Proc. Ninth Ann. Conf. Grassld. Soc. NSW, 1994, pp. 77-82

GRAZING SYSTEMS FOR WEED CONTROL

GRAZING MANAGEMENT - THE ANIMAL FACTOR

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Abstract. Grazing management, that is, varying the frequency and intensity of animal grazing, is required for the maintenance of desirable grasses and legumes. Sheep and cattle have different foraging strategies and preferences which, if left unchecked, can lead to a decline in pasture quality. Graziers have several options in the way livestock graze pasture. Botanical composition can be modified by changing the way animals impact on pasture, eg deferred grazing, heavy or light grazing at strategic stages of plant growth. Mixed species grazing, integrated with other methods of weed control, can provide stable pastures and improved weed control.

Legume pastures form the basis of most of the New South Wales grazing industry and, due to climate, there are differences in pasture production between seasons and years. Pasture quality and quantity vary to each extreme across the feed year and, in many instances, the annual requirements of a ewe or cow breeding enterprise are not satisfied.

Accordingly, for optimum plant and animal production, managers must realise that:

- Pasture species will respond differently to various grazing regimes.
- Defoliation over the year will influence the regrowth of each pasture species differently.
- The feeding requirements of livestock vary over the feed year.
- The interaction of feed supply and demand will be influenced by climate and other environmental factors (Brougham and Chu, 1987).

Grazing by livestock affects pasture plants directly by defoliation, treading and the return of nutrients in the form of dung and urine (Moore, 1967). The extent of defoliation of a plant depends on the frequency and intensity of grazing, and this will directly influence pasture quantity and quality. Pasture *quality* is directly related to botanical composition. Also, the amount of leaf material present, the stage of maturity of the plant and the presence of legumes, and attractiveness to livestock all contribute to pasture quality. Pasture *quantity* influences animal intake, and subsequently animal production, at both high and low pasture mass.

Grazing management

Grazing management means controlling the interaction of livestock and pasture. By varying the frequency and intensity of grazing in conjunction with a knowledge of feed requirements of livestock, pasture production may be manipulated to more appropriately meet animal demands and maintain pasture quality (Bryant and Sheath, 1987). When pasture supply exceeds demand, grazing management will have little impact on animal production, but will have a direct influence when demand outstrips supply (Clark, 1993).

The way that animals graze pasture (grazing behaviour), will have an influence on pasture production and, therefore, animal production. Grazing a plant causes both physiological and morphological changes to the individual and the plant community. These changes may be both beneficial, such as causing the plant to tiller and become more dense, or detrimental (*eg.* causing plant mortality, bare areas and erosion) (Cameron and Canon, 1970). Understanding how sheep and cattle graze pasture will allow improved strategies of pasture management to be developed.

When bare areas are created, weeds are able to colonise them. In most cases weeds are not preferentially grazed by sheep or cattle and so become prevalent in a pasture as greater pressure is placed on more preferred pasture species. It is desirable to manage sheep and cattle on pastures so that desirable species and ground cover are maintained, prevention being better than cure.

When pasture is grazed, recovery is initially slow. Then, as new leaves are produced, which then are able to trap more sunlight, the rate of growth increases. The shorter a pasture is grazed the longer is that initial delay. The critical factor for regrowth is maintaining leaf to intercept light.

Selective grazing

At conservative stocking rates, when pasture production is greater than demand, livestock exert selection. With selective grazing, greater pressure is placed on preferred species, while those less palatable to the livestock are allowed to dominate. These may be plants such as thistles, Yorkshire fog, annual grasses (vulpia, barley grass) or perennials such as phalaris. The species mix which produces the greatest quality in the pasture is soon modified to a lower state following selective grazing (Korte *et al.*, 1987).

Pastures are dynamic plant communities, continually "readjusting" to any imposed action, be it drought, fertiliser or grazing pressure (Brock and Hay, 1993). Thus, the long term outcome of selective grazing of a particular species (*eg.* clover) is that there will be less of that species in the diet (Parsons *et al.*, 1991), possibly resulting in lowered animal production.

For both sheep and cattle, leaf is selected in preference to stem and stem in preference to dead material. However, sheep and cattle have different grazing preferences and different grazing behaviour. When herbage mass is high sheep will:

- select green material;
- tend to graze closer to the ground, selecting out leaf material, and actively selecting clover; and,
- have a greater impact on the botanical composition of the pasture than cattle.

