Crop Residue Collection for Field Grazing

FACTSHEET

Farm Business Management

INTRODUCTION

Crop residues chaff and straw from annual cereal, pulse and oilseed crops are a source of forage for livestock. After the crop is harvested, the residue can either be grazed in the field where it is produced or it can be packaged and transported to another location for feeding. This publication and the accompanying calculator focus on the methods and economics of collecting and bunching crop residue for grazing in the field where produced.

Field grazing crop residue during fall and winter has potential economic advantages of reducing feed and yardage costs. Field grazing has potential environmental advantages as well. Research at Western Beef Development Centre at Lanigan, Saskatchewan, has shown a higher level of nitrogen is recycled back into the soil when livestock are fed (and deposit manure and urine) on a field during winter. This is compared to feeding in confinement and mechanically spreading the manure the following summer.

Cattle graze on chaff/straw pile made using the Whole Buncher.

CROP RESIDUE PRODUCTION

During an average production year, Saskatchewan produces a massive amount of residue from annual crops. The following tables list approximate crop residue amounts that exit the combine for different crops. These estimates are a guideline only and can be relatively variable, depending upon crop height, cutting height, aggressiveness of threshing machinery and weather conditions during combining. Generally, the drier the conditions during combining, the greater the chaff yield.

The chaff and straw amounts in the tables below are used in the Crop Residue Calculator to determine the tonnage of chaff and straw produced on a given set of crops and land base.

Saskatchewan Ministry of Agriculture

A wheat field after combining with a chaff box.

Typical amounts of chaff and straw exiting the combine per bushel of grain:

Crop	Soil Zone	Pounds of straw per bushel of grain	Pounds of chaff per bushel of grain
HRS Wheat	Brown	50	20-25
	Dark Brown	65	20-25
	Black	80	20-25
CPS Wheat	Brown	40	20-25
	Dark Brown	50	20-25
	Black	60	20-25
Barley	Brown	30	5-10
(hulled)	Dark Brown	35	5-10
	Black	45	5-10
Barley *	Brown	30	20-25
(hulless)	Dark Brown	35	20-25
	Black	45	20-25
Oats	Brown	30	5-10
	Dark Brown	35	5-10
	Black	45	5-10
Canola	Brown	40	15-20
	Dark Brown	50	15-20
	Black	60	15-20
Peas	Brown	40	20-25
	Dark Brown	50	20-25
	Black	60	20-25

Source: Alberta Agriculture, Food and Rural Development. *Increasing cow/calf profitability using chaff and chaff/straw feedstuffs*.

***** Estimate based on personal communication with Dr. Brian Rossnagel, U of S.

Crop residue estimates for other crops*:

Crop	Pounds of straw per bushel of grain	Pounds of chaff per bushel of grain
Flax	25	15
Lentils	10	40
Canary Seed	80	5
Fall Rye	60	20
Winter Wheat	60	20-25
Winter Triticale	60	25

* Estimates based on communications with producers and industry.

CROP RESIDUE ECONOMICS AND LOGISTICS

There are four sources of forage for livestock:

- crop residue (chaff, straw)
- annual crops (oats, barley, millets, corn)
- native rangeland
- tame or seeded perennials (grasses, legumes)

Crop residue is potentially the lowest cost forage for livestock. Once a producer has made the decision to grow annual crops for combining, the residue is produced at essentially no extra cost.

The challenge, then, is to provide crop residues to the livestock at a low cost. This is a critical step because most crop residues have relatively low feed value. If money is spent on baling, hauling and handling after the combining operation is completed, there may be little economic benefit in using crop residue.

In most cases, in order to be economical, crop residues need to be bunched in some form by the combine and grazed in the field. There needs to be sufficient acres and residue amount to justify the investment cost of the bunching equipment. Other investment costs that may or may not be required are: winter watering infrastructure, perimeter fences and portable windbreaks.

Ideally, for low cost field grazing, the cropland parcels will be in a block and/or close to headquarters. This will make perimeter fencing less costly and access for the livestock more convenient. The perimeter fence, and especially the internal fences that limit access to the feed, can be single-strand electric wire. Snow can be used as a water source if an adequate amount is available, and natural shelter may be sufficient for wind protection.

