

Fertilizing Grass for Hay and Pasture

An important part of efficient livestock production is ensuring there is sufficient grass for both hay and pasture. However, low soil nutrient levels often limit forage production. With good soil fertility and fertilizer management, the productivity of many hay and pasture fields can be greatly improved.

Brown and Dark Brown soils in southern and east-central Alberta have several characteristics:

- often deficient in nitrogen (N)
- often moderately deficient in phosphorus (P)
- rarely deficient in potassium (K) and sulphur (S)

Two key conditions affect Black, Gray Wooded and Gray-Black transition soils in central and northern Alberta:

- commonly deficient in nitrogen and phosphorus
- occasionally deficient in potassium and sulphur, particularly in sandy soils

This fact sheet reviews the following:

- grass nutrient requirements
- fertilizer practices that can aid Alberta producers to optimize grass production
- several soil sampling techniques and their suitability

Nutrient requirements and yield potential

Grass has a relatively high demand for nutrients. Table 1 provides approximate amounts of nutrient removed per ton of dry matter. Removal will vary depending on grass species and growing conditions.

Table 1. Nutrient removal per ton of grass

Nutrient	Nutrient removed (lb/ton – dry matter basis) ^z
Nitrogen (N)	30 to 35
Phosphorus (P)	4
Phosphate (P ₂ O ₅) ^y	10
Potassium (K)	40
Potash (K ₂ O) ^x	50
Calcium (Ca)	7
Magnesium (Mg)	5
Sulphur (S)	5
Boron (B)	0.08
Copper (Cu)	0.01
Iron (Fe)	0.3
Manganese (Mn)	0.1
Molybdenum (Mo)	0.002
Zinc (Zn)	0.05

^z Amounts of removal are approximate and vary depending on grass species and growing season conditions.

^y To convert P to P₂O₅, multiply P by 2.3

^x To convert K to K₂O, multiply K by 1.6

Grass grown under irrigation or with optimum precipitation and nutrients is capable of producing high annual yields of over 5 tons/ac. However, under dryland rain-fed conditions, yields of 1.5 to 4 tons/ac are more common.

Nutrient requirements

Nitrogen is often the most limiting nutrient in grass production across Alberta. A 3 ton/ac grass crop will remove 90 to 100 lbs N/ac. Little research data is available on what the economic rates of nitrogen fertilizer are for grass production in Alberta.

Most of the nitrogen stored in soil is contained in soil organic matter. One per cent organic matter contains about 1,000 lb N/ac, but less than 1 per cent of this nutrient is released through soil microbial breakdown each year. This process is called mineralization. Mineralization is the process of converting nitrogen from organic to inorganic nitrogen. Inorganic nitrogen is a form that can be taken up by plants.

Microbial activity and the rate of nitrogen release from soil organic matter are influenced by environmental conditions:

- soil temperature
- soil moisture
- organic matter content

Nitrogen released from soil organic matter decomposition during the growing season supplies only 5 to 20 per cent of the total nitrogen needed for grass production. Well-aerated soil with higher levels of organic matter will release more plant-available nitrogen, while compacted soils that have low soil organic matter levels will release little plant-available nitrogen.

Brown and Gray Wooded soils mineralize the least amount of soil nitrogen. For optimum production, the amount of nitrogen required above that supplied from organic matter decomposition must be supplied by fertilization.

Optimum levels of grass production require adequate levels of soil phosphorus (P). Most soils in Alberta are naturally low in plant-available phosphorus. However, residual levels of phosphorus in soils will vary depending on two conditions:

- past phosphate (P_2O_5) fertilizer use
- manure management practices

Fields that have received P_2O_5 fertilizer or manure application for a number of years often have good residual soil phosphorus levels and may not require additional phosphorus. Residual soil phosphorus levels vary depending on past P_2O_5 fertilizer management. A 3 ton/ac crop will remove approximately 30 lb P_2O_5 /ac.

