SWITCHGRASS :

A premium livestock bedding and horticultural mulch

by

Roger Samson

REAP-Canada

Resource Efficient Agricultural Production

ONTARIO BIOMASS PRODUCERS CO-OP

for a cleaner tomorrow

Switchgrass is a resource efficient and long lived native warm season (C_4) grass. It is proving well adapted to Class 3 marginal farmlands.

(photo of Urs Eggimann farm in late June 2015 near Markdale)

The biomass crop is generally mowed after the first killing frost in late fall (~Nov. 1)

SG is raked and baled in early spring (~May 1). Field recovered yields of 7-11 tonnes/ha can be expected.

Spring harvested switchgrass typically goes into storage in a very dry state of 7-10% moisture (ideal for use in bedding applications).

REAP-Canada has been conducting R&D on switchgrass in Eastern Canada since 1991. Ontario Biomass Producers Cooperative is organizing producers to develop the sector. REAP's new switchgrass breeding selections are being scaled up in Ontario by OBPC growers.

At 1 month after planting, superior plants (tall erect and single tiller) are selected for improved seedling vigor and low tillering

Breeding Methods - Steps

- Single-Tiller Selection:
  - Less tillers overall
  - Aim for less tiller mortality and greater % reproductive tillers
- At 1 month:
  - 250 best plants transplanted into ¾ gallon pots and allowed to further mature in greenhouse
- At ~ 7 weeks field transplanting

Sufficient root ball is indicator to plant

June 20th,2015

By August 10th, nursery is 6’ tall and 2014 nursery 8’ tall with synchronization in flowering achieved

Immediately prior to pollination in mid August, superior 2014 plants are identified and inferior plants cut out with a cycle

Organic Production Systems Permitted Substances Lists of Organic Standards (2011)

- Organic plant residue: permitted for mulching. Where organic materials are not readily available, non-organic straw, leaves, grass clippings or hay that are not the products of genetic engineering may be used. Substances prohibited by par. 1.4.1 of CAN/CGSB-32.310, *Organic Production Systems — General Principles and Management Standards*, shall not have been used on these materials for at least 60 days before harvest.
- *(The organic standards appear to indicate mulch and bedding is allowed with switchgrass from non-organic sources however use as a livestock feed would have to be from organic switchgrass sources*)

Switchgrass versus Straw was tested in On-Farm Strawberry Trials in Quebec (2011-2014)

- Spring harvested switchgrass was preferred by growers as most seeds are lost over winter to prevent self seeding.
- Switchgrass mulch was found to reduce annual weed numbers by approximately 80% compared to wheat straw

Switchgrass (SG) vs Straw for Weed Control in Herbicide-Free Strawberries in Quebec

	June 2013		June 2014	
	Straw (check)	Switchgrass	Straw (check)	Switchgrass
Annual weeds/m2	7.7	0.6 (92% ↓)	39.7	9.6 (76% ↓)
Perennial weeds/m2	2.7	1.8	2.3	1.4

Painchard et al 2014

SG and straw both provide shading effects to suppress weeds. The low N SG mulch (~0.3%N) likely is also acting similarly to winter rye and immobilizes N in the shallow surface layer of soil. This shallow soil layer is where soil N dependent annual weeds emerge. Perennial weeds are less affected as they can feed on soil nutrients deeper in the soil.

Chopped and pelleted switchgrass for horticultural mulch in France

Roger’s prairie garden with switchgrass straw mulch

Switchgrass pellets can be used as mulch. Research studies have found it to provide highly effective weed control. Problems include cracking, runoff and fungal growth. Might work best in a blend with chopped switchgrass straw to improve function and aesthetics.

Why Switchgrass for Ontario Dairy Farmers?

Easy to grow:

•It is a productive, low input native warm season perennial grass

•Well adapted to marginal lands

Convenient to Use:

• Dairy producers generally prefer it to wheat straw as livestock bedding

• An emerging high fibre component of mixed dairy rations

Self sufficiency and Cost Control:

•Growers are looking for a low cost source of straw to replace spring cereal straw (purchased or grown)

• Strong interest in producing larger volumes of straw/ha

What Makes a Good Dairy Bedding?