CROP RESIDUE COLLECTION EQUIPTMENT

Four crop residue collection systems that enable field grazing are listed below. Each system collects and bunches either the chaff only, or the chaff and straw together. Producers will need to decide which system best suits their circumstances based on volume of crop residue produced, volume of crop residue required, feed quality needed and desired pile size. For example, a producer with 100 cows and 2,000 acres of annual cropland residue grazing may decide to collect the chaff only. A producer with 100 cows and 200 acres of annual cropland residue grazing is more likely to collect both chaff and straw for the extra volume.

Generally, chaff alone will have higher feed quality than chaff and straw together. There may be situations in which a producer wishes to collect only chaff from some crops, and the chaff and straw together from other crops.

Combines where the chaff and straw exit in separate streams allow the option of chaff-only collection. On combines where the chaff and straw exit in a single stream, only whole-crop residue collection is possible.

An approximate cost for each of the options is listed. This value can be used in the Crop Residue Calculator to determine an annual equipment cost.

Chaff Box ($500)
The chaff box is an old idea that has been re-invented. It collects the chaff only, and deposits the material in piles weighing approximately 20 to 25 lb. Pile dimensions are approximately eight to 12 inches high and four feet long. The size of the box is restricted by the amount of available space at the back of the combine. Ideally, the box should be built to hold as much chaff as possible. The box trips automatically when full and resets using a counterbalance weight. It can only be mounted on combines where the chaff exits in a separate stream from the straw. Wheat, flax, and canola are crops somewhat better suited for chaff-only collection. Producers are building units for their own use, as they are not available commercially.

The approximate time required to build a box is ten hours. Material costs could vary from $50 to $200. Estimated total cost for time and labour is $500.


A home built chaff box.

***Whole Buncher*® ($4,500)**
The *Whole Buncher*® is another old idea that has been modernized. Essentially, this tool is a giant pitchfork that collects both the chaff and straw, and deposits the material in piles weighing approximately 40 to 60 lb. Pile dimensions are approximately three feet high and five feet long. It trips automatically when full, and resets using a counterbalance weight. It is somewhat better suited for combines where the chaff and straw exit in a single stream, but can be mounted on all combines. Barley and pulse crops are somewhat more suited to whole-crop residue collection. The *Whole Buncher*® is patented by AJ Manufacturing in Alberta (www.thewholebuncher.com).

The Whole Buncher.

Redekop chaff blower and wagon (manufacturing discontinued))

This system, previously manufactured by Redekop Manufacturing collects the chaff only. If the wagon is filled, the piles are approximately four to five feet high, seven feet wide and 10 to 12 feet long, and weigh about 800 lb. The piles can be made smaller by tripping the wagon before it is filled. In one case, a producer has modified his straw chopper so the straw can either be directed into the wagon or spread on the field. This enables the options of chaff-only collection, chaff-and-straw collection, or unhooking the wagon and spreading both the chaff and straw.

Chaff blower and wagon. Photo: Redekop Manufacturing.

Redekop MAV and wagon (wagon manufacturing discontinued))

With this system, the chaff is directed into the straw chopper. Both the chaff and chopped straw are blown into the wagon. If the wagon is unhooked, the chaff and chopped straw are spread uniformly across the field.

MAV and wagon. Photo Redekop Manufacturing.

CROP RESIDUE UTILIZATION

Crop residue utilization is determined by the weight of residue the livestock consume, and the percentage of total feed they leave behind.

The Crop Residue Calculator below assumes cows will consume crop residue (10 per cent moisture content) at the rate of 2.2 per cent of body weight per day. Therefore, a 1,300 lb cow will consume approximately 28.6 lb of crop residue per day. If supplemental feed is provided at an average daily rate of 10 lb per cow, then crop residue consumption is assumed to be 18.6 lb per day.

Crop residue piles cleaned up after field grazing.

Supplemental feed may be required during crop residue grazing, depending upon the feed quality of the crop residue and the nutritional requirements of the cows. The nutritional requirements of the cows depend on stage of pregnancy, body condition score, air temperatures and whether or not the cows are milking. It is recommended producers feed test their crop residues and consult with a livestock nutritionist to ensure a balanced diet is being provided.

