Alaska Forage Manual

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Front Cover: Hay field near Palmer, Alaska

Cover Photo: Alaska Division of Agriculture

Alaska Forage Manual

By

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Above: Casey Dinkel at the Arctic Circle monument on the Dalton Highway

At right: Phil Czapla in Barrow, Alaska

Foreword

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May 1, 2012

Dear Alaskans,

When I turned the page on my Potash Corporation calendar today, there was a quote by President Eisenhower printed next to the date. The quote read: "Farming looks mighty easy when your plow is a pencil and you're a thousand miles from the corn field." Anyone who has been involved in Alaska agriculture for the last thirty years can easily relate to President Eisenhower's comment!

Farming isn't easy. Farming in Alaska can be very difficult. Alaskan farmers face challenges that are unique to Alaska. The list is long and varied: unpredictable weather, cold soils, nutritional deficiencies, acidic soils, short seasons, limited infra-structure, limited expertise, long supply lines, higher costs, and smaller markets. Those are the challenges that come to mind and I know there are more. We can't do anything about the weather, the short season, and the cold soils, but many of the other issues can and will be resolved.

I'm a big fan of the Plant Materials Center. The PMC is a good example of a government entity that actually does what it was intended to do and does it well. The PMC really does promote the agricultural industry in Alaska through the work and research of the staff. Their publications are top notch. The Staff at the Plant Materials Center in Palmer is providing practical, useful expertise and services in areas that will benefit local farmers. They are not a thousand miles from the farmer's field; they are in the field and they are talking to farmers. The new Forage Publication produced by the Plant Materials Center is another excellent publication providing the information that will help farmers make the best possible management decisions relating to their specific area, climate, and soil. Everyone who is involved with raising forage crops and hay will benefit from using this current publication as a reference.

Take advantage of the resources offered by the Plant Materials Center and let them know that you appreciate all the fine work that they have done.

Sincerely,

Ken Sherwood
CEO

Section A. Background

- Introduction
- Forage and Alaska
- Forage Types
- Forage and Animals

Introduction

Hay field near Fox River flats - Homer, Alaska

The Alaska Forage Manual was created through a joint agreement between the USDA Natural Resource Conservation Service (NRCS) and the Alaska Plant Materials Center (PMC). The project was designed to synthesize and build upon existing information about forage crops in Alaska. A wealth of knowledge from many different sources has been compiled in this publication to serve present and future managers of livestock and wildlife operations, as well as local agencies.

The goal of this manual is to introduce grasses, legumes and cereal crop species which are commonly planted to provide forage for grazing livestock. Forage species are those seeded on a pastureland and then grazed fresh or harvested for hay, silage or haylage.

An important distinction can be made between pastureland and rangeland. Generally, pastureland is managed and agronomic inputs such as fertilizer and irrigation are applied to maintain native or introduced species. This is most often not the case with rangeland.

For the purposes of this manual, Forage is defined as: "**Herbaceous grasses and legumes available and acceptable to grazing animals, or that may be harvested for feed purposes**" (TN Plant Materials NO. 28, 2001). Depending on location, climate, soil type, and management goals, a different forage species may be better adapted to the site than what was traditionally used.

It is the authors' intention that those who have traditionally used only brome and timothy as their primary forage species will consider trying something different with their next planting.

Target Audience

The intended audience for this manual is primarily managers of livestock and wildlife operations. This manual may also be useful to local organizations and government agencies interested in the conservation value of forage species. This book is prepared with the assumption that the primary goal of planting will be to improve and increase forage for livestock or wildlife.

Content of Manual

This manual has been designed to take the user through sequential order from briefly introducing agriculture in Alaska, forage types and animals, and then proceeding to crop establishment and finally forage species profiles.

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- Introduction
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- Forage and Animals

Section B. Crop Establishment

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Section A - Background: A brief introduction to Alaska agriculture, along with the forage types and animals found consuming forage in Alaska.

Section B - Crop Establishment: Organized to allow a user to understand cultural practices essential for a successful crop stand. The project planning chapter covers determining goals and objectives and evaluating site conditions like soil pH and texture. This section also will guide the reader through some introductory principles to ensure a successful planting such as site preparation, application methods to apply plant material, weed control, and time of planting.

Section C - Plant Profiles: Twenty-four plant species make up the foundation of this manual. Species were chosen based on their forage attributes and ability to survive and thrive in Alaska's diverse regions. The forage value, general morphological characteristics and management of each individual species is detailed. Also accompanying each profile is a table listing plant characteristics such as average height, drought tolerance and pH range. The regions of Alaska to which a plant species is adapted are shown on a color-coded map.

Section D - Additional Information: Glossary, works cited and appendices, including a nutrient study of forage grasses during different growth stages and State of Alaska Prohibited & Restricted Noxious weeds.

Forage and Alaska

Photo: Casey Dinkel, AK PMC

Hay bales are stored in a pole barn in Delta Junction, to protect them from weather. Approximately 20,000 acres of hay are harvested each year in Alaska.

Alaska is a vast state, with a diversity of environmental conditions. It is also an enormous state - 1/5th the size of the contiguous lower 48 states. There is not an abundance of producing farmland, however. Of the 366 million acres in Alaska, about 900,000 acres are farmland. The majority of this farmland - 737,746 acres, is used as pasture.

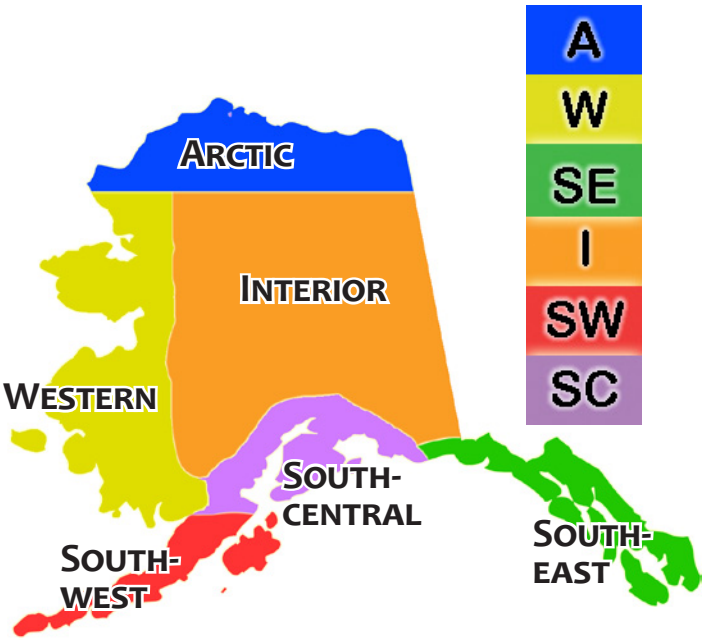
From an agricultural standpoint, Alaska ranks near the bottom of U.S. agricultural production. The top 5 agriculture commodities reported in Alaska for 2010 were:

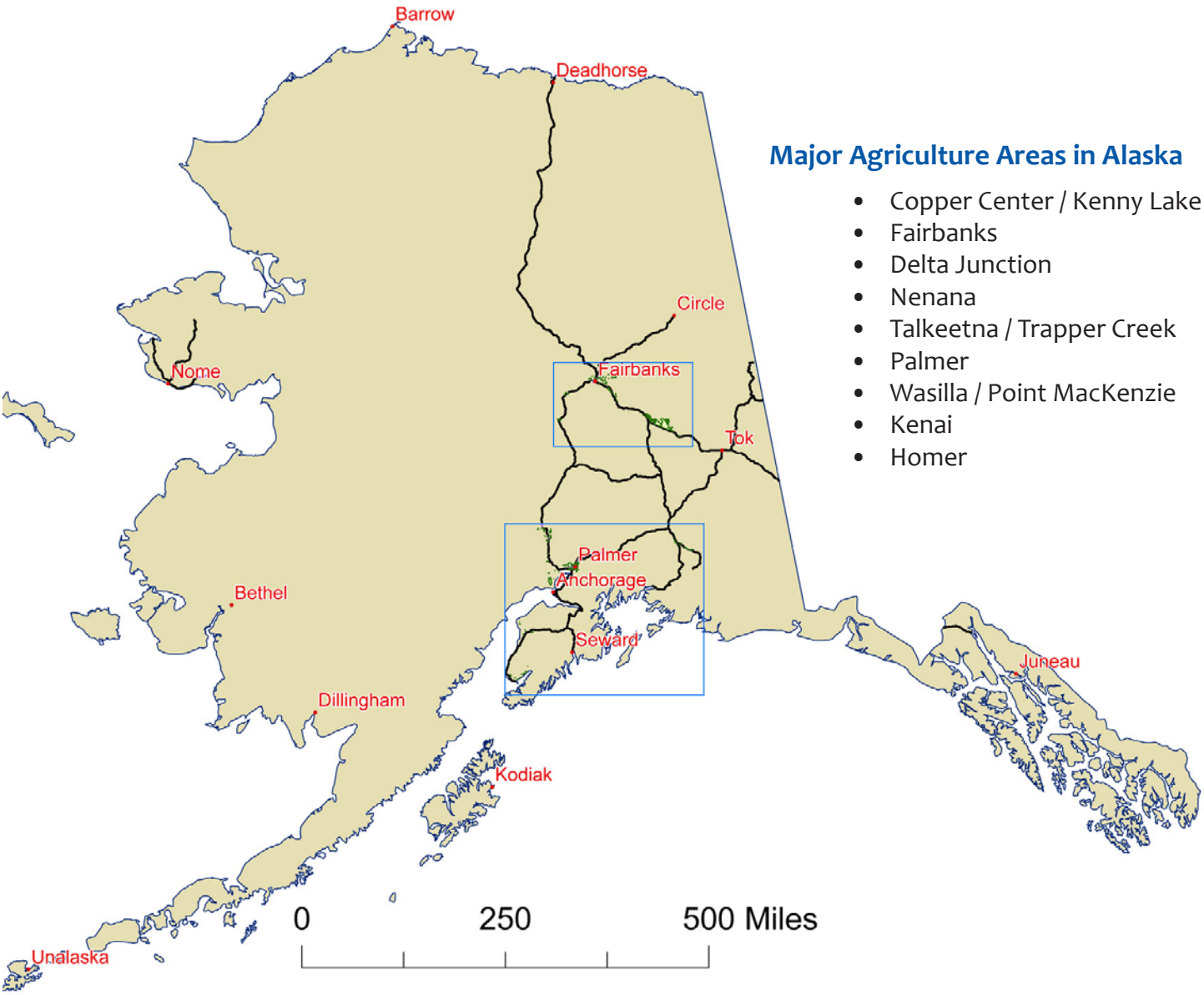
Ag. Commodity Type	Value of Receipts	% of AK Total Farm Receipts
Greenhouse/nursery	$13.0 million	42.3%
Hay	$4.1 million	13.2%
Cattle and calves	$2.4 million	7.9%
Potatoes	$2.4 million	7.7%
Dairy products	$1.6 million	5.2%
- All other commodities -	$7.3 million	23.7%
All Commodities	**$30.8** million	100%

Data: Alaska Agricultural Statistics 2010 - USDA National Agricultural Statistics Service

Regions

For the purposes of this manual, Alaska is broken into several regions: Arctic, Western, Interior, Southcentral, Southwest and Southeast. These regions vary widely in climate. Agricultural lands are located in primarily two regions; the Matanuska and Susitna Valleys in Southcentral, and the Tanana Valley east of Fairbanks in the Interior. The Matanuska Valley has mild summers and moderate winters, while the Tanana Valley is more extreme with hot summers and very cold winters.

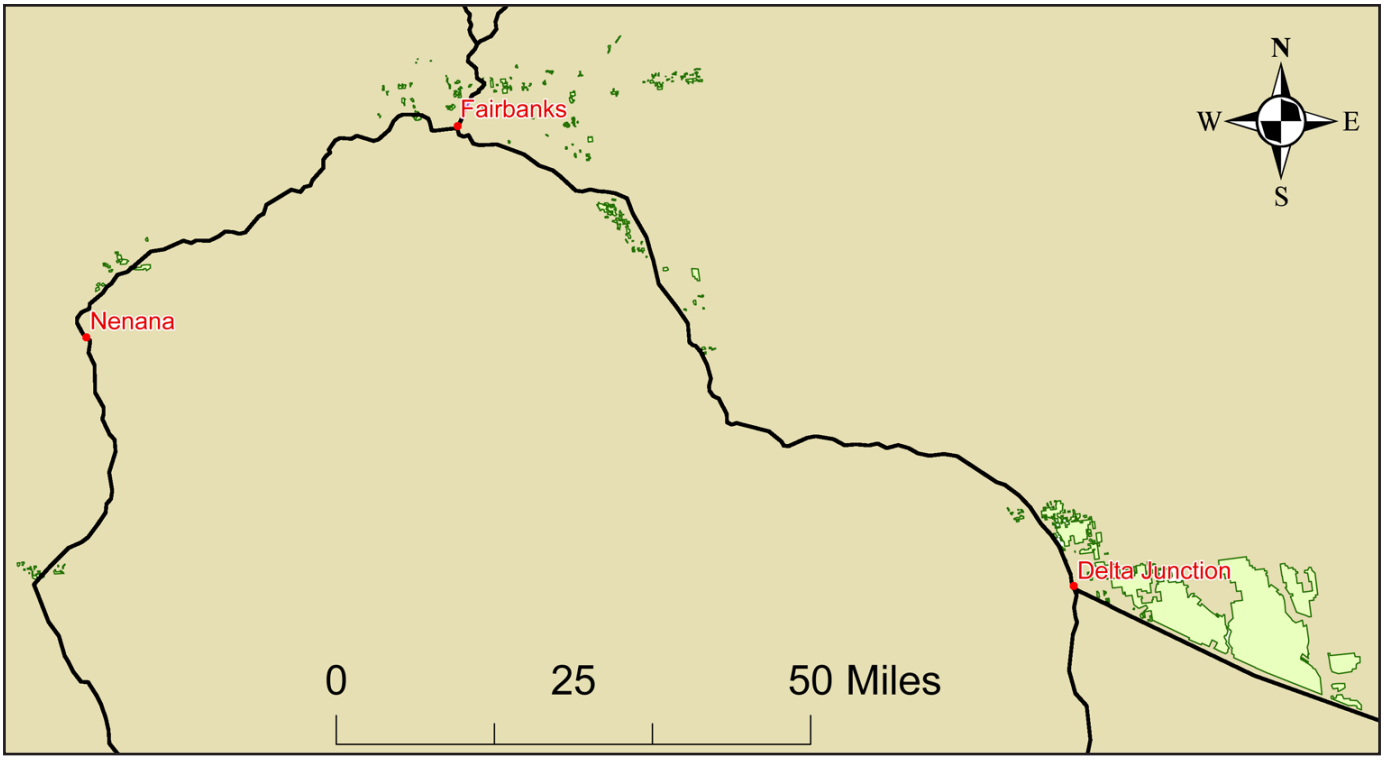




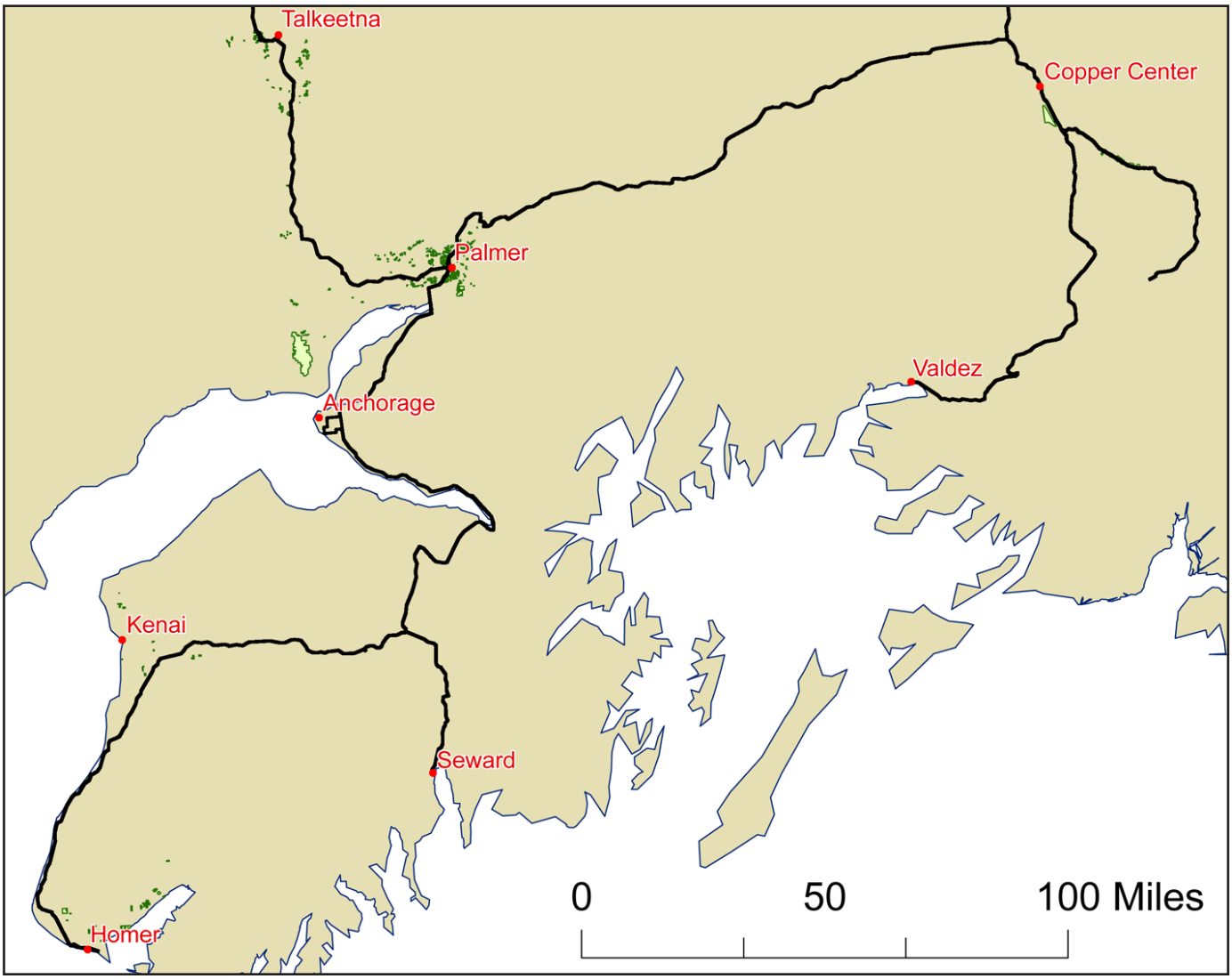
Major Agriculture Areas in Alaska

- Copper Center / Kenny Lake
- Fairbanks
- Delta Junction
- Nenana
- Talkeetna / Trapper Creek
- Palmer
- Wasilla / Point MacKenzie
- Kenai
- Homer

Agricultural parcels in Alaska are clustered around the Matanuska, Susitna and Copper river drainages in the south and the Tanana and Yukon flats in the north. Farms also exist on Kodiak Island and on the Kenai Peninsula.



Agricultural parcels in Interior Alaska are centered around Fairbanks, Delta Junction, and Nenana.



Agricultural parcels in Southcentral Alaska cluster around Palmer and Talkeetna, as well as Copper Center and Homer.

Forage Types

Photo: Alaska Division of Agriculture

A farm near Palmer

Forage crops can be consumed fresh when grazed by animals in a pasture setting. Forages can also be harvested, cured, and preserved in many forms for future use. Forage can be baled into different shapes and sizes and/or stored as silage. Hay is a major source of fodder for the livestock industry during the dormant season.

Animals prefer plants in the early growth stage (vegetative or boot) when the nutritional content of the plant is the highest. For hay and silage purposes, the best compromise between quality and yield occurs when the hay is harvested before flowering. The leaves of most forage species have the highest nutritional content. The stem is of lower quality due to higher concentrations of lignin, cellulose and hemicelulose.

Crops for use as silage are placed in a pit or silo to begin the ensiling process. An anaerobic environment is necessary to maintain the good feed quality that can be achieved with silage.

The period when forage is actively growing and nutritious in Alaska is considerably shorter than the lower 48, due to Alaska's short growing season. Therefore the identification of species growth stages, and the proper timing of animal placement on pasture needs to be managed carefully. Improper management could result in a missed cutting for a hay crop, requiring supplemental feed to balance animal's diet. Animals placed on the pasture when the forage conditions are least favorable (flowering, seed ripening stage) may not get the full nutrient potential of the forage crop.

Grazing Pasture

Cattle graze on pasture land in Southcentral Alaska.

Pasture is land with vegetation cover consisting of grasses and legumes used for livestock in a farm setting. Pastureland can also be used by wild animals for grazing or browsing purposes. In most cases, cultivated forage crops produce higher yields than most native forages. Crops are consumed during different stages of growth.

Control and regulation of grazing intensity, timing, frequency and selectivity are dictated by the producer to control the effects of grazing animals on plants (Holechek, Pieper & Herbel, 2004, p. 127). A study from Owen et al. 1998 found that a high intensity overgrazed pasture ultimately causes plant death. It was found that grasses can be grazed without damage if 50% to 70% of the leaf and stem material by weight is left intact as a metabolic reserve. The remaining 30% to 50% is considered "surplus" that can be consumed.

Hay Cropping

Bales of hay typically contain 10 to 20% moisture.

Hay is a major source of fodder for the livestock industry during the dormant season. Grasses, legumes, or other herbaceous plants are often used as a hay source. At roughly 25% moisture content - plants are cut, left to cure or wilt in the field and then processed into bales. Hay is then used as animal feed when grazing pasture is unavailable due to cold temperatures or when animals are kept in a barn or other enclosed area.

Hay is sensitive to weather conditions which can play a large role in the quality of the product. If harvested in a drought year, plant quality and hay production may be diminished. In wet weather, the cut hay may spoil prior to baling or develop rot and mold once baled. Potential toxins then become a concern, as animals can become sick if they are fed spoiled hay. Musty and/or mildewy odors indicate the presence of mold within hay.

At left:
Hay bales can be subject to free grazing by moose if not protected or stored properly.

Silage Cropping

Photos: Casey Dinkel, AK PMC

Silage is stored in an anaerobic environment to promote fermentation. Typical moisture content ranges from 40% - 60%.

Ensiling is a process that involves taking fairly wet (moisture level between 40-60%) early growth green forage and putting it into silos or pits under airtight, anaerobic conditions. If moisture conditions get any higher, clostridial bacteria may grow. The harvested crop must be well chopped and placed in a pit and packed tightly together, driving out air so the anaerobic fermentation process can begin. Fermentation will produce lactic acid, converting the high moisture forage plants to a stored energy food source.

Producers may choose to routinely produce silage, or produce silage only when field drying is difficult or impossible. A more informative in-depth article about the ensiling process was written by the Iowa State University - Cooperative Extension Service, and can be located at the following address: www.extension.iastate.edu/Publications/PM417H.pdf.

Haylage

These large hay bales have an average moisture content between 20% and 40%. These bales are known as haylage or sometimes called 'Sweet Hay'.

The ensiling process for haylage follows silage and only really differs in the lower moisture content. Crops are ensiled at 20-40% moisture. Slight variations in moisture percentage may affect the desired outcome. When moisture content at harvest time is too low, the crop becomes too dry for harvesting and storage of haylage. At this stage, making the transition to a hay crop is advised.

Photo: Todd Paris, UAF

Individual round haylage bales stored for future use

Evaluating Silage

Advantages

- Lower chance of weather delays and weather related damage during harvest;
- Lower field, harvest, and storage loss; and
- Provides flexibility and is adapted for many feeding programs.

Disadvantages

- Forage content is high in moisture, resulting in heavier forage that is difficult to haul;
- Specialized equipment for harvesting, storing, and feeding may be needed;
- Potential for high losses if silage is not properly made; and
- Quality decreases rapidly after the pit is opened.

Forage and Animals

Photo: Franci Havemeister, AK Division of Agriculture

Dairy cattle on a farm in the Matanuska Valley

In this section, several classes of foraging animals and their basic nutritional requirements are discussed. Protein, carbohydrates, fats, minerals, and vitamins are a few nutritional components necessary for animals to function properly. Other factors such as body size, type of digestive system, and the size and shape of an animal's mouth are also discussed.

Classes of Animals

Livestock can be divided into three groups based on the type of forages they consume; **grazers**, **browsers**, and **intermediate feeders**.

Grazers

This group of animal has a diet that is dominated primarily by various grass species. Cattle, bison, elk, and musk oxen are all considered grazing animals. Horses are also grazers, but have an enlarged cecum. As a consequence, horses have a considerably less efficient digestive system than other grazers. Horses have to consume 50-60% more forage in comparison to cattle to meet the same nutritional requirements.

Photo: Brianne Blackburn, AK PMC

A pair of dall sheep graze within the Brooks Range.

Photo: Casey Dinkel, AK PMC

A Musk Ox at the Alaska Wildlife Conservation Center.

Photo: Casey Dinkel, AK PMC

Bison cow and calf graze on a ranch near Delta, Alaska.

Browsers

Browsing animals have a diet that consists primarily of forbs and shrubs. Moose, deer and domestic goats are the primary examples of browsing animals in Alaska. They utilize a variety of succulent forbs throughout the entire growing season and persist on tall growing woody species during the winter. Moose can be found browsing on grass hay bales, birch limbs, and spruce buds throughout the winter months.

Photo: USDA

At right: A sitka black tailed deer munches on fireweed, *Chamerion angustifolium*.

Photo: Franci Havemeister, AK Division of Agriculture

Domestic goats are browsers.

Photo: Casey Dinkel, AK PMC

A bull moose browses on Dwarf birch, *Betula glandulosa*, in Denali National Park.

Intermediate Feeders

The intermediate feeders group includes the caribou and reindeer. Feeding on grasses, forbs, and shrubs allows the intermediate feeder to adapt its feeding habits to take advantage of available forage throughout the year. This adaptation allows these animals to survive in Alaska's diverse environment.

Photo: Casey Dinkel, AK PMC

A lone caribou in the Talkeetna mountains

Photo: Greg Finsted, UAF.

Feeding a reindeer hand-harvested lichen at the UAF Reindeer Farm. The reindeer's wide rounded muzzle allows them to selectively feed on available forage throughout the year.

Nutritional Components

All animals require food to carry out bodily functions for growth and structure. Alaska's extreme living environment can present unique nutritional challenges. Foraging animals in Alaska may be deficient in several minerals and vitamins. Animals require high energy and/or high quality feed in order to minimize stress and fight disease during the long winters. Therefore, it is important to have a basic knowledge of forage nutritional components that are essential to understanding an animal's overall health and maintenance.

Carbohydrates

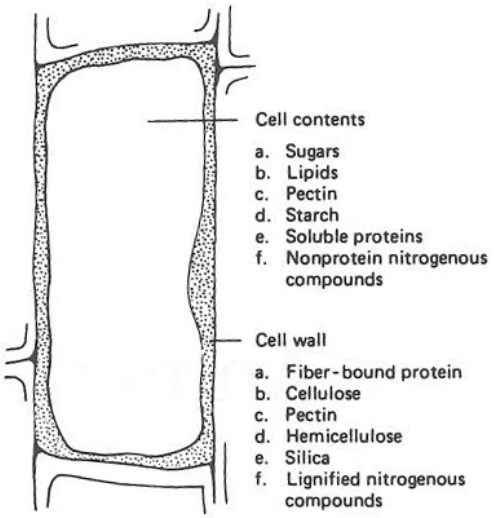
Carbohydrates are the basic energy source for all animals. There are two types of basic carbohydrates; those associated with cell content and those associated with the cell itself. Starches and sugars are found within the cell wall and are easily broken down by the digestive system. Cellulose and hemicellulose are found inside the cell and require microorganisms within the rumen or cecum to assist with digestion. Lignin is also found within the cell wall of a plant and cannot be fully broken down and digested. Lignin concentrations are typically higher in the stem of a plant as opposed to the leaf material and increases as the plant matures.

Fats

Range animals do not have the proper gastrointestinal system needed to break down fats, due to the absence of bile in the small intestine. Bile is produced by the liver and is the main component in the degradation of fat. A small amount of fat is necessary in an ungulates diet. Some fats can be found in the seeds of plants such as corn, peanuts, and sunflowers. Fats have about 2.25 times the energy levels in comparison to carbohydrates, making them the main source of stored energy in range animals.

Protein

Like carbohydrates and fats, proteins are composed of nitrogen, carbon, hydrogen and oxygen atoms. More specifically, they are composed of chains of amino-acids called peptides. These peptides are responsible for carrying out many functions in an ungulate's body, such as the production of enzymes, hormones and antibodies. Proteins cannot be stored in the animal's body, so a consistent supply is required to maintain animal health.



The nutritional composition of a plant cell (Van Soest 1982)

Protein levels in actively growing plants are typically higher than during dormancy. Leaves of grasses, forbs and shrubs contain higher concentrations of protein than other parts such as the stems. However, forbs and shrubs tend to have higher levels of protein on average in comparison to grasses.

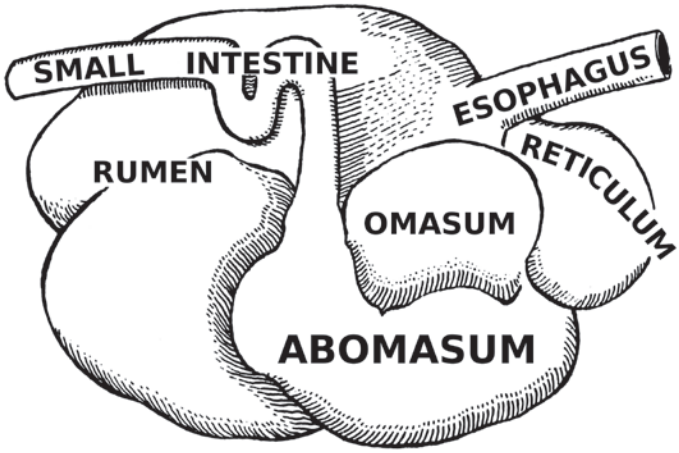


Diagram: fitdaffy.blogspot.com

Ruminant digestive system

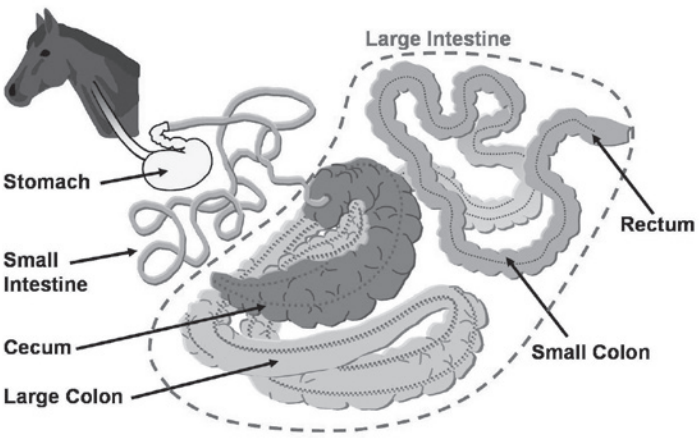


Diagram: seminolewellnessfeed.com

Cecal digestive system

Minerals

Minerals play an important role in many essential body functions, such as muscle movement, nerve transmission, and blood function. Mineral deficiencies can result in poor animal health, increased mortality, and low production. Minerals can be grouped into two separate categories: macro-minerals and micro-minerals.

Calcium, phosphorus, potassium, magnesium, chlorine, sodium, and sulfur are the main macro-minerals needed by grazing animals. These minerals generally encompass less than 5% of an animal's body. Micro-minerals/nutrients are required in substantially lower amounts in grazing animals than macro-minerals, making up of less than .01% of an animal's body. Micro-minerals required by grazing animals are iron, copper, cobalt, fluorine, zinc, molybdenum, selenium, and manganese.

Selenium commonly creates more problems for range animal health than all other micro-minerals. Selenium deficiency can cause skin disorders and/or rapid hair loss in animals. Soils throughout Alaska typically contain lower amounts of selenium as compared to the western United States, where selenium levels are higher.

Cracked or flaking hooves are a symptom of selenium deficiency

Macro - Minerals :	Micro -Minerals :
Calcium (**Ca**) Phosphorus (**P**) Potassium (**K**) Magnesium (**Mg**) Chlorine (**Cl**) Sodium (**Na**) Sulfur (**S**)	Iron (**Fe**) Copper (**Cu**) Cobalt (**Co**) Flourine (**F**) Zinc (**Zn**) Molybdenum (**Mo**) Selenium (**Sl**) Manganese (**Mn**)

Vitamins

Grazing animals require organic compounds such as vitamins to carry out essential bodily functions. Vitamins are separated into two different groups based on their solubility properties. Fat soluble vitamins such A, D, E, and K are stored in the animal's body and used during periods of inadequate dietary supply. Water soluble vitamins, such as C and B complex, cannot be stored in the body and require a constant supply.

Vitamin D is derived from sunlight. Deficiencies of Vitamin D are rare in the contiguous United States, but can be a concern in Alaska. Vitamin E is obtained by consuming the leafy parts of a plant and is almost never deficient. However, in some cases foraging animals have displayed moderate to violent muscle spasms due to Vitamin E deficiency.

Fat Soluble Vitamins :	Water Soluble Vitamins :
Vitamin **A** Vitamin **D** Vitamin **E** Vitamin **K** Vitamin **B2** *(Riboflavin)* Vitamin **B12** *(Cobalamin)*	Vitamin **C** Vitamin **B Complex** *(Excluding B2 & B12)*

Photo: Liz Goldsmith, EquineInk.wordpress.com

This horse shows muscle weakness due to Vitamin E deficiency.

Endophytes

Endophytes are organisms that live inside plants; they can be bacteria, fungi, or nematodes. Many survive only inside living plants and are transmitted from mother plant to seed. There are endophytic fungi that have mutualistic associations with their plant hosts (benefiting both organisms), however, some of these fungi produce toxins. The toxins produced can discourage feeding and can weaken or kill grazing animals. Not all members of an endophyte species produce toxins; growing conditions and time of year can also affect toxin loads. Generally, toxins are at their highest concentration in the crowns and seed heads. Many of the toxins can persist in stored hay for several years.

Symptoms of Endophyte Poisoning In Animals

Clinical symptoms are related to the type of toxin present. The ergot alkaloids present in fescues cause constriction of blood vessels; symptoms include elevated body temperature (animals may stand in water), increased respiration, excessive salivation, restricted blood flow, "*fescue foot*" (dry gangrene in extremities) in cold weather, "*fat necrosis*", nervousness, arched back, reduced weight gain, lowered reproduction, reduced milk production, and roughened hair coat. Ergot alkaloids can also be present in perennial ryegrass. The predominant toxin is typically lolitrem B, a tremorgen that causes tremors and muscle spasms. Lolitrems are the cause of "*ryegrass staggers*," a condition in which the animal displays outstretched neck and limbs, tremors, stiff limbed gait, reluctance or inability to rise, disorientation, reduced weight gain and reduced prolactin levels. Tremors and disorientation are more pronounced when animals are excited.

How to Identify Endophyte Infected Grass

Endophyte infection does not generally cause outward symptoms in host plants, though they may appear more vigorous than neighboring plants, or may experience less grazing pressure. In cases of isolated toxin production in a pasture, the area may be fenced off or livestock may feed on limited quantities of infected grass. Toxin production often increases with plant stress (heat, drought, overgrazing). Lush growth from excessive nitrogen fertilization should be avoided. Avoid feeding crown tissue at any time of the year. Mow or graze infected areas before seed heads develop, since they can contain the highest concentrations of toxins.

Infected pastures should be avoided in the late summer or early fall when toxin levels are high. In more extreme cases of high toxin loads or widespread toxin production, pastures may need to be killed and replanted. Pastures should NOT be replanted with lawn mixes (endophytes can be desirable to protect lawns). Many pasture grasses are tested for fungal endophytes. "**E +**" or "**E -**" labels on seed mixes indicate the presence or absence of endophytes; other labeling systems indicate the percent of infected seed. There are also varieties of pasture grass containing endophyte strains that do not produce mammalian toxins, these provide nutritional and survival benefits to the plant without risk of livestock poisoning.

Laboratory testing is available to confirm the presence of endophytes and their toxins. Please contact the Alaska Plant Materials Center at (907) 745-4469 if you suspect you may have endophyte problems in your pasture.

Section B. Crop Establishment

- Planning
  - Goals & Objectives
  - Evaluating Site Conditions
  - Selection of Species
  - Planting Choice
  - Planting Method
  - Site Preparation
  - Planting Time

Planning

A grower bales hay in the Matanuska Valley.

Developing a forage management plan is a necessary first step in any operation. Attention to detail is essential, as you are working with biological processes that have specific timing and environmental requirements. Continuing management is also important, to deal with the wide range of conditions and problems presented by Alaska's environment. This section details several important factors to consider, including site conditions, species selection, site preparation and various other agricultural practices.

Goals and Objectives

Goals can be distinguished from objectives in that a goal is an over-arching direction, and an objective is a specific measure taken to attain a goal. Goals will vary among managers depending on where the farm operation is located, type of animal, and the forage type desired. These three factors are correlated; the outcome of one may have an effect on the others. Stating goals early on will help in making good decisions and setting objectives as the planning process moves forward. A hay producer in Interior Alaska may have different objectives than one in Southcentral, despite having similar goals, due to climate and other factors.

Evaluating Site Conditions

Potential limiting factors that will affect forage establishment are extensive, and a complete discussion is beyond the scope of this manual. This publication focuses on the limiting factors that have been observed in Alaska, and other parameters important for successful forage establishment.

Plant growth depends on temperature, nutrient/water availability, soil moisture holding capacity and the ability of plant roots to penetrate a given soil. Plant growth also depends on physical characteristics of the soil such as texture and structure.

Soil Texture

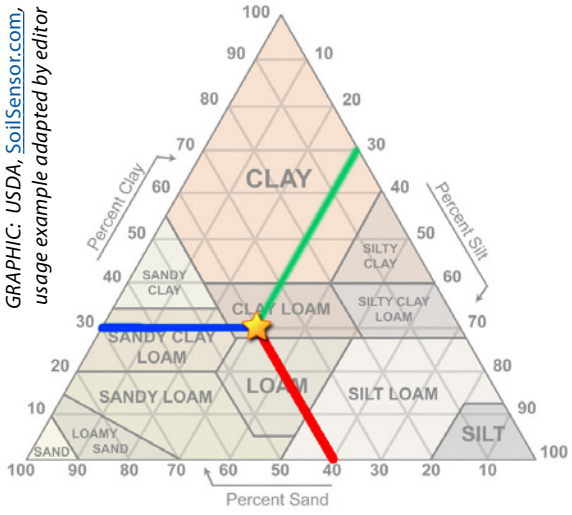
Soil is made up of mineral particles, organic matter, air and water. Soil texture is determined by the composition of soil, expressed as % sand, % silt, and % clay. Three classes of particle size are acknowledged with sands being the largest (2.0-.05 mm), silts (.05-.002 mm) intermediate in size, and clays (<.002 mm) being the smallest.

Quantitative measures to determine soil texture are also available. The Agronomic Soil Textural Triangle is most often used to determine the textural type of a soil. Soil is first divided into its 3 constituent parts and percentages are calculated. The texture of the soil is then determined using the soil triangle and the percentages of sand, silt, and clay to arrive at a specific soil classification. Contact the Alaska Plant Materials Center at (907) 745-4469 for more information about testing and analysis of soils.

Some characteristics of clay soils are that they restrict air and water flow, have high shrink-swell potential, and are highly absorptive. Sand, in contrast, has a low water holding capacity, due to large pore spacing, and has limited absorptive capability for substances in solution.

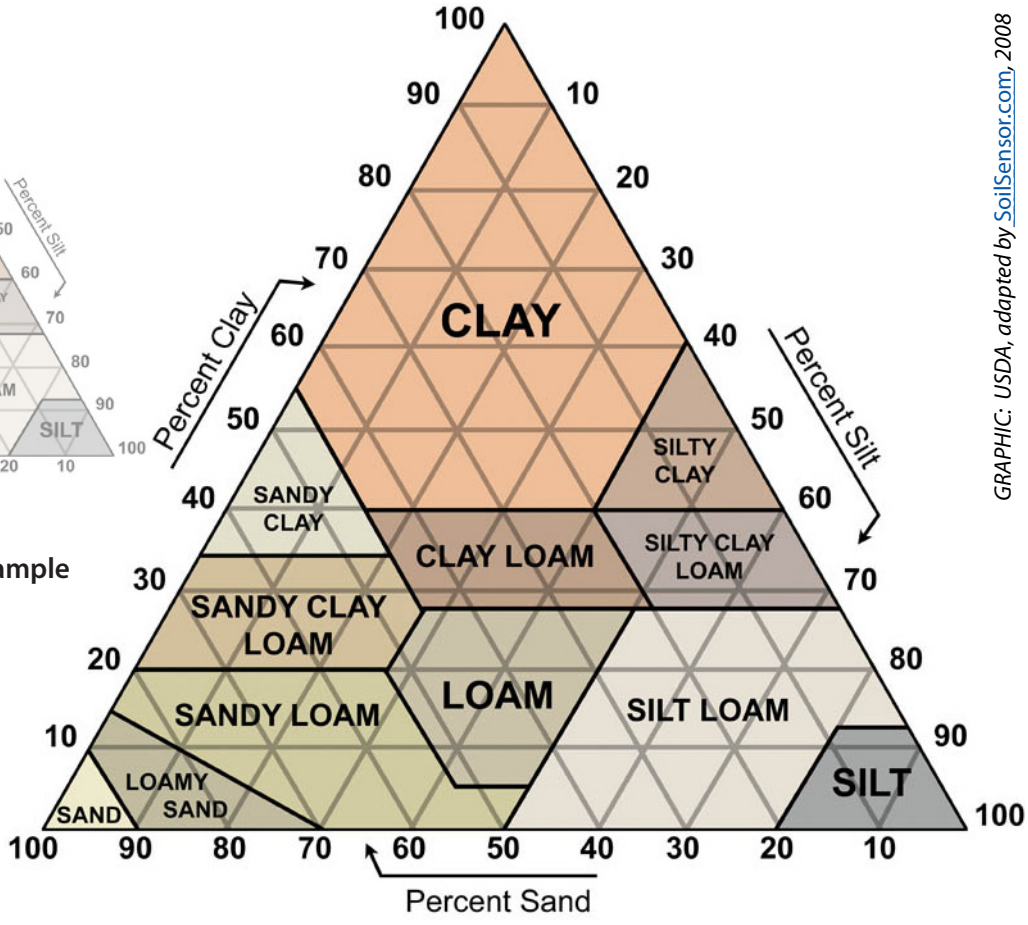
Field analysis of soil texture can be done using the "By Feel" testing method, shown on the chart on page 22. This qualitative method is quick, easy and fairly reliable. The testing procedure involves wetting a sample of the soil and working the soil between two fingers (generally moistened using water). Texture cannot be determined accurately when the soil is dry.

