Saskatchewan

BENEFICIAL MANAGEMENT PRACTICES FOR *flax straw*

To raise awareness of alternatives to burning flax straw, the Saskatchewan Flax Development Commission (SFDC) is working with Agriculture & Agri-Food Canada and the Government of Saskatchewan on an Agri-Environmental Group Plan (AEGP) for straw management. The AEGP initiative enables producers to work together to strategically address a specific agri-environmental priority. For flax producers in Saskatchewan, this means working through SFDC to develop Beneficial Management Practises (BMPs) that will (a) improve air quality through decreased burning; and (b) enhance the economic opportunities for flax straw available to farmers.

Oilseed flax has long tough stem fibers that decay slowly over time. This makes it difficult to incorporate flax straw into the soil after harvest since the fibers wrap themselves around disks, wheels and shovels. In the past, coping with flax straw included dropping it in windrows after the combine and burning it. Today, this practise is discouraged for a number of reasons:

(1) it may have a damaging effect on air quality and human health;
(2) it can increase the risk of soil erosion and soil degradation;
(3) it will destroy any possible economic value of the straw;
(4) it presents safety concerns related to open fires.

Many factors influence the quantity and quality of flax straw produced on a given field in any given year. This document describes factors that contribute to flax straw management, before, during and after harvest. For each of the factors identified, producers must consider two streams of alternatives:

Stream 1: Minimizing problems with straw residue in the field.

Stream 2: Utilizing the straw as a source of fiber.

SaskFlax

Government of Saskatchewan

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

FACTOR: GEOGRAPHIC LOCATION

Considerations

a) Soil moisture and weather effects

- Flax has a shallow rooting depth making it more susceptible to heat or moisture stress. The stage of the plant's development when heat or drought occurs will cause quite different results on both seed and straw. If the stress is in the plant's 'shooting' or 'bolting' stage (roughly 30 to 50 days after seeding), plants will remain short. Stress during flowering reduces the number of ovaries pollinated resulting in less seeds per boll. Heat or drought stress after flowering results in decreased fiber content.

b) Soil zone

- **Brown soil zone**
  The Brown soil zone of Saskatchewan is characterized by relatively low moisture and high heat stress. Flax planted into this soil zone will generally result in short plants and/or low seed yields and/or low fiber content. The low fiber content of the straw will make it easier to chop and spread back on the land, providing additional organic matter to these drier soils.

When stress occurs after flowering, flax plants will be shorter.

- **Dark Brown soil zone**
  For much of Saskatchewan's Dark Brown soil zone, August weather is often hot and dry. Combined with dry soil conditions, this will likely produce straw with lower fiber content. Wet and/or cooler August weather will see the fiber content in flax straw increase.

- **Black and Gray soil zones**
  Flax generally grows best when both moisture and temperature stresses are minimized. This corresponds most closely to the Black and Gray soil zones (although moist portions of the Dark Brown soil zone would also be included). These soil zones generally have the tallest flax plants, the largest seed yields and often the highest straw fiber contents (15 – 20%). High fiber content in straw means the most straw residue and the greatest potential for commercial straw exploitation.

  In the last decade, years with dry, hot August weather or frost in August have pushed fiber contents below 10%. In contrast, wet, cool August weather has generated fiber contents in the range of 20 to 25%.

c) Soil texture

- **Light-textured (sandy) soils**
  Growing flax on sandy land is generally not advised. Drought stress on flax in these soils generally results in short plants and/or low seed yields and/or low fiber content.

- **Heavy-textured (clay) soils**
  These soils hold high levels of moisture for extended periods of time. This is generally beneficial to flax. However, in the spring and early summer, the soil may remain cold and/or water-logged, which can greatly restrict root and stem growth during the "bolting" stage and hence flax plants often remain relatively short in heavy clay soils. This in turn means farmers with heavy land may have much less straw to deal with than farmers with medium textured soils.

- **Medium-textured (sandy loam, loam, clay loam) soils**
  These soils are generally associated with the most substantial flax seed yields, tallest flax plants and highest fiber contents. On average, significant quantities of flax straw will be produced in these soils with excellent potential for commercial applications.

THE BOTTOM LINE

- Producers whose flax fields have suffered heat and/or drought after the flowering stage will have flax straw more conducive to chopping and spreading, and less attractive for commercial processing.
- Flax planted in the Brown soil zone may be of slightly lower fiber content.
- Fiber content is highly variable and dependent on late summer weather in the Dark Brown soil zone.
- Straw quantity and fiber content is generally highest in the Black and Gray soil zones.

Important: Soil texture varies within soil zones.

