Section B. Crop Establishment

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

Planning

Photo: James McCormick

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

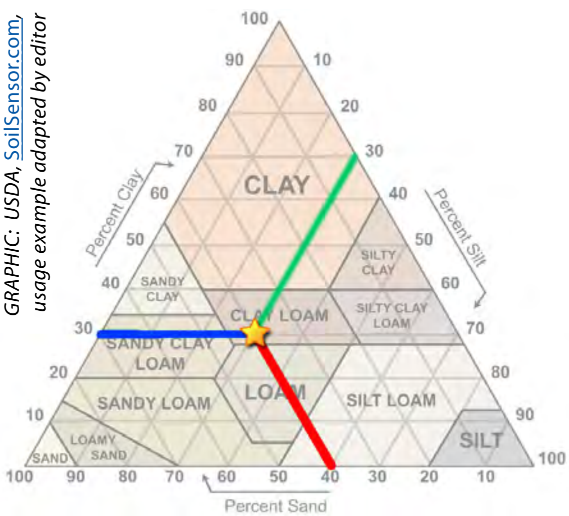
Soil is made up of mineral particles, organic matter, air and water. Soil texture is determined by the composition of soil, expressed as % sand, % silt, and % clay. Three classes of particle size are acknowledged with sands being the largest (2.0-.05 mm), silts (.05-.002 mm) intermediate in size, and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

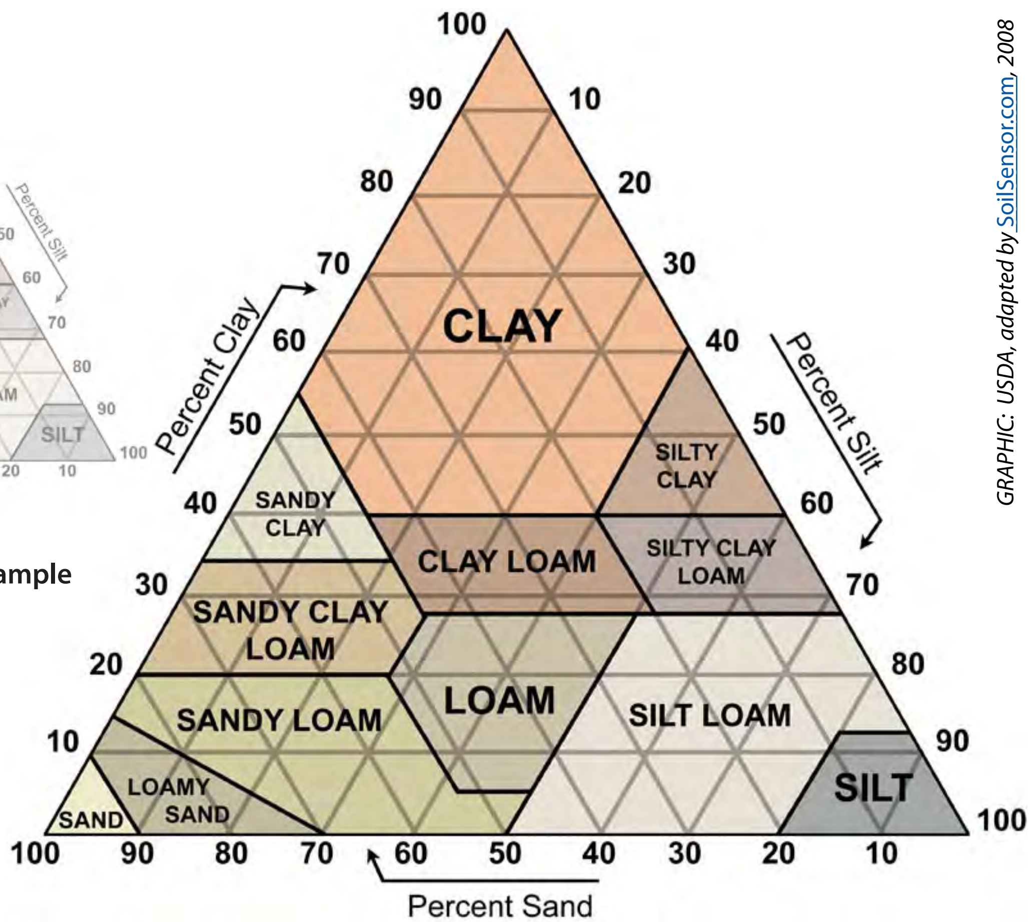
Field analysis of soil texture can be done using the "By Feel" testing method, shown on the chart on page 22. This qualitative method is quick, easy and fairly reliable. The testing procedure involves wetting a sample of the soil and working the soil between two fingers (generally moistened using water).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

