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PLANT MATERIALS TECHNICAL NOTE

TAME PASTURE GRASS AND LEGUME SPECIES AND GRAZING GUIDELINES

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Introduction

Tame pastures are cultivated fields planted with introduced (non-native) grass and legume species or cultivars with the multiple purposes of providing livestock grazing forage to improve animal nutrition and health, balance forage supply and demand during low forage production, reduce soil erosion, improve water quality, improve soil quality and health, and provide food and cover for wildlife. Any one or all of these purposes are optimally achieved when the established pasture plant community is healthy and functioning to capture energy from the sun, and facilitate water and nutrient cycling.

Prescribed grazing is the management practice used on tame pastures to maintain healthy pasture plant communities and thus maintain a healthy forage base, achieve acceptable livestock production, and protect natural resources. Without grazing or mechanical harvest of plant material, dead stems and leaves (plant litter) build up and shade photo-synthetically active plant material reducing the capture of energy that drives the system. However, grazing during the vegetative period when forage plants are most nutritious and digestible reduces the leaf area for energy capture. Careful management of the timing, intensity, and frequency of grazing during the vegetative growth stage is therefore important to allow recovery from grazing and maintain stand vigor. Timing is generally referred to as spring, summer, fall, or winter utilization. The intensity is usually determined by the stubble height of the grass or legume, and frequency is the number of times the pasture is grazed during and year and is regulated by the length of rest period between grazing. See Table 1. for a summary of each species' optimum grazing periods, recommended stubble height after grazing and re-growth ability.

Established forage plants have two general stages of development; vegetative, and reproductive. Plants in the vegetative stage have the greatest proportion of leaf material relative to stem material, at least for grasses. Being the predominant site of photo-synthesis, leaves have more (relative to stems) nitrogen compounds (including proteins), non-structural carbohydrates, and fat compounds that are readily digested. Stems being support structures have cells with thicker, lignified cell walls that provide rigidity but are difficult for digestive systems to break down into energy. Plants in the vegetative stage are functioning at their optimum photo-synthetic capacity, producing energy for root growth, development of buds, reproduction, and storage for future growth. As forage plants mature from the vegetative stage into the reproductive stages, forage quality decreases because energy is allocated to the production and dispersal of seeds. Forage species vary in their timing during the growing season of vegetative and reproductive stages and therefore the time at which forage value is highest. Forage species also vary in the quality of forage after they have reached maturity and therefore their value as a stockpile species for use in fall and winter.

With the exception of pastures in the annual crop phase of a crop rotation cycle, forage pastures are composed of perennial plants that regenerate each year from buds produced the prior year. These buds are on the plant crown at the soil surface (or just below), on stolons at the soil

surface, or on rhizomes just below the soil surface. Dormant buds are activated to grow stems in the spring. Forage plants vary in the timing of active growth in the spring.

Corresponding to the two general stages of growth, forage grasses produce two distinct forms of vertical stems, vegetative and reproductive, both with the shoot apex at the stem tip. The apex has cells capable of cell division and therefore growth. The apex of non-reproductive, vegetative stems produce leaves. These stems are very short and consist of nodes where the leaves grow and non-elongated internodes. The apexes of vegetative stems are thus close to the ground and enclosed within a whorl of leaf sheaths where they are more likely to escape removal by grazing. When leaves are grazed above the apex, re-growth of new leaves from the apex is rapid. If enough leaf area remains after grazing, energy from photo-synthesis can fuel re-growth with little or no cost to the plant from stored energy. If the vegetative stem apex is removed by grazing, the plant can only resume vegetative growth by breaking dormancy of buds on the plant crown, stolons, or rhizomes. It may take a week or more to activate dormant buds and usually at the cost of stored reserves. When the plant allocates stored energy to recover from close grazing, less energy is available for root growth, reproduction, and the ability to recover from natural and competitive stresses. Repeated close grazing that removes the growing apex increases the time it takes the plant to activate buds with each removal. If continued, the plant eventually loses its ability to re-grow and dies. Grass species differ in the length of vegetative stems, the height above the ground of the growing apex, and the ability to recover if grazed too closely.