- When moisture is deficient, light-textured soils generally produce shorter flax plants with lower fiber content.
- Fiber content varies in flax crops planted into heavy-textured soils, depending on temperature and moisture.
- Flax crops planted in medium-textured soils on average produce the highest fiber content.

FACTOR: SOIL QUALITY

Considerations

a) Existing soil health (ie, organic matter content, nutrients, water infiltration)

- Protecting the soil from wind and water erosion is a primary concern. Adopting a zero-till or minimum-till cropping system that leaves the stubble standing after the seeding operation will maintain or enhance soil health. The soil surface is protected by the standing stubble that reduces wind speed

and water movement. The layer of chopped crop residue provides further protection to the soil surface.

- Standing stubble and residue also improve moisture use efficiency. Standing stubble traps snow and reduces the wind speed while the residue cover reduces surface evaporation. Increased soil organic matter from decomposing crop residues and the tap roots of flax leave channels in the soil profile to allow rain and snowmelt water to enter quickly and more uniformly. The surface residue also assists in reducing the impact of raindrops minimizing soil surface crusting in soils low in soil organic matter.
- As soil organic matter increases so does the pool of organic nitrogen, phosphorus and sulphur. Over time the light and medium fractions of soil organic matter cycle (decompose) releasing these plant available macronutrients slowly back into the soil. For example, for every 1000 lbs of actual carbon (C) sequestered as light fraction soil organic matter, about 133 lbs of N; 25 lbs of P and 22 lbs of S are also sequestered in a typical Brown soil in Saskatchewan. When this light fraction of soil organic matter decomposes over time, the nutrients N, P, and S are mineralized (become available) roughly in these same portions. As soil organic matter increases over time, so does productivity due in part to the slow release of essential nutrients, improved nutrient-use-efficiency; improved water infiltration and increased water-use-efficiency.

b) Carbon sequestration

- Growing flax has a role in removing carbon dioxide from the air. Saskatchewan soils have a significant capacity to store carbon. Chopping and spreading flax straw sequesters carbon in the soil. Using flax straw, fiber or shive in the manufacture of permanent or semi-permanent products (e.g., textiles, plastic composites) is another form of carbon sequestration. Burning straw releases carbon dioxide back into the atmosphere in the form of greenhouse gases.

c) Soil structure and soil biodiversity

- When crop residues are left in the field in a zero-till system, the soil structure improves. Soil microbes decompose crop residues, producing sticky substances that help bind soil particles. Improved soil aggregation (soil particles binding together), allows for a healthier soil. The soil air spaces exchange soil gases with the atmosphere more easily; moisture enters the soil better, and channels for root development improve.
- As soil organic matter increases, so do soil microbial populations. Numerous beneficial soil microbes and soil fauna use the soil organic matter and crop residues as food sources resulting in an improved soil biodiversity and a healthier soil system. This also results in reduced population of soil-borne plant pathogens.

Main Characteristics of Flax Varieties, 2006

Variety	Years Seed Yield Tested	Seed Yield Index		Fiber Content Index		Maturity**	Seed Size	Resistance to Lodging
		Area 1 & 2	Area 3 & 4	Area 1 & 2	Area 3 & 4			
CDC Bethune	10	100	100	100	100	L	M	G
CDC Arras	10	95	92	98	98	M	L	F
AC Carnduff	8	86	89	100	100	M	M	G
Flanders	10	90	87	-	-	L	S	G
Hanley	4	90	90	104	104	M	M	G
Lightning	6	92	92	97	97	L	M	G
Macbeth	4	91	93	97	97	L	M	G
CDC Mons	4	99	96	97	97	L	S	G
CDC Normandy	6	91	93	89	89	M	M	F
Prairie Blue	4	99	92	103	103	L	S	VG
CDC Sorrel	4	102	106	-	-	L	L	G
Taurus	6	94	99	101	101	M	M	G
CDC Valour	6	91	86	93	93	E	M	G
Vimy	10	94	90	103	103	M	L	P
AC Watson	6	88	93	100	100	M	M	G
Solin								
CDC Gold	4	78	79	118	118	E	L	G
2047	4	86	89	105	105	M	M	G
2090	4	91	98	105	105	M	L	G
2149	4	88	97	120	120	M	M	F

Data from Regional and Coop yield trials grown over a number of years. Fiber contents from plots grown in 2003, 2004 and 2005.

**Relative Maturity: The relative maturity of the check, CDC Bethune, is L (on average 101 days from seeding to swathing ripeness).

Additional information: Index is using Bethune = 100 All varieties are resistant to rust and moderately resistant to Fusarium wilt.

Above data generated from testing fiber content of 100s of straw samples collected from 12 test sites in regional variety trials over a 3 year period.

Courtesy University of Saskatchewan

Fiber content varies between varieties.

