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A COMPARISON OF THE EFFECTIVENESS OF TWO PROPRIETARY PHOSPHATE PRODUCTS COMPARED TO SUPERPHOSPHATE AS PASTORAL FERTILISERS

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Abstract

A field trial was established by Terracare Fertilisers Ltd on an Allophanic soil on the side of Mount Pirongia in March 2009. This trial compared phosphorus applied to pasture at 20, 40, 80 and 120 kg/ha in three forms of fertiliser – conventional superphosphate, a fully-reverted dicalcic product, DP65, and a proprietary product from Terracare, RePlenish, which contains dicalcium phosphate as part of its composition.

The trial continued for three and a half years, until December 2012 during which time the fertiliser treatments were re-applied twice giving a total of three applications.

Pasture was harvested whenever the ryegrass component of the sward reached the three-leaf stage, and production (in terms of dry matter (DM) yield) was recorded for each plot.

The site was soil sampled (0-75mm) at the start of the trial, and then just before each re-application of treatment fertilisers as well as on completion.

There were significant responses to both the rate and form of P fertiliser throughout the trial. In the first year, RePlenish out-yielded both superphosphate and DP65, with the size of the difference tending to increase from 4 to 7% over superphosphate as the rate of P applied increased.

Year two results again showed that RePlenish treatments out-yielded superphosphate, while DP65 was intermediate between the two. The RePlenish yield increases ranged from 9 to 20% between 20 and120 kg P/ha, while DP65 gave 6 to 9% increases, over superphosphate at equivalent rates of P. RePlenish treatments again yielded more pasture growth in year 3, with increases over those from superphosphate ranging from 6 to 12% between 20 and 120 kg P/ha; DP65 gave yield increases of 4 to 8%.

Averaged over the duration of the trial, the annual yield for the control treatment was 8,450 kg DM/ha, while at 120 kg P/ha/year, superphosphate gave 11,010 kg DM/ha, RePlenish, 12,500 kg DM/ha and DP65, 11,680 kg DM/ha.

An economic analysis, based on “normal” P-rates of 20-40 kg P/ha showed that the marginal cost of changing fertiliser to either alternative product from superphosphate was less than the cost of providing extra feed from outside sources.

The pattern of soil Olsen-P tests differed between fertilisers. Superphosphate increased Olsen P more than either DP65 or RePlenish, with test results on the 120 kg P/ha treatments reaching 31 on the superphosphate 22 on the RePlenish, and 19 on the DP65, treatments. DP65 at higher rates increased soil pH more than the other two forms of P. Along with this,

DP 65 also reduced the amount of exchangeable aluminium – which can be toxic to root growth – in the soil whereas increasing rates of P as superphosphate increased Al levels

Introduction

Dicalcic fertilisers are made by reacting superphosphate with limestone to produce a fertiliser which contains dicalcium phosphate (DCP) as opposed to the monocalcium phosphate (MCP) found in superphosphate. These fertilisers have been made and sold in New Zealand for at least 50 years.

Over time, the performance of dicalcic fertilisers has been claimed to be superior to superphosphate. However, these claims are typically anecdotal, and such research in New Zealand that has been done usually shows the performance of the two forms of P fertiliser to be very similar (Edmeades, 2000). The data Edmeades reviewed showed that when compared to fertilisers containing MCP, DCP fertilisers yielded between 10% less, to 21% more pasture growth. The average yield-difference was close to zero, from which Edmeades (loc. cit.) concluded that either form of P was as effective as the other.

Edmeades (2000) described two mechanisms by which dicalcium phosphate fertilisers could be more effective than monocalcium phosphate P fertilisers; viz:

1. These products contain predominantly dicalcium phosphate (DCP) ($CaHPO_4$), rather than the more soluble monocalcium phosphate (MCP) ($Ca(H_2PO_4)_2$) present in water-soluble P (WSP) fertilisers. It is claimed that DCP is utilized more efficiently because it better matches the plant's demand for phosphorus (P).

2. The dissolution of DCP produces alkali and thus less fertiliser P is "fixed" by reaction with active soil Fe and Al oxides and less P is adsorbed onto the surface of soil minerals. This also results in a more efficient source of P for plant growth:

$Ca\,HPO_4 + H_2O = Ca^{2+} + H_2PO_4^- + OH^-$

If either effect was operating for any of the trials reviewed, the outcome should have been greater levels of production at equivalent rates of P applied. He concluded (Edmeades 2000) that the data he examined provided little evidence for the operation of either of these effects, citing evidence of other contributing factors, such as the liming effect of the DCP fertilisers applied, which typically contained excess lime as well as the liming effect outlined in the above reaction.

