Hay Production in Yukon

Best Management Practices

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Summary

Hay production in Yukon is a well-established industry, comprising 1930 hectares of farmland spread over 62 farms (Yukon Agriculture State of the Industry Report 2013 to 2017), however, there have been no documented best management practices (BMPs) for the production of this important agricultural commodity. To gather information for the writing of a hay BMPs document, a literature review was conducted, and interviews were held with 7 local hay producers.

Grass hay is dominant in the Yukon, with most producers growing smooth bromegrass (var. Carlton) and timothy, though other grass species may be included in seed blends. Production may be dryland or irrigated, with consistently higher yields expected in irrigated production. Nutrient management is achieved mainly through the application of granular fertilizer, which is ideally custom-ordered following soil test results. Blends of nitrogen, phosphorus, potassium and sulphur (N-P-K-S) are recommended. There is some use of manure and other forms of organic amendments as fertilizer in the territory, though use is limited by availability. Fertilizer may be applied in the spring, the fall, or under a split application management plan. If producers are using a split application, more product is typically applied in the fall. There is a tight window for fall application of fertilizer – product needs to be applied before the ground freezes, but after plants have stopped actively growing. Rates of fertilizer vary considerably, with anywhere from 150-500 lbs of product per acre applied. Variability is due to differing soil test results and yield expectations, though the general rule of thumb is 100 lb of N/acre for dryland production and 150 lbs of N/acre for irrigated production.

Rates of irrigation vary by location and soil type, with producers putting down between 6 to12 inches a year and 0.5-3 inches per set, though it should be noted that the high rate of 3 inches per set risks pushing nutrients out of the soil, and more conservative rates are likely appropriate for most farms. Irrigation typically begins in May, and the local recommendation is to limit water a few weeks before harvest in order to allow plants to pull moisture from the ground and stems, creating both a drier hay crop and drier field conditions for harvest. Wheel line irrigation is the most common type, though other options include centre pivot, big gun, and hand line. The type of irrigation system used depends on site specifics and production objectives.

There are few pest issues overall in the Yukon, though weeds can impact hay fields by acting as a harvest contaminant and by competing with the crop and affecting yield. The most problematic species is foxtail barley because it can be a feed contaminant and is difficult to control once established. An IPM approach involving field scouting, record keeping, and consideration of a variety of control methods for weed management.

Some producers may choose to graze their hay fields for part of the year. Grazing should be limited to times of the year when damage to crop will be minimized – ideally ground is frozen. Care needs to be taken to limit opportunities for overgrazing. A benefit of grazing hay fields is the addition of nutrients via manure, though patties need to be harrowed in spring to limit winterkill.

Hay is typically harvested in July, depending on species and local weather conditions at the time. More growers are now using disc mowers, which enables lower cutting heights, though caution needs to be exercised as lower cutting heights can impact the ability of grasses to regrow and may affect long term productivity of the field. Conditioners that crack or crimp stems and speed dry time – typically as part of a mower-conditioner – are commonly used. Moisture testing at harvest is important to prevent baling hay that is too wet and may mold or even combust, or hay that is too dry and prone to breakage. Moisture testing options include the use of digital probes and oven testing methods, with oven testing the most accurate. Tedding of hay is recommended by local producers and is particularly valuable when harvesting within a tight

weather window. Hay is baled as rounds or square bales, with square bales being preferred by a number of smaller operations that do not have equipment for larger round bales. Ideal moisture levels vary by bale type, with local producers recommending 8-10% moisture for large round and large square bales, and 10-12% moisture for baling small squares.

Renovation or rejuvenation of hay fields will likely be required eventually, depending on previous management and yield expectations. Traditional renovation involves spraying or summer fallow the existing stand and breaking the field to achieve a smooth seedbed. Rejuvenation generally refers to utilizing methods such as no-till seed drills and suppression of the existing stand without breaking the field. Rejuvenation is preferred over breaking the field because of fewer production losses, limited risk of erosion, and conservation of soil moisture. If yields have declined to a point that rejuvenation is required, assessments of the stand should be conducted that consider stand density, species composition, and production as a percentage of yield potential for the area. The recommendation for seeding for rejuvenation is to increase the usual seeding rate by 1.5 times. Increasing the rejuvenation seeding rate by more than 1.5 times the usual rate may be appropriate for Yukon conditions, as producers often increase the recommended seeding rate for field establishment as well.

Section 1: Background and Methods

Background

Hay has historically been and remains the principal crop grown in the Yukon, with 1930 hectares in production on 62 farms according to 2016 census data (Yukon Agriculture State of the Industry Report 2013 to 2017). Despite many years of hay production in the territory, there has been a lack of documentation regarding best management practices (BMPs) for hay production in the Yukon. This document provides an overview of the major considerations for maintaining productive hay fields, harvesting quality hay, as well as strategies for rejuvenation of hay fields.

Hay in the Yukon may be produced under either dryland or irrigated conditions. Yields for dryland hay are generally lower (1 - 3 tonnes/acre) than for irrigated hay (3 - 5 tonnes/acre). Most of the farmers interviewed for this project produce irrigated hay, though information specific to dryland production has been included where applicable.

Hay in the Yukon has historically been produced primarily for horses in the territory, though there is a shift in recent years to hay production for other livestock as the number of farming operations with cattle increases.

Methods

Data for this document was collected in two ways:

1) By conducting a review of the available literature on hay production in northern climates (July through October 2018)
2) By conducting detailed interviews (7) with Yukon hay farmers (August through October 2018)

Section 2: General Management Considerations

Identifying Production Objectives

Through conversations with local producers, it became clear that determining your objectives for producing hay is key to making appropriate management decisions. Some questions to consider when developing a management plan are:

- Do I plan to sell the hay I produce, or is this for personal/on-farm use?
- If selling, who is my customer? What livestock are they feeding? Are there particular nutritional requirements they are looking for in their hay?
- Do I want to/am I able to irrigate my fields?
- What are my equipment needs and options?
- Will I graze my hay fields for any part of the year? How do I manage my fields to produce both a quality hay crop and to use as grazing land?