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



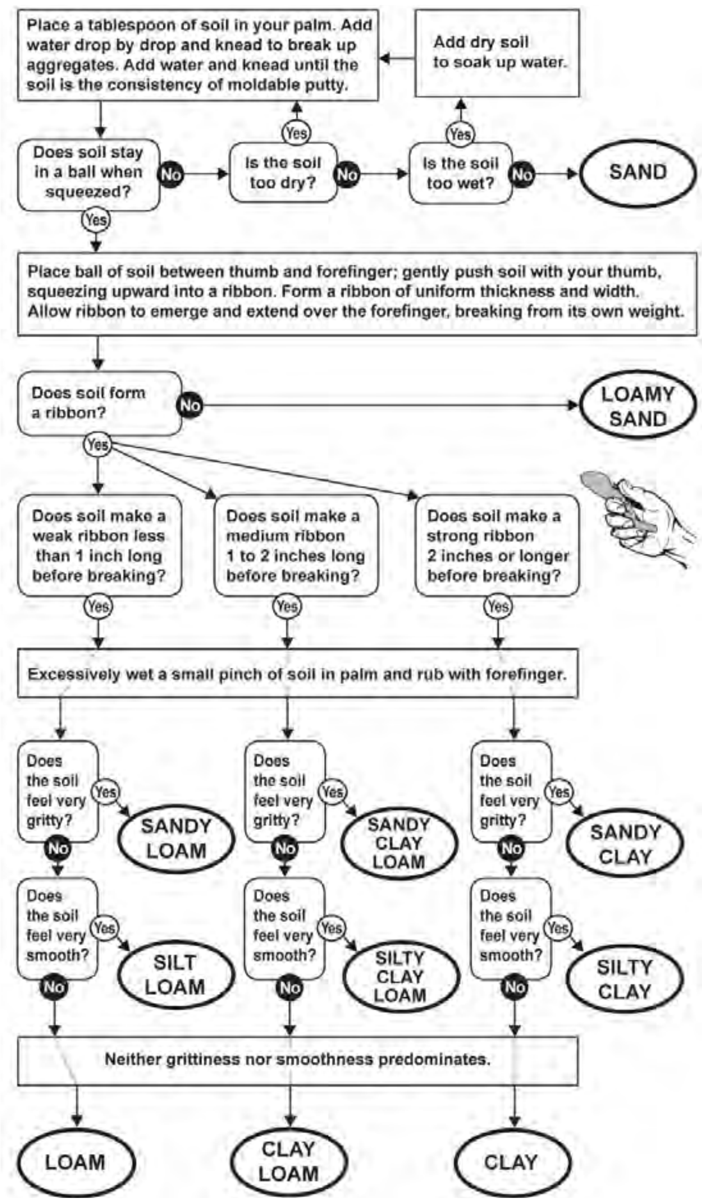
Soil Textural Triangle usage example

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**)

