USE OF REACTIVE PHOSPHATE ROCK FOR PASTURES ON THE SOUTHERN TABLELANDS OF NSW, AUSTRALIA

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ABSTRACT

A comparison was made of pasture production from phosphate fertilisers, including superphosphate, reactive phosphate rocks (RPRs) and a non-reactive phosphate rock at two sites on the Southern tablelands of NSW, Australia. Production from all phosphate rocks was low in the first year at both sites, but RPRs were similar to superphosphate by the fourth year. Production from RPRs was low in a dry year which is consistent with the requirement for moist acid soils for effective release of P from RPRs. Performance of RPRs was better at the site which was moister and had higher summer rainfall.

KEYWORDS

Reactive, phosphate, rock, superphosphate, pastures, clover, yield, production

INTRODUCTION

For many years, superphosphate has been the main phosphate fertiliser used on pastures in Australia. It is a well-balanced product, supplying phosphorus (P) and sulphur (S). Recently there has been interest in other sources of P such as Reactive Phosphate Rock (RPR), which is claimed to provide P in a "slow release" form. RPRs are phosphate fertilisers which can be directly applied to pastures without any manufacturing process. When they react with moist acid soil, they release P in a form that is available to plants. Considerable cost savings may be possibleif RPRs can be effectively used as a P fertiliser instead of manufactured products such as single superphosphate. On the other hand, the use of RPRs in inappropriate situations may be uneconomic.

Previous research in Australia (eg Bolland and Gilkes, 1990) has not shown benefits from using such products, but they have been found to be effective in New Zealand under the right conditions (Sinclair *et al.*, 1990). Also, RPRs contain much less S than superphosphate, and if it is not added, there may be a poor response to the P released (Sale 1994). The purpose of this study was to compare pasture production from a range of RPR's with that from traditional water soluble phosphate fertiliser under conditions which should allow the RPRs to be effective. Experiments were located throughout temperate and tropical Australia, but results presented here are from the Southern tablelands of NSW where there are many acid soils (pH $CaCl_2$ < 4.5) and rainfall is between 500 and 900mm.

METHODS

In 1992, 29 experiments were established across Australia in the National Reactive Phosphate Rock Project which is evaluating the suitability of RPRs as fertilisers for Australian pastures. Two sites within this project were located at Yass and Tarago on the Southern Tablelands of NSW, and details of these sites are shown in Table 1. At each site the existing pasture was sprayed out with glyphosate and seed of *Trifolium subterraneum* oversown in autumn 1992. Throughout the experiments, an attempt was made to maintain legume-dominant pastures by oversowing fresh legume seed each autumn and by applying herbicides to restrict growth of annual grasses (eg *Vulpia* spp.). Fertilisers compared were single superphosphate, RPRs fromSechura, North Carolina, Egypt and Morocco and a non-reactive phosphate rock from Duchess, Australia. Fertilisers were applied in autumn 1992, 1993, 1994 and 1995 at the equivalent of 0,15,30 and 60 kgP/ha and, to avoid other nutrient interactions, basal applications of S, K, Mo, B, Cu, Zn and Mg were made to all plots. Plot size was 5m x 2m and four replications were used. Sampling was carried out from 1 to 3 times per year, usually in spring. At each sampling, the borders of each plot were mown off and the material discarded. A single strip 3.8 x 0.5m was collected from the remaining herbage with a rotary mower, dried and weighed. After sampling, remaining herbage was mulched back onto the plot giving approximately 50% return of nutrients. At each sampling an estimate was made of the proportions of legume, grass and weeds present in each plot.

Data were analysed by fitting Mitscherlich curves to the yield data and calculating a "Substitution Value" (SV) for each product compared to single superphosphate. SVs were calculated as the ratios of RPRs and superphosphate required to produce a given level of DM production or the ratios at a given rate of application. t-tests were used to determine whether significant differences existed between SVs for various products and single superphosphate.

RESULTS AND DISCUSSION

RPRs often take a number of years of annual applications to be as effective as superphosphate (Sinclair *et al.*, 1990). This was demonstrated clearly at both sites, but particularly at Yass, where production from RPRs was low relative to superphosphate in Year 1 and increased in succeeding years (Figure 1). 1994 was an exception however, as production from RPRs was again low. This was a drier than normal year (rainfall 72% of normal) and the poorer result fromRPRs may have been due to slower than normal breakdown of RPR, as both moist and acid conditions are required for RPRs to react with soil (Sale, 1994).

