Structural amelioration as a factor in the management of heavy textured soils

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Grey and Brown Clays, generally considered to be chemically fertile, tend to slake upon wetting into small micro-aggregates of approximately 100 um diameter. Slaking results in sealing of the soil surface during a rainstorm, hence reducing the infiltration rate, and increasing runoff and soil loss. The situation is exacerbated if slaking is followed by dispersion of soil micro-aggregates. When this happens, infiltration rates are severely reduced. resulting in restricted redistribution of water from the surface soil. Excessive evaporation therefore occurs, and the recharge of subsoil moisture is poor. Dispersed soil also tends to remain waterlogged and boggy for extended periods of time. Upon drying it may give rise to surface crusting and a massive structure which causes difficulties with cultivation and plant establishment. Therefore, clay soils which are prone to slaking and dispersion usually have low productivity.

This paper reviews work carried out at the University of New England on the use of gypsum as an ameliorant for such soils. Field trials with dryland wheat were initiated in 1973 and 1974, in conjunction with the N.S.W. Department of Agriculture, and further trials, still being evaluated, were established in 1978. The experiments examined soils ranging from medium clay (34% clay) to heavy clay (72% clay), and from soils with good stable structure (non-sodic) to those with poor, unstable structure (ESP 7-10%).

Results have shown that gypsum increases infiltration of water into the subsoil. The efficiencies for water storage due to 71/2 t ha-1 gypsum application within the top 120 cm of the soil were increased from 15% to 55% on the heavy clay soil, and from 11% to at least 32% on the medium clay soil. It has been shown that the increased water storage is related to the improved hydraulic conductivity of the surface soil which is in turn related to the reduced dispersion of micro-aggregates, due to stabilization by gypsum. Increased subsoil moisture recharge, and to a lesser extent improved germination due to reduced crust strength, has been responsible for the higher wheat yields obtained from the gypsum treated plots. In a wet year such as 1978, gypsum significantly improved germination due to more rapid moisture redistribution from the surface soil, thereby reducing waterlogging damage to seeds.

The more rapid moisture redistributions from the surface soil into the subsoil, due to gypsum addition, results in a reduction in water loss by evaporation. It also results in a rapid initial decline in the moisture content of the surface soil to a level which allows safe movement of farm machinery and hence the timeliness of farm operations on these difficult soils is improved.

In summary, the application of gypsum to unstable heavy textured soils can significantly improve productivity through improved germination and plant growth. It also lowers the cost of production through easier working of the soil, and improved timing of operations, thereby reducing the probability of yield reductions due to late sowing and unsuccessful germination. However, the removal of water as a limiting factor to crop production may expose nutrition as the limiting factor. The supply of nitrogen in particular may be inadequate.