Overseas research (eg. Brennan and Bolland, 2005, on wheat rather than pasture) appears to support the conclusions drawn in New Zealand. However, in a laboratory and greenhouse study, Probert and Larsen (1970 a and b) found that while powdered DCP released P at a similar rate to MCP, when granulated, the release-rate of P from DCP increased over time relative to MCP such that, at 103 days post-application, DCP granules released P faster than equivalent-sized MCP granules. All the results reported above (Edmeades 2000 and Brennan and Bolland 2005) used powdered DCP as this was the form (especially in New Zealand) in which the DCP fertilisers were supplied.

One of the disadvantages of the dicalcic fertilisers compared to superphosphate has been that, as they contain less total P than superphosphate (typically 4% compared to 9%) and incur extra costs in manufacture, the "on-ground" cost of these fertilisers in terms of equal amounts of P applied, is higher. The higher transport and spreading costs associated with the need for higher rates of material needed to supply the same amount of P also contribute to the cost differential.

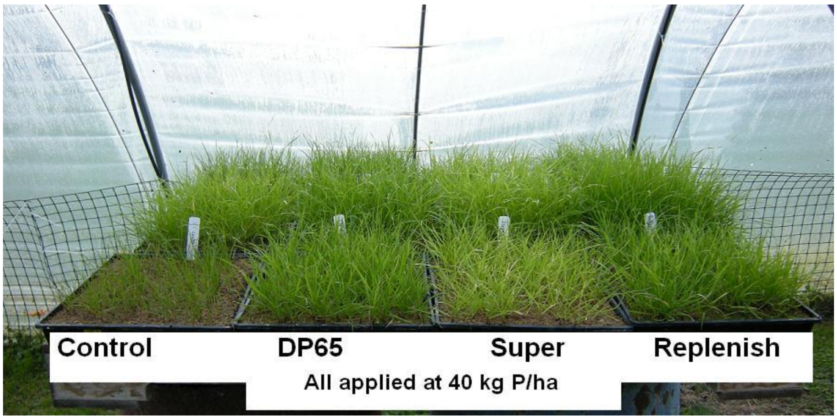
In addition to this, concerns about the safety of spreading powdered products by aircraft prompted Terracare to change their manufacturing process to produce granulated product. All the material used in trials sponsored by Terracare was therefore granulated, unlike that used on the previous work.

In a bid to overcome the transport and spreading disadvantages, Terracare Fertilisers of Te Awamutu formulated a proprietary product – "RePlenish" - containing 9% total P. This was done by using materials other than superphosphate to provide the P in the final product. Before launching the product, Terracare commissioned a glasshouse pot trial comparing the RePlenish with superphosphate (SSP) and reactive phosphate rock (RPR). This trial compared a control, and the three forms of fertiliser applied to supply 33, 66 and 99 kg P/ha.

This trial used a low P soil with a pH of 5.9 and showed that RePlenish produced more ryegrass growth than either superphosphate or RPR (P W Shannon, pers com.). With the yield from the top rate of RePlenish set at 100, the top rate of superphosphate produced a yield of 72 and the top rate of RPR, a yield of 25. The control produced a yield rating of 15. Also of note was that the rating advantage to RePlenish increased as the rate of P applied increased.

This trial was followed with another glasshouse comparison of superphosphate, RePlenish and a more "conventional" dicalcic fertiliser, DP65 (6.5% total P) at 40 kg P/ha as well as a zero P control, on a range of soils – Allophanic, Pallic and Recent. The yields (Shannon, pers com.) showed that RePlenish and DP65 out-yielded superphosphate, with RePlenish tending to grow more than DP65. The pattern of yields is quite clear in the accompanying photograph (Plate 1; Shannon, pers. com).

Plate 1. A comparison between two proprietary P fertilisers and superphosphate on different soils



Over the 6-month life of the trial total pasture yield for RePlenish came to 5,300 kg DM/ha, DP 65 gave 4,100 kg DM/ha while superphosphate gave 2,600 kg DM/ha. The control grew 1,800 kg DM/ha.

Of note in this latter trial was that the pallic and recent soils were acidic (pH of 5.3 and 5.2 respectively), and so they were limed to bring the pH above 5.6, to avoid any aluminium toxicity effects from influencing pasture growth and P-uptake. Thus, the effects noted were likely to be related to differences in the behaviour of the different forms of P in the trial, and not to any possible liming effect from the lime included in the formulation of the dicalcic fertilisers.

Given that these results, while conclusive in themselves, were derived from glasshouse experimentation, Terracare Fertilisers Ltd decided to commission a field trial in which the three forms of P fertiliser would be compared to establish whether the yield pattern noted in the glasshouse would be repeated under field conditions.

