Growing alternative energy crops in West Central Minnesota

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Biomass Feedstocks

- **Current feedstocks**
  - Corn
  - Sugarcane
  - Switchgrass

- **Future feedstocks**
  - Agricultural residues
    - Corn stalks
  - Wood wastes
  - Energy crops
    - Grown for energy content
Feedstocks Being Considered

- 2 types of crops
  - Non-native
    - Miscanthus
  - Native
    - Switchgrass
    - Big bluestem
- Prairies
Common Characteristics

- **Perennial**
  - Grow every year

- **Rhizomatous**
  - Grow by underground stems

- **High Yields**
  - Native grasses
    - 3-5 tons per acre
  - Miscanthus
    - 10-17 tons per acre

- **High energy content**
  - 7400-8200 Btu’s/lb
Miscanthus

- East Asia
- Tallgrass
  - 3.5 meters high
- Triploid
- High energy content
  - 17.5-18 MJ/kg (7400-8200 Btu’s/lb)
- Uses
  - Carbon sequestration potential
    - 6.3 Tonnes/ha (2.6 ton/acre)
  - Animal Bedding
  - Fiber
Establishment of Miscanthus

- Plant rhizomes
- 2 ways to plant
  - Potato Planter
    - 3 ha per day
  - Custom Planter
    - 20 ha per day
- Nutrient addition
  - None in establishment year
- Weed control
  - Herbicide necessary
Management of Miscanthus

- **Overwinter**
  - Poor survival rate
  - Solutions
    - Hybrid
    - Cover

- **Nutrients**
  - Nitrogen
    - 20-80 kg/ha (17.8-71.4 lb/acre)

- **First 2 years of growth**
  - No harvest
Harvest of Miscanthus

- **Spring**
  - Late February to late May
  - Leaves fall off
    - Lower ash content
    - Less tar build up in energy conversion
  - Driest stems
    - Better conversion properties
- **Yield**
  - 10-17 tons per acre
Native Plants

- Native tall grasses
  - 1.8-2.5 meters tall
- High tolerance and adaptability
  - pH, soil type, weather conditions
- High energy content
  - 18-19 MJ/kg (7800-8200 Btu’s/lb)
- Alternative uses
  - Forage
  - Erosion control
  - Wildlife plantings
Establishment of Natives

- Broadcast or drill
- Nutrient addition
  - No nitrogen when planting
  - End of season 50kg/ha (44.6 lb/acre)
- Weed control
  - Extremely important
  - Herbicide addition
    - 2,4-D
- Aboveground growth
  - Very little establishment year
Management Natives

- **Nutrient**
  - Nitrogen addition necessary
    - 50-100 kg/ha (44.6-89.2 lbs/acre)

- **Weed control**
  - Continued importance
  - Early season clipping
  - Biomass removal
    - Burn

- **Not harvested first 2 years**
  - Not substantial biomass
Harvest Native Crops

- **After killing frost**
  - Plants dormant
    - Does not damage plant
  - Low moisture content
    - <20%

- **Yield**
  - Switchgrass
    - 3-5 tons per acre
  - Big Bluestem
    - 2-4 tons per acre
Native Prairies

- Dominant ecosystem
  - Throughout the Midwest United States
- Fire based
  - Rely on fire for continued growth
- Once 1/3 of United States
  - 3,000,000 km² (741,000,000 acres)
  - Less than 3% remains
- 18 million acres in Minnesota
  - 1% remains virgin prairie
Prairies and Fire

• Fire
  ◦ Biomass removal
    ▪ Sun warms soil
  ◦ pH buffering
    ▪ Ash returned to soil
  ◦ Species Composition
    ▪ Fire Favors $C_4$ grasses
  ◦ Expensive
    ▪ 30+ dollars per acre
Harvesting Native Prairies

- Possible alternative to burning
  - Biomass removed
  - Shown to favor forbs and legumes
- Harvested late fall
  - Most birds have fledged
- Sections left un-harvested
  - For remaining animals over winter
- Effect on habitat
  - Favor some birds and small vertebrates
- Yield
  - 1-3 tons per acre
Conclusion

- **Miscanthus**
  - High yields
  - High energy content
  - Poor overwinter
  - Lack of trial in west central MN

- **Native grasses**
  - High energy content
  - Yields
  - Experience in west central MN

- **Prairies**
  - Harvestable
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