Cattle on the other hand:

- select green material.
- are less selective and are able to quickly reduce the mass of herbage, without particular selection of an individual plant species.
- "condition" a pasture (eg before being used by growing lambs). That is, they remove taller shading grass and so encourage clover growth.
- can be used to clean up pastures, because they are less selective and can maintain intake with dry feed, even though it is of lower quality.

Selective grazing, particularly by sheep, may be desirable in some cases, for example with lactating ewes or other high priority stock. The ingress of weeds and undesirable species is a response to grazing management and this must be modified so that desirable species are not threatened.

Stocking rate

The aim of a grazing enterprise is to make profit by:

1. Optimum production from each animal.
2. Optimum production from each hectare of land.

There is a trade-off between per head production and per hectare production. At low stocking rates, intake and therefore production per head will be high. As stocking rate increases and competition for pasture increases past an optimum, per head production will decline. As herbage mass is reduced, the rate of intake per head decreases. To compensate, sheep will increase their grazing time to maintain pasture intake (Allden and Whittaker, 1970). Thus, different stocking rates can be used to achieve different targets, be it for pasture or animal production.

How animals graze pastures

Two main grazing systems exist for Australian producers, continuous grazing of livestock (zero management), or some form of grazing management. In terms of profit from grazing management, it can't be stressed too strongly that stocking rate is the main determinant (Obst, 1987) (*eg.* 4 sheep/ha may cut 16 kg wool, 8 sheep/ha may cut 30 kg).

Continuous grazing

Continuous grazing occurs when a given number of animals graze a paddock for an extended period of time (Robards, 1976). On many properties in Australia, sheep and cattle are grazed continuously, usually at conservative stocking rates. This allows livestock to exert selection in their diet, potentially selecting a diet higher in quality than the average on offer (Foot *et al.*, 1983), although this will be influenced by herbage mass (Hamilton *et al.*, 1973).

Even when livestock are grazed continuously, plants in that pasture are rotationally grazed. The frequency with which a plant will be defoliated will be determined by the proportion of other palatable species in the pasture mix (Hutchinson, 1993).

Rotational grazing

Rotational grazing occurs when stock are regularly moved through a series of paddocks. There is no consistent evidence that rotational grazing provides benefit in animal production (Chapman and Clark, 1984; Christian, 1987).

Which is best?

In the 1940s, fixed rotational grazing was advocated for Australian pastures. Moore *et al.* (1946) compared three systems of grazing, continuous stocking *versus* 4 and 8 week rotations and found no effect of the grazing method on the phalaris/subclover pasture. There was also similar livestock production (sheep liveweight and wool production) from each treatment. However, lucerne persisted only in the 8 week rotation, highlighting the requirement of lucerne to be rotationally grazed. They concluded that unless

stocking rate can be adjusted so that the rate of consumption of pasture is of the same order as its growth, then no increase in pasture yield can be expected.

There are mixed results from research when continuous grazing is compared to rotational grazing based on a fixed rotation interval. Continuous grazing of high priority stock for short periods (*eg.* over lambing) is advantageous to give maximum intake per head at a time when requirements of the animal are highest.

A grazing management system which utilises components of stock rotation and continuous grazing combines the benefits of both systems. Beattie and Thompson (1989) in Tasmania have implemented controlled grazing management - varying grazing pressure on pasture to either ration feed (in early winter) or increase utilisation. However, this strategy has no direct support from research evaluation as being superior to traditional grazing strategies, due to the large number of variables associated with such a project. Nevertheless, those producers who adopt an annual strategy which combines both continuous and rotational grazing periods rarely return to the old system, and report increased carrying capacity, reduced supplementary feeding and improved pasture composition (Beattie, 1993). In the variable temperate environment of NSW, a combination of both continuous grazing and flexible rotational grazing (driven by regrowth requirements of the pasture) may be more appropriate for both animal and pasture production.