Location and Site Specifics

Conversations with Yukon hay producers also demonstrated that there is no “one size fits all” management regime. Location of hay fields can mean significant differences in management practices – for example, sandier soils will hold less water than clay soils, and soils in the Dawson area are generally more developed

than soils in the Whitehorse area and require fewer amendments. Conditions within fields can also vary – low lying areas, areas with greater weed pressure, and areas with greater soil salinity may require different management practices. Understanding site specifics and field history will contribute significantly to producing the best hay crop possible. Some key information to understand and document is:

- Soil type and texture
- Soil pH
- Soil nutrients
- Saline areas
- Drainage patterns (e.g. consistently dry or wet areas of field)
- Weather, aspect and average annual precipitation in area
- Field history (previous management practices)
- Surrounding vegetation (weedy areas)

Recordkeeping and Benchmarking

Keeping detailed records is a good practice for any farming operation. Good record keeping will enable you to track the effects of any changes to management practices over the years and make well informed decisions going forward. Records should be kept for:

- timing and rates of fertilizer applications
- timing and rates of irrigation applications
- timing and rates of pesticide applications
- timing and rates for reseeding efforts
- timing of harvest and related details (weather conditions, moisture testing data)
- yield harvested per field and quality as per hay testing
- machinery maintenance and repairs

Benchmarking areas of the field for monitoring is another good management practice. Benchmarking is done by selecting an area of the field that will be monitored annually, and allows for tracking of the results of new management, or for comparison of differing management practices. It is important to clearly mark the area that is being used for benchmarking. If differing management practices are being compared across areas, try to select areas that have otherwise similar site characteristics to facilitate comparison of data. Benchmarking is commonly used for soil sampling, but may also be used for tracking information such as weed pressure, snow accumulation areas, frost pockets, species composition, and so on. Taking annual photos for comparison of benchmarking areas is recommended.

Section 3: Grass Species for Hay Production in the Yukon

Hay production in Yukon is almost exclusively grass hay, with smooth bromegrass and timothy the most commonly grown species. Legumes (alfalfa and sainfoin) have been grown by a few producers and trialed locally, but issues related to feed quality from northern types and/or winter hardiness have limited the establishment of these crop types in Yukon. Yukon hay producers may grow either a pure stand (typically smooth bromegrass) or a blend of grass species (e.g. smooth bromegrass and timothy).

Smooth bromegrass (var. Carlton)

- cool season, creeping perennial grass
- highest yielding grass variety in local trials (Bisset 1994)
- sod-forming and long-lived (5 to 7 years +) (Dinkel & Czapla 2012)
- deep rooting with fine, fibrous root system
- excellent palatability for livestock. Protein levels may be as high as 11-14% (Peace Forage Seeding Tool), though Yukon protein content is typically lower

Timothy

- cool season, perennial bunchgrass
- grows well in soils with high moisture in root zone but does not tolerate drought well
- does well on clay, silt and peat soils
- good palatability for livestock in earlier growth stages but declines as plant matures

Other Grasses:

Meadow bromegrass

- cool season, slow-creeping perennial grass
- good tolerance to drought
- better regrowth following grazing than smooth bromegrass (Franzen & Griggs 2002)
- less hardy than smooth bromegrass
- grows well on sandy, silty or clay soils
- begins growing earlier in spring than smooth bromegrass (Aasen & Bjorge 2009)

Crested wheatgrass

- cold hardy perennial bunchgrass
- deep, fibrous root system
- well suited to dry conditions
- matures early; later growth stages have poor palatability

Perennial ryegrass

- perennial bunchgrass
- use is limited by poor winter hardiness and poor drought tolerance – may be used as an annual
- closely related to tall fescue

Creeping meadow foxtail (Garrison)

- invasive, sod-forming perennial grass
- spreads by rhizomes and seeds
- closely related to meadow foxtail, species can be crossed
- cold hardy and long lived
- early maturing

Tall fescue

- closely related to perennial ryegrass

- historically poor winter hardiness (AB); newer varieties are better
- not well suited to dryland production
- forage types should be selected (no or low levels of endophytes)

Orchard grass

- bunching growth habit
- not well suited to alkaline soils
- hardiness depends on variety – only the hardiest varieties (ex. Kay) should be used for Yukon
- excellent palatability with good regrowth; often used for pasture
- extensive, fibrous root system

Section 4: Best Management Practices for Hay Production in Yukon: Maintaining Healthy and Productive Fields

4.1 Nutrient Management

Grass hay has a relatively high demand for nutrients, and replacing these nutrients is required as large quantities are removed from the field via harvesting of plant material. Hay quality - namely protein content – is also closely linked to nutrient availability (Lamond, Fritz & Ohlenbusch 1992). A solid understanding of nutrient management a central component of a crop management plan. Table 1 gives an overview of key nutrients for grass hay production.

Table 1. Key nutrients for hay species and their role in plant health

Macronutrients	Role	Notes
Nitrogen (N)	-essential for photosynthesis -building protein -tiller development	-most limiting nutrient in hay production -urea forms of N fertilizer are prone to volatilization over 5°C (surface soil temperature)
Phosphorus (P)	-important for plant maturation, flowering and root development -involved in nutrient uptake -involved in photosynthesis	-Although Yukon soil tests show adequate P levels, it may not be available to plants -availability of P is related to soil pH, moisture and temperature
Potassium (K)	-helps plant adjust to stress -increases water uptake -limits water loss -increases stem strength -improves winter hardiness -improves stand longevity -strengthens root system	-soil tests may show adequate K levels, but it may not be available to plants -availability of K is related to soil pH, moisture and temperature -K is less abundant in sandy soils (Arnason 2013)
Secondary Macronutrients		
Sulphur (S)	-associated with N availability -associated with winter hardiness -plays role in protein formation	-can have an acidifying effect on soil pH -sulphate-sulphur is readily available to plants; elemental

	sulphur takes several years to become available

4.1.1 Assessing Nutrient Needs

Regular testing of soil and hay will enable comparison of data from year to year and help to assess the efficacy of any changes in management practices.

Soil testing: Soil testing is a service offered through the Agriculture Branch. Samples are sent to a laboratory (Exova in Edmonton, AB) for analysis and results can be reviewed with Agriculture Branch staff. Soil samples should be taken regularly (every 1-2 years) and compared from year to year to assess the impacts of management practices. Samples are ideally taken in the fall (prior to any planned fall fertilizer applications) when soil temperatures have declined to less than 7^{o}C (McKenzie 2005). By sampling in the fall, there is time to have the sample analyzed before the growing season and develop a nutrient management plan for the following year.

Soil tests will return information on both macro and micronutrient levels. They may also report the pH, the EC (a measure of salinity) and organic matter (OM) percentage. Soil tests will also provide recommendations for fertilizer inputs for optimal crop nutrition. Although lab soil recommendations are a good starting point, adjustments maybe needed for Yukon's environmental conditions.

Hay testing: Agriculture Branch also offers hay testing services. Results can be reviewed with Agriculture Branch staff. Hay testing will return information on moisture and dry matter percentages, crude protein, mineral content, and ADF (acid detergent fiber) (Agriculture Branch 2018). Hay testing is beneficial information for both growers and their customers.