GRAPHIC: USDA, SoilSensor.com, usage example adapted by editor



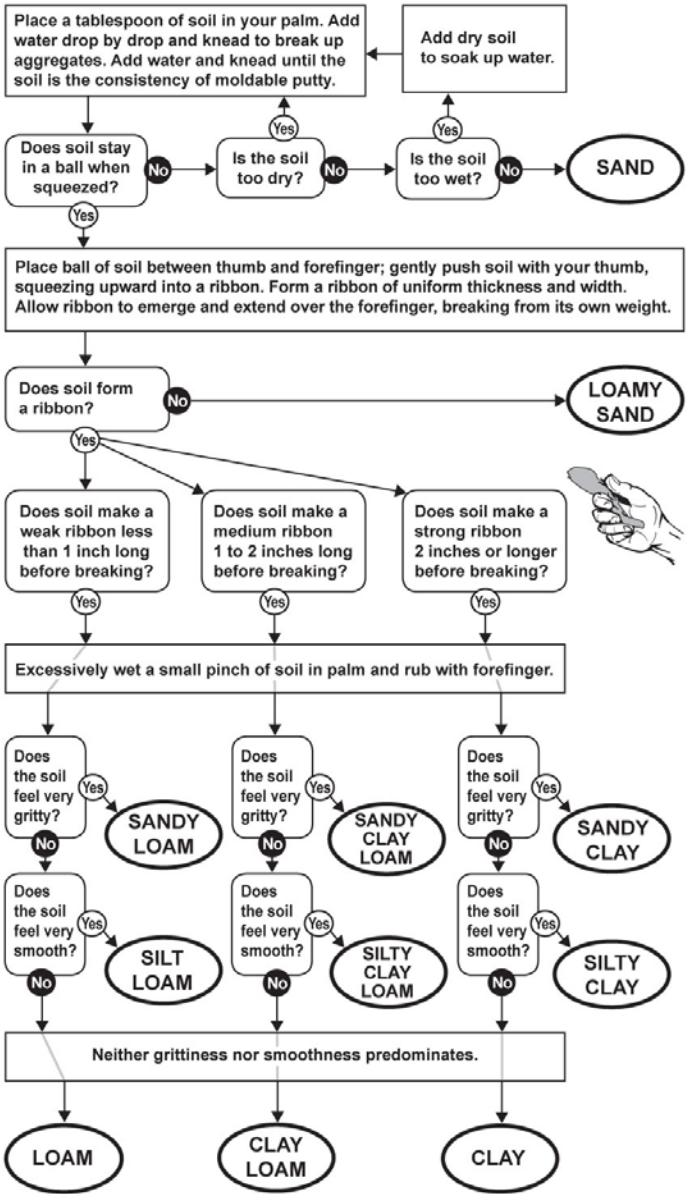
Soil Textural Triangle usage example

In the example above, the soil consisted of 40% Sand (red line), 30% Clay (blue line), and 30% Silt (green line). Thus, the soil can be classified as clay loam (indicated by the intersection of the three lines).



USDA Agronomic Soil Textural Triangle

GRAPHIC: USDA, adapted by SoilSensor.com, 2008



Soil Structure

The aggregation, or combination, of mineral soil particles (sand, silt, clay) is referred to as soil structure. The arrangement of soil particles create varying pore spaces that allow different quantities of moisture to be retained. This is referred to as the porosity of the soil, and will be noted on a soils test.

Soil compaction is a condition where the pore space of the soil is reduced by pressure applied to the soil surface. Compaction compresses micropores and macropores, destroying the soil structure. This affects the uptake and movement of water and can inhibit plant and microbial growth. Breaking up compacted layers can be accomplished by mechanical tillage. Equipment should be operated along the contour to reduce the potential of water entering furrows and creating soil erosion problems.

Nutrients

Nutrients can be classified as non-mineral and mineral nutrients (*North Carolina Dept. of Agriculture*). The best way to assess soil nutrient levels is through a lab soils test. Collecting soil samples will allow the soils lab to specifically tailor fertilizer ratios to the planting site. A listing of essential nutrients follows.

Macro nutrients:	Micro / Trace nutrients:	Non-Mineral nutrients:
Primary Nitrogen (**N**) Phosphorus (**P**) Potassium (**K**) ***Secondary*** Calcium (**Ca**) Magnesium (**Mg**) Sulfur (**S**)	Boron (**B**) Copper (**Cu**) Iron (**Fe**) Chloride (**Cl**) Manganese (**Mn**) Molybdenum (**Mo**) Zinc (**Zn**)	Hydrogen (**H**) Oxygen (**O**) Carbon (**C**)

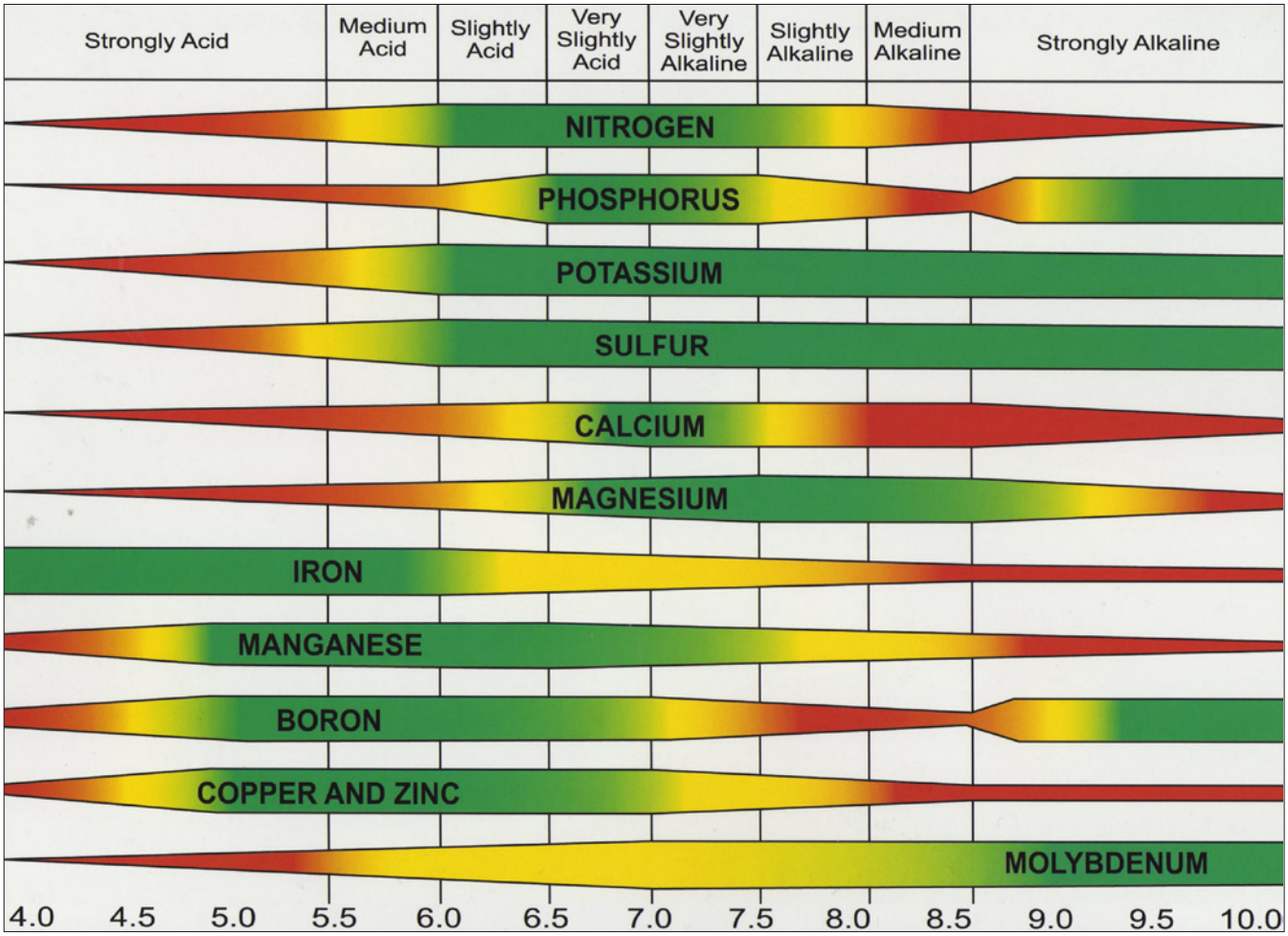
The application of fertilizer at the time of seeding may be necessary for some forage crops. Most commercial fertilizers meet minimum standards for quality. When problems do arise, they can usually be traced to the product becoming wet during storage or shipment.

Fertilizer is described by a three number designator, referred to as N-P-K. These numbers refer to the percentages of three elements: nitrogen, phosphorus, and potassium, respectively. Therefore, 20-20-10 fertilizer contains 20% nitrogen, 20% phosphorus, and 10% potassium by weight.

General fertilizer recommendations for Alaska, based on fields producing 2 tons per acre are as follows:

South-central:	140N-60P-120K lbs. / acre, with split application of Nitrogen (70 lbs. / acre in spring; 70 lbs. / acre mid-summer)
Interior:	120N-40P-20K lbs. / acre, with a dressing of 10 lbs. /acre elemental sulphur
Kenai Peninsula:	80N-40P-40K lbs. / acre, with a dressing of 32 lbs. /acre sulfur

Application rates of fertilizer can be determined by taking soils tests and should be adjusted to the soil conditions present. Excessive fertilization can cause nutrient interactions and salt injury to occur. For site-specific fertilizer recommendations in your area contact the nearest Cooperative Extension office or the Plant Materials Center.



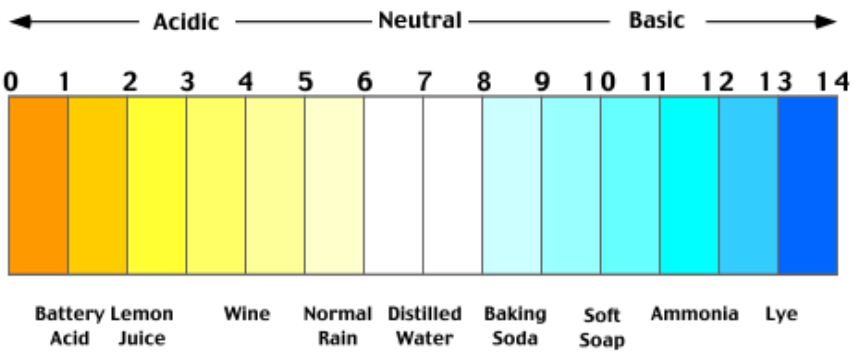
GRAPHIC: Verdegaal Brothers Inc. www.verdegaalbrothers.com

How soil pH affects availability of plant nutrients

Soil pH - Acidity and Alkalinity

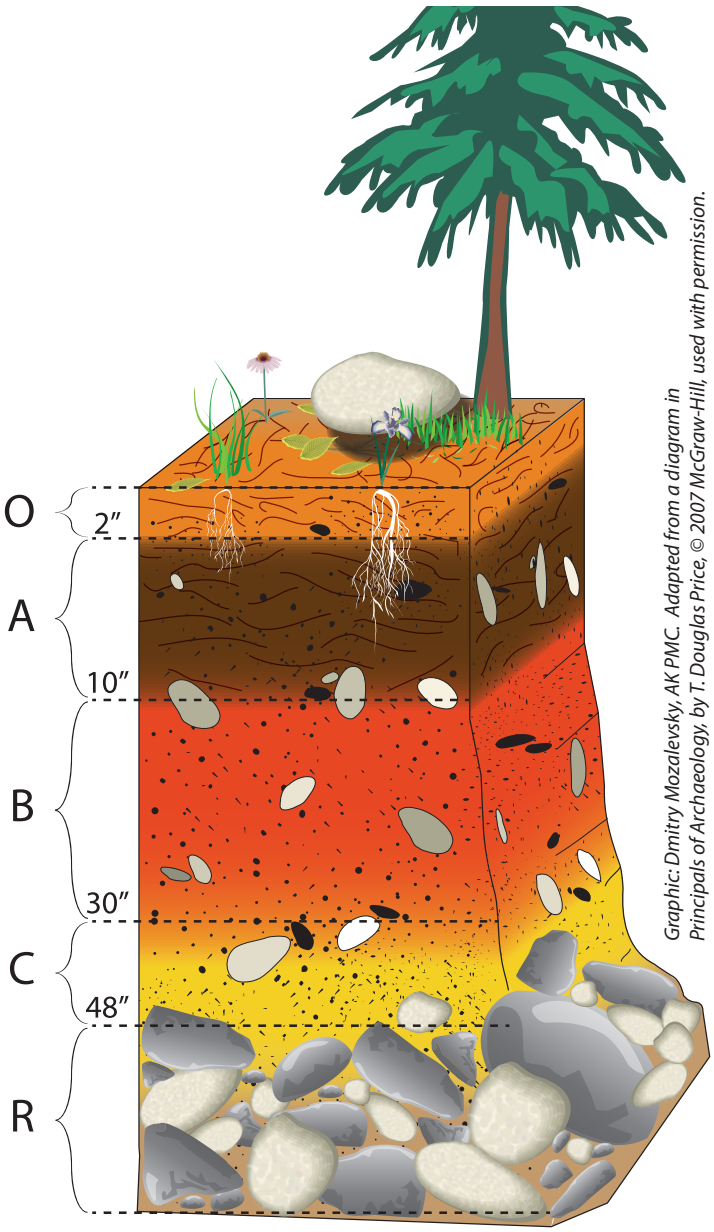
Soil pH is a measurement of soil acidity and/or alkalinity and has a major effect on nutrient availability. It is based on a logarithmic scale from 0 to 14. A number less than 7 represents an acidic soil, with the acidity increasing as the pH value gets closer to zero. Basic or alkaline soils are characterized by pH values greater than 7. Neutral soils are represented by a value of 7.

Basic soils contain high amount of bases (calcium, magnesium, potassium, sodium, phosphates) and are generally found in arid and semi-arid climates. Acidic soils form in wetter climates where the bases have been leached through the soil profile. Having an idea of the pH value of the soil will help with plant selection, as some species prefer more acid soils and others prefer more alkaline soils. To correct acidic (low pH) soils, a limestone application is commonly applied. Sulfur is usually used to mitigate overly basic soils.



Topsoil

The topsoil layer is a source of native seed, plant propagules, organic matter, and soil microbes which can enhance the quality of the substrate being planted. Top soil is a valuable resource in forage establishment, and should be preserved and/or salvaged when possible. However, the topsoil layer existing in undisturbed areas of Alaska is often very thin and therefore expensive to salvage.



Graphic: Dmitry Mozalevsky, AK PMC. Adapted from a diagram in Principals of Archaeology, by T. Douglas Price, © 2007 McGraw-Hill, used with permission.

The diagram shown above displays the typical diagnostic horizons within a soil profile. The 'A' Horizon, also known as topsoil, is a mineral layer directly beneath the 'O' Horizon, a layer of decomposing organic material. The 'B' Horizon consists of an accumulation of Fe, Al, Si and humus. The 'C' Horizon is a layer of unconsolidated earthy material and soft bedrock that underlies the uppermost horizons. The bottom strata consists of rocky material and is referred to as the 'R' Horizon.

Weed Control

Weeds (unwanted or out-of-place plants) can exclude other species on a site because they are quick to germinate and establish. Weeds compete with forage seedlings for moisture, nutrients and light. This competition for resources can have several negative consequences, including weedy forage stands, increased time for crops to establish or even crop failure. Weed control is most critical during the first year of forage production. Planning a weed control strategy prior to and during seedling establishment is essential for a healthy forage stand.

Methods that may be used to control annual and perennial weeds include tilling, mowing and application of herbicides. Excessive soil manipulation loosens the seedbed and dries the soil, so tilling should be done as close to planting as possible. Mowing should be done as close to the ground as possible and prior to weed species setting seed. Perennial weeds may require several cuttings. If the weed infestation is heavy, remove the remaining material left after mowing so that it does not smother the forage.

Chemical weed control is meant to eliminate or reduce competition from weeds during the seedlings vegetative growth phase. Herbicide labels are legal documents providing directions on how to mix, apply, store, and dispose of herbicide. Always follow the product label when using an herbicide. The Alaska Department of Environmental Conservation regulates pesticide and herbicide use within the State. The Pesticide Control Program for the State of Alaska can be accessed at dec.alaska.gov/eh/pest/.

The Department of Natural Resources / Division of Agriculture (DOA) maintains the authority to regulate the entry of seeds, plants, horticultural products and products relating to (AS 03.05.010). Under this authority, the DOA has established seed regulations to prevent "prohibited" or "restricted" noxious weeds from being sold deliberately or transported as a contaminant above allowable tolerances (11 AAC 34.020). It is important to be familiar with noxious weeds and to apply appropriate management practices to prevent these species from establishing in your forage crop. The listed "prohibited" and "restricted" noxious weeds are included in Appendix C. The current Seed Regulations can be accessed at plants.alaska.gov/pdf/SOA-seed-regs.pdf.

Selection of Species

Species selection is one of the most important criteria for a successful forage crop. The harsh and diverse environments of Alaska limit species growth and production potentials. Therefore, it is imperative that species and cultivars (varieties) chosen are winter-hardy and able to survive and thrive in the local environment.

Climatic, topographic, and soil conditions should all be taken into account when selecting species. More importantly, the plant species should meet the needs of the animals that will be feeding on and inhabiting the site.

Desirable species characteristics include site adaptation, palatability, resistance to grazing pressure, and nutritional value. The ability of a species to produce high yields and withstand competition is also highly valued. The Alaska Forage Manual includes profiles of 24 species of grasses, legumes, and grains that are adapted for forage use in various regions across the state.

The final determinant to consider when selecting species is best summarized below:

"Always assess the practical availability of potential species before selecting them. Adequate plant materials must be available, at the correct time, and at an acceptable cost.**"** (Whisenant, 1999)

Photo: Casey Dinkel, AK PMC

Two different varieties of the same grass species were planted in separate blocks to compare their ability to overwinter within the Interior of Alaska. The variety at right has been mostly winter-killed, and would not be a good choice to plant in this region.

Planting Choice

Seed

Seeding is the most common technique for establishing herbaceous plants for forage and hay. Seed is readily available for many species, and is relatively easy and inexpensive to produce. Furthermore, seed is easy to collect, process, handle, and apply to a pasture by drill or broadcast methods.

The objective of seeding is to place the seed where it is needed and in proper contact with the soil. The method and equipment used depend upon the plant species being seeded and the characteristics of the site, such as soil type and topography.

Only drill seeding and broadcast seeding are discussed in this manual, as these are the two most commonly used methods for establishing forage crops.

Causes of Seeding Failure

Forage seeding can involve considerable uncertainty. An awareness of limiting factors pertaining to seeding is valuable, and can help to limit uncertainty. There are many planting details that should be understood to establish forage species for pasture, hay or silage purposes.

A few reasons for seeding failure include seeding too early or too late in the season, poor seedbed preparation, low quality seed, or inadequate depth of seeding. Seeding too deep is a common mistake, and seeding depth should be closely monitored.

A definitive seeding plan which addresses each of the considerations listed above is often the best guarantee of a successful seeding result.

Planting Method

Drill Seeding

Drill seeding is the most widely used method for forage plantings. When drill seeding, furrows are created and the seed is placed in the soil furrow at a controlled depth and covered with a relatively precise amount of soil. Drill seeders are used most often in agricultural settings. The drill seeding method is considered by many to be the best method of distributing seed. It is an effective means for establishing a high yield stand, using a smaller amount of seed compared to the broadcast method.

One type of drill seeder, the Brillion style, is often used for planting forage. This seeder has been successfully used on most soil types, except very gravelly soils. The Brillion seeder delivers the seed into the soil, packs the seed in place, and applies seed with high accuracy.

Photo: Brennan Veith Low, AK PMC

A drill seeder is towed behind a tractor at the Alaska PMC

Broadcast Seeding

The broadcast method scatters seed on the soil surface, and relies on natural processes or harrowing to cover the seed. This is a common form of seeding because advanced equipment is not needed. Broadcasting is fast and is usually the least expensive form of seeding.

In order for this method to be successful, the seedbed should be properly prepared and the seed covered after application. Predation of seed by animals and desiccation by wind and sun may result in lower germination rates.

The recommended seeding rate for broadcasting is double that of drilling, due to the lack of application control and the potential for reduced rates of seed establishment and germination.

Broadcasting includes aerial seeding, hydroseeding, and hand-held methods. Hand-held or hand-operated spreaders can be used on smaller sites effectively, due to their portability and speed. Hand operated spreaders can also be used for both seed and fertilizer application.

Photo: Kasco Manufacturing Co.

A tractor mounted broadcast seeder

Site Preparation

Site preparation is a primary concern in establishing forage pasture and/or hay fields. This phase is the most labor intensive and energy consumptive, and often determines the success or failure of a planting initiative (Vallentine, 1989). The objective of site preparation is to create a series of micro-environments or safe sites where conditions are favorable for seed germination, establishment, and growth.

The surface of the prepared seedbed should be smooth for drilling and rough for broadcast seeding. Agricultural rangeland drills operate efficiently on ground that is relatively flat and free of obstructions that may affect seed distribution and placement. If a site is not seeded immediately after preparation, erosion can become a concern. Roughening or scarifying the surface with a harrow, imprinter, or other implement will help prevent water from coalescing and forming rills.

Prior to final seeding, a light disking will break up the soil crust and smooth the surface. If broadcasting, a small imprinter can be used to crimp the seed and create catchment sites for water. Germination and survival increase tremendously with proper site preparation.

Photo: Omni Manufacturing Photobucket user omnimfg:

An imprinter can be used to firm sandy, silty or loose soils

Procedures relying on mechanical equipment, such as disking, plowing, harrowing and subsoilers, are agricultural methods commonly used to prepare a seedbed. Using these tools, the soil surface is manipulated, existing vegetation that could compete with seedlings is killed, and the planting process is facilitated (Whisenant, 1999).

The final mechanical operation should prepare a firm seedbed which allows water infiltration and provides good seed-to-soil contact (Whisenant, 1999). A loose, fluffy seedbed limits establishment by creating air pockets, soil moisture loss and allowing seed to settle too deeply.

No-Till Seedbed Preparation

An alternative method of seedbed preparation is the **no-till method**. This method moves away from the traditional practice of plowing a field before planting crops. Tilling or plowing turns over the soil and leaves it vulnerable to wind and water erosion. This can further lead to sediment, fertilizer, and pesticide runoff into nearby rivers, lakes and oceans.

The objective of the no-till method is to minimize soil disturbance so the growing site can be as productive as possible. Crops are planted into previous crop residues or stubble. Soil erosion can be reduced and water infiltration may be improved. Additional benefits of the no-till method include the shading of new growth by stubble from the previous year's crop as well as the retention of soil moisture.

The no-till methods adoption may also require fewer passes over a field thereby limiting disturbance to the soil. A criticism of no-till is the reliance on chemical herbicides as well as the need for precision equipment, such as drill seeders. This practice can be cost prohibitive for many growers, especially those with small acreage.

Photo: Casey Dinkel, AK PMC

The 'no-till' seedbed preparation method limits soil erosion and helps retain moisture.

An Ideal Seedbed Should :

1. Be free of construction debris;
2. Have relatively few large rocks or objects;
3. Be free of ruts and gullies;
4. Have the top two inches in a thoroughly tilled friable, non-compacted condition;
5. Be scarified to a depth of 6 to 8 inches if heavily compacted;
6. Be devoid of non-native established weeds. Competition from weeds is a common cause of seeding failure, because they compete with seedlings for moisture, nutrients, and light; and
7. Be without a significant seed-bank of weedy species. Seed stored in the soil as hard or dormant seed may be viable and will germinate if the conditions are right. The presence of a nearby seed-bank often accounts for the surprise of a weedy species showing up on a site.

Planting Time

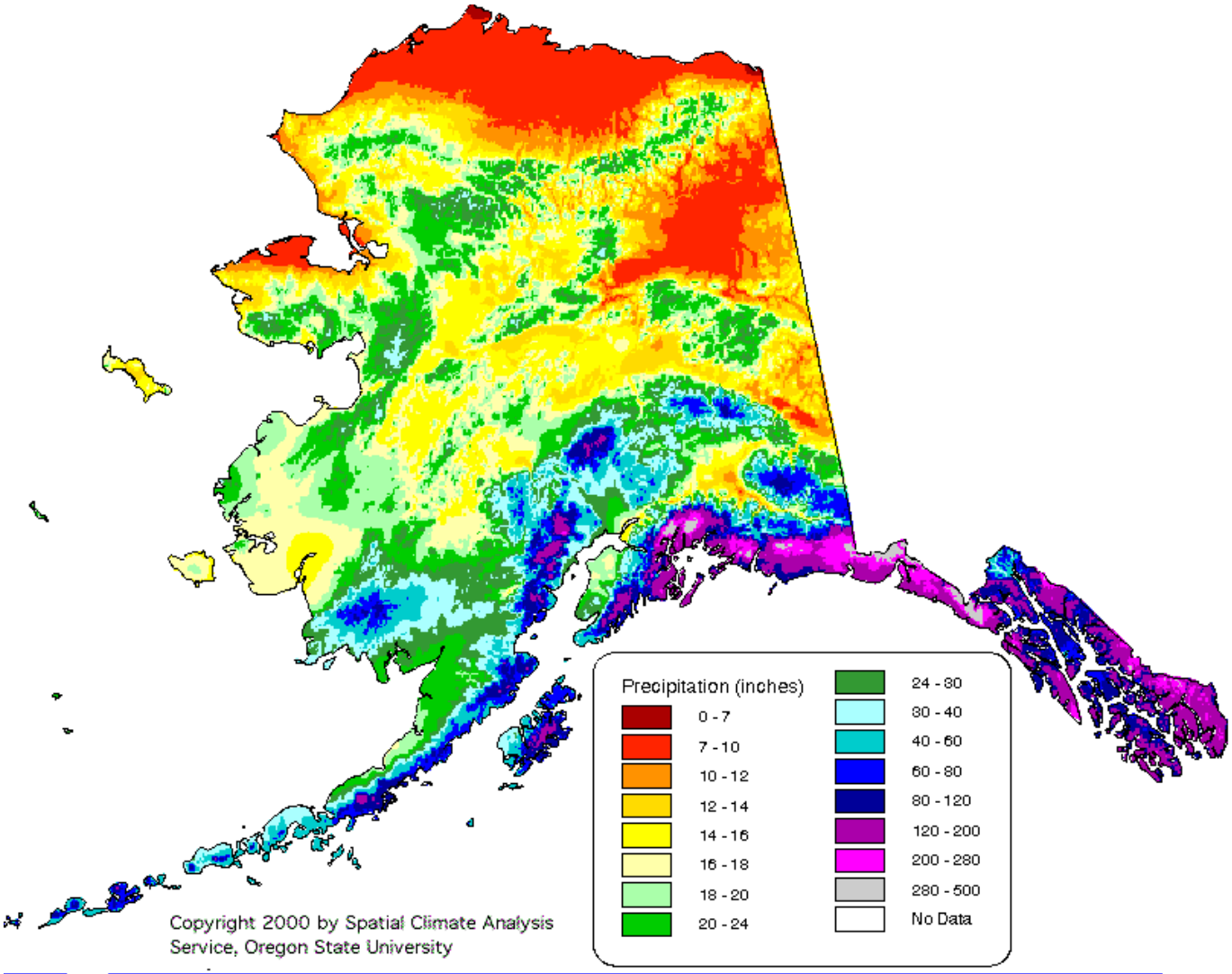
The optimal planting season is just before the longest period of favorable conditions. Planting times are determined by choosing the season when rainfall and temperatures are most favorable for seedling germination and establishment. Many sites dry quickly following spring melt, and precipitation is quite low in some regions of Alaska. A seeding time should be chosen that is the most advantageous to the seeded species.

In Alaska, spring planting is best where the primary growing season occurs in the late spring and/or summer. Early planting allows a species stand to develop a strong root- and-shoot structure, resulting in a plant that is more "winter-hardy".

The following table approximates the end of planting season across several regions of Alaska. The earliest time to plant is when the snow melts and the site is accessible.

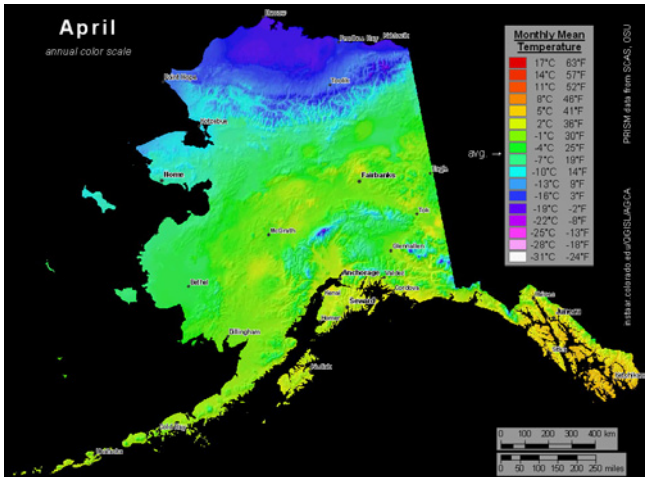
Latest Date to Seed:	
Arctic Coast	**July 15**
Western Alaska	**August 15**
Interior Alaska	**August 15**
Southcentral Alaska	**August 31**
Southeast & Aleutian Islands	**Sept. 15**

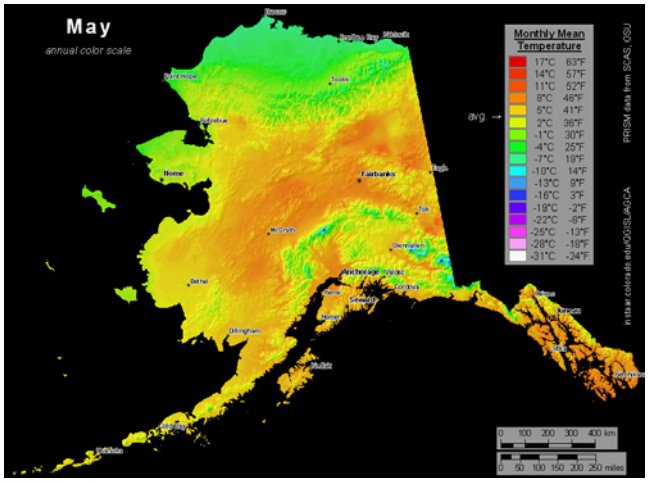
The precipitation and temperature maps that follow may be helpful in determining the appropriate planting time for your region.

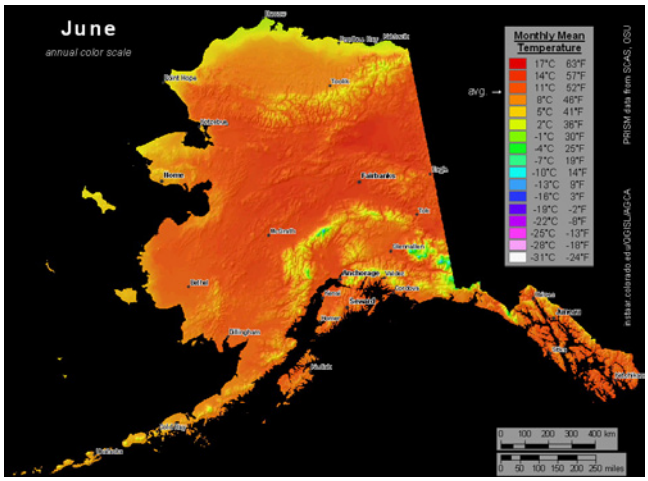


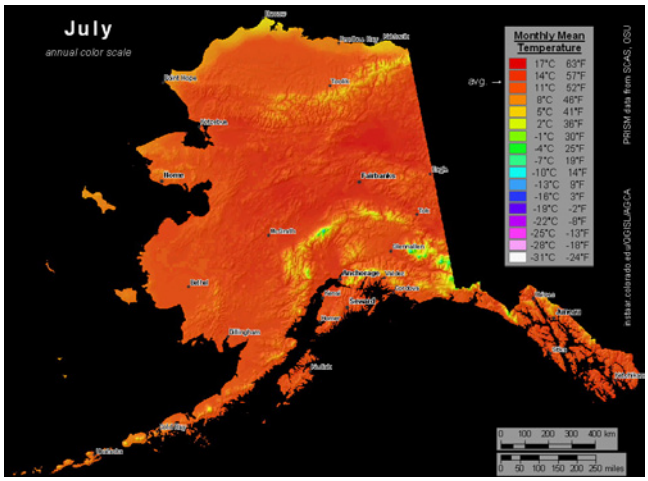
Graphic: The Climate Source, Inc., www.climatesource.com/ak/fact_sheets/fact_precip_ak.html

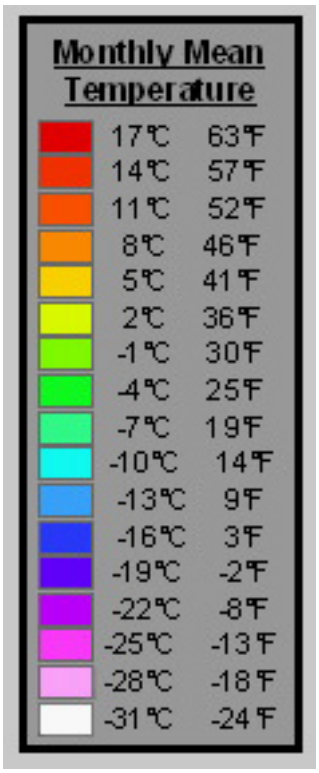
Mean Annual Precipitation in Alaska



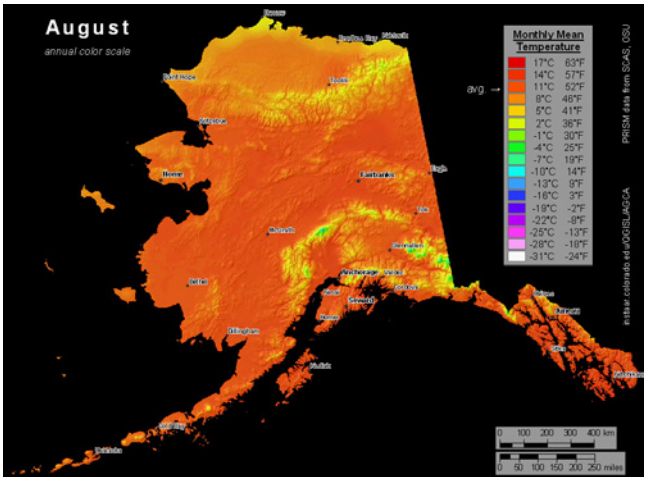


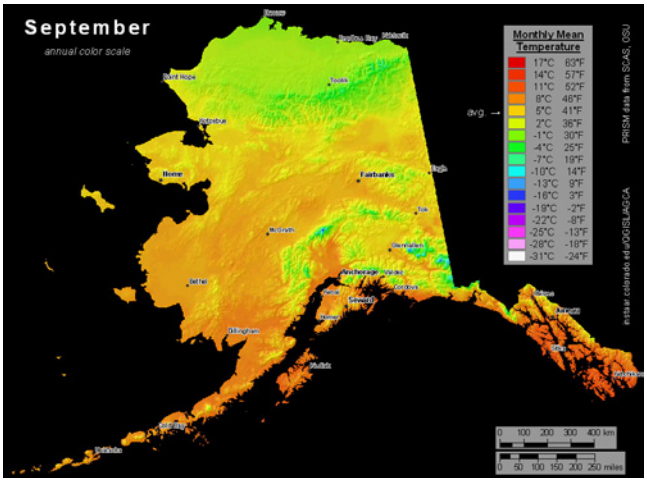






Graphics: Manley, W.F., and Daly, C., 2005, Alaska Geospacial Climate Animations of Monthly Temperature and Precipitation: INSTAAR, University of Colorado, instaar.colorado.edu/QGISL/AGCA





Section C. Plant Profiles

Grasses

Photo: Casey Dinkel,AK PMC

Bluejoint reedgrass, *Calamagrostis canadensis*

Alpine Bluegrass, *Poa alpina*
American Sloughgrass, *Beckmannia syzigachne*
Annual Ryegrass, *Lolium multiflorum*
Beach Wildrye, *Leymus mollis*
Bering Hairgrass, *Deschampsia beringensis*
Bluejoint Reedgrass, *Calamagrostis canadensis*
Kentucky Bluegrass, *Poa pratensis*
Meadow Barley, *Hordeum brachyantherum*
Meadow Foxtail, *Alopecurus pratensis*
Polargrass, *Arctagrostis latifolia*
Red Fescue, *Festuca rubra*
Siberian Wildrye, *Elymus sibiricus*
Slender Wheatgrass, *Elymus trachycaulus*
Smooth Brome, *Bromus inermis*
Spike Trisetum, *Trisetum spicatum*
Timothy, *Phleum pratense*
Tufted Hairgrass, *Deschampsia cespitosa*

ALPINE BLUEGRASS

Photo: Casey Dinkel,AK PMC

A mature stand of Alpine Bluegrass

Alpine Bluegrass

Poa alpina (L.)

Description

Poa alpina (Alpine Bluegrass) is a cool season perennial bunch grass that grows in mountainous areas. It is relatively short, growing erect culms between 15 and 20 centimeters (6 to 8 inches) tall. Alpine Bluegrass has short leaves, a tight crown, and an inflorescence that is from 2.5 to 5 cm (1-2 inches) long. Alpine Bluegrass is a pioneer species, and is usually long lived. The grass grows a small to medium seed and produces about 1,070,000 seeds per pound of seed.

Uses

Livestock: Alpine Bluegrass is palatable to all classes of livestock, such as cattle, sheep and horses. However, it does not produce a large amount of forage.

Wildlife: Alpine Bluegrass provides excellent forage for elk, deer, mountain sheep and bison. It is moderately palatable to all classes of wildlife, and is often used on big game ranges.

Forage Value

Alpine Bluegrass produces high quality forage for most classes of livestock and wildlife. It provides an ample protein supply, but forage yields are usually moderate to low. This grass is palatable for both livestock and wildlife. Alpine Bluegrass has moderate digestibility in comparison with other forage grasses.

Distribution and Adaptation

Alpine Bluegrass can be found growing in sub-alpine to alpine regions throughout Alaska. It has a pH range of 5 to 7.2, and typically prefers moderately fine to moderately coarse textured or well drained soils. Alpine Bluegrass is not tolerant of highly saline or waterlogged soils, but it can withstand prolonged periods of drought. Alpine Bluegrass has low nutrient needs, and will tolerate most nutrient deficient soils.

Culture

Alpine Bluegrass seed should be planted ¼ to ½ inches deep in coarsely textured soils, and ¼" or shallower in finely textured soils. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcasting is 4-8 lbs/acre and 2-4 lbs/acre when drill seeding. When seeded in a mixture, apply at a rate of 4-6 lbs/acre. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation in combination with fertilization should increase overall yields.

Management

Alpine Bluegrass is best suited for pasture land use but it does not respond well to heavy grazing, and new seedlings should be protected from grazing if possible. Little research has been done to examine the effects fertilizer and irrigation might have on Alpine Bluegrass yields. Alpine Bluegrass should not be grown in conjunction with Annual Ryegrass, as ryegrass has negative allelopathic effects. At the present time there are no known major pests that threaten Alpine Bluegrass.