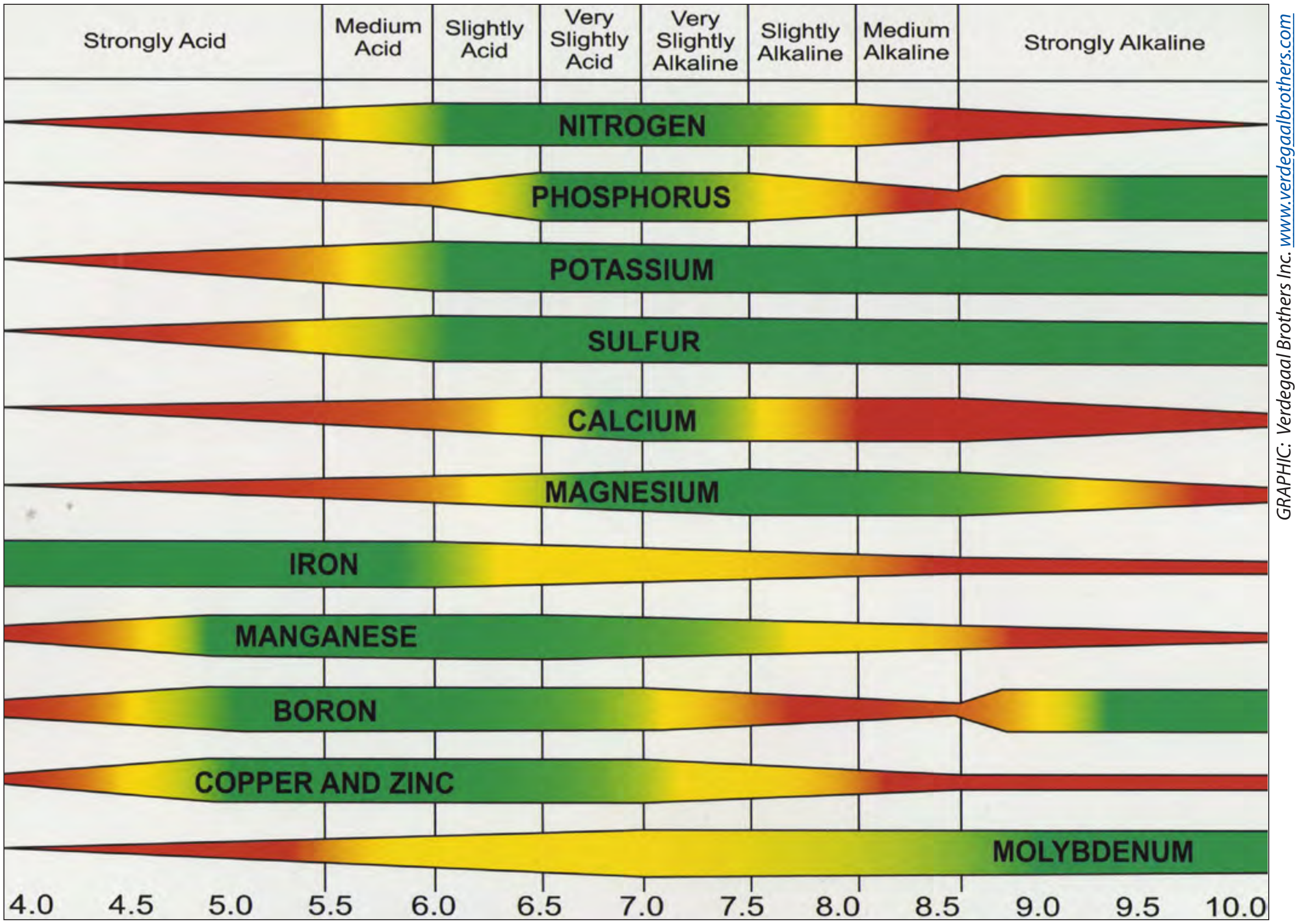
The application of fertilizer at the time of seeding may be necessary for some forage crops. Most commercial fertilizers meet minimum standards for quality. When problems do arise, they can usually be traced to the product becoming wet during storage or shipment.

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.