THE BOTTOM LINE

- Most fields can benefit from the flax residue returned to the soil by chopping and spreading flax straw and chaff.
- Producers may wish to consider the benefits of storing carbon in the soil or in long life value-added flax fiber products.
- The organic matter returned to the soil in the process of chopping and spreading flax straw will improve soil structure and may reduce the population of soil-borne plant pathogens that attack cereal, canola and pulse crops as a result of improved soil microbial biodiversity.
- Growers who wish to minimize problems with straw residue may want to consider seeding a lower-fiber content variety to make it easier to chop and spread their straw after harvest.
- Producers wanting to maximize net returns from the sale of their flax straw for fiber extraction may want to seed oilseed flax varieties with higher fiber contents.

FACTOR: SEEDING

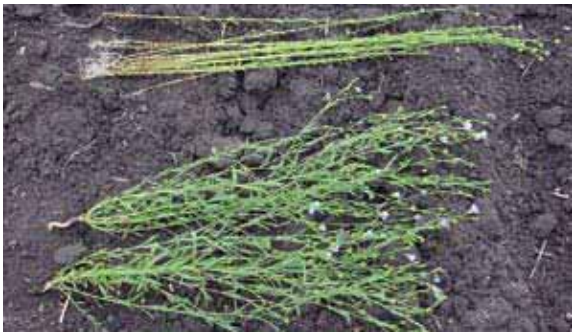
Considerations

a) Variety selection

- Some flax varieties are known to have a lower or higher fiber content relative to others. See page 3 for the fiber content of the most commonly-seeded flax varieties.

b) Seeding into tall flax stubble

- To ensure proper germination and seedling establishment, seeding equipment must adequately pass through flax straw residue. Ground openers and shanks are shaped to prevent dragging and subsequent bunching of the straw. The ability of the opener to pass through standing stubble varies considerably with the planter design.
- Disc openers designed for low-disturbance seeding are very effective at going through tall stubble. Coulters preceding knife-type openers can also cut the residue and reduce bunching. Other planter types, including most low-disturbance hoe or spoon openers, generally cannot handle stubble taller than 16 inches (40 cm) and therefore require a subsequent field operation to chop and spread the residue, especially in moisture areas.
- Chaff or residue falling into the seed furrow can cause poor seed cover and poor furrow closing.



Producers wanting less difficulty managing flax lodging and straw residue should consider seeding at a heavier rate for thinner, finer stems.

c) Seeding date

- Early-seeded flax generally results in higher seed yields, shorter plant heights (i.e., less lodging), and lower fiber content which may be offset by improving the fiber quality as it allows more time for fall retting.
- Oil content and seed size is also maximized with early seeding.

d) Seeding rate

- Higher seeding rates (i.e., greater than 45 Kg/ha or 40 pounds/acre) will have little or no impact on increasing straw yields if seedbed utilization is 8 to 15% (i.e., flax seed knifed in using a 12″ row spacing). Higher seeding rates combined with relatively high seedbed utilization (e.g., hoe drill with 8″ row spacing) can both significantly increase straw yields and improve straw quality as this process decreases average stem diameter and improves the stem evenness leading to faster and more even retting. Heavier seeding rates combined with higher seedbed utilization will also, with other things being equal, create a cleaner crop.

e) Method of seeding (seed spread pattern, row width)

- In conjunction with the movement to zero-till systems has come the move to wider shank or disc spacing (i.e., seed rows further apart) and narrower seed openers or seed furrows. Many producers now use narrow openers to "knife" the seed and fertilizer in so that straw disturbance is minimized. With flax straw, this has the effect of increasing weed competition (i.e., less of the seedbed is used so there is less chance that the flax plants will effectively shade out late maturing weeds).
- A narrow seed furrow also creates increased seedling competition within the furrow, producing a wide range of stem diameters in mature flax plants. A wide range of stem diameters makes flax straw less attractive for purchase due to uneven retting. Without relatively uniform stem diameters, the field will contain a combination of retted and over-retted straw and therefore mixed quality fiber. Higher-end processors are less likely to buy straw "knifed" in with 12″ shank spacing.
- Flax planted with shovels that spread the seed in a wide furrow improve seed bed utilization, tend to compete better with weeds, and produce stems with a much more even stem diameter, thereby improving fiber quality for high-end fiber processing.
- The use of 10″, 11″ or 12″ row spacing make it much easier to seed flax into standing stubble and straw residue produced