Changes in botanical composition

Modification of pasture composition by grazing animals may occur by animal selection, or by strategies such as intensive grazing or spelling from grazing. For example:

- high stocking rate on annual pastures increased the proportion of capeweed and erodium and other prostrate species over grasses (Rossiter, 1966);
- block-grazing of annual pasture over late autumn and winter, increased the proportion of grasses and decreased clover content (Doyle *et al.*, 1993);
- increase stocking rate increased phalaris and decreased annual grasses (Morley *et al.*, 1969); and,
- spelling a phalaris pasture reduced the proportion of annual grasses (Kemp *et al.*, 1990).

Essentially, two strategies exist to utilise animals to modify the composition of pasture:

1. Crash grazing with high stock numbers when the undesirable species is at its weak point, or, conversely,
2. Defer grazing when desirable species are at their weakest point (Kemp, 1991).

Animal species effect on botanical composition

Sheep and cattle exert different pressures on pasture species. The action of cattle is to remove pasture mass with less species selection than sheep (Collins, 1989, Grant *et al.*, 1985). Cattle-grazed pastures are more dense and have a higher percentage of clover (Lambert *et al.*, 1986). Sheep on the other hand are more selective, grazing lower in the sward than cattle (Collins, 1989; Grant *et al.*, 1985). They are able to select particular species, particularly when they are low-growing or mixed with other species. There is evidence that clover is removed quicker in sheep-grazed than cattle-grazed pastures (Bendall, 1973). Collins (1989) suggested that this is due to:

- selective removal of the clover dry matter, which causes;
- grass dominance and shading, which further reduces clover growth.
- over-grazing of essential stolons and growing points.

The grazing of goats can complement that of sheep and cattle by grazing higher in the sward, selectively removing taller grasses and less clover (Collins, 1989; Grant *et al.*, 1985). As a result of goat grazing, the proportion of clover increases as it develops lower in the sward where goats are not actively grazing (Nicol *et al.*, 1987; Nicol and Collins, 1990).

Mixed species grazing, where sheep and cattle graze together, leads to greater sheep production than when sheep graze alone (Hamilton and Bath, 1970; Dickson *et al.*, 1981; Nolan and Connolly, 1989). This is due to different preferences and, so, selection of different diets in a mixed pasture (Arnold, 1980 cited by Collins, 1989), improving overall utilisation of the herbage.

Grazing for weed control

As already stated, mixed species grazing will assist in maintaining pasture production, as several components of the pasture are being defoliated equally, due to different animal preferences. If this in turn maintains ground cover, then weed ingress will be reduced. Utilising the dietary preference of sheep, cattle and goats in conjunction with a planned grazing strategy, can be used to control unwanted pasture species (Allan *et al.*, 1993). Sheep and cattle do not preferentially graze many weed species, but control may be effected by heavy strategic stocking. However, care must be taken to ensure the pasture is not damaged beyond recovery.

Grasses

Plants are most sensitive to grazing pressure during the establishment and reproductive phase. Normally, more-lenient grazing is imposed at this time to preserve the plant species. In the case of unwanted species, grazing at this time (in conjunction with higher stocking density) can be a means of removing species. This management has been used successfully to remove wire grass (*Aristida* spp.) in a *Danthonia* pasture (Lodge and Whalley, 1985). *Danthonia* was not threatened as it flowers at a later stage. At present, similar strategies for other undesirable plants have not been developed.

Strategic stocking of sheep on pasture can have beneficial effects in encouraging consumption of a particular species. Myers and Squires (1970) found that they could exploit the early germination and rapid growth of barley grass to remove it from a pasture within 2 years by deferred grazing with timely introduction of sheep (20 days after the first irrigation). Kemp (personal communication) utilised grazing preference of sheep to remove barley grass from a spelled winter pasture by introduction of sheep as the barley grass was commencing its reproductive stage. Vulpia has been shown to be susceptible to heavy grazing during the vegetative stage (Cameron and Cannon, 1970; Graham, 1990). Overall, Beattie (1993) reported that the key to controlling unwanted grass weeds is based on limiting their reproductive capacity, thus stopping seed production.

Locking up a phalaris pasture over winter has been shown to reduce the proportion of annual grasses in the pasture (Kemp *et al.*, 1990). Similarly, Kemp (1991) reported that grazing of phalaris in autumn is required to stop it dominating pastures and reducing the proportion of legume. This also applies in spring, where grazing to remove excess dry matter will reduce the rank component and encourage subsequent germination of subclover (Quigley, 1992). Similar results were obtained for ryegrass-dominant pastures by Sheath and Boom (1985). The found that light grazing before a summer dry:

- allowed subclover to seed more prolifically than where pastures were heavily grazed;
- re-establishment the following season reflected seed numbers; and,
- following a lax grazing in spring, ryegrass tillering (and therefore density) was reduced the next summer.

