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THE PASTURE/ANIMAL SYSTEM

MANAGING PASTURES BY GRAZING

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Abstract: Pastures need to be properly managed to be sustainable and productive. A key part of pasture management is the maintenance of a desirable botanical composition. Grazing tactics can be used to develop or maintain that desirable composition. Research in progress and some previous work is showing how grazing tactics can be used. Further work over the next few years will help develop better techniques. Results obtained so far suggest that pastures should be rotationally grazed from after the autumn break until late winter. This will favour the legume and perennial grass content over annual grasses, especially if then grazed off at the end of winter. Feed budgeting will help to manage pastures over winter so that you do not run out of fodder. During spring, continuous grazing to limit rank growth is important to maintain a high legume content. Silage and hay cuts can also help to improve pastures. Over summer until the autumn break, normal continuous or slow rotation grazing is satisfactory. The complementary grazing behaviours of different animal species can be used to advantage as can herbicides and fertilisers. The tactics suggested aim to improve animal production per head by producing better quality pastures. They may also be used to allow an increase in stocking rates.

Pastures, '*Our Most Important Resource*', need to be properly managed to successfully sustain livestock production. However, under current management, many pastures are not as good as they could be. The mix of species within pastures is often less than ideal (Kemp and Dowling, 1991) and animal production and the quality of the product demand by markets, is less than the potential possible. There are many reasons for these circumstances including:

- The economic circumstances that have existed for some time, limit the ability of producers to apply fertiliser, sow improved species or control weeds.
- Pasture species are not perfect. Both native and introduced species have their limits in terms of fertiliser and management requirements. Few pasture species will survive continual heavy grazing during variable seasons and remain productive, especially at low nutrient levels. Nor are we likely to develop the perfect plant tolerant of all abuse, given that pasture plants have to be a compromise between survival and being attractive to animals.
- Weed invasion is an ever present problem. Pasture species not only have to regrow after being grazed, but also have to compete against weeds.
- Soil fertility has declined with the inability of producers to apply fertiliser and, or lime. Declining soil pH restricts the numbers of species that can grow in a paddock as well as the growth rates of others.
- Climate, especially rainfall, varies considerably from year to year causing major shifts in pasture composition. Pastures do not always recover to a sustained, high level of production after a drought.
- Knowledge of how best to manage pastures is limited. Many producers and agronomists have developed successful practices but that does apply to all circumstances and regions.

The key to productive, sustainable pastures is the maintenance of a mixture of productive species. This can be achieved either by supplementing the existing native species with oversown legumes, or by sowing

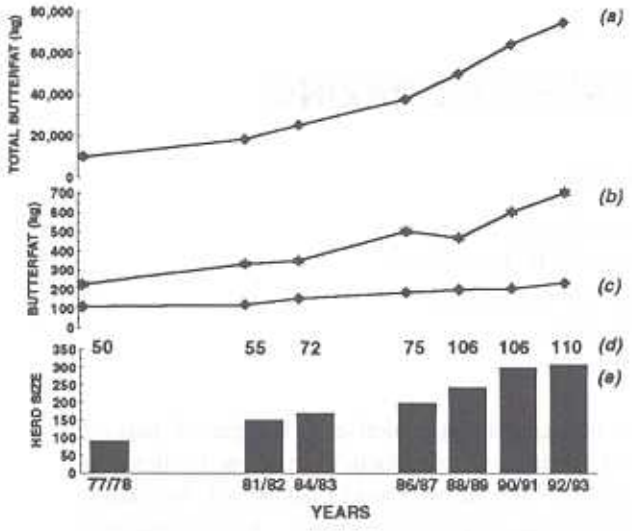

Figure 1: Production at "Silvrian" for 1977 to 1992 - (a) Total butterfat production (kg); (b) Butter fat produced (kg)/effective hectare; (c) Butterfat production (kg)/cow; (d) Total effective dairy hectares ' and (e) Herd size.

meter. Using the best estimate available for pasture growth rates, we set out a feed budget. This is done by a committee of people on the farm.