4.1.2 Phosphorus, Potassium and Sulphur in Yukon Hay Fields

Nutrient uptake by plants is a complex process that is affected by many factors. Soil temperature, texture and pH all play a role in the availability and uptake of nutrients. It is well understood that the addition of nitrogen (N) fertilizer is key for optimal grass hay production, but the availability of P, K and S in Yukon soils and need for inputs is less understood. P and K may be within optimum ranges on soil test results, but not be available for uptake by the crop due to pH or cool soil temperatures. Fertilizing with N only will increase yield, but the addition of other nutrients will contribute to both the long-term productivity of the hay field and to overall plant health. When yield is top of mind, it can be a challenge to invest in fertilizer blends including P, K and S that will contribute to long term productivity but not necessarily give the direct returns (increased yield) that can be observed with N fertilization.

Phosphorus (P): Plants take up phosphorus in the soluble phosphate (PO_4) form. Phosphorus in the soil will mineralize more rapidly and become available to plants in warmer, well-aerated soils. P availability may be limited in soils with a pH between 7.5 - 8.5 (like many Yukon soils) because more stable calcium and phosphorus compounds are formed under these conditions, however research from Alberta indicates that these Ca-P compounds will eventually break down over time and become available to plants (McKenzie 2015). General recommendations for grass hay production in Alberta are to apply a maintenance application of 20-40 lbs of P_2O_5 to established stands (McKenzie 2005). Soil test results from established Yukon hay fields also often show recommendations of 20-40 lbs P/acre, though it should be noted these recommendations are based on common agricultural soil types for Alberta and may need to be adjusted for Yukon.

Symptoms of a P deficiency in grasses include stunting or slow growth, blue or purple colour, and delayed maturity (Government of Saskatchewan 2018).

Potassium (K): Potassium is stored in the stems of crops, making it an important nutrient to manage in hay production as plant matter is removed from the field at harvest (Government of Saskatchewan 2018). Potassium availability decreases as soil acidity increases, and is generally less abundant in sandy soils (Kaiser & Rosen 2018). Potassium availability is also affected by soil moisture and soil temperature. Recommended application rates for established grass hay fields vary depending on soil test results.

Symptoms of a potassium deficiency in grasses include poor winter hardiness, reduced drought tolerance, poor growth and yellowish streaking of older leaves. Scorching to leaf tips may also occur (Lemus 2012).

Sulphur (S): Sulphur is used by plants in the sulphate form and is prone to leaching in sandy soils (McKenzie 2013). Sulphur fertilizers are available in either the sulphate form, which is readily available to plants, or as elemental sulphur, which needs to be converted to the sulphate form by soil microbes before it becomes available. Conversion of elemental S to the sulphate form can take up to 4 years (McKenzie 2013). Rates for sulphur fertilizer application should be based on soil tests. Soil sampling for sulphur is ideally done at multiple depths (0-6, 6-12, and 12-24-inch depths). This allows for more precise fertilizer applications because it considers available sulphur in the subsoil (McKenzie 2013).

Excess sulphur may have an acidifying effect on soils, though literature from Manitoba suggests that attempts to acidify alkaline soils (those with a pH >7.0) using sulphur fertilizer are generally unsuccessful because the high calcium carbonate content of these soils neutralizes acidity (Manitoba Soil Fertility Guide 2007; Hill & Ball 2002). The general management practice for Sulphur in Yukon is to include S to boost protein synthesis and to also help moderate pH in less-carbonate rich soils.

Yellowing of newly emerging leaves is a common sign of an S deficiency in forage grasses (McKenzie 2013).

4.1.3 Fertilizer Types

Synthetic fertilizer: Yukon hay producers typically fertilize their fields using commercial synthetic fertilizers. These fertilizers are available as single nutrients or in blends. Blends for grass hay production generally include N-P-K-S. The amount of each nutrient in a blend is expressed as a percentage, so a blend of 30-10-10-3 would contain 30% N, 10% P, 10% K and 3% S by weight.

Manure: Manure may also be used to fertilize hay fields via broadcast application or grazing. The use of manure is generally dictated by local availability. An advantage of using manure is that it provides micronutrients and organic matter (OM) in addition to macronutrients, though levels need to be determined by testing. Manure can be tested through Agriculture Branch via Central Testing Laboratory in Winnipeg. Other fertilizer sources may be used as available (e.g. feather meal), but local experience is limited.

4.1.4 Fertilizer Rates

Synthetic fertilizer: The amount of product to be applied per acre should be calculated using the recommended rate of nutrient per acre following soil test results, and the amount of nutrient in the selected fertilizer blend. An example of the calculation is made as follows:

> *lbs product/ac = [recommended rate of nutrient (lb/ac)] x [100] ÷ [percentage of nutrient in selected fertilizer]*

Using a recommended rate of 90 lb N/ac and 30-10-10 fertilizer, this would mean:

90 lbs N/ac x 100 ÷ 30 lbs nutrient/ac = 300 lbs product/acre

Applying this rate of product for N means that 30 lbs/ac of P and K would also be applied:

10 lbs/ac P ÷ 100 x 300 lbs product/ac = 30 lbs P/ac

10 lbs/ac K ÷ 100 x 300 lbs product/ac = 30 lbs K/ac

From: Manitoba Soil Fertility Guide, 2007

The Yukon hay producers interviewed apply anywhere from 150-500 lbs of product/acre each year. The variation in rates is due to differing yield expectations, soil test results, access to product, cost, and production objectives.

Dryland fertilizer rates are lower than for irrigated land. The rule of thumb used locally is 100 lb/ac N for dryland hay and 150 lb/ac N for irrigated hay, though once again rates are ideally determined using soil test results. When fertilizing dryland hay, going heavier on the fall application (i.e. 75% fall/25% spring) or applying all fertilizer in the fall may be appropriate given the risk of limited moisture in the spring. For more information on timing refer to 4.1.6 Timing.

Manure: Rates for manure will vary depending on the type of manure used and the nutrient content. Testing of manure for nutrient content is recommended. Caution is advised when spreading manure, as it has the potential to burn crop tissue and may contain weed seeds. Manure should be applied to fields following harvest to limit contact with the crop, and fields should be relatively dry to limit soil compaction from spreading equipment (McKenzie 2005). Synthetic fertilizer recommendations for fields that have a history of manure application need to be carefully considered to prevent over-fertilization because manure releases nutrients slowly over several years, and nutrients in organic forms will not register on a soil test (McKenzie 2005).

4.1.5 Application Methods

Yukon hay producers typically broadcast granular fertilizer. Applying N as urea via broadcast application may result in losses to volatization when soil temperatures are above 5˚C or air temperature is above 10˚C, with greatest losses occurring if fertilizer is applied to a moist thatch layer followed by windy and warm conditions (McKenzie 2005). Volatilization can occur with both spring and fall fertilizing, though losses are more likely to occur in spring conditions. Volatilization can be reduced by application method (e.g. banding instead of broadcasting). Yukon's cool weather and yield results indicate that volatilization of Nitrogen is not a major concern here, but more work needs to be done locally to investigate losses due to volatilization and alternative fertilizer application methods for the Yukon, taking into consideration equipment needs, cost, and product availability.