The two sites gave different responses to RPR application. At the Yass site, single superphosphate always gave more production than the RPRs except in 1995 when Sechura, North Carolina and Moroccan were similar (See Figure 1). The most productive RPRs tended to be Sechura and North Carolina Rock and the least productive was Duchess Phosphate Rock, a non-reactive rock. Once the first year lag was past, performance of RPRs at Tarago was much better than at Yass, with productivity in 1993 being 80 to 115% that of superphosphate. Dry conditions in 1994 (rainfall 80% of normal) again resulted in poorer performance of RPRs (50-80% superphosphate). However, by 1995, performance of all phosphate rocks, including Duchess, exceeded that of superphosphate, although the differences were not significant. The reason for the better performance of RPRs at Tarago is uncertain, but could be due to the higher rainfall than Yass, particularly the higher summer rainfall received.

Results from these experiments suggest that RPRs could be useful fertilisers on the Southern tablelands of NSW, providing the soil is acid and rainfall is adequate. Locations closer to the coast where

more summer rain is received may be more suitable than those to the west. The cost of the particular fertilisers is an important factor in determining whether RPR should be used in preference to superphosphate. Although RPRs have a higher P content than superphosphate (12-14% vs 9.5%P), the need to add sulphur to RPRs, and the lower yield they produce in the early years may mean that superphosphate is still a more economic alternative.

ACKNOWLEDGMENTS
The National Reactive Phosphate Rock Project was funded by the International Wool Secretariat, Dairy Research and Development Corporation, Meat Research Corporation, CSBP Fertilisers, Incitec, Pivot Fertilisers, Jomoco Fertilisers and Quinphos Fertilisers.

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Table 1
Details of experimental sites.

	Yass	Tarago
Altitude	560m	740m
Rainfall	665mm	700mm
Parent Material	Granite	Granite
Soil Type	Red podsolic	Yellow podsolic
pH (1:5 $CaCl_2$)	4.7	4.0
Soil P (Colwell)	10	10
Existing pasture	Annual grass/ subclover	Native grass/ subclover
Previous superphosphate	2.1 t/ha 1970-1989	1t/ha 1975-1990

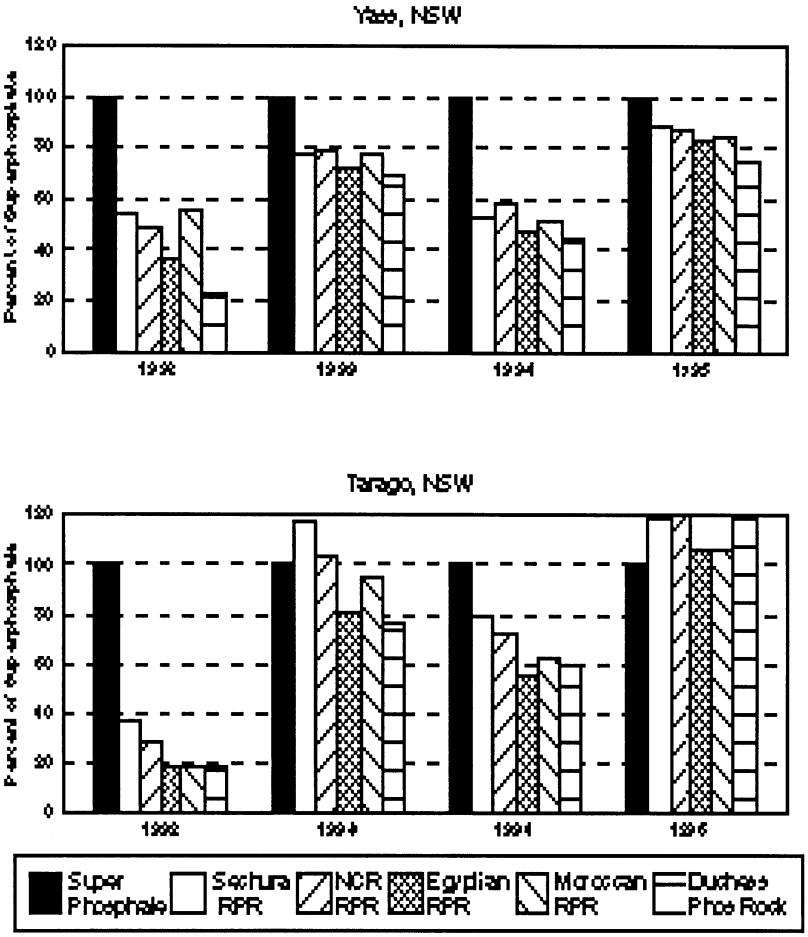

Figure 1
Relative production of pastures fertilised with superphosphate, four reactive phosphate rocks and a non-reactive phosphate rock, at two sites on the Southern tablelands of NSW. Fertilisers are compared at the equivalent of 15 kgP/ha (Percent of yield with superphosphate).