From this assessment, we work out what the likely feed deficit will be and fill this with silage and grain. For most of the first part of the lactation this works out as 1/3 grass, 1/3 silage and 1/3 grain.

Milk production on a daily basis is very sensitive to feed quantity and if we have estimated badly, then we are soon alerted by the vat sight glass.

As the grass growth speeds up, we speed up the rotation and cut down on silage and grain. It is most important to check what is left in the paddock. If too much grass is left then we know the cows are starting to substitute the least cost effective grain and leave the pasture. Once any pasture becomes long and rank it is wasted and is mulched to promote fresh growth.

As the rotation shortens, paddocks become "spare" and these are taken out of the rotation and set aside for silage production. This can be the hardest time of the year because the situation can change so quickly. Suddenly the "magic spring day" (as some call it) is upon us. Grass is now starting to grow faster than the cows can eat it. The problem in terms of pasture management is changed from one of quantity to one of quality.

We have found milk production to be very sensitive to feed quality. Milk production graphs traditionally dip badly in November. This becomes a critical time to be able to assess what is in the paddock so that real surpluses can be conserved to fill next year's deficit. If we are too cautious, we end up with a rapid deterioration in quality.

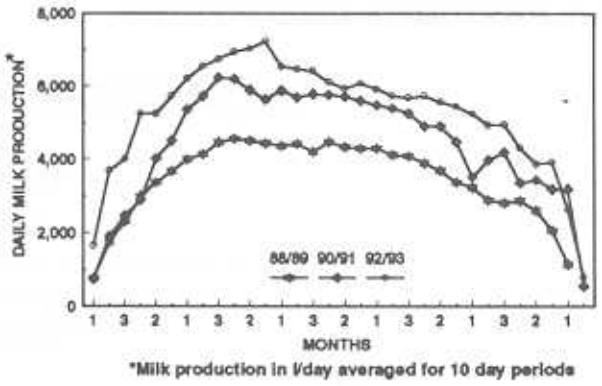

Figure 2: Daily milk production (l/day) at "Silvrian" averaged for 10 day periods.

This is still a time of trial and error for us. Each year we have put more into silage and grazed more cows on a smaller area. The production per cow is increasing (Figure 1) and pasture quality is lasting longer into late spring/early summer.

CONCLUSION

In conclusion while the ability to assess the quantity and quality of pasture in a paddock is only a part of overall management on our dairy farm, I strongly believe it is a very important part.

Our production figures show us that while we have still got a long way to go, we are making some headway. Production per cow and per hectare is increasing (Figures 1 and 2), grain fed per cow is dropping, animal health problems are decreasing and the bottom line is looking healthier.

While we have a continuing program of pasture renovation and establishment, we have found that pasture density and composition has improved with strategic grazing.

So, with a notebook for records, a pasture meter for measurements, a consultant to ring when I cannot find the feed value for a mixed sward of sorrel and nut grass and a portable electric fence, we will continue to stand in the paddock and watch the grass grow till the cows come home!

introduced cultivars. In this paper I want to concentrate on how our knowledge about better ways to manage sown and native pastures is developing. Emphasis will be on grazing tactics that may help in this task. Until recently very little research has studied the manipulation and maintenance of pasture composition using grazing, especially in higher rainfall environments.

OBJECTIVES

The objectives in management of pasture composition are to maximise the proportion of desirable species while minimising the undesirable. Increasing the legume content is often the primary aim because of the important benefits for animal production (Dove, 1988) and soil fertility. Maintaining a high proportion of perennial grasses to utilise soil nitrogen (Helyar, 1991), minimise soil erosion and maximise pasture growth is critical to sustainable pasture systems.

Improving pasture composition should also improve animal performance and reduce the need to resow pastures. Improved animal production would aim for a compromise between maximum animal production per head and per hectare *ie.* for most stock, apart from some uses of merino wethers, pasture management tactics should not result in any significant loss in per animal performance.

