Proc. Seventh Ann. Conf. Grassld. Soc. NSW, 1992, pp 43-46.

MANAGING SOILS FOR BETTER PASTURES:

BEST BET FERTILISER STRATEGIES - PART 1

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Abstract: *Studies of soil nutrient deficiencies of pasture for major areas of the north west slopes, north west plains, northern areas of the central west slopes and plains, and major parts of the upper Hunter have largely been ignored until the present time. This paper outlines a major pasture soil fertility study, conducted by nine district agronomists, throughout the area described above. The project involves 36 experiments. It has detected almost universal sulphur deficiency and widespread phosphorus deficiency. Relatively low rates of fertiliser have on average doubled pasture productivity. Correcting soil deficiencies with relatively low rates of fertiliser and relatively infrequent application appears to be feasible for much of the area. The study suggests sensible soil nutrient correction programs could ultimately return an additional $200 million per year, and also play a major role in reducing soil erosion and improving soil physical and chemical characteristics. Much of the area involved tends to be overgrazed and/or vulnerable to soil erosion because of long periods of insufficient plant cover. Extra pasture production will result in greater plant cover, less erosion, greater populations of desirable soil organisms and improved soil organic matter levels.*

INTRODUCTION

For a combination of reasons the "clover and super revolution" that began in the 1940s and early 1950s on the coast, tablelands, southern slopes and parts of the central west slopes, did not spread to the north west quarter of NSW. Factors suspected of contributing to exclusion of this region from fertiliser studies include: (1) unsuitable climatic conditions (*eg.* too hot, too dry, rainfall too erratic); (2) no pasture species suitable for use under these conditions; and (3) natural soil fertility which was considered too high to warrant investigation of fertiliser responses.

Researchers, advisers, agri-businesses and farmers, all ignored the use of fertiliser to improve pastures in the north west slopes and plains, upper Hunter and northern half of the central western slopes and plains (Figure 1). Recommendations from the small amount of early research conducted at Narrabri between 1954-57 was either ignored or only adopted in isolated pockets.

FERTILISER RESEARCH IN THE NORTH WEST

In 1983, a program was commenced to identify the nutrient deficiencies in the north-west region and formulate fertiliser strategies for improved pastures. It began as a small core of replicated trials in the Coonabarabran district which were designed to compare single superphosphate and SF45 at two rates (100 and 200 kg/ha) against unfertilised plots.

With increasing interest in pasture improvement and fertiliser usage in the region, the program was extended in 1988 to examine pasture responses to phosphorus and sulphur when applied individually and together at relatively conservative rates. By 1991, the program has expanded to include 36 trials managed by nine district agronomists.

The trials are representative of an area of about 15

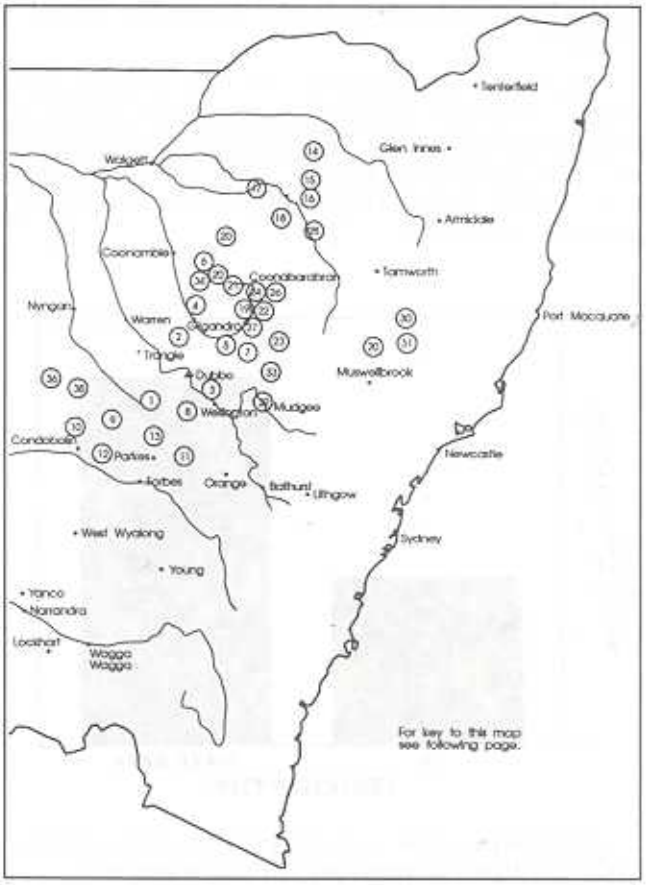
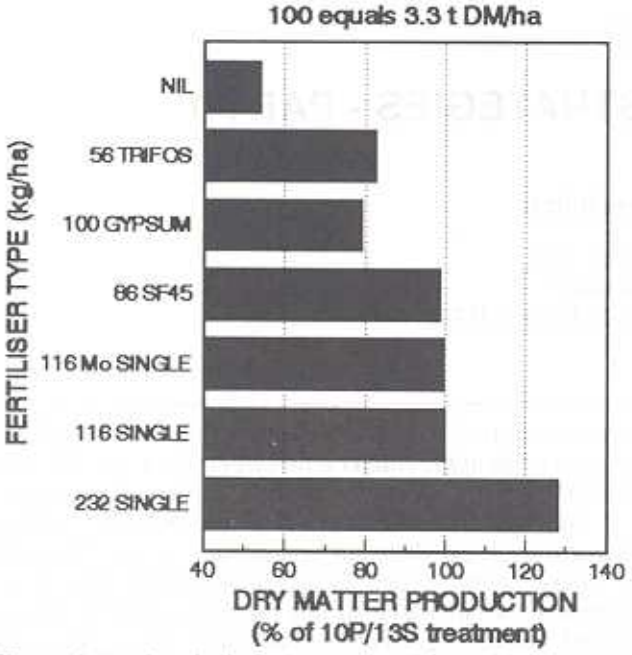