Photo: Stoney J. Wright, AK PMC

Alpine Bluegrass, Poa alpina

Cultivars and Releases

- '**Gruening**' - *Alaska PMC release.*

A W I SW SC SE

- **Teller** - selected class germplasm; *Alaska PMC release.*

W I SW SC SE

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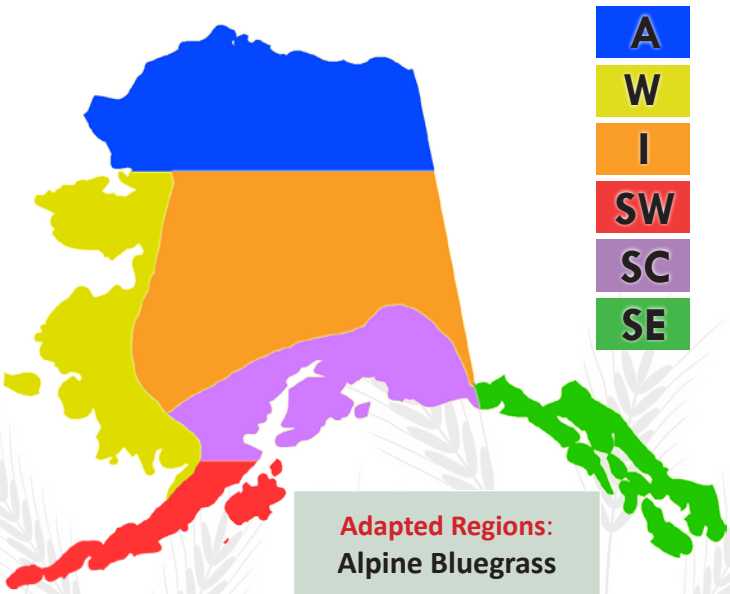
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	0

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Adapted Regions:
Alpine Bluegrass

- All Regions

see variety detail at left

Species not adapted to region

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Bunch	6 - 8 in.	Native	Poor	Good	Poor	Weak	5 - 7.2

AMERICAN SLOUGHGRASS

Photo: Brennan Veith Low, AK PMC

A mature stand of American Sloughgrass

American Sloughgrass

Beckmannia syzigachne (L.)

Description

Beckmannia syzigachne (American Sloughgrass) is a short lived perennial grass that is commonly found in shallow marshes or sloughs. Its shallow root system supports a leafy stem which may be up to 45 centimeters (18 inches) tall. Branched inflorescence, classified as closed panicle. Spikelets have very short pedicels that are arranged on only one side of the panicle. One or two flowered spikelets disarticulate below the glumes. There are approximately 1,270,000 American Sloughgrass seeds per pound of seed.

Uses

Livestock: American Sloughgrass can be used for hay meadows or pasture land. It is highly palatable to all classes of livestock, such as cattle, sheep and horses.

Wildlife: American Sloughgrass is an important component of Alaskan wetland environments. The grass provides shelter and food for wildlife such as waterfowl, songbirds and various small mammals.

Forage Value

American Sloughgrass is highly palatable and a valuable forage species. It has good energy and high protein value. American Sloughgrass is also know to contain high amounts of nonstructural carbohydrates. Livestock and wildlife generally concentrate in the wet meadows and riparian areas where American Sloughgrass grows.

Distribution and Adaptation

American Sloughgrass grows wild in Alaska and the northern United States in wet meadows, marshes and swamps. It is also grown and used as forage in parts of Europe and Russia. American Sloughgrass generally prefers a pH ranging from 5.5 to 7.5. It is commonly found growing in areas that receive at least 30 inches of precipitation per year.

Culture

An average broadcast seeding rate for American Sloughgrass is 10 lbs/acre. A rate of 5 lbs/acre is used when drill seeding, or when seeded in a mixture. American Sloughgrass seed should be planted to a depth of $^{1}/_{4}$ - $^{1}/_{2}$ inch. Be mindful of this grass's high water requirement when choosing a growing site. If the planting site is dry at the time of seeding, irrigation may be necessary. American Sloughgrass seed should be planted in moist to wet soils that are of medium to fine texture. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied.

Management

American Sloughgrass normally produces an abundance of seed that will readily germinate upon reaching a suitable growing site. It can be feasible to use American Sloughgrass on seasonally inundated sites where grain production is unpredictable. American Sloughgrass's vigorous growth habit is suited to sites where temporary, yet productive, cover is desired. The seed unit that falls from the inflorescence at maturity is a firm, free flowing spikelet that presents no difficulties for conventional planting equipment.

Photo: Casey Dinkel, AK PMC

American Sloughgrass, Beckmannia syzigachne

Cultivars and Releases

- **'Egan'** - *Alaska PMC release.*

W I SW SC SE

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Wright, S.J. and P.K. Czapla (2010) Alaska Coastal Revegetation & Erosion Control Guide, State of Alaska, Division of Agriculture, Plant Materials Center, Anchorage, Alaska. 234 pp Link: http://plants.alaska.gov/reveg/

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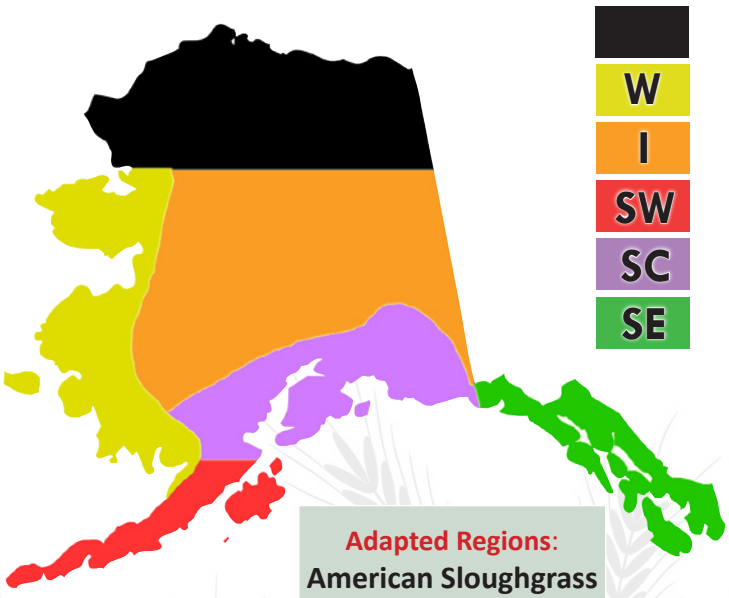

Adapted Regions:
American Sloughgrass

- Western
- Interior
- Southwest
- Southcentral
- Southeast

Species not adapted to region

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	1	3	3	2

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	18 in.	Native	Good	Poor	Excellent	Moderate	5.5 - 7.5

ANNUAL RYEGRASS

A mature stand of Annual Ryegrass

Annual Ryegrass

Lolium multiflorum (L.)

Description

Lolium multiflorum (Annual Ryegrass) is an annual, cool-season, introduced bunch grass. This grass grows erect or decumbent culms between 30 to 60 centimeters (12 to 24 inches) tall. Annual Ryegrass's foliage is usually glossy and produces a spike inflorescence that is between 7 to 15 cm (3 to 6 inches) long. As with most annual grasses, Annual Ryegrass produces a small root structure. This grass produces a medium size seed that grows at a rapid rate. Annual Ryegrass produces approximately 240,000 seeds per pound of seed.

Always use ryegrass labeled for "forage or pasture use". Some available varieties can be toxic. Non-forage types can contain harmful endophytes.

Uses

Livestock: Annual Ryegrass is used for pasture, hay, or silage. It is highly palatable to all classes of livestock, including cattle, sheep and horses.

Wildlife: Annual Ryegrass is consumed by most classes of large wildlife, such as bison, elk, deer, and mountain sheep. Small mammals and song birds will also utilize this grass when available.

Forage Value

Annual Ryegrass produces good quality forage for most classes of livestock and wildlife. It is considered to have high palatability for grazing animals and low palatability for browsing species. This grass has a moderate digestibility, and makes an excellent forage crop when planted with legumes.

Distribution and Adaptation

Annual Ryegrass can be found growing throughout most of North America. Introduced from Europe, it is adapted to cool moist climates, like those found in the Pacific Northwest. Although it can be found growing in Alaska, it will not persist due to its inability to over winter in harsh climates. It can tolerate a pH range of 5 to 8, and typically prefers moderately course to moderately fine textured soils. Annual Ryegrass will not persist during prolonged periods of drought, but it will tolerate areas of high moisture. This grass can withstand highly saline and nutritionally deprived soils.

Culture

Annual Ryegrass seed should be planted no deeper than ½ inch in most soil conditions. It is commonly planted in mixtures with legumes or small grains. Annual Ryegrass seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcasting is 8-16 lbs/acre and 4-8 lbs/acre when drill seeding. When Annual Ryegrass is seeded in a mixture, apply at a rate of 6 - 10 lbs/acre. Seeding rates should be increased by 5 - 10 lbs/acre when planting on poor seedbeds or harsh sites. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation in combination with fertilizer should increase overall yields.

Management

Annual Ryegrass is excellent for temporary pastures or early growth on permanent pastures. This grass should be seeded with other pioneer grass species, due to its short life cycle. Annual Ryegrass will succumb to winters in Alaska. It is also prone to several types of rust disease, although the species is somewhat resistant. Annual Ryegrass requires ample moisture and irrigation should be applied when necessary.

Photo: Casey Dinkel, AK PMC

Annual Ryegrass, Lolium multiflorum

Cultivars and Releases

- There are currently no developed northern cultivars or releases of Annual Ryegrass. Use of locally grown cultivars is advised whenever possible.

References

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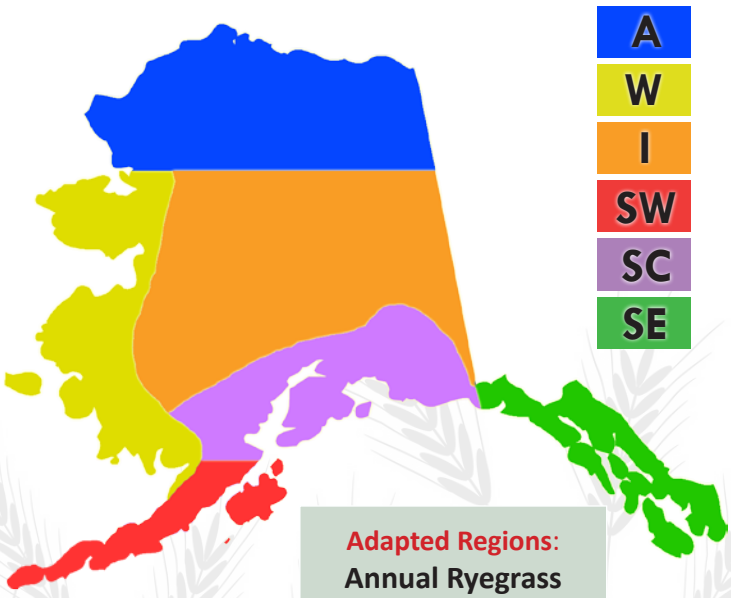
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
1	2	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Adapted Regions:
Annual Ryegrass

- All Regions

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	12 - 24 in.	Introduced	Excellent	Low	Excellent	Strong	5 - 8.0

BEACH WILDRYE

A mature stand of Beach Wildrye

Beach Wildrye

Leymus mollis (L.)

Description

Leymus mollis (Beach Wildrye) is a long lived, cool season, perennial sod forming grass. It grows erect culms 50 to 60 centimeters (20 to 24 inches) tall, from long creeping rootstocks. Beach Wildrye produces stout, aggressive rhizomes, which increases its ability to spread. Leaves vary in length from 25 to 51 cm (10 to 20 inches), and are coarse-textured. The inflorescence is a stiff spike that is 10 - 25 cm (4 to 10 inches) in length and roughly 13 mm (½ inch) wide. Beach Wildrye produces a large sized seed (33,000 seed per pound) and has low seedling vigor and germination rate. A fifty percent germination percentage for Beach Wildrye seed should be considered acceptable.

Uses

Livestock: Beach Wildrye can be used for pasture or silage. It is moderately palatable to a select class of livestock, such as cattle. This grass can be useful forage if grazed or cut for silage at the optimum growth stage.

Wildlife: Beach Wildrye is utilized by small mammals and song birds for forage and cover. Due to its limited range and moderate palatability, it is generally not consumed by large grazing or browsing animals such as moose, caribou, elk or bison.

Forage Value

Beach Wildrye produces a moderate forage yield compared to other forage grasses such as Smooth brome or Timothy. Its palatability for browsers is moderate to low. Beach Wildrye provides moderate to low nutritional value, depending upon when it is cut or grazed. This grass is usually easily digested, but can cause impaction problems in horses if consumed when the moisture content of the grass is low.

Distribution and Adaptation

Beach Wildrye is adapted to tidal and coastal areas and can be found growing along the coast of Alaska. It prefers coarse textured, sandy and/or well drained soils. Beach Wildrye will grow well in soils with a pH between 6.0 and 8.0. This grass can tolerate excessively wet and droughty conditions, and can withstand saline soils.

Culture

Beach Wildrye is commonly grown by planting sprigs from existing plants. A sprig is the smallest division taken from a live plant to grow a new plant. Survival percentage is greater when Beach Wildrye sprigs are planted than from seed. If using seed, drill to a depth of ¼ to ½ inch. Seeding rates depend greatly upon soil type, moisture, and location. The seeding rates below only apply to 'Reeve' Beach Wildrye, and the European species *Leymus arenarius*. An average rate for broadcast seeding of Beach Wildrye is 60 lbs/acre, and 30 lbs/acre when drill seeding. Including Beach Wildrye seed in a mixture is not recommended due to its weak ability to compete with other plants. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Beach Wildrye is highly responsive to nitrogen fertilizer. 20N-20P-20K fertilizer applied at a rate of 500 to 600 lbs/acre yield good results.

Management

Beach Wildrye may be severely damaged or destroyed from traffic that causes compaction. Digestive impaction may occur in horses if grazed when the moisture content is low. A fungus and pest called ergot can replace or destroy Beach Wildrye seed. Ergot occasionally occurs in many cereal crops and other various grass species. This fungus can be poisonous if consumed by animals and should be avoided.


Photo: Casey Dinkel, AK PMC

Beach Wildrye, Leymus mollis

Cultivars and Releases

- '**Benson**' *(Leymus mollis) - Alaska PMC release;* Available only as vegetative cuttings (sprigs).

[redacted] W [redacted] SW SC SE

- **'Reeve'** (*Leymus arenarius*) - *Alaska PMC release;* Available as seed.

[redacted] W [redacted] SW SC SE

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Wright, S.J. and P.K. Czapla (2010) Alaska Coastal Revegetation & Erosion Control Guide, State of Alaska, Division of Agriculture, Plant Materials Center, Anchorage, Alaska. 234 pp Link: http://plants.alaska.gov/reveg/

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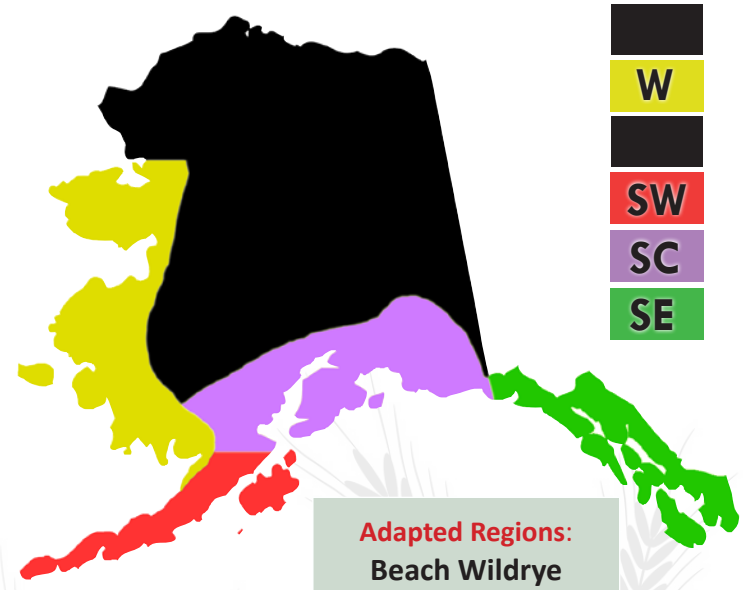
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
2	3	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Adapted Regions:
Beach Wildrye

- Western
- Southwest
- Southcentral
- Southeast

see variety detail at left

[redacted] *Species not adapted to region*

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Sod	24 in.	Native	Excellent	Good	Good	Weak	6.0 - 8.0

BERING HAIRGRASS

Photo: Stoney J. Wright, AK PMC

Bering Hairgrass has tufted leaves and a branched inflorescence

Bering Hairgrass

Deschamspia beringensis (L.)

Description

Deschampsia beringensis (Bering Hairgrass) is a highly variable, perennial, cool season bunch grass. The species grows from 50 to 60 centimeters (20 - 24 inches) tall. Stems are erect, and the leaves are between 1.5 - 4 mm (.06 and .16 inches) wide, flat or rolled. The leaves are mostly basal in a dense tuft. Bering Hairgrass's inflorescence is a loosely branched, open panicle from 10 - 25 centimeters (4 to 10 inches) in length. There are two florets (flowers) per spikelet. Flowering occurs from May to September. Bering Hairgrass seeds mature from late June to late September, depending on location. *Deschampsia beringensis* produces approximately 1,360,000 seeds per pound of seed.

Uses

Livestock: Bering Hairgrass can be utilized as hay or as a pasture crop. It is used by cattle, horses, and sheep. The palatability of Bering Hairgrass is moderate to low for most classes of livestock.

Wildlife: A large variety of wildlife utilize Bering Hairgrass for cover. Most wildlife will not typically utilize the species as often as domestic livestock. Bering Hairgrass has moderate to low palatability for elk, bison and moose.

Forage Value

Bering Hairgrass produces good quality hay for most classes of livestock and wildlife. Hairgrass provides ample amounts of protein, depending on its growing stage. Bering Hairgrass can provide good summer pasture forage, however most livestock find this grass unpalatable. As a result, an animal's diet may consist of only 1-3% Bering Hairgrass.

Distribution and Adaptation

Bering Hairgrass populations occupy moist to seasonally flooded, sunny environments. Bering Hairgrass is adapted to a pH range from 5.5 to 7.2. Salinity tolerance is generally low, but plants growing in coastal estuaries may be slightly more salt tolerant. Bering Hairgrass habitat includes coastal terraces, upper tidal marshes, seasonally wet prairies, and moist subalpine mountain meadows.

Culture

When planting Bering Hairgrass, seed should be planted ¼ to ½ inch deep. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcasting is 12 lbs/acre and 6 lbs/acre when drill seeding. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary. Irrigation in combination with fertilization should increase overall yields.

Management

Bering Hairgrass is adapted to coastal regions and is well suited for Alaska's maritime environments. One should be aware that Bering Hairgrass grows aggressively and tends to compete with other grass species. Several diseases are associated with Bering Hairgrass, including ergot, stripe smut, blind seed and several turf diseases. Hairgrass is also vulnerable to several leaf spots and rusts. Insect pests such as aphids, billbugs, and leafhoppers can threaten stands of Bering Hairgrass, and should be monitored.

Photo: Brennan Veith Low, AK PMC

Bering Hairgrass, Deschampsia beringensis

Cultivars and Releases

- **'Norcoast'** - *University of Alaska Fairbanks release.*

A W I SW SC SE

References

Wright, S.J. and P.K. Czapla (2010) Alaska Coastal Revegetation & Erosion Control Guide, State of Alaska, Division of Agriculture, Plant Materials Center, Anchorage, Alaska. 234 pp Link: http://plants.alaska.gov/reveg/

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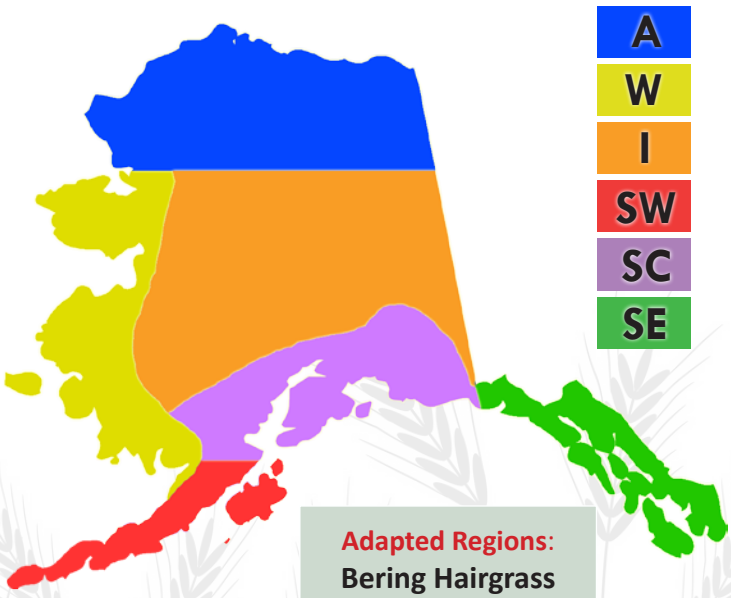
Natural Resource Conservation Service (2000) USDA National Plant Data Center [online] Link: http://plants.usda.gov/java/

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	1	3	3	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Adapted Regions:
Bering Hairgrass

- All Regions

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	20 - 24 in.	Native	Poor	Good	Good	Strong	5.5 - 7.2

BLUEJOINT REEDGRASS


Photo: Casey Dinkel, AK PMC

Bluejoint Reedgrass, Calamagrostis canadensis

Bluejoint Reedgrass

Calamagrostis canadensis (L.)

Description

Calamagrostis canadensis, Bluejoint Reedgrass is a tall, erect, cool season perennial grass that is found in wet meadows and prairies. The creeping rhizomes and rootstocks result in natural stands having a hummocky, uneven appearance. Erect culms are slender, not branched; grow to be 90 to 100 centimeters (36 to 40 inches) tall. Leaves are bluish green, elongated and very narrow; rough to the touch. The caryopses are ellipsoidal, yellow-brown, smooth, and about .76 to 1.27 mm (.03 -.05 inches) long. Inflorescence (seed-head) open panicle with single caryopsis borne in each spikelet (Barkley, 1986). Bluejoint flowers from June to August and is a typical wind pollinated species like most grasses. *Calamagrostis canadensis* produces approximately 2,720,000 seeds per pound of seed.

Uses

Livestock: Bluejoint may be used for hay or pasture land. Cattle, sheep and horses find this grass highly palatable during early growth prior to seedhead formation.

Wildlife: Bluejoint is utilized by bison, elk and deer, especially during the early portion of the growing season. It also has value as food and cover for waterfowl, small rodents, and some upland game birds.

Forage Value

Bluejoint furnishes excellent forage for livestock and some wildlife. As this grass matures, it quickly becomes tough and unpalatable, causing protein values to drop considerably and crude fiber content to increase. Bluejoint makes favorable hay and is palatable forage if managed properly. However, when putting effort and expense into seedbed preparation, one should consider growing more desirable forage grasses than Bluejoint Reedgrass. Seed availability is poor and prices are usually high for this species.

Distribution and Adaptation

Stands of Bluejoint can tolerate a thick build up of litter and mulch. This species can be found in highly organic peat and clay soils, but prefers a silty soil. Bluejoint is adapted to a wide range of temperatures (-40 °F to 105 °F) and precipitation regimes. It is extremely winter hardy.

Bluejoint has broad ecological adaptations; occurring in a wide range of environments - from lowland wetlands to wind-swept alpine ridges. The species has a wide pH tolerance (pH 4.5 to 8), from very acidic to moderately alkaline soils. Bluejoint can tolerate fresh to slightly brackish water.

Culture

An average broadcast seeding rate for Bluejoint is 6 - 8 lbs/acre. When drill seeding, 2 - 4 lbs/acre is appropriate. Fall seedings should be made at least 6 weeks before a killing frost is expected. Seedings should be drilled at a depth of $^{1}/_{4}$ inch and no deeper than $^{3}/_{8}$ of an inch if possible. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Bluejoint responds well to nitrogen, which has been shown to increase protein levels and overall forage yields. Pastures and hay fields should be irrigated when necessary. Irrigation, in combination with fertilization, should increase overall yields.

Management

Bluejoint is intolerant of heavy grazing and/or repeated harvests. Heavy trampling by livestock or wildlife can break the rhizomes and add to soil compaction in wetter areas. When over 40 percent of the plant is grazed, future yields can decrease by 15-20 percent. Harvesting should be restricted to a single cutting per growing season. When unfertilized and subjected to frequent grazing or harvest, Bluejoint stands are often damaged and persistence is poor.

Fertilized stands of Bluejoint may produce 2 or 3 times more total forage than unfertilized stands. Also, fertilized stands can produce 10-20% higher protein yields and are considered more palatable for livestock and wildlife. Problems can occur with virgin stands of Bluejoint Reedgrass due to the large amount of surface debris that can accumulate from previous years' growth. This hummocky layer can prevent top dressed fertilizers from reaching the living grass root zone. This layer can be removed by burning, blading, or mechanical mixing of the surface organic layer.

Several potential pests have been associated with Bluejoint Reedgrass throughout the lower 48 states and parts of Alaska. The nematode *Subanguina calamagrostis* invades the leaf tissue of the grass, forming galls that cause the leaves to become twisted and contorted. A fungus, *Dilophospora alopecuri*, can then invade the leaves of Bluejoint Reedgrass, using the entry wound caused by the aforementioned nematode.

Cultivars and Releases

- '**Sourdough**' - *University of Alaska Fairbanks release.*

A W I SW SC SE

Photo: Brennan Veith Low, AK PMC

A mature stand of Bluejoint Reedgrass

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Wright, S.J. and P.K. Czapla (2010) Alaska Coastal Revegetation & Erosion Control Guide, State of Alaska, Division of Agriculture, Plant Materials Center, Anchorage, Alaska. 234 pp Link: http://plants.alaska.gov/reveg/

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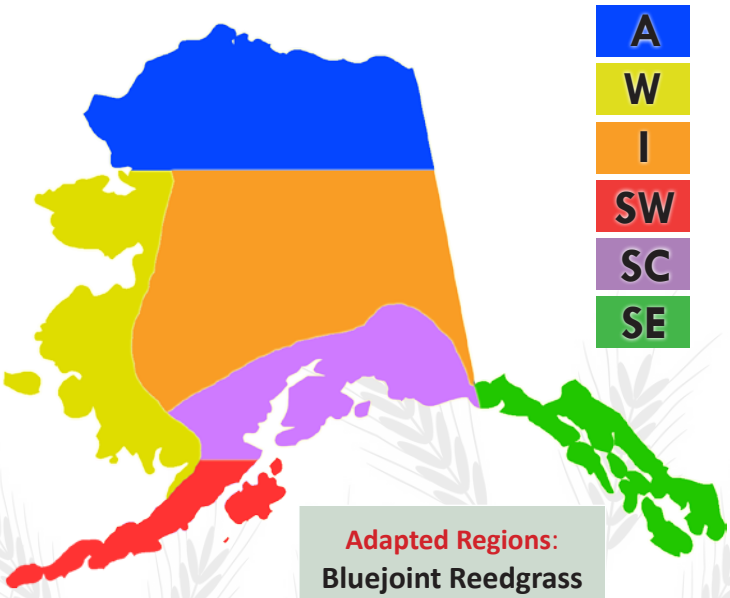

Adapted Regions:

Bluejoint Reedgrass

- All Regions

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	3	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Sod	36 - 40 in.	Native	Poor	Good	Good	Strong	4.5 - 8

KENTUCKY BLUEGRASS


Photo: Alaska PMC

Kentucky Bluegrass, Poa pratensis

Kentucky Bluegrass

Poa pratensis (L.)

Description

Poa pratensis (Kentucky bluegrass) is a perennial, cool-season, sod-forming grass native to Europe. This plant is about 45 to 60 centimeters (18 - 24 inches) tall, although this height falls to 10 to 15 cm (4 - 6 inches) when intensively grazed. Inflorescence (seed-head) has an open panicle and produces many small seeds. There are about 2,177,000 seeds per pound of seed.

Leaves are from 15 to 30 cm (6 to 12 inches) long, and boat-shaped (keeled) at the tips. Leaves are smooth, soft, and about 3 - 7 mm ($^1/_8$ to $^1/_4$ inch) wide. Kentucky bluegrass becomes dormant during the heat of summer, but regains its green color in fall. Growth starts early in the spring. Tiller buds develop into stems or rhizomes. New rhizomes also arise from nodes of older rhizomes. Most rhizomes will penetrate 2 to 4 inches into the soil, but some go down more than 5 inches.

Uses

Livestock: Kentucky bluegrass is typically used for pasture land rather than as a hay crop, due to its shorter growing height. It is highly palatable to cattle, horses and sheep early in the spring, before other plants begin to grow. Kentucky bluegrass produces relatively low yields compared to other pasture grasses.

Wildlife: Kentucky bluegrass is highly palatable to bison and elk. The tender plants are grazed immediately after growth begins, and the leaves remain succulent and green as long as soil moisture is present. *Poa pratensis* seeds are also eaten by several kinds of songbirds and rodents.

Forage Value

Kentucky bluegrass is excellent forage grass for most livestock and wildlife. It provides adequate nutritional value in the early spring before other plant species emerge. Once Kentucky bluegrass develops seed, the forage value and palatability drop considerably. Kentucky bluegrass is commonly used for pasture land, but considered undesirable for hay fields because of its low growth form, poor yield, and early maturity.

Distribution and Adaptation

Kentucky bluegrass is used throughout the U.S. It is best adapted to well-drained, fertile, medium-textured soils of limestone origin. Performance on poorly drained and heavy-textured soils is satisfactory. Favorable pH level for Kentucky bluegrass is between 6.0 and 7.5. Kentucky bluegrass grows best in humid areas. Optimum temperatures for forage production are between 60 °F and 90 °F. Kentucky bluegrass is essentially dormant during dry or excessively hot weather, allowing it to survive extreme temperatures. It grows best with direct sunlight, but will do well in the shade, so long as ample moisture and nutrients are available.

Culture

An average broadcast seeding rate for Kentucky bluegrass is 6 - 10 lbs/acre; a rate of 2 - 4 lbs/acre is used for drill seeding or when seeded in mixtures. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B. Kentucky bluegrass seed should be planted to a depth of $^1/_4$ inch to $^1/_2$ inch.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. A pasture containing Kentucky bluegrass should be irrigated when necessary. Irrigation in combination with fertilization should increase overall yields.

Management

Proper fertilization and liming are the most important phases of Kentucky bluegrass management. For pastures, grazing should begin when grass is about 5 inches tall. Kentucky bluegrass should not be grazed shorter than 1-$^1/_2$ to 2 inches. Otherwise, sod will become weedy and unproductive. When overgrazed, poor root and rhizome development occurs, allowing weeds and shrubs to invade the pasture.

Kentucky bluegrass is susceptible to attack by many diseases and insects. It is sometimes vulnerable to fungal infections, leaf spot, rust and powdery mildew. Depending on region, the grass is also susceptible to white grubs, billbugs, and sod webworms.

A field of Kentucky Bluegrass in southcentral Alaska

Cultivars and Releases

- '**Nugget**' - *released by University of Alaska Fairbanks.*

I SC SE

- '**Park**' - *released from Minnesota*

I SC SE

References

Wright, S.J. and P. Hunt (2008) A Revegetation Guide for Alaska, State of Alaska, Division of Agriculture, Plant Materials Center, Anchorage, Alaska. 160 pp Link: http://plants.alaska.gov/pdf/RevegManual.pdf

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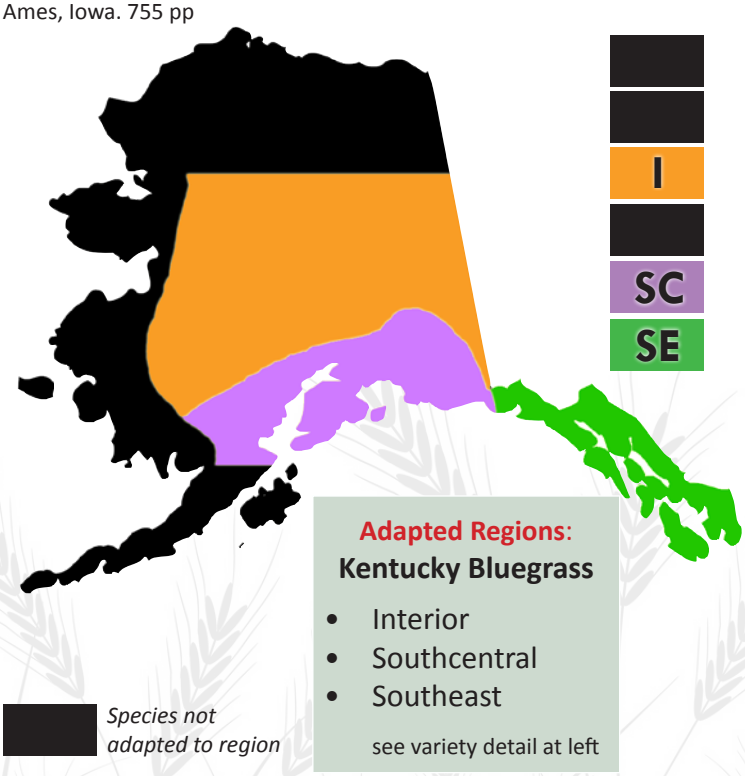
Maurice, E.H., D.S. Metcalfe and R.F. Barnes (1973) Forages, The Science of Grassland Agriculture. University of Iowa State, Iowa State University Press. Ames, Iowa. 755 pp

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	3	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Sod	18 - 24 in.	Introduced	Poor	Poor	Good	Moderate	6 - 7.5

MEADOW BARLEY

Photo: Casey Dinkel, AK PMC

Meadow Barley has a narrow panicle with a purplish hue.

Meadow Barley

Hordeum brachyantherum (L.)

Description

Hordeum brachyantherum (Meadow Barley) is a short to intermediate lived, cool season, perennial bunch grass. It grows semi erect to erect culms 38 - 75 centimeters (15 to 30 inches) in height. Leaves are green to bluish green, and are 3 to 6.5 mm (1/8 to 1/4 inch) wide. The inflorescence, or seed-head, is a narrow panicle that is 2.5 - 10 cm (1 to 4 inches) in length and often of purplish color. This grass produces a medium sized seed with good seedling vigor. Meadow Barley seed possesses bristle like awns and non-viable florets that should be removed for easier seed flow through planting machinery. Seed per pound can vary widely depending upon the degree of seed conditioning. Bulky seed may contain 30,000 to 100,000 seeds/lb, while highly processed seed can have upwards of 150,000 seeds per pound of seed.

Uses

Livestock: Meadow Barley can be used for pasture land or hay. It has moderate to low palatability for most classes of livestock. Palatability is higher if grazed in early spring before setting seed. Meadow Barley starts its growth in the early spring and matures in early to mid September.

Wildlife: Meadow Barley is considered to have low palatability for most large wildlife animals, such as elk, bison, and moose. However, deer are known to utilize Meadow Barley in the spring, when nutrient values are still high. Small mammals, song birds, and water fowl may use this grass for cover and food, throughout various stages of its life cycle.

Forage Value

Meadow Barley produces a marginal amount of protein and is utilized most often by large grazing animals in the early spring. As with most grasses, nutritional value and digestibility diminish substantially after seed development or without adequate moisture.

Distribution and Adaptation

Meadow Barley is adapted to cool climates and can be found growing in wet meadows, salt marshes, along beaches, and riparian areas. This grass is adapted to finer textured soils like silts and clays but can also tolerate coarser textured soils that have adequate moisture. It prefers soils with a pH of 6.0 - 8.5, and will not persist well in acidic environments. Meadow Barley has a moderate tolerance to drought conditions. It can also tolerate low nutrient and high saline soils.

Culture

Meadow Barley seed should be planted ¼ to ½ inch deep when drill seeded. This grass establishes easily and has high seedling vigor. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcast seeding is 4-8 lbs/acre, or 2-4 lbs/acre when drill seeding. When seeded in a mixture, apply at a rate of 4-6 lbs/acre. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary. Irrigation, in combination with fertilization, should increase overall yields.

Management

Meadow Barley is responsive to irrigation and should be irrigated if planted on drier sites. It does not respond well to heavy grazing and pasture deferment should be considered for healthy stands to persist. This grass may be susceptible to several fungal diseases such as head smut and/or leaf and stem rust. Meadow Barley's bristly awn can cause harm to some animals by working its way into the nose, mouth, and intestine.

Photo: Brennan Veith Low, AK PMC

Meadow Barley, Hordeum brachyantherum

Cultivars and Releases

- **Lowell Point** selected class germplasm;
  - Alaska PMC release.

W SW SC SE

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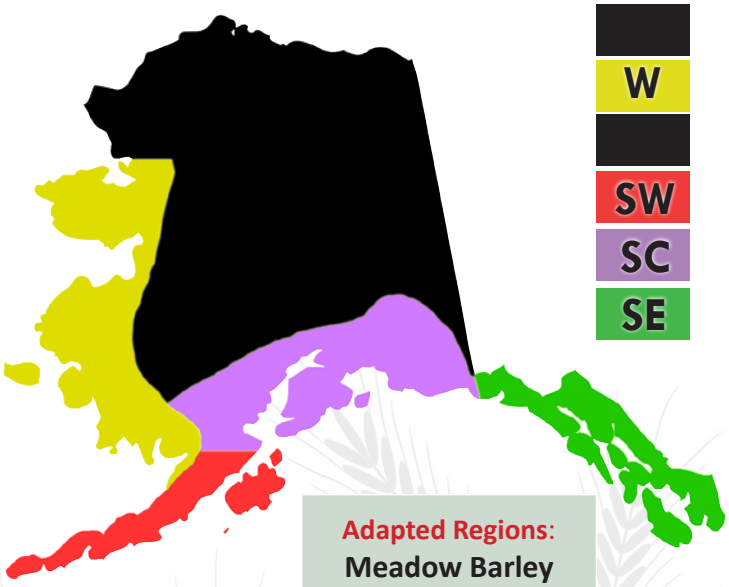
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	1	3	3	2

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Adapted Regions:
Meadow Barley

- Western
- Southwest
- Southcentral
- Southeast

Species not adapted to region

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Bunch	24 in.	Native	Good	Good	Good	Weak	6.0 - 8.5

MEADOW FOXTAIL

Meadow Foxtail, Alopecurus pratensis

Meadow Foxtail

Alopecurus pratensis (L.)

Description

Alopecurus pratensis (Meadow Foxtail) is a long lived, cool season, perennial bunch grass. It grows decumbent or erect culms 30 to 50 centimeters (12 to 20 inches) tall. Leaves vary in length from 5 to 30 cm (2 - 12 inches), and are roughly 6 to 13 mm (1/4 to 1/2 inch wide). Meadow Foxtail's inflorescence is a dense panicle and is 2.5 to 7.5 cm (1 to 3 inches) in length, and usually about 6 to 13 mm (1/4 to 1/2 inch) wide. This grass produces a medium size seed, which retains a hairy pubescence making it light and/or fluffy. Once established, Meadow Foxtail has high seedling vigor. Meadow Foxtail produces approximately 406,000 seeds per pound of seed.

Uses

Livestock: Meadow Foxtail can be used for pasture, hay, or silage. It is highly palatable to all classes of livestock, such as cattle, sheep, and horses. Meadow Foxtail starts its growth in early spring and provides livestock with adequate forage.

Wildlife: Meadow Foxtail has moderate palatability for most classes of wildlife. Grazers such as elk and bison tend to select Meadow Foxtail more often than moose. It is also utilized by small mammals and song birds.

Forage Value

Meadow Foxtail produces moderate amounts of protein and is excellent quality forage for large grazing animals. It possesses good nutritional value and digestibility similar to that of Timothy (*Phleum pretense*). Browsers such as moose do not find Meadow Foxtail to be as palatable as do grazing animals like cattle, bison and elk. As with most grasses, nutritional value diminishes substantially after seed development or without adequate moisture.

Distribution and Adaptation

Meadow Foxtail is adapted to cool, wet climates. It can be found growing in hay meadows, irrigation ditches, and along stream banks. Meadow Foxtail prefers fine-textured or poorly drained soils, such as silts and clays. This grass performs well in soils with a pH ranging from 5.8 to 8.0. Meadow Foxtail has a moderate tolerance to droughty and saline environments. *Alopecurus pratensis* can be found growing throughout most of Alaska, and portions of Canada and the United States.

Culture

Meadow Foxtail seed should be planted a ¼ to ½ inch deep, when drill seeded. This grass can be difficult to establish, but once in place seedling vigor is considered high. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcasting is 4-8 lbs/acre and 2-4 lbs/acre when drill seeding. When Meadow Foxtail is seeded in a mixture, apply at a rate of 4-6 lbs/acre. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation in combination with fertilization should increase overall yields.

Management

Meadow Foxtail makes an excellent pasture, hay, or silage forage crop. It is less winter-hardy than Smooth Brome (*Bromus inermis*) but is more tolerant of acidic soils. Meadow Foxtail is found in areas with milder winters and more acidic soils, such as the Kenai Peninsula. Meadow Foxtail can be problematic when planting with a drill seeder, due to the hairy pubescence that remains on the seed after cleaning. To reduce mechanical problems, Meadow Foxtail can be planted along with other grass or legume species. It responds well to grazing as long as there is ample moisture. At present, there are no major pests in Alaska that threaten Meadow Foxtail.

Photo: Paul Slichter, Pacific Northwest Wildflowers

A mature stand of Meadow Foxtail

Cultivars and Releases

- There are no developed northern cultivars or releases of Meadow Foxtail at present.