The amount of feed left in the field after grazing can vary significantly. This depends upon how long the livestock are held on an area to clean up remaining feed, and how access to the residue is controlled to limit fouling, trampling and feed loss under drifting snow. With chaff only, the amount of feed left behind or wasted under ideal conditions may be less than 10 per cent. With chaff and straw residue collected together, there may be cases where feed left behind is greater than 30 per cent. The calculator assumes an average feed waste of 25 per cent for both options of chaff only or chaff and straw combined.

CROP RESIDUE CALCULATOR INSTRUCTIONS

This calculator is a tool for estimating the total cost of wintering a cow when grazing crop residue in the field, with or without supplemental feeding.

Investment Cost of Equipment and Infrastructure

1. Determine your equipment and infrastructure requirements for collecting and field grazing crop residue. Requirements include: residue collection equipment, winter watering system, portable windbreaks, perimeter fence and cross fence. If needed, additional items can be included under Other Infrastructure.
2. For each item required, enter the original cost. If the equipment or infrastructure is already owned or in place, you may decide to assign only a portion of the original cost to crop residue field grazing. Ensure values for expected life, expected salvage value and interest rate are entered. The calculator will determine an annual cost for each item.

Other Costs (daily labour, fuel, machinery)

Enter a cost per cow per day to allow for daily expenses such as: monitoring the livestock, monitoring and servicing the water system, moving the internal electric fence, and moving portable windbreaks.

Number of Cows, Average Cow Weight, Soil Zone, Supplemental Feed

1. Enter the number of cows to be grazed and their average weight. These entries are needed to determine the amount of residue consumed. It is assumed a cow will consume crop residue (10 per cent moisture content) at the rate of 2.2 per cent of body weight per day.
2. Click on Soil Zone and select the zone where your land base is located. For some of the crops, the soil zone influences the amount of straw produced.
3. Determine which supplemental feeds will be fed during crop residue grazing. Enter a value for the supplemental feeds that includes the cost of delivery to the livestock.

Field Size, Grain Yield, Crop Residue Option, Supplement, Supplement Amount

1. Select the crops from which you intend to collect residue. Enter the acres and grain yield for those crops. The total acres of crop residue collected will be displayed at the bottom of the Field Size column.
2. For the remaining crops listed where no residue is collected, enter zero for the acres and grain yield.
3. Click on the Crop Residue Option and select either Chaff or Chaff and Straw.

The above entries along with the Soil Zone will determine chaff yield collected, straw yield collected and total crop residue yield collected.

4. Click on Supplement Choice and select the supplement you plan to feed with each crop residue collected. For some crop residues, supplemental feed may not be required.
5. Click on Supplement Amount and enter the amount you plan to supplement per day with each crop. These two entries will determine a daily supplement cost.

Expected Residue Utilization and Days of Grazing
The calculator determines expected residue utilization based on cow size and amount of supplemental feed provided. It is assumed a cow will consume crop residue (10 per cent moisture content) together with supplemental feed at the rate of 2.2 per cent of body weight per day. The calculator allows 25 per cent crop residue feed waste during grazing. When grazing chaff only, feed waste may be as low as 10 per cent. Feed waste could be 30 per cent or higher when grazing a combination of chaff and straw.

Cows graze chaff piles in mid-winter.
Supplemental hay is visible in the background.

Investment, Depreciation and Other Costs
This cost is determined by the combination of: 1) annual costs of equipment and infrastructure, 2) other costs, 3) number of cows grazing and 4) total days of field grazing.

Total Cost/Cow/Day
This cost is a total of the supplement, investment cost of equipment and infrastructure, and other costs.

The calculator can be downloaded from the Ministry of Agriculture website at:
www.agriculture.gov.sk.ca/production_economics

Tips for Building a Chaff Box

1. Build the box as large as possible. Larger piles enable field grazing in deeper snow.

2. The width of the box may be limited by the clearance between the rear tires. With the combine parked, turn the steering wheel from full left to full right. Observe the space available. If inadequate, extend the axles outward.

3. If the chaff box is attached to the rear axle, observe the vertical movement the box will travel when the rear axle pivots.

4. The hinge point of the box should be approximately one-third of the length of the box from the front. For example, if the box is 38 inches long, the hinge point should be 12 to 14 inches from the front.

5. The "hinge" can be a pipe with an outside collar. If using these materials, drill holes in the collars for grease nipples. Another option is one inch steel rod, bearings and pillow blocks. These ensure the box will not stick when tipping.

