Impact of Lime and Gypsum on Wheat Yield, Soil and Solution Properties in the Short and Long Term

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Subsoil aluminium (Al) toxicity or soils with Al_{CaCl2} content > 2.5 mg Al kg^{-1} in the soil layers below 10 cm is a significant problem in south Western Australia. Both lime and gypsum can be used to treat subsoils Al toxicity because these products decrease the toxic effect of soil Al leading to an increase in crop grain yields. In this presentation, results are reported from three field lime by gypsum rate experiments located in the east of Merredin. The experiments examine the short (1 year), medium (2 years and eight months, 2.7 years) and long-term (10 years) effect on crop grain yield, soil properties, soil solution properties and soil solution Al species distribution. All sites had Al toxicity limiting crop production in the subsoil. For the short and medium-term experiments, where soil pH_{CaCl2} in the surface 0–10 cm was higher than 5.5, gypsum application increase canola and barley grain by 14–19%. The gypsum response developed even following relatively dry years due to the rapid leaching of applied sulfate into the subsoil. For the long-term experimental site, soil pH_{CaCl2} in the surface 0–10 cm was less than 4.6, gypsum, lime and lime plus gypsum applications increased wheat grain yield by 6–48%. In both the medium and long-term experiments, the application of lime resulted in a greater reduction to a greater depth in Al_{CaCl2} than the increase in pH_{CaCl2}. Indicating Al_{CaCl2} is a more sensitive measure of the impact of lime and gypsum application than soil pH_{CaCl2}. Gypsum application, in the short-term increases in the soil solution concentration ionic strength (IS_{Soln}) resulting in a reduction in subsoil Al toxicity. In the long-term, sulfate applied as gypsum is leached below the Al toxicity layer (10–30 cm) reducing its effect on IS_{Soln} and subsequently subsoil Al toxicity. The application of lime did not affect soil and solution properties in the short-term but in the long-term decreased subsoil Al toxicity. The higher solubility of gypsum compared to lime has the potential to reduce subsoil Al toxicity and produce short-term grain yield responses. However, long-term management of subsoil Al toxicity should use a combined application of lime and gypsum to increase soil pH and reduce toxic forms of Al within the subsoil.