References

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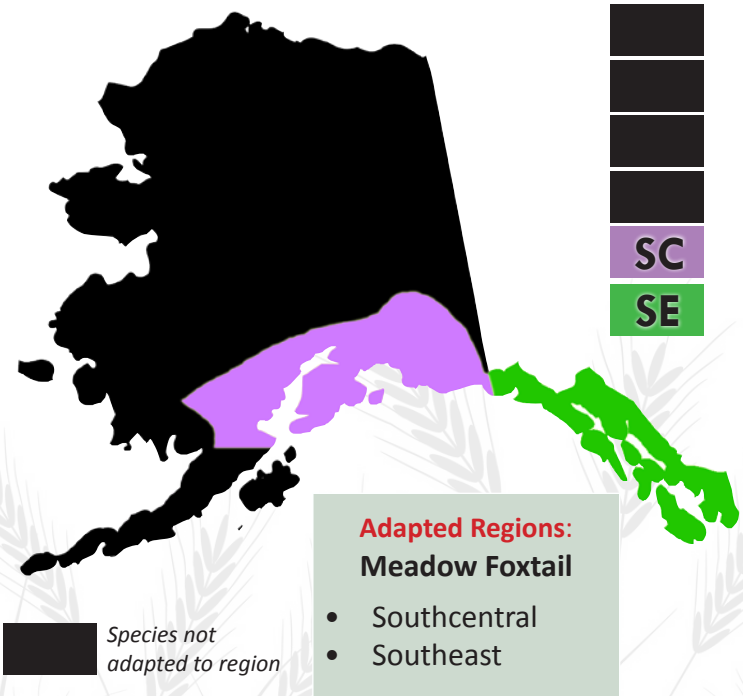
OSU Rangeland Ecology and Management (2005) Meadow Foxtail Plant Characteristics [online] Link: http://oregonstate.edu/dept/range/sites/default/files/Meadow_20Foxtail.pdf

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	1	3	3	2

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Bunch	12 - 20 in.	Introduced	Good	Good	Excellent	Strong	5.8 - 8.0

POLARGRASS

Polargrass, Arctagrostis latifolia

Polargrass

Arctagrostis latifolia (L.)

Description

Arctagrostis latifolia (Polargrass) is a long lived, cool season, perennial, sod forming grass. It grows erect culms 45 to 60 centimeters (18 to 24 inches) tall. Polargrass leaves vary in length from a few inches to a foot and are usually 6 to 13 mm ($^1/_4$ - $^1/_2$ inch) wide. Inflorescence (seed-head) is narrow to somewhat open panicle 8 to 28 cm (3 to 11 inches) in length. Polargrass has low seedling vigor and produces a small seed with about 1,800,000 seeds per pound of seed.

Uses

Livestock: Polargrass can be used for pasture, hay, or silage. This grass is capable of generating high yields and can provide livestock with adequate forage and nutrition.

Wildlife: Polargrass has shown to provide good forage for caribou and reindeer in northern regions throughout Canada and Alaska. Grizzly bears have been observed grazing large quantities of polargrass during spring and summer months. It also provides cover and forage for small mammals and various song birds.

Forage Value

Polargrass produces large amounts of protein and is a high quality forage for large grazing animals. It possesses good nutritional value and digestibility similar to that of Timothy (*Phleum pratense*). Browsers such as moose and deer do not find Polargrass to be as palatable as grazing animals like cattle, bison and elk. As with most grasses, the nutritional value of Polargrass diminishes substantially after seed development or without adequate moisture.

Distribution and Adaptation

Polargrass is adapted to cool, wet climates, and is found growing along rivers, meadows, tundra, fresh water marshes, and inland levees. It is adapted to cold boggy soils and/or mesic up lands. This grass will grow well in soils with a pH ranging from 4.9 to 6.8. Polargrass is intolerant to droughty and/or saline environments. It prefers northern latitudes and can be found growing in portions of Greenland, Canada, and Alaska.

Culture

Polargrass seed should be planted ¼ to ½ inch deep. Low seedling vigor can make this grass difficult to establish. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate when broadcasting Polargrass is 8 lbs/acre and 5 lbs/acre when drill seeding. Seeding Polargrass as part of a mix is not recommended because of the grass's weak ability to compete with other plants. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary. Irrigation in combination with fertilization should increase overall yields.

Management

Polargrass seedling vigor is poor and early growth rates are usually slow. It requires an environment with low competition, moderate moisture, and adequate nutrients. However, once Polargrass is established, it has early and vigorous spring growth. Production trials of unfertilized vs. fertilized Polargrass have shown the differences in yield to be insignificant, suggesting that Polargrass does not respond well to commercial fertilizers. More research needs to be conducted to validate this theory, however.

Polargrass requires moderate amounts of moisture and should be irrigated when applicable. *Arctagrostis latifolia* is an extremely winter hardy grass, with a greater tolerance to winter ponding and icy conditions than other forage grasses like Timothy (*Phleum pratense*) and Smooth Brome (*Bromus inermis*).

Photo: USDA Natural Resource Conservation Service

A field of Polargrass, Arctagrostis latifolia

Cultivars and Releases

- '**Kenai**' - *University of Alaska Fairbanks release.*

  A W I SW SC SE

- '**Alyeska**' - *University of Alaska Fairbanks release.*

  A W I SW SC SE

References

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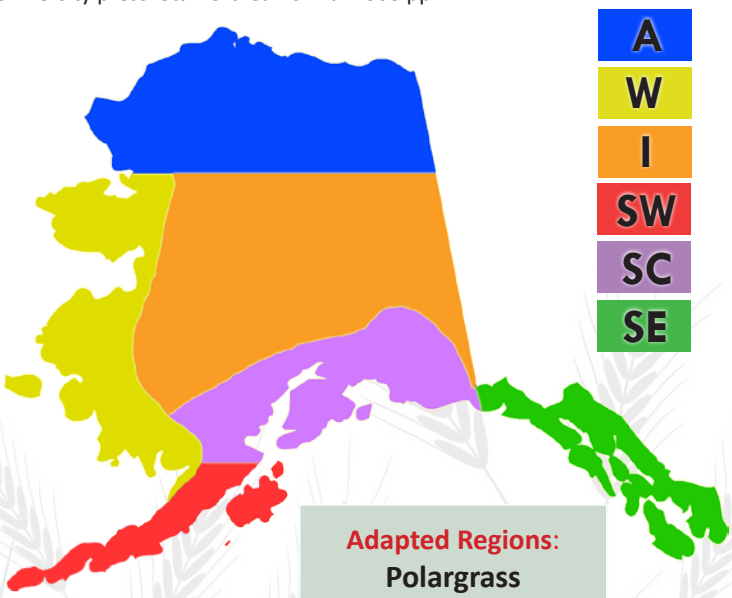
Hulten, E. (1968) Flora of Alaska and Neighboring Territories. Stanford University press. Stanford California. 1008 pp

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	1	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Adapted Regions:
Polargrass

- All Regions

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Sod	24 in.	Native	Poor	Good	Excellent	Poor	4.9 - 6.8

RED FESCUE


Photo: Brennan Veith Low, AK PMC

Red Fescue is a winter-hardy grass, adapted for use across Alaska.

Red Fescue

Festuca rubra (L.)

Description

Festuca rubra (Red Fescue) is a cool season, introduced, sod-forming grass. Leaves of Red Fescue are bright green, wiry, and narrow. They are pressed together in a "V" shape and appear nearly round. Sheaths reddish or purplish at base, culms sometimes bent and growing to about 35 - 46 centimeters (14 - 18 inches) tall. The inflorescence (seed-head) is a contracted and/or narrow panicle. Red Fescue produces about 410,000 seeds per pound of seed.

Uses

Livestock: Red Fescue is used for hay, pasture land, or silage. It is also utilized by cattle and horses. In some cases, Red Fescue will make up 10-15% of domestic sheep diets.

Wildlife: Red Fescue is consumed by deer, moose, elk and a variety of other wild ungulates. It is also great forage for upland game birds and various species of water fowl such as the lesser Canada goose.

Forage Value

The forage value of Red Fescue ranges from fair to good, depending on geographic location. It possesses fair nutritional value, even after freeze-up, until snow becomes too deep for grazing. Red Fescue is also known to retain high protein values throughout its growth stage.

Distribution and Adaptation

Red Fescue is hardy, wear-resistant, and shade tolerant. This grass is adapted to wet, acidic environments. It prefers well drained soils with a pH between 5 and 7.5, but requires ample moisture to become established. Red Fescue is adapted to cooler zones.

In areas of high temperatures and humidity, Red Fescue may turn brown or deteriorate during the summer months. This grass will generally recover in the fall when temperature and moisture conditions are more favorable. Red Fescue is highly competitive and is found all over North America.

Culture

When planting Red Fescue, seed should be planted ¼ to ½ inch deep. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcasting Red Fescue is 12 lbs/acre and 6 lbs/acre when drill seeding. Seeding rate calculations are based on Pure Live Seed (PLS), as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Fertilization, combined with irrigation, may increase overall yields.

Management

One should be aware of Red Fescue's aggressiveness and ability to out-compete other plants. It is not uncommon for Red Fescue to dominate a growing site even when planted in a mix with other grass species. This should be considered when formulating a forage seeding mix. Red Fescue can also be used to prevent the invasion of alders and willows.

References

Wright, S.J. and P.K. Czapla (2010) Alaska Coastal Revegetation & Erosion Control Guide, State of Alaska, Division of Agriculture, Plant Materials Center, Anchorage, Alaska. 234 pp. Link: http://plants.alaska.gov/reveg/

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Photo: Alaska PMC

A field of Red Fescue in southcentral Alaska

Varieties and Releases

- '**Arctared**' - *University of Alaska Fairbanks release.*

  A W I SW SC SE

- '**Boreal**' - *Alberta, Canada release.*

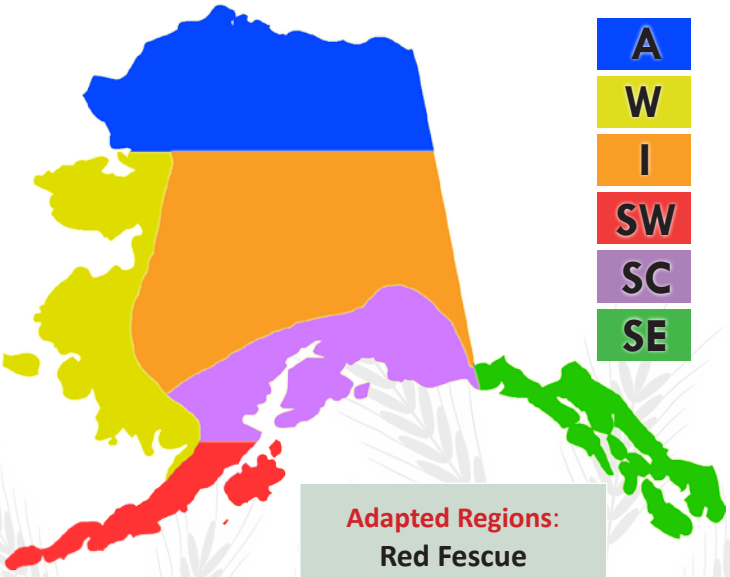
  [redacted] W I SW SC SE

- '**Pennlawn**' - *Pennsylvania release.*

  [redacted] [redacted] [redacted] SW SC SE

- **Henderson Ridge** selected class germplasm; - *Alaska PMC release.*

  [redacted] [redacted] [redacted] SW SC [redacted]



[redacted] *Species not adapted to region*

Adapted Regions:
Red Fescue

- All Regions

see variety detail at left

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
1	2	3	3	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor - Good	Sod	14 - 18 in.	Introduced	Poor	Good	Good	Strong	5 - 7.5

SIBERIAN WILDRYE


Photo: Casey Dinkel, AK PMC

Siberian Wildrye seedhead

Siberian Wildrye

Elymus sibiricus (L.)

Description

Elymus sibiricus (Siberian Wildrye) is a tall growing, erect perennial bunchgrass, that grows from 75 - 90 centimeters (30 to 36 inches) in height. It is a cool season species native to fragmented intermountain areas. Siberian Wildrye can be easily identified by its long, lax, drooping seedhead. This grass species produces an abundance of seed, and has a conspicuous ability to grow in open, unshaded and infertile sites. Siberian Wildrye is known for its extreme winter hardiness and excellent seedling vigor. It produces approximately 127,000 seeds per pound of seed.

Uses

Livestock: Siberian Wildrye can be utilized as hay or as a pasture crop. It is used by cattle, horses, and sheep. The palatability of Siberian Wildrye is moderate to low for most classes of livestock.

Wildlife: A large variety of wildlife utilize Siberian Wildyre for cover. Most wildlife will not typically utilize this grass for feed as often as domestic livestock. Siberian Wildrye has low palatability for elk, bison and various species of waterfowl.

Forage Value

Siberian Wildrye has marginal forage quality. This grass also has poor digestibility due to large amounts of lignin, cellulose and hemicellulose. It has a protein content similar to Polar Brome (*Bromus inermis*), Slender Wheatgrass (*Elymus trachycaulus*), and Timothy (*Phleum pratense*), after the first year of establishment. Like most forage grasses, Siberian Wildrye nutrient levels are highest just before the plant develops its seedhead. There is limited Siberian Wildrye research data available concerning actual nutritional value, palatability, and grazing utilization.

Distribution and Adaptation

Siberian Wildrye is distributed across Europe, Asia, Russia, and parts of Canada and Alaska. It can be found growing in sandy soils, in areas receiving between 24 and 55 inches of annual precipitation. Siberian Wildrye is a very drought tolerant species and will not grow well in wet areas or areas with poorly drained soils. The grass is adapted to slightly acid to neutral soils, with a pH range from 5.0 to 7.2. Siberian Wildrye will not tolerate saline soils or shaded environments.

Culture

An average broadcast seeding rate for Siberian Wildrye is 12 lbs/acre. A rate of 6 lbs/acre should be used when drill seeding or when seeded in a mixture. Siberian Wildrye seeds should be planted at a depth of $^{1}/_{4}$ in. to 1 in. Seed should be planted in medium to coarse textured, well drained soil if possible. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Little information is available regarding the effect fertilizer and irrigation may have on Siberian Wildrye yields.

Management

Siberian Wildrye appears to be a good forage species, although more research is needed to determine its overall value. There are several potential problems for growers dealing with Siberian Wildrye. This grass possesses a needle like appendage or awn that could potentially be harmful to livestock. Siberian Wildrye should not be grazed within the first year of its planting. Grazing could potentially destroy or diminish its life span. During its first year of growth, Siberian Wildrye does not produce a high overall yield. There has been little research into pests (such as insects, mildews, or rust) that could be harmful to Siberian Wildrye.

Photo: Casey Dinkel, AK PMC

A field of Siberian Wildrye in southcentral Alaska.

Cultivars and Releases

- *There are no commercial Siberian Wildrye cultivars or releases currently available.*

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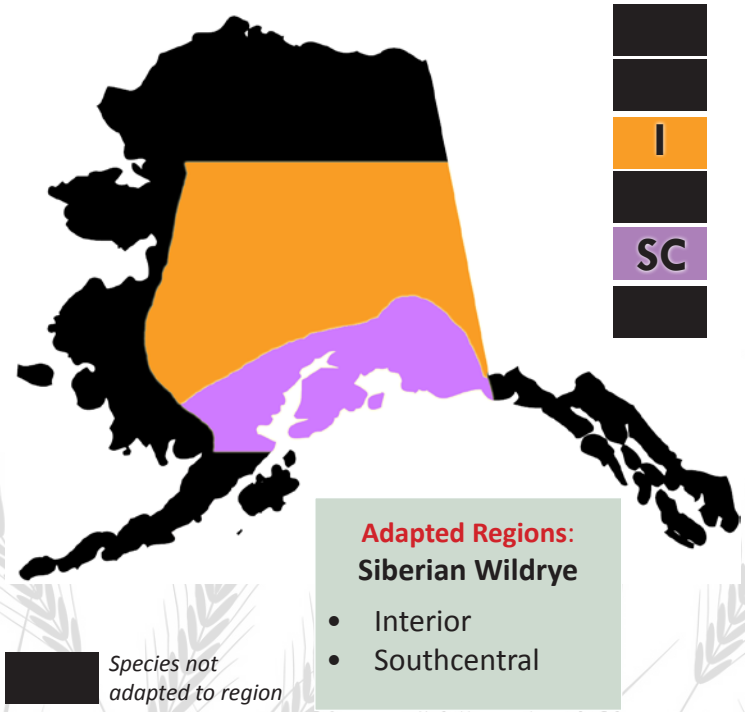
Klebesadel, L.J. (1993) Winterhardiness and Agronomic Performance of Wildryes Compared with Other Grasses In Alaska, and the Responses of Siberian Wildrye to Management Practices. Agricultural and Forestry Experiment Station, University of Alaska. Palmer, Alaska. 19 pp.

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
1	2	2	1	0

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Bunch	36 in.	Disputed	Poor	Good	Poor	Moderate	5.0 - 7.2

SLENDER WHEATGRASS

Photo: Brennan Veith Low, AK PMC

Slender Wheatgrass seed head

Slender Wheatgrass

Elymus trachycaulus (L.)

Description

Elymus trachycaulus (Slender Wheatgrass) is an erect, tufted bunchgrass ranging in height from 60 to 70 centimeters (24 to 30 inches). It is a cool season, perennial species native to the mountain and intermountain areas of the western United States and the northern Great Plains. Slender Wheatgrass has very short rhizomes and the seedstalks and stems have characteristic reddish to purplish tinge at the base. It is seldom found in pure stands and is relatively short lived with a life expectancy of only 4-6 years. Slender Wheatgrass has about 133,000 seeds per pound of seed.

Uses

Livestock: Slender Wheatgrass can be used for hay or pasture land. It's highly palatable to cattle and sheep, and provides good quality animal fodder.

Wildlife: Slender Wheatgrass is utilized by buffalo, elk, moose, mountain goat and dall sheep throughout Alaska. It is also used as forage and cover for some songbirds, upland game birds, small mammals, and waterfowl.

Forage Value

Slender Wheatgrass is valuable forage for most classes of livestock and wildlife. It is generally considered to have a good energy value and high protein content compared to other grasses. Slender Wheatgrass produces good quality hay if managed properly.

Distribution and Adaptation

Slender Wheatgrass is widely distributed across North America. Its range extends from Alaska to Newfoundland and south to North Carolina, Kentucky, Arkansas, Texas, and western Mexico. Slender Wheatgrass has been found growing at elevations from 4,500 to 12,000 feet. It prefers loams to sandy loams in areas receiving at least 14 inches of annual precipitation. Slender Wheatgrass is a drought tolerant species, but may still succumb to drought, since it sometimes matures later in the fall. The grass is adapted to slightly acid to slightly alkaline soils, growing in soils with a pH ranging from 5.6 to 9.0. Considerable genetic variability is present in Slender Wheatgrass populations, and some ecotypes may be rather specific to their original sites.

Culture

An average broadcast seeding rate for Slender Wheatgrass is 10 lbs/acre, or 5 lbs/acre used when drill seeded or included in mixtures. Seeding depth should be $^{1}/_{4}$ to $^{3}/_{4}$ inch. Seed should be planted in fine to medium textured well drained soil if possible. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures containing Slender Wheatgrass should be irrigated when necessary and/or applicable. Irrigation in combination with fertilization should increase overall yields.

Management

Slender Wheatgrass is best suited as a filler seed in mixtures containing slower establishing, longer lived grass species. It performs well when grown in combination with legumes. Slender Wheatgrass is moderately tolerant to grazing pressure, and requires good management to maintain stands. It is also considered to be a decreaser species on over grazed rangelands.

When choosing Slender Wheatgrass as forage in Alaska, one should highly consider planting a cultivar or release that is adapted to the climate in which the plants will become established.

Photo: Casey Dinkel, AK PMC

Slender Wheatgrass is an excellent drought-tolerant forage crop.

Cultivars and Releases

- **Wainwright** selected class germplasm;
  - Alaska PMC release.

  W I SW SC

- **'Revenue'** *- Canada release.*

  W I SW SC

- **'Primar'** *- released from Oregon and Washington.*

  W I SW SC

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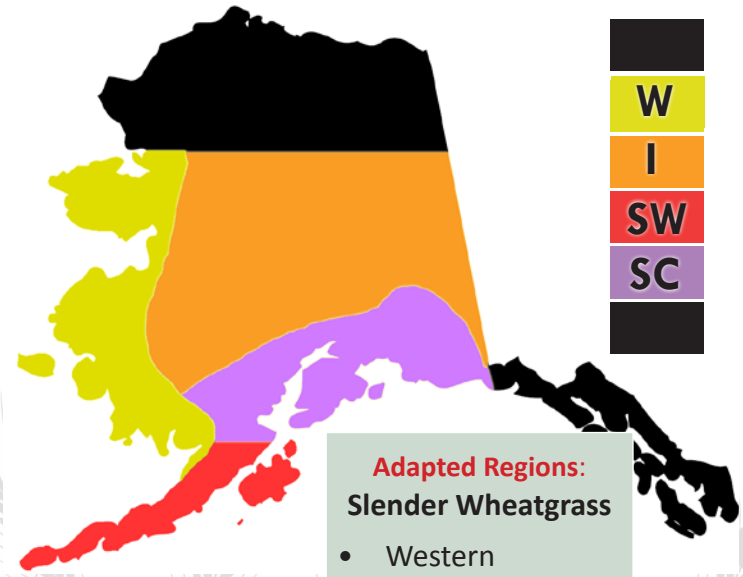
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	0

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	24 - 30 in.	Native	Excellent	Excellent	Good	Strong	5.6 - 9

SMOOTH BROME


Photo: Casey Dinkel, AK PMC

Smooth Brome is resistant to drought and temperature extremes.

Smooth Brome

Bromus inermis (L.)

Description

Bromus inermis (Smooth Brome) is a sod-forming perennial cool season grass that spreads by rhizomes. Culms vary from 30 to 45 centimeters (12 to 18 inches) in height on average. This plant produces numerous basal and stem leaves that vary in length from 10 to 25 cm (4 to 10 inches). Frequently, Smooth Brome leaves are marked by a transverse wrinkle resembling a "W" a short distance below the leaf tip. The inflorescence develops a characteristic rich purplish-brown color when mature. Brome seed is produced in semi-compact, 127 mm (5 inch) long panicles with ascending branches. The flat compressed seed is usually awnless, about 8.5 mm ($^1/_3$ inch) long, and smooth. Smooth Brome is the most widely used of the cultivated brome grasses. It produces approximately 142,000 seeds per pound of seed.

Uses

Livestock: Smooth Brome is used for hay, pasture, and/or silage. Cattle, sheep and horses find this grass highly palatable during the early growth stage, as well as late in the year after fall green-up.

Wildlife: Smooth Brome is used by wildlife to varying degrees, depending upon the quality of the grass and the animal species. Elk and Bison use it as winter forage. Upland game birds and waterfowl use Smooth Brome for nesting cover and rearing their brood. Rodents such as voles and shrews use it for food and cover throughout the year.

Forage Value

If grazed before flowering, Smooth Brome is high in protein with relatively low crude-fiber content. Forage value decreases rapidly with maturity, once seed is produced. Northern varieties of Smooth Brome produce less forage on average than southern varieties, but are just as palatable for livestock and wildlife.

Distribution and Adaptation

Smooth Brome is adapted to cool climates. It is resistant to drought and extremes in temperature. It is a long lived grass, living 5 to 7 years on average, but can live as long as 10 years or more. This plant is very susceptible to disease in areas of high humidity. Smooth Brome grows best on well drained silt and clay loam soils with high fertility. It will also grow well on lighter textured soils where adequate moisture and fertility are maintained. Smooth Brome performs best in a slightly acid to slightly alkaline environment (pH range of 6.0 to 7.5). Stands are difficult to obtain and growth is poor on soils high in soluble salts.

Smooth Brome's range of distribution is centered within the corn belt of North America and includes portions of Canada and Alaska. Depending on variety, this grass can grow in several regions of Alaska, as far north as Fairbanks.

Culture

Due to slow rates of germination and establishment, Smooth Brome requires a clean, firm seedbed. An average seeding rate for broadcast seeding is 20-25 lbs/acre, 10-15 lbs/acre when drill seeding. If seeded as part of a mixture, 5-10 lbs/acre should be used. When seeding in the fall, make sure to have seed in the ground at least six weeks prior to the first expected frost. Seedings should be drilled at a depth of $^1/_2$ to $^3/_4$ inch. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios for Smooth Brome depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation, in combination with fertilization, should increase overall yields.

Management

Smooth Brome requires heavy applications of nitrogen in early spring and in fall to maintain high yields in a pure stand. Optimum forage production is obtained when brome is used in a planned cropping system and plowed out after 3 to 4 years. Smooth Brome's heavy sod makes it an excellent soil-conditioning crop, when included in cropping systems. In deep, well-drained soils it will root to 4 feet. Smooth Brome performs best in grassed waterways, field borders, and other conservation uses, where the forage can be cut and removed while in early bloom.

Pastures should not be grazed prior to attaining a minimum height of about 10 inches at the beginning of the grazing season. Grazing pressures should be adjusted throughout the season to avoid grazing this grass below a minimum height of 4 inches.

Grasshoppers and seed blight can be a factor during grass establishment, in semi-humid areas. Foliar diseases in humid areas have also been known to cause serious problems. Smooth Brome can be dramatically affected by seed midges, such as *Stenodiplosis bromicola*, in some northern areas.

Cultivars and Releases

- '**Carlton**' - *Western Canada release.*

- '**Manchar**' - *Washington release.*

- **'Polar' -** *Alaska developed 'Polar' Brome may become commercially available in the future. Check with the Alaska Plant Materials Center for further detail.*

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Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
1	3	3	3	2

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Photo: Alaska PMC

Smooth brome, Bromus inermis

Klebesadel, L.J. (1992) Bromegrass in Alaska. I. Winter Survival and Forage Productivity of Bromus Species, Types, and Cultivars as Related to Latitudinal Adaptation, University of Alaska Fairbanks, School of Agriculture and Land Resources Management, Bulletin 87, 13 pp

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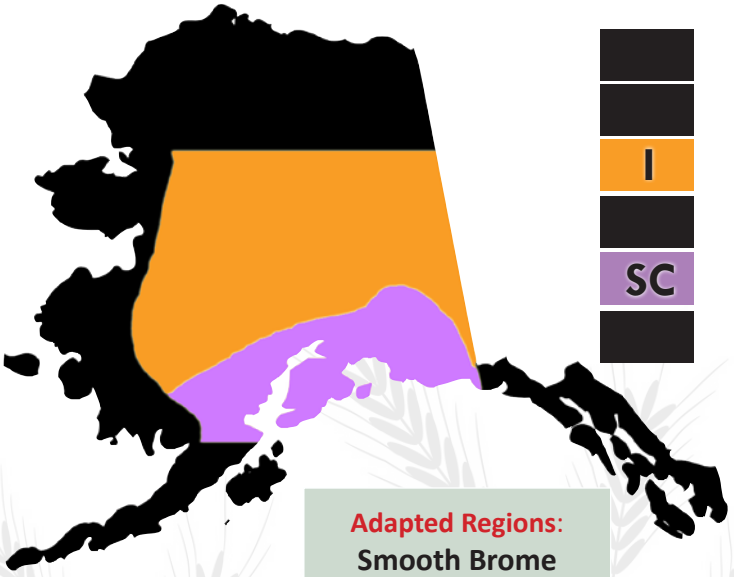

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Sod	12 - 18 in.	Introduced	Poor	Good	Fair	Strong	6.0 - 7.5

SPIKE TRISETUM

Photo: Natural Resource Conservation Service (NRCS)

Spike Trisetum seed head

Spike Trisetum

Trisetum spicatum (L.)

Description

Trisetum spicatum (Spike Trisetum) is a relatively short-lived, cool-season perennial bunch grass. It grows erect culms 50 to 75 centimeters (20 to 30 inches) tall. Leaves are usually flat to folded, and 2.5 to 13 cm (1 to 5 inches) in length. The inflorescence is also 2.5 to 13 cm (1 to 5 inches) long, narrow, dense, and sometimes purplish green. Spike Trisetum seed is small, with about 2,000,000 seeds per pound of seed. Spike Trisetum has a high root/shoot ratio in comparison with other grasses.

Uses

Livestock: Spike Trisetum is commonly used for pasture. It is considered highly palatable for all classes of livestock. When used for hay, Spike Trisetum provides nutritious forage for cattle, sheep, and horses.

Wildlife: Big game animals such as bison, elk, and deer, commonly utilize Spike Trisetum throughout its growing season. This grass is highly palatable to all classes of wildlife.

Forage Value

Spike Trisetum produces excellent quality forage for all classes of livestock and large wildlife, though it does not respond well to heavy grazing pressure. It is highly palatable to browse and grazing animals, and produces large amounts of protein in comparison to other grasses. Spike Trisetum has good digestibility and is considered to be an important grass for mountainous regions.

Distribution and Adaptation

Spike Trisetum is adapted to medium textured or well drained soils, and prefers a pH range of 4.9 to 7.5. It is found growing on drier areas of mountain meadows, roadsides, clear cuts, and is distributed almost worldwide. Spike Trisetum is tolerant of prolonged periods of drought or moisture, though it will not persist under conditions of high salinity.

Culture

Spike Trisetum seeds should be planted from ¼ to ½ inch deep. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcast seeding is 6 - 12 lbs/acre and 4 - 6 lbs/acre when drill seeding. When seeded in a mixture, apply at a rate of 2 - 4 lbs/acre. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation in combination with fertilization should increase overall yields.

Management

Spike Trisetum starts its growth in early spring. Like many grasses, its protein values diminish upon setting seed. Spike Trisetum does not respond well to heavy grazing pressure. Precaution should be taken not to over graze this grass. Spike Trisetum will stay green well into August or until covered by snow. It seldom occurs in dense stands, but usually cures well when cut for hay. Seed can be damaged more easily than most other grasses due to a liquid endosperm. Care should be taken when drill seeding to limit seed damage. At present, there are no known pests that are a concern for Spike Trisetum.

Photo: Casey Dinkel, AK PMC

A mature stand of Spike Trisetum

Cultivars and Releases

- **Nelchina** - selected class germplasm; *Alaska PMC release.*

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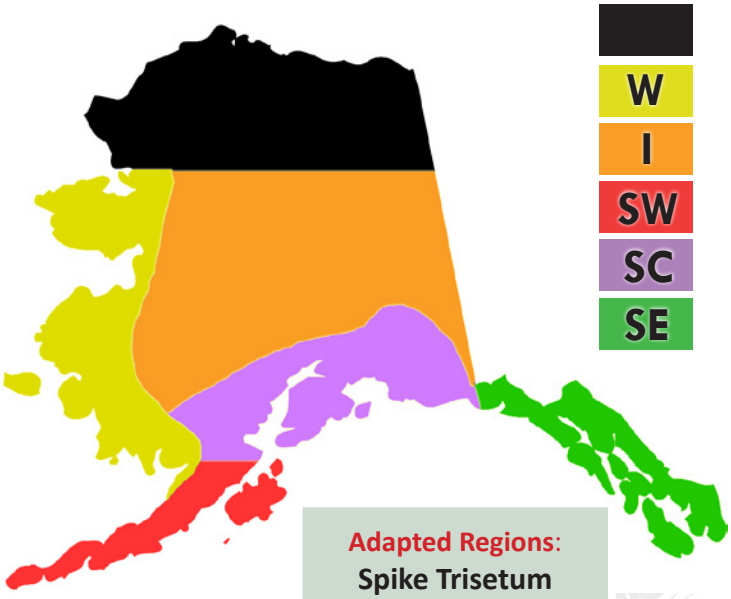

Species not adapted to region

Adapted Regions:
Spike Trisetum

- Western
- Interior
- Southwest
- Southcentral
- Southeast

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
1	2	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Bunch	20 - 30 in.	Native	Poor	Good	Good	Strong	4.9 - 7.5

TIMOTHY


Photo: Casey Dinkel, AK PMC

Timothy seed head

Timothy

Phleum pratense (L.)

Description

Phleum pratense, Timothy is a relatively short-lived, cool-season perennial bunch grass that grows in stools or clumps and has a shallow, compact, and fibrous root system. It grows in erect culms 50 to 100 centimeters (20 to 40 inches) tall. Leaves vary in length from 5 to 30 cm (2 to 12 inches) and are about ($^1/_4$ inch) wide, narrowing gently toward the tip. Heads spike-like and dense, from 5 to 15 cm (2 to 6 inches) in length. The seed is very small and usually remains enclosed within the glumes. Timothy produces approximately 1,230,000 seeds per pound of seed. Timothy is different from most other grasses in that 1, or occasionally 2, of the basal internodes of the stem swell into a bulb-like growth. This characteristic is often used to identify the plant during its early stages of growth.

Uses

Livestock: Timothy is used for pasture and silage, but mostly for hay. It is palatable and nutritious for cattle and sheep, and also makes excellent hay for horses. Timothy is considered good forage for cattle and horses during the spring, summer, and fall. When being grazed by sheep it is considered good forage during the summer and fair during the spring and fall.

Wildlife: Big game animals such as bison, elk and deer commonly utilize Timothy throughout its growing season. Some studies have shown that Timothy makes up to 20% of bison and elk diets. Small mammals, song birds, upland game birds and waterfowl will also use Timothy for nesting, brood rearing and escape cover.

Forage Value

Timothy produces good quality hay for most classes of livestock and wildlife. It also provides ample amounts of protein within the first 25 days of its growing cycle. Once Timothy is mature, crude protein values and digestibility diminishes greatly, a fact that should be considered when producing a hay crop. After the first hay cutting, Timothy can provide good late summer and early fall pasture forage.

Distribution and Adaptation

Timothy is adapted to a cool, humid climate. Timothy thrives in rich moist bottomlands and on finer textured soils, such as clay loams. It does not do well on coarser soils. Timothy prefers a pH of 5.5 to 7.0. Timothy will grow for a time on soils low in fertility, but it is better adapted to high fertile soil. It is not well adapted to wet, flat land where water stands for any considerable time, although it can withstand somewhat poorly-drained soils. Under conditions of limited moisture, Timothy performs poorly; it does not tolerate drought or prolonged high temperatures. Timothy is distributed throughout the entire United States.

Culture

When planting Timothy, seeds should be planted a ½ inch deep in moist soil, and ¾ inch in dry or coarse textured soils. It is commonly planted in mixtures with legumes or small grains. Seeding rates for Timothy depend greatly upon soil type, moisture, and location. An average seeding rate for broadcasting is 4-8 lbs/acre, and 2-4 lbs/acre when drill seeding. When Timothy is seeded in a mixture, apply at a rate of 4-6 lbs/acre. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Timothy is highly responsive to fertilizers and should be fertilized frequently and in ample quantities. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation in combination with fertilization should increase overall yields.

Management

Timothy makes a first rate companion grass for alfalfa, trefoil, or clover as it is the grass that competes least with legumes. Over 31 diseases have been reported as affecting Timothy; however, most of these are of little concern and can be controlled. Timothy is susceptible to stem rust disease which can cause loss of vigor and forage quality. Rust-resistant varieties have been developed to control this disease.

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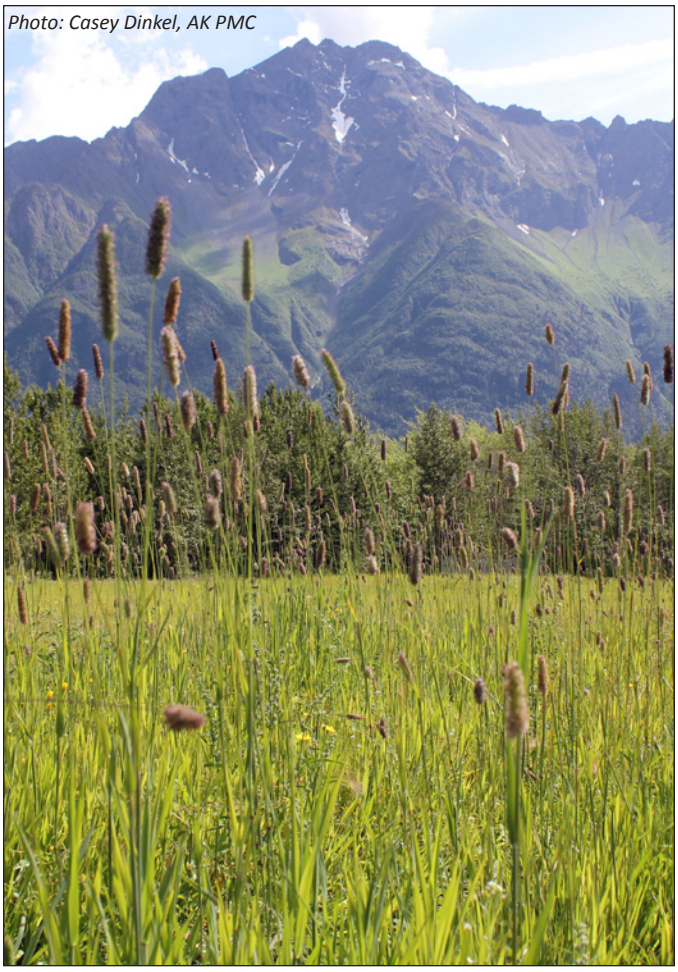


Photo: Casey Dinkel, AK PMC

A mature stand of Timothy, Phleum pratense

Cultivars and Releases

- **'Engmo'** - *Norway release.*

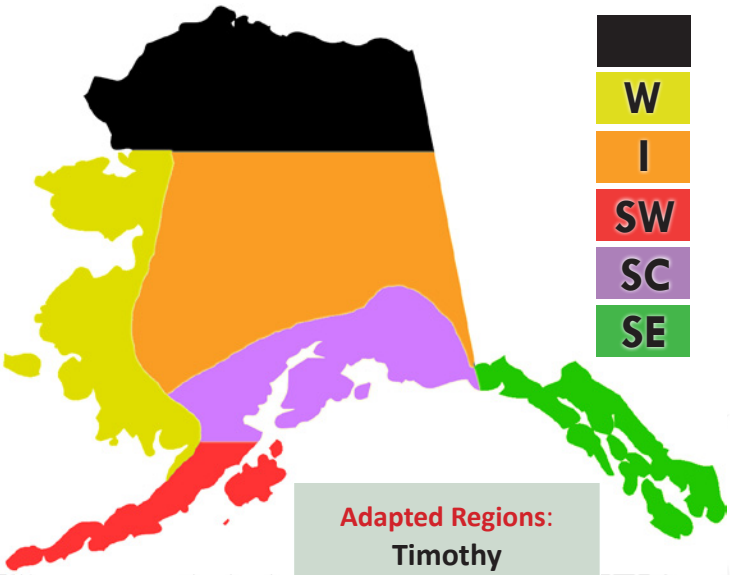
  W I SW SC SE

- **'Climax'** - *Canada release.*

  W I SW SC SE

- **'Champ'** - *Canada release.*

  W I SW SC SE



Adapted Regions:
Timothy

- Western
- Interior
- Southwest
- Southcentral
- Southeast

Species not adapted to region

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	3	2

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	30 in.	Introduced	Poor	Poor	Good	Moderate	5.5 - 7.0

TUFTED HAIRGRASS


Photo: Brennan Veith Low, AK PMC

Tufted Hairgrass is well suited for Alaskan environments.

Tufted Hairgrass

Deschampsia cespitosa (L.)

Description

Deschampsia cespitosa (Tufted Hairgrass) is a highly variable, perennial cool season grass species that grows from 51 to 61 centimeters (20 - 24 inches) tall. Stems are erect, and the leaves are between 1.5 and 4 mm (.06 - .16 inches) wide, flat or rolled. The leaves are mostly basal in a dense tuft. Tufted Hairgrass's inflorescence is upright to nodding, loosely branched, open and 10 to 25 cm (4 to 10 inches) long. There are two florets (flowers) per spikelet. Flowering occurs from May to September. Tufted Hairgrass seeds mature from late June to late September, depending on location. Tufted hairgrass produces approximately 1,360,000 seeds per pound of seed.

Uses

Livestock: Tufted Hairgrass can be utilized as hay or as a pasture crop. It is used by cattle, horses, and sheep. The palatability of Tufted Hairgrass is high to moderate for most livestock.

Wildlife: A large variety of wildlife utilizes Tufted Hairgrass as forage and/or cover. However, most wildlife will not utilize Tufted Hairgrass as often as domestic livestock. The species has moderate to low palatability for elk, bison, bear and various species of waterfowl.

Forage Value

Tufted Hairgrass produces good quality hay for most classes of livestock and wildlife. It also provides ample amounts of protein depending on its growing stage. Tufted Hairgrass can provide good summer pasture forage for livestock. Although forage value is usually moderate to high, Tufted Hairgrass consist of only 1-3% of wild animal diets.

Distribution and Adaptation

Populations of Tufted Hairgrass occupy sunny to partially shaded environments that are moderately moist to seasonally flooded. The species grows in a wide variety of soils; fine to coarse, mesic to hydric soil types. Tufted Hairgrass is adapted to a pH range from 4.8 to 7.5. Some populations have extreme tolerance to heavy metals and high soil acidity. The salinity tolerance of Tufted Hairgrass is generally low, but plants growing in coastal estuaries may be slightly more salt tolerant.

Tufted Hairgrass crowns typically survive all but the most severe (hottest) fires. One of the most widely distributed grasses on earth, Tufted Hairgrass is found in arctic and temperate regions. It occurs from sea level to elevations of up to 14,000 ft. Tufted Hairgrass habitat includes coastal terraces, upper tidal marshes, seasonally wet prairies, moist subalpine mountain meadows, open forests, and alpine areas above timberline.

Culture

When planting Tufted Hairgrass, seed should be planted ¼ to ½ inch deep. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate for broadcasting is 12 lbs/acre and 6 lbs/acre when drill seeding. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied.

Management

Tufted Hairgrass is adapted to northern regions and is well suited for Alaskan environments. One should be aware of Tufted hairgrass's aggressive growth characteristics; it tends to compete with other grass species. A number of diseases are associated with Tufted Hairgrass, including ergot, stripe smut, blind seed and other turf diseases. Hairgrass is also vulnerable to several rusts and leaf spots. Insect pests such as aphids, billbugs, and leafhoppers can threaten stands of Tufted Hairgrass, and should be monitored.

