Proc. Fourteenth Ann. Conf. Grassld. Soc. NSW, 1999, pp. 55-58.

The Acid Soil Action program for Southern NSW

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Abstract: Acid Soil Action (ASA) is a NSW government initiative aimed at improving the management of acid soils and soil acidity. The main focus of the program is the permanent pasture zone of the NSW tablelands and slopes. ASA is funding research to establish the economic responses of liming pastures. Cropping systems in high rainfall areas are also being evaluated as a way of paying for incorporating lime in a pasture improvement program. In addition to these research projects a large number of community group projects have been funded that will complement research as well as explore local soil acidity issues.

The effects of soil acidity were first documented in the 1950's by CSIRO (Donald and Williams, 1954; Williams and Donald 1957). This work was carried out in the permanent pasture areas of the Crookwell district, and showed that there was a long-term decline in soil pH under pasture which had been sown to introduced pastures and fertilised with superphosphate.

During the 1970s and early 1980s, NSW Department of Agriculture showed that soils became acid under crop/pasture rotations. During the 1980s, crop and pasture species responses to lime were demonstrated. It was shown that in the cropping systems, a productive, profitable and sustainable system could be maintained with lime as a key input.

NSW Agriculture research and extension programs made major contributions to the changes that occurred on farms. These included the development of a clearer understanding of the effect of different soil types, improved crop/pasture rotations, the breeding and selection of acid tolerant cultivars, and a demonstration of profitable responses to lime on-farm. The profitability of liming in many cropping systems, and particularly those systems that included canola, increased the use of lime. This has been documented through surveys of lime sales (Figure 1).

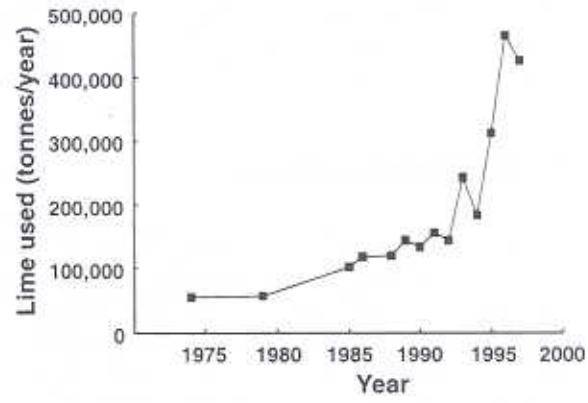

Figure 1. Use of agricultural lime in NSW.

Acid soils in the permanent pasture zone of southern NSW.

Research, such as that by Williams (1980), has clearly demonstrated that traditional pasture systems on the southern Tablelands acidify the soil. Extension has been successful in raising soil acidity as an important land management issue. Surveys by NSW Agriculture agronomists in 1989 for the Albury, Nowra, Goulburn and Dubbo districts showed a high level of awareness by farmers. Similarly, the Murrumbidgee Catchment Action Plan, in consultation with the community, has identified soil acidity as an issue of high priority in the Upper and Mid Murrumbidgee.

Soil test data collected by NSW Agriculture agronomists in the period 1984 to 1988 have also highlighted the importance of soil acidity. Results of 1765 soil tests from the southern Tablelands are presented in Figure 2, and show that more than half of the samples collected during this period were below pH 4.5 ($CaCl_2$) for both the 0 to 7.5 cm and 0 to 15 cm depths. Only 10% of tests recorded a pH over 5 ($CaCl_2$) in the 0-15 cm layer.

In contrast to the cropping zone, consistent economic responses to liming have not been demonstrated in Tableland pastures. In 1997, NSW Agriculture researchers commented that as far back as the 1960's, lime responses as measured by pasture yield were noted as being difficult to describe and predict. They conclude that, "30 years later, it is still difficult to predict the circumstances and likelihood of pasture responses on the tablelands to lime application" (Dowling *et al.* 1997).

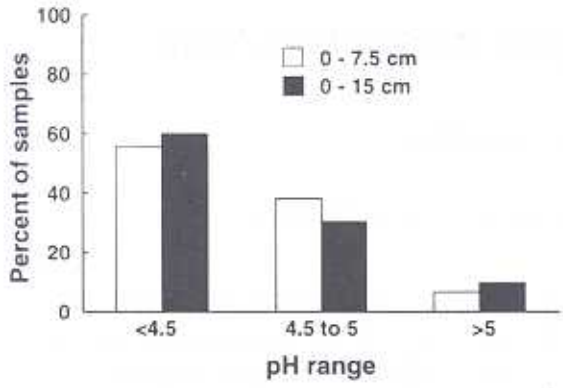

Figure 2. Average pH ($CaCl_2$)of soils in the Goulburn, Queanbeyan, Crookwell and Yass Agronomy Districts, 1984-1988 (total 1765 samples).