Phosphate fertilizer can either be applied annually to grass stands or as a batch/bulk application before establishing a new stand. A batch application before establishment of 100 to 200 lb of P_2O_5 /ac could effectively meet crop requirements for phosphorus for up to 6 years or longer, depending on phosphorus removal rates. A large batch application of P_2O_5 can be either banded or broadcast-incorporated before stand establishment. Annual applications of phosphorus fertilizer are more economical for producers. Under good soil moisture conditions, grasses can effectively utilize surface broadcast applications of P_2O_5 fertilizer.

Grass also needs potassium, sulphur, calcium (Ca), magnesium (Mg) and micronutrients. Most Alberta soils have adequate-to-high available soil potassium (greater than 300 lb/ac of ammonium acetate extractable potassium), calcium and magnesium. Intensively cropped sandy soils tend to be deficient in potassium and sulphur. However, deficiencies tend to occur more commonly in the following:

- Black soils
- Gray-Black transition soils
- Gray Wooded soils in central and northern Alberta

Deficiencies rarely occur in Brown and Dark Brown soils in southern and east-central Alberta.

Soil testing helps identify deficiencies in potassium or sulphur. Further research is needed to accurately determine when grass will respond to added potassium or sulphur fertilizer. There are no scientifically documented reports of calcium or magnesium deficiencies with forage crops on Alberta soils.

There has not been much micronutrient research work done in Alberta with forage crops. However:

- micronutrient deficiencies that could be potentially cause problems in the future are boron (B) and copper (Cu)
- boron deficiency could occur on sandy, low organic matter soil
- copper deficiency could occur in the Black or Gray-Black sandy or loam soils with relatively higher levels of organic matter (6 - 10 per cent)

Extreme care is required when applying micronutrients. Depending on soil pH, micronutrients, such as boron, can be toxic to grass with a 3 lb/ac application. Micronutrient fertilizers are not recommended without completing a soil test and consulting with either a forage or soil specialist. For further information on micronutrients, see *Micronutrient Requirements of Crops in Alberta*, Agdex #FS531-1, which is available on-line at: [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex713](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex713)

Soil sampling and testing: when, where and how

Field soil sampling and testing is an important tool for two key reasons:

- assessing soil fertility
- developing proper fertilizer recommendations

Sampling and testing are also valuable to monitor soil changes resulting from management practices or to diagnose specific grass production problems.

To get accurate soil-sampling results:

- use proper soil sampling technique
- sample at the right time
- do a proper analysis

The greatest challenge in the effective use of soil testing is obtaining representative soil samples. Proper soil sampling will help to provide accurate soil test results and reliable nutrient recommendations.

When to soil sample?

Ideally, it is best to sample fields after early October when soil temperature conditions have declined to less than 7°C, or in early spring.

However, in spring there is limited time for all the steps:

- take samples
- have samples analyzed
- order fertilizer
- apply fertilizer

Soil sampling in late fall allows time for the analysis to be done and then still have ample time to develop a fertilizer management plan for the spring.

Problem soil areas can be sampled anytime.

Where to soil sample?

Soil variability is a major concern when deciding where to take soil samples. **Random** soil sampling is the traditional approach for uniform fields having little variation. Random sampling involves taking samples from average production areas.

Normally, 15 to 20 soil samples must be taken to have a good representation of the field. If the person taking the soil samples does not take the time or does not have first-hand knowledge of the field to take samples from appropriate locations, the results may not be representative of the field.

Each field with the same crop and management history must be sampled separately. Size up each field and observe variations in the following:

- yield and crop growth
- texture
- colour
- slope
- degree of erosion

- drainage
- past treatment

Sizable areas of fields where growth is significantly different from the rest of the field should be sampled separately.

When sampling, avoid unusual areas:

- dead or back furrows
- old straw, hay or manure piles
- waterways
- saline spots
- eroded knolls
- old fencerows

Select sampling sites representative of the portion of the field to be tested.

