Environmental Improvement Through Sound Fertiliser Practices

By Bob Freebairn and John S. Glendinning

Research in the Central West of New South Wales has shown that good fertiliser practice can improve soil structure, increase soil organic matter levels, increase water infiltration rates and improve water use efficiency, as well as increase farm productivity and farm profitability.

This research, conducted at Ulamambri, near Coonabarabran, was started in 1987. It shows that the benefits of fertiliser go far beyond the generally accepted role of simply increasing production at the expense of the environment.

The trial site had been a native pasture paddock for many years and was of very low productivity, the soil set very hard. Very little pasture growth was produced, even in the spring time when it is normally expected that pastures will produce a good body of feed. The area was commonly low in plant cover. Because the soil set so hard, when rain fell it was almost totally lost through run-off, often taking with it more of the valuable topsoil.

Treatments

The trial was started because of the feeling amongst research and extension workers and landholders that animal production could be improved very significantly with good fertiliser practice and that better use could be made of the available moisture when rain fell. It was also felt that all this could add up to beneficial effects on a number of soil characteristics without any detrimental effects on the environment.

Soil erosion is one of the biggest problems facing agriculture.

Soil tests before the trial was started showed quite high phosphorus(P) levels, but soil sulphur(S) was low. For this reason the only treatment applied to the trial area was to broadcast 2 kg/ha of subterranean clover. There were two annual applications at 100 kg/ha of S-fortified superphosphate, containing 5.6 percent P (12.8 percent P_2O_5) and 42 percent total S.

No other fertiliser was applied over the first 9 years of the trial.

Results

Organic Matter – Soil tests on samples taken in 1996, 9 years after the trial commenced, showed that the organic matter content of the soil doubled from 1.8 percent organic carbon to 3.6 percent.

This effect on the soil organic matter is of major significance. It shows how productive pastures can restore the health of soils, for such things as a cropping phase, where organic matter has declined through over-cultivation. It is also of major importance in protecting the soil from loss due to erosion during very heavy rainfall events or stress periods brought about by drought conditions.

The protection of the surface layers of the soil also helps to conserve the important, high-fertility profile of the soil. When this part of the soil profile is lost due to erosion from whatever cause, a major part of the soil fertility and previous investment in fertilisers is also lost. In some cases, it may lead to loss of nutrients and other fertility components in dust storms; in others, it may be lost by water erosion and find its way into water courses, creeks and rivers and, in extreme cases, increase the problems of contamination by blue-green algae and the eutrophication of the water course.

Stubble retention, reduced cultivation and improved pastures help prevent erosion.

Soil pH – There was a small drop in soil pH over the period of the trial from 5.9 in 1987 to 5.7 in 1996, when measured in a weak solution of calcium chloride. This may have been an artifact due to seasonal variation in the soil or an effect due to sampling differences. In any event, it is of very minor extent and is something that is expected to occur when any form of improved agriculture is practiced. Such changes in soil pH are due in part to a build-up and leaching of soil nitrates and calcium(Ca) compounds, and release of organic acids in the soil; and partly to the removal of Ca compounds in the process of selling animal products off the farm.

Water Use Efficiency – Equally significant was the effect of fertiliser treatment on water infiltration. A test on the trial site found that the water infiltration rate, determined by measuring the rate of absorption of water from above ground cores, increased from 1.3 mm per minute to 10.5 mm per minute. This is a clear indication of better and faster retention of rainfall, especially following storm events.

The improved water infiltration led to greatly increased water use efficiency. Dry matter (DM) production from the fertilised and unfertilised areas was measured at key times of the year during the winter-spring period. Dry matter production at this critical time of the year was 567 kg/ha from the unfertilised area compared with 3,111 kg/ha from the fertilised area. This is equivalent to 2.03 kg DM/mm of rainfall from the unfertilised area compared with 11.13 kg DM/mm of rainfall from the fertilised area.

Microbial Activity – Another interesting effect of this application of fertiliser was on the level of microbial activity in the soil.

CSIRO at Armidale examined the trial site for microbial activity, an indication of the soil's biological health. The fertilised areas showed considerably higher rates of basal respiration and microbial carbon.

Implications for Farm Management – Similar beneficial effects to those shown in this trial should also apply to most well managed pasture improvement programs. Sound management is obviously a key consideration to ensure that the improved pasture species survive and that sufficient of the extra pasture production is retained to protect the soil. BCI

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