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FORAGE PRODUCTION & MANAGEMENT CHALLENGES –
WHEN THE SEASON ISN'T NORMAL

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Managing forages is a challenge even during ‘normal’ growing seasons. Forage crop managers must have an awareness of the nutritive quality for livestock needs, growth differences of different forage species, and issues relating to a ‘perennial’ plant growth strategy all require careful consideration throughout the growing and harvest season. Even the most optimistic producer will acknowledge that only about 3 or 4 years out of 10 is a ‘normal’ growing season; the others often have weather-related limitations sometime during the year.

This presentation addresses some of the most notable influences of environmental stress on forage growth, yield and quality, with some guidelines for forage management during these years when the weather doesn’t cooperate.

Background

Forages are grown and used as a feed nutrient source for many types of livestock. Management of forages is complicated by the need to simultaneously manage the crop for seasonal yield, acceptable nutritive quality for the type and class of animal to which it will be fed, and the physiological processes that maintain the plants as vigorous and productive perennial plants. Successful management is nearly always a compromise. Managing to maximize any one will usually lead to a limitation or reduction in one or more of the others.

For the most part, the above ground, vegetative portions of the plants are product of interest. The vegetative material is removed during harvest of grazing. This vegetative material varies in proportion of leaf and stem content over the growing season. Thus, yield and nutritive value vary over the growing season. The physiological contribution of the vegetative topgrowth supports the vigor of the root/plant crown complex and ultimately the perennation of the plant.

The relative nutritive value of forage plants is determined by the availability and proportion of leaves and stems of the plants, and their changing chemical composition. Leaves always exceed stems in nutritive quality. Management of forages for quality seeks to maximize the contribution of leaves and minimize the contribution of stems.

Stems, however, contribute toward maximization of seasonal dry matter yield. With grasses, a significant stem component is often only present during a portion of the growing season – late-spring for the ‘cool-season’ grasses, and mid- to late-summer for the ‘warm-season’ grasses. Stems are present through all growth cycles of most legume forages. Stems of ‘young’ morphological age are of higher nutritive quality than are ‘old’ or ‘mature’ stems, thus stage of morphological development is an important criterion in forage use management.

Most ‘average’ to conservative cutting or grazing systems provide sufficiently for ongoing plant vigor and perennation. Excessive defoliation during significant portions of the growing season is detrimental to stand productivity and persistence.
Environmental conditions influence fundamental physiological processes, such as photosynthesis, respiration rates, leaf to stem ratios, and morphological development. These affects are sometimes subtle, but do influence how the crop grows and should provide guidance for its management.

**Influence of Temperature**

Temperature has the greatest influence on forage quantity.

Extreme temperatures produce extreme results, most not manageable. For example, extremely hot temperature will inhibit photosynthesis, break down enzyme systems and cell membranes leading to tissue and plant death. Extreme cold temperature (exceeding the cold tolerances of the plant) will also disrupt cell membranes and lead to partial or complete tissue and plant death.

Less extreme temperature variation has a significant affect on respiration rates. A portion of the plant carbohydrates produced is used by the plant for various growth and non-growth respiration processes. The higher the temperature, the greater the respiration rates. Forage plants growing under cool conditions experience lower respiration losses, and generally have higher sugar content and more digestible cell wall (fiber). Forage growing under high temperatures has relatively more cell wall (fiber), less digestible cell wall (fiber), less non-structural carbohydrates, thus, lower nutritive quality.

Temperature also influences the rate of morphological change. Plants growing under an extended cool period have slightly delayed rates of stem and reproductive development. Plants growing under extended periods of warmer than normal temperature have somewhat more accelerated rates of development (and usually flowering or heading at a shorter height), thus lower yields of more mature forage.

**Influence of Water Deficit / Excesses**

Water deficit stress is usually the major physical limitation to yield.

Water is integral to all plant processes: at the chemical reaction level, cellular level, in nutrient uptake and temperature moderation, etc. Because heat and water deficit stress often come together, and the close relationship with plant temperature regulation, it is often difficult to separate water deficit stress effects alone. Its influence on plant yield comes with cell enlargement and development – plants whose cells do not enlarge, are shorter, with smaller diameter stems, and resulting lower yield.