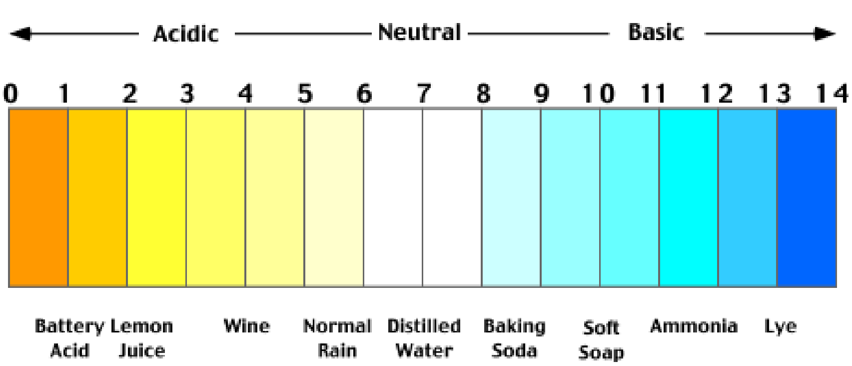


How soil pH affects availability of plant nutrients

Soil pH - Acidity and Alkalinity

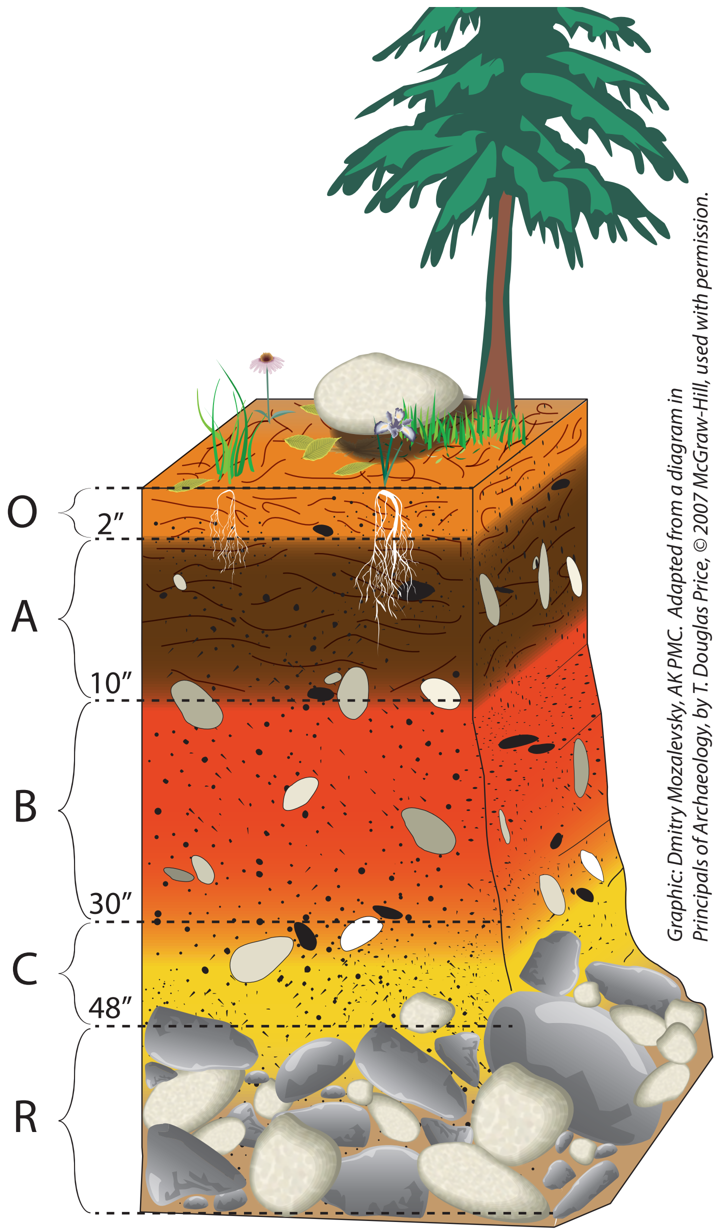
Soil pH is a measurement of soil acidity and/or alkalinity and has a major effect on nutrient availability. It is based on a logarithmic scale from 0 to 14. A number less than 7 represents an acidic soil, with the acidity increasing as the pH value gets closer to zero. Basic or alkaline soils are characterized 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 found at dnr.alaska.gov/ag/akpmc/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)

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.

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: Kasco Manufacturing Co.