Benchmark sampling is recommended for fields with more soil or topographic variability. Benchmark sampling reduces the variability of a field by reducing the area sampled. Rather than adding each variable area in the field to a composite soil sample, such as is done under random sampling, each variable area is sampled separately.

A small area (about 1/4 - 1/2 of an acre) that is representative of the majority of the field is selected. Fifteen to 20 soil samples are taken at the representative location, which is the same number as with random sampling. This is the reference area from which fertilizer recommendations are made.

The benchmark site should be marked with a global positioning system (GPS) or other means so that samples can be taken at the same location in subsequent years. Sampling from the same area should reduce variability and create a better picture of year-to-year changes.

When picking a benchmark area, use observable features such as grass growth, landscape position, soil color and soil texture to identify where different soil types occur. Select a site or sites that have characteristics similar to most of the field or the dominant soil types. More than one benchmark is recommended if there are several uniquely different production areas in a field.

How should samples be taken?

Use a core-sampling tool to take representative soil samples. It is essential to use this tool when sampling to depths below 15 cm (6 inches).

To obtain samples:

- take soil cores from 0 to 15 cm or 0 to 30 cm (0 - 6 inches or 0 - 12 inches) at each of the 15 to 20 sampling sites

- for improved sulphur evaluation or where problem soils are encountered, separate samples should be taken from the 0 to 15, 15 to 30 and 30 to 60 cm (0 - 6, 6 - 12 and 12 - 24 inch) depths at the same 15 to 20 sites
- place soil cores in clean plastic pails or bags, then mix cores taken from the same depths, crushing lumps in the process
- keep samples taken from individual depths separate from one another

Soil core samplers may be available on request from fertilizer dealers, private labs or crop advisors. Most fertilizer dealers also offer soil-sampling services.

Sample preparation

It is very important to prepare samples for laboratory analysis:

- air-dry soil samples immediately after sampling by spreading the soil in a thin layer on clean paper, plastic sheets or in clean shallow containers at room temperature
- do not store in a moist condition before sending to a laboratory for testing as nutrient levels can change
- do not dry with artificial heat
- some laboratories accept moist samples, but delivery to the laboratory must be on the same day as the samples are collected
- before sending samples to the lab, check with their staff regarding proper preparation and delivery instructions
- provide complete field history on laboratory information sheets provided by the lab for each set of soil samples
- note in detail any unusual soil or crop problems
- keep a completed field plan of the area represented by each sample

Laboratory analysis

Consult with the laboratory regarding laboratory analyses of agricultural soils. Research in Alberta indicates that the typical soil analyses package for surface (0 - 15 or 0 - 30 cm; 0 - 6 or 0 -12 inches) agricultural soils should include the following soil tests:

- nitrate-nitrogen
- available phosphorus
- available potassium extractable sulphur
- soil pH and salinity (electrical conductivity)

If possible, the nitrogen and sulphur analyses should be completed for subsurface soil samples (15 - 30 and 30 - 60 cm; 6 - 12 and 12 - 24 inches).

Producers may also request additional analyses for micronutrients (boron, chloride, copper, iron, manganese or zinc) or organic matter for the surface soil samples. Some laboratories provide additional analyses as part of their routine analysis package, to improve interpretation and recommendations.

Consideration for fields with a history of manure application

Fields that have received previous manure applications can be a challenge for soil sampling, soil testing and interpretation.

Unlike commercial fertilizers where the nutrients are readily available during the current year, manure releases its nutrients slowly over several years. Nutrients in organic forms will not show up in a chemical soil test, so conventional nutrient calibrations may result in an over-application of nutrients.

When developing fertilizer recommendations, soil test labs need to take into account the field's commercial fertilizer and manure application history. A gross accounting procedure of manure nutrients and fertilizer inputs versus nutrient removal, along with soil testing, helps to monitor the nutrient balance for fields that receive manure.