Heavier grazing pressure throughout the year maintains the competitive edge of ryegrass, suppressing less-productive species (Radcliffe, 1972). A similar effect was found for white clover-dominated pastures that had the grass overburden removed in spring, allowing the clover an opportunity to exploit open spaces (Sheath and Boom, 1985). Both species were limited in spring and the subsequent late summer, when a "pasture mat" resulted from lax spring grazing. The long-term consequences of allowing a build up of spring pasture (low utilisation), may be a reduced proportion of desirable species.

For perennial ryegrass, close grazing in spring, aiming to keep the pasture green and of higher quality is recommended, to give greater utilisation by livestock. However, continued close grazing over periods of moisture stress can cause the death of ryegrass plants (Korte *et al.*, 1984).

Broadleaf weeds

Heavy grazing with sheep and cattle during thistle seedling emergence (autumn) may assist in controlling populations of thistle (Beattie, 1993). Bendall (1973) in Tasmania reported that in a pasture free from stock after the autumn break, thistles grew taller rather than prostrate. When sheep entered the paddock (8 weeks later) the thistles were more palatable and were grazed by sheep. Spelling of pastures from grazing in autumn is also beneficial in maximising the competitive advantage of a rapidly growing pasture (Forcella and Wood, 1986).

Pearce (1972) found that Paterson's curse declined as sheep stocking rate increased. Grazing of scotch thistle by sheep and cattle was insufficient to control seeding and limit the spread of the thistle (Auld, 1988; Campbell and Holst, 1990). A similar result was found when winged thistle and wild oats were grazed by sheep (Auld, 1988).

Nodding thistle was not controlled by grazing management (Martin and Rahman, 1988). However, strategic application of herbicide (May to June) followed by crash grazing has been shown to lower thistle numbers at flowering (Sanders, 1990). Similarly, Campbell and Holst (1990) found that spraying at early stem elongation with MCPA followed by sheep grazing increased consumption of the vegetative thistle by sheep but not by goats. In the case of nodding thistle (and this may apply to other weeds), control should start with a vigorous pasture cover in autumn to exert strong competition with the seedlings and so reduce thistle numbers (Edmonds and Popay, 1983).

Selective grazing to effect control of a weed is seen more often from the grazing of goats. Goats were successful in controlling Scotch thistle (Campbell and Holst, 1990), artichoke thistle (McGregor *et al.*, 1990), nodding thistle and variegated thistle (C.J. Allan unpublished data). Goats have been used to consume Poa tussock, reducing the shading mass of the tussock and

allowing surrounding pasture to compete (Campbell *et al.*, 1984). An equivalent result was only achieved at two and a half times the goat stocking rate with sheep.

Allan *et al.* (1993) have documented grazing strategies for weed control using goats with sheep and cattle. For example, where Scotch thistle covers 30% of a paddock, 70% of the carrying capacity of the paddock is maintained as sheep or cattle and the balance replaced with goats (*ie.* 30% of the carrying capacity).

The adoption of an integrated approach to weed control, utilising some herbicide and the grazing action of livestock, has been shown to be a valuable means of reducing the weed populations in Western Australia ("Spray-grazing", Pearce, 1972). The effect of grazing by sheep on Paterson's curse was enhanced when 2,4-D was applied followed by high sheep stocking. Pearce (1972) aimed for 80-90% control of flowering while avoiding pasture damage. "Spray grazing" was reported as being able to be utilised on most annual weeds (eg capeweed, docks, geranium, mustard weed, saffron thistle, radish, spear thistle, turnip and variegated thistle). Another integrated approach has been proposed, using goat grazing followed by burning to control scotch broom (C.J.Allan, 1993 unpublished) and blackberry (Kajons and Holst, 1977).

Conclusion

Animal species, timeliness and intensity of stocking, alone or in conjunction with some other management tool, are all means of maintaining desirable species in a pasture. Prevention of ingress of undesirable species may also be achieved by a combination of these strategies. However, the overall effect of botanical change on animal productivity needs to be considered in adopting such strategies.

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