Sown grass productivity: run down but not run out

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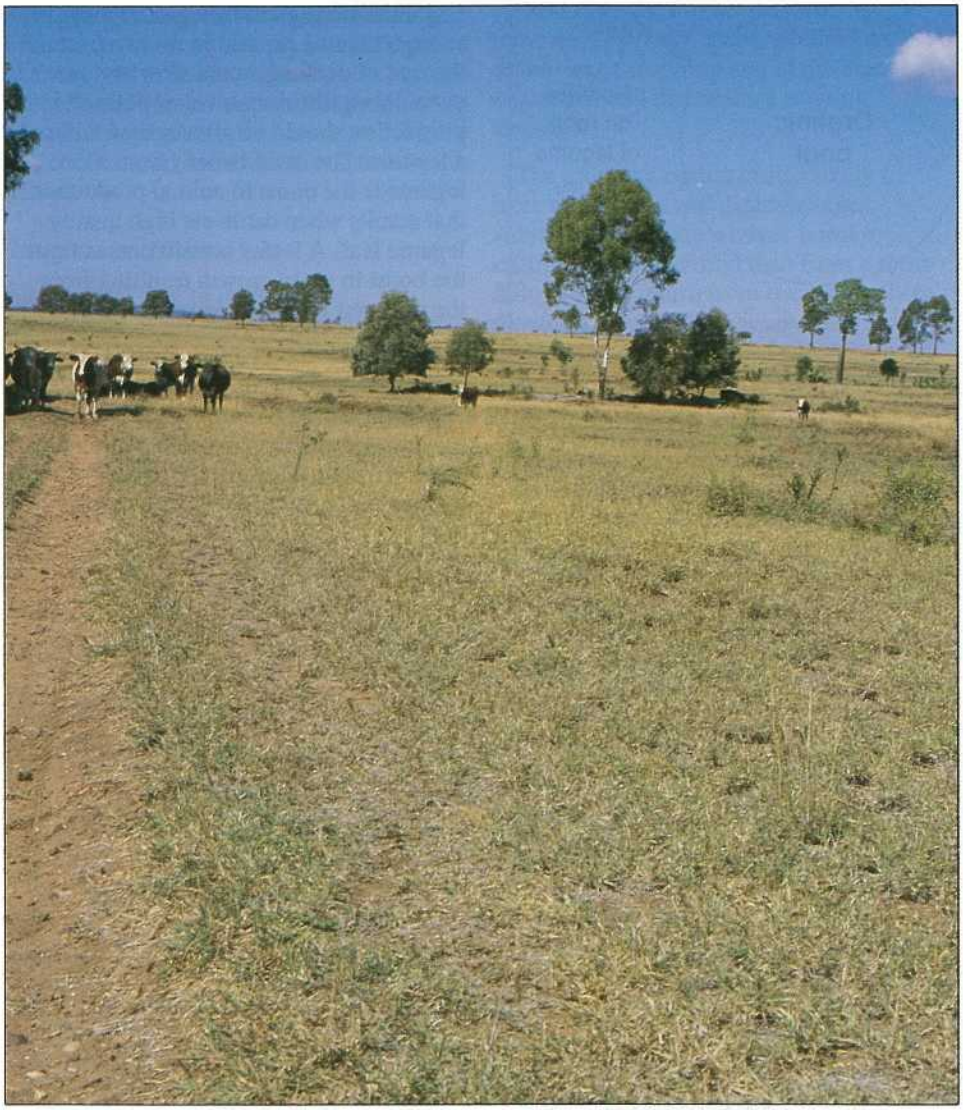

Plate 1. A run down buffel grass pasture in central Queensland showing signs of nitrogen deficiency.

Paddocks covered in tall green pastures of buffel grass, rhodes grass or green panic are a common sight in Queensland. These pastures are productive and profitable. But the high productivity does not last long, as the pastures run down with age.

Graziers have long recognised that sown grass pastures run down. They see thinning of the sward, declining vigour, pale green or yellow leaves, declining seed production and, most importantly, declining cattle production and profit.

Trial results have shown cattle liveweight gain to decline at the rate of 9 to 13 kg/head for each year the pasture ages. This means that cattle which gain 180 to 200 kg/head a year on young pasture will gain only 130 to 150 kg/head on old pasture. Steers could take an extra year to reach sale weight. Alternatively, a grazier may be able to maintain production for each head but have to reduce the stocking rate.

In this article we are going to discuss why sown grass pastures run down and possible solutions, including:

- accepting lower productivity
- sowing legumes
- using a short fallow
- cropping for one or more years
- renovating with a single cultivation
- fertilising with nitrogen.

Why sown grass pastures run down

Simply, sown grass pastures run down because the amount of soil nitrogen available to the plants reduces as a pasture ages. Nitrogen accumulates in forms that are unavailable to the plant, the pasture becomes nitrogen-deficient and productivity falls.