THE BOTTOM LINE

- Producers planning to seed into flax stubble must consider whether their seeding equipment can adequately handle the tall stubble.
- Producers wanting less difficulty managing flax lodging and straw residue should consider seeding earlier.
- Producers wishing to extract fiber from their flax straw (in many areas of the province), need to consider seeding their flax crop earlier to allow time for retting in the fall; or be prepared to overwinter and remove the flax straw in the spring.
- Higher seeding rates combined with high seedbed utilization will increase straw yield and raise the quality of straw.
- Using wide rows may make it easier to seed into standing stubble or previous residue.
- Wide rows may allow for greater chance of weed contamination, which can decrease the value of the straw for further processing.
- To enhance quality straw characteristics (evenness of stem diameters), producers should consider seeding with shovels that spread the seed in a wide furrow.
- Using fertilizers with flax crops will generally increase the flax straw as well as the seed yield produced, so producers will need to consider how they will deal with the additional straw.
- Weed control and crop cleanliness are very important considerations for producers planning to sell or utilize their flax straw, even for low-end processing.

by the previous crop. Widely spaced rows leave the flax crop more vulnerable to decreased yields because of late flushes of weeds that may appear after spraying is completed. Flax plants generally do not bush out or tiller much and hence are not as effective as cereal or canola crops at shading out newly emerging weeds. This reduces the chance of the straw being accepted and purchased for extraction of the fiber.

FACTOR: FERTILIZER APPLICATION

Considerations

- Few controlled replicated trials have been done under Western Canadian conditions to study the effect of different soil nutrients on the quantity and quality of flax fiber. Initial observations (in large fields that were neither replicated nor controlled) showed that the application of nitrogen fertilizer in excess of 40 to 60 pounds/acre (45 to 67 kilos/hectare) can lead to lodging, delayed maturity, large diameter stems, higher straw yields and lowered fiber content.
- Where possible, fertilizer should be banded during the one-pass seeding operation. Flax is very sensitive to seed-placed fertilizer, even at low rates. Low disturbance openers with separation between seed and fertilizer allow for fertilizer banding at the time of seeding. Coulter, disc and knife openers can be used to sideband or mid-row band fertilizer during the seeding operation, or as a separate operation. Alternatively, fertilizer may be banded into the soil prior to seeding.
- Additional research is still needed on nitrogen and other nutrients on straw growth and quality in a Western Canada context.

FACTOR: WEED CONTROL AND CROP CLEANLINESS

Considerations

- Almost all applications for flax straw (except perhaps as a heating or fuel source) require the straw to be free of weeds, weed seeds and foreign matter such as plastic twine or trash.

THE BOTTOM LINE

- If the field test indicates weak straw, producers can be confident their combine chopper will work to chop and spread the flax straw. Commercial straw processors will not be interested in purchasing this straw as a source of high-end fiber
- If the quick field test indicates the straw strength is high, then producers may need to:
  - drop the straw for baling
  - cut the straw as high as possible to allow direct seeding into the straw next spring
  - allow further field operations that will make the straw attractive to higher end processors.

FACTOR: FIBER CONTENT ASSESSMENT

Considerations

- This simple field test can be done before harvest by the farmer to decide whether the straw should be chopped or further managed for fiber extraction. More exact tests (i.e., Near Infrared [NIR] machine) are available from Crop Fibers Canada in Saskatoon, SK. 1.306.955.4506.

Field test for flax straw fiber content

1. Take 10 to 15 stems roughly a foot long.
2. Firmly grasp the straw in each hand, allowing for space between.
3. Jerk the straw back and forth a number of times, much like testing hay for dryness.
4. When fiber content is relatively low, the straw will break into small sections.
5. When fiber content is relatively high, small pieces of straw may break or "sliver off" the main bundle of straw, but the main bundle of straw will remain intact even though the bundle eventually gets quite soft.

TOP / Straight-cutting allows the operator to adjust stubble height.

MIDDLE / A stripper header's specialized teeth remove only the bolls from the crop and leave the straw standing.

BOTTOM / The correct height setting is key when using a stripper header to maximize yields.

THE BOTTOM LINE

- For best results chopping and spreading flax straw, harvest flax in hot, dry conditions during the warmest hours of the day.
- Rotary combines will make it easier than conventional combines to chop and spread flax straw. Straw residues with these systems are not suitable for higher value-added processing.