However, many farmers relate anecdotal evidence of the preference of animals for limed country and improved animal performance on limed areas. Unfortunately, little research has been undertaken to monitor the effect of liming on animal performance.

The MASTER experiment

The one long running lime experiment studying animal responses to lime is the Managing Acid Soils Through Efficient Rotations (MASTER) experiment at Book Book, east of Wagga. The MASTER trial was established by a team led by Dr Keith Helyar in 1992. The soil type is an acidic yellow solodic with pH ($CaCl_2$) values of 4.1 with aluminium 30% of total cations in the 0-10 cm layer. The soil is highly acidic to 30 cm.

The systems under investigation in the MASTER experiment are perennial pasture (phalaris, cocksfoot, lucerne, subterranean clover), a perennial pasture/crop rotation (three year perennial pasture followed by three years of crop rotation), annual pasture (annual ryegrass and subterranean clover) and an annual pasture/crop rotation (one year subterranean clover, one year wheat rotation). Superimposed on these pastures are plus and minus lime treatments for all systems. The rate of lime applied in the plus lime treatments is sufficient to maintain a pH ($CaCl_2$) of 5.5 in the top 10 cm of soil.

Merino wether hoggets are introduced each year and grazed for a 12 month period. Carrying capacity is established on the basis that available feed is similar for the different treatments. This has resulted in stocking rate being increased by 3.5 dry sheep equivalents (dse) on the limed plots. Liveweight gain per hectare has increased by 21-44% and wool production by 9-30% compared with minus lime treatments.

Total dry matter of pasture did not respond to lime, but the pasture composition changed significantly (Figure 3). Given the lack of total dry matter response, it seems likely that the change in pasture composition accounted for the increased animal performance.

Acid Soil Action Program

The MASTER trial, while providing some answers, also posed further questions, and became one of the springboards for seeking Government funding for further research and extension in managing soil acidity. This was provided by Acid Soil Action (ASA), a NSW Government initiative which recognises soil acidity as a major environmental and economic threat to the NSW community. The program commenced in July 1997.

ASA called for applications for funded projects from people working within government agencies, universities and community based organisations who could contribute to the better management of acid soils in agricultural areas, and acid sulphate soils on the coast. Except for some specific projects, the direction of the ASA program is driven by the projects that are submitted.

For the agricultural areas, this has resulted in the program focusing on the permanent pasture zone of NSW, that is the tablelands and slopes areas. We discuss mainly Acid Soil Action in southern NSW, but it should be noted that there is a similar number of projects in northern NSW (see Duncan, this Proceedings), as well as projects in irrigation, horticultural and the dryland cropping systems.

Research in the permanent pasture zone has two key components. The first is to study the economic response to limed pastures. The second is to evaluate the role of cropping in high rainfall pasture systems as a way of funding lime incorporation and establishing improved pastures.

Information on the economic response of livestock to liming of pastures is crucial if farmers are to make well informed decisions on their pasture

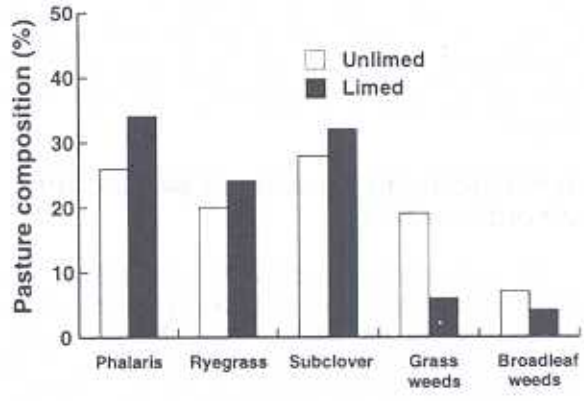

Figure 3. Botanical composition of limed and unlimed perennial pastures in the MASTER experiment at Book Book, NSW (Helyar and coworkers, unpublished data).

Table 1. Acid Soil Action Community Group grazing projects in southern NSW.

