Perennial Ryegrass Yields

2,000 #/A by 2020

Reality or Pipe Dream!
Saskatchewan Forage Seed
Dave Grafstrom, University of Minnesota
January 11, 2018
Where Are We Located?

Minnesota

Lake of the Woods
MN Magnusson Research Farm
40 acres, 6 miles NW Roseau, MN
Presentation Outline

- General crop economics
- Ryegrass economics
- Theoretical perennial ryegrass seed yields
- Management strategies for high ryegrass yields
- Fertility
- Growth Regulators
- Diseases
- Summary
## Estimated 2018 Cost/Returns

<table>
<thead>
<tr>
<th>01/8/18</th>
<th>2018</th>
<th>2018</th>
<th>2018</th>
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<tbody>
<tr>
<td>Projected</td>
<td>Ryegrass</td>
<td>Wheat</td>
<td>Soybeans</td>
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<tr>
<td>Yield per Acre</td>
<td>800</td>
<td>60</td>
<td>37</td>
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<tr>
<td>Price/ Unit</td>
<td>$0.60</td>
<td>$6.14</td>
<td>$8.56</td>
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<td>Gross Income</td>
<td>$480.00</td>
<td>$368.4</td>
<td>$316.72</td>
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<td>Total Costs</td>
<td>$381.50</td>
<td>$351.33</td>
<td>$289.37</td>
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<tr>
<td>Profit Per Acre</td>
<td>$98.5</td>
<td>$17.07</td>
<td>$27.35</td>
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<tr>
<td>Profit Margin</td>
<td>25.8%</td>
<td>4.9%</td>
<td>9.5%</td>
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<tr>
<td>BEP</td>
<td>$0.48</td>
<td>$5.86</td>
<td>$7.82</td>
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</table>
Estimated Production Costs ($/A) for Perennial Ryegrass in 2018 ($381.50)

- $12.00 – Seed
- $98.00 – Fertilizer
- $55.00 – Chemicals
- $10.00 – Rouging
- $18.00 – Fuel & Oil
- $20.00 – Repairs
- $10.00 – Custom Hire
- $55.00 – Rent
- $12.00 – Interest (op)
- $12.00 – Crop Insurance
- $1.25 – Lease (mach)
- $45.00 – Indirect Costs (dep., hired labor, mach & building interest)
Perennial Ryegrass - Direct Expenses for 2018 ($306.20)

$/Acre

- Fertilizer: 98
- Land Rent: 55
- Chemical: 55
- Repairs: 20
- Fuel & oil: 18
- Op Interest: 12
- Seed: 12
- Crop Insurance: 12
- Rouging: 10
## Perennial Ryegrass Profit Margins at Various Yield Goals

<table>
<thead>
<tr>
<th>FBM Projected</th>
<th>Ryegrass 2018</th>
<th>Ryegrass 2018</th>
<th>Ryegrass 2018</th>
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<tbody>
<tr>
<td><strong>Yield per Acre</strong></td>
<td>800</td>
<td>1000</td>
<td>1200</td>
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<tr>
<td><strong>Price/ Unit</strong></td>
<td>$0.60</td>
<td>$0.60</td>
<td>$0.60</td>
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<tr>
<td><strong>Gross Income</strong></td>
<td>$480.00</td>
<td>$600.00</td>
<td>$720.00</td>
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<tr>
<td><strong>Total Costs Direct + Overhead</strong></td>
<td>$381.50</td>
<td>$381.50</td>
<td>$381.50</td>
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<tr>
<td><strong>Profit Per Acre</strong></td>
<td>$98.5</td>
<td>$218.50</td>
<td>$338.50</td>
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<tr>
<td><strong>Profit Margin</strong></td>
<td>25.8%</td>
<td>57.3%</td>
<td>88.7%</td>
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</table>
Yield Drives Profits

- Average yields: negative cash flow
- Utilize technology (GPS, auto steer, GIS mapping, Satellite, UAS)
- Engage entire management team
- Regular crop scouting
- Understand grass seed plant growth and development, GDD model & pest patterns
- Control controllables
Control the Controllables

**Control**
- Crop/variety selection
- Timings of crop inputs
- Nitrogen rate & timing
- Regular budget review
- Pay close attention to details
- DETAILS MATTER
- Utilize all management resources
- When to swath
- When to buy inputs?

**No control**
- Weather
- Commodity prices
- Input prices
- Government programs & policies
- Interest rates
- Global economy
- Agriculture policy
What are the major factor/s limiting seed production on your farm?
Theoretical Seed Yield for Perennial Ryegrass

Maximum Yield
10,000#/A

Florets not pollinated or aborted - 3,500#/A

Shattered Seed - 1,000#/A

Light Seed - 3,500#/A

Actual Field Harvested Yield = 2,000#/A

Oregon State University
Yield Components: Perennial Ryegrass Seed Production

- 12,022,560 culms/acre
- 21 spikelets/spike
- 9.4 florets/spikelet
- 0.213 seeds/floret
- 0.00000419 pounds/seed
- 2215 pounds/acre
How Do Perennial Ryegrass Yields in MN Compare to West Coast?