Plants under water deficit stress do, however, have a relatively less stem tissue and relatively more leaf tissue compared with plants growing under more normal soil moisture conditions. This high leaf to stem ratio and slightly higher sugar content makes each harvested or grazed quantity of forage of higher nutritive quality. There is a compounding influence on forage quality when water deficit is coupled with higher temperature - the reduced stem fraction (a positive) is somewhat negated by its relatively lower fiber digestibility.

Excess water (from waterlogged soils) reduces soil oxygen, thus reducing the respiration of soil microorganisms and plant roots. This condition (anoxia), if present for several days, will begin...
to reduce plant vigor (and color), and can begin to adversely affect plant yield. If this condition persists for several weeks, root tissue will begin to die and secondary, wet-soil disease organisms will begin to attack the plant root and crown system.

**Influence of Solar Radiation**

Solar radiation can have multiple influences. Average to high levels of solar radiation are generally not considered to be a concern. However, plants growing under extended periods of cloudy weather or under shaded conditions are more affected.

Plants growing under extended cloudy conditions or shade are somewhat taller, with thinner leaves and smaller diameter stems – both conditions improving forage quality modestly. The impact on the ‘energy’ relations (vigor) within the plant is more immediate. Photosynthesis and the supply of plant sugars are reduced. This limits new cell initiation, reduces energy available for nitrogen fixation in legumes, and limits the excess carbohydrates for storage or accumulation in the crown and taproot.

Grass plants growing in dense canopies (shade) have fewer new vegetative tillers (side shoots) which limits later plant density.

**Forage Management Strategies**

**Management Following Winter Injury**

Winter injured plants generally are recovering from both cold-damaged buds and root tissue, and, a reduced level of ‘stored’ carbohydrates and amino acids. These plants must use all available stored energy resources to recover leaf area. Only when sufficient leaf area is regenerated, can the plant restore a vigorous root system, nitrogen fixation in legumes, and begin to restore energy reserves. If at all possible, allow these winter injured stands to mature a few days longer than usual, to allow the plants to recover their ‘vigor’ before the first spring harvest of grazing. Defoliation, too soon (before the plants have recovered) will extend the period of reduced plant vigor.

**Management of Stands Following Extended Periods of Excess Soil Moisture**

Plants growing in waterlogged soils are often under carbohydrate stress and nitrogen deficiency. If at all possible, delay cutting or grazing until the plants recover their more normal color and reestablish a better carbohydrate metabolism. Defoliation too soon after extended waterlogging will delay the rate of regrowth.

**Management During Cool, Cloudy Spring Months**

Alfalfa will be delayed in bud and flower development. Plants will be relatively tall, large stemmed and will likely ‘lodge’ before first harvest. Lower stems will continue to ‘mature’ and deposit less digestible fiber, so, if you are managing alfalfa for harvested, dairy quality, forage, use some sort of in-field quality assessment program (scissors clipping or PEAQ) to give you a ‘heads up’ on how rapidly the forage is declining in standing crop quality.
Grass hay meadows and pastures will follow the same general pattern. Cut grass hay a little sooner than the reproductive development indicates. Grass hay under both clouds and tall growth will also benefit from earlier cutting to encourage earlier basal tillering. Follow normal grazing management practices.

**Management in a Dry Spring**

Forage growing in a dry spring will be short. Harvest legumes and grasses at the same reproductive stages as normal, knowing that yields will be low. When grazing slow-growing pastures in the spring, if they are not recovering quickly, be ready to feed supplemental hay – sooner than later – to take some of the defoliation pressure off the pastures. They will recover quickly with the first significant rainfall. Nitrogen fertilizer will not grow more grass where moisture stress is the limiting factor. If possible, delay N fertilization until mid- to late-spring to extend the pasture forage supply further into the summer months.

**Management in a Hot. Dry Summer**

Most existing grass and legume-grass pastures are overgrazed and have gone dormant during a summer drought. Even though the minimal summer regrowth is desirable forage and may be critically needed, consider a light grazing management to allow forage plants to regain their vigor following unusually harsh summer management. Continued supplemental feeding of hay or grain on pasture or in a dry-lot will lessen the dependence on the pasture and speed recovery.