Photo: Casey Dinkel, AK PMC

Tufted Hairgrass, Deschampsia cespitosa

Cultivars and Releases

- **'Nortran'** - *University of Alaska Fairbanks release.*

W I SW SC SE

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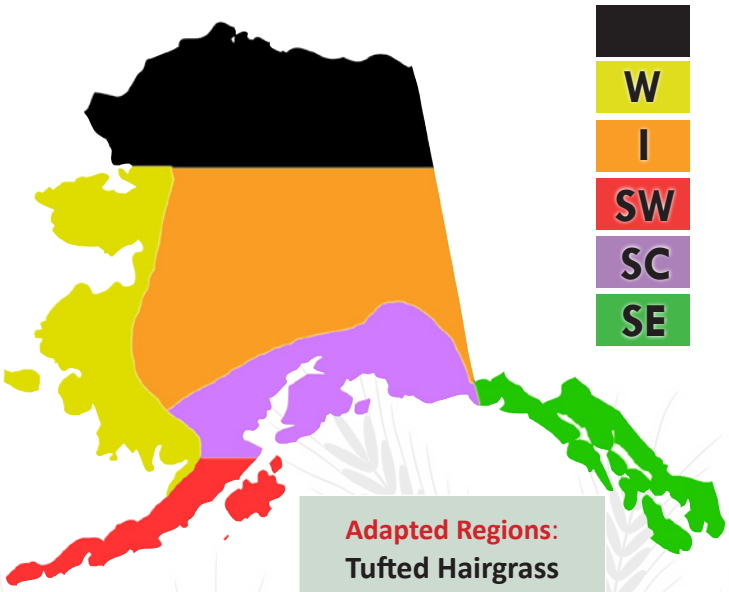
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	1	3	3	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Species not adapted to region

Adapted Regions:
Tufted Hairgrass

- Western
- Interior
- Southwest
- Southcentral
- Southeast

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	20 - 24 in.	Native	Poor	Good	Good	Strong	4.8 - 7.5

Cereal Grains

Photo: Brennan Veith Low,AK PMC

Barley, *Hordeum vulgare*

Barley, *Hordeum vulgare*

Common Oat, *Avena sativa*

BARLEY (Cereal)

Barley seedhead

Barley

Hordeum vulgare (L.)

Description

Hordeum vulgare (Barley) is an erect annual bunch grass that can reach a height of 90 centimeters (36 inches) depending on the variety. This small grain can be intercropped with legumes, such as Field Pea, to increase forage nutrients and palatability. Properly managed, legumes provide needed nitrogen for grasses and protein for livestock. Stems of Barley are hollow, smooth, and glabrous (shiny). Some varieties are susceptible to lodging. Barley leaves are typically 13 - 19 mm (½ to ¾ of an inch) wide and roughly 30 cm (12 inches) in length. Barley spikelet's exhibit short or long, narrow, and scabrous (rough) awns that can be problematic when fed to livestock. It produces a large spindle shaped seed with high seedling vigor. Barley plants produce roughly 13,000 seeds per pound of seed.

Uses

Livestock: Barley is commonly produced for grain fodder, but is sometimes fed directly as "green cut" when intercropped with a legume such as peas. This small cereal grain produces excellent forage and is highly palatable to all classes of livestock. In addition, Barley produces excellent straw, generally used by dog mushers for bedding.

Wildlife: Barley makes excellent fodder for large ungulate wildlife, such as moose, elk and bison. It also provides feed and cover for upland game birds, small mammals, waterfowl and various song birds.

Forage Value

Barley is considered highly palatable and excellent forage for most classes of livestock and wildlife. On average this small grain produces 12% protein when grown in monoculture. Total forage protein levels should increase if Barley is intercropped with Field Pea. Nutritional levels will vary depending on climate, location, and other agronomic inputs such as fertilizers, irrigation, and harvest time.

Distribution and Adaptation

Barley can be found growing throughout much of the world including Alaska, Canada, and the contiguous United States. It is adapted to medium textured soils and prefers a pH ranging from 5.3 to 8.5. Barley is moderately tolerant of droughty and/or wet conditions but does not persist well in shady environments. It is highly tolerant of saline soil conditions.

Culture

Barley grows well in cool moist climates and should be planted ½ to 1½ inches deep. A firm seedbed is essential in providing good seed to soil contact. This will provide a more reliable water supply and prevent large air pockets in the soil that are less than ideal for seedlings to establish.

Barley is typically drill seeded at a rate of 70 to 100 lbs/acre depending upon soil type, moisture, and location. When seeded with a legume, seeding rates should be reduced by about half and growth cycles must be synchronized. Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before seeding. Irrigation in combination with fertilization should increase field productivity.

Management

Barley is an excellent grain and forage crop if properly managed. Barley is well adapted to Alaska's long day length and short growing season. Several barley cultivars have been specifically developed to survive Alaska's harsh climate, while producing higher nutritional grain and forage values. The cultivar '*Weal*' is an awnless Barley that was developed as a dual purpose grain and/or forage.

Barley requires adequate moisture and responds well to nitrogen fertilizer. When planting Barley with legume species nitrogen should not be over applied due to the adverse affects it can have on nitrogen fixing plants. Lodging can also be problematic with some Barley cultivars; one should conduct ample research about their selected cultivar before planting. Currently, producers are evaluating the costs and benefits of irrigation on the production of Barley and other cereal grains throughout Alaska.

Barley is susceptible to powdery mildew (*Blumeria graminis*), leaf scald (*Rhynchosporium secalis*), and barley rust, (*Puccinia hordei*), covered smut (*Ustilago hordei*), loose smut (*Ustilago nuda*) and ergot (*Claviceps purpurea*). To date, these Barley diseases have not been found in Alaska. Therefore, cultivars developed for Alaska do not have a strong resistance to disease. Before planting, many farmers treat seed to prevent ergot and smut. Managers should also rotate crops and select disease free seed when applicable.

References

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Hulten, E. (1968) Flora of Alaska and Neighboring Territories. Stanford University Press. Stanford California. 1008 pp

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Cultivars and Releases

- **'Otal'** - *University of Alaska Fairbanks release.*
- **'Datal'** - *University of Alaska Fairbanks release.*
- **'Albright'** - *Canada release.*

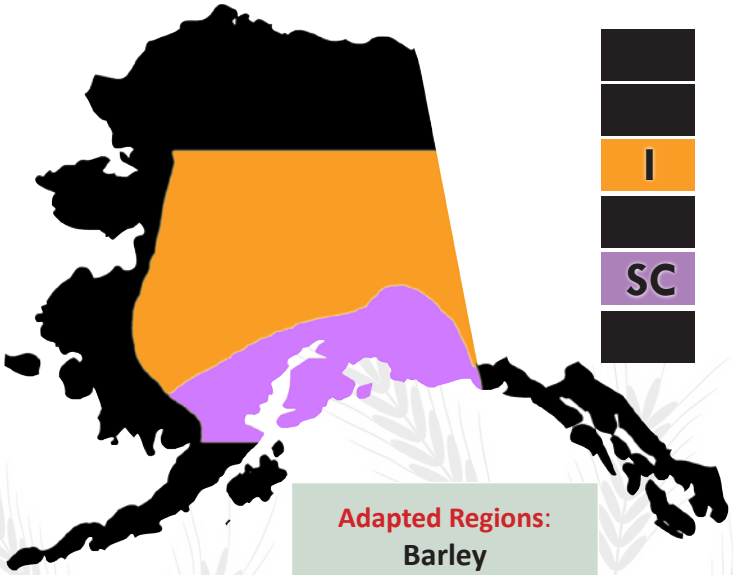
- **'Thual'** *(hulless)* - *Univ. of Alaska Fairbanks release.*
- **'Weal'** *(awnless)* - *Univ. of Alaska Fairbanks release.*

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Photo: Powell Gardens, Kansas City's Botanical Garden (powellgardens.org)

Barley, Hordeum vulgare



Adapted Regions:
Barley

- Interior
- Southcentral

see variety detail at left

Species not adapted to region

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	24 in.	Introduced	Good	Good	Good	Moderate	5.3 - 8.5

COMMON OAT (Cereal)

Photo: Henrik Reinholdson (Wikimedia.org)

Common Oat, Avena sativa

Common Oat

Avena sativa (L.)

Description

Avena sativa, Common Oat is an erect growing annual bunch grass that produces a fibrous root system. This small grain can attain heights greater than 60 centimeters (24 inches), depending on variety. Oats are generally intercropped with various legumes such as clovers and/or field peas to increase forage nutrient levels. This also allows some legumes to use their tendrils to climb the stalks of standing grass. Leaves are non-auriculate and medium to dark green in color. *Avena sativa* produces a large, lance shaped seed with high seedling vigor. Oat plants typically produce 20,000 seeds per pound of seed, depending upon the variety.

Uses

Livestock: Oats are commonly used as a hay and silage crop, but can also be used for pasture. This small cereal grain makes excellent forage and is highly palatable to all classes of livestock. Early growth oat plants can be fed as "green cut" forage for livestock. In addition, oat straw makes excellent roughage.

Wildlife: Oats have excellent forage value for a large variety of wildlife such as bears, elk, bison and moose. They are also used for food and cover by upland game birds, waterfowl, small mammals and various song birds.

Forage Value

Oats are highly palatable and excellent forage to all classes of livestock and wildlife. The species produces moderate/high protein and carbohydrate levels. Oats can be fed as hay, silage, green cut, grain, and/or eaten directly on the pasture. Nutritional levels will vary depending upon the selected form that oats are fed as well as how other agronomic inputs (fertilizer, irrigation, harvest time) are managed and applied. Oat hay generally contains 10 to 15 % protein and is typically intercropped with a legume such as peas for added nutrition.

Distribution and Adaptation

Oats can be found growing throughout much of the world including Alaska, Canada, and the contiguous United States. It is adapted to fine to coarse textured soils, and prefers a soil pH between 5.3 - 8.5. Oats are moderately tolerant of saline soils and droughty conditions. However, this small grain prefers adequate moisture and will not tolerate shady growing environments.

Culture

Oats are best adapted to cool moist climates and should be planted 1½ to 2 inches deep. A firm seed bed allowing good seed to soil contact is essential. Soil samples should be collected and analyzed before seeding. Oats are generally drill seeded at a rate of 50 to 90 lbs/acre. Seeded with a legume, seeding rates should be reduced by about half, and growth cycles should be synchronized. Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Irrigation in combination with fertilization should increase field productivity.

Management

Oats make an excellent forage crop when properly managed. This small grain is well adapted to Alaska's long days and short growing season in the summer. Oats are better adapted to lower pH soils than Barley or Wheat. Oat will complement various legumes when intercropped, and the species makes a high protein and carbohydrate fodder. When planting oats with a legume species, nitrogen should not be over applied due to the adverse affects it can have on nitrogen fixing plants.

Common Oat (*Avena sativa* L.) is the species most used in in Alaska, although other species such as Black Oat (*Avena strigosa* L.), Red Oat (*Avena byzantina* C. Koch), and Hulless Oat (*Avena nuda* L.) are also successfully grown throughout the state. Oat straw does not contain long awns, making it more desirable than barley straw for use as animal bedding. Some oat varieties have difficulty with lodging - conduct research prior to planting.

Oat diseases have not been a significant problem in Alaska. Fungi such as scald (*Rhynchospoium secalis*), stripe (*Pyrenophora graminea*), net blotch (*Pyrenophora teres*), spot blotch (*Cochliobolus sativus*) and smuts (*Ustilago spp*.) have been known to occur. To help prevent disease outbreaks, managers should rotate crops in the field periodically and be prudent about selecting disease free seed.

Cultivars and Releases

- **'Toral'** - *University of Alaska release.*
- **'Nip'** - *Sweden release; Univ. of AK Fairbanks release.*
- **'Ceal'** - *University of Alaska release.*

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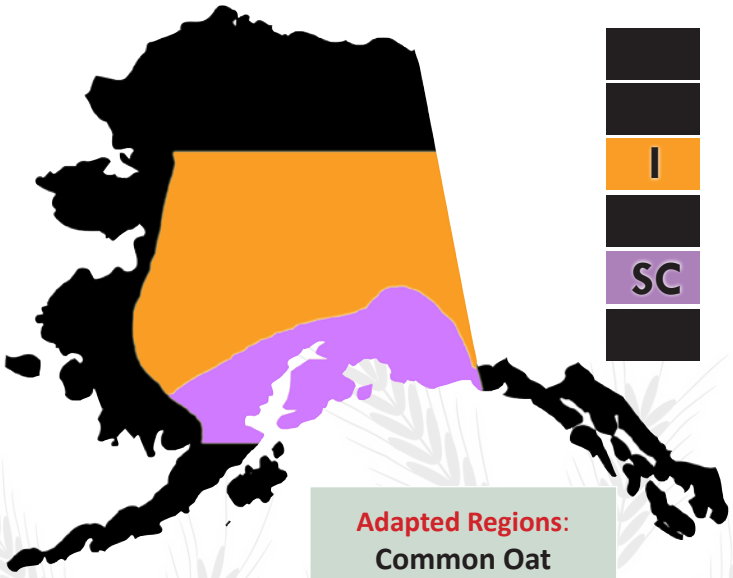
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Photo: H. Zell (Wikimedia.org)

Common Oat, Avena sativa



Adapted Regions:
Common Oat
- Interior
- Southcentral

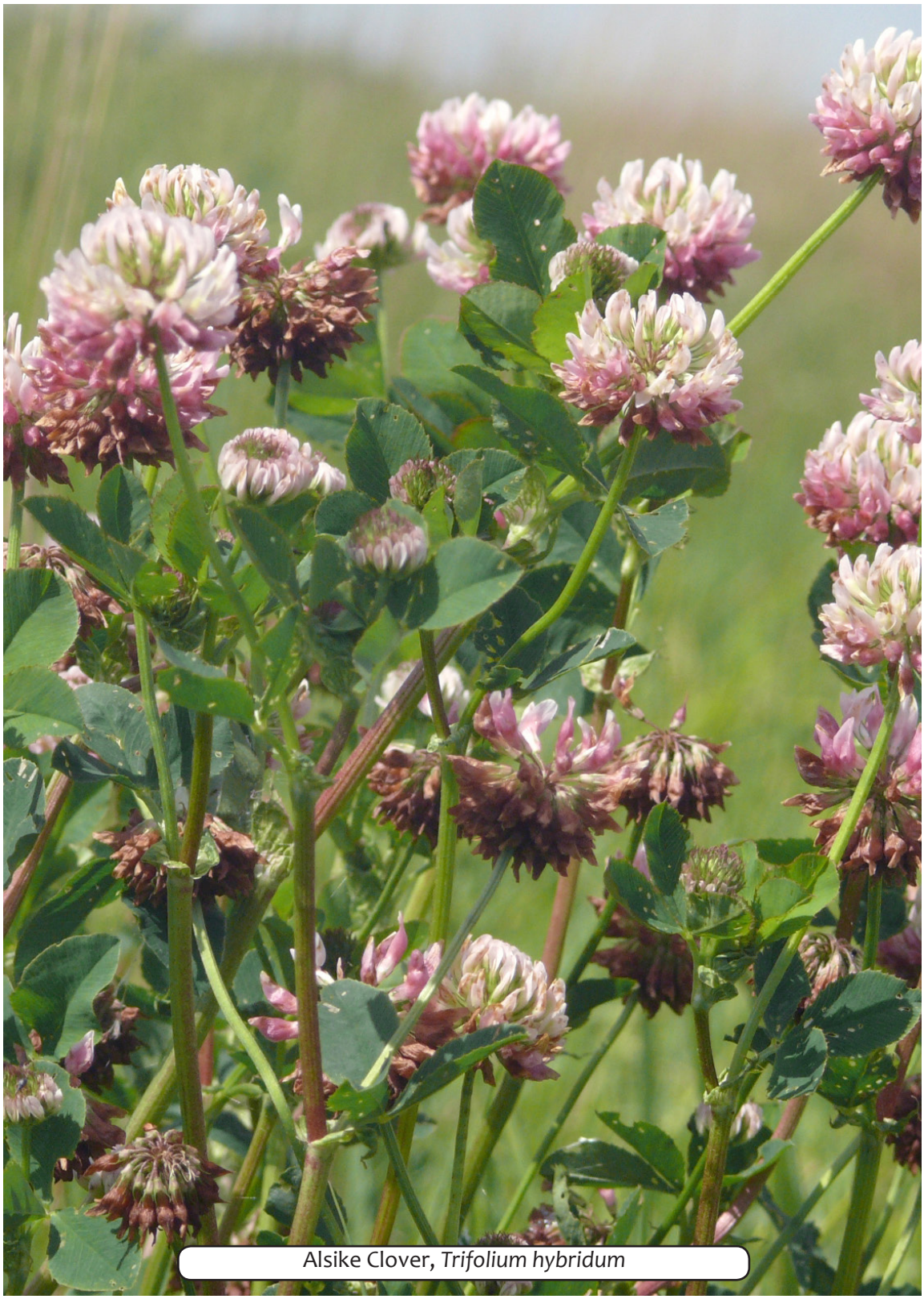
see variety detail at left

Species not adapted to region

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Bunch	24 in.	Introduced	Fair	Fair	Good	Moderate	5.3 - 8.5

Legumes

Photo: User BerndH (Wikimedia.org)



Alsike Clover, *Trifolium hybridum*

Alfalfa, *Medicago sativa*
Alsike Clover, *Trifolium hybridum*
Field Pea, *Pisum sativum*
Red Clover, *Trifolium pratense*
White Clover, *Trifolium repens*

ALFALFA

Photo: Sten Porse (Wikimedia.org)

Alfalfa

Medicago sativa (L.)

Description

Medicago sativa, Alfalfa is a long lived perennial legume. It grows erect culms, 76 - 91 centimeters (30 to 36 inches) in height, branching from a single base. Leaves alternate on the stem and are pinnately trifoliolate, while individual leaflets are obovate (ovalish) or lancolate (lance shaped). Alfalfa produces numerous flowers that are purplish to yellow and borne in loose racemes or clusters. Alfalfa grows a series of lateral roots, with a distinct tap root that may penetrate 6 to 9 meters (20 to 30 feet) below soil surface. This legume produces a small kidney shaped seed. Alfalfa produces 190,000 to 220,000 seeds per pound of seed, depending upon variety. Seedling vigor can be low to moderate, also depending upon the selected variety.

Uses

Livestock: Alfalfa is typically used for haying, silage, and pastures land. However, it can also be fed as haylage, wafers, pellets or dried meal. It is highly palatable to all classes of livestock, but caution is advised when feeding Alfalfa due to its high bloat hazard.

Wildlife: Alfalfa is highly palatable to a variety of large wildlife, such as deer, elk and bison. It is utilized as food and cover by small mammals, waterfowl and upland game birds. Canada geese, sandhill cranes, rough grouse and mallard ducks can be found utilizing Alfalfa.

Forage Value

Alfalfa produces large amounts of protein and is excellent quality forage for all classes of livestock and wildlife. This legume has the highest feed value of all commonly grown hay crops. Alfalfa is one of the most important forage plants in production agriculture; sometimes called the "*Queen of the Forages*". It is high in mineral content and possesses excellent nutritional value, containing at least 10 different vitamins.

Distribution and Adaptation

Alfalfa is adapted to a variety of climatic and soil conditions, and can be found growing throughout the United States and parts of Canada. Varieties such as 'Denali' have been hybridized to better withstand extreme Alaskan climates. Generally, Alfalfa prefers deep well drained medium textured soils, with a pH of 6 to 8.5. It is highly drought tolerant and can withstand saline soils. Alfalfa will not tolerate sites with frequent overflow or high water tables.

Culture

Alfalfa should be planted no deeper than a ¼ inch on fine textured soils and ½ inch deep on coarse soils. It should be drill seeded on a firm seed bed. Cultipacking the soil before and after planting Alfalfa is normally recommended. Seeding rates depend greatly upon soil type, moisture, and location. Note that Alfalfa can have trouble over-wintering and competing with perennial grasses.

An average seeding rate when broadcasting Alfalfa is 10 lbs/acre and 5 lbs/acre when drill seeding. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B. Appropriate fertilizer ratios depend upon soil type, chemistry and location. Research in Alaska has shown that the application of fertilizer produces no significant yield change. If applying fertilizer, collect and analyze soil samples first. Pastures and hay fields should be irrigated when necessary and/or applicable.

Management

Alfalfa makes an excellent pasture, hay or silage forage. Although this crop is usually harvested 2 years after planting, one should be aware that most varieties will not over-winter throughout Alaska. This can be attributed to several environmental factors such as acid soils, nutrient deprived soils, cold stress and damage to the plants root system. There are several varieties of Alfalfa that have been developed or hybridized to combat these factors.

Alfalfa will tolerate moderate pasture grazing, but stands will weaken if over grazed or grazed too often. When applicable, Alfalfa can be grown with a perennial grass species, such as

Photo: Wikimedia.org

Alfalfa, Medicago sativa

Smooth Brome (*Bromus inermis*). This can greatly reduce the danger of bloating in livestock when pasture grazing. Alfalfa is susceptible to many agricultural pests, including spotted or pea aphid, alfalfa weevil, stem nematode, bacterial wilt, snout beetle and several leaf spots.

Cultivars and Releases

- *Denali Alfalfa was developed by UAF, but is not commercially available as of mid 2012. Check with the Alaska Plant Materials Center for further information.*

References

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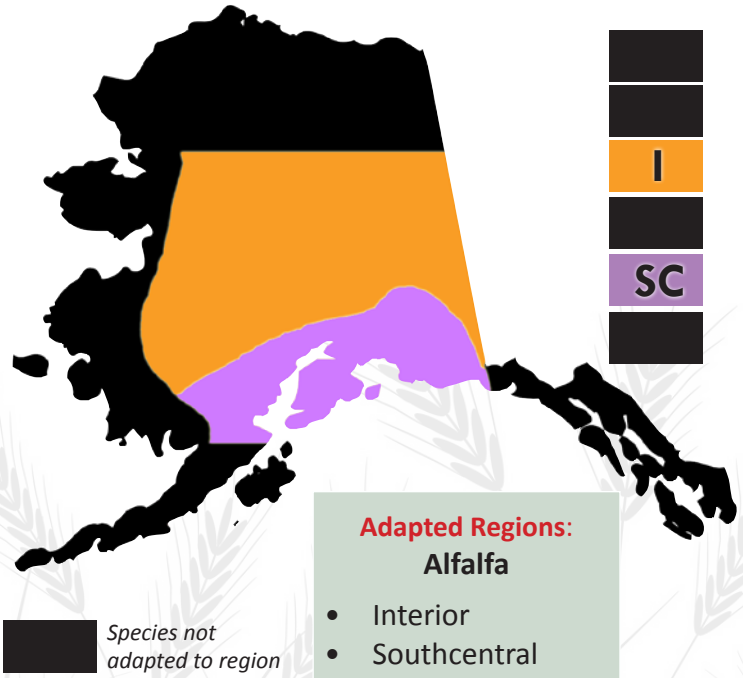
Stubbendieck, J., S.L. Hatch, L.M. Landholt, (2003) A Field Guide, North American Wildland Plants, University of Nebraska, University of Nebraska press. Lincolin, Nebraska. 501 pp

Klebesadel, L.J., and Taylor, R.L, (1973) Research Progress With Alfalfa in Alaska. *In* Agroborealis, Vol 5, # 1, July, 1973, pp 18-20

Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
1	2	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Upright crown	30 - 36 in.	Introduced	Excellent	Poor	Excellent	Strong	6 - 8.5

ALSIKE CLOVER

Photo: User Aiwok (Wikimedia.org)

Alsike Clover, Trifolium hybridum

Alsike Clover

Trifolium hybridum (L.)

Description

Trifolium hybridum, Alsike Clover is a short lived perennial and/or biennial legume that can reach 45 to 60 centimeters (18 to 24 inches) tall. It grows decumbent to erect vertically ridged culms. Leaves are palmately trifoliate with long petioles on the lower leaves and smaller or reduced petioles on the upper leaves. Individual leaflets are obovate (ovalish) or elliptic (narrow oval) with narrow tipped stipules. Alsike produces numerous flowers that are pink, red, and/or white and borne in leaf axils at the end of stems.

Alsike is similar to several other introduced *Trifolium* species that occur throughout Alaska, such as Golden Clover (*Trifolium aureum*), Lupine Clover (*T. lupinaster*), Red Clover (*T. pratense*), White Clover (*T. repens*), and Field Clover (*T. campestre*). This legume produces a small round shaped seed, and most varieties produce roughly 650,000 seeds per pound of seed. Seedling vigor is low to moderate, depending upon the selected variety.

Uses

Livestock: Alsike is used for hay and pasture grazing. It is highly palatable to all classes of livestock. Caution should be taken when feeding Alsike to horses, as it can be toxic under some conditions. Also be cautious when feeding Alsike in large quantities, due to its high bloat hazard.

Wildlife: Alsike is highly palatable to a variety of large wildlife, such as deer, elk and bison. It is utilized as food and cover by small mammals, waterfowl and upland game birds. Canada geese, sandhill cranes, rough grouse and mallard ducks utilize Alsike Clover.

Forage Value

Alsike is capable of producing large amounts of protein and is excellent quality forage for most classes of livestock and wildlife. Although it is generally out-produced by other legumes, it is highly palatable and produces a high relative feed value (RFV). It provides adequate mineral and vitamin content and is commonly grown with other grass species, including Timothy (*Phleum pratense*). As with most legumes, caution should be taken when feeding alsike due to the possibility of bloat.

Distribution and Adaptation

Alsike is adapted to a variety of climatic and soil conditions. It is found growing throughout the entire United States and parts of Canada. Alsike can tolerate fine to medium textured soils with a pH ranging from 5.6 to 7.5. Although it can persist in wetter and more acidic soils better than other clover species, Alsike will not tolerate shady, droughty or saline environments.

Culture

Alsike should be planted ¼ to ½ inches deep in a firm seed bed, preferably in silty loams and/or finer textured soils. Seeding rates depend greatly upon soil type, moisture, and location. An average seeding rate when broadcast seeding Alsike is 6 lbs/acre and 2-4 lbs/acre when drill seeding. Seed should be inoculated prior to planting with appropriate rhizobium to assist plant establishment. Seeding rates are determined using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before field seeding. High rates of nitrogen application can damage or destroy stands of Alsike, and caution should be taken when applying fertilizer. Pastures and hay fields should be irrigated when necessary and/or applicable.

Management

Alsike makes an excellent pasture or hay forage. This legume is adapted to acidic, poorly drained, and/or moderate to low nutrient soils. Alsike can be difficult to control for the first several years of production, due to its aggressive nature and tendency to compete with other plants. It is highly recommend that Alsike be seeded in combination with a grass species to keep it from dominating a forage stand. Typically, Alsike Clover is seeded with a grass species such as Timothy (*Phleum pratense*) to reduce the risk of bloating and toxic affects when feeding to horses. Seeding with a grass species will also help Alsike stand upright making for an easier harvest.

Photo: User BerndH (Wikimedia.org)

A mature stand of Alsike Clover

This legume will readily move into disturbed areas, and one should be mindful when selecting this species as a forage choice. Alsike requires a minimum of 110 frost-free days for successful reproduction and will continue to bloom throughout the entire growing season. Alsike responds well to irrigation, moderate grazing pressure, and commercial fertilizers. Little research has been conducted concerning potential pests that may affect Alsike in Alaska.

Cultivars and Releases

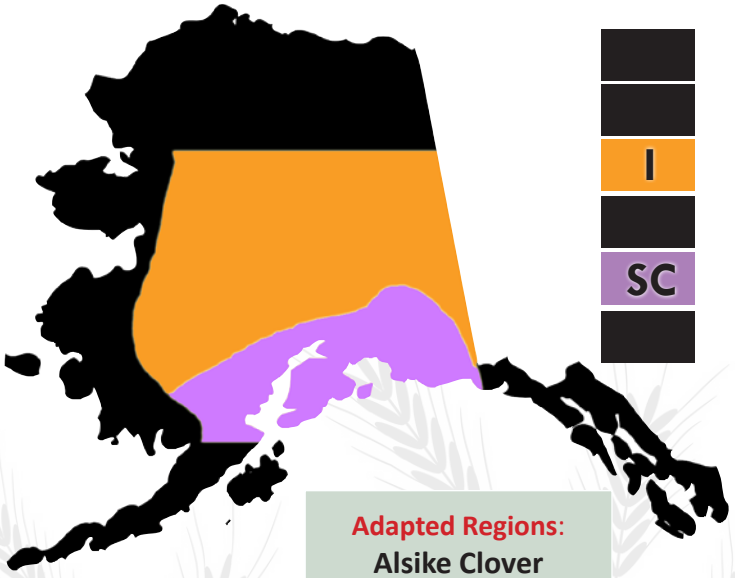
- **'Aurora'** - *Alberta, Canada release.*

- **'Dawn'** - *Canada release.*

References

Natural Resource Conservation Service (NRCS) (2000) USDA National Plant Data Center [online] Link: http://plants.usda.gov/java/

Montana State University, Extension Service Alsike Clover (*Trifolium hybridum*) [online] Link: http://animalrangeextension.montana.edu/Articles/Forage/Species/Legumes/Alsikeclover.htm



Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	0

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Upright crown	18 - 24 in.	Native	Poor	Poor	Good	Weak	5.6 - 7.5

FIELD PEA

Photo: User Rasbak (Wikimedia.org)

Mature Field Pea plant

Field Pea

Pisum sativum (L.)

Description

Pisum sativum, Field Pea is an annual legume that is prostrate (flat growing) by nature. When intercropped with a grass or small grain, however, the legume can reach a height of 60 to 120 centimeters (24 to 48 inches), depending on variety. Intercropping allows Field Pea to wrap itself around the secondary crop allowing it to grow upward. A single leaf consists of one to three pairs of leaflets that are terminated with a branched tendril (used for climbing). Field Pea leaves are usually pale green with white blotches. This legume has a large round shaped seed and generally produces 1,600 to 5,000 seeds per pound of seed, depending upon variety. Seedling vigor is low to moderate and seeds should be inoculated with proper bacterium when applicable.

Uses

Livestock: Field Pea is used for pasture, hay, silage and/or green cut. It is excellent forage and is highly palatable to all classes of livestock. This legume is often intercropped with annual grasses or oats to obtain optimal nutrient and mineral requirements of livestock.

Wildlife: Field Pea is highly palatable to a variety of wildlife such as deer, elk, moose and bison. It is also utilized as food and cover for small mammals, waterfowl and upland game birds.

Forage Value

Field Pea is highly palatable to all classes of livestock and wildlife. It produces 20 to 25 percent protein on average and contains high levels of carbohydrates. This legume generally produces greater than 85% total digestible nutrients, with low fiber content. Intercropped with annual grasses or small grains, Field Pea can increase combined protein levels two to four times higher than with grass or small grains in monoculture. Field Pea has a moderate bloating factor, compared to other legumes, and should be fed with a grass or small grain forage to reduce the risk of bloating.

Distribution and Adaptation

Field Pea prefers cool, moist conditions and can be found growing throughout parts of Alaska, Canada, Greenland and the contiguous United States. Field Pea is adapted to a variety of soil textures such as sandy loams, silts to heavy clays, and requires adequate drainage with a pH between 5.2 and 6.5. This legume cannot tolerate saline or droughty conditions.

Culture

Field Pea should be planted 1 to 3 inches deep in a moist firm seedbed. This promotes good seed to soil contact. Seeding rates depend greatly upon soil type, moisture, and location. Field Pea should be drill seeded when applicable, and is generally seeded at a rate of 190 lbs/acre, or 7 to 9 plants per square foot. This legume does not compete well with other species. A heavier seeding rate allows field pea to better compete with weeds.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before seeding. Field Pea requires phosphorus and potassium in relatively large amounts. Nitrogen is also necessary if planting in nutrient deprived soils. Over application of nitrogen fertilizer can have adverse affects, however, reducing the potential of nitrogen fixation by plants. Fields should be irrigated when necessary. Irrigation in combination with fertilization can increase field productivity.

Management

Field Pea makes an excellent forage crop if properly managed. It can provide needed nitrogen for grasses and protein for livestock. Field Pea is not typically used for grazing, but rather it is used for silage or green chop. There are several pests that can affect Field Pea production, such as *Mycosphaerella* and *Ascochyta*. These fungi can result in poor plant performance and death if not managed. A preferred management tactic is to rotate field pea stands for several growing seasons, thus not allowing the fungus spores to persist. Fungi can survive for several years on Field Pea stubble and seed. Insects such as aphids, lygus bugs and grass hoppers can also affect Field Pea performance, though they are not usually a problem.

Photo: Jean Tosti (jeantosti.com)

Field Pea, Pisum sativum

Cultivars and Releases

- **'Century'** - *Canada release.*
- **'Lenca'** - *Canada release.*
- **'Procon'** - *Minnesota release.*

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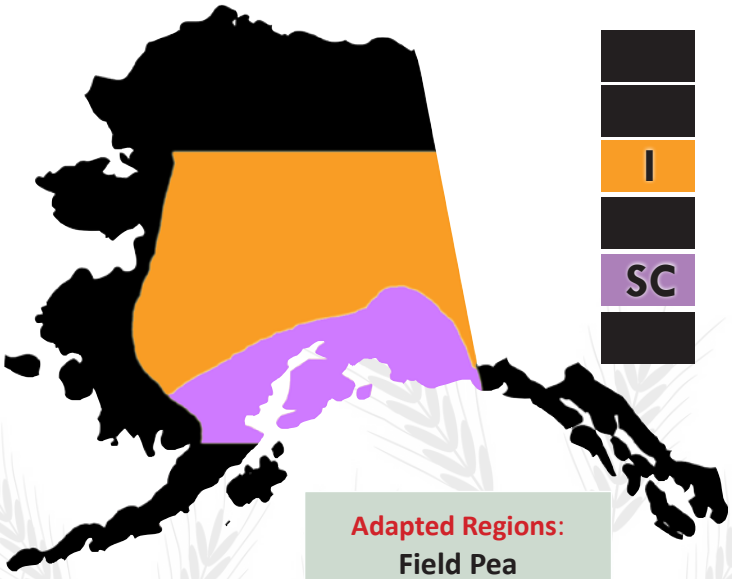
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.



Species not adapted to region

Adapted Regions:
Field Pea

- Interior
- Southcentral

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Upright / Prostrate	24 - 48 in.	Introduced	Poor	Poor	Fair	Moderate	5.2 - 6.5

RED CLOVER

Photo: Michael Apel (Wikimedia.org

Red Clover, Trifolium pratense

Red Clover

Trifolium pratense (L.)

Description

Trifolium pratense, Red Clover is a short lived perennial or biennial legume. It grows erect to decumbent culms that are hairy and hollow. Each leaf consists of a slender stalk which is petiolated and bearing 3 leaflets, which are oblong to obovate (ovalish shape). Red Clover produces numerous flowers borne in compact clusters that are reddish to pink in color. There are two types of Red Clover that are commonly referred to as **Medium** and **Mammoth**. Medium Red Clover ranges in height from 45 - 60 centimeters (18 to 24 inches), while Mammoth Red Clover reaches an average height of 75 centimeters (30 inches). Red Clover grows a series of lateral roots with a tap root that is extensively branched. This legume produces a small kidney shaped seed that is yellow to deep violet in color. Red clover has high seedling vigor and produces roughly 270,000 seeds per pound of seed.

Uses

Livestock: Red Clover is typically used for hay, pastureland, and/or silage. It produces high quality forage that is palatable to all classes of livestock.

Wildlife: Red Clover is highly palatable to large grazing and browsing animals such as deer, elk and bison. It is also utilized as food and cover by small mammals, waterfowl, and upland game birds.

Forage Value

Red Clover can produce high yields and is excellent forage for all classes of livestock and wildlife. Depending on season of harvest, protein content of 15-25% is common. Digestibility and relative feed value start high, but decline with plant maturity. Caution should be taken when feeding *Trifolium pratense* to animals due to the possibility of bloat.

Distribution and Adaptation

Red Clover is adapted to a variety of soils types but grows best in well drained loamy soils. It can be found growing throughout the United States and Canada. Red Clover prefers a pH of 5.5 to 7.5 and has low drought tolerance. This legume can tolerate high moisture environments and has a moderate to low shade tolerance.

Culture

Red Clover should be planted at ¼ to ½ inch deep in well drained loamy to silt loam soils that have a high water holding capacity. It should be inoculated with the appropriate rhizobium innoculant, as this will help with plant establishment and seedling vigor. When seeded alone in pure stands, Red Clover should be drill seeded at a rate of 6-12 lbs/acre and 20-25 lbs/acre when broadcast seeding. Red Clover can also be seeded in mixtures with small grains or grasses like Barley (*Hordeum vulgare*), Timothy (*Phleum pratense*), and Smooth Brome (*Bromus inermis*). Standard seeding rates when seeded in a mix is 4-8 lbs/acre. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before fertilizer is applied. Phosphorus is used in large quantities by Red Clover, which is a limiting factor on most soils. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation in combination with fertilization should increase overall yields.

Management

Red Clover makes an excellent pasture, hay, or silage forage. It should be harvested ¼ to ½ in bloom during the first cutting. Successive grazing or a second cutting should occur when the legume is ¼ of the way into bloom stage, and at least 2 inches of growth should remain after harvest. Red Clover responds well to fertilizers and should be supplied with ample amounts of phosphorus and/or potash. Red Clover also responds well to irrigation when planted in moderate to well drained soils. When growing Red Clover, one should monitor for powdery mildew in areas of high humidity and/or rainfall. Resistant cultivars have been developed to reduce the occurrence of these pests.

Photo: Wikimedia.org

A mature stand of Red Clover

Cultivars and Releases

- **'Alaskaland'** - *University of Alaska Fairbanks release.*

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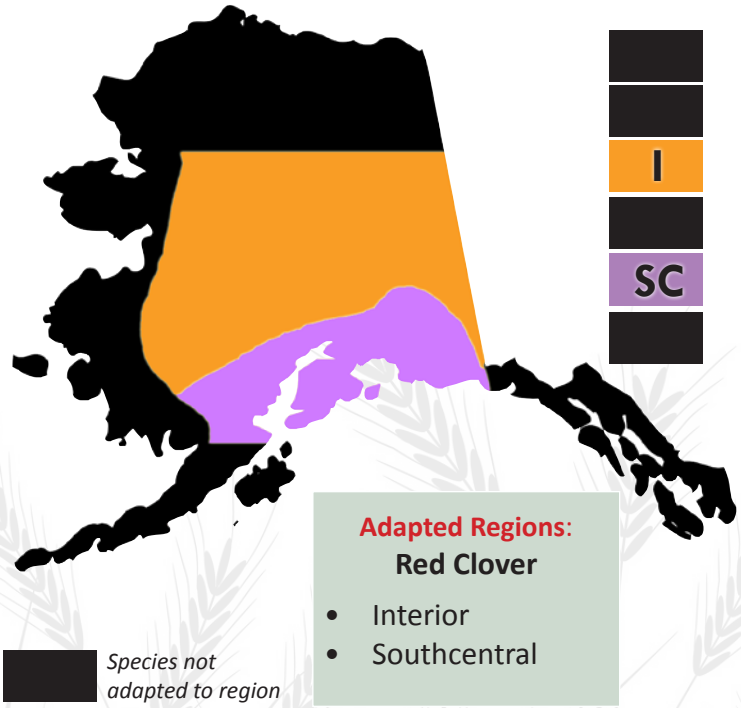
References

Natural Resource Conservation Service (NRCS) (2000) USDA National Plant Data Center [online] Link: http://plants.usda.gov/java/

Maurice, E.H., D.S. Metcalfe, R.F. Barnes (1973) Forages, The Science of Grassland Agriculture. Iowa State University Press. Ames, Iowa. 755 pp

Hulten, E. (1968) Flora of Alaska and Neighboring Territories. Stanford University press. Stanford California. 1008 pp



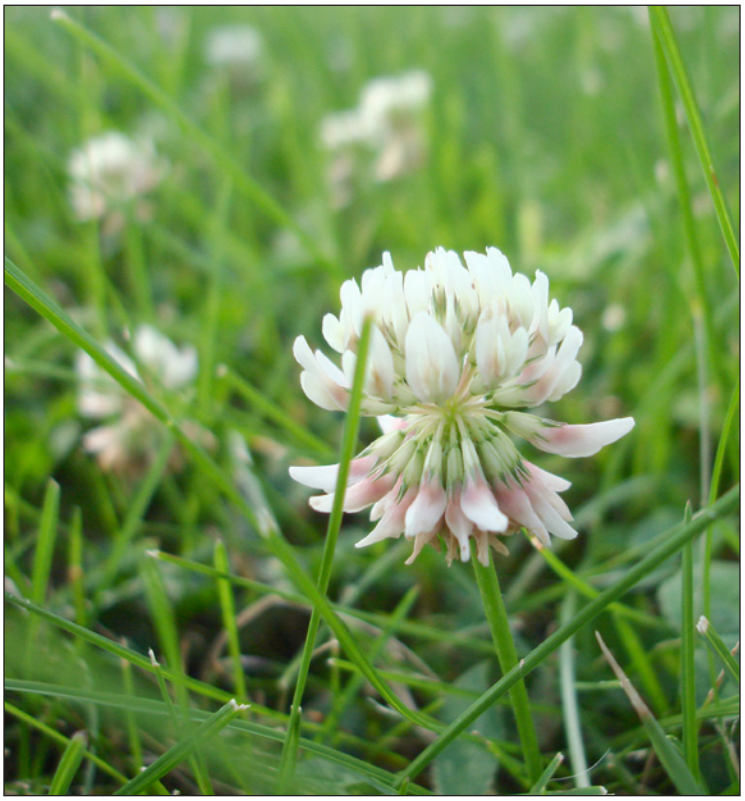
Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	1

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Good	Upright crown	18 - 24 in.	Introduced	Poor	Poor	Good	Moderate	5.5 - 7.5

WHITE CLOVER

Photo: Wikimedia .org



White Clover in bloom

White Clover

Trifolium repens (L.)