Materials and Methods

The site selected for this trial was located on the slopes of Mount Pirongia on a site accessed via Sainsbury Road, at 38.0038 S, 175.1656 E at an altitude of 205m a.s.l. The topsoil is a clay loam of Allophanic origin. Initial soil tests (0-75mm depth) showed that it had an average soil pH of 5.9, while Olsen P levels averaged 14 and Resin P, 12. ASC levels were high, averaging 99. Soil potassium levels were adequate with test levels of 10 (Quick Test (QT) units). Sulphur reserves were high (Total S averaged 1336 mg/kg), while soil exchangeable calcium (Ca) averaged 6 and magnesium (Mg), 19 QT units.

The trial site pasture was in a low-fertility state, as would be expected from the generally low soil P levels. There was some ryegrass and white clover (origins unknown) present in the sward; it was expected that, with the improvement in soil P levels resulting from the application of fertilisers over the next three years, that pasture composition would improve.

The trial was laid out on the 11th of November 2008, and trimmed off to a 3cm residual using a rotary mower.

Fertilisers for the site were drawn from stocks held at Terracare (superphosphate) or manufactured on a small granulation plant (DP65 and RePlenish) according to the composition then in use by Terracare in the manufacture of commercial stocks. Sufficient quantities were made or held to provide for the trial needs for three years. The fertilisers were stored in plastic bins with sealed tops to avoid contamination.

Prior to application, representative samples were sent to Eurofins' Hamilton laboratory to be tested for total P, citric soluble and water soluble P, total Ca and total S. The amounts needed for each plot for each treatment were calculated from the results obtained.

Treatments for the trial were all combinations of rates of 20, 40, 80 and 120 kg P/ha/yr and forms of P fertiliser (RePlenish (RPL); DP65, and Superphosphate (SSP)), plus a zero P control.

Each treatment was replicated 5 times, with the trial being laid out as a randomised complete block design; this gave a site with 65 plots in five blocks of 13.

Fertilisers were applied on 13/03/2009, and the trial was harvested thereafter whenever the ryegrass plants present on-site had reached the 3-leaf regrowth stage.

Treatment fertilisers were re-applied on 16/05/2010 and 09/08/2011 just after a trial harvest was taken, so that fertilisers could be applied with little or no risk of being removed in harvested material. Prior to each re-application, the stored fertilisers were re-sampled and re-analysed to check that composition had not changed appreciably in storage. The results are given in Table 1.

Soil samples were taken from each plot (0-75mm) immediately before the fertilisers were applied, and again at the end of the trial on 23/12/12.

Basal fertilisers – potassium chloride (50% K) and borate 48 (15% B) were applied every 6 months to all treatments to provide 70 kg K and 1 kg B/ha.

At each harvest, two strips 460mm wide were cut from each plot using a rotary lawnmower, and the herbage material collected was placed in a plastic bag and sealed. The remainder of the pasture on each plot was then mowed off to the same height and the cut material was spread over the plot.

The collected material from each plot was weighed, then a sub sample of approximately 100g was withdrawn from the bulk material, placed into a paper bag and dried in a forced-draught drying oven set at 100C for 24 hours, after which they were re-weighed.

Plot dry matter yield was then calculated using the percentage DM reading obtained from the sub-sample.

In March 2011, it was decided to spray out the trial-site and re-sow with ryegrass (Lolium perenne cv Samson) and white clover (Trifolium repens cv Kopu II) because the expected improvement in pasture composition had not occurred. Accordingly, the site was sprayed on 28/03/2011with glyphosate (36% a.i.) diluted 100:1. On 01/04/2011 the area was mown off to ca. 1 cm, after which it was scarified and the seed was broadcast over the site to achieve a sowing rate of 20 kg of ryegrass and 3 kg of white clover/ha. The site was then rolled to improve seed/soil contact.

Production harvests recommenced on 23/09/2011, a month after the third application of trial fertilisers.

While some data analysis was carried out after each harvest, the main data analysis was centred on annual yields, which were obtained from the summing of all harvests taken between fertiliser applications.

An initial one-way analysis of variance (ANOVA) was carried out using the Data Analysis Pak™ available with Microsoft Excel 2016. The results of this analysis were used to determine the Least Significant Difference for the results. Next, the P-treatment plot yields were analysed using the "Two-Way ANOVA – With Replication" facility in Excel. The results of this analysis were used to determine if there were treatment responses to both the rates of P applied, and to the forms of P fertiliser used (SSP, RePlenish and DP65) in the trial. Finally, the results were plotted in a scatter-plot chart, and the curve-fitting function in Excel was used to establish trend lines (yield vs P applied) for each form of P-fertiliser. A power function ($y = a*rate^b$) was selected as the basis for the curve-fitting as it gives a diminishing-response curve which generally follows the way fertiliser responses change with increasing rates of applied nutrient.

Soil test results were also analysed using the same protocol, to determine if there were significant effects relating to both the rate of P applied and the form of P-fertiliser.

