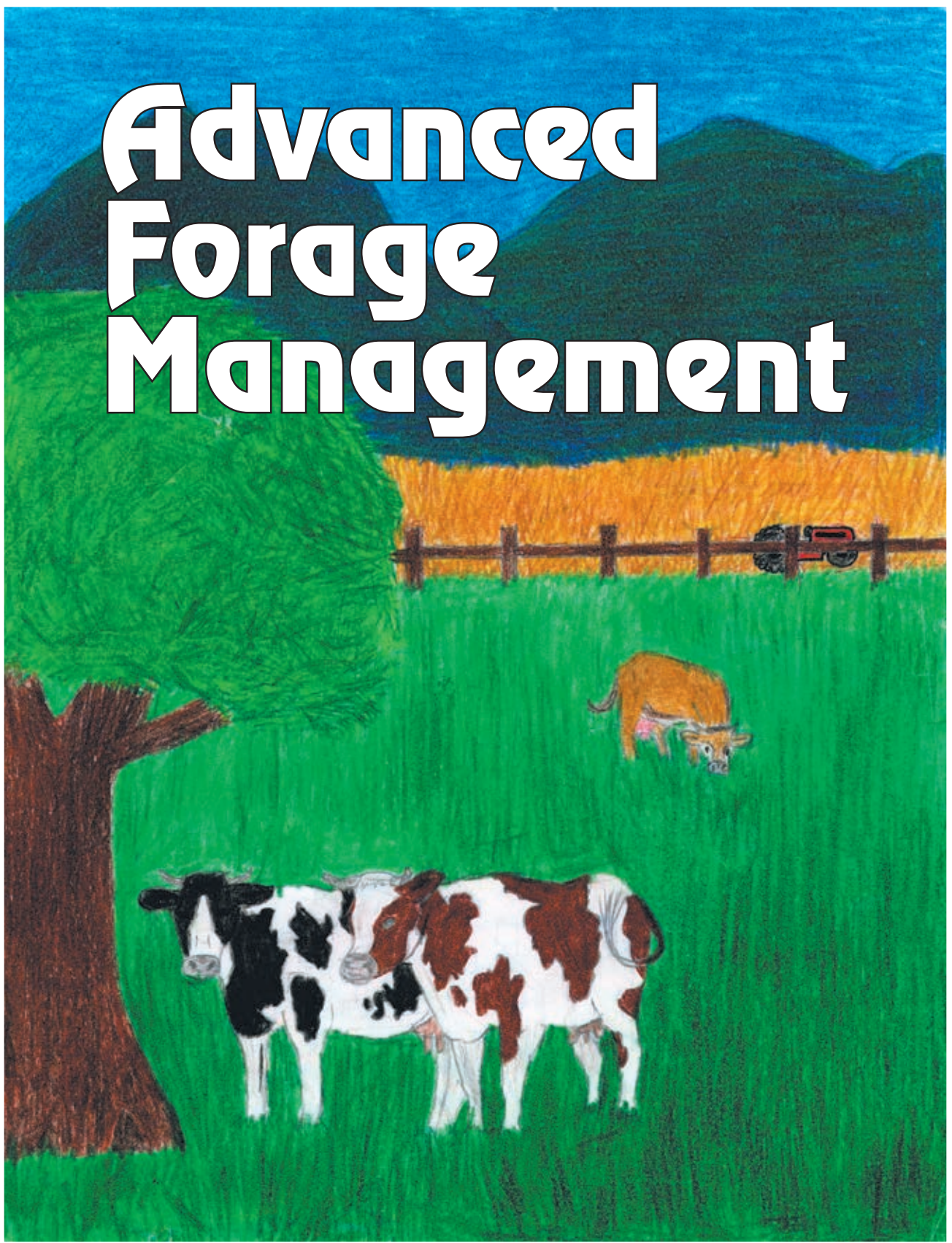


Advanced Forage Management



A production guide for coastal British Columbia and the Pacific Northwest

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Grazing Management

CHAPTER GUIDE

- ◆ Pasture growth dynamics
- ◆ Herbage intake — animal factors
- ◆ Herbage intake — forage factors
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Pasture Growth Dynamics

Forage produced on well-managed pasture is one of the most cost-effective feeds that can be produced and utilized in British Columbia and the Pacific Northwest. When properly managed, grazed forage is of higher feed value than any form of conserved forage because harvesting is frequent and there are no storage or harvesting losses. A good understanding of how grasses grow is very helpful in managing pastures effectively (See Ch. 1).

Herbage growth rates are very high in spring, and because the pastures have not yet been grazed, height of herbage is fairly uniform across all the grazing land. For pastures consisting mainly of taller

forages, such as orchardgrass, tall fescue, red clover and alfalfa, the optimum height for grazing is typically 20 – 25 cm (8 – 10 in). In contrast, optimum height is 10 – 15 cm (4 – 6 in) for low growing species such as perennial ryegrass, fine-leaved fescue, bluegrasses, bentgrasses and white clover. Carefully managed strip grazing can be used to effectively graze tall herbage.

Surprisingly, over 40% of seasonal production occurs before the end of May in our region. Because of the rapid growth in spring, first grazing should begin early; for tall species when forage heights reach 10 – 12 cm (4 – 5 in), for short species at about 7 cm (3 in). Grazing of tall species should be stopped at 4 cm (1.5 in) and the grazing of short species should be stopped at 2.5 cm (1 in).

Starting grazing of *some* of the pasture land at this intensity helps create a staggered forage regrowth pattern and promotes tillering and new leaf development. This strategy ‘conditions’ the forages to maintain leafy, high-quality herbage over a longer period of time.

Another pasturing strategy to help maintain a constant supply of high-quality feed is to use a compliment of early and late-maturing varieties. The late-maturing varieties will maintain feed quality later into the growing season than early-maturing varieties.

Table 1. Effects of clipping intensity on tillers, roots and leaves of grass plants.

Treatment	Number of tillers		Weight of plants at end of test	
	At start of test	At end of test	Roots grams	Leaves
Not clipped	87	431	147	202
Clipped to 12.5 cm	77	427	78	160
Clipped to 7.5 cm	81	192	30	59
Clipped to 3.8 cm	73	53	7	18



Fig. 1. Effect of clipping intensity on roots (from Agriculture and AgriFood Canada publication 1589).

