Growing and Using
Switchgrass and Miscanthus

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Growing and Using Switchgrass and Miscanthus

• Today’s Presentation:
  – Walk through switchgrass and miscanthus production
  – Biomass markets, including new livestock bedding and feed videos

• Thank you to the funding partners:
  • OMAFRA-University of Guelph Knowledge Translation and Transfer Program
  • Livestock Research Innovation Corporation
  • Ontario Agri-Food Technologies
  • Ontario Biomass Producers Co-op
Key Points

• We know how to establish and grow switchgrass and miscanthus in Ontario effectively.
• Existing proven markets make the crops make sense today.
• Ontario Biomass Producers Co-op is your key point of contact to get into the business or buy biomass.
Why Grow Switchgrass?

- Farmer-friendly, low investment, minimal labour.
- Can be grown on both prime ag and lower quality Class 3 and 4 soils, including stoney, gravelly, or shallow soils.
- Low cost seed establishment.
- Harvest with conventional farm equipment.
- Harvest generally off-season from other farm activities.
Switchgrass Basics

• Switchgrass is a high-yielding biomass crop
• Switchgrass is grown for its biomass, unlike wheat straw which is a byproduct of grain production.
• Ontario yield: 7 – 12 t/ha (3-5 tonnes per acre) on a dry matter basis.
• Current markets: premium livestock bedding, feed, composting, mulch.
  – Future: bioeconomy?
• Environmental benefits: carbon in roots, erosion control, bird and pollinator habitat.
Why is Switchgrass a Promising Biomass Crop?

- Good drought tolerance
- Low nutrient requirements
- Can thrive on low-quality crop land
- Longevity as perennial (some plots 15 years old)
- C₄ photosynthesis (like sorghum, sugarcane)
  - 40% more efficient solar conversion and 50% less water use than C₃ crops like wheat and timothy
Site Selection

• Grows well on Class 1 and 2 land
• Very good choice for Class 3 land:
  – Good yield
  – Alternative field crops may have low yields or failure risks
  – Net $/acre may be higher than on Class 1 and 2 land because low land rent value and competitive yield
Site Selection

• Good establishment on well-drained loam and sandy soils.

• Tougher to establish on poorly drained clay soils:
  – Poor penetration thru heavy soils.
  – Slow warm-up in spring delays growth.

• Can have good establishment and productivity on coarse, gravelly, stone-filled, or low-fertility soils, or on south-facing slopes where other crops might struggle.

• Good drainage is best for productivity
  – Dry soil during spring harvest
  – Well-drained clay soil may be more productive than sandier soils
Site Preparation, Seeding, Nutrients

• Good site preparation is key to good establishment

• Common problems:
  – Poor soil packing
  – Poor quality seed
  – Planting too deep
  – Poor weed control

• Can use regular cereal drill with a forage seed box. Brillion seeder works well.

• No-till drill for alfalfa works too, particular when seeding with no nurse crop.

• No nitrogen application in establishment year since SG is excellent nutrient scavenger
Establishment Challenges

- SG has low canopy formation in first year, so weed control is important
- Control perennial weeds the year before SG establishment
- Poor establishment can cause lingering problems for many years since most SG plots are kept 7-10 years+.
  - Limited weed control options for annual grass weeds
- On Class 1-3 lands formerly in field crops annual grasses are key concern
  - Often emerge earlier than SG
- On Class 3 – 4 land formerly in long-term forages:
  - Must kill off forages and established weeds
  - Problems with large residual seed bank of perennial and forage seeds
  - Break up clods to make nice seed-bed
First Year

- Typically SG is not cut at end of first year: leave young plant intact to prevent winter injury.
- No registered herbicides. PMRA minor use registration under development for Aatrex (atrazine) and Buctril M
  - See OBPC Switchgrass Agronomy Guide for direction
- Often farmers observe first year field doesn’t look very good (slow growth, weeds).
  - Have patience!
  - If sufficient seedling success, stand will fill out and outcompete weeds in 2^{nd} and following year, establishing dense canopies.
Establishing with a Nurse Crop

- Spring wheat used in >2400 CHU zone in Ontario: short height, early maturing.
- Generates first year revenue
- Improved weed management: with options for approved pesticides, nurse crop nutrient use, and cover that outcompetes weeds
- Generally grown to early/full maturity, harvested to avoid cutting SG growing tip.
- SG can reach 45 – 60 cm by late fall in a good establishment year
Post-Establishment Management

