

# FILLING FEED HOLES: ADVANCES AND CURRENT ISSUES IN FORAGES AND GRAZING MANAGEMENT

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The past few years have seen wild swings in the costs of grain, fuel, and fertilizer, and also market prices for livestock products. These fluctuations have created significant financial challenges for livestock operations, especially those that depend on grain or grain byproducts as their primary source of nutrients. Confinement dairies, feedlots for beef cattle and sheep, and monogastric production systems are particularly vulnerable to these fluctuations (Clark et al, 2010), and the recent series of dairy buyouts is sad evidence of this stress.

Partially in reaction to these risks, many livestock producers around the country have shown a growing interest in altering their operations to incorporate improved forages and intensive grazing as the primary feed source (Kriegl and McNair, 2005). These operations cover a wide array of management systems: they may rely on forages for all or part of their nutrients; they may sell their products through traditional commercial markets or through alternative venues; they may label their products as “grassfed” or “organic”. These operations are not necessarily small or marginal. In response to this growing interest, the USDA recently established market standards for “grassfed” ruminants (Federal Register, 2007) and revised its pasture access rules for organic operations (Federal Register, 2010).

One of the main challenges facing grass-based operations is to overcome low periods of forage growth or to find ways of raising or maintaining forages during the slow months of the year. Winter growth is usually not possible across much of the country, and during the summer, many cool-season grasses experience a “summer slump” that greatly reduces yield (Barnes, 1999). Because mechanically-harvested forages are considerably more expensive than grazed forages (Gerrish, 1999), progressive grass-based producers strive to maximize the use of grazing. They utilize a variety of improved forages and grazing techniques, many of which have been developed in the last fifteen years. In this paper, I will describe some of the new forages and grazing techniques currently used by intensive management systems to reduce the monthly variation of forage growth. I will focus on improved pastures, primarily in the northern regions of the country and in the maritime areas of the Pacific Northwest.

## NEW FORAGE SPECIES & VARIETIES

### Italian Ryegrass

Annual ryegrass (ARG, *Lolium multiflorum*) is a common grass grown throughout the Southeast and is becoming popular in other places of the country due to its rapid

establishment, excellent response to fertility, high yield, relatively inexpensive seed, and high nutritional value (Nelson et al., 1997). Because it is an annual species, its establishment costs can be high relative to its yield. There are, however, at least two main genetic lines of ARG: the *Westerwolds* and the *Italians*. the *Westerwold* cultivars are true annuals. They were developed in the Westerwolde region of the Netherlands (Nelson et al., 1997). Planted in fall or spring, *Westerwold* varieties will set seed in the early summer, and thus provide only a few months of forage. In contrast, the varieties of *Italian Ryegrass* generally require vernalization to stimulate seed development. If a cultivar of Italian Ryegrass is planted in the spring after frosts, it will not set seed during its first year but instead will provide vegetative growth during that first summer and autumn. It will then overwinter, grow vegetatively during the second spring and set seed in its second summer. Italian ryegrass can effectively provide two seasons of vegetative growth for the cost of one planting, including months of high quality forage during the hot summer. A critical management issue with the Italian Ryegrasses is to plant them late enough to avoid vernalization, otherwise they will go to seed during that first year.

Progressive grazers in the Pacific Northwest are using Italian Ryegrass varieties to reduce tillage costs and provide high-quality feed in the summer. These varieties may show promise for the hot summers of the Southeast.