The irony is that most soils contain a large amount of nitrogen; it's just that most of this nitrogen is unavailable to the plant. For example, many soils contain as much as 3000 kg of nitrogen in 1 ha to 50 cm depth, equivalent to the nitrogen in 130 bags of urea (and some soils contain much more than that). However, of that 3000 kg, only about 60 kg (equivalent to the nitrogen in just 2.6 bags of urea) may be available to the plant.

Most nitrogen is tied up in the organic 'pool' in the soil, in organic material such as humus (figure 1). Soil microorganisms break down the relatively complex forms of nitrogen in the organic pool, converting nitrogen into simpler forms that make up the mineral pool. This process is called 'mineralisation'. Grasses can take up only the simple forms of nitrogen in the mineral pool.

As pastures age, nitrogen accumulates in the organic pool (plant litter, animal residues and the like) and in the soil microbes themselves. The mineral pool becomes depleted, limiting the growth of the pasture.

Interestingly, run down pasture is not caused by loss of nitrogen from the paddock, since only a small amount of nitrogen is removed in animal products.

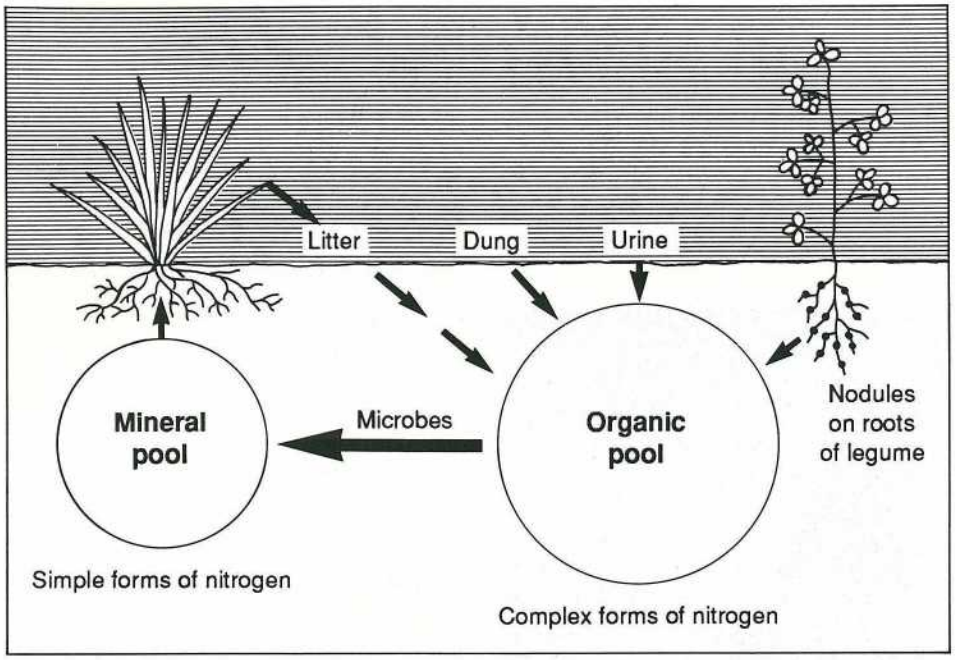

Figure 1. Flow of nitrogen from organic to mineral pool.

Almost all the nitrogen consumed by the animals is recycled in the paddock. Nitrogen deficiency, the tell-tale sign of pasture rundown, is induced by changes that occur in the form of nitrogen present in the soil.

What makes new sown pastures so productive?

During property development, the removal of plant cover and the disturbance by clearing and stickraking stimulates nitrogen mineralisation. There is a large increase in the flow of nitrogen from the organic to the mineral pool (figure 1). The resulting run up in available nitrogen causes rapid pasture growth, high pasture quality and good cattle growth in the first few years.

This is followed by a gradual run down in pasture and animal production, as nitrogen accumulates in the organic pool. Eventually an equilibrium is reached where available nitrogen limits improved grass production to a level similar to that of native pasture. Unfortunately, run down takes only a few years on many soil types.

Possible solutions

Accepting lower productivity

Accepting a lower level of production is a simple way of dealing with run down of sown grass pastures.

As mentioned earlier, there is a run up in pasture growth after development and this can give an unrealistic expectation of production. Some graziers become worried when pasture production returns to a more sustainable level. However, pasture decline is normal and predictable. Perhaps expectations should be based on a lower level of production since it is unrealistic to expect pasture production to continue at run up levels.

Sowing legumes

Legumes are high in nitrogen. If there is enough legume present in a sown pasture, the rate of decline should slow and the eventual equilibrium level of pasture production should be greater than without a legume. The main benefit from a legume is the boost in animal production that results when cattle eat high quality legume leaf. A lesser benefit comes from the boost in grass growth resulting from the nitrogen fixed by legumes.

Legumes can benefit associated grasses, but not as directly as fertiliser can. Over a long period, legumes increase the amount of nitrogen available for mineralisation. Decomposition of the legume plant and of the nitrogen-rich

Plate 2. Cultivating pastures and maintaining a fallow for at least three months is one option to improve production from run down pastures.

nodules on the roots feed nitrogen into the organic pool and not into the mineral pool (figure 1). This material must be broken down further by microorganisms to make nitrogen available to plants.