A significance level of $p<0.05$ was used as the determinant of a significant response; if the significance level was greater than this, but less than 0.10, the effect noted is described as a trend.

Results and Discussion

Fertiliser analysis

Fertiliser composition is shown in Table 1. The pattern of results was as expected – superphosphate having most of its total P present in citric soluble form and a high proportion as water soluble P, while in comparison RePlenish had a slightly lowered proportion of citric soluble P and a markedly lower proportion of water-soluble P. DP65 showed a pattern typical of "reverted superphosphates" with proportionately lower citric and very low water soluble, P levels.

Pasture Yield

In the first year (Figure 1) there was a strong response to increasing rates of phosphorus applied ($p<0.002$), and a significant difference ($p<0.02$) between the RePlenish treatments and those of superphosphate and DP65, which were not significantly different from one another; indeed, the DP65 treatments tended to grow less than the superphosphate treatments.

Table 1. Results of trial fertiliser analyses throughout the trial

Analytes		**Year**	
	2009	**2010**	**2011**
Total P		%	
SSP	9.44	9.24	9.35
RPL	9.73	9.84	9.81
DP65	7.16	7.02	7.29
Citric-soluble P		%	
SSP	8.25	8.19	8.12
RPL	7.76	7.44	7.47
DP65	5.05	4.82	4.84
Water-soluble P		%	
SSP	7.36	7.75	7.41
RPL	4.79	4.2	3.95
DP65	0.41	0.26	0.28

Note: SSP = superphosphate; RPL = RePlenish.

The size of the difference between the RePlenish and Superphosphate treatments tended to increase as the rate of P increased – the range being from 4 to 7% between 20 and 120 kg P/ha. In contrast, DP65 yields tended to be around 98% of those measured for superphosphate.

In the second year (Fig. 1), there was again a significant response to increasing rates of P ($p<0.006$), and a significant difference to responses to different forms of P ($p<0.009$). This year, DP65 tended to out-yield superphosphate, while RePlenish out yielded both superphosphate and DP65. Again, the differences between amounts of pasture grown tended to increase as the rate of P increased, with yields from RePlenish increasing from 9 to 20% between 20 and 120 kg P/ha and 6 to 9% for DP65 compared to superphosphate at the same rate of P applied.

By the third year (Fig 1), both RePlenish and DP65 tended to out-yield superphosphate ($p<0.10$), with little difference in yields between RePlenish and DP65. There was still a significant response to increasing rates of P ($p<0.07$).

The size of the difference in yields ranged from an 6% increase at 20 kg P/ha up to a 12% increase over superphosphate at 120 kg P/ha/yr for RePlenish, and from 4% to 8% over superphosphate for DP65 over the same range of P inputs.

Accumulated pasture yield over the three years (Fig 2) show that RePlenish out-yielded both superphosphate and DP65 ($p<0.03$), while DP65 tended to give more growth than superphosphate. There was also a strong response to increasing rates of P ($p<0.003$). The size of the yield increase over superphosphate ranged from 7% at 20 kg P/ha to 13% at 120 kg P/ha for RePlenish and from 2 to 5% for DP65 again with reference to superphosphate.

The trends displayed in these results imply that over time, both RePlenish and DP65 can grow more pasture than superphosphate when applied at equivalent rates of P. Also, if the results are compared between years, it shows that the differences between RePlenish and DP65 and superphosphate tended to increase over time; for example, at 120 kg of P/ha/yr, the advantage to RePlenish over superphosphate went from 7% at year 1 to 20% in year 2 and 12% in year 3. DP65 went from -2% in year 1 to an 8% increase in year 3.

Figure 1. The effect of rates and forms of P on pasture yield throughout the trial.