The other form of vertical stem forage grasses produce is the reproductive stem. When temperature or day length stimulates the plant to flower, the dormant internodes of the vegetative stems begin to elongate and elevate the apex above the leaves. The apex also differentiates into the reproductive inflorescence. Grazing after the transition to reproductive stages is likely to remove the growing apex because it is higher in the canopy causing the stem to die and requiring regeneration of new tillers. The timing of initiation for reproduction and the time it takes to complete this stage of growth varies among forage species.

After reproduction, forage plants generally go into a period of dormancy that enables them to endure periods of low soil moisture or freezing temperatures. Forage plants are capable of breaking summer dormancy to initiate vegetative growth in the fall if moisture and temperature conditions are suitable. Forage species vary in the timing and ability to break dormancy in the fall and spring.

There are a number of differences between forage grass and legume species. Grasses have fibrous root systems where as legumes are, for the most part, tap-rooted. The tap root of legumes not only absorbs water and nutrients from the soil, but also stores carbohydrates and proteins needed during re-growth after defoliation and for winter survival. Symbiotic rhizobia bacteria infect root hairs of legumes and make nitrogen available to the plants through nitrogen fixation. Nitrogen fixation is a high-energy demand process and the rhizobia get the energy from carbohydrates produced by the plants. Nitrogen fixation is higher for vigorous plants than plants under stress. Defoliation causes nitrogen fixation to stop temporarily, and frequent defoliation can result in sloughing of root nodules that contain the rhizobium.

Carbohydrate storage in legumes is greatest at or shortly after bloom. Frequent grazing reduces the ability of legumes to re-grow and survive winter. Defoliation during mid-October increases the chance of winter injury compared to mid-September defoliation.
Similar to grasses, perennial legumes have root crowns that contain buds for new growth. Grazing tolerant legumes have many crown buds on low-set, broad crowns. Also similar to grasses, the apexes of the vegetative shoots are at the tip of the stem and the ends of stem branches. However, the terminal bud is at or near the top of the plant and nearly always

removed by grazing. When the terminal bud is removed, re-growth comes from buds at the leaf axils, the nodes of grazed stems, or the crown buds, sometimes resulting is prostrate growth.

Grass Varieties

Crested wheatgrass (*Agropyron critatum*), desert wheatgrass (*Agropyron desertorum*), and Siberian wheatgrass (*Agropyron fragile*) are a long-lived, cool-season, drought-tolerant, and winter-hardy perennial bunchgrasses with extensive root systems. They are palatable to all classes of livestock and preferred feed in the spring, or in the fall when conditions allow re-growth. Crude protein content and dry matter digestibility are high in the spring and early summer but drop off rapidly after heading. They become coarse and less desirable in the summer. Use in the winter requires protein supplements. Growth in the spring begins about ten days after bluegrass species and two weeks before native bunchgrasses. Grazing of new stands should be deferred until after seed production begins. On established stands, spring grazing can begin after six inches of new growth. Grass tetany can be avoided during spring grazing by providing magnesium and calcium supplements. To maintain long-term plant health, three inches of stubble should be left at the end of each grazing period. Spring/fall deferment or grazing rotations are recommended for maximum forage production. Research indicates that grazing crested wheatgrass after the start of culm elongation reduced tiller persistence ratios.

Intermediate wheatgrass (*Thinopyrum intermedium*) and pubescent wheatgrass (*Thinopyrum intermedium* ssp. *barbulatum*) are high yielding, and slightly rhizomatous. Spike emergence is about two weeks later than smooth brome and crested wheatgrass. They are palatable to all classes of livestock year round but are most preferred in mid-spring, early-summer, and fall when there is re-growth. Stands decline under continuous heavy grazing. On established stands, grazing in the spring should begin after ten to 12 inches of new growth. On irrigated pastures and pastures with high moisture conditions, a 21- to 28-day recovery period should be allowed between grazing periods. A six-inch stubble height should be left after each grazing and going into the winter. Intermediate wheatgrass has been reported to be short lived under intensive defoliation. Research in North Dakota showed that tiller persistence was greater when intermediate wheatgrass was grazed during early vegetative or mid-culm elongation than during late boot. In addition, there was lower tiller persistence when grazed at all stages of growth in dry years compared to wet years.

Tall wheatgrass (*Thinopyrum ponticum*) is a coarse-leafed, late-maturing bunchgrass that produces forage and persists on alkaline and saline sites. Plants are palatable during late summer and protein and digestibility are sustained over a grazing period of 11 to 12 weeks. The grazing stubble height should be ten inches and never below six inches. Grazing height can be regulated by cutting the crop for hay at the ten inch height. The remaining stiff stubble will prevent animals from grazing closer than the ten inch height. Mowing at the ten inch height can be used if too much old growth accumulates.