Grazing and Animal Health

When I was a student 20 years ago, my professor of dairy nutrition, Dr. Grieves, taught us about a phenomenon in dairy cattle called “Dry Lot Depression.” He described that cattle continuously in confinement and dry lot conditions would not perform as well as cattle that were pastured for a few months every year. The reasons given were rather vague and the poor performance was not well defined at the time.

In today's intensive dairy operations, farmers must maximize animal density to ensure profitability. On some farms, this has had grave effects upon animal comfort, health, disease, and psychological stress—for both farmers and their cows.

Dairy cows do not live as long today as in the past. Farmers are often compelled to cull otherwise good cows because of lameness, injury, or reproductive problems. Sound grazing practices could help us manage our dairy animals so that they remain productive longer meaning fewer replacement heifers would be needed. Also, higher herd production averages may be attained since a dairy cow would reach peak production in her fifth or sixth lactation.

Many dairy cows are culled because of reproductive failure and unobserved heats are the biggest reason for reproductive culls. Grazing systems allow cows to socialize more naturally and with less competition. This allows sexually active groups to form around cows that are in and around heat. One study showed that cows would stand to be mounted six to eight times an hour on pasture versus just two mounts an hour on a slippery barn floor.

Infectious diseases thrive on psychological stress and crowding. Pasturing can help reduce infectious diseases by simply dispersing the animals and reducing close contact. Calving pens can be emptied and given a thorough cleaning while cows are allowed to calve on pasture.

Exercise is a forgotten element in intensive animal production systems. Young rapidly growing animals develop stronger feet and legs if allowed to roam freely. Mature cows have fewer post calving problems. In fact, cows with feet and leg problems or physical injuries from comfort stalls will usually rejuvenate after a period on pasture. No one has developed a so-called ‘comfort stall’ that is as comfortable as a field of soft grass!

Despite the many health benefits, it is important to be alert to potential problems associated with grazing and animal health. The following are ten potential health problems to look for on pasture:

1. Internal and external parasites
2. Plant and chemical poisoning
3. Bloat
4. Grass tetany
5. Nutrient (macro and micro) deficiency or imbalance
6. Rapid changes in pasture nutritional quality
7. Heat stress
8. Poor water availability
9. Lameness due to rocky lane ways
10. Mastitis due to mud holes and sloughs.

If you anticipate and remedy potential health problems on pasture, the health benefits of grazing far outweigh the problems. *Grazing makes cows smile!!*

**Contributed by
E. Reynolds, D.V.M.**
Little Mountain Veterinary
Clinic Ltd., Chilliwack BC.



Fig. 2. Grazing makes cows smile!
— E. Reynolds D.V.M



Fig. 3. The goal of grazing management is to maximize intake.

Herbage Intake—Animal factors

The daily growth of the herbage determines the maximum number of animals that can be stocked per hectare of pasture. However, daily intake of nutrients ultimately determines the productivity of animals in any livestock operation. Likewise, herbage intake is the overall factor that governs animal productivity on pasture.

The goal of grazing management is to maximize intake.

Grazing behaviour

Feed consumption (intake) depends on the following factors:

- **Grazing Time:** How long does the animal spend grazing?
- **Bite Rate:** How rapidly does the animal take bites?
- **Bite Size:** How much forage does the animal consume per bite?

$$\text{Daily Intake} = \text{Grazing Time} \times \text{Bite Rate} \times \text{Bite Size}$$

Of these three factors, bite size seems to affect the intake rate most. When herbage is in short supply bite size is small so animals try to compensate by increasing both their biting rate and grazing time. When this happens, usually intake is diminished.

Bite weight depends on the amount and distribution of herbage offered within the pasture. The bite size is determined as:

$$\text{Bite Volume} \times \text{Density of the selected herbage}$$

The bite volume is the product of *bite area* and *bite depth*. Both bite depth and consequently bite volume increase as sward height increases. If the herbage is very dense, livestock will take smaller bites.

To manage your pastures for maximum rate of herbage intake, consider the following factors:

Physical attributes of animals

Intake of concentrates by animals in confinement is primarily regulated by their energy requirements. In contrast, intake of forage is limited also by the animal's physical ability to accommodate the bulky herbage material. Therefore, large animals with low body condition (skinny) and large reticulo-rumen capacity (big stomachs) can accommodate more herbage, hence are inclined to have high intake rates.

Physiological condition of animals

Physiological status of the animals also influences consumption. For both cows and ewes, forage intake

- A. increases slightly over maintenance levels during mid-gestation
- B. declines in late pregnancy (in spite of increasing energy needs)
- C. drops off sharply around parturition
- D. rebounds during lactation.

During early lactation, forage intake lags behind energy requirements, so body reserves are utilized. Late in lactation, intake remains high, while milk production drops off, so body reserves are replenished. Lactating cows consume 35 – 50% more forage than gestating cows of the same weight and on the same diet, under conditions of high feed availability.

Intake is also regulated by the rate at which the forage is digested and passes through the rumen, which is affected by quality. Low-quality forages, which are slowly digested due to high fibre content,



Fig. 4. Physiological status of animals affects quantity of intake.

The Mechanics of Grazing: How cattle, sheep and horses eat on pasture

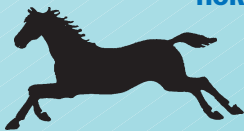
Grazing is a complex activity. It starts with the search for and selection of suitable herbage. After selection, the animal prehends (grasps) the herbage and takes it into its mouth. The forage is then chewed, mixed with saliva, formed into a bolus, and forcefully swallowed down into the forward part of the rumen. Varying amounts of time are spent on each activity. Jaw activity during grazing is complex and differs for each livestock species because each animal has a unique arrangement of jaw, teeth, and other mouth parts.



CATTLE grazing tall herbage use their tongues to encircle the herbage and draw it into the mouth. Short grass is gripped between the upper and lower molars or between the incisor teeth in the lower jaw and the muscular pad of the upper jaw, then severed by a backward jerk of the head. The horizontal movement of the grazing animal's head results in a mower effect, with the tops of the plant being "trimmed" off evenly. Cattle do not graze closer than 5 cm (2 in) from the ground unless forage is in short supply.