### Hybrid Forage Brassicas

The Mustard family (*Brassicaceae*) is a large category of broad-leaved plants that includes turnip (*Brassica rapa*), rape (*B. napus*), the mustards (many genera), cabbage (*B. oleracea*), radish (*Raphanus sativus*), and many common vegetables. Many annuals of the *Brassica* genus are well-known forages, such as bulb turnip, leafy rape, kale (*B. oleracea*), and swedes (rutabaga, *B. napus*). Turnips have traditionally been used for a one-time mob grazing, especially with breeding stock, as these plants can often be grazed in the winter. Turnips can produce high yields of leaf and bulbs, although these are actually two nutritionally-different feeds. There has been a growing interest in new varieties of brassicas that can support multiple grazings and also remain green after killing frosts One of the earliest leafy cultivars was ATyfon,@ a cold-tolerant hybrid of stubble turnip and chinese cabbage which could provide 2-3 grazings in a season. But this cultivar has been supplanted by varieties far more exciting to graziers: the new Hybrid Forage Brassicas, which are much improved hybrids bred for improved leaf yields, quick establishment, multiple harvests, high nutritional quality, and good heat and drought tolerance. These include varieties such as AHunter,@ a cross between turnip and rape, and AWinfred@, a cross between turnip and kale, and others. In addition, many graziers are planting a new hybrid forage radish AGraza@ which is a cross between garden radish and perennial seaside radish (*R. maritimus*) and cabbage. With good soil fertility and sufficient water, these hybrid forage brassicas can be grazed only 50 days after planting and then every 30-35 days thereafter.

Graziers utilize the new forage brassicas in many ways in addition to providing high-quality forage at different times throughout the year. Since these plants can remain productive for a year, producers can plant them in fields with the intention of ultimately

renovating these fields into perennial grass-legume pastures. These brassicas are sometimes planted with sorghum-sudangrass to provide continuous feed through the summer and fall and early winter. Graziers can also use these brassicas to eliminate grass weeds from a field. A field can be sprayed, planted in forage brassicas, and then sprayed multiple times for annual and perennial grasses. The brassicas continue to produce forage, shade out most competition, and thus allow the field to remain in production for that growing season. Brassicas can also help control nematode gastrointestinal parasites. Since brassica fields must be cultivated prior to planting, the annual brassica plants grow relatively free of these nematode larvae. Using brassicas and other annual forages in a parasite control program is a technique that promises to gain importance over time, as there is a growing problem of gastrointestinal parasite resistance to anthelmintics, particularly in small ruminants (Min and Hart, 2003).

Brassicas, however, do have some potential caveats of which producers should be aware. Brassicas are associated with a number of nutritional disorders. Brassicas may contain high levels of glucosinolates that inhibit the uptake of iodine by the thyroid gland and thus cause an iodine deficiency (Cheeke, 1998). Brassicas also contain relatively high levels of sulfur, often greater than 0.4% DM. The combination of high sulfur levels and low fiber levels is associated with the occurrence of polioencephalomalacia (Gould, 1998). Brassicas have also been linked with Acute Bovine Pulmonary Emphysema (Fog Fever, ABPE) due to rumen production of 3-methyl-indole from tryptophan when cattle are moved from dry feed to succulent forage like brassicas. Less commonly, ruminants can also suffer from Brassica Anemia due to the unusual amino acid S-methylcysteine sulfoxide that occurs in this forage (Cheeke, 1998). However, all these problems can usually be managed with proper management and are not compelling reasons for avoiding this forage.

## Herbs

Graziers are beginning to use two unusual herb-like plants as mainstream forages: chicory and plantain. Both are found wild in the United States, typically as weeds, but New Zealand geneticists bred improved leafy cultivars of them (Labreveux et al., 2004). These species are broad-leaved perennials with deep taproots and soft, low-fiber, highly palatable leaves. They thrive over a wide range of soil pH, are high-yielding and very responsive to improved soil fertility. Both species are included in pasture mixtures to improve forage variety, ground cover, and seasonal yield.

Of these two species, Chicory (*Cichorium intybus*) is more popular around the U.S, primarily because of its winter-hardiness and good summer growth. The improved commercial variety APuna® has been available since 1985 (Labreveux et al., 2004), and other varieties has since been released commercially. Producers must manage chicory carefully to reduce its tendency to bolt in the hot summer, although the newer varieties have suppressed this characteristic. Chicory may also have some value in controlling gastrointestinal parasites (see below).

The second herb species, plantain, is not the common plantain found in many gardens.