Figure 1: Location of pasture fertiliser trial sites

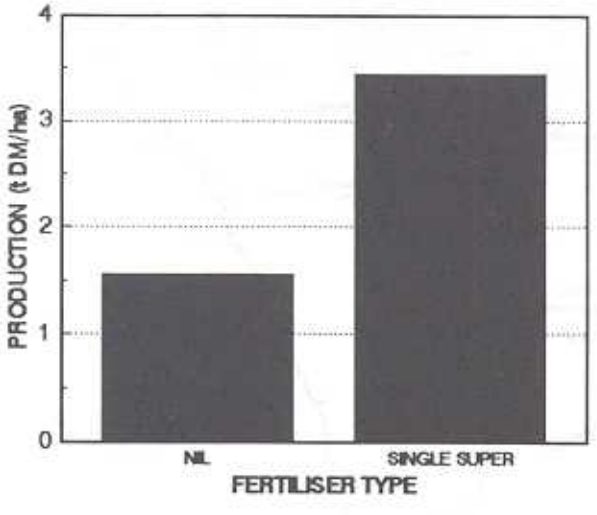


Figures in brackets indicate the number trials used in the comparison with single superphosphate applied at 116 kg/ha.

Figure 2:: Spring response (first/second year) for pastures fertilised with different products.

million hectares and more than 7000 properties. The area extends from Condobolin in the south west, Gulargambone and Coonamble in the north west, Narrabri in the north, the upper Hunter in the east, Mudgee and Wellington in the south and many centres in-between including Gwabegar, Gilgandra, Coonabarabran, Dubbo, Tomingley and Parkes (Figure 1).

The extended program now includes comparisons of different fertilisers (including organic products) at a similar standard phosphorus rate. Several experiments are endeavouring to evaluate the residual worth of superphosphate (8.6% P; 11.5% S) or SF45 (5.5% P; 44.6% S) when applied at a conservative rate.



Single superphosphate applied at 166 kg/ha (10P and 13S). Note that slightly different rates were used in some trials.

Figure 3: Pasture production on phosphorus responsive sites (average of 29 sites - 81% of trials)

METHODS

The current study involves measurement of response of permanent legume-based pastures to P and S fertilisers at the 36 experimental sites in NSW (Figure 1). One experiment is sited on a lucerne pasture and the balance are annual legume pastures which include serradella (4 experiments), medics (9) and subterranean clover (22).

Most of the major soil types of the region are also represented including: basalts, sandstones, granites, red earths, shales, red-brown earths and alluvials. Wherever possible, experiments were located on pastures which had received little or no previous fertiliser application. However, a few experiments were sited on paddocks where limited fertiliser may have been used during the cropping phase of a ley rotation.