Whether or not rain has fallen. Fertilizer will do little to stimulate growth while the pasture plants are dormant, but when adequate soil moisture and cooler autumn temperatures return, stressed pasture plants will respond to applications of fertilizer, particularly nitrogen. Consider applying 30 to 60 lb/A of nitrogen to pastures during late July or August to stimulate recovery of pasture plants and autumn forage. A significant volatilization loss of nitrogen can occur from surface applications of urea forms of nitrogen. Consider using the ammonium nitrate form if available. If urea is used, time the application just before a rain to minimize the exposure time of urea on a dry soil surface.

Many alfalfa- and red clover-based hay meadows either will not yield a normal 2nd (3rd) harvest or are in a semi-dormant state with no appreciable regrowth for harvest. “To cut or not to cut” very short, mid-summer growth alfalfa? My recommendation is that if there is enough dry matter to justify the cost of harvest, then harvest. If there is not enough growth to harvest, but the regrowth that is there is in the bloom stage, leaving the vegetation standing, uncut will not be detrimental to the future regrowth. Leaving the alfalfa uncut will, however, lead to slightly higher fiber in the next harvested forage crop; a condition which may limit production from a high producing dairy cow but will not generally be detrimental to the production demands of other types or classes of livestock. Regrowth from these fields can be surprisingly rapid following a significant rainfall event. If hay meadows have not received their annual topdressing of fertilizer applying the phosphorus and potassium prior to a break in the weather pattern will also stimulate their recovery. Modest amounts (40 to 60 lb/A) of nitrogen should also stimulate autumn recovery of grass hay meadows.
Management in a Dry Late-Summer / Autumn

Most grass and legume-grass pastures are overgrazed and have gone dormant; whether or not rain has fallen. Fertilizer will do little to stimulate growth while the pasture plants are dormant, but when adequate soil moisture and cooler autumn temperatures return, stressed pasture plants will respond to applications of fertilizer, particularly nitrogen. Consider applying 30 to 60 lb/A of nitrogen to pastures during late August to stimulate recovery of pasture plants and autumn forage. A significant volatilization loss of nitrogen can occur from surface applications of urea forms of nitrogen. Consider using the ammonium nitrate form if available. If urea is used, time the application just before a rain to minimize the exposure time of urea on a dry soil surface.

Even if autumn regrowth improves, and may be critically needed, consider a light grazing management to allow forage plants to regain their vigor following unusually harsh summer management. Continued supplemental feeding of hay or grain on pasture or in a dry-lot will lessen the dependence on the pasture and speed recovery.

Many alfalfa and red clover based hay meadows either will not yield a normal 3rd harvest or are in a semi-dormant state with no appreciable regrowth for harvest. “To cut or not to cut” very short, alfalfa growth in August? My recommendation is that if the crop has reached harvest maturity, and there is enough dry matter to justify the cost of harvest, then harvest. If there is not enough growth to harvest, but the regrowth that is there is in the bloom stage, leaving the vegetation standing, uncut will not be detrimental to the future regrowth. Leaving the alfalfa uncut will, however, lead to slightly higher fiber in the next harvested forage crop; a condition which may limit production from a high producing dairy cow, but will not generally be detrimental to the production demands of other types or classes of livestock. Regrowth from these fields can be surprisingly rapid following a significant rainfall event. If hay meadows have not received their annual topdressing of fertilizer, applying the needed phosphorus and potassium prior to a break in the weather pattern will also stimulate their recovery. Modest amounts (40 to 60 lb/A) of nitrogen should also stimulate autumn recovery of grass hay meadows.

The winter survival of hay meadows and rate of regrowth the next spring is often influenced greatly by the fertility program and intensity of harvest or grazing practiced during late summer and autumn of the previous year. A ‘fall recovery management strategy’ for most hay meadows should include 1) a portion of this years (or even a part of next years) fertilizer application being applied in late summer; 2) allowing a 4 to 5 week ‘fall rest’ period for the field during September and early October; and 3) leaving the autumn regrowth uncut or ungrazed. If forage from the autumn growth is desperately needed in the livestock operation, delay the final harvest of the season until after a 23 or 24 F ‘killing frost’ in October and then leave a 4 to 5 inch stubble if possible. An ill-timed last cut or intensive grazing frequently leads to a slightly slower spring regrowth and slightly lower first harvest yields the following spring.