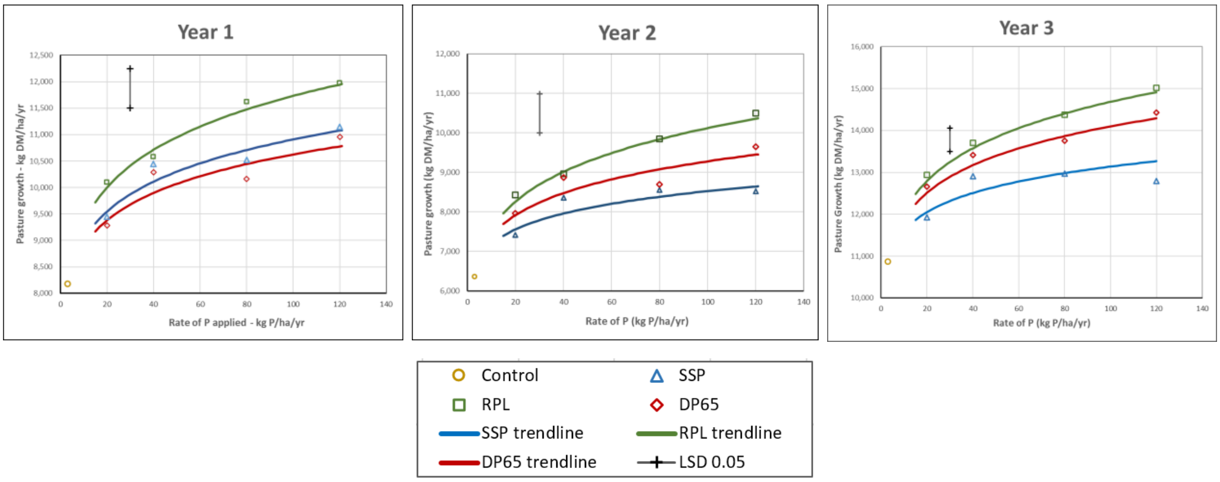
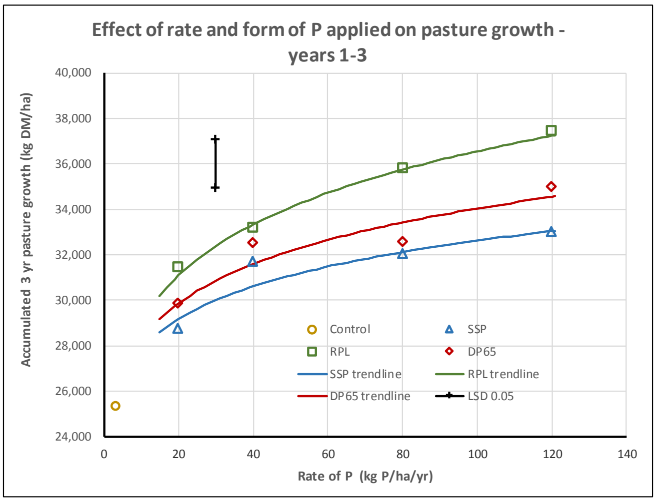


Figure 2. The effect of rates and forms of P on pasture yield – accumulated yield, years 1-3



This pattern of responses was like that implied in the P-release study from dicalcic P fertiliser granules carried out by Ramakrishnan and Perrot (2004), who used a technique designed by Perrot and Kear (2000) to leach P from different P fertilisers. A similar pattern of responses could also be inferred from the results of Devine *et al* (1968), who found that granular dicalcic phosphates initially released P more slowly than superphosphate, but, over time, gave higher levels of available P in the soil than those from superphosphate.

The practical implications of these results are that both RePlenish and DP65 appear capable of either (a) supporting higher rates of pasture growth than superphosphate at the same rate of P applied or (b) supporting the same amount of pasture growth with less P than would be needed from superphosphate. These results also indicate that one or both of the outcomes stipulated by Edmeades (2000) as indicating that dicalcic P fertilisers were capable of out-performing superphosphate, were being achieved.

Point (a) above is demonstrated in Table 2 which shows how the relative agronomic efficiency (RAE) as defined in Bolan *et al*, (1990) varied over time through the trial. Apart from year 1 for DP65, both RePlenish and DP65 had a RAE of greater than 1. Also, the RAE tended to increase with time for both products, which indicates that the supply of plant-available P was accumulating in the soil in a manner similar to that described by Devine *et al* (1968).

Table 2. Changes in Relative Agronomic Effectiveness(RAE)* of RePlenish (RPL) and DP65 with reference to Superphosphate(SSP) over the duration of the trial.

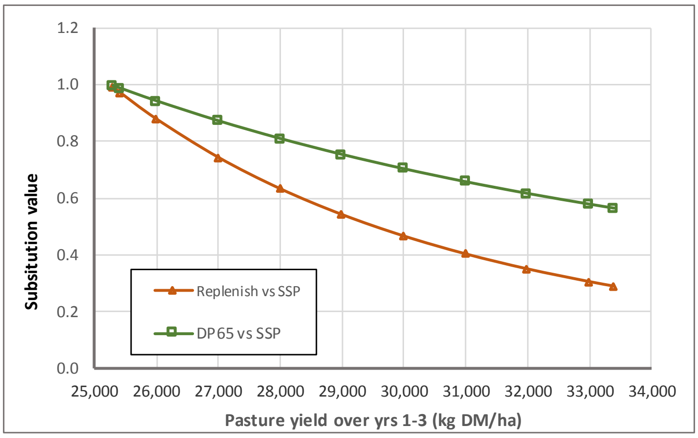
	RPL	DP65
Year 1	124	92
Year 2	181	137
Year 3	165	141
Years 1-3	152	119
Years 2-3	173	139

*These values are derived from the fitted trend lines rather than the raw data.