BASIC REQUIREMENTS

Pasture management is done within the context of the whole farm operation (Michalk and Kemp, 1993). Most producers then translate their broad management goals into more specific actions on individual paddocks. This is assumed in this discussion, along with a few other basic requirements for managing pastures by grazing. These include:

- Pastures are established and contain a reasonable proportion of desirable species *ie.* some legumes and productive grasses.
- Soil fertility is sufficient to enable the persistence of desirable species. Management tactics to manipulate pasture composition are unlikely to work if soil phosphate, pH *etc.*, are too low.
- Properties have subdivision fencing to allow stock to be moved around as required.
- Properties usually have a diversity of pastures across their paddocks so that not all paddocks need to be managed in the same way, at the same time. Some paddocks may not need any special attention.

BASIC PRINCIPLES

The basic principles for the manipulation of pasture composition (Wilson and Hodgkinson, 1990) include:

- Stocking rate (grazing pressure) is the most important tool *ie.* both heavy and light grazing can influence pasture composition.
- Proper timing of rest periods for desirable species and pressure for undesirable species, based on the phenology of species, is important.
- Grazing systems can reduce production per animal unless there is a desirable change in botanical composition.
- Pastures with mixtures of desirable and undesirable species represent opportunities for improving pasture composition by grazing management.
- Grazing management should always be integrated with other options.
- Changes in botanical composition may take time (*ie.* years) and the restoration path may be a different grazing strategy to the degradation path.

These principles have been understood for some time, but the main difficulty has been how to translate them into practice. We know that grazing can change composition, but we do not always know which season has the biggest effect, either positive or negative and, within each season what is the best tactic. Current research being supported by the Meat Research Corporation and the Wool Research & Development Corporation, aims to resolve these questions. The emphasis in these programs is on how to maintain the productivity of newly sown pastures or restore the productivity of typically degraded pastures eg. those

where legumes and, or perennial grasses have been replaced by annual grasses or weeds.

GRAZING TACTICS AND SEASONS

Pasture composition and growth rates vary considerably during the year due to climate and the different growth patterns of different species. The impact of grazing on a species will therefore vary with season and with competition from other species, both good and bad. The best opportunity for manipulating composition is when there are good conditions for growth by the species of interest. Consideration of the seasonal cycles in pasture production will illustrate in general, how grazing may influence pasture performance.

Autumn

In autumn in southern areas, most species are regenerating from seeds, crowns, rhizomes and stolons. Plants are small so that maximum species growth rates depend upon the number of seedlings or plants present. Generally perennial species have an advantage over annuals as they start as bigger plants, but annual species may still dominate as a result of high seedling densities. In areas where summer rainfall is effective, whole plants often survive the summer with active green leaves, improving their growth rates and competitive ability.

Grazing tactics in autumn should aim to maximise growth of the desirable species from the autumn break. In an annual pasture, deferred grazing can result in more total pasture growth, compared with set stocked pastures, in years where autumn growth rates are low *eg.* the 'break' is late or a dry period occurs after the opening rains (Doyle *et al.*, 1993). An initial deferment will allow plants to establish a reasonable leaf area before winter resulting in higher subsequent growth rates. In a vigorous perennial pasture though, moderate grazing pressure is needed to control the grass *eg.* phalaris, and allow regenerating legumes to establish. Results from experiments at Orange have shown that unless phalaris pastures are grazed in autumn, the legume contents will decline significantly. Work at Glen Innes (FitzGerald 1989) found that most legumes benefited from a rest after germination in late summer / autumn, except if grass growth became too rank.

Winter

Winter is often a time of limited feed supply and the major constraint on the carrying capacity of many properties. Winter rainfall is usually reliable, but temperatures are a major restriction on growth, especially for legumes. As the feed supply is low, plants in continuously grazed pastures are eaten frequently which further reduces their growth rates. Under grazing, legume regrowth rates are likely to be slower than that of grasses because they will be preferentially grazed. Perennial grasses are also likely to be slower growing than annuals, which are often in a reproductive state. When grasses commence reproductive development, this stimulates their growth rates.