Fertilizing established grass

Nitrogen on grass

Nitrogen fertilizer requirements depend on the soil test level of nitrate-nitrogen ($\text{NO}_3\text{-N}$). The need for nitrogen fertilization increases as available soil nitrogen levels decline. Grass will respond dramatically to nitrogen fertilizer when soil nitrogen is deficient.

Table 2 provides general nitrogen fertilizer recommendations for each soil zone in Alberta. Under very good moisture conditions, higher rates of nitrogen fertilizer are economical. However, high rates should only be applied when soil test $\text{NO}_3\text{-N}$ levels are low and moisture conditions are good. Nitrogen fertilizer rates should be reduced when spring soil moisture conditions are drier than normal.

Table 2. General N fertilizer recommendations for grass for each soil area in Alberta*

Soil test N (lb/ac in 0 - 24 in)	Soil test areas					
	Irrigated	Brown	Dark Brown	Thin Black	Black	Dark Gray & Gray Wooded
N (lb/ac)						
0 - 10	200	70	80	100	120	110
11 - 20	190	60	70	90	110	100
21 - 30	180	50	60	80	100	90
31 - 40	170	40	50	70	90	80
41 - 50	160	30	40	60	80	70
51 - 60	150	20	30	50	70	60
61 - 70	140	10	20	40	60	50
71 - 80	130	10	10	30	50	40
81 - 90	120	–	–	20	40	30
91 - 100	110	–	–	10	30	20
101 - 110	100	–	–	–	20	10
111 - 120	90	–	–	–	10	–
121 - 130	80	–	–	–	–	–
131 - 140	70	–	–	–	–	–
141 - 150	60	–	–	–	–	–
151 - 161	50	–	–	–	–	–
161 - 170	40	–	–	–	–	–
171 - 180	30	–	–	–	–	–
181 - 190	20	–	–	–	–	–
191 - 200	10	–	–	–	–	–

* Rates are in lbs N/ac with medium to good soil moisture conditions and average growing season precipitation.

Nitrogen fertilizer should be applied early in the spring before grass begins active growth. If more than one cut is planned, second cut nitrogen requirements should be applied immediately after the first cut is taken.

When only one cut is taken for hay, all nitrogen fertilizer should be applied in early spring. If two cuts are planned, then the total nitrogen to be applied should be split. Approximately 60 per cent of the nitrogen fertilizer should be applied in early spring, with the remaining nitrogen applied immediately after the first cut is completed.

When fertilizing grass for pasture, nitrogen applications should be split, using two to four applications over the growing season, depending on production potential. For example, on irrigated pasture, a total of 200 lb N/ac is

needed over the growing season. This total could be split into four applications:

- 60 lb N/ac in early spring
- 50 lb N/ac in mid-June
- 50 lb N/ac in mid-July
- 40 lb N/ac mid-August

Various split application times and rates could be developed to suit the soil and climatic area, yield potential of the grass and the rotational grazing system used by the producer. However, more applications result in higher costs and, when coupled with uncertainty of moisture, increase production risk. Further, with the increasing price of nitrogen fertilizer, the economic benefit of split nitrogen applications is reduced, particularly in less nitrogen-responsive unimproved pasture situations.

Until 2005, the two most commonly used nitrogen fertilizer forms for broadcast application were ammonium nitrate (34-0-0) and urea (46-0-0). Unfortunately, 34-0-0 is no longer manufactured in Western Canada. It was an excellent product whose use would not result in volatilization losses. Volatilization is the change from urea to gaseous ammonia that can result in proportions of this material being lost to the air.

Urea is the only single analysis granular nitrogen fertilizer available for broadcast application. When broadcast applied, it is subject to volatilization when surface soil temperatures are greater than 5 °C or air temperatures are greater than 10 °C.

In central and northern Alberta, spring temperatures are generally cool enough to allow early spring broadcast urea with minimal nitrogen losses. However, in southern Alberta with warmer spring temperatures and windy Chinook conditions, urea volatilization can be a serious problem.