4.1.6 Timing

Spring application: Spring application of fertilizer often coincides with other management practices like harrowing, re-seeding and aerating. Spring application of fertilizer may be more easily managed under irrigated hay production, as the grower can control field moisture and ensure fertilizer is able to move into the soil. Spring application of fertilizer on dryland hay may be riskier due to dry springtime conditions.

Fall application: Fall fertilizing can be advantageous as nutrients are immediately available when plant growth begins in spring. This can be particularly valuable if field conditions in the spring make it difficult to get equipment on the field. Local producers have experienced success with fall fertilizing; however great care needs to be taken with the timing of application. The ideal window is before freeze-up, but after the plant is no longer actively growing – usually, this means around the third week of September in Yukon. If fall fertilizer is applied too early, a late flush of growth is encouraged, increasing risk of winter kill. If applied too late, the fertilizer will not have a chance to move into the soil and the majority will be lost over the winter.

Split rate application: A split rate fertilizer application is commonly used by Yukon hay producers. When using a split rate, local producers tend toward applying more product in the fall, though if fall/winter grazing is planned, applying more product in the spring may be advantageous for regrowth after cutting.

Local research trials in 2013 and 2014 showed the highest yield of irrigated smooth bromegrass with a higher rate of fertilizer (150 kg N/ha vs. 100 kg N/ha) and a 75% fall/25% spring split application (Ball, Barton & Isbister 2014).

4.2 Irrigation

Installation and maintenance of irrigation systems requires significant investment in terms of both time and money, but the resulting higher yields (up to 5 tonnes/acre is possible) and increased control over production generally make irrigating hay fields a worthwhile undertaking. It should be noted that increased yields as a result of irrigation and fertilizer use also mean increased labour needs that should be planned for in advance of harvest.

4.2.1 Irrigation Scheduling

Irrigation scheduling can be very complex, involving multiple calculations using information on water holding capacity of the soil, evapotranspiration (ET) rates, climate information (humidity, wind, temperature), and more. Detailed general information on irrigation management can be found in the *B.C. Irrigation Management Guide* (see "Useful Links and Resources" at the end of this document).

Ultimately, the goal of irrigation systems is to supply adequate moisture to the effective rooting zone - depending on the grass species and soil characteristics, this depth can range from 6 to 30+ inches (Franzen & Griggs 2002) - on a schedule that takes into consideration water holding capacity of the soil and moisture from rainfall. Soils irrigated using an overhead sprinkler system should generally not be allowed to decline to less than 50-60% of their water holding capacity within the root zone (Tam, Nyvall & Brown 2005).

There are several types of devices available that measure soil moisture using different parameters (tensiometers, electrical resistance blocks, and others). If using a soil moisture probe, ensure that readings are taken from the entire rooting zone, not just the upper few inches.

In-field precipitation monitoring is encouraged. Precipitation can be measured using a manual rain gauge or as part of a climate station that also measures temperature, evaporation and precipitation.

4.2.2 Rates

Yukon hay producers interviewed apply anywhere from 6 to 12 inches of irrigation per year and between 0.5 to 3 inches per set. Variability is due to grass type, soil type, and production objectives. Soils with higher clay content, will have a greater water holding capacity than soils with higher sand content. Local experience has

shown that Ibex Valley soils may be able to “bank” water from heavier irrigation earlier in the season (i.e. 3 inches per set) and then tapering off the amount applied on subsequent sets, whereas sandier soils may need more frequent irrigation events with smaller amounts to keep moisture in the root zone. It should be noted that applying 3 inches per set risks pushing nutrients out of the soil, and more conservative rates are likely to be appropriate for most producers.

Very little information was available in the literature regarding recommended irrigation rates for grass hay production in northern areas. Because of differing climatic conditions, annual irrigation needs in more southern latitudes are generally higher than what is needed in the Yukon, making comparison between regions challenging. The rule of thumb for irrigation for Yukon hay production is minimum 6 to 8 inches. Although any water down is likely to benefit the crop due to the semiarid conditions faced in the Yukon.

4.2.3 Timing

Yukon hay producers generally apply the first set of irrigation in mid-May, depending on local weather that season. Springtime irrigation should follow any fertilizer applications or reseeding efforts so that movement of fertilizer into the soil and seed germination is encouraged. Depending on rainfall amounts, a set of irrigation can be applied every ~10 days until late June/early July, with an aim to harvest mid-July. Leaving a few weeks without irrigating prior to harvest allows the ground to dry sufficiently to safely get equipment onto fields, as well as allowing plants to pull moisture from the ground and stems, resulting in a drier crop going into harvest.

If there is no rainfall and conditions are dry, some local producers find irrigation post-harvest limits plant stress and encourages regrowth, which contributes to health and long-term productivity of the field.

4.2.4 Types of Equipment

Most of the producers interviewed for this project use wheel line irrigation, though there is some use of centre pivot, big gun and hand line irrigation in the Yukon. The type of irrigation equipment selected is based on site specifics, needs, cost and availability.

Wheel line or wheel move


Credit: Wikimedia Commons

Pros:

- Most commonly used type of irrigation in Yukon, generally bought used
- Simple to operate and maintain
- Generally, a cost-effective option
- Well suited to square or rectangular fields

Cons:

- Moderately labour intensive to move from one set to another
- Not well suited to irregular fields or those with slopes greater than 5% (Scherer 2018)

Centre pivot

Pros:

- Least labour-intensive option (automated)
- Low wind distortion
- Provides high uniformity irrigation

Cons:

- Can cause ruts in field
- Not well suited to irregularly shaped fields
- One of the more cost-intensive types

Big gun

Pros:

- Adaptable to a variety of field conditions
- Versatility

Cons:

- Requires higher pressure to operate optimally
- More labour intensive - must be moved frequently

- Wind can distort coverage

Hand line or hand move

Pros:

- Most affordable and versatile irrigation option

Cons:

- Most labour intensive

4.3 Pest Management

This section focuses on control of weeds. Insect pests and plant diseases may affect Yukon hay fields, though pest pressure here is generally low. It is good practice to scout your fields during the growing season to look for signs of insect pests or disease (weak areas, leaf discolouration). The *Alberta Forage Manual* contains a thorough section on possible pests and diseases of forage crops – see "Useful Links and Resources" at the end of this document.

4.3.1 Weed Management

Weeds can impact hay production by being crop contaminants as well as by competing with desired species and affecting yields. The most common and problematic weed species in Yukon hay fields is foxtail barley. Foxtail barley is difficult to control once established, and its seed heads contain bristles that can cause mouth ulcers in livestock.

Other weeds that may impact hay fields include:

- narrow-leaf hawksbeard
- woody species – wild rose bushes, willow
- fireweed
- pepperweed
- silverweed
- shepherds purse
- non agronomic grasses

Weed pressure is generally low in well established fields (Filley 2015). Control during field establishment is recommended, and on-going management will be required if weed pressures start increasing.