SHEEP either bite the foliage off the plant or break it off by gripping the herbage and jerking their heads backward or, less commonly, forward. Sheep are similar to cattle in having only a muscular pad in the upper jaw rather than teeth. In contrast with cattle, sheep have a cleft upper lip that permits close grazing.



HORSES have both upper and lower sets of incisors. These teeth enable horses to bite closer to the ground than sheep and cattle.

All three species move with their muzzles in a horizontal plane as they graze and select forage in a vertical plane. Because sheep have the smallest mouths, they can take small bites and so are able to be most selective of plant species and plant parts. However, all three species are able to vary their methods of harvesting forage according to the structure of the vegetation.

are retained in the rumen longer. When ingesting low quality forage, the animal feels full quickly and ceases to graze. In contrast, highly digestible, immature forages are slightly laxative, which means they pass quickly through the rumen enabling the animal to graze and ingest more.

Diurnal grazing pattern – can it be manipulated to increase intake?

Grazing lactating dairy cows typically have about five meals per day. Each

meal lasts an average of 110 minutes (Fig. 5). The first meal of the day begins shortly after dawn, followed by two to three meals between morning and afternoon milking. A long and intensive meal around dusk (8 PM) provides sufficient food to digest during the night period. A short meal (30 min) may be taken at about 1 AM but the rest of the night is spent ruminating and resting. Cattle with lower intake requirements in relation to their weight (e.g. dry cows, mature bulls) have fewer and

shorter meals.

While cattle feed mainly between dawn and dusk, night-time feeding will take place when intake requirements are high or days are short. Cattle spread out their meals over the daylight hours by manipulating length and number of meals, hence in mid-summer there are a greater number of meals in the daylight but they are of shorter duration (Fig. 6). Nocturnal feeding is more likely to occur on a well-lit night, and in hot, humid conditions night grazing is in-

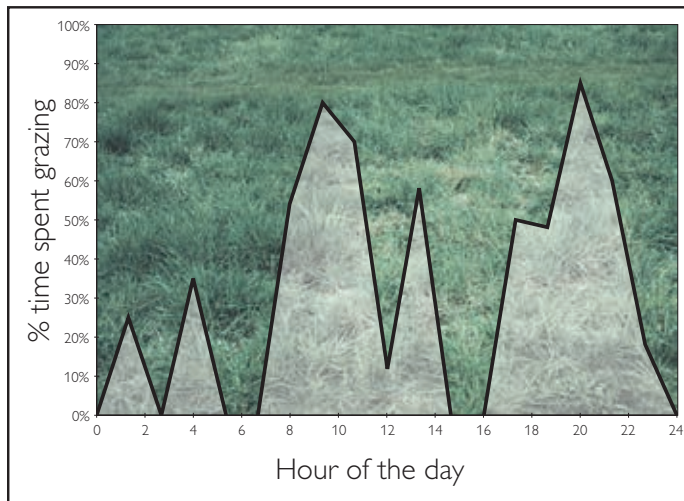


Fig. 5. Time spent grazing by dairy cows over a 24 h period.

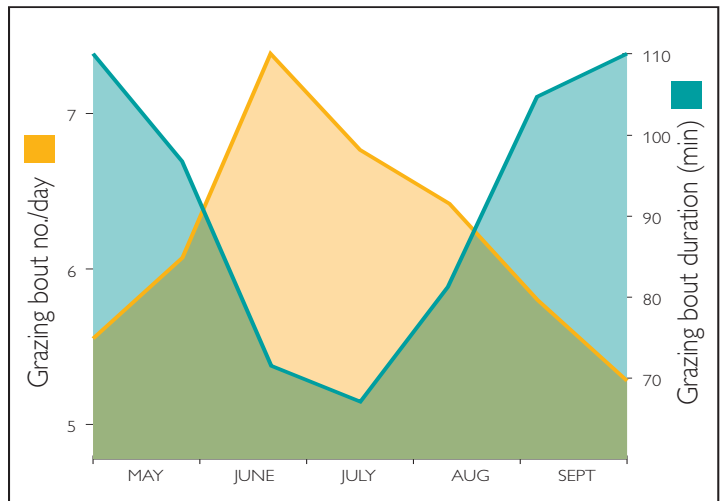


Fig. 6. Changes in duration and frequency of grazing bouts each day over the growing season.

Table 2. Daily activities of horses, cattle and sheep on pasture.

	HORSES	CATTLE	SHEEP
	Average time in hours spent on activity*		
Grazing	14 (10.8 – 16)	9 (5.4 – 12.7)	9 (8.4 – 10.6)
Standing	8 (5.6 – 10.1)	4 (1.1 – 9.4)	3 (1.1 – 6.6)
Lying Down	1 (0 – 1.6)	9 (8.5 – 11.3)	11 (8.3 – 13.1)

*Values in parentheses represent the range

A SPECIAL CASE

How Horses Graze

Horses have a different grazing behaviour than ruminants. Whereas cattle can be managed to graze a pasture quite uniformly, horses like to pick their spots. They designate certain areas for feeding ("lawns" or "greens") and other areas for defecation ("roughs"). Close attention to management of horse pastures is critical because if left to their own habits, horses will overgraze the greens, potentially weakening the stand.

creased to limit exposure to sun during the day.

The speed of grazing or biting is reduced at night, probably because the cattle do not have the necessary visual cues for fast herbage selection. As the day progresses, both the proportion of time spent grazing and the rate of biting increase. This increased rate of herbage intake is due also to an increase in sugar content of the herbage over the day and the need to store up sufficient food for digestion at night.

Can an understanding of these daily and seasonal grazing habits be used to manipulate the grazing system for increased intake? Possibly. If cattle have their biggest meal at dusk, they should be out on pasture at that time and not in the barn being milked. Furthermore, cattle should have an ample supply of fresh herbage for their large dusk meal.

Weather and Grazing

The climate along the west coast of North America is well suited for grazing because of moderate temperatures. Intense heat reduces feed intake on pasture, but the jury is still out on what is the best way to deal with it. Providing shade makes cattle more comfortable but won't necessarily increase feed intake because when the animals are standing under a tree, they're not eating! If the livestock are kept on pasture without shade, they must be provided with ample water at all times.