In the past, broadcast ammonium nitrate nitrogen fertilizer was recommended in southern Alberta and for other areas of Alberta when soil and air temperature were warm at the time of application. Now producers will have to use urea or liquid nitrogen fertilizer (28-0-0; a 50:50 liquid blend of urea and ammonium nitrate). Liquid nitrogen can be successfully dribble-banded onto grass in early spring.

It is important to remember that approximately half the nitrogen in liquid fertilizer is urea, and it is subject to the same volatile losses as granular urea. Therefore, the same caution applies to 28-0-0 as it does to 46-0-0. Urea can be treated with a urease inhibitor that will reduce volatile losses of nitrogen for about 10 days.

Polymer-coated urea has recently been made available to Alberta producers for forage production. The coating provides excellent protection from volatile gaseous losses; however, it releases very slowly when broadcast and may not release quickly enough in spring to meet crop nitrogen requirements in the early part of the growing season.

Research is being done with this new fertilizer to determine the best management practices. One possibility will be to use a combination of urea and coated urea to meet both early and mid-season crop requirements for nitrogen.

Nitrogen on grass-alfalfa mixtures

The amount of nitrogen fertilizer required for grass-alfalfa mixtures is less than for pure grass stands. As the percentage of alfalfa in the forage stand increases, the amount of nitrogen fertilizer applied should be reduced by approximately the same percentage.

For example, if the recommended amount of nitrogen fertilizer for a pure grass stand is 60 lb/ac, then the recommended nitrogen in a stand with 25 per cent alfalfa would be reduced by about 25 per cent to 45 lb N/ac.

There is little need for nitrogen fertilizer if the percentage of alfalfa exceeds the percentage of grass in a forage stand. However, some research suggests that although total forage production may not be as high without nitrogen fertilizer, mixed stands with 30 to 40 per cent alfalfa can sustain the grass in a pasture stand.

Phosphorus

For optimum production, P_2O_5 fertilizer should be broadcast annually on grass stands in phosphorus-deficient soils:

- a batch application of 100 to 200 lb of P_2O_5 /ac before establishment to meet crop requirements for 4 to 6 years
- a lower application of 100 lb of P_2O_5 /ac is recommended on Brown, Dark Brown or Gray soils that have lower yield potential
- in areas with higher production potential, such as Black soils or irrigated soils, a 200 lb of P_2O_5 /ac batch application before establishment should be considered

Annual applications of P_2O_5 fertilizer to grass are reasonably effective and are also more economical for producers. If phosphorus is limiting production, growers should apply an annual maintenance application of 20 to 40 lb of P_2O_5 /ac to meet crop removal rates.

Under good moisture conditions, grass has feeder roots near the soil surface and can take up broadcast phosphorus with reasonable efficiency. Broadcasting is presently the only practical method of in-crop granular P_2O_5 fertilizer application and should be done in early spring. Dribble banding of liquid P_2O_5 (10-34-0) can also be used; however, the cost-per-pound of phosphorus fertilizer is usually higher than for granular phosphorus fertilizer.

As far as the timing of a phosphorus application, late fall may provide several benefits:

- lower fertilizer cost
- time
- dissolution of fertilizer before spring

However:

- the increased soil residence time from a fall application may allow for increased potential reactions with soil constituents that may reduce phosphorus availability
- phosphate fertilizer should not be fall broadcast onto sloping fields that could potentially have runoff into surface water
- Table 3 provides general P_2O_5 fertilizer recommendations.

Table 3. Phosphate fertilizer recommendations for grass, based on the modified Kelowna soil P test method

Soil test P (lb/ac in 0 - 24 in)	Soil test zones					
	Irrigated	Brown	Dark Brown	Thin Black	Black	Dark Gray & Gray Wooded
	(lbs P ₂ O ₅ /ac)					
0 - 10	60	35	40	45	50	45
10 - 20	50	25	30	35	40	35
20 - 30	45	15	20	25	30	25
30 - 40	40	10	10	15	20	15
40 - 50	35	10	10	10	10	10
50 - 60	30	10	10	10	10	10
60 - 70	25	10	10	10	10	10
70 - 80	20	10	10	10	10	10
>80	0	0	0	0	0	0

Potassium

Grass does not commonly respond to potassium (K) fertilizer, even in fields that test low in soil K. Most grasses are deeply rooted and are fairly efficient in taking up soil potassium.