Description

Trifolium repens, White Clover is a moderate lived perennial legume that can attain heights of 15 - 30 centimeters (6 to 12 inches), depending upon variety. It has a prostrate (flat) growth habit, spreading laterally by stolons. Leaves are composed of three leaflets that sometimes display a watermark or crescent. Leaves and roots are borne along the stolon at each node. Inflorescence (seed-head) consists of 40 to 100 florets that are borne along long slender stalks. Florets are usually white, but sometimes display a pink hue. White Clover has a shallow root system with a primary tap root that seldom roots deeper than 60 centimeters (24 inches). This legume grows a small heart shaped seed, and produces roughly 700,000 seeds per pound of seed. Seedling vigor is low to moderate depending upon the selected variety.

Uses

Livestock: White Clover can be used for pasture, hay or silage production. It is highly palatable to all classes of livestock and has a low potential of bloating.

Wildlife: White Clover is highly palatable to a variety of large wildlife, such as deer, elk, moose and bison. It is also utilized as food and cover by small mammals, waterfowl and upland game birds.

Forage Value

White Clover is highly palatable to all classes of livestock and wildlife. It produces ample amounts of protein with consistently high mineral content, compared to other clover species. This legume is highly digestible and generally produces a higher percentage of amino acids than Alfalfa and/or Red Clover. When nutrients are available, White Clover can concentrate Na, P, Cl, and/or Mo, delivering these nutrients to grazing animals. The risk of bloating is generally moderate to low and is greatly reduced when White Clover is grown with grass species.

Distribution and Adaptation

White Clover is adapted to moist and/or wet conditions and can be found growing throughout the United States, Canada, and some portions of Alaska. It prefers fine texture soils such as silts and clays, containing moderate to high nutrient levels. White Clover will persist in soils with a pH ranging from 5.2-8.0. It will not tolerate or sustain in shady, droughty, saline, or nutrient deprived environments.

Culture

White Clover should be planted ¼ to ½ inch deep in a firm seed bed with well drained silty or clay loam soils. Seeding rates depend greatly upon soil type, moisture, and location. It is highly recommended that White Clover be drill seeded to ensure good seed to soil contact. An average seeding rate when drill seeding White Clover is 2-4 lbs/acre. This seeding rate applies to almost all situations and can be used when planting White Clover with a grass species. A widely accepted ratio of 2:1 is an ideal balance of grass to clover, using the above recommended clover drilling rate. All seeding rates are determined by using Pure Live Seed (PLS) calculations, as described in Appendix B.

Appropriate fertilizer ratios depend upon soil type, chemistry, and location. Soil samples should be collected and analyzed before field seeding. High application rates of nitrogen can damage or destroy stands of White Clover and caution should be taken when applying fertilizer. Pastures and hay fields should be irrigated when necessary and/or applicable. Irrigation in combination with fertilization should increase field productivity.

Management

White Clover makes an excellent pasture forage, but is generally not used for hay or silage production unless large and/or tall cultivars are selected and grown. The cultivar '**Ladino**' is a large and tall growing variety of white clover that is commonly used for hay, silage, and green chop production. White Clover will respond well to irrigation, moderate grazing pressure, and commercial fertilizers. This legume usually displays adverse affects when nitrogen fertilizers are supplied in excess. Liming may be necessary to achieve the optimal pH for white clover growth.

Photo: Forest and Kim Starr (Wikimedia.org)

White Clover, Trifolium repens

LEGUME

White Clover is typically grown with other forage grasses. This is generally implemented in order for grasses to take advantage of the nitrogen fixating ability of White Clover, and to lower the potential of bloating by adding dry matter to the feed mix. White Clover can be susceptible to a number of root and leaf diseases as well as insect pests. Most of these potential problems exist in mid to lower latitudes.

Cultivars and Releases

- **'Ladino'** (Large type) - *developed in Italy.*

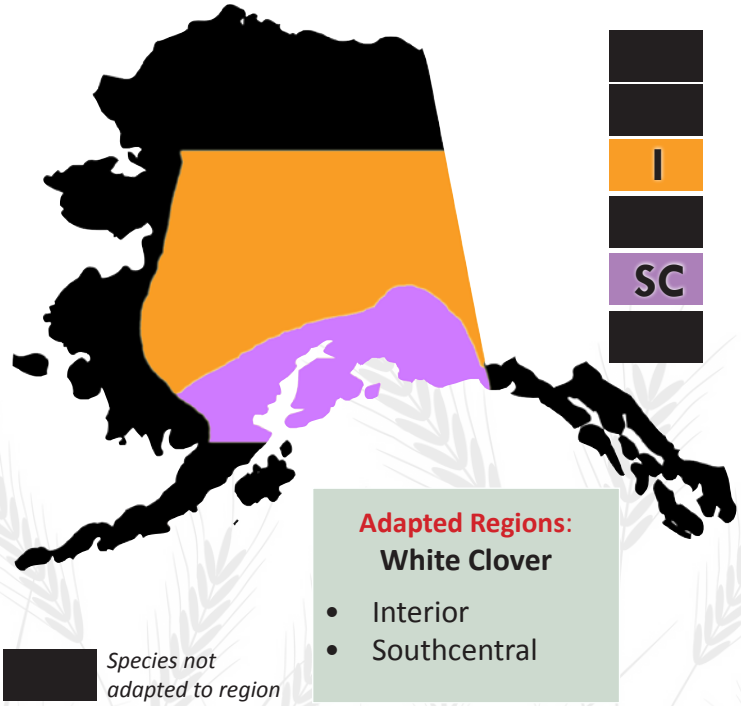
- **'Pilgrim'** (Large type / winter-hardy)
- **'Merit'** (Large type / winter-hardy)
- **'New York'** (Small type)
- **'Kent Wild'** (Small type)

References

Natural Resource Conservation Service (NRCS) (2000) USDA National Plant Data Center [online] Link: http://plants.usda.gov/java/

Maurice, E.H., D.S. Metcalfe, R.F. Barnes (1973) Forages, The Science of Grassland Agriculture. Iowa State University Press. Ames, Iowa. 755 pp

Hulten, E. (1968) Flora of Alaska and Neighboring Territories. Stanford University press. Stanford California. 1008 pp



Soil Texture *				
Coarse	Moderately Coarse	Medium	Moderately Fine	Fine
0	2	3	2	0

* **Soil texture is** graded on a scale of 0 to 3; higher numbers denote textures to which species is most adapted.

Availability	Growth Form	Average Height	Native or Introduced	Saline Tolerance	Drought Tolerance	Wet Soil Tolerance	Competitiveness	pH Range
Poor	Prostrate	6 - 12 in.	Introduced	Poor	Fair	Good	Weak	5.2 - 8

Section D. Additional Information

- Appendix A: Nutrient Study
  - Introduction
  - Methods and Procedures
  - Lab Analysis
  - Report of Findings
  - Species Growth Charts
- Appendix B: Seed Specifications / Certification
- Appendix C: Prohibited & Restricted Noxious Weeds
- Glossary
- Works Cited

Appendix A: Nutrient Study

(Analysis of Collected Plant Nutritional Quality Data at Different Growth Stages)


Photo: Brianne Blackburn AK PMC


Photo: Casey Dinkel (AK PMC)


Photo: Stoney J. Wright (AK PMC)

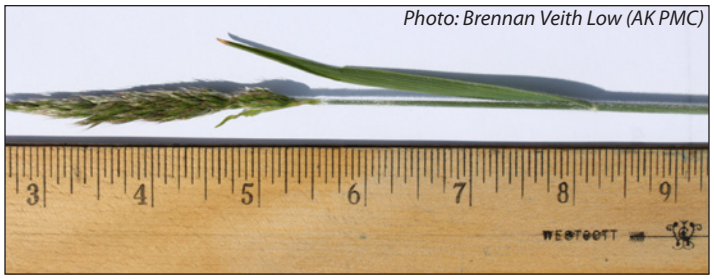


Photo: Brennan Veith Low (AK PMC)

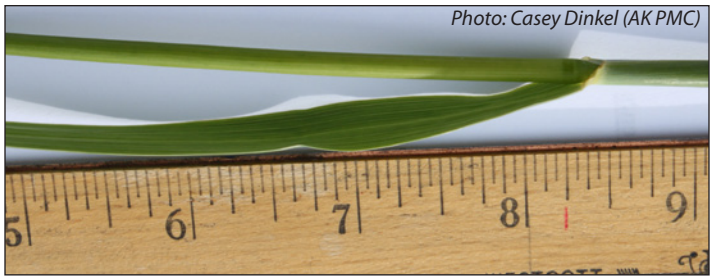


Photo: Casey Dinkel (AK PMC)

Detailed measurements of nutrient availability at various plant growth stages were taken during this study.

Introduction

Forage production in Alaska presents unique challenges, due to the short growing season (100-118 days) and harsh environments encountered throughout diverse regions of the state. Spring planting is optimal, as planted species are able to utilize available moisture from winter snowmelt and take advantage of the warmer temperatures and longer days of summer. Average summer temperatures in Alaska range from 51 - 61˚F, with an 18 to 24 hour photo period in June.

Though these climatic factors present some challenges, forage production numbers are stable. The mean per ton cost varies largely in Alaska, from $225/ton - $750/ton, considerably higher than the $90 per ton common in the lower 48. The high price variability can be attributed to high production costs, a shortage of available hay and uncontrollable climate variables. To adapt to and overcome Alaska's climate and geography, managers should choose forage species with high nutritional value. This will enable an animal's nutrient intake levels to be met while minimizing the expense of nutritional supplements.

Purpose

The goal of this study was to determine nutrient content of forage species within each distinct plant growth stage. Five growth stages were examined for grass, legume, and cereal crop species - Vegetative, Pre-boot, Boot, Anthesis (flowering) and Caryopsis (ripening). Samples of vegetative matter were taken at each stage and sent to a lab for nutrient analysis. Data extrapolated from testing can be used by producers and consumers as a means of choosing forage species based on the needs of livestock and/or wildlife.

An additional intent of this study was to look at the nutritional content of native and non-native plant species, and determine if any non-native species have sufficiently high nutritional value to warrant inclusion in forage plantings in Alaska. Timothy and Brome are two examples of non-native species with high nutritional value.

Methods & Procedures

This effort was conducted at Alaska Plant Materials Center in Palmer, Alaska during the 2011 growing season. Fields were well established and fairly free of weeds. Plant species were evaluated and growth stages were monitored daily. Each species collection was accompanied by field observations as noted by the sample collector. Standardized collection procedures were followed.

Growth State Indicators

1. **Vegetative**: Leaf growth and development; no stems
2. **Pre-boot**: Stem elongation or "jointing"; stem or culm development occurs
3. **Boot**: The seedhead (inflorescence) emerges from the tiller
4. **Anthesis** (flowering): Pollen starts to shed from the anthers
5. **Ripening**: This stage begins with the development of the caryopsis (seed) and ceases when they are ripe. Also denotes the end of the growing season; leaves start to change color.

Species Collection

1. A handful of grass was clipped with scissors, leaving about 2-3 inches of stubble above ground. Five samples were collected for each species.
2. Each sample was cut into sections of approximately 8 inches in length, placed into a five gallon bucket and then mixed together so representative samples could be taken. Any decadent (previous year's) growth was removed so that only the current season's growth was analyzed.
3. Approximately 200 grams of grass was removed from the five gallon bucket and put into a ½ gallon bag. Each bag was labeled with date, species name, and growth stage.
4. Samples collected were delivered the same day to the University of Alaska Fairbanks Experiment Farm for testing.

Lab Analysis

Samples were collected from well established fields near the Plant Materials Center in Palmer, Alaska. The samples were gathered during the following growth stages; Vegetative, Pre-boot, Boot, Anthesis (flowering) and Ripening. The rationale of collecting samples in these growth stages was to determine the gain and loss of nutrients throughout a typical graminoid life cycle.

Samples submitted for analysis were tested for crude protein (**CP**) , minerals, acid detergent fiber (**ADF**), neutral detergent fiber (**NDF**), total digestible nutrients (**TDN**) and various other constituents. ADF and NDF are used to measure the portion of indigestible material within the sample, which inversely correlates to nutrient content.

The relative feed value (**RFV**) is an estimate of forage quality and is calculated from ADF and NDF percentages. The RFV grading system assumes that full bloom alfalfa has an RFV of 100; this legume is typically used as a baseline reference for grading forage. The RFV for each grass species within this study was calculated for all five growth stages. Results can be compared to the ranges given in the table below, developed by the American Forage and Grassland Council as a guideline for measuring forage quality.

Forage Grade	ADF	NDF	RFV
Prime	Under 30%	Under 40%	Over 151
1 (Premium)	31% - 35%	41% - 46%	150-125
2 (Good)	36% - 40%	47% - 53%	124-103
3 (Fair)	41% - 42%	54% - 60%	102-87
4 (Poor)	43% - 45%	61% - 65%	86-75
5 (Very Poor)	Over 46%	Over 66%	Under 74

Report of Findings

As expected, all grass species showed higher crude protein values during the vegetative and pre-boot (early growth cycle) stages. Decline in protein levels became evident after boot stage, though indigestible nutrients (fiber) began to increase. Other essential minerals like phosphorus (**P**), potassium (**K**), and Calcium (**Ca**) were measured in higher levels during the early growth stages and began to drop as plant species neared maturity. Acid and Neutral detergent fiber percentages increased steadily throughout the plant's life cycle, lowering the relative feed value and total digestible nutrients percentage of each forage species. On the graphs for each species

This nutrient assessment can assist growers in determining the best possible time to harvest forage based on the needs of their livestock and/or wildlife. If a grower seeks high quality and/or high nutrient forage, grasses should be harvested during an earlier growth such as the boot stage. When high production yield is the goal, grasses should be harvested later, during the anthesis and/or flowering stage. Scheduling the harvest based on stages of plant development can be a reliable way to obtain a desired yield and/or quality forage from year to year.

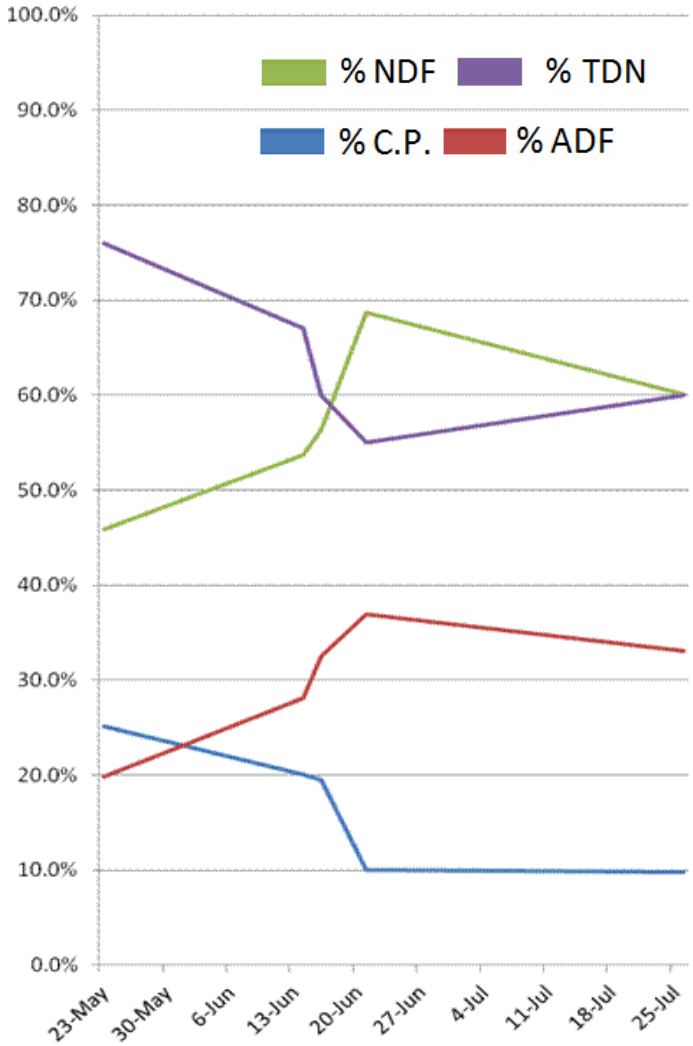
Graph Interpretation

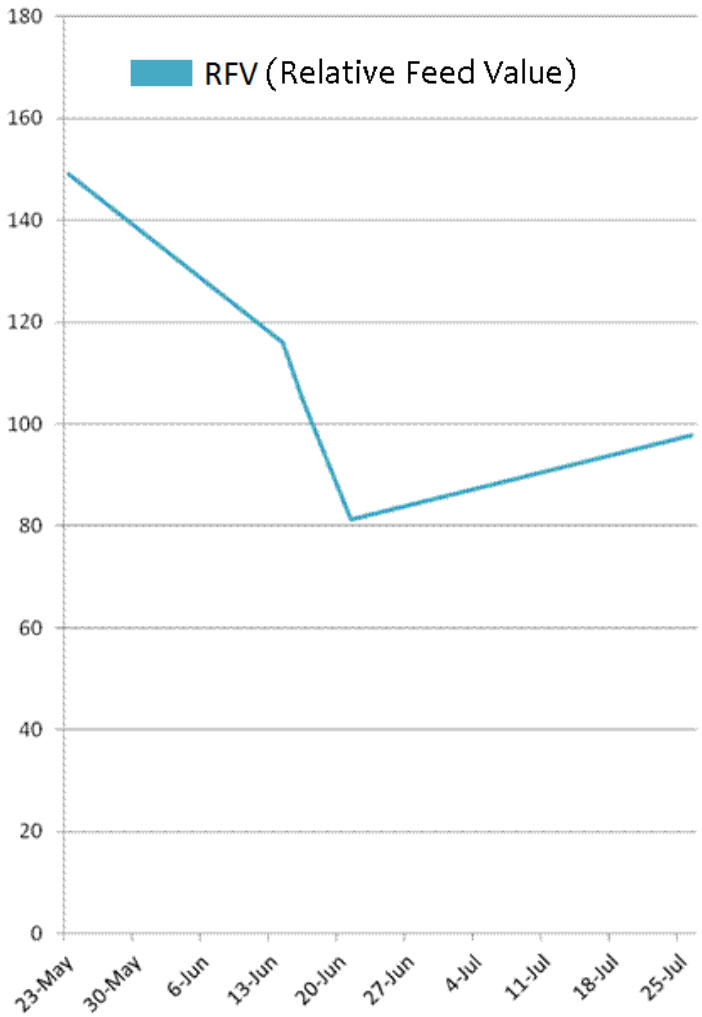
When interpreting data in the Nutrient Study, one should be aware of several characteristics associated with the following graphs. In general, Relative Feed Value (RFV), Crude Protein (CP) and Total Digestible Nutrient (TDN) values will decrease with time as a plant matures through the growing season. Contrarily, Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) values should typically increase with time and plant maturity. Pronounced increases or decreases (spikes) within the graphs can be attributed to the variability in randomly selected forage samples.

All data within the graphs of this study are displayed, so the reader may compare nutrient values and trends with other grass species. While not presented in graph form, values for phosphorus (P), potassium (K), calcium (Ca), in-vitro dry matter digestibility (IVDMD), metabolized energy, net energy, and dry matter (DM) are listed in a table for each grass species.

Alpine Bluegrass, *Poa alpina*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	25.11	0.28	1.77	0.51	19.82	45.88	77	76	1.33	0.92	149	95.8
Pre-Boot: June 14th	19.47	0.32	2.15	0.46	32.52	56.35	63	60	1.02	0.67	105	95.70
Boot: June 16th	20.03	0.38	2.51	0.43	28.12	53.67	69	67	1.14	0.77	116	95.52
Anthesis: June 21st	10.05	0.26	1.85	0.23	36.98	68.74	57	55	0.91	0.58	81	96.97
Ripening: July 26th	9.80	0.25	1.01	0.34	33.11	60.07	62	60	1.01	0.66	98	97.59



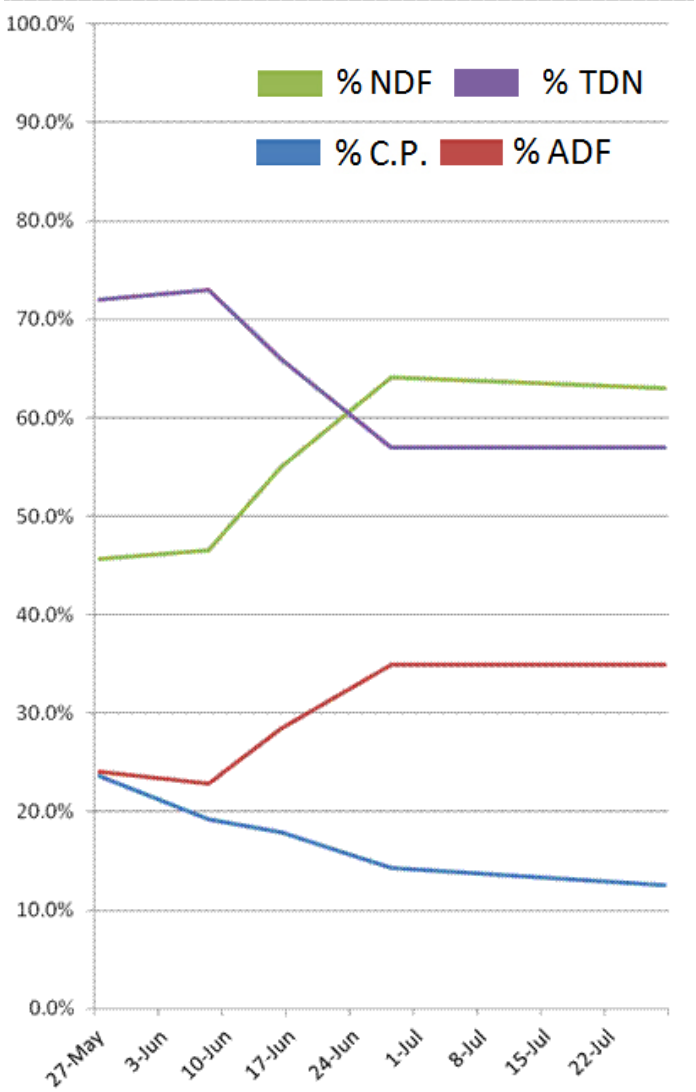


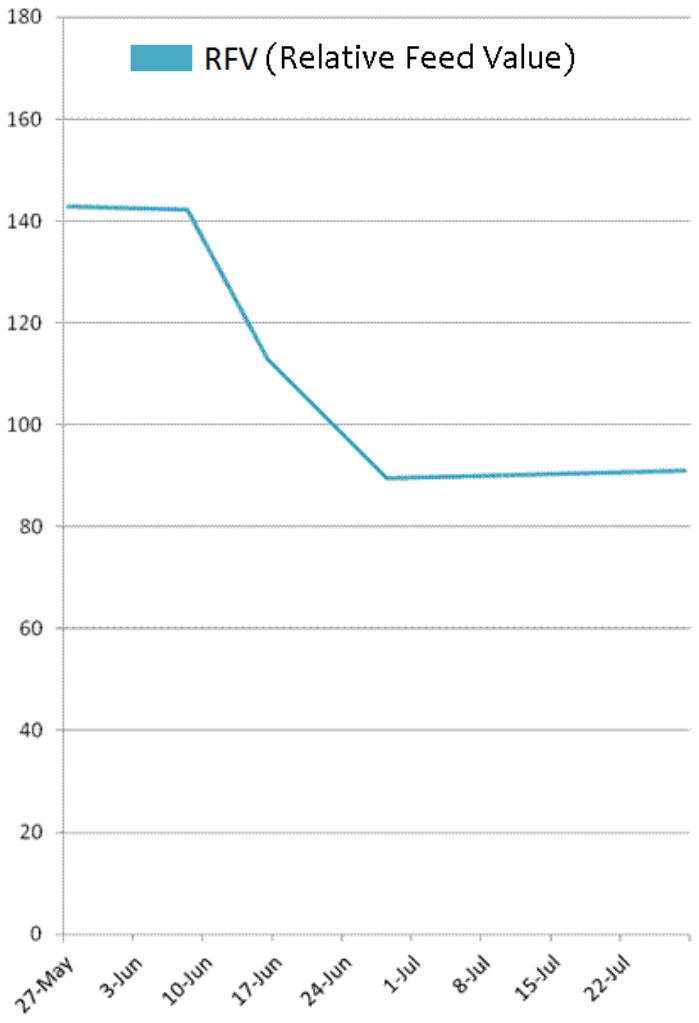
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	6.50	0.07	0.46	0.13	5.13	11.87	19.93	19.67	0.34	0.24	39.0	25.88
Pre-Boot: June 14th	5.09	0.08	0.56	0.12	8.50	14.74	16.47	15.69	0.27	0.18	27.4	26.15
Boot: June 16th	5.66	0.11	0.71	0.12	7.95	15.18	19.51	18.95	0.32	0.22	32.8	28.28
Anthesis: June 21st	2.60	0.07	0.48	0.06	9.55	17.76	14.72	14.21	0.24	0.15	21.0	25.83
Ripening: July 26th	4.17	0.11	0.43	0.14	14.09	25.56	26.00	26.00	0.43	0.28	42.00	42.55

American Sloughgrass, *Beckmannia syzigachne*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	23.61	0.26	1.73	0.33	24.07	45.64	74	72	1.25	0.86	143	95.86
Pre-Boot: June 8th	19.22	0.34	2.83	0.43	22.88	46.49	75	73	1.28	0.88	142	98.24
Boot: June 16th	17.91	0.30	3.30	0.27	28.44	54.99	68	66	1.14	0.76	113	95.97
Anthesis: June 28th	14.27	0.29	2.06	0.28	34.88	64.07	60	57	0.96	0.62	90	95.90
Ripening: July 28th	12.56	0.27	1.59	0.30	34.86	63.05	60	57	0.96	0.62	91	97.55





As Fed

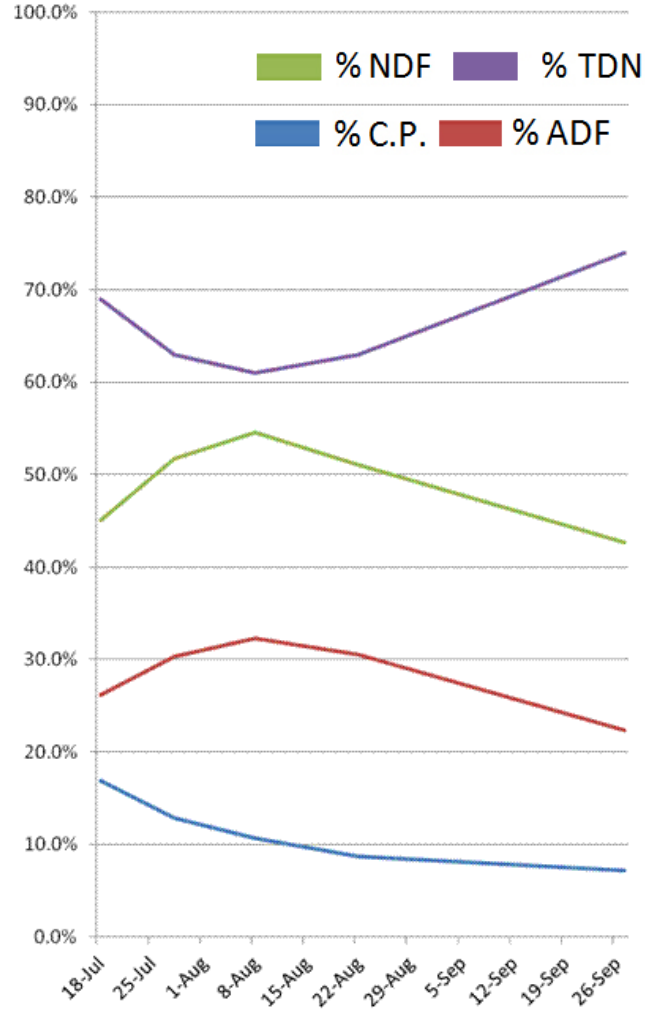
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	5.36	0.06	0.39	0.07	5.47	10.36	16.81	16.35	0.28	0.20	32.00	22.71
Pre-Boot: June 8th	2.57	0.04	0.38	0.06	3.06	6.23	10.04	9.77	0.17	0.12	19.04	13.39
Boot: June 16th	2.80	0.05	0.52	0.04	4.45	8.61	10.65	10.34	0.18	0.12	17.68	15.66
Anthesis: June 28th	2.50	0.05	0.36	0.05	6.12	11.24	11.00	10.00	0.17	0.11	16.00	17.55
Ripening: July 28th	4.33	0.09	0.55	0.10	12.01	21.72	21	20	0.33	0.21	31	34.56

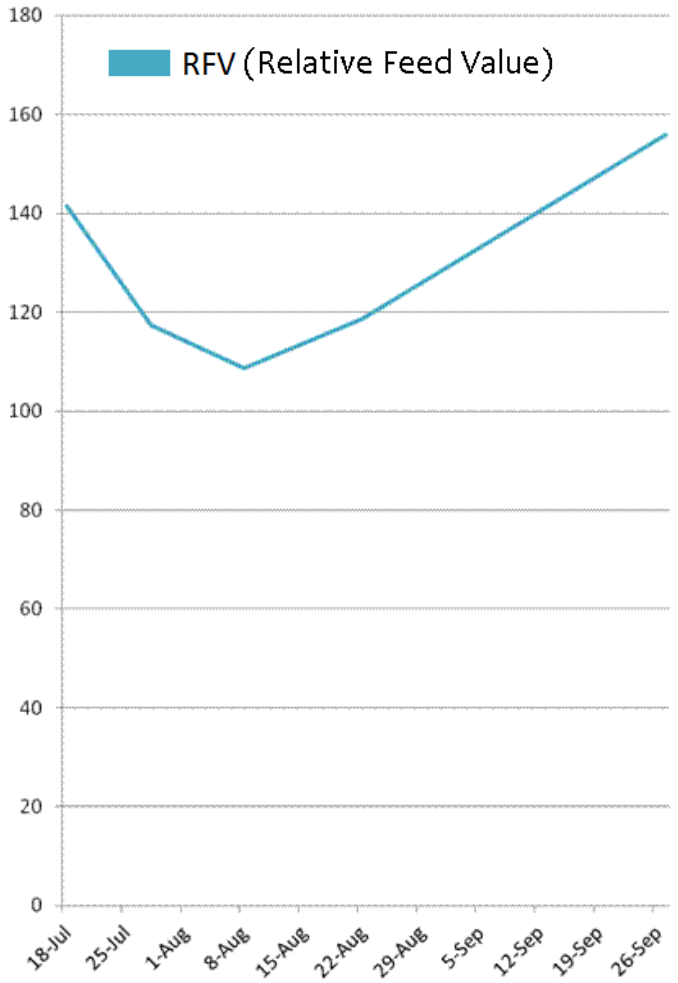
Annual Rye, *Lolium multiflorum*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 18th	16.86	0.35	4.15	0.59	26.18	45.06	71	69	1.20	0.81	141	97.13
Pre-Boot: July 28th	12.82	0.33	2.82	0.52	30.37	51.75	66	63	1.08	0.72	117	97.52
Boot: August 8th	10.73	0.25	1.71	0.48	32.34	54.52	63	61	1.03	0.68	109	97.28
Anthesis: August 22nd	8.70	0.25	1.27	0.46	30.52	51.06	65	63	1.08	0.72	119	97.69
Ripening: September 27th	7.15	0.23	0.59	0.32	22.40	42.62	75	74	1.29	0.89	156	96.98

* *note - this sample was not taken from an established field; samples were taken from 1st year planting - planting date June 25th*





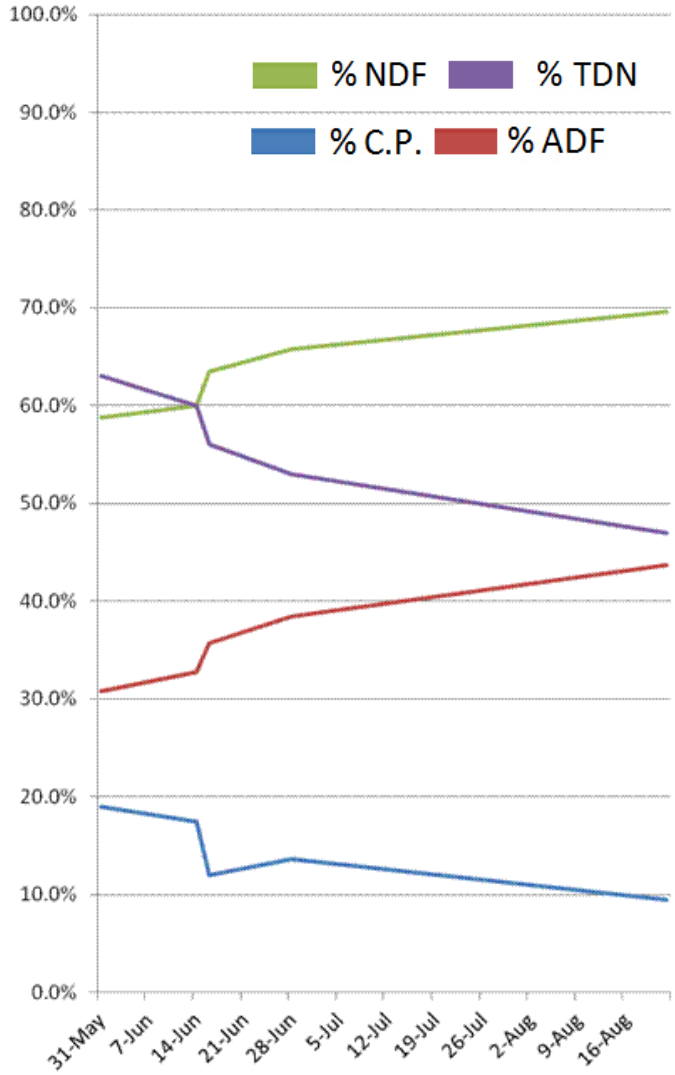
As Fed

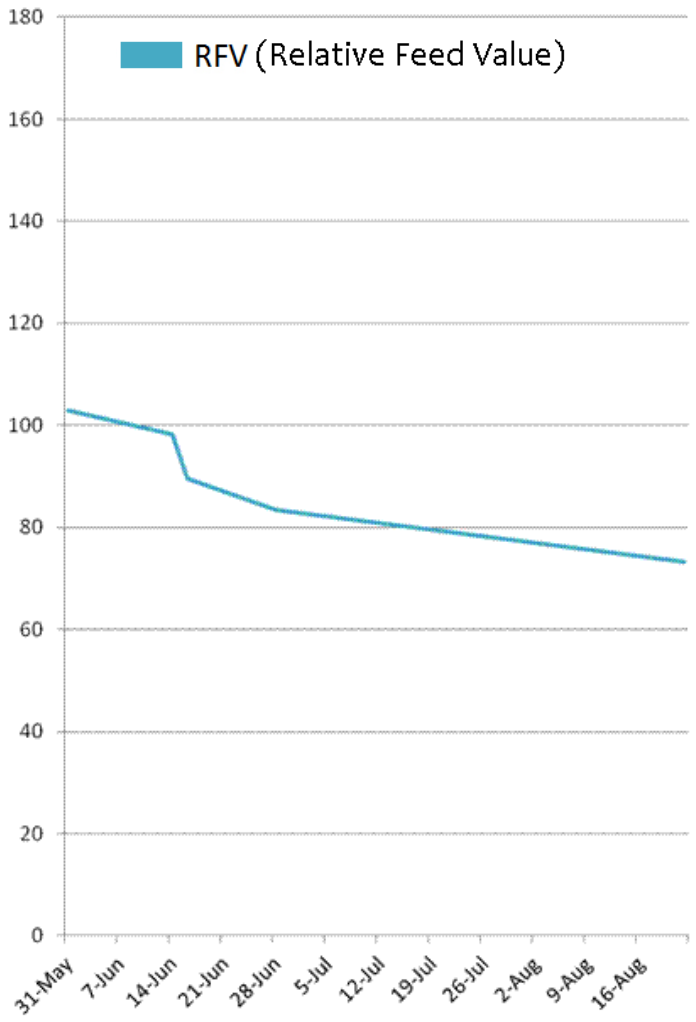
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 18th	1.91	0.04	0.47	0.07	2.97	5.11	8	8	0.14	0.09	16	11.34
Pre-Boot: July 28th	2.52	0.06	0.55	0.10	5.97	10.17	13	12	0.21	0.14	23	19.66
Boot: August 8th	2.93	0.06	0.38	0.11	7.20	12.14	14	14	0.23	0.15	24	22.26
Anthesis: August 22nd	2.52	0.07	0.37	0.13	8.85	14.80	19	18	0.31	0.21	34	28.99
Ripening: September 27th	2.95	0.09	0.24	0.13	9.25	17.60	31	31	0.53	0.37	64	41.30

* *note - this sample was not taken from an established field; samples were taken from 1st year planting - planting date June 25th*

Beach Wildrye, *Leymus mollis*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	19.01	0.18	2.60	0.13	30.75	58.73	65	63	1.07	0.71	103	96.31
Pre-Boot: June 14th	17.44	0.19	3.19	0.18	32.75	59.99	62	60	1.02	0.67	98	96.04
Boot: June 16th	11.97	0.21	2.92	0.26	35.67	63.47	59	56	0.94	0.61	90	95.56
Anthesis: June 28th	13.57	0.17	2.44	0.18	38.39	65.82	56	53	0.88	0.55	83	95.34
Ripening: August 22nd	9.46	0.10	2.27	0.23	43.70	69.61	50	47	0.76	0.46	73	98.42



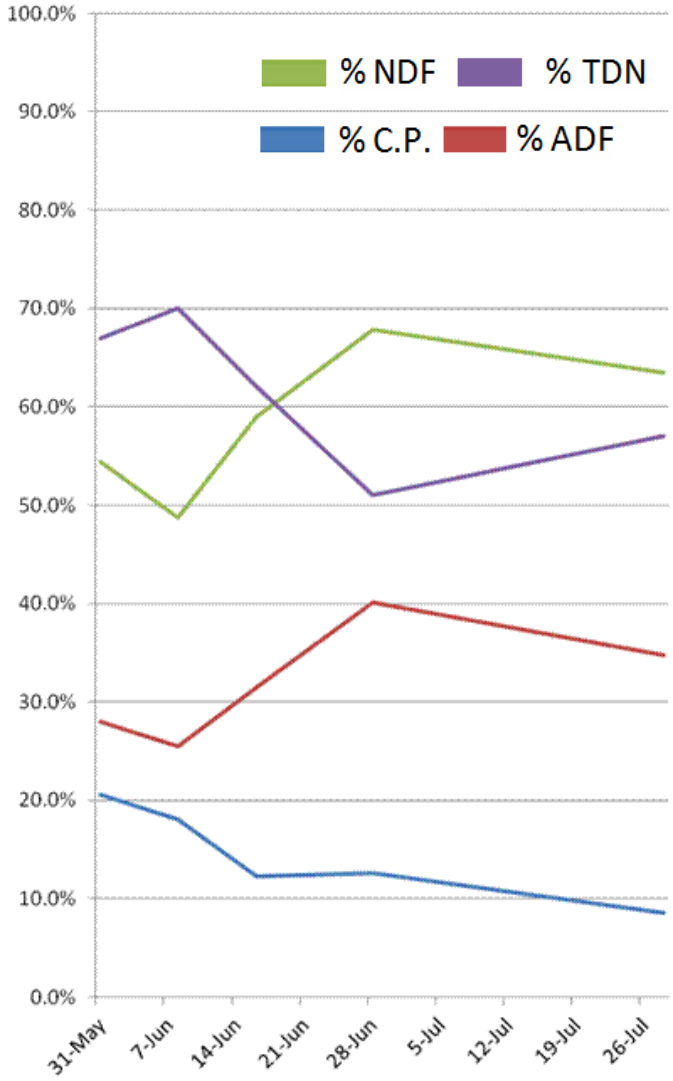


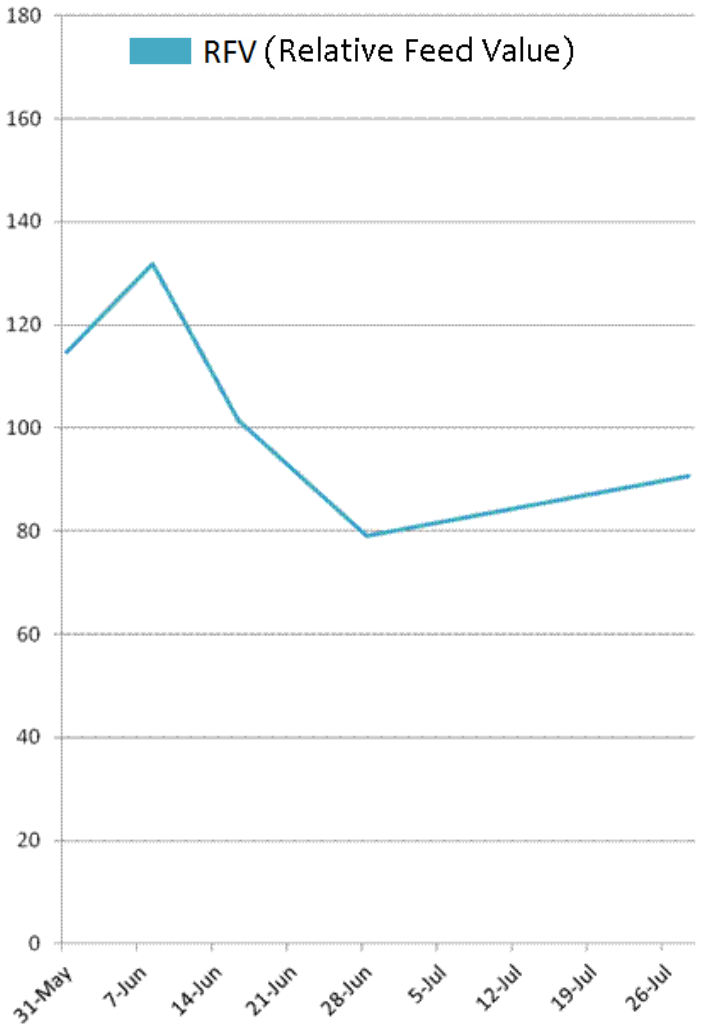
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	4.08	0.04	0.56	0.03	6.59	12.59	13.94	13.51	0.23	0.15	22.00	21.44
Pre-Boot: June 14th	3.37	0.04	0.62	0.03	6.33	11.60	11.99	11.60	0.20	0.13	19.01	19.34
Boot: June 16th	2.15	0.04	0.52	0.05	6.41	11.40	10.60	10.06	0.17	0.11	16.09	17.96
Anthesis: June 28th	2.59	0.03	0.47	0.03	7.31	12.54	11.00	10.00	0.17	0.10	16.00	19.05
Ripening: August 22nd	2.72	0.03	0.65	0.07	12.54	19.98	14.00	13.00	0.22	0.13	21.00	28.70