Integrated Pest Management (IPM)

Weeds are best managed using an IPM (Integrated Pest Management) approach that considers efficacy and economics of various control methods as well as impacts on the environment (Government of BC 2018). IPM involves:

a) pest identification
b) regular monitoring of fields and keeping records of monitoring data
c) management efforts that may use a combination of control tools, and
d) evaluation of the program following any control efforts

Management tools or techniques under an IPM program may involve:

- **Cultural control**: Cultural controls are any methods that modify field conditions to minimize the likelihood of weed establishment or limit the spread of current populations. Examples include using species that are well suited to local climate and field conditions, crop rotation, and proper grazing management.
- **Mechanical or physical control:** These control methods are those that involve mechanical or physical contact or removal to control weeds – common examples include tillage, hand pulling and mowing.
- **Biological control:** Biological control involves using natural enemies of weed species that will limit the spread of weed populations through predation. Examples include grazing or the release of insect species that feed on weeds.
- **Chemical control:** Chemical control (herbicides) should generally be used as a last resort if other control methods have been unsuccessful, however chemical weed control is usually required at field establishment for forage crops.

Action thresholds: An important component of IPM programs is the use of an action threshold. Action thresholds are the point at which control measures should be taken in order to prevent economic losses from pests. Action thresholds are specific to crop type and pest type, and may be developed through research or based on grower's experience and tolerance level for weed pressure. Currently, there are no established action thresholds for weed management in forage production in northern climates, and tolerance levels will vary by producer.

Weed Control Options for Yukon:

Cultural control:

- Re-seed weakened or disturbed areas as needed to prevent establishment of weeds. Areas that may require spot re-seeding include those damaged by winterkill or by grazing activities from either livestock or wildlife. Monitor fields regularly in the spring and summer to identify and treat these areas.
- Fertilize to encourage a healthy, competitive crop

Mechanical control:

- Scout fields and hand-pull weeds, ideally before they go to seed.

Chemical control: The following products are registered for control of weeds in forage crops and have a history of use in the Yukon. There may be other herbicide products that are registered for use in forage crops and can be used here. When using any pesticide product, be sure to follow the instructions on the label and

make note of grazing restrictions, timing, and non-target impacts. See the section *Useful Links and Resources* at the end of this document for information on pesticide compliance and contact information for the Pest Management Regulatory Agency (PMRA).

- Kerb 50 WSP (Propyzamide) can be used to control foxtail. Kerb 50 WSP is registered for use in established pasture in the late fall, prior to freeze-up. There is a 60 to 90-day grazing restriction following application, depending on the rate used. Kerb 50 WSP is a Group 15 herbicide that acts through root absorption and inhibits shoot growth (Dow Agrosciences; Martin 2000). Applying this product to fields with a high proportion of timothy or crested wheatgrass is not recommended as severe stand reduction will occur.
- Glyphosate can also be used for spot treatment of foxtail and other weeds. Glyphosate is a non-selective herbicide and should be used with caution in hayfields or pasture. There are many formulations of glyphosate on the market; consult with a supplier for product recommendations.
- Grazon (Picloram and 2,4-D) can be used for control of broadleaf weeds and woody species such as wild rose bushes. CAUTION: Picloram persists in the manure of animals that have consumed plants treated with Grazon. As a result, broadleaf plants such as those grown in backyard vegetable gardens can be damaged by manure containing picloram. Degradation of the herbicide may take several years depending on exposure to sunlight, heat and moisture (Oregon State University 2018).

4.4 Impacts of Grazing

Some Yukon hay producers graze livestock on the regrowth in their hay fields in the fall and winter, a practice sometimes referred to as “stockpile grazing”. The decision to graze hay fields is dependent on several factors (economics, feed availability, production objectives) and will be unique to each farm. Smooth bromegrass and timothy have slow regrowth compared to other grass species, and are well suited to grazing in a one-cut system where the rest period prior to fall grazing begins early (July) (Johnston 1999).

Potential benefits of grazing hay fields:

- Good source of fertilizer – manure provides organic matter and micronutrients
- Efficient use of hay regrowth
- Reduced feed costs

Potential drawbacks of grazing hay fields:

- Impact on plant health if grazed too heavily (heavy grazing affects root development) (Franzen & Griggs 2002)
- Damage to field from manure patties if not spread out (harrowed)
- Damage to field from livestock pawing or bedding activities

If hay fields are being grazed, ensure plants have gone dormant and field conditions are dry enough/frozen so they are better able to withstand livestock traffic. Ontario research on fall clipping and fall grazing of hayfields and pasture showed no serious damage to fields the following spring, though spring yields were generally higher with later timing of clipping or grazing the previous fall (November-December) (Johnston et al. 1998).

Section 5: Best Management Practices for Hay Production in Yukon: Harvesting Quality Hay

5.1 Timing

In general, Yukon hay producers can plan to cut hay in early to mid-July, though crop type, maturity, and a window of suitable weather is the ultimate determinant of when hay can be harvested. Smooth bromegrass should be cut at late heading to early flower for best hay quality (Aasen & Bjorge 2009). Experienced local producers aim for ~10% flower at harvest for smooth bromegrass. In blends, timing of harvest should be dictated by the maturation of the predominant species and production objectives – for example, one local producer times harvest for when the meadow bromegrass in the field is flowering to maximize hay protein levels. This timing is slightly earlier than other hay fields and may mean a lower yield, but in this case, the higher protein level is more desirable.

Yukon hay farmers generally harvest hay once per season, while efforts to do multiple cuts per season have been met with minimum success. A second cut in irrigated fields may be possible, depending on production objectives. This is only likely to work if a first cut can be taken earlier (June) so that there is adequate regrowth for a second cut (August). The second hay cutting is riskier in terms of curing, as nighttime temperatures are cooler and dew increases, which can slow the time it takes to dry the crop. Also, from the limited data, yields and overwinter health in field suggest a two-cut system needs more research.

5.2 Cutting Height

Yukon hay producers generally operate on a one-cut system, meaning cutting heights may be lower (~2 inches) than for regions in southern Canada, where leaving adequate stubble for optimal regrowth for subsequent cuts is a concern. The increased use of disc mowers in the territory also enables producers to cut hay lower, however lower cutting heights may stress plants and impact long term productivity. For cool season grasses, a minimum stubble height of 3 inches is recommended (Miller 2018; Franzen & Griggs 2002). Leaving more stubble may also improve airflow and therefore decrease drying time, as cut hay is prevented from lying in close contact with the ground.

5.3 Harvesting Equipment

There are many equipment options available for all stages of hay making, from cutting to conditioning to baling. Ultimately, the right equipment choice for the farm is the one that fits within constraints related to finances and availability, without compromising production objectives.