Two of the 36 experiments were commenced in 1987, but most did not start until 1989, 1990 or 1991. Size of plots varies from trial to trial ranging from 10 m x 10 m to 5 m x 2 m. All but five Narrabri trials were replicated three times.

All experiments compared a range of products, most at a common phosphorus rate, usually about 10 kg P/ha. Trials were assessed by random quadrat cuts taken from each plot. All yields have been assessed on a dry matter basis. All but one trial was statistically analysed.

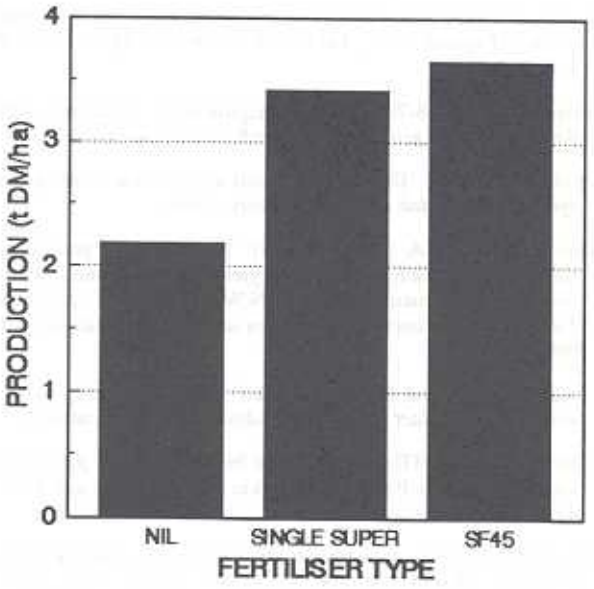
Trials are fenced and closed to stock between the autumn break and the last measurement in spring. Some experiments have been measured only once in the spring, whereas others have been assessed up to four times during autumn, winter and spring. Except for some Narrabri trials which have been measured in summer, sites are generally opened for grazing over the summer period. All trials are uniformly grazed down prior to the beginning of the next autumn break.

The effect of specific fertiliser treatments for up to five years following initial application is being investigated in a few of the longer running experiments. The aim of these studies is to evaluate how frequently fertiliser needs to be applied to maintain pasture productivity and stability.

RESULTS & DISCUSSION

The outstanding responses to relatively low rates of fertiliser in nearly all the trials indicates that correcting soil nutrient deficiencies in pastures throughout the study area should prove to be highly economical. For example, the average response in the first or second year following one application of 116 kg/ha single superphosphate doubled pasture yield (Figure 2). Similar responses were measured for 116 kg/ha of Mo single superphosphate and 86 kg/ha of SF45 (Figure 2).

All but five of the 36 sites showed a significant response to sulphur. A significant response to phosphorus was measured in all but seven trials (Figure 3), although often the P response was smaller than the response to sulphur.In 17 trials (47% of sites), the low phosphorus/ high sulphur fertiliser, SF45, applied at 86 kg/ha produced an equivalent (95%+) or better response than 116 kg/ha of single superphosphate (Figure 4). In 23 trials where superphosphate was applied at double the standard rate (*ie*. 232 kg/ha *versus* 116 kg/ha), yield was increased by a further 28% (Figure 2).



Single superphosphate applied at 116 kg/ha (10P and 13S); SF45 applied at 86 kg/ha (5P and 38S. Note that slightly different rates were used in some trials.

Figure 4: Pasture response to fertilisers applied to low S/high P sites (average of 17 trials - 47%)

Several trials compared a number of products at a standard phosphorus rate of about 10 P kg/ha (there was light variation in P rate between some trials). Some of the alternative products to superphosphate show promise, but on typical phosphorus and sulphur deficient country superphosphate generally outperformed them. Reasons for this advantage may include insufficient sulphur or lack of readily available sulphur in some fertilisers.

The trials generally showed pasture responses to the different fertiliser products were consistent with those expected from examining the nutrient contents on the registered label. This emphasises the importance of ensuring that the fertiliser used has the required amount of **available** phosphorus and/or sulphur for the particular situation.