Russian wildrye (*Psathyrostachys junceus*) is a long-lived perennial bunchgrass with an extensive fibrous root system and excellent cold and drought tolerance. It is palatable to all classes of livestock. It is tolerant of grazing and re-grows quickly after grazing when soil moisture is adequate. However, stands should be managed carefully to avoid over utilization. It begins growth in the spring later than crested wheatgrass but retains green foliage longer into the summer. It can be grazed during all seasons, but stands can be injured by extensive spring grazing and only light grazing is recommended at this time. Magnesium and calcium supplements should be provided to prevent grass tetany if used for spring grazing. It has high digestability and protein, and maintains five to seven percent protein in the fall through winter. It is recommended for late summer through winter grazing and maintains palatability and adequate nutritive quality for mature livestock on winter maintenance rotations. Stands can be stockpiled for use from August through November. Studies showed that yearlings did not

benefit from protein supplements when grazing Russian wildrye in the fall. The minimum stubble height to maintain stand vigor for Russian knapweed is three inches.

Altai wildrye (*Leymus angustus*) is a long-lived, deep-rooted perennial with short-creeping rhizomes tolerant to cold and drought. It starts growth in the spring later than Russian wildrye and grows into late fall. It recovers well after grazing if moisture is adequate and stubble is maintained at six inches. Although leaves and stems are coarse, Altai wildrye is palatable to cattle and sheep. Leaves are mostly basal, maintain their nutritive quality at maturity, and they protect above-shallow snow in the winter. Coarse-erect stems that reach heights ranging from two to four feet protrude above shallow snow in the winter and allow deep snow to bridge over the top of leaves so cattle can remove snow with their muzzles. Altai wildrye is valuable forage from October through February when digestible nutrients remain high.

Smooth Brome (*Bromus inermis*) is a persistent rhizomatous sod-forming perennial grass resistant to drought and temperature extremes. It is high in protein content, low in crude fiber content, and highly palatable. Vegetative growth begins early in the spring, with the southern-type growing earlier than the northern-type, and reproductive growth begins early in the summer. Smooth brome produces the majority of its growth in the early spring and has a slow summer growth rate. Smooth brome should be allowed to reach a minimum height of ten inches before grazing in the spring and a minimum stubble height of four inches should be maintained. Re-growth after defoliation is initiated from crowns and rhizomes and is therefore slow. A period of 28 to 35 days between grazing should be planned to allow re-growth. To avoid bloat in mixed stands of smooth brome and alfalfa, grazing should be deferred until alfalfa is in the bud to early bloom stage. Initiating stockpiling of smooth brome after June first but before July first provides the most forage production for fall, winter, or early spring grazing. Addition of 56 kg/ha N optimizes levels of forage and leaf mass. New stands of smooth brome do not tolerate heavy grazing and can die-out after four years.

Meadow brome (*Bromus biebersteinii*) is a deep-rooted, long-lived perennial bunchgrass that produces stout rhizomes four to six inches long. It is palatable to all classes of livestock. Growth begins early in the spring and productivity is high during the cool season. It is also capable of strong summer growth and recovers rapidly after grazing because it reinitiates growth from existing tillers and not from the crown. Because meadow brome establishes roots slowly, new plantings should not be grazed until late summer or early fall of the first year under irrigated conditions and the second year under dry land conditions to prevent uprooting. Harvesting for hay during establishment is recommended to prevent grazing damage. Once established, spring grazing should begin after forage is eight to 12 inches high and animals should be removed when stubble height is four inches high. A three to four week recovery period is recommended between grazing. Six inches of re-growth in the fall to build up food reserves will provide for early growth the following spring. Allowing plants to mature and produce seed will help maintain the longevity of the stand.

Meadow foxtail (*Alopecurus pratensis*) and creeping foxtail (*Alopecurus auundinaceus*) are long-lived perennial grasses with short rhizomes (meadow foxtail) or vigorous rhizomes (creeping foxtail). The foxtails begin growth early in the spring and provide season-long forage for all classes of livestock. Leaves remain green and palatable in the hot summer months. Recovery after grazing is rapid. Livestock should be rotated off pastures when stubble height is grazed down to four inches.