It is important to ensure that any equipment you are considering purchasing for use on your farm is compatible with the other equipment you are running – for example, ensuring that the size of windrow formed by your hay rake is appropriate for your baler capacity.

5.3.1. Mowers

Disc mower-conditioner:

This is the mower type most commonly used by the Yukon hay producers interviewed, though they may not be necessary or viable for smaller operations. Brand names include DiscBine (New Holland), MoCo (John Deere), DC3 series (Case) and FC series (Kuhn), among others. Mower-conditioners decrease drying time by cracking stems (using rubber or steel roller conditioners) or by removing the waxy cuticle (using flail conditioners) at the same time as mowing, allowing moisture to leave the stems more quickly.

Other mower types include:

Sickle-bar mower:

Credit: tractortoolsdirect.com

Pros:

- Requires less power than disc mowers
- Cuts cleanly and leaves a uniform swath
- Can also include a conditioner, depending on model

Cons:

- Slow compared to disc mower
- More prone to clogging, especially if working in dense material
- Blade maintenance and repair can be time consuming and expensive

Drum mower:

Credit: agrimir.com

Pros:

- Durable design, fewer parts
- Can operate at high speeds
- No hydraulics required

Cons:

- Heavy, may not be suitable depending on tractor
- Currently there is limited use and equipment knowledge in Yukon (none of the producers interviewed reported use of drum mowers)

5.3.2 Conditioners

The time it takes to cure hay in the field is largely dependent on crop moisture levels at harvest and weather conditions (namely wind and relative humidity), but post-harvest management with hay conditioners can significantly reduce drying time. Increased time left in the field increases risk of running into rainy weather and increases dry matter loss by respiration (Henning & Wheaton 2018).

Roll type:


Credit: deere.com


Credit: masseyferguson.com

Hay is passed through rubber or steel rollers that crimp and crack stems, allowing moisture to leave the stem faster. Grasses are well suited to conditioning by steel rollers, though other conditioner types may be used depending on grass species and whether irrigated or dryland hay is being harvested. Steel rollers are preferable in terms of equipment longevity. Roller conditioners are typically used as part of a mower-conditioner.

Flail:


Credit: deere.com

These condition hay by removing the waxy cuticle on stems, which also allows moisture to leave stems faster. This conditioner type is also usually seen in a mower-conditioner.

ReCon:


Credit: harcoag.ca

AgShield manufactures a hay conditioner called a ReCon that works by using rollers designed to aggressively condition stems by crushing, and re-fluffs or spreads swaths to improve airflow. Options include a spinner-spreader (replaces tedder) or bolt-on deflectors that direct hay into a fluffed windrow – this attachment can eliminate rake passes on rows up to 12" wide (AgShield 2018).

Macerators: Macerators (or super-conditioners) are a kind of conditioner that cut the hay then pass it through a series of rubber then metal rollers that have a shredding action on plant stems, further decreasing drying time. None of the interviewers interviewed for this project use a macerator, and the potential for their use in the Yukon requires further investigation.

5.3.3 Tedders


Credit: deere.com

Credit: tradefarmmachinery.com

Hay tedders use tines to lift, flip and spread hay that is in windrows, increasing airflow through the pile. Tedding may occur multiple times before hay is baled, depending on moisture and weather conditions. Tedding can result in increased leaf loss, though this is typically more of a concern in legume hay. Different sizes of tedders are available to best suit the size of your operation and field terrain.

Yukon hay producers may use a conditioner as well as a tedder, and both may be used more than once depending on weather conditions during haying.

5.3.4 Rakes

The final step before baling hay is raking into windrows, if conditioning equipment has not already done this for you. Again, there are many available options for rake types:

Wheel rake:

Pros:

- Generally, the most cost-effective rake as there is typically no PTO or hydraulics component
- Available in a variety of sizes and configurations (single frame, twin frame, mounted, etc.)

Cons:

- "Roping" of the windrow which decreases drying time can be a problem
- May result in higher ash content than other rake types (Rankin 2017)
- Performance is affected by hay moisture – best suited to dry hay

Rotary rake:

Pros:

- Creates a fluffy windrow that improves drying
- Does not require contact with the soil, minimizing contamination of the crop
- Able to handle forage with a higher moisture content

Cons:

- More expensive than wheel rake

Belt rake:

Credit: tractortoolsdirect.com

Pros:

- Similar in action to a rotary rake but more compact and lightweight; suitable for smaller tractors
- Available in several sizes, enabling belt rakes to handle a variety of terrain
- Can easily be modified to operate as a tedder

Cons:

- Use may be limited to smaller scale or hobby farm operation

5.3.5 Balers

The type of baler selected will depend on desired bale type. Bale type is determined by equipment availability, labour availability, customer preference, and economics. Hay can be baled in round bales, small squares, or large squares. The baler selected needs to be compatible with other equipment and production specifics, i.e. size of windrows formed by rakes and baler capacity.

Round bales may be preferable for the following reasons:

- Better weather resistance compared to square bales
- Balers are less expensive than those for square bales
- Less labour intensive than handling small squares if using appropriate equipment

Square bales may be preferable for the following reasons:

- Easier to store than round bales

- Generally sell at a higher price
- Easier handling though more labour intensive (small squares)
- Good marketability for horse owners

Round balers:


Credit: tractor.com

Round balers may come in fixed or variable chamber models, or a combination. Variable chamber models can make different bale sizes. Continuous models kick the bale out; otherwise the machine needs to be stopped and the bale unloaded.

Square balers:


Credit: zeiglercat.com

Square bales can be either small or large. Square balers automatically drop bales out, after which they can be stacked by hand on a flatbed or gathered and loaded using an accumulator. Large square bales are becoming more popular, with equipment on the market designed to handle 3x3, 3x4 or 4x4 bales. Square balers are typically more expensive than round balers and require more horsepower.

5.4 Moisture Testing

Baling hay that is too wet impacts quality and can mean moldy or even combustible hay, whereas hay that is baled too dry loses feed value and is prone to leaf loss. Hay moisture testing should occur both in-field (windrows) and as the first few bales are made.

5.4.1 Moisture Testing Options

Oven testing: Oven testing can be done in conventional ovens, microwave ovens, or with a portable tester (i.e. Koster moisture tester). These tests measure moisture content (MC) by dividing the oven-dried weight of a hay sample by the weight of the sample before drying and calculating % moisture content.

Example:

Hay sample weight before drying: 200 g

Hay sample weight after drying: 150 g

150 g /200 g = 0.75 (or 75% dry weight)

100 – 75 = 25

This means 25% of the initial sample was moisture content (Laurenzi 2014).

These tests offer the most accuracy, though depending on the type of oven testing, can take a long time - up to a day in some cases. Portable oven testers (such as the Koster) are the fastest way to test for MC with a high degree of accuracy, with drying times of about 25-40 minutes (Koster Inc. 2016).