The plantain genus is quite large. Improved leafy plantain cultivars were bred in the 1990s from Narrowleaf Plantain (Ribgrass, *Plantago lanceolata*) and are marketed commercially under the names *A*Tonic<sup>®</sup> and *A*Lancelot<sup>®</sup> (Rumball et al., 1997). Plantain offers graziers a different array of traits from other forages. Plantain is winter-active and does not bolt during the summer, which gives it a particularly attractive growth pattern for mild climates such as the Pacific Northwest or areas of the Southeast. Plantain can provide feed during the slow periods of forage growth. It establishes rapidly and is tolerant of a wide range of soil drainage conditions. Plantain is becoming a standard forage in pasture mixtures in the mild areas of the Pacific Northwest.

Although both species are perennials, long-term persistence can be a problem. Their exceptional palatability makes it challenging to maintain them in a sward, particularly under continuous grazing systems (set-stocking) because livestock will preferentially graze them out. Graziers who intensively manage their pastures are usually more successful in maintaining these plants over time.

### Novel Endophytes

Tall fescue (TF, *Schedonorus phoenix*, formerly *Festuca arundinacea*) is one of the most widely-grown perennial grasses in the U.S. However, in many areas, particularly in the South and Southeast, the most common TF varieties are heavily infested with a fungal endophyte (*Neotyphodium coenophialum*). This endophyte secretes the ergot alkaloid ergovaline that causes the well-known syndromes of fescue toxicosis. These include fescue foot, summer slump, bovine fat necrosis, reduced gain and milk production, poor reproduction, agalactia in mares, and others (Bouton et al, 2002). Endophyte has a symbiotic relationship with the host grass that gives the infected plant a selection advantage under practical field conditions. Endophyte imparts to the host plant improved drought tolerance and increased resistance to damage by various insects. In fact, turf varieties of TF are sold as *A*endophyte enhanced<sup>®</sup> because of the agronomic benefits provided by endophyte. But in spite of its endophyte, TF is a primary forage species in many regions particularly in the Southeast, as it is a persistent perennial responsive to good soil fertility, it can provide good yields during spring and summer, and it is also the preferred species for fall stockpiling (Barnes, 1999).

For years, producers have struggled to manage fields of endophyte-infected TF by utilizing a number of traditional management and grazing techniques (Hancock and Andrae, 2009). But recently an exciting new strategy has become available for TF: novel endophytes (sometimes known as animal-friendly endophytes). These are strains of endophyte that do not produce ergovaline but do produce alkaloids that impart drought tolerance and insect resistance to the plant (Hancock and Andrae, 2009). In New Zealand, a novel endophyte strategy has been used for many years to successfully address the problem of ryegrass staggers caused by the perennial ryegrass endophyte *Neotyphodium lolii* (Cheeke, 1999). It wasn't until the late 1990s, however, that a novel endophyte was successfully introduced into TF (Bouton et al., 2002), which was subsequently released commercially as Max-Q (Hancock and Andrae, 2009). Livestock grazing novel endophyte TF show similar performance as animals grazing endophyte-free TF, but the TF plants

containing novel endophyte show the same persistence and vigor as traditional endophyte-infected TF (Gunter and Beck, 2004). Replanting TF fields with novel endophyte-infected TF cultivars is becoming an attractive option for graziers where TF is a main grass species and hot summers favor it. Renovating old TF fields is not easy because of the large amount of residual seed, but there are a number of strategies that can be followed for a successful renovation (Hancock and Andrae, 2009). As of this writing, alternative novel TF endophytes are beginning to reach the market.

### High-Sugar Perennial Ryegrass

Perennial Ryegrass (PRG, *Lolium perenne*) has long been a staple component of productive pastures, particularly in temperate regions with mild winters. PRG consistently provides high-quality forage and responds quite well to high rates of fertilization, although it is generally not as cold-tolerant as other cool-season grasses. A recent development with PRG is attracting the attention of intensive graziers. The Wales Institute of Grassland & Environmental Research (IGER) released a set of PRG varieties that contain elevated levels of water soluble carbohydrates (Downing et al., 2008). These are collectively known as the High-Sugar Ryegrasses, and they were originally marketed under the variety names of AberDart, AberAvon, AberEcho, and others. Currently one American company is marketing them under the name of SucraSeed.