FACTOR: HARVESTING SYSTEMS

Considerations

a) Rotary vs. conventional combines

- Under dry harvest conditions, rotary combines break down straw residue more than conventional combines.

b) Swath vs. straight-cut vs. stripper header

- When flax is swathed, all of the swathed straw will pass through the combine. Processing the straw through the combine uses more power and eliminates the possibility of using this straw for higher end uses, but makes the straw easier to chop, since the insides of the combine have already done much chopping and breaking before dropping the straw on the ground for baling for lower end uses.
- Leaving the flax stubble taller is one way to effectively reduce the amount of flax straw that has to be chopped and spread by the combine. Cutting the flax stubble taller may leave the portion of the flax stems that contain the greatest amount of flax fiber standing, so parts that go through the combine have less fiber, again making chopping easier.
- With a straight-cut harvest system, the combine operator can control the amount of flax straw going into the combine and can adjust the stubble height while keeping an eye on how well the fine-cut chopper/spreader is performing. Straight cutting close to the ground is very similar to swathing. All the straw goes through the combine and is broken up before it reaches the chopper.
- For flax straw with a high fiber content, straight cutting just below the flax bolls puts only a small portion of the straw though the combine and offers the opportunity to add much more value to the remaining standing straw. After cutting, the straw can be rolled or mowed close the ground to produce a thin layer of straw in close contact with the ground for retting. It can then be raked up after retting with a large v-rake and baled for higher end processing.
- Stripper-header technology allows for even less flax straw to pass through the combine. When seeding directly into standing flax straw, the consideration with a stripper header is to have a seeding system that can pass through the taller flax stubble. Modern seeders with disc or knife openers and wider row spacing should be considered for this harvest system.
- A stripper header allows for earlier harvesting of flax as it strips the bolls off the flax stems rather than cutting them off. Earlier harvesting is beneficial for high-end fiber extraction because it allows more time for proper retting of the flax straw.
- In fields with very uneven topography or flax plants with bolls at many different heights, stripper headers may leave seed bolls unharvested. In such cases, the use of a straight header or swather will give a higher seed yield than a stripper header. However, relative to a stripper header, the use of a straight cut header or swather will often delay harvest.

c) Stubble height

- Taller stubble can trap more snow and this is especially important in the drier areas of the province.
- When a stripper header is used or flax stubble is cut high, consider using GPS tracking and Smart Hitch™ technology to seed between the rows of the tall straw and reduce the risk of plugging.
- Research on tall and extra-tall wheat stubble systems at Swift Current has shown improved yield and moisture use efficiency for crops sown directly into the tall stubble when the tall stubble remained standing after the seeding operation.
- Leaving strips of tall flax straw every 20-40 feet is an effective way to trap snow, especially in the dry areas of the Brown and Dark Brown Soil zones.

d) Pre-harvest perennial weed control with glyphosate

- Using pre-harvest glyphosate (such as Round-Up™) as a desiccant makes straw more brittle and easier to chop. To be effective, glyphosate should be sprayed early enough to be absorbed into the plant. Sprayed too late in the growing season, it may be absorbed so slowly that it is not effective at drying down the straw, although it may still be effective at killing weeds in the standing crop. The recommended stage of application is at 75% of the boll turning stage. See label recommendations.
- It is not known for sure if the use of desiccants reduces fiber content in flax straw. It is speculated that it may have a variable effect depending on whether or not the flax plants are still producing cellulose (i.e. fiber) when the desiccant is applied.

FACTOR: WEATHER IMPACT AT HARVEST TIME

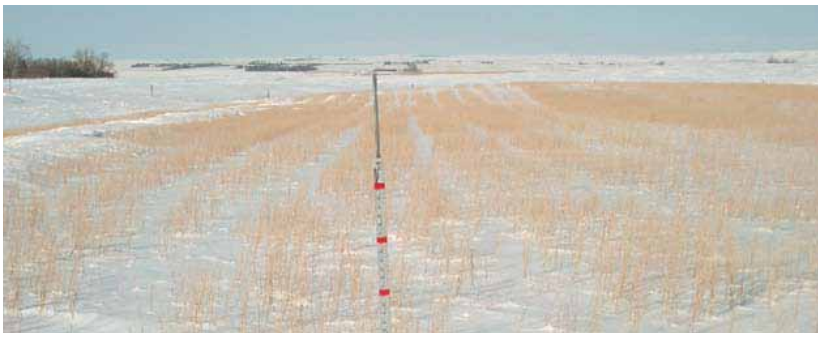
Considerations

- The ability to chop and spread flax straw is significantly influenced by the harvest weather. As fiber gains strength as moisture levels rise, hot, dry conditions will make it much easier to chop flax straw into small pieces relative to chopping the same field of flax on a damp cool day.
- During the early morning and late evening, flax straw can be damp and tough, which may lead to more difficult harvest conditions including wrapping of the straw on harvesting equipment.

THE BOTTOM LINE

- Swathing and combining make chopping and spreading easier.
- Stripper headers allow for earlier harvest, longer straw, and more time for retting – important considerations for producers planning to sell their flax straw for fiber.
- Using a stripper header or straight-cutting to harvest flax straw will leave taller stubble in the field, which can trap snow more easily and add moisture to drier soils. Tall stubble also allows for production of value-added straw for sale.
- Timely application of pre-harvest glyphosate may make chopping of flax straw easier. Always consult labels for proper rates and timing.