Bering Hairgrass, *Deschampsia beringensis*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	20.62	0.26	2.10	0.33	27.99	54.36	69	67	1.15	0.77	115	95.76
Pre-Boot: June 8th	18.10	0.25	1.93	0.44	25.43	48.72	72	70	1.22	0.83	132	98.40
Boot: June 16th	12.24	0.22	1.93	0.37	31.45	59.04	64	62	1.05	0.70	101	95.54
Anthesis: June 28th	12.64	0.19	1.11	0.37	40.09	67.86	54	51	0.84	0.52	79	95.40
Ripening: July 28th	8.57	0.15	1.45	0.35	34.80	63.42	60	57	0.96	0.62	91	97.74





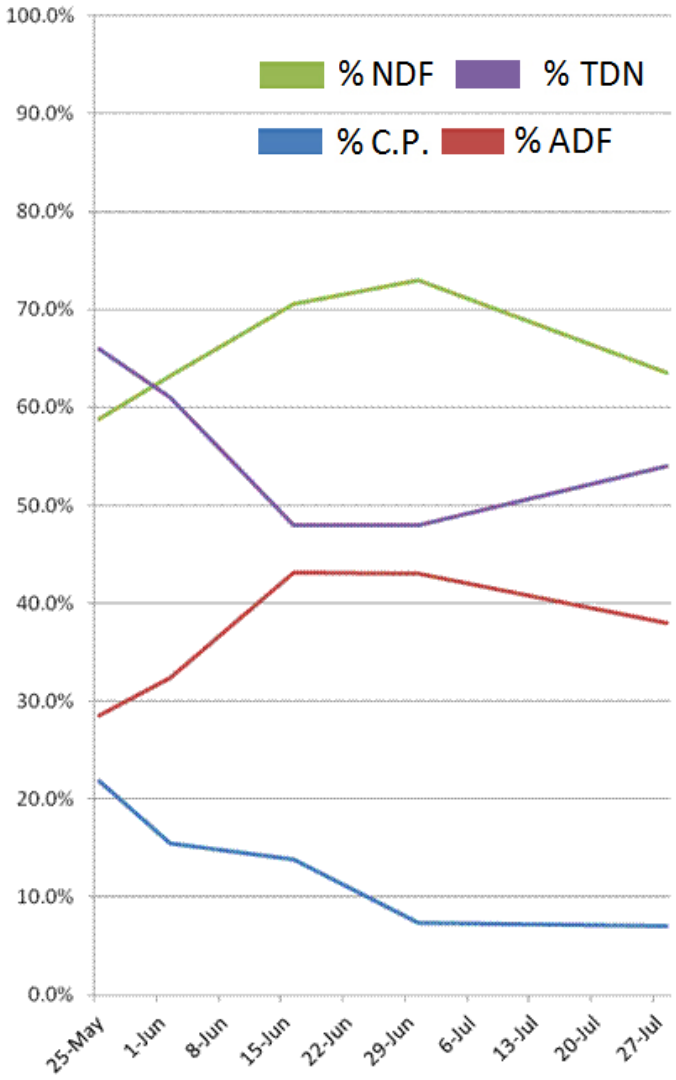
As Fed

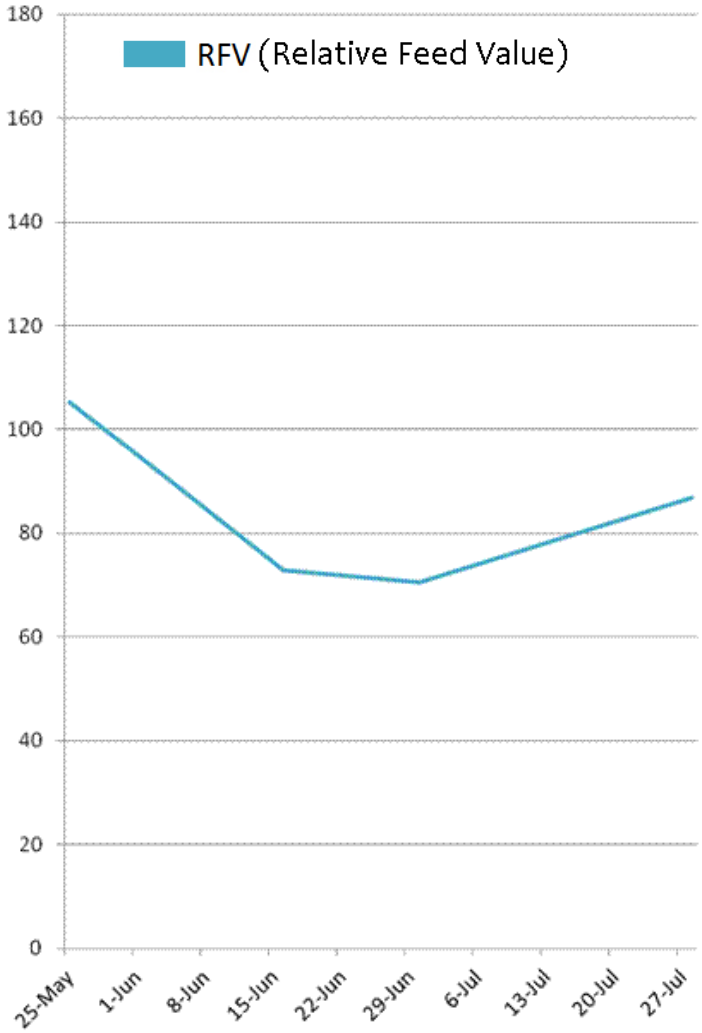
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	4.53	0.06	0.46	0.07	6.16	11.95	15.17	14.73	0.25	0.17	25.00	21.99
Pre-Boot: June 8th	4.15	0.06	0.44	0.10	5.83	11.17	16.50	16.04	0.28	0.19	30.24	22.92
Boot: June 16th	3.00	0.05	0.47	0.09	7.72	14.49	15.71	15.21	0.26	0.17	24.90	24.54
Anthesis: June 28th	3.42	0.05	0.30	0.10	10.84	18.34	15	14	0.23	0.14	21	27.03
Ripening: July 28th	2.67	0.05	0.45	0.11	10.84	19.75	19	18	0.30	0.19	28	31.14

Bluejoint Reedgrass, *Calamagrostis canadensis*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	21.89	0.26	3.11	0.22	28.56	58.85	68	66	1.13	0.76	105	96.51
Pre-Boot: June 2nd	15.45	0.26	2.36	0.22	32.41	63.18	63	61	1.03	0.68	94	96.28
Boot: June 16th	13.79	0.16	1.79	0.14	43.14	70.57	51	48	0.77	0.47	73	96.05
Anthesis: June 30th	7.39	0.13	1.12	0.14	43.04	72.94	51	48	0.78	0.47	71	95.58
Ripening: July 28th	7.08	0.15	0.77	0.27	37.98	63.51	56	54	0.89	0.56	87	98.06





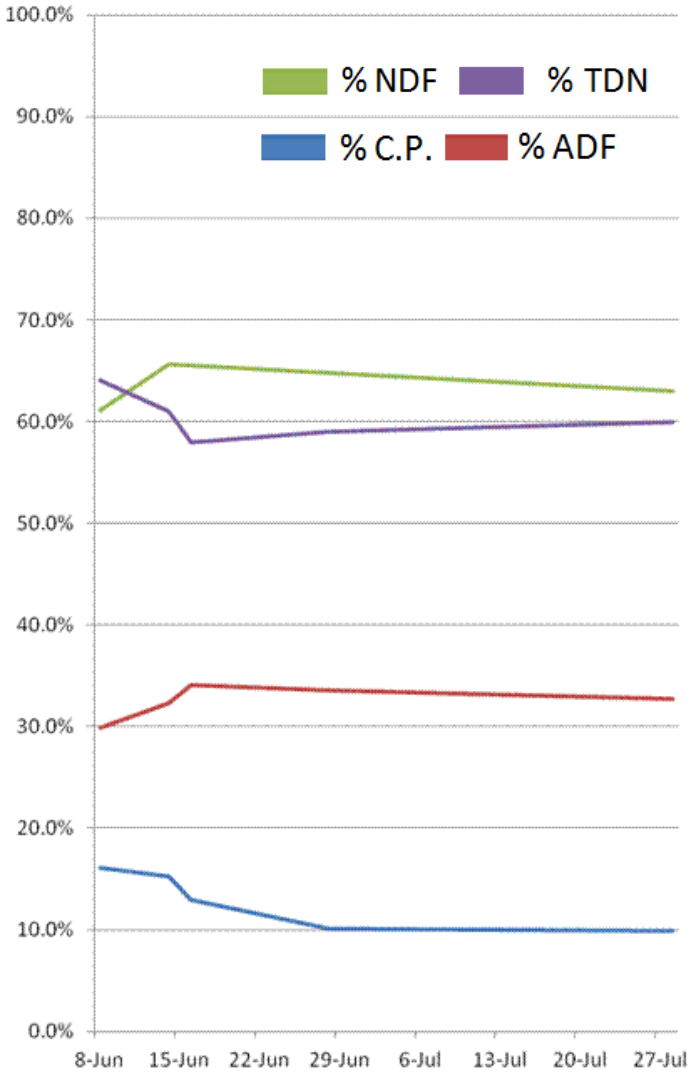
As Fed

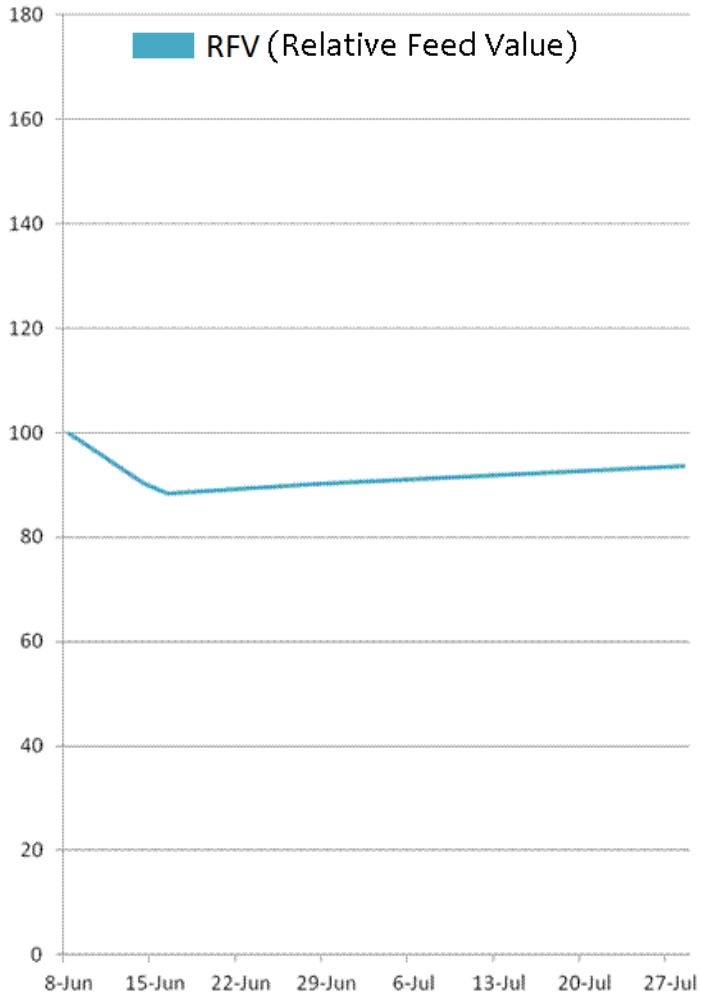
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	4.11	0.05	0.58	0.04	5.37	11.06	12.78	12.40	0.21	0.14	20.00	18.79
Pre-Boot: June 2nd	3.04	0.05	0.46	0.04	6.38	12.43	12.39	12.00	0.20	0.13	18.00	19.67
Boot: June 16th	3.66	0.04	0.47	0.04	11.44	18.71	13.52	12.72	0.20	0.12	19.32	27.51
Anthesis: June 30th	2.03	0.03	0.31	0.04	11.81	20.01	14	13	0.21	0.13	19	27.43
Ripening: July 28th	3.14	0.07	0.34	0.12	16.85	28.17	25	24	0.39	0.25	39	44.36

Kentucky Bluegrass, *Poa pratensis*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: June 8th	16.13	0.30	2.29	0.39	29.91	61.06	66	64	1.09	0.73	100	98.43
Pre-Boot: June 14th	15.29	0.25	2.17	0.36	32.33	65.64	63	61	1.03	0.68	90	95.70
Boot: June 16th	12.93	0.24	2.04	0.35	34.10	65.56	61	58	0.98	0.64	88	95.21
Anthesis: June 28th	10.17	0.20	1.26	0.40	33.58	64.77	61	59	0.99	0.65	90	95.30
Ripening: July 28th	9.95	0.20	1.60	0.64	32.76	63.03	62	60	1.02	0.67	94	98.01



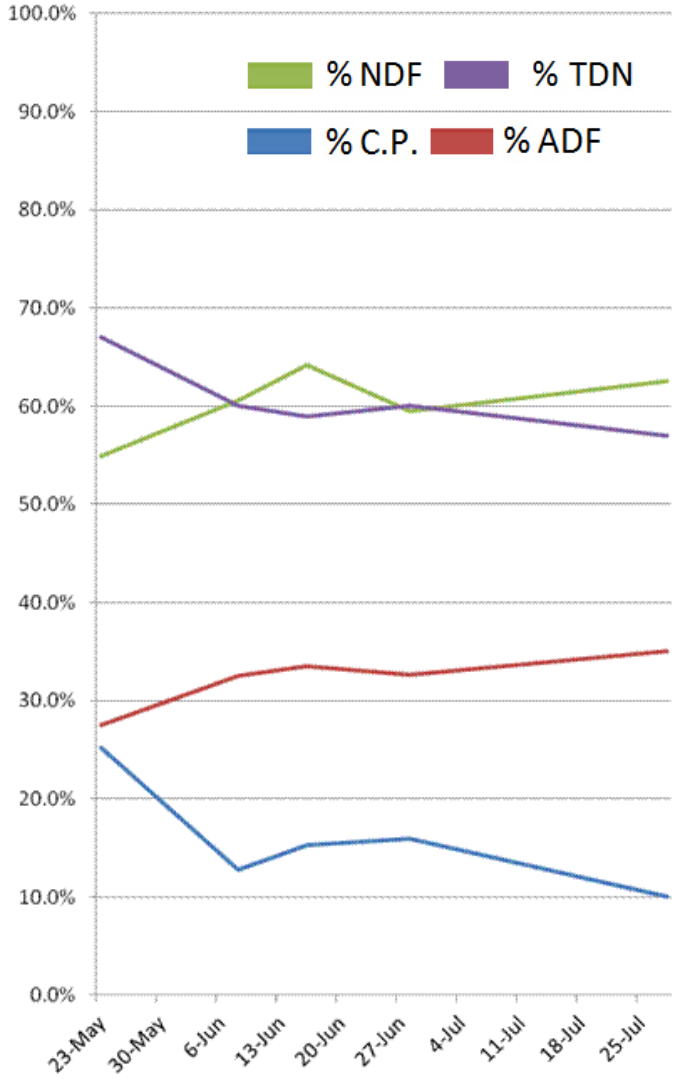


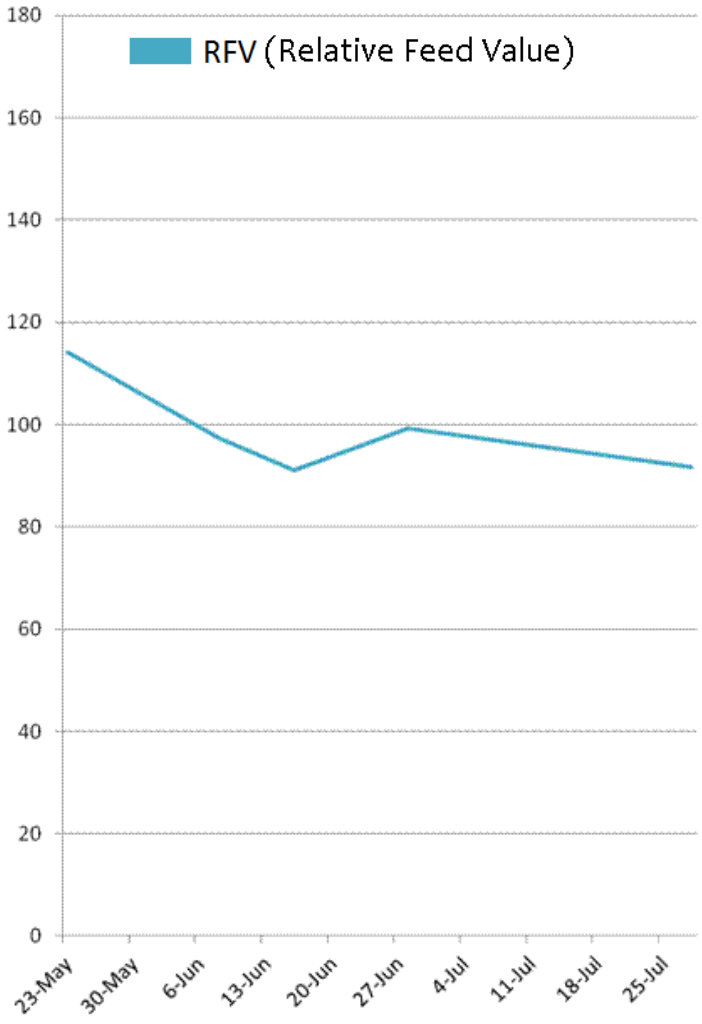
As Fed

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: June 8th	4.09	0.08	0.58	0.10	7.59	15.48	16.74	16.23	0.28	0.19	25.34	25.36
Pre-Boot: June 14th	3.46	0.06	0.49	0.08	7.31	14.85	14.25	13.80	0.23	0.15	20.42	22.62
Boot: June 16th	3.70	0.07	0.58	0.10	9.77	18.78	17.47	16.61	0.28	0.18	25.33	28.64
Anthesis: June 28th	3.87	0.08	0.48	0.15	12.78	24.66	23.00	22.00	0.38	0.25	34.00	38.07
Ripening: July 28th	3.81	0.08	0.61	0.25	12.55	24.15	24.00	23.00	0.39	0.26	36.00	38.32

Polargrass, *Arctagrostis latifolia*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	25.21	0.32	3.13	0.45	27.52	54.94	69	67	1.16	0.78	114	95.7
Pre-Boot: June 8th	12.74	0.26	2.61	0.36	32.57	60.64	63	60	1.02	0.67	97	98.57
Boot: June 16th	15.23	0.29	2.87	0.48	33.53	64.17	61	59	1.00	0.65	91	95.59
Anthesis: June 28th	15.96	0.26	1.81	0.43	32.63	59.54	63	60	1.02	0.67	99	95.55
Ripening: July 28th	10.02	0.20	1.77	0.47	35.02	62.57	60	57	0.96	0.62	92	97.91

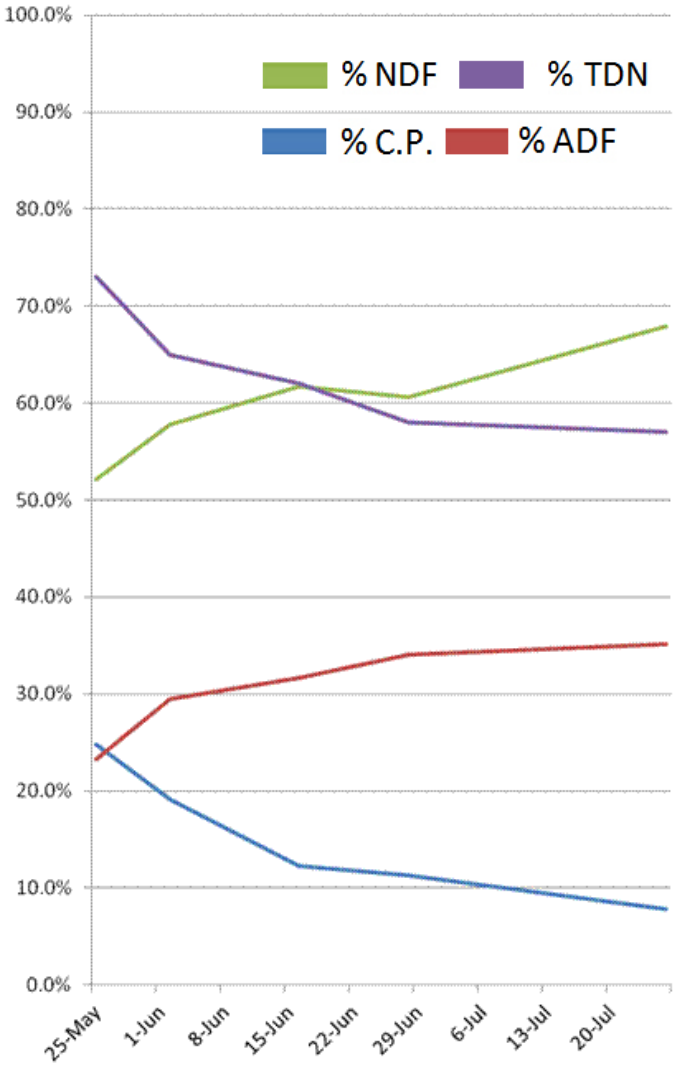


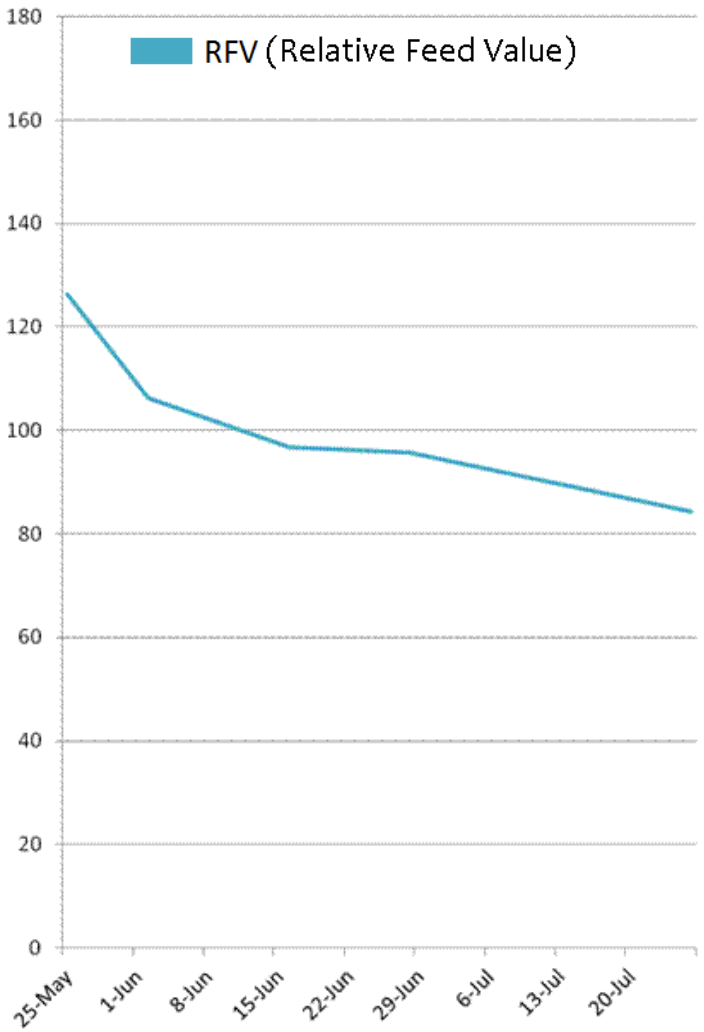


As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 23rd	4.25	0.05	0.53	0.08	4.64	19.26	11.63	11.29	0.20	0.13	19.00	16.85
Pre-Boot: June 8th	2.59	0.05	0.53	0.07	6.61	12.30	12.78	12.17	0.21	0.14	19.77	20.29
Boot: June 16th	3.20	0.06	0.60	0.10	7.04	13.48	12.81	12.39	0.21	0.14	19.11	21.00
Anthesis: June 28th	3.64	0.06	0.41	0.10	7.45	13.59	14	14	0.23	0.15	23	22.82
Ripening: July 28th	2.80	0.06	0.49	0.13	9.79	17.49	17	16	0.27	0.17	26	27.96

Red Fescue, *Festuca rubra*

Moisture Free												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	24.77	0.31	3.00	0.32	23.32	52.08	74	73	1.27	0.87	126	97.19
Pre-Boot: June 2nd	19.12	0.35	2.51	0.41	29.49	57.74	67	65	1.11	0.74	106	96.12
Boot: June 16th	12.32	0.28	2.75	0.35	31.60	61.74	64	62	1.05	0.69	97	95.86
Anthesis: June 28th	11.33	0.25	1.74	0.47	34.02	60.61	61	58	0.98	0.64	96	95.96
Ripening: July 26th	7.81	0.17	1.36	0.50	35.14	67.95	59	57	0.95	0.62	84	97.76



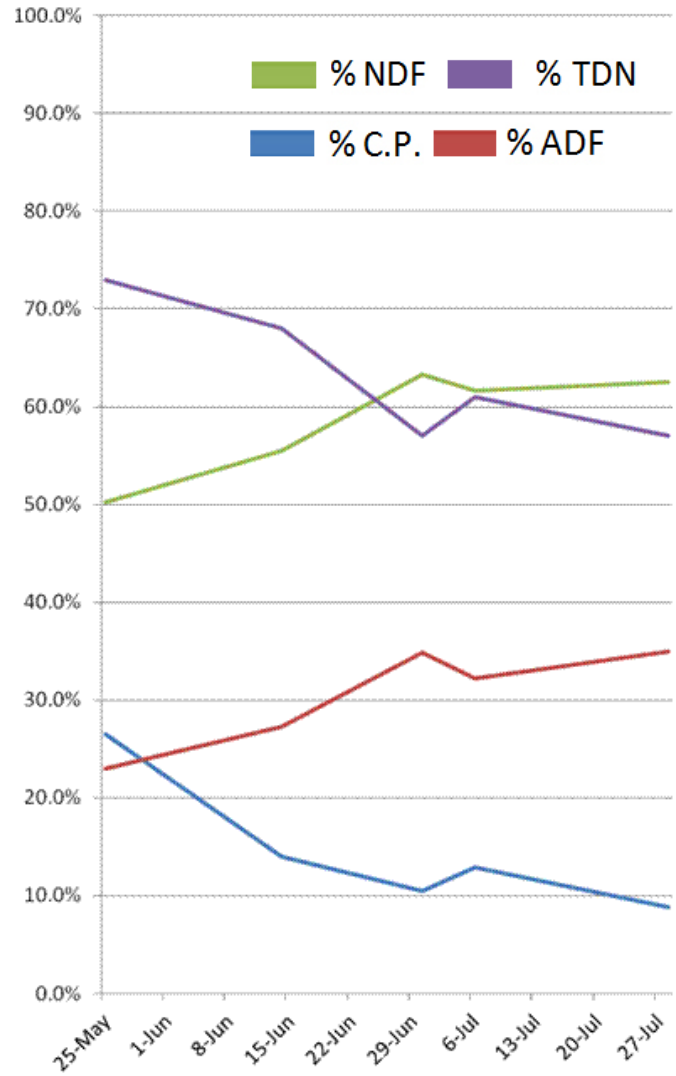


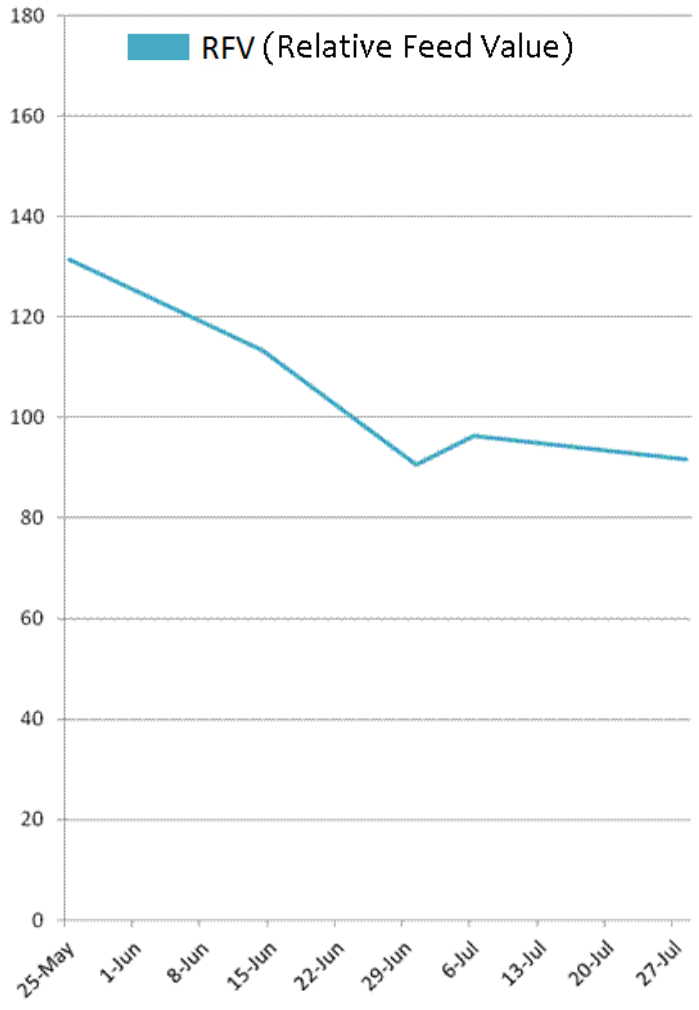
As Fed												
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	5.40	0.07	0.65	0.07	5.08	11.35	16.13	15.91	0.28	0.19	28.00	21.80
Pre-Boot: June 2nd	3.97	0.07	0.52	0.09	6.12	11.98	13.90	13.49	0.23	0.15	22.00	20.75
Boot: June 16th	3.16	0.07	0.71	0.09	8.10	15.82	16.40	15.88	0.27	0.18	24.81	25.62
Anthesis: June 28th	3.24	0.07	0.50	0.13	9.73	17.34	17.00	17.00	0.28	0.18	27.00	28.61
Ripening: July 26th	2.79	0.06	0.49	0.18	12.57	24.31	21.00	20.00	0.34	0.22	30.00	35.77

Siberian Wildrye, *Elymus sibiricus*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	26.48	0.26	2.97	0.35	22.95	50.23	75	73	1.28	0.88	132	97.03
Pre-Boot: June 14th	13.99	0.21	2.09	0.32	27.23	55.55	70	68	1.17	0.79	113	95.16
Boot: June 30th	10.43	0.15	1.39	0.26	34.85	63.34	60	57	0.96	0.62	91	95.27
Anthesis: July 6th	12.86	0.16	1.33	0.35	32.17	61.60	63	61	1.03	0.68	96	98.19
Ripening: July 28th	8.87	0.15	1.01	0.33	34.94	62.58	60	57	0.96	0.62	92	97.95





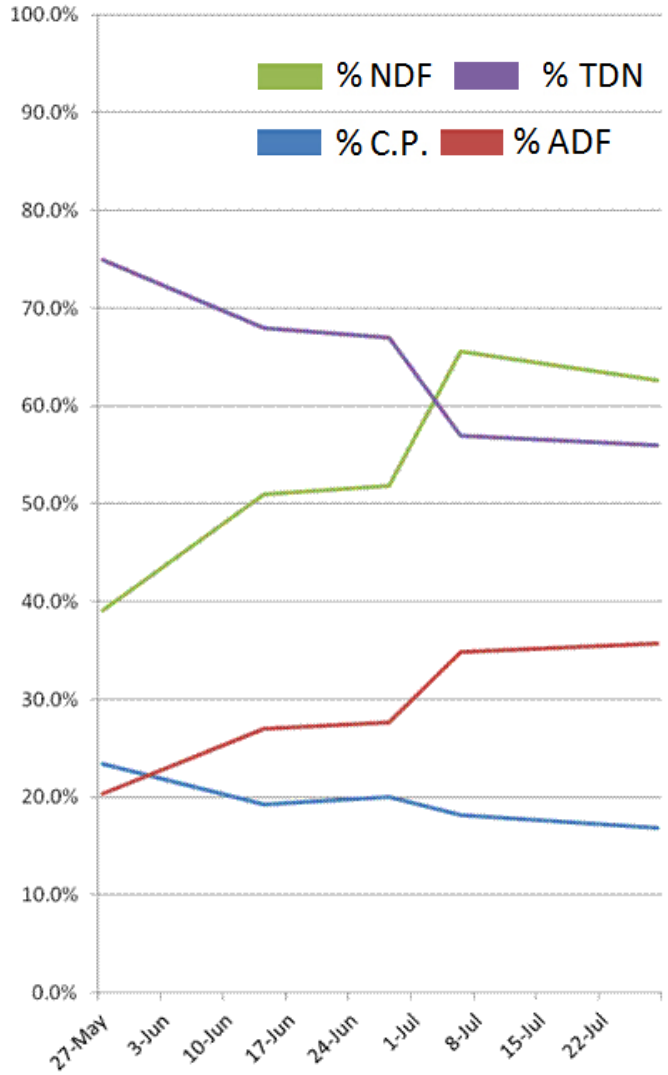
As Fed

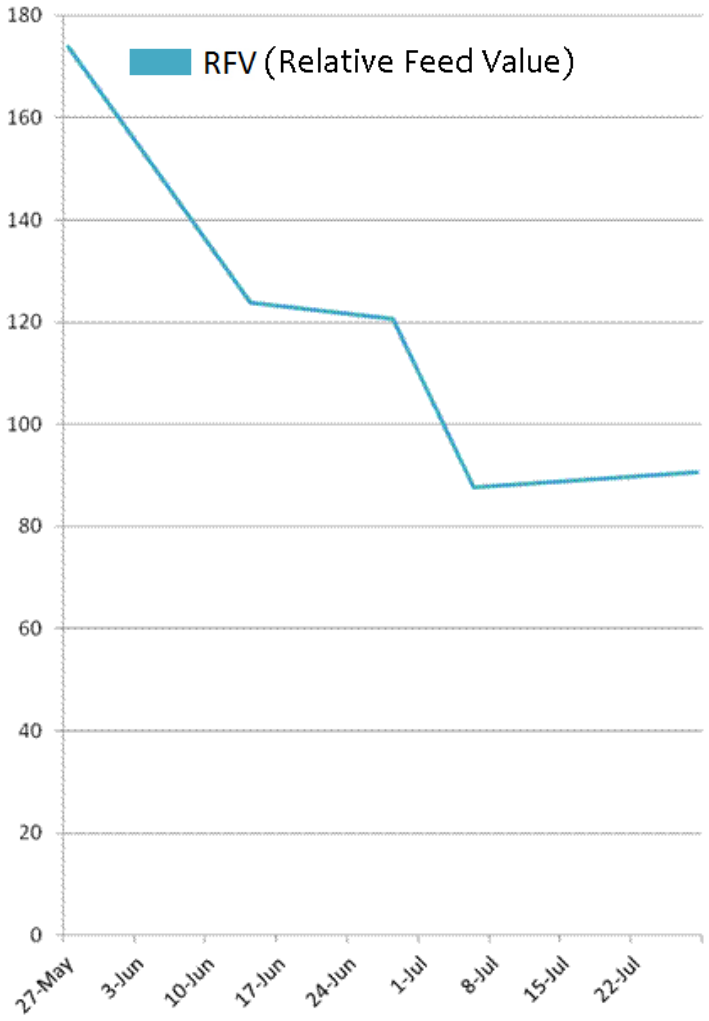
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 25th	5.67	0.06	0.64	0.08	4.92	10.76	16.07	15.64	0.27	0.19	28.00	21.43
Pre-Boot: June 14th	3.49	0.05	0.52	0.08	6.80	13.88	17.49	16.99	0.29	0.20	28.31	24.98
Boot: June 30th	2.65	0.04	0.35	0.07	8.85	16.08	15	14	0.24	0.16	23	25.39
Anthesis: July 6th	4.63	0.06	0.48	0.13	11.58	22.18	23	22	0.37	0.24	35	36.01
Ripening: July 28th	3.92	0.07	0.45	0.15	15.43	27.64	27	25	0.42	0.27	40	44.17

Slender Wheatgrass, *Elymus trachycaulus*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	23.43	0.23	2.67	0.34	20.36	39.09	77	75	1.32	0.91	174	96.04
Pre-Boot: June 14th	19.30	0.24	2.95	0.31	27.00	50.99	70	68	1.18	0.80	124	95.84
Boot: June 28th	20.02	0.25	2.03	0.48	27.69	51.87	69	67	1.16	0.78	121	95.20
Anthesis: July 6th	18.20	0.22	2.13	0.39	34.82	65.57	60	57	0.96	0.62	88	98.20
Ripening: July 28th	16.81	0.24	1.89	0.49	35.73	62.64	59	56	0.94	0.61	91	97.82





As Fed

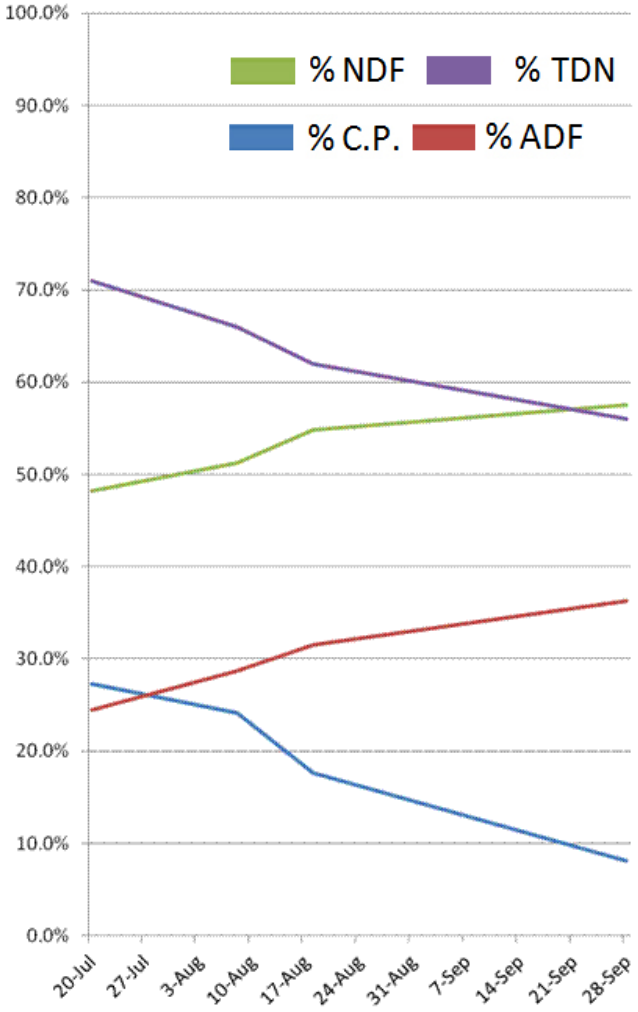
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	5.45	0.05	0.62	0.08	4.73	9.08	17.89	17.43	0.31	0.21	40.00	23.24
Pre-Boot: June 14th	4.28	0.05	0.65	0.07	5.99	11.30	15.52	15.08	0.26	0.18	27.45	22.17
Boot: June 28th	4.95	0.06	0.50	0.12	6.85	12.83	17.00	17.00	0.29	0.19	30.00	24.73
Anthesis: July 6th	4.41	0.05	0.52	0.09	8.44	15.89	15.00	14.00	0.23	0.15	21.00	24.24
Ripening: July 28th	5.53	0.08	0.62	0.16	11.75	20.26	19.00	18.00	0.31	0.20	30.00	32.89