Annual applications of potash fertilizer (K₂O) may be necessary (Table 4) in fields testing deficient in soil potassium. Fields that have sufficient soil potassium may occasionally respond to a 50 lb/ac application of K₂O fertilizer in early spring, under unseasonably wet, cool weather conditions. Soil potassium is less available and less mobile in the soil under these conditions.

Table 4. Potash fertilizer recommendations for irrigated grass, based on the ammonium acetate soil K test method

Soil test potassium (K) (0 - 24 in) (lb/ac)	K ₂ O recommendation (lb/ac)
0 - 25	160
25 - 50	145
50 - 75	125
75 - 100	110
100 - 125	90
125 - 150	75
150 - 175	55
175 - 200	40
200 - 225	20
>225	0

However, such positive responses to K₂O fertilizer are not common. Therefore, applications should first be tried in carefully marked test strips to determine if potassium fertilizer is beneficial. On-farm strip trials are useful to check for a field-specific response to potassium fertilizer before using potassium on large fields. A forage or soil specialist should be consulted before setting up on-farm trials.

Sulphur

A soil test for plant-available sulphate-sulphur (SO₄-S) can be useful to determine if sulphur fertilizer is required.

Sulphate-sulphur is mobile in soil; therefore, soil samples should be taken at different depths to find out how much sulphur is available at each level.

Samples should be taken at the following depths:

- 0 to 15 cm (0 - 6 inches)
- 15 to 30 cm (6 - 12 inches)
- 30 to 60 cm depths (12 - 24 inch depths)

It is very important to note that plant available SO₄-S can be highly variable across fields. When a field is uniformly low in sulphur, a soil test is very useful to estimate S fertilizer needs. However, if only 10 to 20 per cent of a field is low in sulphur, it can be difficult to identify these areas without intensively soil sampling areas separately.

Sulphur levels are usually adequate to high in the Brown and Dark Brown soil zones and frequently lower in the Black and Gray Wooded zones.

Much of the sulphur in the topsoil is contained in the soil organic matter and is slowly released as $\text{SO}_4\text{-S}$, which is the form that crops use. Sulphate-sulphur is similar to nitrate-nitrogen in that it is mobile in soil and subject to leaching, particularly in sandy soils. Table 5 can be used as a guide to determine when sulphur fertilizer is required and how much sulphur fertilizer to apply.

Table 5. Sulphur fertilizer recommendations for grass, based on the calcium chloride soil test method

Soil test level $\text{SO}_4\text{-S}$ (lb/ac) (0 - 24 inch depth)	Sulphur recommendation (lb/ac)
0 - 5	20
5 - 10	15
10 - 15	10
15 - 20	5
>25	0

For irrigation farmers, irrigation water naturally contains sulphate-sulphur. Although amounts in irrigation water vary over time, approximately 30 lb/ac of sulphate-sulphur is added to the soil in 12 inches of irrigation water. Therefore, sulphur fertilizer is rarely required on irrigated lands.

Sulphur fertilizers containing sulphate-sulphur such as ammonium sulphate [21-0-0-(24)], which contains 24 per cent $\text{SO}_4\text{-S}$, are best if soils are deficient in sulphur. These fertilizers contain sulphate, which is immediately available to the crop.

Fertilizers that contain elemental (pure) sulphur are best used in a long-term soil sulphur-building program. Elemental sulphur must be converted to the sulphate form by soil microorganisms before the crop can use it. The conversion of broadcast applied elemental sulphur is usually too slow to satisfy crop needs in the first several years after application.