- Comfortable surface for cows to lay down on.
- Absorbs fluids to keep the stall dry and cows clean.
- Absorbs nutrients, ammonia and other odours.
- Non-slippery and cushions the cow's feet.
- Non-abrasive to cow's knees and hock joints.
- Contains low numbers of environmental mastitis causing organisms in raw state.
- Readily available at reasonable costs.
- Easily stored, applied and removed.
- Low dust.
- Environmentally friendly when spread on land

(adapted from Milk2020)

Ontario farmers and researchers are making efforts to further develop switchgrass as a more convenient and improved livestock bedding

Don Nott of Clinton Ontario is producing pre-chopped high density bales to improve user convenience

Roto-chopping prior to baling leaves the dust in the field and increases SG bale density

Switchgrass (SG) vs. Wheat Straw

SG fiber length and strength is greater

SG stem walls are about 2-3 x thicker

(SG has greater ability to resist compressive forces)

SG is ~.3%N , wheat straw is 0.8-1.0%N

(SG is more biologically inert)

Chopped or baled SG has a higher bulk density (~15%)

(SG improves user convenience)

The fibre strength of switchgrass and its hollow stem structure appears to create a more textured surface to the pack. Wheat straw is “flattened” more easily. Switchgrass appears to be:

1) **providing better support to resting and standing cows.**
2) **more efficiently evaporating water from the pack**

Many positive producer testimonials:

- ***SG breathes and releases moisture from the pack***
- ***SG stays drier on the top and doesn't deteriorate as quickly***
- ***Better footing for the animals***
- ***SG doesn't need to be reapplied as frequently***

Why is switchgrass (SG) providing more comfort to cows than straw?

•Structural strength of SG appears to more homogenously distribute the body weight of a 1400 pound cow

•Need to achieve good contact pressure distribution to improve the blood and oxygen supply which will prevent skin damage and ulcers

•SG has superior elastic properties

•SG has more fatigue resistance
(not a saggy or easily flattened bed)

Switchgrass and manure packs based on switchgrass provide important soil quality benefits to producers

1. Switchgrass has a large root system and can develop 10-15 tonnes/ha of below ground biomass.

2. Leaves of switchgrass are prolific producers of phytoliths (plant stones or opals). Phytoliths are highly resistant to decomposition. Organic C encapsulated in phytoliths is a substantial component of the carbon pool in deep carbon rich prairie soils.

Carbon : Nitrogen Composition Changes of Bedding Packs after 6 Weeks

(Spieshet et al., 2012)

C:N ratio	Wheat straw	Switchgrass	Wood Chips	Wood shavings
0 weeks	69:1	222:1	404:1	485:1
6 weeks	17.4:1	22.8:1	28.2:1	24.5:1

Note1 Wheat straw is more vulnerable to decomposition in the barn with its low C:N ratio
Note 2. Herbaceous-based bedding packs will compost more quickly and more efficiently turn over manure N to the subsequent crop (woody biomass is problematic)
Note 3. Herbaceous manure packs make better feedstocks for anaerobic digestion
Note 4. Switchgrass normally is about .3-.5% N or (ie. a C:N ratio of 90:1-150:1) when harvested in the spring (ie about double wheat straw)

Detailed studies are soon to be published by team led by Dr Renee Bergeron at the University of Guelph assessing cow preference and performance of switchgrass vs. wheat straw bedding packs.

Switchgrass (SG) performs similarly to wood shavings as poultry litter

Numerous U.S. studies indicate SG bedding provides similar weight gain and feed efficiency

May be some benefits to legs of birds from being on SG litter

SG needs to be chopped to about 1”

The finer the chop the better the ammonia absorption

For more Information:

- Contact www.Ontariobiomass.com

ONTARIO BIOMASS PRODUCERS CO-OP

for a cleaner tomorrow

- Additional supporting slides

Switchgrass (SG) can substitute for straw in Dairy cattle feeding

Two main options:

- 1. Can be used as a low energy–low potassium feed in a dry cow TMR's.
- 2. Can be used in a lactating cow TMR's to increase the effective fiber in the ration for improved rumination

1. Use in Dry Cow TMR

- Straw (or potentially switchgrass) inclusion typically ranges from 6 to 12 lb. per cow day depending upon availability and cost and TMR mixing constraints.

- Potential benefits for dry cows in addition to dietary energy restriction include reduced dietary potassium and cation-anion difference to reduce the incidence of milk fever and increased rumen fill to reduce the incidence of digestive disorders (such as displaced abomasums). (Shaver and Hoffmann 2014)

Using Low Potassium straw or SG in a TMR for Close-up Dry Cows

- Early lactation cows often experience low blood calcium due to the demands of the onset of lactation. The resulting hypocalcemia can result in milk fever, retained placenta and mastitis as well as other metabolic disorders (1).