If survival of new seeding was very poor or the entire stand was lost to dry conditions, then reseeding should be considered. Late summer, with respect to new forage seedings, is the period from early-August through mid-August for northern Iowa, and through the first few days of September in southern Iowa for the actual seeding operation. The important time interval for
the success of a late-summer seeding is 6 to 8 week period during September and October for seedling growth and development. Later seeding dates increase the risk of late-summer seeding failure. Soil moisture availability in mid- to late-August and prospects for autumn rainfall are extremely important in making the decision whether to replant in a late-summer seeding or whether to wait until the following spring. A very firm seedbed and good seed-to-soil contact are critical for successful late summer seedings. If soil moisture and rainfall prospects are not favorable, defer seeding until the following spring.

Harvest of drought damaged corn is a possible management practice in a drought year. The strongest take-home lesson for livestock producers with drought-damaged corn is not to be too hasty to ‘get in to the corn field’. As long as the corn plant is still alive it will be accumulating some additional dry matter. Each developmental stage of corn growth – stalk elongation, ear formation, and grain fill -- will add several tons per acre of dry matter to the potential harvested product. For comparison sake, normal corn chopped for silage will yield about 16 - 22 tons/A (65 % moisture basis), nearly normal sized stalks with little or no grain will yield about 10 - 12 tons/A, and stunted corn (4 - 6 feet tall) with little or no grain would yield about 6 - 10 tons/ A. In addition to the dry matter considerations, other factors should also be assessed. Stage of development or condition of growth also has an influence on the feed value of the harvested crop. Compared to normal corn, corn that would yield about 20 to 40 bu./ A would have about the same pound for pound feed value. Very poorly pollinated stalks with 0 to 20 bu/A yield potential would have about 80 to 90% the feeding value of normal corn. Short, barren stalks would have only about 70 to 80% the feed value of normal corn.

In what form will the corn be harvested and used? The three most practical options for using drought-damaged corn are green chopping, ensiling and storing as dry stover. Each system has some advantages and disadvantages.

Green chopping corn provides an immediate source of feed for dry lot, or supplement on pasture. A disadvantage may be a potentially high level of nitrates in the drought damaged, fresh forage. Producers are encouraged to have fresh chopped corn tested for nitrates at a nearby commercial feed testing laboratory if there is any concern about high levels.

Chopping corn for silage provides a less immediate feed source, but a form which can be stored and fed over a longer period of time. One of the main management challenges of harvesting drought damaged corn for silage is cutting the plant at the proper moisture content for the type of silo structure in which the forage will be stored. Corn should be stored at 65 - 70% moisture in a bunker or trench silo and at 60 - 65% moisture in upright silos. In plants with at least some grain, the dry down rate of the grain will provide a rough guide for predicting whole plant moisture. Using the ‘milkline’ on the maturing corn kernel may be the best visual in-field indicator. Until the milkline is half and preferably 3/4 or more of the way down toward the tip of the kernel, the whole plant moisture will likely still be greater than 70 %. Hybrids vary somewhat in this trait. Plants with no grain, and some live green leaf tissue still evident, will have surprisingly high moisture content (75 - 80%); too high for direct cut and ensiling. In some cases even when all the visible leaves have turned brown, the whole plant moisture is still above 70% moisture. Plants, which have actually died, will lose moisture very quickly and could drop below 50% moisture in a short time; too low in this case for proper ensiling.
An accurate moisture test from a representative field sample is an important piece of information needed to manage a corn crop for silage. Moisture determinations can be made at a nearby feed testing laboratory, or with a home check using an accurate scale and a microwave oven or heat lamp to dry the sample. Nitrates are less of a concern when drought damaged corn is ensiled because some of the nitrate is converted to other forms of nitrogen in the ensiling process.