Point (b) is shown in Figure 3, which shows how the substitution-value between either RePlenish or DP65 decreases as the target yield increases. This means that, under similar conditions to those found on the current trial-site, where either RePlenish or DP65 is used, less total P will need to be applied to achieve a given yield target than if superphosphate was used. If this trend is found on other sites, it means that the risk of P-loss to waterways could be reduced as less total P would be present in the soil.

A similar pattern of substitution values between superphosphate and RePlenish was found in the initial glasshouse pot trial (P W Shannon, pers comm.)

Figure 3. The change in substitution-rate between superphosphate and RePlenish or DP65, based on accumulated yield, years 1-3



Economic Effectiveness

While the proprietary products produced higher pasture yields than superphosphate, the production of these products adds further costs over those of making superphosphate. This means that they cost more than superphosphate.

If the rate of P application is maintained, these results predict that changing fertilisers would lead to higher rates of pasture growth and hence, an increase in feed supply. Another way to increase stock feed supplies is to purchase additional feed from off-farm.

For the purposes of this paper, a cost-comparison was made using a farm running 12.5 rsu/ha and growing (at 65% pasture utilisation) 10,490 kg DM/ha/yr., with a maintenance fertiliser requirement of 20 kg P/ha/yr. If the fertiliser was to be changed to either RePlenish or DP65, the trial results predict that production would be increased as outlined in Table 3.

The outcome of the comparison shows that the marginal change in costs to provide the same increase in feed supply would be lower where the fertiliser policy was changed rather than by using imported feed.

Table 3. A comparison of the difference between extra costs in applying RePlenish or DP65, and purchasing supplementary feed to supply the same increase in feed supply.

	Superphosphate	RePlenish	DP65
Pasture growth (kg DM/ha/yr)	10,490	11,180	10,740
Yield increase (kg DM/ha/yr)		690	250
Fertiliser rate (kg/ha) to supply 20 kg P/ha[1]	220	220	310
Fertiliser cost (applied) ($/ha)[2]	$99	$134	$159
Cost increase from superphosphate ($/ha)		$34	$59
Amount of maize silage needed (kg DM/ha)[3]		660	240
Maize silage cost ($/ha)		$254	$92
Saving (silage cost less increased fertiliser cost)		**$220**	**$33**

Notes: 1. Superphosphate and RePlenish currently have 9%, while DP65 has 6.5%, total P.
2. Prices as at February 2017, plus $30/T cartage and $100/T spreading.
3. Maize silage is costed at $305/T, with 10.5 MJME/kg DM and allowing for 70% utilisation (fed in-field).

A similar exercise with a scenario needing 40 kg P/ha as superphosphate, yielded cost-savings of $465/ha for RePlenish, and $85/ha for DP65.

Soil Test results

Soil Olsen P

It was obvious from year 2 onwards that soil Olsen P test readings were lower on the RePlenish and DP65 treatments than on those topdressed with superphosphate. This has important ramifications in that if the effectiveness of fertiliser applications are judged by the change in soil test levels, then the immediate perception could be that the RePlenish or DP65 were not as effective as superphosphate. However, the pasture growth measurements showed that the application of these P fertilisers often resulted in higher pasture growth-rates than those achieved from using superphosphate.

The changes over time at increasing rates of P are shown in Figure 4 for each individual form of P fertiliser used in the trial. By the end of the third year for example, at the 120 kg P/ha/yr rate of P application, soil Olsen P levels had increased to 31 on the superphosphate treatment, but had only reached 23 and 20 on the RePlenish and DP65 treatments respectively.

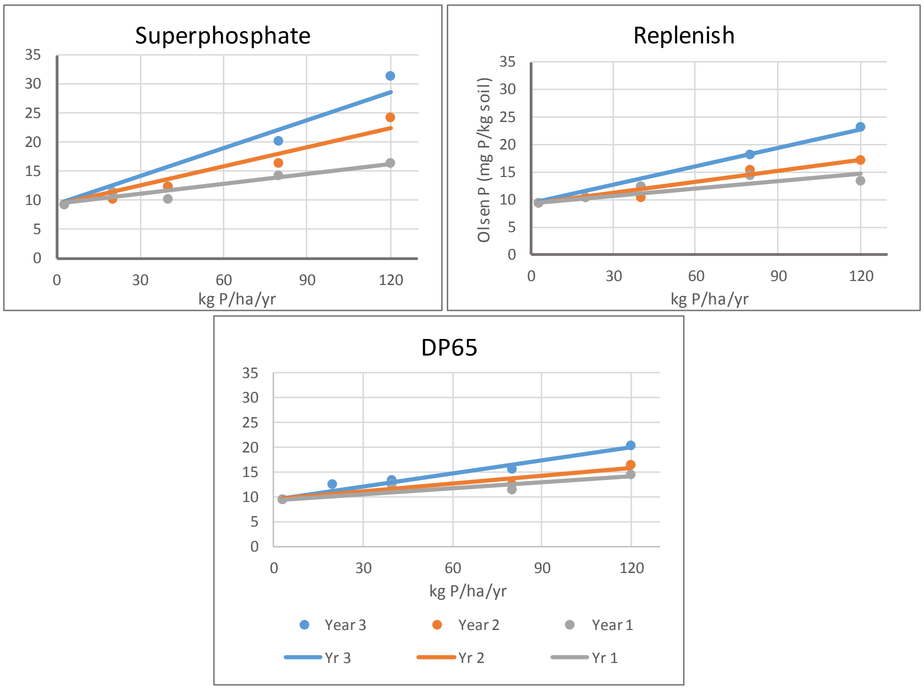
From this, given the differences in pasture growth-rates between the different forms of P-fertiliser, it follows that the calibration-curves relating pasture growth to the soil Olsen P level will also be different for each form of P fertiliser.