The high levels of water soluble carbohydrates may provide some practical advantages. These ryegrasses show improved fermentation characteristics for making silage (Downing et al., 2008) and also a slight increase in vitro digestibility (Lee et al., 2002). They may be more palatable than standard PRG varieties (Jones and Roberts, 1991). Better palatability, however, may be of minimal value in intensive grazing systems where livestock are not given a choice of forages and are removed from a paddock when the target residual pasture mass has been reached. A more important practical aspect of high sugar ryegrasses is that they may improve rumen fermentation under the conditions of good pasture management. PRG is typically planted in fields with good soil fertility. Forages that receive high applications of nitrogen fertilizer often contain crude protein levels greater than 20%, with perhaps one third of this nitrogen as soluble non-protein nitrogen (Van Soest, 1994). The high sugar ryegrasses have been shown to reduce rumen ammonia, probably due to the increase of readily-available energy for the rumen microbes to support microbial protein synthesis (Lee et al., 2002).

Some progressive graziers are already incorporating the high-sugar ryegrasses into pastures, particularly on dairies and in finishing pastures for beef cattle and sheep. More research is needed to identify the appropriate and most efficient use of these varieties.

### Forages Containing Condensed Tannins

One of the primary drawbacks of grazing systems is the problem of gastrointestinal parasites, particularly nematodes. For more than forty years, producers have relied on commercial anthelmintics to reduce parasite loads. Unfortunately, these drugs are becoming less efficacious as the nematodes are becoming increasingly resistant to them,

particularly with small ruminants. An encouraging recent development has been the observation that condensed tannins in some forages seem to have a suppressing effect on nematode gastrointestinal parasites, although the precise mechanism of this mitigation is not well-understood (Min and Hart, 2003).

Condensed tannins are found in a number of forage species, including birdsfoot trefoil (*Lotus corniculatus*), big trefoil (*L. pedunculatus*), chicory (*Cichorium intybus*), sulla (*Hedysarum coronarium*), sainfoin (*Onobrychis viciifolia*), and sericea lespedeza (*Lespedeza cuneata*). Chicory also contains sesquiterpene lactones which may have similar anti-parasite effects (Foster et al, 2009). Much current parasite research in the U.S., however, has focused on sericea lespedeza, which has consistently shown positive results in reducing nematode parasite load in sheep and goats, either as grazed forage or when fed as hay (Moore et al, 2008). Sericea lespedeza is a drought-tolerant, warm season perennial legume that has been widely planted on reclaimed eroded land or fields of low fertility. It grows well on acidic pH soils and does not cause bloat, but is slow to establish and has a high percentage of hard seed (Barnes, 1999). It also has a reputation for low forage quality, which may be in part due to its high level of condensed tannins which discourage livestock from grazing it until it becomes more mature.

The practical management of tannin-rich plants in a grazing system may be quite complex. From a nutritional perspective, condensed tannins have variable effects on animal performance. Tannins are astringent, and high tannin levels can depress intake, but low to moderate levels can improve protein nutrition by increasing the proportion of bypass protein (Cheeke, 1999). Additionally, condensed tannins are secondary plant compounds, and their levels in forage plants can vary greatly with season and genetics (Gebrehiwot et al, 2002). Although tannin-containing forages have long been used in mixed pastures, the use of these plants to control parasites is still a new concept. More research is needed to identify effective forage species and develop practical and reliable forage-management systems that maximize the effects of these forages on parasites.