Harvesting drought injured corn, as silage will not be a good option for everyone! Making good silage from a normal corn crop requires some degree of skill and attention to detail. If you do not already have the harvest machinery, a silage storage structure in good condition, experience in making corn silage, and a well defined plan for silage use then making silage from drought damaged corn may be a high risk venture. The concern about plant moisture is large enough even when you have the proper equipment and can harvest the crop in a timely manner; but, if you are depending on a custom operator, by the time they ‘get to you’ your crop may be too dry for proper ensiling. Many well intentioned, ‘first time’ silage makers end up with a lot of spoiled silage at a relatively high cost. Using a well-designed silage storage structure that is in good repair or a temporary ‘silage bag’ is a best management approach. Too often producers who are looking for the ‘cheap way’, choose to store silage in a wide, low pile on the ground, possibly even bounded on each side by a row of large round hay bales. These piles may seem to be low cost initially but spoilage and waste is often high and as a result the ‘cost’ per ton of usable, good quality silage is higher than expected.

Drought damaged corn that dries below 55-60% moisture should be considered for possible stacking or baling as dry corn stover. Timeliness is not quite as critical when harvesting stover. It should be dried to 20% moisture or less to avoid spoilage in storage, and should be harvested before excessive leaf loss occurs. High nitrates can be a concern in stover. If you’re concerned, have a nitrate test done on a representative sample. A few other suggestions are to store stover at a dry location near the site of feeding, and provide for limited access to stover during feeding to stretch feed supplies and minimize feeding waste.

Soybeans may be considered viable alternative forage, especially in two situations: 1) when alfalfa or clover is in short supply due to winter-killing, or 2) when an early-killing frost or other drought-induced condition terminates soybean growth prior to normal grain maturity. Both situations could exist in Iowa this year.

The effect of soybean harvest maturity on yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), and ether extract (EE) concentrations of the whole plant forage were determined in a Wisconsin study. They found that soybeans produce reasonable yields of forage that are comparable in quality to alfalfa harvested in the first-flower stage. Maximum dry matter yields of soybean harvested for forage was 4.1 tons/acre compared to 2.7 tons/acre for seeding year alfalfa and 4.5 ton/acre for second year alfalfa harvested from adjacent fields.

Harvest maturity has the greatest effect on the yield and quality of forage produced. Soybeans were harvested at four growth stages starting at initial flowering (R1) and ending just prior to maturity when the pods had reached maximum weight and the leaves had turned yellow (R7).
Dry matter yields increase uniformly with advancing maturity at harvest, from 1.1 ton/acre at R1 to 3.3 ton/acre at R7. Quality parameters were more variable over maturity ranges. Crude protein concentrations declined from 20.1% at R1 to 18.1% at R3 but then increased to 19.2% at R7.

Based on these and other studies we recommend that soybean forage be harvested between stages R6 and R7. At this stage, seeds completely fill the pods and the lower leaves of the plant are just beginning to turn yellow. At this time the plant has achieved its maximum dry matter yield and is just beginning to decrease in moisture content. Harvesting soybean forage during early reproductive development (R1-R5) can produce high quality forage but dry matter yields are often less than 1/3 the yield when harvested at R6-R7. Unless forage is in very short supply, we do not recommend harvesting at these earlier maturity stages.

Soybean forage can be harvested as either silage or hay. Leaf shatter can be excessive when dried and baled at safe dry-hay moisture conditions. Store soybean hay inside or under cover. If harvested as silage, follow good silage production practices. It is advisable to allow the forage to wilt to approximately 55-65% before ensiling alone, or to mix the direct cut soybean forage with corn forage before ensiling. In the Wisconsin study, soybeans direct cut at R1 to R5, had approximately 80% moisture, and at R7 it was 66% moisture. Test soybean hay or silage before feeding to help make better feeding decisions.

Producers should consider the herbicides or insecticides used in their corn or soybean production. Growers should carefully check the label for any restrictions that may affect harvest or harvest timing.

**Summary**

Adverse weather conditions can have a significant influence on forage growth and quality. It is up to the producer to carefully evaluate the compromise goals between forage yield, nutritive quality and stand vigor/persistence, and to manage to best meet the desired outcomes.