Fertilizing with manure and compost

Manure can be used as a fertilizer on established grass. However, it should be used with caution:

- manure, particularly liquid manure, can burn leaves, resulting in reduced yield and quality
- manure application equipment can be quite heavy, contributing to soil compaction, and may damage the crowns of some grass species

- manure can contain weed seeds, and the nitrogen in the manure can have the undesirable effect of stimulating weed growth

Ideally, manure is best utilized on non-legume annual crops. If no other land is available to spread manure, then the field with the oldest forage stand should be used. To minimize manure contact with the crop, solid manure should be well broken up and applied immediately after harvesting. Soils should be firm and relatively dry to minimize soil compaction.

Application rates will depend on the type of livestock manure used and the manure nutrient content. Testing of manure nutrient levels is recommended. Tri-Provincial Manure Application and Use Guidelines should be consulted before application of manure onto hay or pasture land. These are available online at: [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/epw8709](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw8709).

Very little research has been done on composted manure applications onto grass. However, compost contains considerable amounts of potassium and phosphorus. Therefore, an application of compost on soils deficient in either of these nutrients could be very beneficial.

Great care must be taken not to apply manure or compost onto fields that are subject to water runoff onto certain areas:

- other fields
- wetland areas or watercourses to prevent environmental contamination
- saline soils (soils with E.C. >2 dS/m)

Plant tissue analysis

Soil fertility levels should be monitored throughout the life of a grass stand to ensure optimum production. Plant tissue analysis may provide useful information on soil fertility and the nutritional health of a grass crop. For optimum production, grass just before heading should contain a minimum of the following:

- 2.0 per cent nitrogen
- 0.25 per cent phosphorus
- 1.5 per cent potassium
- 0.2 per cent sulphur

Table 6 provides approximate levels of each nutrient in the whole aboveground plant before seed heading. Approximately 25 plants should be selected at random across a typical area and should be cut off just above ground level. Samples should be air dried and sent to a laboratory for analysis.

Grass tissue analysis can determine the nutritional levels of the crop before visual symptoms of deficiency appear. Tissue analysis, coupled with soil tests, can make for a more comprehensive fertilizer management program for grass. Further information on plant tissue sampling procedures can be obtained from a soil-testing laboratory.

Table 6. Levels of nutrients in the whole plant grass tissue before seed heading^z

Nutrient	Low	Sufficient	High
Per cent %			
Nitrogen	<1.8	2.0 - 3.0	>4.0
Phosphorus	<0.15	0.25 - 0.50	>0.80
Potassium	<1.0	1.50 - 3.0	>5.0
Calcium	<0.15	0.20 - 0.50	>1.0
Magnesium	<0.10	0.15 - 0.50	>1.0
Sulphur	<0.10	0.15 - 0.40	>0.80
Parts per million (ppm)			
Boron	<3	5 - 25	>75
Copper	<2	5 - 25	>50
Iron	<15	20 - 250	>500
Manganese	<10	15 - 100	>250
Zinc	<10	15 - 70	>150

^z These are average numbers, which will vary depending on grass species.

Fertilizer products

Selection of fertilizer types for grass should be governed by several factors:

- availability of the fertilizer
- type of product
- method of application
- cost per unit of the nutrient
- relative convenience in using the product

Nitrogen

Urea (46-0-0) is the highest analysis granular product and, generally, the least expensive. Urea, when surface-applied can result in losses due to volatilization as the urea changes to gaseous ammonia resulting in portions of this material being lost to the air.

For this reason, **urea must be used with caution for broadcast application onto established grass in southern and south central Alberta, particularly under warmer conditions.** If broadcast urea is used, it is suggested that air temperature be less than 10°C (50°F) or soil temperature be less than 5°C (40°F) to minimize nitrogen losses. Coating the urea with a urease inhibitor may reduce potential volatilization for up to 10 days.