Group name	Animal enterprise	Pasture type[A]	pH 0-10 cm	Al% 0-10 cm
Hovells Creek (Cowra)	Merino wethers	Newly sown phalaris/clover		
Tumut	Merino wethers	Native + subclover	4.4 - 4.5	5 -6
Durran Durra (Braidwood)	Merino ewes	Old phalaris/clover	4.4 -4.6	5 - 11
Binalong	Merino ewes	Native + subclover	4.2 - 4.4	19 -25
Dudauman/Frampton (Cootamundra)	Merino wethers	Est. phalaris + subclover	4.8 - 4.9	1 - 2
Yaven Creek (Adelong)	Yearling cattle	Newly sown phalaris mix	4.2 - 4.3	22 - 23
Mannus Valley (Tumbarumba)	Yearling cattle	Est. phalaris mix	4.2 - 4.5	19 -20
Rydal (Bathurst)	Sheep	Newly sown	4.2	17
Belgravia (Orange) Bellview	Sheep & cattle	3 year old perennial grass mix	4.6 -4.8	1 - 7
Ponds	Yearling cattle	Est phalaris mix	5.0 - 5.6	<1
Bathurst Merino Assn[B]	Merino wethers	Native/introduced + subclover	4.8 - 5.4	1 - 2
Wyagdon (Bathurst) Peronne	1 sheep	Native + subclover	4.2 - 4.6	4 -12
Wanstead	1 cattle	Est phalaris/ annuals	4.1 - 4.4	4 - 18
South West Slopes	Cattle	Newly sown		
Narrawa (Crookwell)	Merino wethers	Old phalaris/clover	4.2 - 4.3	22 - 23

[A] Pasture: all pastures have a sub clover component. Old = established more than 20 years ago; Established = sown in last 10 years; [B] This site limed 7 years ago. The subsoil (10 to 20 cm sample) is acid with high levels of aluminium.

management. A major research project is being established at Sutton, about 30 km north of Queanbeyan, to study the effects of lime application on soils, pastures, livestock performance and economics. The soils are predominantly of sedimentary origin with a mean pH ($CaCl_2$) of 4.2, and a generally acid subsoil. The pasture consists of remnant native species (*Danthonia, Microlaena, Aristida*) oversown to phalaris, cocksfoot, perennial ryegrass and subclover.

Treatments include 3 rates of lime, 2 rates of superphosphate and a sewage ash treatment. Merino wethers will be stocked at 3 stocking rates. Lime is topdressed rather than incorporated, as this is a more appropriate practice for much of the permanent pasture zone. A feature of the trial is the relatively large area, with the 27 plots covering a total area of 22 hectares.

Evaluation of cropping on the tablelands is being carried out at 2 sites. One is at Oolong near Gunning with the other located at Neville. Different tillage systems and crop rotations with and without lime are being tested. The aim of this research is to establish whether cropping has a role in generating sufficient cash flow to pay for lime as part of a pasture improvement program.

These trials are complemented by community group projects which cover various aspects of acid soil management. The community sites are investigating the movement of topdressed lime and animal responses to limed pastures. Table 1 provides an overview of the scope of these projects, with a range in animal species, pasture type and geographic area. Most sites are paired paddock demonstrations, but three (Narrawa, Durran Durra and Bathurst Merino) are replicated trials. Information will be collected on soil chemistry, lime movement, pasture production and composition and animal production. The animal production data will include bodyweights, fleece weights and wool quality. In one case, water quality data will also be recorded. Grazing with trial animals commenced at most sites in spring 1998. Data will become available over time with the first meaningful lime movement data to be collected in Autumn 1999.

The Acid Soil Action program is not limited to working with grazing groups and the following provide an overview of other community projects:

- Pasture establishment and monitoring (11 projects)
- Cropping (3 projects)
- Soil testing and mapping (8 projects)
- Integrating Prime Pastures (5 projects)

Conclusions

The Acid Soil Action program will provide data on some of the key questions relating to the management of soil acidity in the permanent pasture/livestock grazing systems of the southern tablelands and slopes. Data relating to the economic performance of animals grazing limed and unlimed pastures and the rate of movement of topdressed lime are being generated through research and community projects. This approach is aimed not only at providing answers, but also to promote the adoption of best practice through working with landholders in solving problems associated with acid soils.

Acknowledgment

The authors thank Dr Keith Helyar and his team

for data from the MASTER project.

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