Project No.: LP0454086

Project Title: Understanding reaction products of granular and fluid P fertilisers in Australian soils: a way to enhance fertiliser efficiency

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Executive Summary

This project aimed to study the reactions of fluid and granular fertilisers in soils using advanced spectroscopic and isotopic techniques, in order to provide a scientific basis for improving fertiliser formulations and effectiveness. This project was the industry component of an Australian Research Council (ARC) Linkage project (LP0454086) which has already been reported. The project successfully developed and applied a range of isotopic and spectroscopic methods to the study of fluid and granular fertilizer dissolution/diffusion, reactions and potential plant availability in a range of soils. The reasons were determined for the superior agronomic performance of fluid phosphorus and trace elements on highly calcareous soils, observed by SARDI field trial research. Small changes and movements in soil water and dissolved ions such as phosphorus and calcium around fertiliser granules were found to explain the stronger fixation of granular fertiliser nutrients in highly calcareous soils (compared to equivalent fluid products). The release of trace elements from micronutrient-enriched granular phosphorus fertilisers was also found to be poor, mainly because micronutrient metals such as copper, manganese and zinc form very insoluble compounds with phosphorus and the fact that these nutrients are intimately mixed in most fertiliser formulations. Supplying these elements simultaneously with phosphorus is therefore problematic, and further research needs to be conducted to try to improve release of trace elements from micronutrient-enriched phosphorus fertilisers, and to develop fluid phosphorus formulations that can supply micronutrients without precipitation occurring.

Reactions of ammonium polyphosphate (APP) in soils were also examined, and phosphorus forms in this fertiliser were found to bind strongly to soil, perhaps reducing precipitation (fixation) reactions. It was found that APP needs to be stored in cool conditions, and not acidified (to improve trace element solubility), as this could cause degradation of the product. Using a new isotopic-labelling technique, we could find no strong evidence that APP mobilises large amounts of native soil phosphorus. Soil moisture conditions were found to have a major influence on the fixation of fertiliser phosphorus in soil, and calcareous soils behaved differently to other soils in this regard. In contrast to the expected outcome, dry soil conditions actually increased the fixation of phosphorus from granular fertilisers in calcareous soils. This has implications for fertiliser management in a situation of changing climate and generally drier soil conditions in southern Australia.
Outcomes from the project are being adopted in a number of ways. Commercially there is intense interest from the fertiliser industry in using and applying the techniques developed in this project, with the aim to increase fertiliser effectiveness not only in Australia, but also globally through a major international manufacturer

(Mosaic LLC, the second largest global fertiliser manufacturer who supply Australian retailers with product). On a grower level, outcomes from the project have been incorporated into a South Australian Fluid Fertiliser Manual, which we hope will act as a reference handbook for SA growers and consultants interested in this technology.