Cold wet weather is a significant factor for those farmers near the coast who are able to graze in the winter season on well-drained land.

Herbage Intake-Forage factors

Improving animal productivity by maximizing forage intake is a function of the quantity and quality of the herbage consumed by the animal. *Which affects intake most: quantity or quality of forages?*

Digestibility and protein content of grazed herbage is usually higher than that of conserved feed. This is because the herbage on pastures is generally younger, storage losses have not occurred and animals can select their feed. Intensive grazing systems typically maintain sufficiently high forage quality to meet the dietary requirements expected from the forage component of the diet. However, even high-quality pasture herbage may limit the quantity of forage consumed when the supply is inadequate. For this reason, quantity of available forage more often limits animal production on pasture than forage quality.

To ensure maximum intake, livestock must be provided with herbage of sufficient volume (height and density). This holds as long as growth stage is not so advanced that quality rather than supply limits intake. Canopy height and density affect bite size by the grazing animal.

Maximum feed intake takes place when there is 2200 – 3600 kg/ha (1 – 1.5 T/ac) dry matter of standing herbage. For tall grasses like orchardgrass, optimum initial grazing height is between 20 and 25 cm (8 – 10 in). For short grasses, like perennial ryegrass, optimum initial grazing height is 10 – 15 cm (4 – 6 in) in



Fig. 7. Cows resting in mid-day at the Pacific Agri-Food Research Centre (PARC), Agassiz, BC.

Table 3. Quantity of available herbage affects intake.

Available herbage kg/ha (lb/ac) of dry matter	Intake % of maximum
2200-3600 (2000-3200)	100
1800 (1600)	97
1350 (1200)	93
900 (800)	83
450 (400)	60
225 (200)	35

dense stands and 15 – 20 cm (6 – 8 in) in thinner stands. Optimum height for grazing tall fescue is in between. Sufficient grass should always be available so as not to limit intake, even during the last hours of grazing a field.

Table 3 shows how intake declines when there is inadequate herbage mass. Given the importance of available herbage to intake, several devices have been devel-

oped to help farmers estimate the standing herbage on their pastures. These devices range in complexity from calibrated walking sticks and falling plate meters to sophisticated electronic capacitance meters.

Our cool-season grasses are best suited for grazing while they are in the vegetative growth stage because at that time they consist of only leaves and sheaths and have no true stems (see Chapter 1). Ruminants select young, green leaf tissue and avoid stems and dead material. Of the cool-season grasses, orchardgrass and tall fescue flower only in spring and remain mostly vegetative throughout summer and fall. Timothy and some varieties of perennial ryegrass flower more than once in a growing season.

Intake of forage by livestock increases directly with increasing digestibility in the range of 55 – 75% (Fig. 8). Over-mature grasses have digestibility values as low as 50% while immature grasses can reach 80% digestibility. Note that high moisture content may limit the intake of immature grasses. It is obviously difficult to manage pastures so that they have more than 2,000 kg/ha (1 T/ac) of herbage with greater than 70% digestibility.

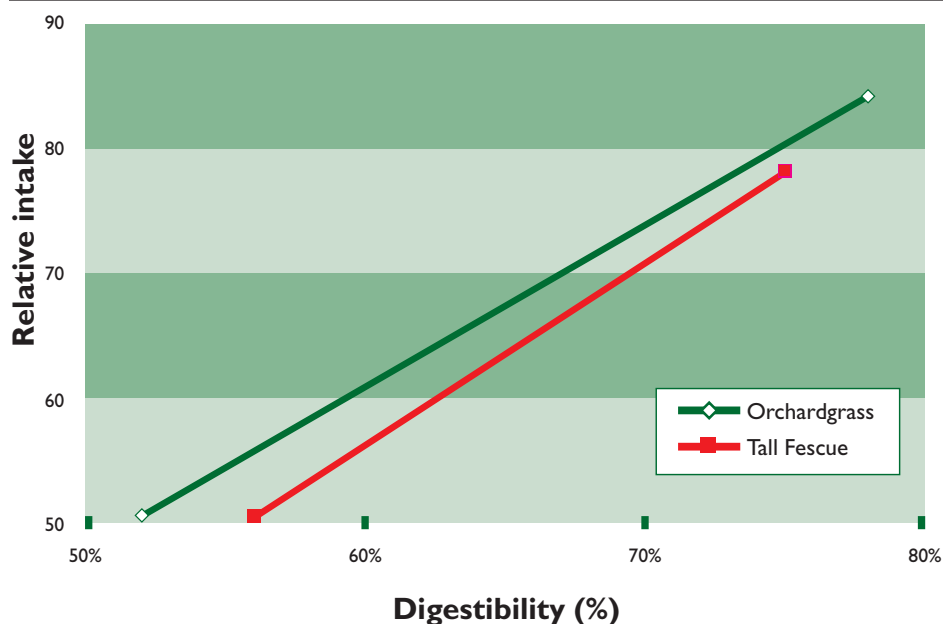


Fig. 8. Relationship between intake and organic matter (ash removed) digestibility for temperate grasses.

GRAZING AND DUNG PATCHES

An advantage of grazing is that animals return nutrients, in the form of dung and urine, back to the ground. Grazing should be managed so that livestock distribute dung and urine uniformly over the paddock. Uniform grazing minimizes the need for supplemental nutrients.

Animals soon graze over urine patches but avoid dung patches for a much longer period of time. The area avoided can be several times larger than the actual dung deposit. Pasture losses due to fouling of the grass may range from 45% under low stocking rates to below 10% under high stocking rates. Under high stocking rates, competition for feed forces animals to graze close to the dung deposit.

Encouraging uniform grazing over the entire paddock helps to evenly distribute dung and urine, and reduce pasture losses due to avoidance.

This is best accomplished by keeping stocking rates high and residency periods short. For high-producing dairy cattle, the residency period should be no more than a day. Some producers chain harrow paddocks after grazing to break up dung patches or clip the rejected stalks but both practices are probably of questionable benefit. Under local high rainfall conditions, intensively managed cows fully graze "dung areas" within 2-3 grazing rotations (less than 2 months).