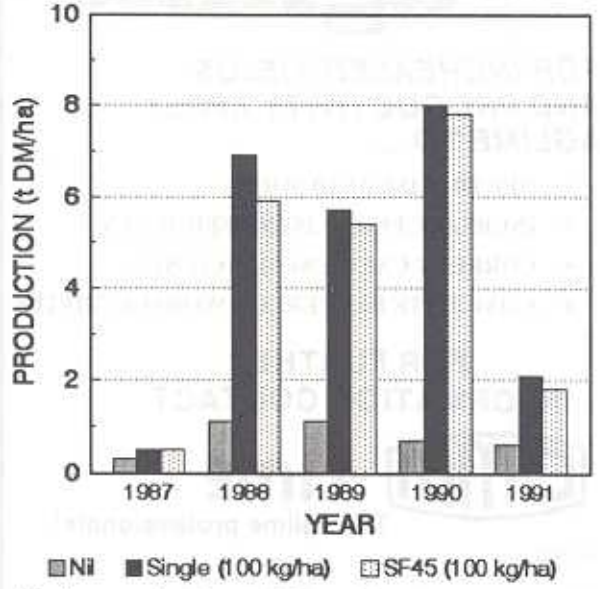
Fertilisers which performed below expectation in the first one or two years when compared to single superphosphate may have done so because the sulphur content was principally in the more slowly available elemental form. These differences may prove to be less significant with time.

It is also important to carefully assess the form of phosphorus in the fertiliser. Citrate insoluble forms are believed not to perform well in low or erratic rainfall areas. Citrate soluble phosphate may be more useful for application to acidic soils in higher rainfall areas where pasture are dominated by perennials. A large proportion of phosphorus in most of the fertilisers tested in this program is in the water soluble form which is immediately available to plants.

Of major significance to the pastoral industries of the study area are the few longer running trials which suggest relatively long-term residual value for appropriate fertilisers when used on soils high in phosphorus but low in sulphur. One trial which has been running for five years continues to show a high residual value of SF45 which was only applied in the first year (Figure 5). Most of the trials have not run long enough to confirm if this will be a general trend.

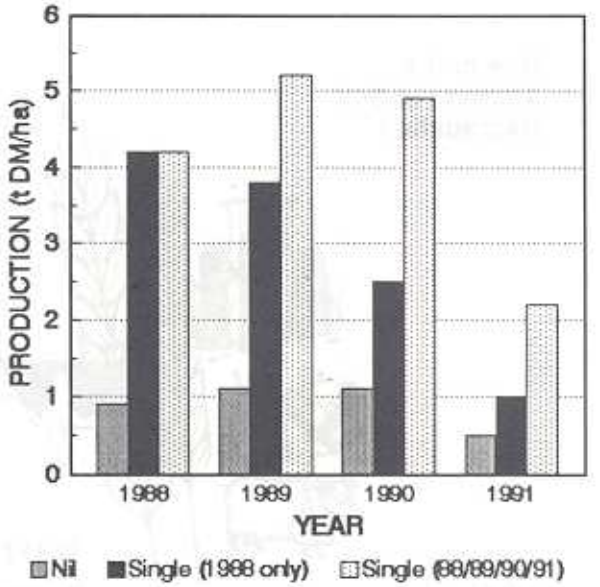
Another trial located on a soil with low available phosphorus has shown a much faster decline in response over time to a single superphosphate application (Figure 6). However, it is significant that even after four years, the single application of single superphosphate was still superior to unfertilised plots. In this low phosphorus low sulphur site, SF45 was inferior to single superphosphate because SF45 contained insufficient phosphorus at the application rate.

Overall, there were few major responses to molybdenum. Of the 21 trials where Mo was applied, the average yield of Mo-fortified superphosphate was no greater than single superphosphate (Figure 2).



Single superphosphate applied at 100 kg/ha every year. SF45 applied at 100 kg/ha once only in 1987.

Figure 5: Residual value of fertiliser applied to a low S/high P site (Ulamambri, NSW)



Single superphosphate applied at 100 kg/ha. Brackets indicate the years when fertiliser was applied.

Figure 6: Residual value of fertiliser applied to a low S/low P site (Binnaway, NSW)

CONCLUSION

The results from this program suggest fertiliser is an economical proposition for a large part of NSW previously considered too harsh to warrant its use. Other benefits include: (1) an increased ground cover leading to less erosion; (2) better drought protection; (3) improved soil fertility due to fertiliser inputs and nitrogen fixation by legumes; (4) better soil structure.The benefits of the program is ultimately expected to exceed $200 million per year.

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