However, every bit of extra nitrogen helps. If a legume can be established successfully into a pasture, and its production maintained, then pasture productivity will benefit. Of course, different legumes are adapted to different localities and soils throughout Queensland. For advice as to the best legume or legume mixture for a particular site, contact your local QDPI extension officer.

Using a short fallow

A successful way to improve the productivity of run down sown grass pasture is to plough out the pasture and re-sow after a bare fallow lasting at least three months. In trial work on old buffel grass pastures, a three month fallow increased the yield of resown grass by 60% over two years.

Advantages of the short fallow include boosting nitrogen mineralisation and recharging the mineral pool. Disadvantages include an erosion risk on the bare fallow and the need to re-sow a new pasture, with the associated risk of establishment failure and high costs of re-establishment. Whether the advantages outweigh the disadvantages will depend on the situation.

Cropping for one or more years

This option is really an extension of the short fallow idea. However, cultivation and cropping are extended over at least one year. The large number of cultivations means that more nitrogen is likely to be mineralised than in a short fallow, although at least some of this would be removed in the crop. In a current trial, the impact on re-sown pasture of different crops, of different durations of cropping and of different degrees of soil disturbance is being assessed.

The cropping option is also likely to have advantages and disadvantages. Advantages include a larger boost to nitrogen mineralisation than from a short fallow, and a return from the crop to help pay for the operation. Disadvantages include the cost of cropping and the need to re-sow a pasture, with associated costs and risks. The relative returns from cattle and crop will influence the decision at any time.

In addition, not all cattle producers have the inclination, machinery, suitable land to embark on a cropping enterprise. Nevertheless, the ultimate application of a cropping phase is to set up a system of crop–pasture rotations, ensuring sustained high production from both crop and pasture.

Renovating with a single cultivation

This is the most controversial option of all, since the responses to renovation have often been inconsistent. Many graziers have had a lot of success by renovating old grass pastures. However, there is a good chance that many of the benefits are more illusory than actual. Grass grows greener and taller but, if the sward is more open than it was before renovating, there may be no increase in pasture yield.

Unfortunately, the results from research have also been inconsistent. Some have shown that a temporary increase in feed quality for up to three months but no increase in pasture yield. In other research, pasture dry matter yield and pasture nitrogen yield were increased by 30% and 50% respectively after a single cultivation, compared with uncultivated pastures. In the latter, cattle liveweights were increased by 35 kg/head for one year. However, this finding has no yet been repeated.

Renovating with a single cultivation has the advantages of being a relatively cheap option, not dependent on the need to re-sow a new pasture. However, it is not yet clear whether any extra liveweight gain will consistently pay for the cost of renovating.

Fertilising with nitrogen

This is one option that we know can maintain high levels of grass productivity. However, high rates of fertiliser are needed and these are costly. Furthermore, the older the pasture, the more fertiliser that is needed to boost productivity. Fertilising with nitrogen is likely to be prohibitively expensive for most pastures at present.

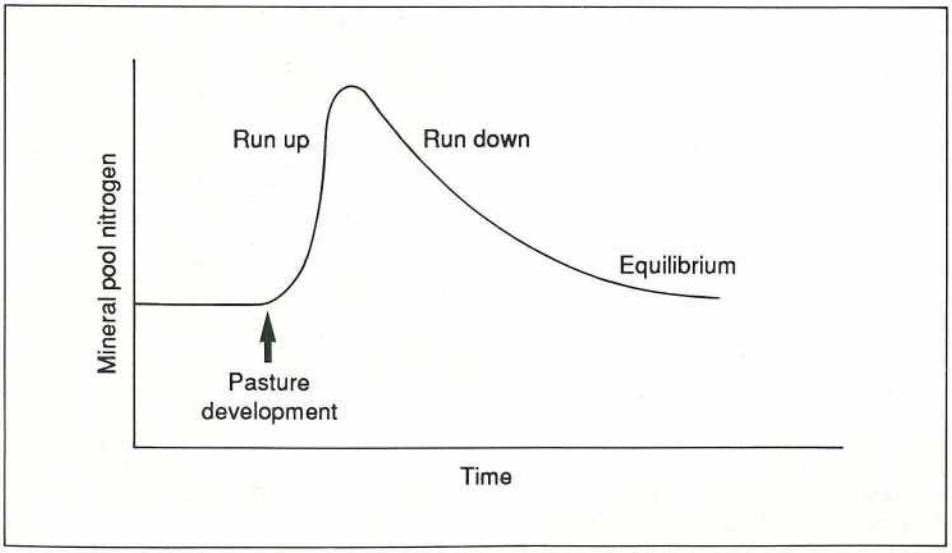

Figure 2. Nitrogen levels in pasture over time.

The best solution

There is no 'best solution' which suits all situations. The options we have presented here range from accepting a lower level of productivity through to cropping or fertilising with nitrogen. The most appropriate solution will depend on individual circumstances.

Sown grass pastures are a valuable resource in Queensland which must be sustained. Current and future research, together with valuable producer experiences, are necessary to achieve that goal.