Moisture probe: Moisture probes are time efficient, and though less accurate than oven testing, still provide useful MC readings – however, it is important to keep in mind that unlike oven testers, probes will not measure MC within a grass stem. Hay can be tested with a moisture probe both in-field (from windrows) and when baled.

To test hay from the windrow: Gather loose hay and pack it tightly into a bucket. After the first reading, mix the hay and repack it in the bucket and test again. Repeat several times to obtain an average MC reading. It is important to take windrow tests from several areas of the field, namely those that are expected to have higher MC (low-lying areas, areas with denser windrows) before deciding to begin baling (Laurenzi 2018). Also note that hay packed into a bucket is unlikely to be packed as tightly as hay in a bale, making testing of the first few bales an important step.

To test bales: Probes are simply inserted into the bale. Readings should be taken from several places in the bale to obtain an average reading because MC is not consistent through a bale.

Baler-mounted sensor: Some balers include a sensor that gives moisture readings as the hay is baled, though these will only read the hay that passes across the sensor and may not give an accurate reading for the entire bale.

Hand testing (twist test): Hand testing is not recommended as a stand-alone moisture test, but with experience, it can be valuable in addition to results from the probe or oven tester. Hand testing involves taking a handful of hay, twisting the stems and observing the amount of breakage.

5.4.2 Optimal % Moisture

Local experience indicates that 8-10% moisture at baling is appropriate for large round and large square bales and 10-12% moisture for small square bales. Baling at a higher MC (15% for round bales, 12-16% for large square bales and 18-20% for small square bales) appears to be common practice in other hay-producing regions (Kopp 2005). For all bales, MC% increases as the bale “sweats” (respirates), meaning readings at baling will be lower than a reading taken a few days later in storage.

Section 6: Renovation and Rejuvenation of Hay Fields

6.1 Assessing the Field

Hay fields have a productive lifespan that depends on crop type and management practices. Decline in productivity can be attributed to numerous, often concurrent factors:

- Age of crop plants (smooth bromegrass plants have a lifespan of 5 -7 years)
- Encroaching native grasses and weed species
- Shift in predominant crop species due to various management practices (timing of harvest and effect on natural re-seeding opportunities, irrigation favouring one crop type)
- Poor plant vigour related to crop establishment (tillage depth, poor soil moisture conditions at establishment, winterkill)
- Poor plant vigour related to nutrient management
- Overgrazing

Many of the above issues can be avoided or mitigated with good management practices, however, yields will likely eventually decline to a point that renovation (traditional breaking and re-seeding of the field) or rejuvenation (less aggressive, no-tillage approach) will be necessary so that hay production remains profitable. When assessing older hay fields to determine whether renovation or rejuvenation is required, the following factors should be considered:

- Yields
- Species desirability
- Species diversity
- Plant density
- Plant vigour
- Soil erosion
- Plant residue
- Litter
- Woody canopy
- Perennial weeds

From the Alberta Forage Manual (2005)

Assessing stand density: Stand density counts may be useful at the time of assessment, depending on crop species. Bunch grasses like timothy should produce adequate dry matter for hay at 65 to 100 plants/m² or 6-10 plants/sq. ft (Aasen & Bjorge 2005). Stand density of creeping grasses like smooth bromegrass is less critical as part of an assessment, as these grasses can spread and fill in gaps given suitable conditions.

Percent production from desired species: In general, at least 75% of total dry matter production in a hay field should come from the desired species, and less than 50% of total dry matter production coming from the desired species indicates a field in need of improvement (Aasen & Bjorge 2005).

Nutrient assessment: If not already a regular management practice, assessing soil fertility through soil testing can help to better understand issues related to stand productivity.

The following table (Narzako 2008) provides a guide for determining the condition of hay fields:

Determining the Condition of Pasture/hayland

	Excellent	Good	Fair	Poor
Yield as a % of potential yield for your area	75-100%	60-75%	50-60%	Less than 50%
Production from desirable species	95%	75-95%	50-75%	Less than 50%
Production from undesirable species/weeds	5%	5-25%	25-50%	More than 50%
Suggested management	Maintain current management.	Maintain current management.	Change management. May be able to rejuvenate by fertilizing, mowing, herbicide use, rest periods. Consider adding new species.	Change management. Add new species and improve grazing management.

Adapted from SAFRR (2002b) and G. Ehlert, Alberta Agriculture (1990).

6.2 Traditional Renovation or Rejuvenation?

If the assessment of the fields indicates that renovation or rejuvenation of the field is necessary, the next step is determining whether to traditionally renovate the field using tillage, or to rejuvenate the field without tillage. There are benefits and drawbacks to each method, and financial analysis is necessary to make the best decision for your operation.

Traditional renovation involves:

- Termination of existing stand using herbicide
- Tillage of field to create a uniform, weed-free seedbed
- Reseeding field with desired species

This method generally takes two years before a new hay crop is established (Narzako 2008). Seeding an annual crop like oats for the first year is an option and may be of benefit if seedbed condition is poor or if there are issues with weeds or disease (Hutton et al. 2005). Rotation of other crops through hay fields is perhaps the most cost-effective method during renovation, though there are limited options for crop rotation in the Yukon and more work is needed to better understand the feasibility and economics of this practice.

Rejuvenation may involve:

- Suppression of existing stand (various methods; often herbicide). Refer to 6.3
- Implementing or adjusting fertilizer management plans,
- Overseeding and soil disturbance to improve seed-to-soil contact,

- Direct seeding into existing stand using a no-till drill

Current research and management recommendations encourage minimal-tillage methods over traditional renovation involving breakage and reseeding. Minimal tillage is generally favoured because of lowered production costs (fuel, labour, wear on equipment), fewer production losses, limited risk of erosion, and conservation of soil moisture (Nazarko 2008).

The rest of Section 6 focuses on recommended management practices as part of a minimal-tillage rejuvenation effort. Further work on BMPS for traditional renovating and re-establishing hay fields, possibly including crop rotation options, may be of value for Yukon.

6.3 Suppression of Existing Vegetation

Rejuvenation efforts can be undertaken without suppression of the existing stand, though rates of success using this method are generally limited (Sparrow et.al 2003; Aasen & Bjorge 2009; Narzako 2008). Successful establishment of new seedlings into an existing stand requires minimizing competition from existing plants. Existing stands can be suppressed using herbicide (most common), intentional overgrazing or mowing. Other methods include burning and spiking of fields, though research has shown these methods to be less effective than herbicide use (Narzako 2008). Herbicide use for suppression has been focused on for the purposes of this document.

Herbicide options: Non-selective, non-residual herbicides should be used. Glyphosate is the most commonly used herbicide for suppression prior to direct seeding, and has good activity against grasses. Recommended rates for glyphosate for summer or fall application for Saskatchewan are 1.5 to 2 L/acre (356 g ai/L), depending on the species (Narzako 2008).

