rotations have decreased the stability of macroaggregates (>250 μm diameter) and simultaneously decreased the lengths of roots and hyphae and the % total organic matter in the soil. Regardless of the rotation, particles 50-250 μm diameter were very stable due to organic matter.

The results also show that several binding agents, both organic and inorganic, are responsible for stabilizing aggregates of various sizes. Organic matter is the main agent responsible for binding clay-sized particles (<2 µm diameter) into stable aggregates >50 µm diameter, and that organic matter also binds fine particles <0.2 µm diameter into aggregates <2 µm diameter. Cementing due to amorphous oxides, crystalline oxides and highly disordered alumino-silicates was also responsible for some of the binding of particles <0.2 µm diameter into aggregates. From these results, a model of an aggregate for a red-brown earth is proposed.