Long rotations between each grazing during winter has been shown to increase the proportion of phalaris over annual grasses at Canberra (Morley *et al.*, 1969) and Orange (Kemp, Dowling & Michalk, unpublished). In annual pastures, long rotations between grazing over winter have doubled the legume content in experiments in central NSW and if combined with a quick grazing off at the end of winter (August), this has resulted in removing barley grass from the pasture. The control of barley grass in a pasture at Grenfell from this combined grazing tactic, has been as good as that achieved with herbicides. Timing of heavy grazing and, or the grazing pressure, around the end of winter may though be critical, as work at Trangie (Michalk *et al.*, 1976) found that heavy grazing from late winter to September only reduced the height of barley grass seedheads. This response was useful to control grass seed contamination of lambs, but did not control the population of barley grass. Continuous grazing at Trangie, at high stocking rates over autumn and winter, resulted in greater reductions in barley grass (Michalk *et al.*, 1976), though this same treatment also caused an increase in the *Vulpia* content (Campbell and Beale, 1973). At Trangie the barley grass content was directly related to the amount of surface mulch in autumn.

Long rotations over winter have the benefit of increasing the average size of plants and therefore their growth rates, a tactic used within the New Zealand intensive grazing systems (Sheath *et al*, 1987). However in subterranean clover pastures frequent grazing during winter, which may reduce forage yields, can be important for increasing flowering and

seed set (Collins, 1978).

Spring

Pasture growth in spring is often the most difficult to control. Rank pasture growth can shade out the lower growing plants leading to dominance by taller species such as phalaris. Most species are reproductive during spring, and this restricts the production of new tillers or stolons. Production of stems plus limited growth of new leaves, lowers feed quality significantly. This period is often a weak point in the life cycle of many species as heavy grazing during flowering can cause the death of plants and, or prevent seed set, limiting regeneration during the next year. A major problem is that both desirable and undesirable species are often flowering at the same time which means that it can be difficult to use grazing to always shift the botanical composition in the right direction.

To maintain legumes in a pasture some control of rank growth is essential. If too many paddocks require some control and there are insufficient stock, mowing, silage or hay making can all help. At Orange using extra stock to graze a phalaris pasture whenever it reached 250 mm and grazing it down to 100 mm resulted in a doubling of legume content, especially of white clover. This had long term effects as the clover set more seed and after the 1990/91 drought twice as much clover regenerated on that pasture compared to the control, where no special effort had been made to limit spring pasture growth. Control of spring growth needs to start early, before the pasture gets too tall. Grazing down to 100 mm imposes no stress on the animals if done before the pasture is rank. The resultant pasture at Orange was in fact preferred by the animals. A target height of 150 mm may be more feasible as fewer animals would be required to control rank growth. A further result from controlling spring growth at Orange, was that annual grasses were removed from the pasture. Rank pastures may also be more difficult to finish stock on.

Grazing the newer cultivars of phalaris (*eg.* Sirosa) during spring can cause the death of plants. October is considered the most sensitive month in central and southern NSW (Hill and Watson, 1989; Culvenor and Oram, 1992). The work at Orange did reduce the density of phalaris initially, but not to a level considered a problem. The original Australian Commercial phalaris cultivar is not as susceptible to grazing during spring, although heavy grazing can even reduce it's plant density over several years (Hutchinson, 1992).

With native grass pastures in summer rainfall areas, control of rank growth is less important as white clover appears to be able to survive satisfactorily under those circumstances (FitzGerald, 1989). Such pastures do not become as tall as phalaris.

If the aim is to thicken up a pasture with desirable species and weeds are not a major problem, then resting in spring to allow seed set and for that seed to mature and shed, can help regeneration. In that context, the paddock may need to also be rested for some time in the following autumn and winter to allow seedling plants to establish.