In diverse stands, palatability affects grazing behaviour and forage intake. When there is ample herbage, livestock select desirable plants or plant parts over those that are unpalatable whether due to their stage of maturity or sensory attributes. Consequently, the stand is grazed unevenly and the rejected plants mature further, becoming even less palatable. Livestock may reject less palatable species, such as tall fescue or reed canarygrass, when they are in mixtures with more palatable species but feed well on these species when no choice is offered. When compelled by shortage of herbage, livestock will graze very unpalatable plants but intake may suffer.

Table 4. Comparison of 'Management Intensive Grazing' to 'Traditional Grazing' techniques.

Characteristic	Management Intensive Grazing	Traditional Rotational Grazing
Stocking Density*	Up to 200 cows/ha (80 cows/ac)	5 – 20 cows/ha (2-8 cows/ac)
Stocking duration	12-24 hours	1-2 weeks
Rotation length	10-20 days	30 days +

*Stocking density refers to the number of cows grazing in a 1 ha paddock at a time.



Fig. 9. Many graziers in BC and the PNW use high intensity - short duration grazing systems.

Concentrate supplementation and water supply affect intake on pasture

In situations where nitrogen is limiting, the addition of small amounts (<1 kg or 2 lb) of high-protein supplement has been found to enhance herbage intake. Feeding more than 1.5 kg (3 lb) of supplemental grain to cattle may reduce forage intake. As a rule, substitution of grain for forage stretches the forage supply and enhances animal production levels by enriching the dietary energy levels. On the other hand, supplements reduce the relative use of forage and increase cash costs.

Keeping an adequate water supply within a relatively short distance ensures herbage intake is not limited due to water shortage and walking time. As long as cattle have to walk less than 250 m (820 ft) to water, grazing patterns and subsequent defecation patterns will be uniform throughout the pasture. Forage located beyond this distance from a water source will be under-utilized. It is important to note that if the cattle establish a particular grazing pattern during early grazing cycles, the effect becomes much greater later in the season. Forage rejected early at far distances from water becomes more mature and is even more likely to be rejected later in the season.

Perennial Ryegrass for Pastures in the Pacific Northwest

Perennial ryegrass is among the most palatable of all forage grasses, meaning that animals seem to prefer it to other grasses. Perennial ryegrass also produces the highest sward density of any pasture grass, helping grazing animals to achieve the maximum dry matter intake (See Herbage Intake – Forage factors). Most importantly, perennial ryegrass (and closely related Italian ryegrass) is highly digestible so that it has a very high energy (TDN) content (see Ch.7). High digestibility means fast rumen passage, leading in turn to yet more feed intake. Dry matter intake is the key to high milk production, high average daily gain, and overall high animal performance.

The combination of palatability, density, and digestibility is the reason that farmers in New Zealand, Western Europe and the UK depend on perennial ryegrass almost exclusively for grazing and conserved feed. However, many farmers are concerned that perennial ryegrass is insufficiently hardy for

colder-than-average winters in the Pacific Northwest.

Many of the perennial ryegrass varieties first introduced to North America originated in New Zealand. Varieties from New Zealand remain active during winter rather than becoming dormant. Experience has shown that to survive winters here, perennial grasses must have more winter dormancy than found in New Zealand varieties. The climate in European countries like Holland is much more like ours. Crops in Holland are often exposed to winter temperatures reaching -15 degrees C (0 degrees F) without protection from snow cover. Many of the new perennial ryegrass varieties from Europe become dormant in the fall and have considerably more winter hardiness than in the past. This means that farmers will be able to plant more ryegrass pastures without losing sleep.

Contributed by J. Thijssen, Barenbrug, USA and S. Wallace, Mid West Forage Sales



Fig. 10. Tumble-wheel type electric fence facilitates controlled grazing.

Intensive Grazing Systems for Coastal BC and the PNW

Many graziers in coastal BC and the Pacific Northwest use the high intensity/short duration grazing system. The reported advantages are:

- Animals spread out quickly so grazing and defecation are uniform over the paddock.
- Stand persistence may be greater because individual plants are grazed only once during a grazing period.
- Selectivity is reduced so even less-preferred species are grazed and thus maintained in optimal growth condition.
- Trampling is minimized and pastures have ample time for rest and recovery.

It should be pointed out that research in New Zealand and the United Kingdom has **not** shown that high intensity /short duration grazing systems produce more grass, promote better utilization, or improve animal production compared to continuous grazing. In these countries, rotational grazing is practised only to ration feed in the fall or whenever herbage is in short supply.

How well does the experience overseas apply here? Unfortunately, we have little experimental data. We do know that there are some differences in our situation. Many farmers here graze orchardgrass and tall fescue rather than perennial ryegrass, which is by far the dominant grazing

grass in both New Zealand and the UK. Orchardgrass and tall fescue should be allowed to attain a greater height than perennial ryegrasses at the start of grazing and the taller herbage is better grazed with intensively managed systems. Furthermore, land is scarcer and nutrient supplements are more heavily used in our region. Finally, expectations for milk production on both 'per cow' and 'per land area' bases are far greater in our region than in New Zealand or the UK due to economic differences. These factors suggest that controlled grazing systems may indeed be

well suited for some farms in coastal regions of BC and the Pacific Northwest.

Principles of Rotational Grazing

*Also referred to as **Prescribed Grazing Management** or **Management Intensive Grazing***

The goal of rotational grazing management is to allow plants to continually produce large volumes of high quality leaf material by setting (1) **frequency**, (2) **intensity** and **timing**, and (3) **duration** of grazing.

Frequency of Grazing

The period of time a pasture is allowed to recover between successive grazings is referred to as the rest period. The rest period (plus residency time, see below) sets the frequency with which a pasture is grazed. Rest periods should vary over the growing season to allow plants to achieve their maximum rates of growth without becoming so tall and rank that quality is reduced and intake losses occur (see Fig. 8). Note that maximum growth rate occurs at a greater height with tall grasses (orchardgrass) than short grasses (perennial ryegrass, bluegrass).

During the spring, orchardgrass and tall fescue pastures of coastal BC and the PNW produce 100–125 kg/ha (90–110 lb/ac) of dry matter per day. In a 15 – 20 day growth period, the forage height will reach 20 – 25 cm (8 – 10 in) and contain between 1200

Table 5. Recommended residency periods.