A tractor mounted broadcast seeder

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

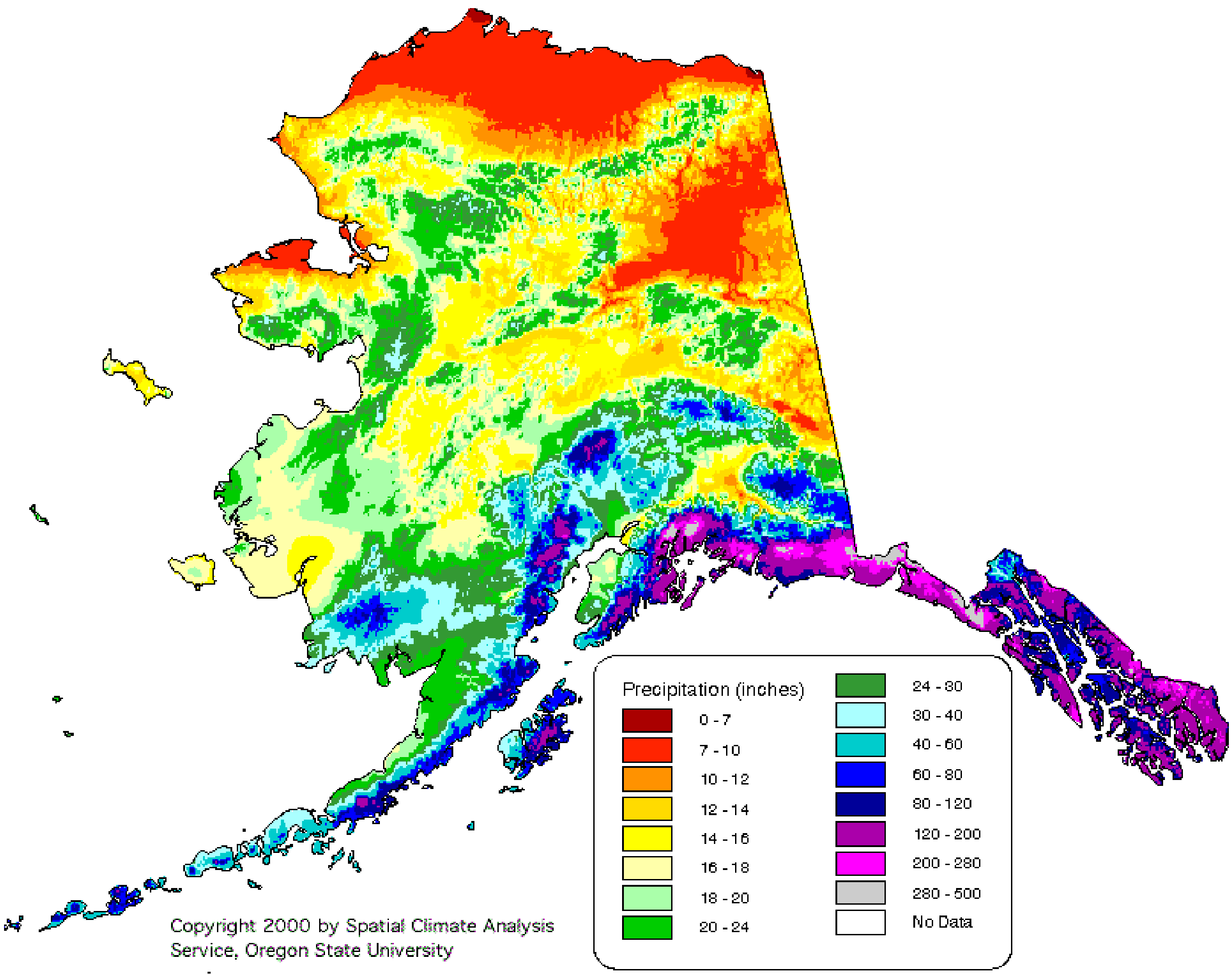
The optimal planting season is just before the longest period of favorable conditions. Planting times are determined by choosing the season when rainfall and temperatures are most favorable for seedling germination and establishment. Many sites dry quickly following spring melt, and precipitation is 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.

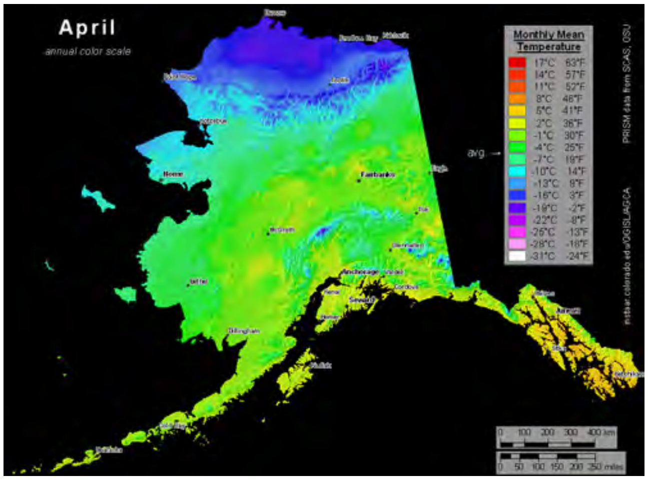
Latest Date to Seed:	
Arctic Coast	**July 15**
Western Alaska	**August 15**
Interior Alaska	**August 15**
Southcentral Alaska	**August 31**
Southeast & Aleutian Islands	**Sept. 15**