Summer

Dry summers are a feature of temperate Australia. Plant growth is very limited except for the deeper rooted perennials that can tap soil water reserves. Plant survival becomes a major objective of pasture management so that regeneration in autumn is satisfactory. In wet summer areas some control of pasture growth may be needed to maintain legumes and low growing species. Moderate grazing pressure on white clover will enhance its persistence in perennial grass pastures (Archer 1989, Archer and Robinson 1989) while continuous grazing prior to autumn will help subterranean clover (FitzGerald 1989) and serradella to regenerate.

Grazing during dry summers should aim to maintain soil cover to minimise erosion risks, and ensure that perennial plants survive to autumn and that annual species seed reserves are not at risk. In wet summers, control of rank growth as discussed for spring, is important in order to maintain perennial legumes and encourage tillering. As growth rates in summer are not as great as in spring it is an easier task.

LONGER TERM GRAZING STRATEGIES

Pastures need to be managed year round. From the above discussion it can be seen that some tactics can be linked into year round practices. These practices though, may not need to be applied to each paddock in each year. This philosophy is similar to the individual attention producers pay to paddocks

when considering weed control, fertiliser applications, cropping *etc.* The more involved strategies may be necessary only where problem pastures exist. If a pasture is satisfactory then normal grazing practices should be continued and management efforts concentrated on problem paddocks.

The results obtained so far suggest that some form of long rotational grazing from the autumn break to the end of winter (*eg.* to just prior to lambing or calving) will help legumes and perennial grasses, increase average pasture growth rates and reduce some problem grasses (barley grass) in areas of reliable winter rainfall. Short grazing periods on a paddock with long rests is envisaged. The optimum length of the rotation interval is not yet known, though from six to twelve weeks is probably necessary. Control of grazing during the rotation would be helped by assessing pasture yields, using smaller paddocks and limiting stock to maintenance intake ie. do a feed budget. These procedures should help to insure that you do not run out of feed during winter, particularly when stocking rates are near the maximum for a property. An option at the autumn break is to confine animals to a small paddock and hand feed until pastures have regenerated to a satisfactory level eg. 500-1000 kg (green) DM / ha. This will increase pasture growth rates going into winter and may reduce the total amount of supplements required during the year. Grazing off pastures at the end of winter is likely to be important for annual grass management.

In spring, control of rank pasture growth using continuous grazing at higher stocking rates, or adding extra animals to a paddock as the spring flush occurs, will enhance legume content and further remove annual grasses from perennial pastures. To be effective control of the spring flush should start before it gets away. Concentrate on the paddocks where the legume content is low and grass content high. Silage and hay cuts will also help to control rank growth and weeds. If desirable species are low and weeds are not a big problem then allowing species to flower, set seed and the seed to mature can help them regenerate, provided they are also rested or grazed lightly, the following autumn and winter when seedlings are establishing. Not all species can be regenerated by these means. Set stocking from early spring fits in with lambing and calving.

Normal practices of continuous or slow rotation grazing over summer up to the autumn break would seem satisfactory. If the summer is wet, control of rank growth would be important. Beware of overgrazing so that plants can regenerate as fast as possible with the autumn break before low temperatures limit growth.

The suggestions offered here have not been fully tested and still need to be worked up into animal production systems. This will be done over the next few years. Some producers do tend to follow these practices to some extent and have done so for many years.

Longer term grazing tactics may also be needed to address specific pasture problems. The wire grass problem in northern NSW is a well known case (Lodge, 1987). Heavy grazing pressure is applied to the *Aristida* (wire grass) when it is flowering or regenerating from seed, while pastures are rested when *Danthonia* (wallaby grass) flowers and when it regenerates, to cause a shift in species composition to the more desirable grass. Fire is also used to supplement the grazing tactics. Work done with nodding thistle also shows that one heavy grazing in spring can help control that weed in combination with herbicides (Medd, 1979).