Orchardgrass (*Dactylis glomerata*) is a deeply-rooted medium- to long-lived bunchgrass. It initiates growth early in the spring and is highly productive during cool conditions. It also grows well during hot summer months because its deep roots access moisture in lower soil profiles. It is highly palatable to all classes of livestock and is usually selected over other grass species by livestock and wildlife. New plantings on irrigated pastures should not be grazed until late

summer or fall of the first growing season, and late summer or fall on dry land pastures. On established pastures, grazing should begin when growth reaches eight to nine inches and terminated when stubble height is down to four inches. Close grazing in the fall is associated with winterkill of orchardgrass. Winter grazing should be limited to 60% of the annual growth and grazing during the growing season should be limited to 50% of the annual growth. Orchard grass does not tolerate close or continuous grazing because food storage is mainly in the lower stem and leaf parts.

Timothy (*Phleum prate*nse) is a short-lived, shallow-rooted perennial bunchgrass. It is nutritious and palatable to cattle and horses. In the spring, the crowns of timothy plants form a group of swollen, bulblike internodes that store energy. Close grazing and trampling can damage the bulblike internodes and reduce timothy stands. It is most productive in early summer. Timothy can be grazed before jointing and again before early head and full bloom. Second and successive grazing should also be timed before jointing and when basal sprouts appear at the soil surface. Plants do not normally joint after the second grazing and therefore sprouts are indicators of grazing readiness. A four-inch stubble height is recommended for Timothy.

Kentucky bluegrass (*Poa pratensis*) is a long-lived, shallow-rooted perennial grass that has sod-forming rhizomes. It is highly palatability and productive when fertilized and irrigated, but under dry land conditions goes dormant and is unproductive during hot dry weather. Grazing in the spring can start when Kentucky bluegrass is five inches tall and livestock should be removed when stubble height is down to two inches high. Livestock can be rotated back onto pastures when re-growth is six inches tall.

Tall fescue (*Schedonorus phoenix*) is a robust, long-lived perennial bunchgrass. More than 90% of tall fescue plants are infected with the endophytic fungus *Neotyphodium coenophialum*. Infected fescue plants produce alkaloids that cause fescue foot, bovine fat disorder, and fescue toxicosis disorders in livestock. Toxin concentration in endophyte-infected plants is greatest in the inflorescences, moderate in stems and leaf sheaths, and lowest in leaf blades. Early and frequent grazing in the spring when tall fescue is most productive can reduce alkaloid concentrations in animal diets. Stubble height should be maintained at four inches. Tall fescue also has good growth in the fall and can be used for fall pasture. The thick cuticle of the leaves helps them stay green through early winter. Consequently, tall fescue can be stockpiled for winter use.

Reed canarygrass (*Phalaris arundinacea*) is a long-lived, rhizomatous bunchgrass with coarse stems reaching two to eight feet tall. It begins growth early in the spring and has good distribution of growth throughout the growing season. All parts of reed canarygrass plants contain some form of alkaloids as an anti-herbivore mechanism. Its palatability is negatively related to its total alkaloid concentration and sheep reject it at concentrations greater than 6 g/kg. In the spring, early and frequent grazing is effective for preventing or reducing stem and panicle production. Forage quality can be maintained by not allowing growth over 12 inches high and not grazing stubble to shorter than four inches.

Legume Varieties

Alfalfa (*Medicago sative*) is a deep tap-rooted perennial forb considered the queen of forages. Cultivated for about 9,000 years, it is the oldest crop grown solely for forage. Alfalfa is very palatable and withstands grazing well. After defoliation, alfalfa starts to re-grow quickly, but build up of food reserves is slow. Frequent defoliations at short intervals deplete food reserves and reduce survival. Therefore, pastures with alfalfa should be rested five to six weeks after grazing. Stubble height should be two inches. Also, grazing should be terminated three to four weeks before the first killing frost to allow food reserve buildup for winter survival. To reduce the incidence of frothy legume bloat, alfalfa should be mixed with 50% or more grass, or grazing

should be delayed until after bloom. Poloxaline (bloat guard) pre-mix or blocks are also available.