- High concentrations of potassium (K) in forages fed to dry cows can have a large influence on the incidence of hypocalcemia in early lactation cows. (McFadden 2008)

Potassium Content of Alfalfa Hay

Comparison of Forage Potassium levels of legume and legume-grass mixtures in Wisconsin, Ashland, 1994

		----------% Potassium----------			
		Cut 1	Cut 2	Cut 3	Average
Alfalfa	Solo	3.82	2.97	2.36	3.05
Alfalfa	With ryegrass	3.45	3.80	2.24	3.16

Potassium Content of Ontario Straw and Switchgrass

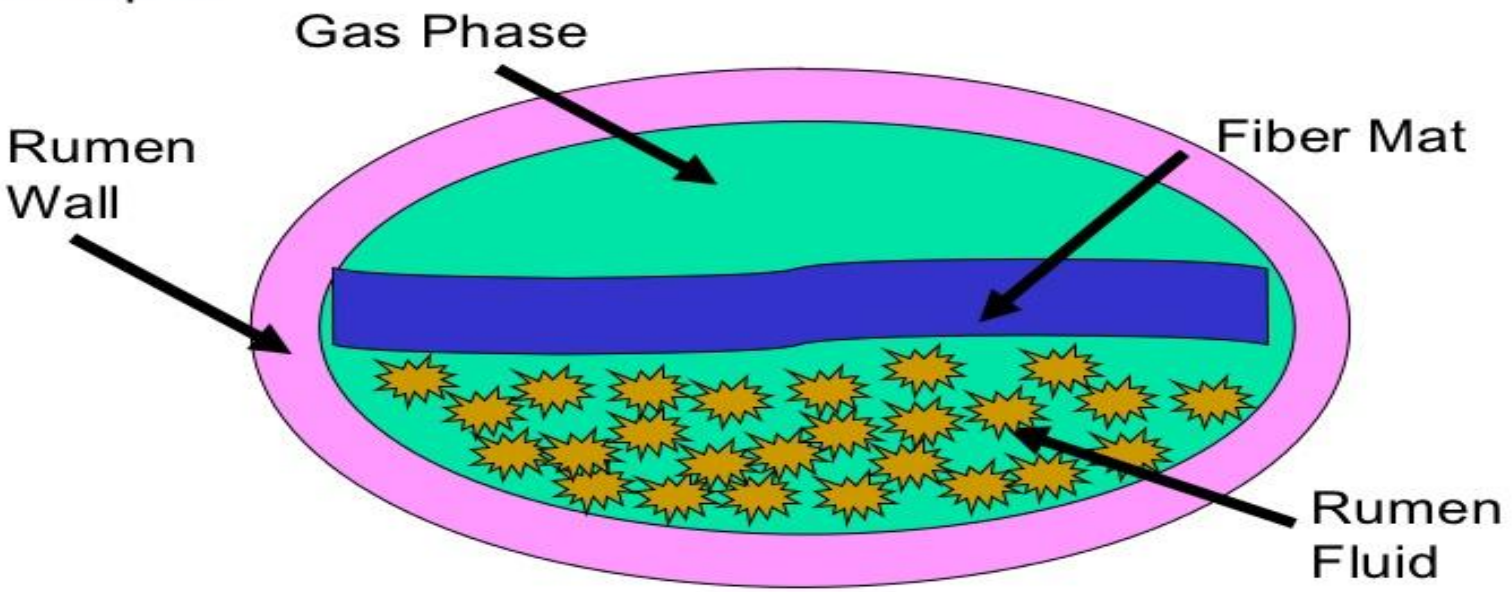
Wheat straw (~1.20%)
Fall harvested switchgrass (~0.90-1.00%)
Spring harvested switchgraass (~0.05-0.10%)
(spring harvest is highly leached by winter/spring precipitation)

2. Improving Rumen Function with Straw or Switchgrass in Lactating Cows

- Nutritionists may recommend need to increase the effective fiber in the ration for improved rumination, desire to increase rumen fill and (or) or slow the rate of passage of digesta from the rumen when only finely chopped and (or) very highly digestible forages are available on the farm, and the need to extend farm forage inventories.

- Straw inclusion is typically limited to less than 2 lb. per cow per day to avoid greatly reducing intake or the energy density of TMR's for lactating cows. Usage is most common in TMR's for fresh cows. (source: Shaver and Hoffman 2010)

Location of Microbes



Feeding a high fibre source like straw or switchgrass at up to 2 lbs/day can help ensure an effective fiber mat is present in the rumen. This can help improve cud chewing and help enables slow growing fibre decomposing microbes to digest materials. Straw or switchgrass is not required if sufficient fibre is present in the ration. A possible inclusion rate should be based on a ration analysis. Some producers have found straw or SG to help increase depressed butterfat levels.