ANIMAL SPECIES

Different animal species can have variable impacts on pasture composition and productivity. These differences can be usefully exploited to manage pastures better. Sheep tend to select desirable species such as legumes and can more effectively remove them from pastures than cattle do. Species such as white clover often persist better in pastures grazed by cattle. Cattle can also be more useful than sheep for the removal of rank pasture growth. Goats, in contrast, avoid legumes and prefer more fibrous forage. Goats can be a very effective pasture management tool for manipulating pastures to desirable ends. The benefits from using goats in this way may justify their wider use in many circumstances. The benefits in reduced herbicide usage and the need to resow pastures may exceed the costs of keeping goats. Where pasture composition may respond to a rest from grazing by sheep, the use of cattle or goats during that period may achieve a similar result. Unfortunately there is little information to guide such decisions

though, it will be tested in some current research. Where different animal species are used on a property their complementary grazing behaviours should be fully exploited.

HERBICIDES

Herbicides are a valuable pasture management tool. In many circumstances herbicides can be used to remove specific weed problems and allow desirable species the opportunity to increase within the pasture. The value of some grazing tactics though, is that control of undesirable species may be similar to that achieved with herbicides. The results with annual grasses considered above are in this category. By using grazing more feed is produced and consumed by animals than herbicide tactics allow. The cost may also be less.

NUTRIENT TRANSFER

Under set stocking or slow rotation grazing, especially over extended periods in large paddocks, stock camps develop. A large proportion of the nutrients within a paddock is transferred to these camps. Grazing practices may help to distribute nutrients more uniformly around paddocks. Rotational grazing, use of small paddocks or temporary electric fencing to exclude animals from stock camps, all could help. One consequence could then be more efficient use of fertiliser as more nutrients stay where they are applied. More uniform distribution of dung and urine may also reduce the amount of nutrients washed off paddocks in storms. The costs and benefits of grazing practices on nutrient transfer have not though, been the subject of research.

DROUGHTS

Droughts are a regular part of agriculture. Unfortunately, it is not always possible to adjust quickly and appropriately to unusually dry seasons. One advantage of rotational systems is that producers can often see more clearly the amount of feed they have in front of them. If seasons do become drier than normally expected, there are advantages in amalgamating mobs and switching to rotational grazing in order to ration feed and so be in a better position to judge ones position. Associated with this would be the use of small sacrifice areas for hand feeding so that most of the pasture is rested. After a drought, paddocks will then recover much faster than if they had been heavily grazed continuously during the drought. Sacrifice areas could be those intended for resowing pastures or cropping. Flat areas are preferred to minimise soil and nutrient loss from erosion.

CONCLUSIONS

The ideas and results discussed in this paper aim to develop and maintain sustainable, productive pastures. Much of the available information comes from current research. Further work over the next few years should identify the better techniques and help resolve the best approaches to pasture management. Some caution is warranted in adopting any new grazing tactics until sufficient evidence exists for producers to explore their options and develop practices that suit them and their pastures.

Maintenance of a desirable botanical composition should be a major goal of pasture management. Grazing tactics are an important means of achieving that goal. Grazing tactics should be viewed in the same light as other management practices such as fertiliser applications and herbicide use and the benefit / costs of each needs to be assessed. Grazing procedures not only help to manage pastures but at the same time convert those pastures into livestock products. By maintaining better quality pastures for longer, the cost of resowing pastures is reduced substantially.

With pastures that have a higher proportion of desirable species animal production should improve. The tactics suggested here ie. long autumn-winter rotations, close grazing in spring and normal continuous grazing over summer until the autumn break, aim to impose minimal stress on animals and optimise animal production by having a high output per hectare without sacrificing production per animal. In many cases better pastures should result in greater growth rates of individual animals and may allow increases in stocking rates. This will fit with current industry aims of better quality products tailored to market needs.

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