Kind of Livestock	Number of Days
Lactating dairy cattle	one-half to 1
Milking sheep or goats	1 to 2
Growing stock (steers, heifers, lambs)	3 to 4*
Beef cow/calf, ewe/lamb, deer/fawn, etc.	3 to 4*
Most adult non-lactating stock	4 to 7*

** may also be continuously grazed with proper planning*

and 2000 kg/ha (1100 – 1800 lb/ac) of dry matter available for grazing above a 5 cm (2 in) residual stubble height. During the summer and early fall, growth rates slow to 50 – 70% of those in the spring so a longer rest period (25 – 30 days) is required to accumulate a similar amount of forage. Long rest periods occasionally expose forages to the risk of leaf diseases such as scald (late spring and summer), stripe rust and powdery mildew (late summer and fall).

Intensity and Timing of Grazing

The degree to which pasture herbage is grazed down during a grazing event is referred to as the intensity of grazing. The greater the intensity of grazing, the greater the rate of forage utilization, and the greater the harvest efficiency. In practice, grazing intensities are evaluated by comparing pre-grazing and post-grazing forage heights.

When establishing grazing heights, the most important factors include (1) type of pasture plants, (2) time of year, and (3) production objectives of the livestock enterprise.

Pastures consisting of tall grasses (timothy, orchardgrass, tall fescue, reed canarygrass) and legumes (red, ladino and alsike clover, etc.) should be grazed from an initial forage height of 20 – 25 cm (8 – 10 in) down to a residual stubble height of 5 – 6 cm (2 – 2.5 in). This results in 70 – 80% apparent forage utilization. However, the time of year must also be taken into consideration.

On wet soil conditions, where punching or poaching (excessive trampling) of the pasture could be a problem, it is best to let the forage accumulate to a greater height prior to grazing and then to leave a larger proportion of the forage in the pasture after grazing. Keep in mind that grazing cattle may uproot tall grasses on wet soils. Orchardgrass is probably more susceptible to being uprooted than tall fescue or perennial ryegrass. Although this method will help protect the soil and the stand, it does reduce harvesting efficiency, and will require that the pasture be clipped once the soil dries out.

Grazing heights may also need to be adjusted during hot dry weather. Some producers say that it is best to leave more residual forage in the pasture to shield the soil from the sun in order to prevent excessive soil temperatures and encourage good root growth. A large proportion of

roots are near the soil surface and leaving some forage canopy protects the roots from overheating and drying out.

Choice of grazing height has a different effect on productivity per animal and productivity per unit of land area. As the proportion of herbage utilization increases, production as measured on an individual animal basis decreases. This is because the longer and more closely livestock graze a pasture, the amount and quality of forage available for grazing declines. As a result, there is a reduction in dry matter intake per animal and in individual animal performance.

In contrast, increasing the amount of forage utilization increases production per unit area. Even though production per animal is lower, a greater number of animals

may be supported, and as a result, a greater amount of the forage produced is converted into livestock product. Paradoxically, if too much of the available forage is utilized, not only is there a reduction in production per animal, there is also a reduction in the amount of production per area.

Farmers must find a compromise between maximizing production per animal and per land area that suits the production objectives of their livestock enterprise. Because grazing heights are the primary controlling factor in the efficiency of pasture production and utilization, they can be extremely useful in guiding the compromise. For optimum animal performance, the previously recommended residual forage heights would be increased by perhaps 50%. For maximum



Fig. 11. The duration that livestock are allowed to access a paddock or field is called the residency period.



Fig. 12. Cattle graze selectively; they consume the best forage first and leave the rest for last.

A tale of four dairy farms

Grazing success stories in BC, Washington and Oregon

Several dairy producers in coastal BC and the Pacific Northwest have recently switched from confinement feeding to pasture-based systems. The overall objectives were to reduce input costs and labour demands. The following table describes how four grazing-based dairy farms are organized.

	Beaver Meadow Farms	Shannon Farms	Hidden Acres Dairy	Double J Jersey Inc.
Location	Comox, BC	Port Alberni, BC	Lynden, Washington, USA	Monmouth, Oregon, USA
Size of operation	300 milking (Holstein) *Herd split into 2 groups for simplified grazing.	130 milking (Holstein)	100 milking (Jersey)	130 milking (Jersey)
Milk production	25 L/day (55 lb/day)	26 L/day (57 lb/day)	20-23 L/day (45-50 lb/day)	25 L/day (55 lb/day)
Grazing area	32 ha (80 ac) Subdivided into small paddocks; 64 ha (160 ac) in larger paddocks.	28 ha (70 ac)	45 ha (110 ac)	32 ha (80 ac)
Paddock size	0.67 ha (1.5-2 ac)	0.8 ha (2 ac), will increase size if cows graze too low.	Subdivided into 0.6-0.8 ha (1.5-2 ac) paddocks.	1 ha (2.5 ac)
Stocking density	225 cows/ha (91 cows/ac)	160 cows/ha (65 cows/ac)	100 head per day on each subdivided paddock	130 cows/ha (50 cows/ac)
Grazing duration per paddock	8-12 hours	12 hours	12 hours	12 hours
Beginning of grazing season	Depends on moisture in fields, usually late April to early May.	On higher land, mid-April. Well-drained sandy loam soil allows cattle traffic pretty well all year. On lowland, after harvesting 1st crop. Will rotate cows twice through high land before moving them down to lowland.	Late April to early May. Depends on grass growth and soil moisture conditions.	Depends on moisture in fields, usually mid-March.
End of grazing season	Depends on moisture, usually mid- to late-October.	Mid-October, when wet or growth has slowed down.	Mid-October, depending on moisture. End of November for replacement heifers.	Usually late October or early November.
How much growth is there when cows put on pasture?	About 2500-2800 kg/ha (1-1.1 T/ac) of dry matter. Measured with a pasture probe.	15-25 cm (6-10 in), depending on species.	15-25 cm (6-10 in)	30-36 cm (12-14 in) for orchardgrass, 15-20 cm (6-8 in) for perennial ryegrass.
How much growth is left on pasture when cows pulled off?	About 1500 kg dm/ha (2/3 T/ac). Measured with a pasture probe.	5-8 cm (2-3 in)	5-8 cm (2-3 in)	10 cm (4 in)
Grazing rotation (rest period)	10-12 days in spring, longer in summer.	15 days in spring, longer in summer.	Early season: 8-10 days; July-September: up to 30 days.	10-12 days, shorter in spring.
Supplementation	1.5 kg (3 lb) grain/day during grazing season.	6 kg (13 lb) of rolled barley throughout year. In winter, add silage and alfalfa hay to ration.	5.5 kg (12 lb) of concentrates: 3.5kg (8 lb) textured parlor feed with vitamins; 0.5-2 kg (1-5 lb) rolled corn, beet pulp.	9 kg (20 lb) in parlor (free choice). Used to balance grazing system. If grain consumption is increasing, cows are given more forage or are sold.
Species/mixtures	Perennial ryegrass preferred. Old stands of tall fescue in some paddocks.	Perennial ryegrass and clover. Over-seeded ryegrass into old stands of orchardgrass. Tall fescue where not grazing.	Perennial ryegrass mix (40 ac), tall fescue (30 ac), native grasses (40 ac).	Mix of perennial ryegrass, orchardgrass, and white clover. Cows prefer ryegrass. Orchardgrass used for its deep roots.
Lane-ways	Bark mulch laneways. Equipment is kept off laneways.	Unimproved gravel laneways used for cattle and equipment.	10% dirt lanes; 150m (500 ft) of 15cm (6in) fill gravel over geo-textile fabric (Tytar).	Pit-run gravel with 60cm (2 ft) wide concrete slab on part of it. No equipment.
Chain-harrowing	No	No	In spring, once.	No

