Partially acidulated rock phosphates (parp) as fertiliser for perennial pastures

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Since the major portion of P in superphosphate is present as water-soluble mono-calcium phosphate, the rate of release of P from the superphosphate granule generally exceeds the short-term demand by perennial pasture plants. Theoretically, a P fertiliser with an extended period of P release which more closely approximates the P demand by pasture plants should be more efficient than superphosphate, especially when significant amounts of fertiliser P are fixed in the soil or leached from the root zone. Furthermore, the potentially higher residual value of the applied P (in the medium term) from such a fertiliser may enable the farmer to reduce costs by less frequent fertiliser applications.

Partially-acidulated rock phosphates (PARP) contain a portion of their P in the water-soluble form, and the remainder as rock phosphate; they therefore contain readily available and slow-release P fractions. This paper reports on a glass-house experiment that examines the effectiveness of partially-acidulated rock

phosphates as potential P fertilisers for legume-based perennial pastures.

Methods

Two lucerne plants (CUF 101) were grown in 15 cm diameter pots containing 1500 g of a medium-fine, granite-based soil (pH 6.1) containing medium levels of bicarbonate extractable P (20 pg g^{-1}). The pots were free-draining and were watered by automatic overhead sprinklers. Different PARP formulations and single superphosphate were applied at 10, 20, 40 and 80 kg P ha^{-1} in a circular band (5 cm in diameter) at a depth of 2 cm in the middle of the pot. Fertiliser particle size was 1-2 mm. Basal nutrients were resupplied to each pot every 8 months. A total of 15 harvests were carried out over a 21-month period. Each harvest was performed when 10% of plants had begun flowering. Dry matter yields, P and S uptake were measured for each set of three harvests.

Results and Discussion

Lucerne yields increased ($P < 0.05$) when the acidulation rate was increased from 25% to 50%, when elemental S was included in the fertiliser (10% w/w), and when 50% of the plant tops were returned to the pots to simulate nutrient recycling. The addition of sulphate-S did not affect plant yield. Thus the beneficial effect of elemental S presumably resulted from its bacterial oxidation, leading to an increase in the rate of P release from the rock phosphate fraction.

The data presented in Figure 1 are consistent with the hypothesis that P release from the water-insoluble P fraction of the PARP, although limited in the short term, does increase with time. The displacement of the PARP response curve above that of single superphosphate during the last six harvests represents the contribution to the available P supply from the water-insoluble P fraction of the PARP. The significance of this extended period of P release from PARP fertiliser is now being examined in the field.

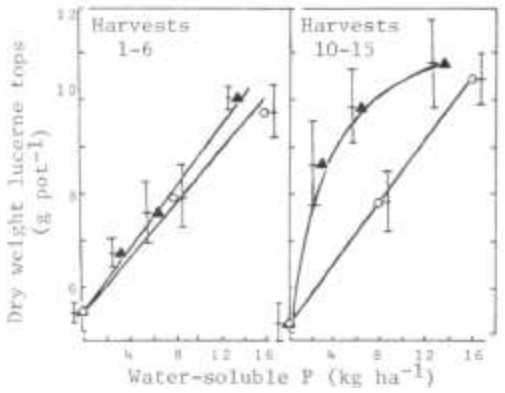

Figure 1. Dry weight of lucerne tops as a function of the level of water-soluble P applied in a single superphosphate (o) and 50% acidulated Duchess rock + elemental S (▲). Vertical bars represent ? standard error of mean for treatments where plant residues were returned to the pots.