Courtesy Ministry of Saskatchewan Agriculture



Courtesy Agriculture & Agri-Food Canada

Courtesy Redekop Manufacturing

TOP / This crop was seeded among tall stubble using GPS and SmartHitch™ technology.

MIDDLE / Tall stubble can trap snow more easily.

BOTTOM / Chopped straw should be spread as widely as possible.

FACTOR: POST-HARVEST SYSTEMS

Considerations

a) Chopper/spreader equipment

On combine

- To ensure fewer problems during seeding the following spring, producers want to finely chop and uniformly spread chaff and chopped straw across the entire width of the combine header cut or the width of the swather cut.
- The fine-cut chopper hammers/flails need to be in good to excellent condition and the knives must be sharp. Some manufacturers of fine-cut straw choppers and spreaders offer self-sharpening knives that keep the knives performing at peak for many more acres. Flax producers may also switch the knife set to the sharp, unused side or have an extra set of new knives and switch to the new knife set for the flax crop.
- Another suggestion may be to custom-hire a neighbour to combine the flax fields if they have a modern fine-cut chopper/spreader on a combine with adequate horsepower.

  This option ensures your flax straw management is complete at the same time the crop is harvested. Earlier harvesting allows for more time for decomposition of the flax straw.

TOP / Using a land roller can help put the flax straw in an even layer on the ground.

BELOW / Raking is one way to collect retted straw for baling.

RIGHT / From top to bottom:
(1) Yellow straw;
(2) Weathered straw;
(3) Partially retted;
(4) Optimally retted;
(5) Over-retted.

THE BOTTOM LINE

- Keep chopper knives sharp for ease of chopping flax straw.
- Forage harvesters may offer another option for chopping flax straw effectively.
- Special rotary mowers show promise for managing flax straw residue.
- Producers planning to sell flax straw for high-end fiber uses will need to ret their straw. This may involved spring straw removal if retting is not completed in the fall.
- Raking equipment can be used to collect flax straw into rows for baling.

Chopping later

- Some producers may not have adequate horsepower to operate fine-cut straw choppers and can experiment with techniques for post-harvest residue management such as windrowing and using a forage harvester to chop and spread the flax straw.
- Also available today is a residue manager – a rotary mower than can be used to shred straw in late fall or in the spring of the year before the spring operations start. Producers may want to experiment with this technology to see how well it will work for managing their flax residue. A study by AAFC found that chopping the straw in the spring was easier because the straw was partially retted.

FACTOR: FIELD RETTING

Considerations

- For fiber extraction, flax needs to decompose or "ret" slightly so that the fiber and shive begin naturally to separate. Retting requires the straw to come in contact with the soil to allow microbes to get in and begin decomposing the straw.
- Early results from demonstrations conducted by the Saskatchewan Flax Development Commission have shown that the earlier in the fall that flax straw is placed in a thin layer touching the ground (i.e., not clumps, and not sitting on the stubble), the faster and more even the straw will ret.
- Using a land roller is one method that can be used to put the flax straw in an even layer in contact with the ground. It is usually better to leave the straw standing for several days before rolling to allow clumps of seed holders and straw that came out of the combine to fall on the ground before rolling. Another method that shows promise is cutting the straw very close to the ground with a disc bine mower or rotary mower.
- SaskFlax research indicates that flax cannot be seeded too deeply or narrowly into furrows, or it will be difficult to break the standing straw at ground level using a land roller. If the straw does not break, it will not remain in contact with the soil and may "pop" back up. More flexible rollers may work best to cope with more deeply-seeded flax or for standing straw grown on uneven terrain.
- Heavier clay soils are challenging for flax crops during growth due to problems of crusting and lumpy seed beds and after harvest as the ground may be too wet to roll.

FACTOR: COLLECTION METHODS FOR RETTED FLAX STRAW

Considerations

- Once retting is complete, the straw needs to be collected so that it can be baled and hauled to a processing facility or other use. Raking is one way to collect the straw into rows for more efficient baling.
- Many large V-rakes have a four foot gap in the center where the windrow is formed. However, if the straw in this gap is not raked, it will not be picked up during baling because it is touching the ground and not sitting up on stubble. If it is not picked up it will cause problems during subsequent seeding operations. Hence V-rakes with such center gaps need to have extra rake wheels added in the center or the operator has to overlap about 50% to make sure no straw is left unraked; another option is to add extra wheels in front of the tractor.

The strong, durable characteristics of flax fiber and the increasing demand for natural products are creating new possibilities for producers who are willing to produce a product that meets the demands of these markets.

