Research on Bio-fuel crops in Alaska

Can you really grow biomass feedstock in the subarctic?
Why do we care?

Alaska is oil producing and exporting state BUT,

Energy costs very high, especially in remote, rural communities.

Up to 95c per kWh
Up to $10 per gallon ($2.60 per litre) heating fuel
Why do we care?

• Lots of interest in locally available, alternative energy sources, including biomass.
Biomass energy at work – Tok, Alaska

- In 2010, a 5.5 million Btu chip-fired Messersmith biomass boiler system was installed in the 88,000 square foot Tok High School.
- In 2011, a steam turbine was added that currently produces 60 kW, matching the average load of the school (it still needs grid power during peak times) and covering 75% of electricity needs.
Biomass energy at work – Tok

- Excess heat is still available; a greenhouse is being built to provide vegetables to school lunches, and a district heating system to neighboring city buildings is under assessment.
- Using fire prone black spruce, but planting for future harvests, and educating children on local biomass
- Savings – $206,000 on heating alone!!
Biomass energy at work – Delta Junction

- Delta Junction leveraged the expertise developed in Tok and installed the same 5.5 million Btu chip-fired Messersmith biomass boiler system in its Delta High School, a 77,000 square-foot building, which serves 200 students
- Total savings $276,000 annually!
- More savings expected as labor efficiency increases

Photo by Daisy Huang/ACEP
How does biomass cropping fit in?

- Supplementing local softwood harvests
- Reducing distance to harvest
- Maintaining forest diversity
- Allowing longer regeneration for slower growing species
Plants used in biomass research

- Work to date on biomass cropping in Alaska has been with woody species and cool-season perennial grasses
- Both native and introduced species
Plants used in biomass research

- Woody species
  - Alder, poplar, willow

- Grasses
  - Bromegrass, hairgrass, reed canarygrass, bluejoint reedgrass, wheatgrass, wildrye

- Other herbaceous species
  - Tall fireweed
Most work to date has been screening trials to determine which species have potential as bioenergy crops in AK.

Some work on management:
- Mostly harvest management
- Nitrogen management
Grass research

- Harvest management study
  - Double harvest (mid-summer & fall)
  - Fall harvest
  - Spring harvest

- N rate study
  - 3 rates: 10, 50, 100, 100 kg N ha⁻¹
Some results with grasses

• Some yields as high as 11 MT ha\(^{-1}\) but typical yields 3 – 4 tons dry matter ha\(^{-1}\) yr\(^{-1}\)

• Introduced species (brome grass, reed canarygrass) seem to have higher yield potential than native grass spp.

• But jury still out
Grass research

- Double-cut harvest regime (mid-summer + fall) yields about the same as single-cut fall harvest

- Fall conditions cool and wet: not conducive to field drying
  - Fall cut grasses had senesced, but still high moisture

- Spring – moisture < 15%, yields low.
N rate

Delta Junction

- Brome grass
- Hairgrass
- Wheatgrass

Dry matter yield (Mg ha\(^{-1}\) yr\(^{-1}\))

Nitrogen application rate (kg N ha\(^{-1}\) yr\(^{-1}\))
Willow and poplars

- Southcentral Alaska: balsam poplar produced 11 MT/ha wood biomass after two years regrowth.

- Central Alaska, balsam poplar: 1.9 MT/ha wood biomass on a moderately well drained site and 3.5 MT/ha on a poorly drained site after four growing seasons since establishment.

- Central Alaska, feltleaf willow: produced 2.8 MT/ha biomass on a moderately well drained site and 6.5 MT/ha on a poorly drained site after four growing seasons since establishment.
Willows and poplars

- Really too early to tell much

- Available soil water is huge factor affecting growth and yield.
Conclusions

• Too early to say much about yield potential for biomass crops in Alaska, but with some species and under optimum conditions, yield potential is fairly high

• Lots of management questions that need to be addressed

• Not yet enough data to study economics of biomass cropping in Alaska
Potential impacts

• This study could result in significantly reduced energy costs for rural communities in Alaska
• However, numerous questions remain to be addressed, such as:
  • Best low-tech methods to convert biomass to energy
  • Best management practices for cropping biomass in various regions in Alaska.
  • Cost of production for biomass crops in Alaska
  • Cost/benefit analysis for biomass energy vs. other energy sources in Alaska.
Thank you to Funding Agencies

- Department of Defense, US Air Force
- USDA National Institute of Food and Agriculture
- Alaska Center for Energy and Power

Amanda Byrd
Biomass Coordinator
Alaska Center for Energy and Power
University of Alaska Fairbanks
agbyrd@alaska.edu