• Generally, 60-70 kg N/ha sustains 8 – 10 t/ha
• Too much N = lodging, too little = reduced yield
• P and K leaching when crop left to over-winter in swath, 90-95% of K returns to field
• Few insect problems for switchgrass
Long Term Switchgrass Management

• Switchgrass is well suited to part-time and retired farmers:
  – Low labour requirements
  – Longevity
  – Low risk of crop failure once established

• Significant soil health contribution
  – Increased soil organic matter and improved soil structure from extensive roots

• Expect growing interest in 5-8 year SG rotation
  – Capitalize on soil improvements for next crops
  – May be necessary on fields susceptible to Heat Smut
Harvest

• One cut per year in Ontario.
• Late fall harvest, spring bale is most common
• Cut several weeks after 1\textsuperscript{st} frost, at leaf yellowing, late October, early November.
  – Allows nutrients and energy to translocate to roots
  – Means no P or K needed
  – Ash content drops from 5\% to 3\%: nutrients back to soil
• For fall harvest need to choose early-maturing variety, and lay in wide swaths to dry out
• Late summer cutting has proven bad for regrowth
Mowing and windrowning

• Difference from mowing other forages: more material, longer length
  – Discbine with mower conditioner, particularly for smaller operations
  – Self-propelled mower-conditioner for larger operations
Leave SG in swath over winter

• Leave 10 cm stubble to keep swath off ground
  – Facilitates good drying in spring
  – Also traps winter snow
  – Stubble downside: flat tires

• Spring ‘flip’ of swath to speed drying
  – Use basket rake or rotary rake, not ground-driven wheel rake
  – Can rake 2 swaths together for pick-up with high volume baler
Spring Raking
• Raking 2 swaths together for high density baler
Spring Baling

- Bales typically 8-12% moisture
- Bale before emergence of spring growth
- Dry spring conditions mean easy field access
- Overall: efficient use of labour and equipment because little overlap with other crop activities
Switchgrass Markets

• Livestock bedding and feed
  – Organic straw market will be key driver
• Mushroom composting
• Mulch, ground cover
• Bioeconomy: pellets for heating, biofibres

• New OBPC videos show details
  – www.ontariobiomass.ca
Switchgrass Questions?
Why Grow Miscanthus?

• Very high yielding biomass crop (8-12 dry t/ac)
• Long-term perennial with easy annual management and low input needs.
• Harvest generally off-season from other farm activities.
• Grows well in Ontario.
Miscanthus Basics

• Miscanthus is a tall warm season grass, origin in Asia
• Established from rhizomes (root material)
• Ontario yield: 17 – 26 t/ha (8-12 tonnes per acre) on a dry matter basis.
• Current markets: premium livestock bedding, feed, composting, mulch.
  – Future: bioeconomy – lignin, fibre, chemicals
• Environmental benefits: carbon in roots, erosion control, bird and pollinator habitat.
Why is Miscanthus a Promising Biomass Crop?

• High yield
• Good drought tolerance
• Low nutrient and input requirements
• Large root system gives robustness, nutrient efficiency, and carbon benefits
• Longevity as perennial (some plots 20 years old)
Site Selection

• Miscanthus grows best on Class 1, 2 and 3 land in south and central Ontario
  – Best on well-drained land
  – Sandy soils best for nursery establishment

• Follow conventional row crops with history of good weed control to avoid weed pressure during establishment.
  – No approved pesticides yet.
Rhizome Quality

• Miscanthus grows from a massive root ball with long spreading underground rhizome branches
• Rhizomes harvested from sandy nursery in early spring (before sprouting)
• New crops are established by chopping up rhizomes into individual sections, and replanting them
• Maintaining rhizome viability and quality is key to good establishment
• Rhizomes should have 2-3 unsprouted buds at time of planting
Rhizome Harvester
Establishment and Site Preparation

• Good site preparation is key to good establishment, particularly for no-till planting
  – Weed control
  – Packing
• P and K at establishment only if low soil test levels.