The Saskatchewan Flax Development Commission has funded considerable research into building a fiber industry that will allow producers to capture significant value from managed flax straw. As with most industry development, it takes many years of investigation, trial and promotion before investments and full-scale commercial production will follow. To date, SaskFlax has completed a body of research that clearly supports the potential of a successful fiber industry in Western Canada.

FACTOR: LOCAL USES AVAILABLE

Considerations

- Flax straw is generally sold as loose straw, as bales, or in pelletized form. Local uses for growers to investigate include:

a. Bales, large or small, used as a simple building/ insulation material for:
- Livestock wind-break structures
- Feeder-pig barn wall insulation
- Containment for feed bunks/grain pile storage

b. Bales, or as loose straw, as a geotextile for:
- Erosion control on slopes and in water courses
- Emergency erosion control on wind-swept, barren ground
- Soil stabilization around livestock feedlots
- Soil stabilization in oil-patch road and drilling site preparation
- Soil remediation/enhancement during road construction
- Weed control and moisture retention in shelter belts, gardens, golf courses
- Bedding cattle outside, especially at sites where the bedding can be left in place, such as field wintering sites

c. Bales as heating/fuel source for:
- Yard sites
- Greenhouses
- Hog barns
- Grain drying/wood drying

d. Pelletized straw for use in:
- Grain/Wood/Pellet Burning stoves
- Coal Burners

FACTOR: PROXIMITY TO STRAW PROCESSORS

Considerations

- In Canada, there are still relatively few processors who utilize Saskatchewan oilseed flax straw. These include:
  - Schweitzer-Mauduit Canada, based in Winkler, Manitoba. SMC uses hammer-milling to produce fiber for the pulp and paper industry.
  - Bio-Fibre Industries, based in Canora Saskatchewan. Bio-Fibre processes flax straw into short-fiber lengths for use in biocomposite materials.

TOP / Flax bales can be used to insulate pig barns.

BELOW / Saskatchewan flax straw has a multitude of different uses.

Courtesy C&C Feeders

FACTOR: QUALITY REQUIREMENTS

Considerations

- Flax straw has a multitude of different uses, from loose straw used for erosion control, to highly processed fibers spun into pure linen woven and knitted garments. To sell straw for these different uses, producers will need to consider the quality requirements of these different buyers.
- Producers wanting to sell their straw for high value uses must cover their flax straw supply if storing, as moisture is an issue if in storage for a long time.
- Virtually all uses (except for burning) require flax straw that is free of weeds, weed seeds, plastic twine, or any other trash or foreign material. Producers are always advised to consult with buyers for specific requirements.

THE BOTTOM LINE

- Growers need to investigate opportunities in their area for selling their flax.
- Growers with flax fields close to processors have an opportunity to sell their straw for these uses, providing buyer requirements are met.
- To receive the best value for their flax straw, producers need to become familiar with buyers' specifications for quality, delivery methods, timelines, etc.
- Producers will likely need to take the initiative to inform potential buyers of what their flax straw can be used for.

FACTOR: MARKETING OPTIONS

Considerations

- While there are a number of uses for flax straw, many potential users of flax straw may be unaware that flax straw could be available to them. This means the onus is on producers to market their straw, to inform potential clients of what they have available – in what form (from standing flax stubble harvested with a stripper header, to combined windrows ready to bale, to baled small squares, to baled large round or square bales stacked and ready to move) – and in what location, and for what asking price. Some producers have even suggested some of the potential uses for straw when advertising their flax for sale.
- One tool that producers may consider using to help get the word out that they have flax straw for sale is Saskatchewan Agriculture's Feed Grain and Forage Listing Service. This is a free service that producers can use to list their flax straw for sale online, at the following website: http://www.agr.gov.sk.ca/apps/feedforage/default.asp. Producers can also get their product listed by calling the Agriculture Knowledge Centre for staff to post the information on producers' behalf: 1.866.457.2377 (toll-free)

TOP / The pulp and paper market is the largest existing use of flax straw in North America.

MIDDLE / Shives are the broken pieces of stem left after fiber is extracted. One use for shives is as a plastic filler.

BOTTOM / There is a growing trend to use natural fibers (like flax) to make insulation.

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The recommended practices for flax straw management in Saskatchewan are as follows:

1. PRE-HARVEST FACTORS

Soil moisture and weather

- Producers whose flax fields have suffered heat and/or drought after the flowering stage will have flax straw more conducive to chopping and spreading, and less attractive for commercial processing.

Soil zone

Important: Soil zone cannot be considered in isolation from soil texture as soil texture varies within soil zones. However, generally speaking:

- Flax planted in the Brown soil zone may be of slightly lower fiber content.
- Fiber content is highly variable and dependent on late summer weather in the Dark Brown soil zone.
- Straw quantity and fiber content is generally highest in the Black and Gray soil zones.