This is shown quite clearly in Figure 5. At an Olsen P level of 25, the superphosphate trend line indicates that superphosphate-treated soils would have produced 32,000 kg DM over 3 years. This same amount of pasture growth would be indicated by Olsen P levels of 15 for DP65 and 13 for RePlenish. This is broadly similar to the trends found when Reactive Phosphate Rock (RPR) fertilisers were compared to superphosphate (Roberts *et al*, 1995); at similar yield levels, soil Olsen P levels were lower where RPR was used than where superphosphate was applied.

Soil pH

Figure 6 shows how soil pH on the different forms and rates of P fertiliser changed over time. The data analysis showed that both the rate of P ($p<0.05$) and the form of P ($p<0.05$) had significant effects of soil pH by the end of the third year. The graphs show that, while soil pH increased with the rate of P applied, this trend was most pronounced on the DP65 treatments,

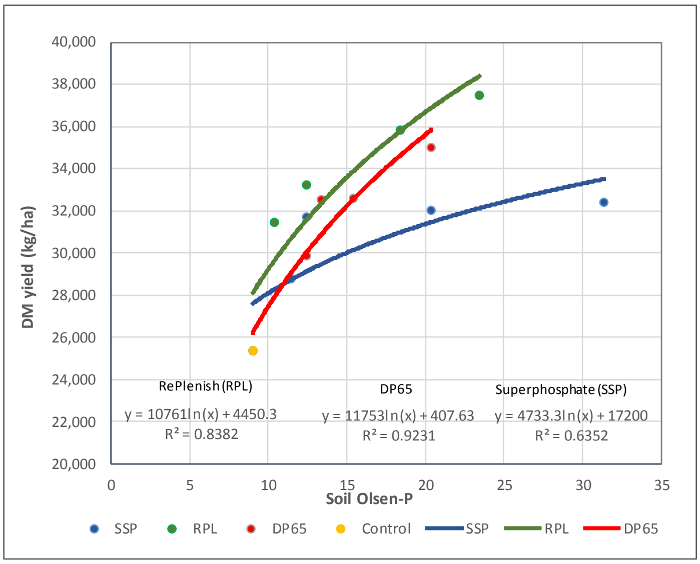
Figure 4. Changes in Soil Olsen P (0-75mm) over time for each form of P-fertiliser



where the pH was increased over the control pH by 0.4 units at 120 kg P/ha/yr, compared to ca. 0.3 units for RePlenish and 0.2 pH units for superphosphate. At lower rates (eg, 40 kg P/ha/yr), the changes were from no increase (superphosphate) to 0.1-unit increase (RePlenish) to 0.2-unit increase (DP65).

These results show that DP65 was capable of meeting soil maintenance liming requirements at lower rates of P application, and, in a developmental situation, of increasing soil pH as well as available P levels. This may have implications for the planning of soil developmental programs, where high rates of P fertiliser are needed, especially where soil pH levels are within 0.2 to 0.4 pH units of the desired soil pH level.

Figure 5. The relationship between yield and soil Olsen P (0-75mm) for each form of P-fertiliser