	Beaver Meadow Farms	Shannon Farms	Hidden Acres Dairy	Double J Jersey Inc.
Aeration (see Chapter 6)	Yes, occasionally.	Yes, usually used in fall. Not needed to enhance irrigation infiltration.	No.	Just purchased an aerator – not used yet.
Dung pile management	Rely on natural soil biology.	Rely on natural soil biology. Especially dung beetles when warm.	Rely on natural soil biology.	Rely on natural soil biology.
Drinking water	Use 160 L (45 gal) plastic barrels. Fields plumbed so watering container can be moved to each new paddock.	Water-trough at lane junction. Cattle have to come back down laneway to get water. Will add troughs in future.	Placed no more than 150m (500 ft) from cows. Usually 90m (100 yd) or less from grazed paddock.	Use portable plastic container. Fields plumbed so watering container can be moved to each new paddock.
Irrigation	Yes	Yes. Irrigate 8 ha (20 ac) per day using 2 large irrigation reels. Used throughout grazing season.	None	Yes, hand-move irrigation pipes on half of farm; 'Big-gun' on otherhalf. June - October.
Fertility	Very little N used because active soil biology will release adequate N. Use soil and foliar test for other nutrients. Foliar tests show that Bo, Cu, Mg, Se, and Co levels are low.	Follow soil test. N applied at approximately 50 kg/ha (45 lb/ac) every 30 days; less late in season. Apply manure mixed with irrigation water. Use soft-rock phosphate for P and micronutrients according to soil test. K according to soil test. S – on regular basis.	Apply 100-110 kg/ha (90-100 lb/ac) of urea fertilizer. Soil test every 2 years. Tests show phosphorus deficiency.	No inorganic fertilizers. Soil sample every year, occasionally forage samples. K in moderate range. Some problem with milk fever in summer probably due to high K.
Manure	Lagoon liquid is applied with irrigation water.	Blended 1:6 with irrigation water. Have flush barn with solid/liquid separator. Cattle will graze right under the gun. Solids applied on silage/hay fields.	Apply 3.5million L (900,000 US gal) of manure over entire acreage. 2 applications. Use Nova meter when applying to know nutrient content. In general, 150,000 L (40,000 US gal) contains 20kg (50 lb) of ammonium-nitrogen.	Irrigate with lagoon water on pastures 3 times during growing season: late February, mid-June, August. Solid manure goes on neighbour's land.
Lime	Very important. Lime is used to supply calcium more than to adjust pH.	Yes, over 100 tons/year applied on farm.	Yes. pH values have been amended with lime. Over the last 8 years have raised pH from 5 to 5.6.	Yes, lime is applied at 600-1200 kg/ha (500 to 1000 lb/acre) every 2nd year.
Pasture harvesting	On first crop, will harvest some pastures for silage when grass gets ahead.	Will make silage out of lowland pastures for 1st crop. Upland pastures only clipped if growth exceeds consumption.	Will harvest pasture as silage when grass gets ahead. Close-off field sections of 4-8 ha (10-20 ac) and harvest as silage or hay.	Generally, no more than once a year. Usually set aside 6 ha (15 ac) for silage. The key is harvesting early.
Fencing	Main paddocks have a permanent single-strand electric fence. Secondary paddocks are larger, about 4 ha (10 ac) and subdivided as necessary with temporary electric fence.	Permanent electric fence around larger paddocks, up to 12 ha (30 ac), subdivided with temporary electric fence.	Use 'tumblewheel' fences in front of herd, and poly wire reel in back of grazing herd. Perimeter fencing is a combination of high tensile wire and barbed wire.	Permanent electric fence around larger paddocks, 4 - 6 ha (10-15 ac), subdivided with temporary electric fence.
Weed management (see Chapter 5)	Not a big deal – clip thistles.	We let the cows do it. Spot-spray thistles.	Clip weeds once during the season. In the more acid soils, buttercup can be a concern.	Most weeds, except for bull thistle, are palatable and nutritious. Cows will eat Canada thistle if mowed and prickles are facing away.
Main advice	Attitude	Attitude – make up your mind what you're going to do and do it!	Farmers ask me about switching to grazing to save their operations. If they are heavily capitalized (buildings and equipment), a switch to grazing can't save them. Intensive grazing can provide more satisfying management option for many farmers. Intensive grazing management takes about an 80% time commitment in labor (just like confined operations), but you're outside more with your herd and that makes it worthwhile. The cows are working for their feed, instead of the farmer.	Need to be flexible in all your management.

production per land area, residual forage heights should be reduced by perhaps 25%. Managing grazing heights is a skill gained with grazing experience.