Soil texture

- When moisture is deficient, light-textured soils generally produce shorter flax plants with lower fiber content.
- Fiber content varies in flax crops planted into heavy-textured soils, depending on temperature and moisture.
- Flax crops planted in medium-textured soils on average produce the highest fiber content.

Soil quality

- Most fields can benefit from the flax residue returned to the soil by chopping and spreading flax straw and chaff.

Carbon sequestration

- Producers may wish to consider the benefits of storing carbon in the soil or in long life value-added flax fiber products.

Soil structure and soil biodiversity

- The organic matter returned to the soil in the process of chopping and spreading flax straw will improve soil structure and may reduce the population of soil-borne plant pathogens that attack cereal, canola and pulse crops.

Seeding: Variety selection

- Growers who wish to minimize problems with straw residue may want to consider seeding flax varieties with lower fiber content to make it easier to chop and spread their straw after harvest.
- Producers wanting to maximize net returns from the sale of their flax straw for fiber extraction may want to seed oilseed flax varieties with higher fiber contents.

Seeding into tall flax stubble

- Producers planning to seed into flax stubble must consider whether their seeding equipment can adequately handle the tall stubble.

Seeding dates

- Producers wanting less difficulty managing flax lodging and straw residue should consider seeding earlier.
- Producers wishing to extract fiber from their flax straw (in many areas of the province) may need to consider seeding their flax crop earlier to allow time for retting in the fall; or be prepared to overwinter and remove the flax straw in the spring.

Seeding rate

- Higher seeding rates combined with high seedbed utilization will increase straw yield and raise the quality of flax straw.

Method of Seeding (seed spread pattern, row width)

- To enhance quality straw characteristics (evenness of stem diameters), producers should consider seeding with shovels or disc openers that spread the seed in a wide furrow.
- Using wide rows may make it easier to seed into standing stubble or previous residue.
- Wide rows may allow for greater chance of weed contamination, which can decrease the value of the straw for further processing.

Fertilizer application

- Using fertilizers with flax crops will generally increase the flax straw as well as the seed yield produced, so producers will need to consider how to will deal with the additional straw.

Weed control and crop cleanliness

- Weed control and crop cleanliness are very important considerations for producers planning to sell or utilize their flax straw, even for low-end processing.

2. HARVEST/POST-HARVEST FACTORS

Fiber content assessment

- If the field test indicates weak straw, producers can be confident their combine chopper will work to chop and spread the flax straw. Commercial straw processors will not be interested in purchasing this straw as a source of high-end fiber.
- If the quick field test indicates the straw strength is high, then producers may need to:
  - drop the straw for baling
  - cut the straw as high as possible to allow direct seeding into the straw next spring
  - allow further field operations that will make the straw attractive to higher end processors.

Weather Impact at harvest time

- For best results chopping and spreading flax straw, harvest flax in hot, dry conditions during the warmest hours of the day.

Rotary vs. conventional combines

- Rotary combines will make it easier than conventional combines to chop and spread flax straw. Straw residues with these systems are not suitable for higher value-added processing.

Swath vs. straight-cut vs. stripper header

- Swathing and combining make chopping and spreading easier.
- Stripper headers allow for earlier harvest and adequate time for retting – important considerations for producers planning to sell their flax straw for fiber.

Stubble height

- Using a stripper header to harvest flax straw will leave taller stubble in the field, which can trap snow more easily and add moisture to drier soils or allow for production of value-added straw for sale.

Pre-harvest perennial weed control with glyphosate

- Timely application of pre-harvest glyphosate may make chopping of flax straw easier.

Chopper/spreader equipment

- Keep chopper knives sharp for ease of chopping flax straw.
- Forage harvesters may offer another option for chopping flax straw effectively.
- Special rotary mowers show promise for managing flax straw residue.

Field retting

- Producers planning to sell flax straw for high-end fiber uses will need to ret their straw. This may involved spring straw removal if retting is not completed in the fall.

Collection methods for retted flax straw

- Raking equipment can be used to collect flax straw into rows for baling.

3. FACTORS AFFECTING THE SALE OF FLAX STRAW

Local uses available

- Growers need to investigate opportunities in their area for selling their flax.

Proximity to straw processors

- Growers with flax fields close to flax straw processors have an opportunity to sell their straw for these uses, providing buyer requirements are met.

Quality requirements

- To receive the best value for their flax straw, producers need to become familiar with buyers' specifications for quality, delivery methods, timelines, etc.

Marketing options

- Producers will likely need to take the initiative to inform potential buyers of what their flax straw can be used for.

SaskFlax

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