## NEW TECHNIQUES

### Management-Intensive Grazing

Rotational grazing has been a recommended practice for decades, but one of the most exciting and practical grazing strategies developed in the past twenty years has been Management-intensive Grazing (MiG, Gerrish, 1999). This is not simply a system of rotating animals through small paddocks. Rather, MiG is a grazing strategy that utilizes animals as harvesting units, maintains the forage in a high-quality vegetative state, and moves animals according to the needs of the different paddocks. Forage is allocated to livestock by fencing an appropriate area to provide feed for a limited number of days, usually a period short enough to minimize the opportunity for grazing regrowth. MiG balances forage quality with efficient yield, supports persistence of perennial forages, and reduces weed infestation. MiG is a system of intensive management, not intensive grazing, since management decisions must be made intelligently in response to changing conditions of forage growth, weather, and economics, and animals nearly always graze

intensively.

Grazers who practice MiG are acutely aware of pasture mass and rates of forage growth. They monitor their paddocks quite regularly, sometimes with weekly measurements of pasture mass using visual estimations, rising plate meters, or equivalent equipment. They generally rely extensively on electric fencing for dividing paddocks. They adjust animal movements and grazing cell size in response to forage growth in each paddock, and these adjustments may change radically over the course of the growing season, depending on the type of forage in each paddock, soil fertility and other soil characteristics, costs, and marketing opportunities. Each year presents a different set of circumstances, and the specifics of animal movement will change in response to these circumstances.

MiG requires significant management input. The traditional concepts of rotational grazing have serious flaws in relation to forage growth, but MiG is designed to be responsive to the vagaries of weather and variability of forage growth. If followed properly, MiG can improve pasture health and soil fertility, support persistence of high-yielding perennial forages, and provide a consistent diet of high-quality feed to the livestock (Martz et al, 1999).

#### K-Line Irrigation

A recent change in irrigation technology has been the development of the K-Line Irrigation System<sup>®</sup> by Rx Plastics Ltd. in New Zealand (Rx Plastics, 2010). This system, which is designed expressly for pastures, consists of plastic pods containing sprinkler nozzles positioned every 40-50 feet on an above-ground, flexible, low-density plastic hose. The hose is attached to a primary water source and is moved every 12 or 24 hours by pulling it with an all-terrain vehicle (ATV) in a crisscross pattern across the field. Unlike most other irrigation systems, the sprinkler line can be moved without shutting off the water. Moving a line takes only a few minutes. The K-line system is proprietary, but alternative pod-irrigation systems are becoming available commercially.

Many grazers on the West Coast are installing K-Line systems in pastures, either by retrofitting it onto an existing irrigation system or by designing a new system for each paddock. Some of the advantages of the K-Line system are that it is labor efficient, it supplies a steady gentle stream of water that is less affected by wind shear, it operates at relatively low water pressures, and it can be customized for pastures of all sizes including irregularly-shaped fields. It can be used for any type of improved pasture and also for fields of annuals such as corn, sorghum-sudangrass, and brassicas when the plants are short. On a practical level, the labor-saving feature is critical because it is becoming more difficult to hire temporary workers to attend to irrigation chores. But attracting workers to use an ATV to move K-Line systems is far easier than hiring people to work with traditional irrigation systems.

Irrigation of pastures and hay fields is a common strategy in the western U.S. but is relatively rare in the Midwest or East. The K-Line irrigation system, however, is a radical change from traditional systems, and the economics of using it for supplemental irrigation

in non-traditional settings should be analyzed carefully. Two recurrent problems that face Midwestern and Eastern grazers are the predictable summer slump of forage growth and the unpredictability of rain. The development of the K-Line irrigation system may alter the economics of supplemental irrigation and change the structure of risk management and options for growing summer forages.

## FINAL NOTES

These are only a few of the many forages and techniques that progressive grazers are currently utilizing to reduce feed costs and provide a more consistent supply of high-quality forage throughout the year. Others not discussed here include forage species such as galea grazing brome, Persian clover, and the improved varieties of crabgrass, and techniques such as the grazers' wedge and the use of stocking density instead of stocking rate. Although many of the forages and techniques discussed in this paper are relatively new, they are quickly gaining wide acceptance in the field. Additional research is necessary to characterize more aspects of them and identify ways in which they can be used more efficiently and profitably.

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