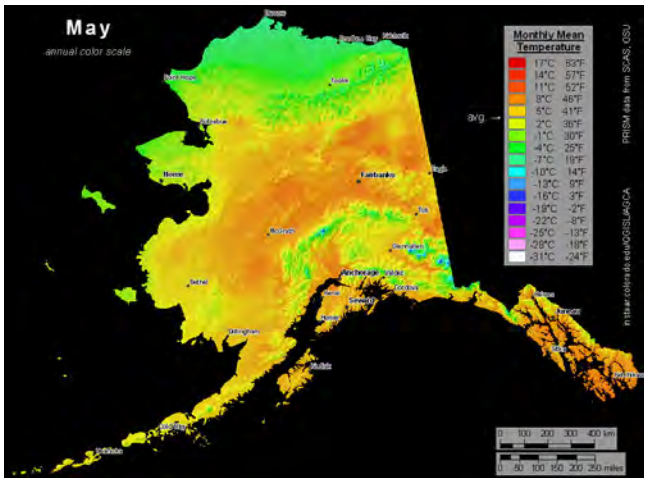
The precipitation and temperature maps that follow may be helpful in determining the appropriate planting time for your region.

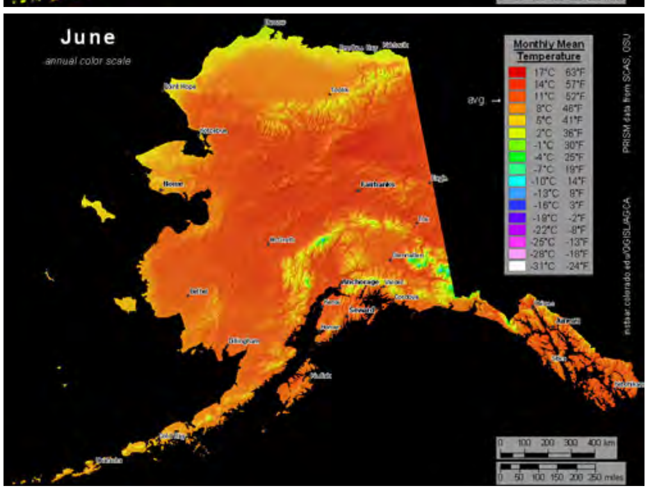


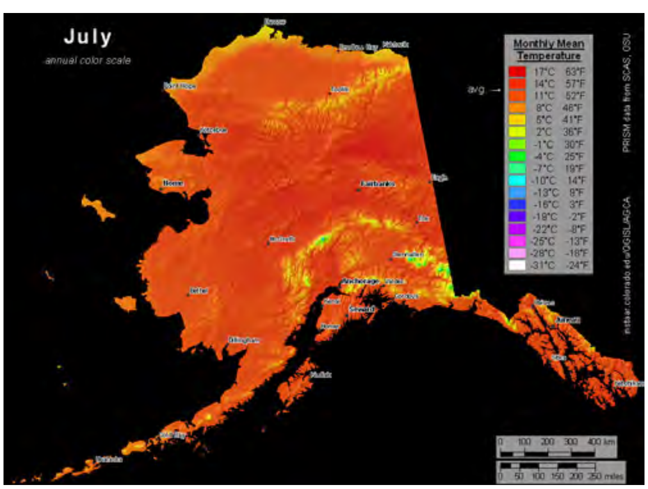
Graphic: The Climate Source, Inc., www.climatesource.com/ak/fact_sheets/fact_precip_ak.html

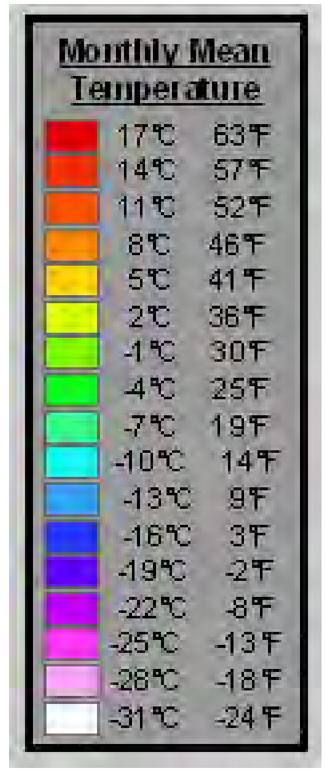
Mean Annual Precipitation in Alaska











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