Timing: Manitoba and Alberta experience has shown that late summer or early fall is the optimal time to apply herbicide for suppression of existing vegetation as there is greater downward translocation in the plant later in the season, allowing more herbicide to move into plant roots (Aasen & Bjorge 2009). The plant needs to still be actively growing to allow for translocation of the herbicide, and 6 - 8 inches of regrowth are recommended at the time of spraying (Tailleau 2007). Spraying the field at this time of year also allows for sod decomposition over the fall and winter, resulting in more favourable conditions come seeding time in the spring (Tailleau 2007). If you are planning to graze fields, check product label to make sure grazing restrictions are being followed.

6.4 Re-seeding for Rejuvenation

The seeding information provided beginning in Section 6.4.1 pertains to re-seeding as part of a dedicated rejuvenation effort. It should be noted, however, that through the interviews conducted for this project it was learned that some producers have re-seeded into existing fields on a regular basis using no-till equipment, in some cases as often as every year to maintain desired species composition and improve patches with poor performance. The efficacy of this “maintenance” reseeding practice has not been well studied, but based on anecdotal evidence, frequent re-seeding coupled with other management practices like fertilization, harrowing and aeration may help to delay the need for a dedicated rejuvenation effort.

Seeding Equipment: Broadcast seeding into an existing stand for the purposes of rejuvenation is not typically recommended because the seed is unlikely to penetrate the thatch layer and seed-to-soil contact will be

limited (Nazarko 2008). If broadcast seeding, soil disturbance (harrowing, aerating) is required to improve seed-to-soil contact.

Yukon producers have used no-till drills for "maintenance" seeding into existing stands, and have reported some success. A study from Alaska found no improvement in forage yield or quality by seeding into an existing stand using no-till equipment, though there was no suppression of the existing stand prior to re-seeding using no-till methods (Sparrow et al. 2003).

The recommended seeding depth for smooth bromegrass is ½ inch (Hutton et el. 2005; Roberts & Kallenbach 2000). Seeding into existing stands requires that the sod be broken, and the seed placed beneath the thatch layer to ensure good seed-to-soil contact (MacArthur 2006). Equipment with disc or knife openers are best suited to seeding into old stands (Hutton et al. 2005). Equipment that has been used in the Yukon for no-till reseeding includes the Truax grass seeder and the John Deere 1590 no-till drill.

Timing: The best time to seed is when conditions will be optimal for germination. Generally, this means the spring as soil moisture and temperature conditions are favourable for germination, however spring is typically the driest time of year in the Yukon and dryland producers may risk inadequate rainfall for germination.

Fall seeding is another option which may be appropriate for some producers. Fall seeding should happen before freeze-up, and after soil temperatures are below 2˚C to prevent germination. If fall seeding, increase seeding rates by 25-30% to account for loss over the winter (Nazarko 2008).

Rates: Increasing seeding rates is recommended when direct seeding into existing stands (Narzako 2008). For smooth bromegrass, the recommended seeding rate is 8 lbs/ac (Aasen & Bjorge 2009). This rate is often increased by Yukon hay producers. Because there have been few hayfield rejuvenation efforts to this point in the Yukon, a recommended seeding rate for direct seeding into existing stands is not well established. A rate of 8-12 lbs/ac has been used for smooth bromegrass/timothy blends when direct seeding into existing fields – this number may serve as a guide for seeding rates for rejuvenation. The recommendation from Alberta is to increase seeding rates by 1.5 times if direct seeding into a recently suppressed forage stand (Hutton et al. 2005).

Section 7: Management Schedule

Below is a general management schedule for Yukon hay production. Keep in mind that every year is different in terms of weather and plant development, and management decisions will need to be adjusted accordingly. Tasks have been identified for both irrigated and dryland production.

Spring: May and June

- Harrow fields as needed to break up thatch layer and manure from grazing. Local experience has shown spring harrowing can dry out dryland fields – chain drag may be preferable.
- Use aerator if needed – local producers aerate every few years; less frequent aeration is recommended for dryland hay.
- Spot seed in weakened areas if applicable. Seeding rates should generally be increased for Yukon.
- Apply fertilizer as needed. Use rates and amounts as determined from soil and plant tissue testing results and whether you are doing full or split rate application.
- Scout fields and control weeds as needed.

On irrigated fields:

- Apply first set of irrigation around mid-May, depending on weather and field conditions. Local experience has shown that clay soils can take more water earlier in the season (up to 3 inches for the first set) and "bank" it for later. Sandy soils may require more frequent sets with less water.
- Depending on weather, continue to irrigate ~ every week to 10 days, up to a few weeks before harvest – this allows plant to draw water from soil and from stems and become drier prior to harvesting

Summer: July and August

- Harvest: watch for a weather window that coincides with plant development. Most grass species have highest protein content at late boot to early heading stages (Government of Alberta 2018).
    - After mowing, condition hay as needed
    - Tedder hay as needed
    - Test hay for moisture content using preferred equipment (probe, Koster moisture tester). Learning how to assess dryness using the hand method is valuable in addition to using moisture probes
- Post-harvest (irrigated fields): consider a light irrigation if there is no rain in the forecast (particularly if grazing is planned) to reduce plant stress

Fall: September and October

- Soil test
- Scout fields for weeds. Make note of areas for control in spring.
- Apply fall fertilizer. Use caution with timing of application – aim to apply before freeze-up but after plant has stopped growing – this often means the third or fourth week of September in Yukon
- Avoid grazing until ground is frozen if possible
- Manage grazing pressure as applicable

Winter: November through April

- Adjust fertilizer plans for upcoming season as needed following soil test results
- Repair and maintain equipment as needed
- Manage grazing pressure as applicable

Useful Links and Resources:

B.C. Irrigation Management Guide: This comprehensive general guide provides information on irrigation management. https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/water/irrigation/irrigation-management-guide

Pests and disease of forage crops: The Alberta Forage Manual provides detailed information on potential pests and diseases of forage crops. https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex16

Pest Management Regulatory Agency (PMRA) InfoServe (general inquiries, label interpretation questions): https://www.canada.ca/en/health-canada/corporate/contact-us/pest-management-information-service.html

PMRA Regional offices (compliance & enforcement, can also respond to some general inquiries): https://www.canada.ca/en/health-canada/corporate/contact-us/pest-management-regulatory-agency-compliance-program.html

PMRA Label Search Website and App (to search for and view pesticide labels): https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/registrants-applicants/tools/pesticide-label-search.html

Why and When to Rejuvenate: This worksheet can be used as a decision-making tool for a potential rejuvenation effort.
http://www.saskforage.ca/images/pdfs/Publications/Pasture%20Rejuvenation%20Handout.pdf

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