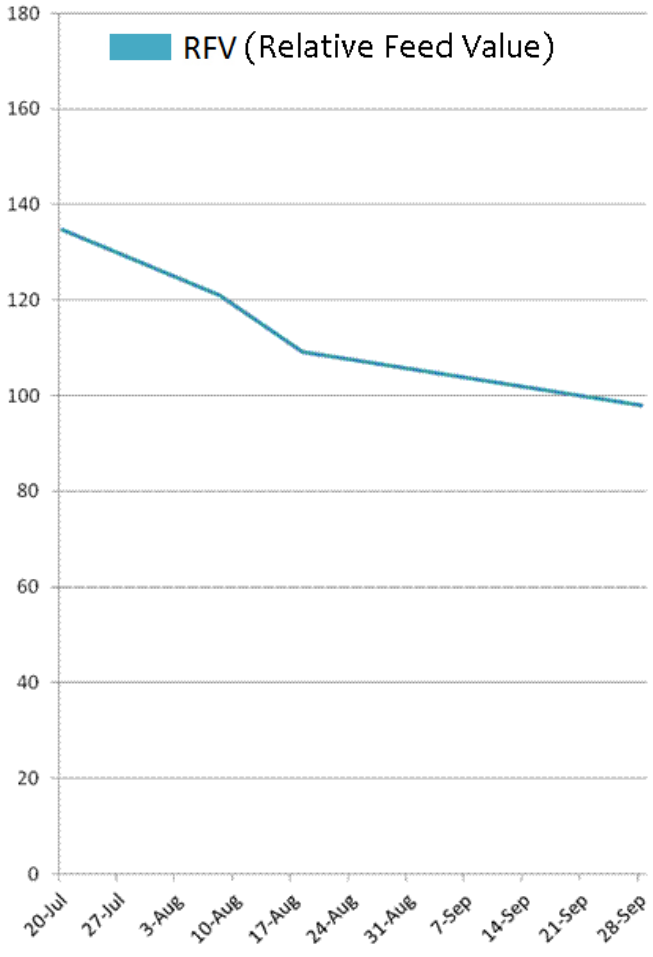
Smooth Brome, *Bromus inermis*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	27.33	0.39	3.51	0.33	24.46	48.24	73	71	1.24	0.85	135	97.44
Pre-Boot: August 8th	24.17	0.38	2.19	0.43	28.67	51.2	68	66	1.13	0.76	121	96.73
Boot: August 18th	17.67	0.31	2.36	0.38	31.53	54.82	64	62	1.05	0.69	109	97.97
Anthesis: September 28th	8.12	0.14	0.81	0.20	36.30	57.58	58	56	0.93	0.59	98	97.81

** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*





As Fed

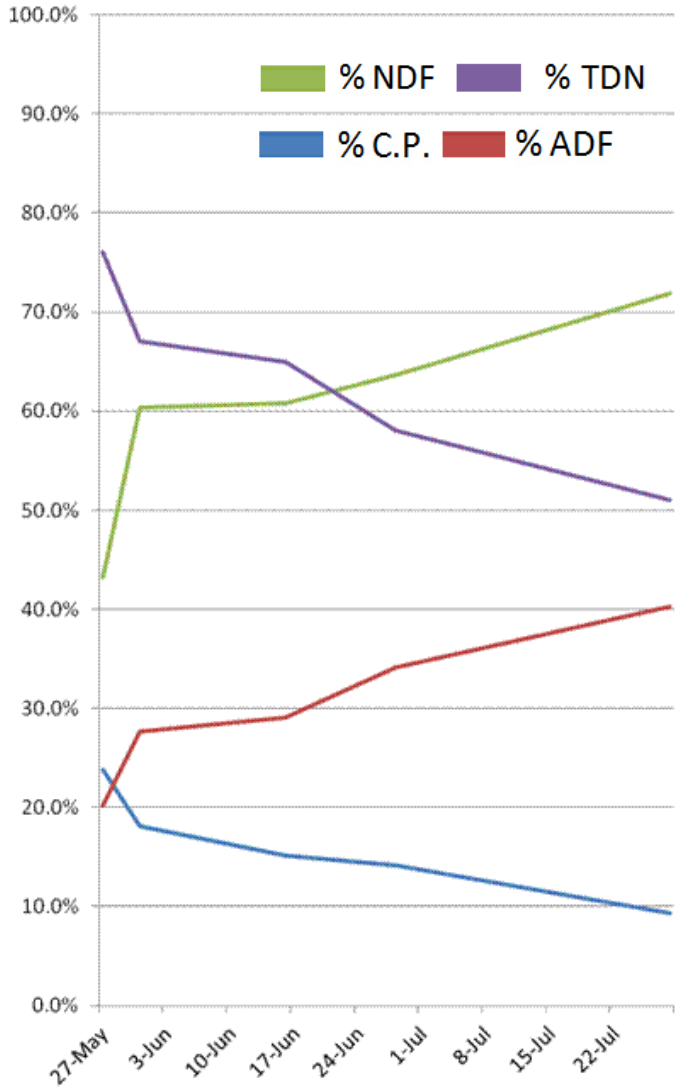
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	4.91	0.07	0.63	0.06	4.39	8.66	13.00	13.00	0.22	0.15	24.00	17.95
Pre-Boot: August 8th	3.74	0.06	0.34	0.07	4.43	7.92	11.00	10.00	0.17	0.12	19.00	15.46
Boot: August 18th	3.41	0.06	0.46	0.07	6.09	10.59	12.00	12.00	0.20	0.13	21.00	19.31
Anthesis: September 28th	2.84	0.05	0.28	0.07	12.68	20.12	20.00	20.00	0.32	0.21	34.00	34.94

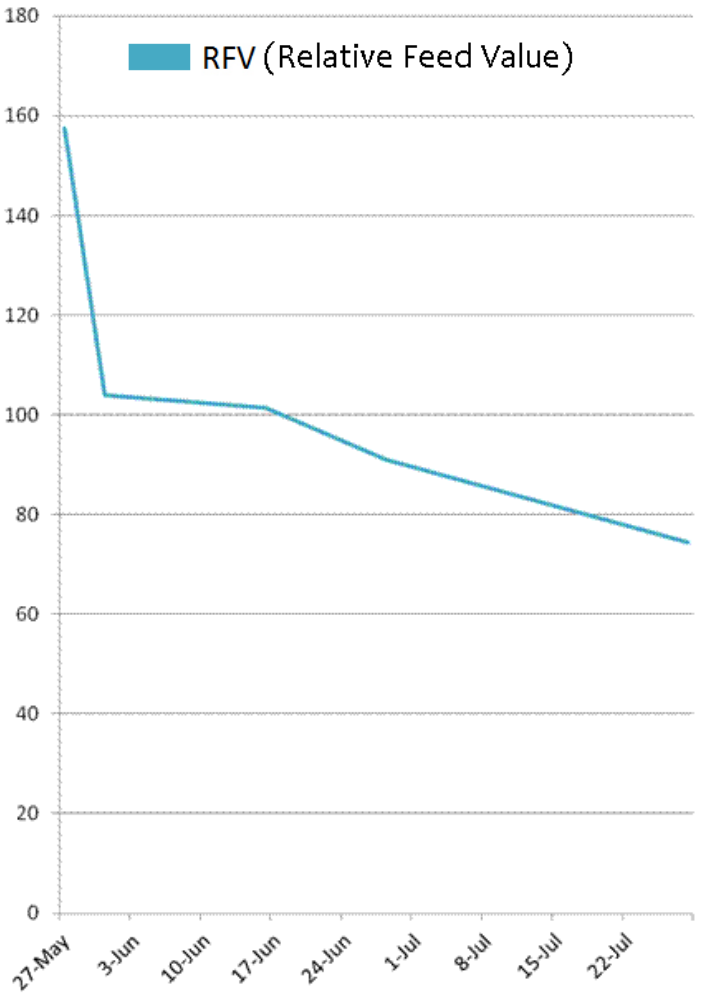
** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*

Spike Trisetum, *Trisetum spicatum*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	23.86	0.22	1.81	0.33	20.19	43.24	77	76	1.32	0.92	157	96.13
Pre-Boot: May 31st	18.12	0.27	1.94	0.28	27.64	60.34	69	67	1.16	0.78	104	95.89
Boot: June 16th	15.17	0.22	1.72	0.24	29.07	60.75	67	65	1.12	0.75	101	95.58
Anthesis: June 28th	14.15	0.21	1.39	0.29	34.17	63.65	61	58	0.98	0.64	91	95.44
Ripening: July 28th	9.32	0.19	1.21	0.40	40.25	71.91	54	51	0.84	0.52	74	97.93





As Fed

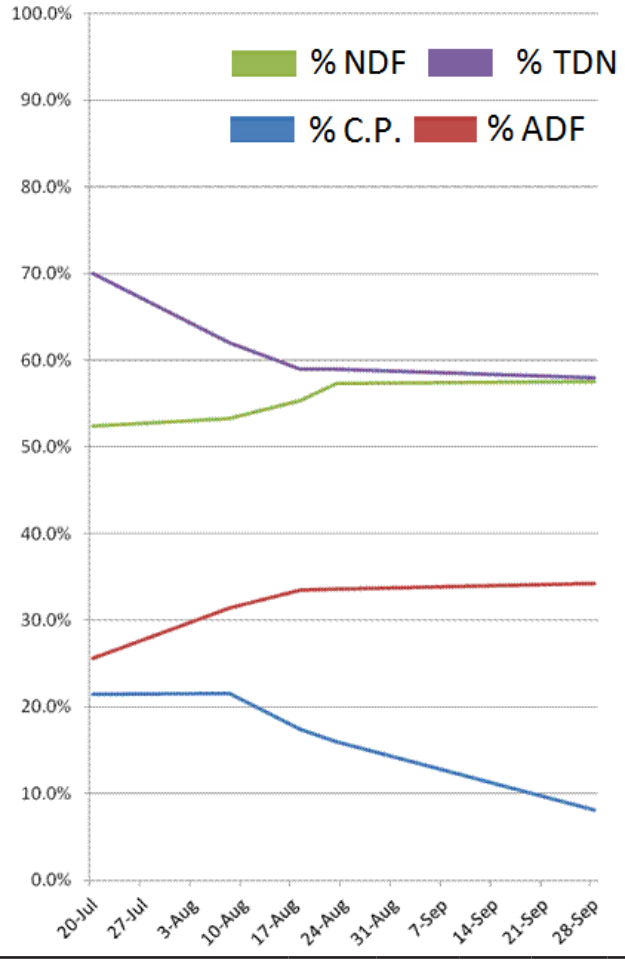
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 27th	5.81	0.05	0.04	0.08	4.92	10.53	18.75	18.51	0.32	0.22	38.00	24.35
Pre-Boot: May 31st	4.38	0.07	0.47	0.07	6.68	14.59	16.68	16.20	0.28	0.19	25.00	24.18
Boot: June 16th	4.91	0.07	0.56	0.08	9.41	19.67	21.69	21.05	0.36	0.24	32.85	32.38
Anthesis: June 28th	4.85	0.07	0.48	0.10	11.71	21.81	21.00	20.00	0.34	0.22	31.00	34.27
Ripening: July 28th	4.33	0.09	0.56	0.19	18.70	33.40	25.00	24.00	0.39	0.24	35.00	46.45

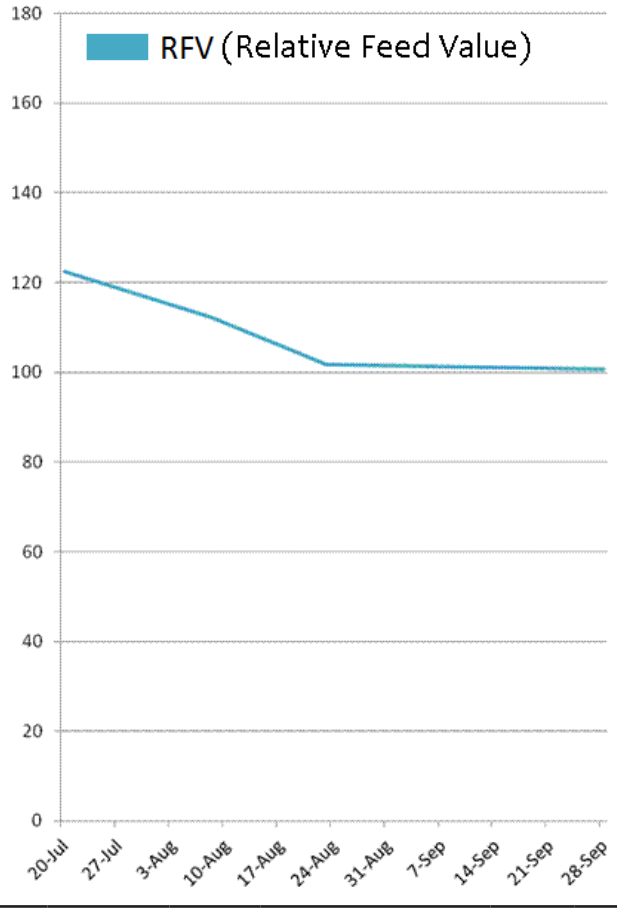
Timothy, *Phleum pratense*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	21.43	0.35	3.09	0.29	25.61	52.39	72	70	1.21	0.83	122	97.41
Pre-Boot: August 8th	21.53	0.34	2.63	0.37	31.42	53.33	64	62	1.05	0.70	112	97.00
Boot: August 18th	17.42	0.27	2.05	0.27	33.53	55.41	61	59	1.00	0.65	105	97.96
Anthesis: August 23rd	15.95	0.26	1.71	0.34	33.57	57.38	61	59	0.99	0.65	102	98.01
Ripening: September 28th	8.12	0.15	1.01	0.11	34.20	57.58	61	58	0.98	0.64	101	97.73

** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*





As Fed

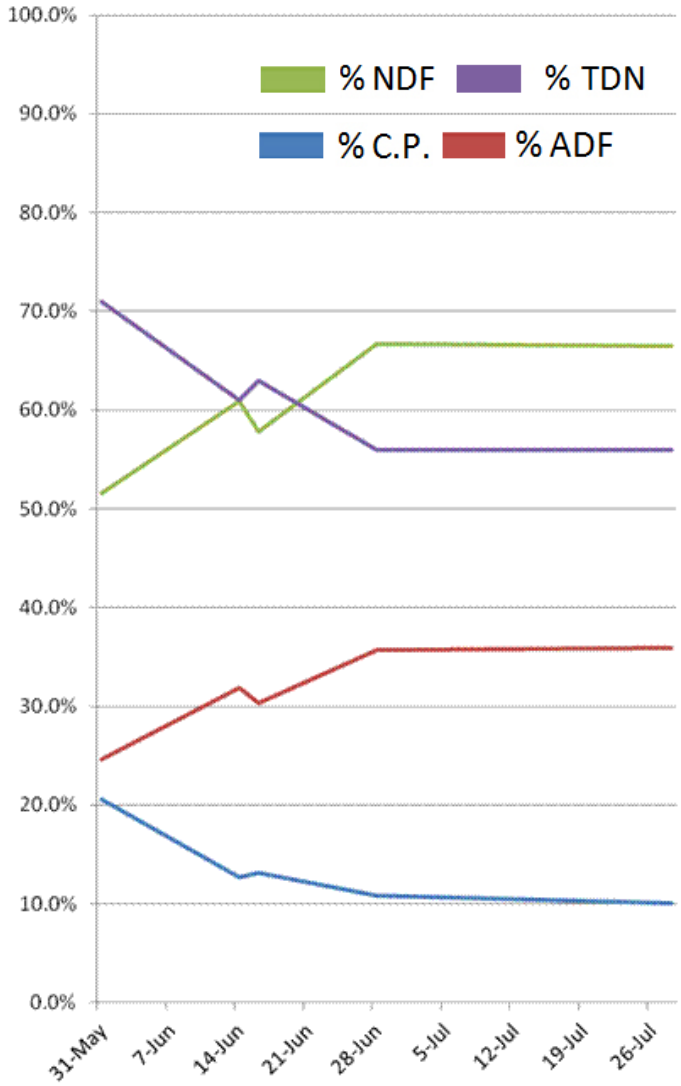
Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: July 20th	4.02	0.07	0.58	0.05	4.80	9.82	13.00	13.00	0.23	0.16	23.00	16.74
Pre-Boot: August 8th	3.43	0.05	0.42	0.06	5.01	8.50	10.00	10.00	0.17	0.11	18.00	15.94
Boot: August 18th	3.71	0.06	0.44	0.06	7.14	11.8	13	13	0.21	0.14	22	21.3
Anthesis: August 23rd	3.24	0.05	0.35	0.07	6.82	11.66	12.00	12	0.20	0.13	21.00	20.32
Ripening: September 28th	2.51	0.05	0.31	0.03	10.56	17.78	19	18	0.3	0.2	31	30.88

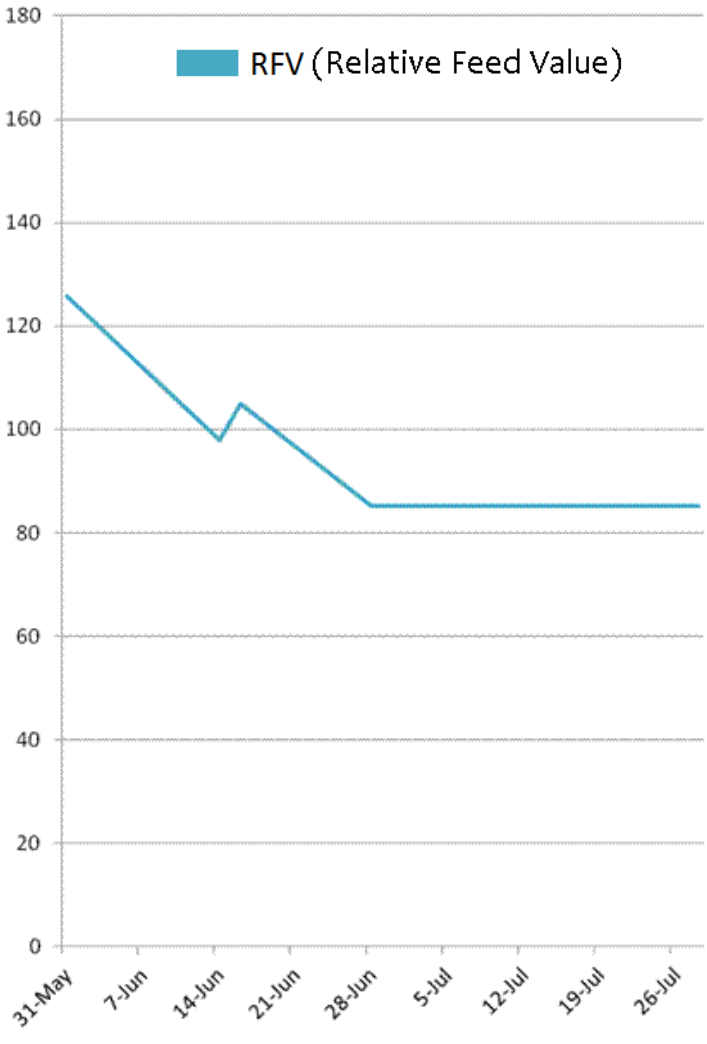
** note - sample was not taken from the PMC, instead came from established nearby hayfield. Samples were collected after 1st hay cutting was harvested*

Tufted Hairgrass, *Deschampsia cespitosa*

Moisture Free

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	20.54	0.27	2.07	0.34	24.64	51.59	73	71	1.24	0.85	126	95.85
Pre-Boot: June 14th	12.67	0.27	2.15	0.34	31.87	60.86	64	61	1.04	0.69	98	95.73
Boot: June 16th	13.11	0.31	2.79	0.40	30.38	57.84	66	63	1.08	0.72	105	95.84
Anthesis: June 28th	10.89	0.26	1.63	0.30	35.69	66.71	59	56	0.94	0.61	85	95.28
Ripening: July 28th	10.09	0.18	1.42	0.46	35.95	66.50	59	56	0.93	0.60	85	97.95





As Fed

Growth Phase	% CP	% P	% K	% Ca	% ADF	% NDF	% IVDMD (est.)	% TDN	Metab. Energy (MCal / Lb)	Net Energy (MCal / Lb)	RFV	% DM
Vegetative: May 31st	5.18	0.07	0.52	0.09	6.22	13.02	18.42	17.91	0.31	0.21	32.00	25.23
Pre-Boot: June 14th	2.71	0.06	0.46	0.07	6.83	13.04	13.71	13.07	0.22	0.15	20.98	21.42
Boot: June 16th	3.26	0.08	0.69	0.10	7.55	14.38	16.41	15.66	0.27	0.18	26.08	24.86
Anthesis: June 28th	3.32	0.08	0.50	0.09	10.89	20.35	18	17	0.29	0.19	26	30.50
Ripening: July 28th	3.57	0.06	0.5	0.16	12.71	23.51	21	20	0.33	0.21	30	35.35

Appendix B: Seed Specifications / Certification

Seed Specifications

Quality seed is critical to success. Specifying "certified" seed assures quality because the seed must meet certain standards for germination and purity; certification also provides some assurance of genetic quality.

Alaska Certified seed tags

Some native seed species are not available as certified seed. Seed quality can still be ascertained by examining percent germination and percent purity; information that will be clearly labeled for any seed sold in Alaska. This labeling is required by 11 AAC, chapter 34: Seed Regulations.

The true cost of seed can be determined by the Pure Live Seed calculation. To calculate Pure Live Seed (PLS), use the equation:

$$PLS = \left[\frac{\text{Germination \%} \quad x \quad \text{Purity \%}}{100} \right]$$

The true price of seed, then, can be determined using the equation:

$$\text{Price}_{PLS} = \left[\frac{\text{Bulk cost of seed / lb} \quad x \quad 100}{PLS} \right]$$

These calculations can increase the accuracy of bid comparisons. PLS price is a good method of comparing different seed lots at time of purchase. All seed sold or used in the state of Alaska must also be free of noxious weeds, under **11 AAC 34.075**. This is noted on seed tags, along with germination and purity.

Seeding Rates

When determining seeding rates, divide the desired seeding rate by the percent germination of the seed being used. For example, to achieve a 10 lbs/ acre seeding rate with seed having an 80% PLS (determined using the equation above), 10 lbs / .80 indicates that 12.5 lbs / acre should be used. If problems occur or questions arise regarding seed, call the Alaska Plant Materials Center at (907) 745-4469.

Seed stored on site should be kept cool, dry, and in rodent-free areas. Remember seed is a living commodity. A bag may contain seed; however some percentage may be dead husks - the equivalent of cadavers. Always buy seed based on the PLS Calculation.

Certified Seed

The term "certified seed" can be used in two different situations. The official use of the term Certified seed (with a capital C) is to describe seed that has been grown under the rules of the Seed Certification Program. Certified seed is the usual commercial category of seed. Its ancestry can be traced back to Registered Class or Foundation Class seed. In addition, Certified seed must meet various standards of purity and germination. These standards are a means of verifying authenticity of a seed source. All Alaska developed seed varieties or cultivars can be sold as either Certified or common.

Seed can also be certified (without a capital C) to be free of weeds or as meeting a minimum germination standard (**11 AAC 34.075**). This has nothing to do with variety identification — it simply indicates the quality of the seed. In other words, the buyer knows quality, but has no assurance of type (other than species).

Certified seed should be used when available. Seed produced in Alaska is easy to trace to its origin. It may be classified as common (uncertified) 'Arctared', but it is still 'Arctared'. Minimum purities and germination should always be stated with orders. Common seed is a usable product and may be used to meet demands. Common seed should meet Certified standards with regard to germination and purity, although these standards may need to be relaxed to acquire sufficient material for a large job. Lower germination rates can be overcome by increasing the seeding rate. Lower purities, however, should be avoided, as weeds can become a problem.

Pre-certified class seed tags

Other Certification Classes

When purchasing seed, a buyer should be aware of the differences between certification classes. Many new sources of native seed are being developed in Alaska. Generally, these will not be sold as Certified seed. They may carry the following designations: 'Source Identified', 'Tested', or 'Selected'. These classes will be consistent with the certification standards of germination and purity, however the term 'Certified seed' will not apply. These classes are called 'Pre-certified' classes.

Appendix C: Prohibited & Restricted Noxious Weeds

(A) The following are prohibited noxious weeds:

Photo: Steve Dewey, Utah State University | Bugwood.org

Field bindweed (*Convolvulus arvensis*)

Photo: Elizabeth Bella, USDA Forest Service | Bugwood.org

Austrian fieldcress (*Rorippa austriaca*)

Photo: John D. Byrd, Mississippi State University | Bugwood.org

Galensoga (*Galensoga parviflora*)

Photo: Tom Huette, USDA Forest Service | Bugwood.org

Hempnettle (*Galeopsis tetrahit*)

Photo: Ted Bodner, Southern Weed Science Society | Bugwood.org

Horsenettle (*Solanum carolinense*)

Photo: Steve Dewey, Utah State University | Bugwood.org

Russian Knapweed (*Acroptilon repens*)

Photo: Mary Ellen Harte | Bugwood.org

Blue-flowering lettuce (*Lactuca pulchella*)

Photo: Steve Dewey, Utah State University | Bugwood.org

Quackgrass (*Elymus repens*)

Photo: Michael Rasy, University of Alaska | Bugwood.org

Perennial sowthistle (*Sonchus arvensis*)

Photo: William M. Ciesla, Forest Health Mgmt. Intl. | Bugwood.org

Leafy spurge (*Euphorbia esula*)

Photo: Steve Dewey, Utah State University | Bugwood.org

Canada thistle (*Cirsium arvense*)

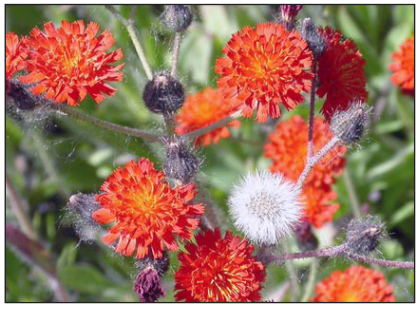
Photo: Mary Ellen Harte | Bugwood.org

Whitetops and its varieties (*Cardaria draba, C. pubescens, Lapidium latifolium*)

Photo: John D. Byrd, Mississippi State University | Bugwood.org

Purple loosestrife (*Lythrum salicaria*)

Photo: Michael Shephard, USDA Forest Service | Bugwood.org



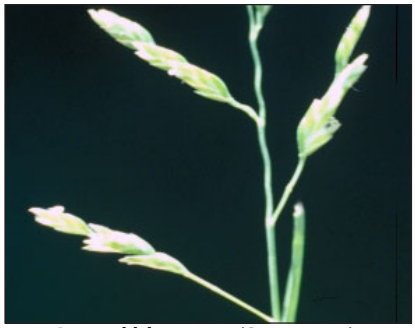
Orange hawkweed (*Hieracium aurantiacum*)

Statutory Authority:
AS 03.05 010
AS 03.05.030
AS 44.37.030
11AAC 34.020

This list is available online, at:
plants.alaska.gov/invasives/pdf/noxious-weeds.pdf

(B) The following are restricted noxious weeds, with their maximum allowable tolerances:

Photo: Steve Dewey, Utah State University | Bugwood.org



Annual bluegrass (*Poa annua*), 90 seeds per pound

Photo: Elena Rostunova

Blue burr (*Lappula echinata*), 18 seeds per pound

Photo: Joseph M. DiTomaso, University of California Davis | Bugwood.org

Mustard (*Brassica juncea, Sinapis arvensis*), 36 seeds per pound

Photo: Steve Dewey, Utah State University | Bugwood.org

Wild oats (*Avena fatua*), seven seeds per pound

Photo: Chris Evans, River to River CWMA | Bugwood.org

Buckhorn plantain (*Plantago sp.*), 90 seeds per pound

Photo: Joseph M. DiTomaso, University of California Davis | Bugwood.org

Radish (*Raphanus raphanistrum*), 27 seeds per pound

Photo: Michael Shephard, USDA Forest Service | Bugwood.org

Yellow toadflax (*Linaria vulgaris*), one seed per pound

Photo: Michael Rasy, University of Alaska | Bugwood.org

Tufted vetch (*Vicia cracca*), two seeds per pound

Photo: Richard Old, XID Services Inc. | Bugwood.org

Wild buckwheat (*Polygonum convolvulus*), two seeds per pound

Statutory Authority:
AS 03.05 010
AS 03.05.030
AS 44.37.030
11AAC 34.020
(In effect before 7/28/59; am 3/2/78, Reg. 65; am 10/28/83, Reg. 88)

This list is available online, at:
plants.alaska.gov/invasives/pdf/noxious-weeds.pdf

Glossary

Round bale of Smooth Brome and Timothy hay


Bunch grass growing in coarse textured soil


Sod grass farm near Palmer, Alaska

Term	Definition
Acid Detergent Fiber (ADF):	The indigestible portion of a forage sample. It is measured much like NDF except that a forage sample is boiled in an acidic detergent. The boiling removes sugars, fats, starches, proteins, and hemicellulose. The amount of ADF residue is inversely related to energy so high quality forages have low amounts of ADF.
Age Class:	A descriptive term to indicate the relative age of plants.
Agronomy:	The application of soil and plant sciences to soil management and crop production.
Allelopathy:	Chemical inhibition of one plant by another.
Amino Acids:	Amino groups with at least one carboxyl group, linked together in a definite pattern to form a protein molecule.
Annuals:	Plants that die after completing their life cycle within one growing season.
Anthesis:	Stage in floral development when pollen is shed.
Anaerobic:	Living in the absence of free oxygen; the opposite of aerobic.
Anti-quality Components:	Compounds like alkaloids, tannins, and other toxic compounds that cause problems in animal health and performance. Even if often present in small amounts, they can override the nutritional value of forage, even when the forage tests high for CP and TDN. Tall fescue endophyte contains a major anti-quality component. *Sericea lespedeza* is high in tannins, especially when mature.
Autotoxicity:	A specific type of allelopathy where the presence of adult plants of a species interferes with the germination and development of seedlings from that species.
Auriculated:	Having ear or hair like parts or extensions.

Term	Definition
Biennials:	A plant that completes its life cycle in two years.
Bloat:	Excessive accumulation of gases in the rumen (stomach) of an animal.
Boot Stage:	Growth stage when the sheath of the upper most leaf encloses a grass reproductive seedhead.
Bunch Grass:	Grass that produces a tufted growth or clump that gradually enlarges as tillers are produced around the outer edge of the tuft. (i.e. Timothy).
Carbohydrate:	Carbohydrates consist of simple and/or complex sugar molecules that function as readily available energy. Examples are fructose, glucose, sucrose, starch and hemi-cellulose.
Caryopses:	The grain or fruit of grasses.
Cellulose:	Major skeletal material in the cell wall of plants. Provides fiber for diet but minimal nutrition.
Compound Leaf:	A leaf separated into two or more leaflets.
Cool Season Plant:	A plant that makes its major growth during the cool part of the year, mainly in the spring but in some localities in the fall or winter.
Crude Protein (CP):	The total amount of protein, some of which is insoluble or non-degradable. Crude protein is measured in the laboratory by first measuring nitrogen and then multiplying by 6.25.
Cud:	Food regurgitated from the first stomach to the mouth of a ruminant and chewed again for further breakdown.
Cultivar:	The international term cultivar denotes an assemblage of cultivated plants that is clearly distinguished by any characters (morphological, physiological, cytological, chemical, or other) and when reproduced (sexually or asexually), retains its distinguished characters.
Culm:	The stem of a grass that has elongated internodes between nodes.
Decreaser:	Plant that is gradually replaced by other species in a stand.
Decumbent:	Lying or growing along the ground, but erect at or near the apex of some stems.
Dehiscent:	Splitting open along seed capsule or pod to emit individual seeds.
Digestible Dry Matter (DDM):	Digestibility estimated from ADF. The higher the ADF, the lower the digestibility.
Drought Tolerance:	The ability of a plant to withstand lack of rainfall for a portion of the year or for extended periods, sometimes multiple years.
Dry Matter (DM):	The percent of the forage that is not water.
Dry matter Intake (DMI):	Although it can be determined from feeding trials, it is usually estimated from NDF. The higher the NDF, the lower the intake.
Forage:	Herbaceous grasses and legumes available and acceptable to grazing animals.
Elliptic:	Longer than wide with rounded ends; rounded oval.
Ellipsoidal:	Three-dimensional object that is widest at the middle, tapers to ends of the same size, and is round in cross section.
Endophyte:	An organism (fungus, bacteria, nematode, etc...) growing inside of a plant.
Ensile:	To store forage as silage.
Friable Soil:	A soil with a readily crumbled or broken apart surface.
Glabrous:	Without hair, smooth.
Glumes:	A pair of bracts found at the base of a grass spikelet and not containing pistils or stamens; occasionally one or both glumes are absent.
Haylage:	Product resulting from ensiling forage with about 20-40% moisture, in the absence of oxygen.
Hemicellulose:	Polysaccharide fraction existing largely in the secondary cell wall of the plant.
Herbaceous:	Plants having aerial stems that die back to the soil level each year while the underground parts remain alive.
Introduced:	A species not part of the original fauna or flora of the area in question, but introduced from another geographical region through human activity.
Keel:	Projecting central rib usually found on the back of an organ and resembling a boat's keel.

Term	Definition
Lanceolate:	Much longer than wide, widest below the middle and tapering toward both ends, sometimes rounded at the base.
Lemma:	Lower bract of the grass floret, placed above the glumes with its back toward the outside of the spikelet or away from the rachilla.
Lignin:	Complex non-carbohydrate strengthening material in the thickened cell walls of plants; practically indigestible.
Lodging:	Collapse of top heavy plants, particularly grain crops, due to excessive growth or pressure from wind and rain.
Meadow:	An area of perennial herbaceous vegetation, usually grasses or grass like, used primarily for hay production.
Metabolic Energy:	Food intake gross energy minus fecal energy, minus energy in the gaseous products of digestion, minus urinary energy.
Monoculture:	Cultivation of a single species to the exclusion of other potential crops.
Native Plant / Species:	A plant that occurs naturally in a particular region, state, ecosystem, and habitat without direct or indirect human actions. Climate, soil, and biotic factors determine its presence and evolution in an area.
Net Energy (NE):	Calculated from ADF. Net energy estimates are used largely by dairy producers in ration balancing for maintenance (NEm), gain (NEg), and lactation (NEl).
Neutral Detergent Fiber (NDF):	An estimate of the portion of a forage sample that is in the walls of a plant cell. It is measured by boiling a forage sample in a neutral detergent and weighing the residue. Boiling removes the soluble components of the cell - most of the sugars, fats, starches, and proteins. The remaining residue is composed of cell walls made up of cellulose, hemicellulose, and lignin. The amount of NDF residue is inversely related to forage intake. High quality forages have low amounts of NDF.
Nitrate Poisoning:	Condition sometimes resulting when ruminants ingest nitrates (NO_3). The rumen bacteria convert to nitrite (NO_2); the nitrites compete with oxygen, tying up the oxygen-carrying mechanism in the blood and causing the animal to suffocate.
Node:	Joint on a stem, represented by position of origin of a leaf or bud
Oblique:	Lop-sided, one side of leaf base is larger, wider or more rounded than the other.
Oblong:	Two to four times longer than broad.
Obovate:	Inversely ovate, attached at the narrow end.
Obovoid:	Leaf shape that is inversely egg-shaped or ovoid.
Obtuse:	Blunt or rounded at the tip, with sides coming together at an angle greater than 90 °.
Oval:	Twice as long as broad, widest at the middle, both ends rounded.
Ovate:	Egg shaped in outline, narrower at the tip and attached at the larger end. Applies to flat surfaces.
Ovoid:	Egg shaped; Applies to three-dimensional structures.
Palatability:	The relish with which a particular species or plant part is consumed by an animal.
Palea:	Upper bract of the floret, placed above the lemma with its back toward the rachilla.
Palmate:	With three or more lobes, veins or leaflets arising from one point, often five to seven.
Pasture:	Grazing land comprised of introduced or domesticated native forage species that are used primarily for the production of livestock. These lands receive periodic renovation and/or cultural treatment (such as tillage, fertilization, mowing, weed control), and may be irrigated.
Perennials:	Plants that normally live for more than two years.
Petiole:	The stalk that joins a leaf to stem; (leaf stalk).
Petiolule:	The stalk of a leaflet of a compound leaf.
pH:	A measure of the hydrogen-ion concentration in a solution, expressed on a negative log 10 scale of 0 (highly acidic) to 14 (highly basic) with pH of 7 being neutral. See charts on page 23.
Pilose:	Long soft hairs.

Term	Definition
Pinnate:	Compound leaf with leaflets arranged on opposite side of common axis.
Prostrate:	Lying flat upon the ground and growing horizontally
Protein:	Essential part of all living matter and animal feed, consisting of a complex combination of amino acids, always containing carbon, hydrogen, oxygen, and nitrogen.
Pure Live Seed:	The portion (percentage) of the seed lot that is pure and viable.
Racemes:	Pedicled flowers along one stem.
Rachilla:	Axis of a grass spikelet; a stalk-like, sometimes jointed, structure extending above and between the glumes and bearing the florets.
Relative Feed Value (RFV):	An estimate of hay quality. It is calculated from NDF, ADF, and crude protein with emphasis on NDF. The RFV grading system assumes that full bloom alfalfa has a value of 100. Immature alfalfa has a higher RFV and stemmy alfalfa has a lower RFV.
Rhizome:	Underground stem, usually horizontal and capable of producing new shoots and roots at the nodes.
Rills:	Long, straight and narrow depressions on a soil surface, caused by water erosion.
Rumen:	The large, first compartment of the stomach of a ruminant from which ingested food is regurgitated for chewing and in which digestion is aided by the symbiotic action of microbes.
Ruminant:	Even toed, hoofed mammal that chews the cud and has a four chambered stomach.
Rust:	A parasitic fungi that is harmful to other plants.
Saline Soil:	A soil condition in which soluble salts are present in the soil in sufficient quantities to affect the ability of plants to absorb water from the soil.
Salt Tolerance:	Relative ability of a plant to reproduce and grow under saline conditions.
Scabrous:	Slightly roughened.
Selected Class Release:	Phenotypically selected plants of untested parentage that have promise, but no proof of genetic superiority of distinctive traits.
Seedhead:	The inflorescence (flowering part) of a grass where the seed will develop.
Shade Tolerance:	Relative ability of a plant to reproduce and grow under shade.
Silage:	Forage preserved in a succulent condition by partial fermentation.
Sod grass:	Grass that is spread vegetatively by the growth of underground stems, called rhizomes. (i.e. Smooth Brome).
Soil Texture:	The relative portion (percentage) of sand, silt and clay in the soil.
Stage of Maturity:	The development of a forage used to describe a point in time in its progress toward maturity and readiness for harvest of forage, hay, or seed.
Stipules:	Very small stalk of an organ; a small prolongation of a rachilla beyond the uppermost floret in the spikelets of some grasses.
Stolon:	A horizontal stem which grows along the surface of the soil and roots at the nodes.
Stools:	A stump of root stock producing shoots or suckers.
Swath:	A strip of cut herbage lying on the stubble left by a cutter bar, blade, flail, rotary drum, mower, mower-conditioner, binder, swather, or small grain head on a combine.
Taproot:	A plant root system dominated by a large primary root, normally growing straight downward, from which most of the smaller roots spread out laterally.
Total Digestible Nutrients (TDN):	An estimate of digestible forage. TDN is not measured directly but is calculated from ADF. TDN is used by many beef producers to balance rations.
Trifoliate:	A pinnate leaf form with three leaflets.
Ungulate:	A hoofed animal; includes ruminants, but also includes horses and swine.
Vegetative:	Term used to designate stem and leaf development in contrast to flower and seed development.
Water Tolerance:	Relative ability of a plant to reproduce and grow under saturated or flooded conditions.
Yield:	The quantity of a product in a given space and/or time. Also known as the harvested portion of a product.

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Temperature	Temperature	Volume		Length		Length	
C	F	C	F	Liters	Quarts	cm	inch	cm	feet
100	212	5	41	1	1.1	2.5	1	300	10
90	194	0	32	2	2.1	5	2	400	13
80	176	-5	23	3	3.2	10	4	500	16
70	158	-10	14	4	4.2	20	8	1,000	33
60	140	-15	5	5	5.3	30	12		
50	122	-20	-4	6	6.3	40	16		
40	104	-25	-13	7	7.4	50	20		
35	95	-30	-22	8	8.5	60	24		
30	86	-40	-40	9	9.5	70	28		
25	77					80	32		
20	68					90	36		
15	59					100	39		
10	50					200	79		

Metric Conversions

To convert this	*to this*	*multiply by*
Length		
inches	millimeters (mm)	25.4
feet	centimeters (cm)	39
yards	meters (m)	.91
miles	kilometers (km)	1.61
millimeters	inches	.04
centimeters	inches	.4
meters	inches	39.37
meters	yards	1.1
kilometers	miles	.6
Temperature		
Fahrenheit	Celsius	.56 (after subtracting 31)
Celsius	Fahrenheit	1.82 (then add 32)
Farm products		
pounds per acre	kilograms per hectare	1.14
short tons per acre	kilograms per hectare	2.25
kilograms per hectare	metric tons per hectare	.001
kilograms per hectare	pounds per acre	.88
tons per hectare	short tons per acre	.44
tons per hectare	kilograms per hectare	1,000
Area		
square inches	square centimeters	6.5
square feet	square meters	.09
square miles	square kilometers	2.6
acres	hectares	.4
square centimeters	square inches	.16
square meters	square yards	1.2
square kilometers	square miles	.4
hectares	acres	2.5

Back cover photos:
Upper left: *A swather mows grass near Palmer;*
Upper right: *A tedderer lays down hay for drying;*
Center: *Horses feed on pastureland in Palmer;*
Bottom left: *A mower-conditioner working a hay crop;*
Bottom right: *Pasture field near Palmer;*

Photos: Casey Dinkel, AK PMC


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