White clover (*Trifolium repens*) is a shallow tap-rooted perennial legume that produces stolons. Because most of the forage production is from leaves, it is highly nutritious and palatable to all classes of livestock. It is most productive in the spring and begins growth fairly early. Shallow roots do not allow white clover to tolerate drought and it does not grow well during the hot months of summer. Grazing should begin after eight inches of growth. Management should maintain 40-50% clover in a mixed stand with grass. Grazing to a stubble height of two inches will favor white clover over grass and lighter grazing will favor grass. Bloat hazard is similar to alfalfa and normal precautions should be taken.

Red clover (Trifolium pretense) is a short-lived perennial legume. It normally only persists in a pasture mix for two to three years. It is highly nutritious and palatable to all classes of livestock. Start grazing when it is in one-quarter to one-half bloom and leave at least two inches of stubble. Red clover can be grazed again when it returns to one-quarter bloom. Bloat hazard is similar to alfalfa and normal precautions should be taken.

Cicer Milkvetch (*Astragalus cicer*) is a winter-hardy, drought-tolerant, long-lived legume with a vigorous, creeping root system. It is palatable to all classes of livestock and no cases of bloat have been reported. The vigorous rhizomatous roots enable Cicer milkvetch to tolerate trampling from heavy grazing. After defoliation, new shoots grow from buds on the rhizomes, crowns, and from the nodes of the lower leaves allowing for rapid recovery even after close grazing. The best forage growth generally is in mid-summer. Cicer milkvetch a good stockpile forage for fall grazing because of good leaf and nutrient retention in late growth. Rest periods of five to six weeks are recommended to maintain Cicer milkvetch stands. Stubble height should be maintained at two inches. Photo-sensitzation has been reported in livestock grazing pure stands of Cicer milkvetch in Minnesota, but not in western states.

Sainfoin (*Onobrychis viciaefolia*) is a deep-rooted, drought-resistant legume that begins growth early in the spring. It is highly palatable and provides good nutritional quality without the danger of bloat. Grazing should begin in the early bloom stage and stubble height should be kept above eight inches.

Sweetclover (*Melilotus spp*) is an annual or biennial legume that grows four to five feet tall and has yellow or white flowers depending on the species. Growth begins early in the spring and growth is rapid in June and July. Stubble height should be maintained at 12 inches to keep some leaves to produce carbohydrates and allow light to reach the base of the stem where active buds recover growth. Bloat and scours can be reduced if animals have access to dry roughage.

Birdsfoot trefoil (*Lotus corniculatus*) is a moderately long-lived perennial legume with a well developed tap-root with many lateral roots. It is a non-bloat legume with fairly high palatability. It produces 20% more forage after July first than most dry land leguminous forages. New stands establish slowly and it should be grazed lightly in the first utilization year. Re-growth after grazing originates from buds formed in the leaf axils. Grazing in the spring should begin after there is eight inches of growth and four inch stubble should be left after grazing. Allow 24 to 38 days re-growth between grazing rotations. Stands can be maintained by regeneration from its own seed production if it is allowed to grow to maturity every three years. Grazing should be terminated three to four weeks before the first killing frost to allow food reserve buildup for winter survival.

Table 1. Optimum grazing periods for tame grass and legume varieties, their re-growth ability, and recommended stubble height (inches) after grazing.

Grass Variety	Re-growth ability	Optimum Timing of Use	Stubble
Kentucky bluegrass	High	Spring, Fall	2
Meadow brome	High	Spring, Summer, Fall	4
Smooth brome	Medium	Spring, Summer, Winter	4
Tall fescue	Medium	Spring, Fall, Winter	4
Creeping and meadow foxtail	High	Spring, Summer	4
Orchardgrass	High	Spring, Summer, Fall	4
Timothy	Medium	Spring, Summer	4
Crested and Siberian wheatgrass	Low - Medium	Spring, Fall	3
Intermediate wheatgrass	Medium	Spring, Summer, Fall	6
Pubescent wheatgrass	Medium	Spring, Summer, Fall	6
Tall wheatgrass	Medium	Summer	6
Altai wildrye	Medium - High	Spring, Summer, Fall Winter	6
Russian wildrye	Medium - High	Summer, Fall, Winter	3
Reed Canarygrass	High	Spring, Summer	4
Alfalfa	High	Summer	2
Clover, white and red	High	Spring	2
Cicer milkvetch	High	Summer, Fall	2
Sainfoin	Medium	Spring, Summer	8
Sweetclover	High	Summer	12
Birdsfoot trefoil	High	Summer	4

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