6. An extension plate may need to be attached to the back of the sieve to ensure the chaff load falls on or slightly behind the hinge point. The shaking action of the sieve helps to push the chaff further back onto the box.

7. Attach a chain from the combine frame to the front of the box to limit the angle of tipping. When tipped, there should be five to six inches of clearance between the chaff box and the ground. This will ensure the box will not be damaged if it is tipped while the combine is backing up.

8. Keep construction materials light, especially behind the hinge point. The box needs to be sturdy but not overbuilt. Quarter-inch plywood is sufficient for the floor.

9. Sides on the box should be 12 inches or higher to prevent the chaff from blowing away under windy conditions. They should be constructed of lightweight material as well, especially behind the hinge point.

10. A back door hanging down from the combine is recommended.

11. Test the box for counterbalance by placing a 10 to 15 pound weight 18 inches back from the hinge point. Depending upon the box size, this amount of weight should trip the box.

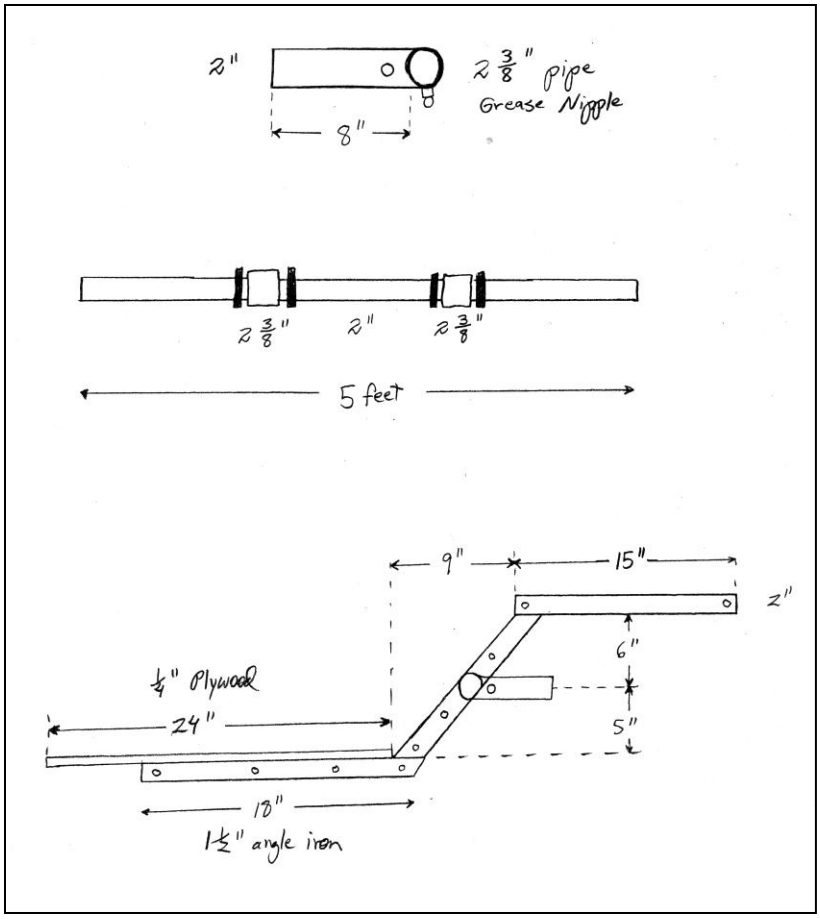
12. Construct the box so that counterbalance weights can be quickly and easily added or removed in the field.

Chaff box for John Deere 9600 series combines:

Note the angle of the side arms on the frame. This design allows the box to empty completely before tipping back into position.

Quarter inch plywood bolted to frame.

Back door hanging from combine frame and chaff pan extension.



Dimensions for JD 9600 series.

Chaff box for John Deere pull-type combine:

Chaff box for CAT combine:

The frame behind the hinge point is heavier than necessary. This requires more counter balance weight on the front to reset the box.

Quarter inch plywood floor bolted to the frame.

Finished chaff box. Note the back door hanging from the combine frame, and the chaff pan extension made with galvanized tin.

For more information:

- Contact the Agriculture Knowledge Centre at 1-866-457-2377.