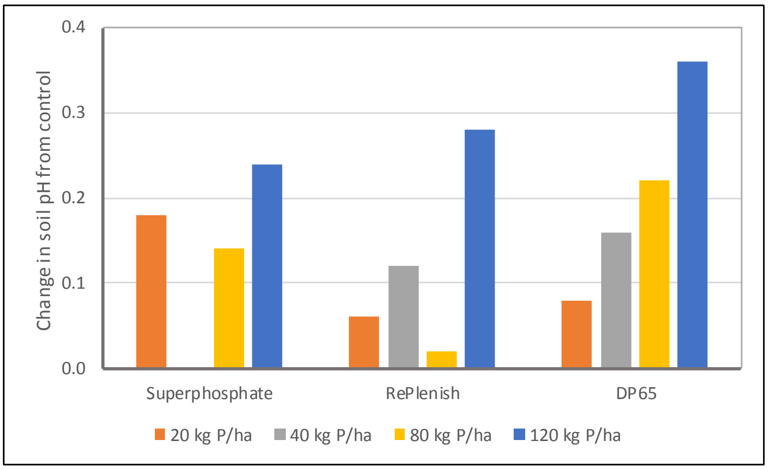


However, given the relatively high soil pH level at the start of the trial, it is unlikely that the performance of either DP65 or RePlenish was enhanced by a liming effect; earlier work (Edmeades et al, 1985) having shown that pasture growth responses to increases in soil pH from a starting pH of 5.9 are unlikely to occur.

Soil Exchangeable Aluminium

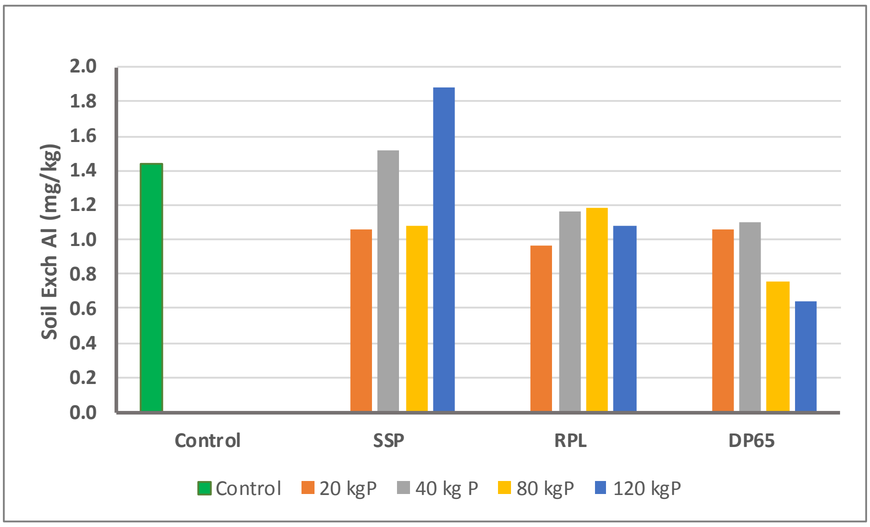
High levels of exchangeable aluminium (exch Al) in soils can reduce plant growth. Legumes such as white clover, important for biological nitrogen fixation, are more sensitive than grasses. While levels on the trial site tended to be low (< 3 mg/kg) the trends shown here may have implications for sites with higher soil exch Al levels.

Figure 6. Changes in soil pH (0-75mm) after three years for each form of P fertiliser



Data analysis showed that, while there was no significant effect of rate of P fertiliser on soil exchangeable aluminium (exch Al) levels, there was a significant effect of form of P fertiliser used ($p<0.01$). This showed that soil exch Al levels in soils treated with superphosphate were higher than those on soils treated with either DP65 or RePlenish. There was also a significant form by rate interaction ($p<0.05$). This latter came about because (Figure 7) increasing rates of P as superphosphate tended to increase soil exch Al levels, while increasing P rates tended to decrease exch Al where DP65 was used. RePlenish tended to have no effect on soil exch Al.

Figure 7. Changes in soil Exchangeable Al (0-75mm) with different forms and rates of P fertiliser (end of year 3)



The effects of DP 65 and Superphosphate were most pronounced at the higher rates of P applied – that is, decreases in soil exch Al were lower at the lower rates of P applied as DP65; while the increases with superphosphate also tended to be smaller at the lower P-rates. This means that where maintenance P is being applied (maintenance P rates tend to be between 20 and 40 kg P/ha/year) then the effect of the type on fertiliser on soil exch Al levels may be small.

Conclusions

1. RePlenish and DP65 caused higher rates of pasture growth than superphosphate over the three-year period of the trial
2. DP65 was slower to act than RePlenish in that yield increases did not occur until the second year of the trial
3. The differences in response can lead to either an increase in production for the same amount of P input, or to needing less P to achieve a given level of production.
4. Using either alternative product to increase feed supply would be more profitable than importing extra feed.
5. DP 65 at higher rates (80 or 120 kg P/ha/yr) can increase soil pH whereas superphosphate and RePlenish are not likely to produce any change.
6. Increasing rates of DP65 decreased soil exchangeable Al levels while increasing rates of superphosphate increased soil exchangeable Al.
7. The yield-soil Olsen P relationship is different for the different P fertilisers; at equivalent rates of P, superphosphate increased soil Olsen P more than RePlenish or DP65.

Note: Terracare have advised that the product DP65 has been re-branded as uPgrade.

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