• No N application in establishment year since it’ll feed the weeds
• Plant as soon as soil warms
No-Till Planting

• No-till planter
  – Places rhizome at 5-10 cm depth
  – Can plant 20-25 ha/day at 8 km/hr
  – No or minimum till depending on soil, previous crop
  – Tillage for weed control and clod break-up if previous forage crop
  – Planting at same time as corn. Planting too late may mean dry conditions which significantly impact establishment
  – Emergence by 3 weeks.
Broadcast Planting

• New approach in 2016
• Broadcast rhizomes from manure spreader at 13 km/hr, then plow to incorporate
• Reduces establishment cost and time for large fields
Establishment Challenges

• Miscanthus has low canopy formation in first year, so weed control is important
• Control perennial weeds the year before miscanthus establishment
• Poor establishment can cause lingering problems for many years since most plots will last at least 10 years.
First Year

• Typically miscanthus is not cut at end of first year: leave young plant intact to prevent winter injury.

• No registered herbicides.  
  – See OBPC Switchgrass Agronomy Guide for direction

• If sufficient seedling success, stand will fill out and outcompete weeds in 2\textsuperscript{nd} and following year, establishing dense canopies by 3\textsuperscript{rd} year.
Post-Establishment Management

- Generally, 20-60 kg N/ha
- Too much N = lodging, too little = reduced yield.
- No insect problems for miscanthus
- P and K leaching when crop left to over-winter standing, so no P and K applications
Harvest

• One cut per year in Ontario.
• Can cut several weeks after 1<sup>st</sup> frost, right up until spring re-growth
  – Allow nutrients and energy to translocate to rhizome
• Intended use will determine harvest approach
• Fall harvest: keeps leaves, moisture, nutrients
• Spring: very dry (10% MC), low nutrients, fewer leaves
Harvest

- Use conventional or specialized equipment
  - Disc mower
  - Discbine with crushing/crimping rollers
  - Self-propelled forage harvester (like corn silage) with rotary head chopper
  - Pull-type forage harvester or pull-type with pick-up if first cut by discbine
Spring Baling

• Bales typically 8-12% moisture
• Bale before emergence of spring growth
• Dry spring conditions mean easy field access
• Overall: efficient use of labour and equipment because little overlap with other crop activities
Miscanthus Markets

- Premium livestock bedding
- Ginseng
- Lignin
- Future bioeconomy applications
- OBPC videos on miscanthus use
Miscanthus Questions?
Biomass Markets: Livestock

• Generally purchased by early adopters
• Great exposure during 2015 wheat straw shortage
  – Led to experience with ‘premium’ values:
    • More structural resilience than straw – maintains fluff, effective wicking and movement of moisture, and grip
    • Low-K for switchgrass dairy ration
    • Low ammonia in barns due to high C content
    • Organic market: no-spray straw

• Many repeat buyers
• OBPC members sell out every year
Biomass Bedding Video

• Livestock producer experiences:
  – Multiple livestock markets using biomass
  – Very dry bedding, keeps ammonia down
  – Better moisture management: use less, better clean-out, animal cleanliness/health, body score
  – Structural resilience, stands-up well, good traction, a load lasts longer
  – Composts well compared to wood shavings
  – Organic certifiable – no spray residues
  – Used it, liked it, planted it
Biomass Feed Video

- Video focuses primarily on dairy, both dry cows and milking cows
- Reliable and consistent fodder supply – even in drought years – high yield, deep roots
- “Physically Effective Fibre”, rumen scratching function, saliva buffer for high concentrate rations
- Dry cows:
  - Lowest-K fodder crop in Ontario
  - High forage, low energy diet – increases bulk without increasing energy
- Farmer with strong focus on cow-care liked it
- Consult your nutritionist: 1 kg/day milking cows in TMR, dry cows 2.5 - 5 kg/day
Next Steps in Biomass Markets

• Grow existing livestock bedding and feed
• Dedusted material in plastic-wrapped small bale to target wood shavings market
• Organic no-spray straw
• Research to strengthen market potential
  – Dairy Rations
  – Stomping resilience
  – Darkling beetle deterrence
  – Rhizome storage
• Biochemistry commercialization “Engineering Life”
• Single-desk co-op selling to secure fair price for members
• Collaborative environment for growers and users
• Access to early new varieties of higher-production switchgrass seed

Contact:  www.ontariobiomass.com  info@ontariobiomass.com