In the past, ammonium nitrate (34-0-0) was the preferred nitrogen form for broadcast application onto grass, containing half its nitrogen in the nitrate form and half in ammonium form. This combination was an advantage, as the nitrogen would not volatilize. It could be safely broadcast onto established stands with minimal concern for nitrogen losses. Unfortunately, as of July 2005, the form 34-0-0 was no longer manufactured and sold in Canada.

Polymer-coated urea is a new urea product that is coated to minimize volatile nitrogen losses and also reduce overall potential loss. Initial work in southern Alberta has shown that when broadcast onto grass in early spring, the nitrogen releases too slowly to meet early season grass requirements. Further research is needed to develop the best management practices for this product. Using a combination of urea and coated urea may be a way to achieve both early and mid-season nitrogen crop requirements.

Urea-ammonium nitrate (UAN) liquid fertilizers (28-0-0, etc.) contain urea and ammonium nitrate dissolved in water. Liquid fertilizers are convenient because less time and labor is required if the producer has the necessary application equipment. Dribble-banding liquid fertilizers onto grass can be effective. However:

- the urea in the liquid fertilizer is subject to the same volatilization losses as granular urea and must therefore be managed carefully to prevent gaseous losses
- used at higher rates, liquid fertilizers used can cause burning of actively growing plant tissue

As such, application is most successful when applied in early spring before grass starts to actively grow. Liquid fertilizers are well suited for fertigation through irrigation systems.

Blended granular or liquid fertilizers are physical mixes of nitrogen and phosphate and, at times, other nutrient fertilizers. They can be custom blended to a producer specification and, if required, can include potassium, sulphur or micronutrients. They are more convenient to use than the basic products applied separately.

Phosphorus

Commercial granular phosphate fertilizer in Alberta is monoammonium phosphate. It contains 11 to 12 per cent nitrogen and 51 to 55 per cent phosphate (P_2O_5).

Commercial liquid phosphate fertilizer is ammonium polyphosphate (10-34-0) and usually contains 10 per cent nitrogen and 34 per cent phosphate.

Monammonium phosphate is the most commonly used form of phosphate fertilizer. Research has shown it to be slightly more successful than triple super-phosphate (0-45-0) or diammonium phosphate (16-48-0), particularly on high pH soils. Liquid polyphosphate (10-34-0) is applied in a soluble form, breaking down rapidly into plant available form, with equal performance to granular ammonium phosphate.

Potassium

Commercial potassium fertilizer sold in Alberta is potassium chloride (KCl) and is often referred to as muriate of potash. Potassium chloride (0-0-60 or 0-0-62) is the potassium form in these fertilizers. Some dealers may also carry other potassium fertilizer forms including potassium nitrate or potassium sulphate.

Sulphur

Fertilizer containing sulphate-sulphur such as ammonium sulphate [21-0-0-(24)] (which contains 24 per cent SO_4-S) is best used if the soil is deficient in sulphur. This fertilizer contains sulphate, which is immediately available to the crop. Fertilizers that contain elemental (pure) sulphur (e.g. 0-0-0-90) are only recommended if soil sulphur levels need to be built up over time.

Microorganisms must convert elemental sulphur to the sulphate form before it can be taken up by the crop. The conversion to sulphate requires several months to a number of years. The rate of conversion is affected by soil temperature and moisture conditions. In most cases, conversion is too slow to fully satisfy crop needs in the first several years after application on deficient soils. Elemental forms could be used for long term sulphur building over a period of years.

Micronutrients

For specific information on micronutrient recommendations, sources and methods of application for grass production on problem soils, consult a soil or forage specialist and review Agdex 531-1, *Micronutrient Requirements of Crops*. This factsheet is available on line on Alberta Agriculture's website at [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/agdex713](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex713)

Summary

Through good fertilizer management, the productivity of many hay and pasture fields can be significantly improved. For more information on fertilizing grass for hay or pasture production, contact the Alberta Ag-Info Centre toll-free in Alberta at 1-866-882-7677.

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