Duration of Grazing

The duration that livestock are allowed access to a paddock or field is called the residency period. Residency periods are based on balancing the total amount of forage required by the livestock with the amount of forage in the pasture so that an appropriate amount of forage utilization is achieved. Note that for continuous grazing, residency time is season-long.

The principle of rotational grazing is that residency periods should be long enough to allow the stock to harvest the forage, but not so long that damage to plant growth occurs from uncontrolled defoliation. Residency periods should also ensure that livestock performance is not reduced below acceptable limits, and that forage is not wasted through increased trampling and fouling with manure and urine. When forage supply is in balance with demand, selecting a shorter residency period will provide a higher and more consistent quality of forage, and increase forage consumption by grazing animals (improved harvest efficiency).

Animals graze selectively, they consume the highest quality forage first and leave the rest for last. Unfortunately, what is left is subjected to increased amounts of trampling and fouling with manure and urine. As a result, the longer the grazing animals reside in a paddock, the greater selection they will exercise. Extending residency periods for too long not only reduces the amount of forage actually harvested, it can also negatively influence animal performance.

In order to maintain high and consistent levels of milk production, lactating dairy cows should be given fresh paddocks every milking or every other milking (Table 5). Other classes of livestock can meet their minimum nutritional requirements with longer residency periods (including season-long occupancy – called continuous grazing) provided the total forage supply is adequate, and wasting forage is not a concern. However, where maximizing forage production and harvest efficiency are indicated as primary concerns, residency periods should not exceed seven days.

TEN TIPS FOR SUCCESS

Farmers' recommendations for successful grazing

1. Do your homework. Read up on the latest information on grazing management. Get a firm grip on how grasses grow (see Ch. 1).
2. "PLAN, PLAN, & REPLAN" — Develop a written Grazing Management Plan starting with a list of objectives. Make sure the plan takes into account the soil, plant and climatic characteristics specific to your operation.
3. Design and construct a cost-efficient fencing system that will keep the cattle in and be easy to manage.
4. Design and construct a solid laneway that won't turn into mud when the rains come.



Dry laneways are essential for effective grazing management.

5. Establish a watering system that ensures cattle have a ready supply of fresh water. They shouldn't have to walk all the way to the barn to get it.
6. Monitor fields regularly to ensure consumption and production of forages are in balance. Walk each paddock at least every 10 days making careful observations. Make sure that the plants are always in a growing state.
7. Be flexible. If cows can't keep up with forage production, set aside some land to harvest as conserved forage. If forage production is getting behind, don't overgraze. Provide livestock with supplemental feed.
8. Once you are convinced grazing is for you, plant grass varieties bred particularly for grazing. Legume/grass mixes help reduce nitrogen requirements, but beware of bloat (see 'Latest strategies for reducing bloat,' on p. 71).
9. Develop an irrigation system to ensure consistent growth in dry years and through the drier months of summer.
10. Develop a nutrient management strategy that makes best use of manure and minimizes fertilizer costs. The strategy should outline how you will apply manure without smothering or fouling the foliage.



Irrigation helps to maintain uniform production.

The latest strategies for reducing bloat on legume pastures

What is bloat?

Cattle grazing on pastures with a high content of legumes may be killed by a digestive disorder called 'frothy bloat'. In North America, this condition is primarily encountered on pastures containing white clover and alfalfa. Frothy bloat occurs when the eructation (belching) mechanism is impaired by frothy, foamy rumen content. Gas produced naturally in the rumen remains trapped in the rumen fluid, forming an emulsion of small bubbles about 1 mm (1/25 in) in diameter. The frothy material expands and fills the rumen. As the rumen fills, the nerve endings that control the opening into the oesophagus are inhibited. Since gas is produced very rapidly in the rumen, bloat can develop very suddenly.

Bloat reduction tips:

- ✓ The risk of bloat decreases substantially with advancing maturity of the legume. Alfalfa in the vegetative to early bud stages of growth is most likely to cause bloat.
- ✓ Grazing or feeding systems that are continuous are less likely to induce bloat than those that are interrupted.
- ✓ Cattle should be turned out to new pastures in the afternoon rather than in the morning when dew might still be on the alfalfa or clover.
- ✓ Swathing and wilting alfalfa prior to grazing reduces the risk of bloat. For example, bloat was reduced by 70% when alfalfa was swathed and wilted for 24 to 48 hours as compared to direct grazing.
- ✓ Pasture management that promotes continuous and rapid ruminal clearance (more bypass, less gas production — see Ch. 7) is likely to reduce the incidence of bloat.

Bloat misconceptions:

- ✗ The notion that alfalfa is bloat-safe after a killing frost is unfounded.
- ✗ Mineral supplements and household detergent ('Tide®') have proved ineffective for reducing bloat under experimental conditions.

New research

New research from Agriculture & Agri-Food Canada (Kamloops Research Centre) now provides the grazier with some additional tools for reducing the risk of bloat.

- ✦ A new variety of alfalfa with reduced tendency for causing bloat, called AC Grazeland, has recently been released by Agriculture & Agri-Food Canada. Tests in western Canada indicate that this cultivar may reduce the incidence of bloat by 60-85%. This variety features a lower initial rate of digestion in the rumen compared to conventional varieties. AC Grazeland is the product of more than 15 years of research.
- ✦ A number of legumes, such as sainfoin, birdsfoot trefoil and cicer milkvetch, do not cause bloat. The non-bloating characteristic of sainfoin is attributed to presence of a substance referred to as tannin. Tannins are absent in alfalfa. A recent study showed that feeding 10% sainfoin (dry matter basis) with alfalfa reduced the occurrence of bloat by 80-90% compared to pure alfalfa. Further research is needed on factors that control tannin content in sainfoin.
- ✦ A newly introduced legume called 'berseem clover' caused 85% less bloat than alfalfa.
- ✦ In an experiment at Kamloops, a product out of New Zealand, Blocare® 4511, was completely effective in the prevention of alfalfa bloat in Jersey steers. The product was added to the drinking water at a concentration of 0.1% and did not affect water consumption. (The most logical approach for administering anti-bloat agents is through the water supply.) Blocare® 4511 is not yet licensed in Canada.

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