- Oregon data suggests over 2,000#/acre
- MN average - 800#/acre
- High 20% - 1,200#/acre
- U of MN Magnusson Research Farm – Over 1700#/acre
- Area seed conditioners field documented yield approaching 1,500#/acre
TO MAXIMIZE PERENNIAL RYEGRASS YIELDS, WE MUST UNDERSTAND THE GROWTH, DEVELOPMENT, AND POTENTIAL PEST PROBLEMS AND PATTERNS

Leaf and Stem Rust in Lake of the Woods County
Lake of the Woods Ice-Out Date, 2005-2017

Calendar Date

DNR Data, Average Ice-out Date, Average May 3; Earliest April 8, 2000; Latest May 21, 2014
Perennial Ryegrass Biomass Production influenced by Nitrogen Rate, Location and Year

Data from Eric Koeritz
Growing Degree Days

What is it?
GDD – Can be used to estimate the growth and development of plants and insects

How is it calculated?
- GDD = (Tmax + Tmin)/2 - Tbase
- Tmax = Daily max temp
- Tmin = Daily min temp
- Tbase = Base temp for plant/insect
Growing Degree Day: Example

Daily Temperature Data

- High temp for day was 65 and low 45 F
- \((65+45)/2 = 55 - 32 = 23\)

- 23 GDD were accumulated on this day
Ryeegrass GDD Model

- Works well to predict ryeegrass growth stages
- Can be used to predict pest outbreaks (mildew in bluegrass and rust in ryeegrass)
- The big limitation of the GDD model - does not account for level of plant growth (e.g. thin, medium or lush)
Perennial Ryegrass Growth Stages

- Vegetative
- Tillering
- Jointing
- Flag leaf
- Full head extension
- Pollen Shed (anthesis)
- Mature Seed
<table>
<thead>
<tr>
<th>Plant Stage</th>
<th>GDD</th>
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<tr>
<td>2-3 Leaf</td>
<td>500 - 650</td>
</tr>
<tr>
<td>1-2 Nodes</td>
<td>700 - 850</td>
</tr>
<tr>
<td>2-3 Nodes</td>
<td>900 - 1050</td>
</tr>
<tr>
<td>Boot Stage</td>
<td>1100 - 1250</td>
</tr>
<tr>
<td>50% Headed</td>
<td>1300 - 1550</td>
</tr>
<tr>
<td>Pollen shed</td>
<td>1600 - 1750</td>
</tr>
<tr>
<td>Swathing</td>
<td>2750 - 2900</td>
</tr>
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Averaged over years & locations
GDD Uses in Grass Seed Production

- Herbicide timings
- Growth regulator schedules
- Fertilizer timings
  - Fall, spring or split applications
- Monitoring for pests
  - Mildew, rust, grasshoppers
Average GDD Accumulation to Onset of Leaf Diseases in Turf Seed Production

- Mildew
- Crown Rust
- Leaf & Stem Rust

GDD
Factors Affecting Perennial Ryegrass Seed Yield

- Stand losses (winterkill, heavy straw...)
- Time of seeding (spring or fall)
- Fertility (nitrogen losses?)
- Full straw load (biomass)
- Control lodging
- No rust control
- Weed control
- Reduce cleaning losses
- Harvest & storage
Perennial Ryegrass Fertility

- Nitrogen must be available in the spring at spike initiation 400 GDD
- Perennial ryegrass yields not limited by nitrogen content of 140#/A Rolston et al 2010
- Linear response of seed yield and nitrogen rate; 12.32 # seed for each # nitrogen (Rolston et al 2010)

Crop decision making guides
- GDD model
- Light meter?
- Biomass produced?
- Days to 50% lodging?
- Tissue testing?
- Foliar nitrogen?
### Perennial Ryegrass Fertility Trial

**Magnusson Research Farm - 2011**

<table>
<thead>
<tr>
<th>Trt.#</th>
<th>fertilizer/source</th>
<th>Timing****</th>
<th>#/ac.</th>
<th>Ht(in.)</th>
<th>Lodging***</th>
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<tr>
<td>1</td>
<td>0</td>
<td></td>
<td>470</td>
<td>18</td>
<td>1.0</td>
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<tr>
<td>2</td>
<td>60+0+0</td>
<td>Fall</td>
<td>901</td>
<td>21</td>
<td>1.3</td>
<td>7/29</td>
</tr>
<tr>
<td>3</td>
<td>100+0+0</td>
<td>Fall</td>
<td>1441</td>
<td>23</td>
<td>2.5</td>
<td>7/29</td>
</tr>
<tr>
<td>4</td>
<td>50urea+50coated N</td>
<td>Fall</td>
<td>1222</td>
<td>21</td>
<td>1.5</td>
<td>7/29</td>
</tr>
<tr>
<td>5</td>
<td>100+0+0+22s</td>
<td>Fall</td>
<td>1378</td>
<td>23</td>
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<td>7/29</td>
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<tr>
<td>6</td>
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<td>7</td>
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<td>1501</td>
<td>23</td>
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<tr>
<td>8</td>
<td>(25+25)(25+25)**</td>
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<td>spring</td>
<td>1215</td>
<td>22</td>
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<td>7/29</td>
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<tr>
<td>15</td>
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<td>spring</td>
<td>1416</td>
<td>22</td>
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<tr>
<td>16</td>
<td>100+0+0+22s</td>
<td>spring</td>
<td>1503</td>
<td>23</td>
<td>2.0</td>
<td>8/1</td>
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<tr>
<td>17</td>
<td>140+0+0</td>
<td>spring</td>
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<td>23</td>
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<td>8/2</td>
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<tr>
<td>18*</td>
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<td>Fall+liquid</td>
<td>1084</td>
<td>21</td>
<td>1.5</td>
<td>7/29</td>
</tr>
</tbody>
</table>

**LSD @5% level**

|         | 156 | 1.6 | 1.0 | 1.4 |

**Note:**
- LSD: Least Significant Difference
- Timing: Fall, Split
- Lodging: Measurements for lodging

**Units:**
- Ht: Height
- Lodging: Lodging measurements
Nitrogen Stress on Left
Photosynthetically Active Radiation (PAR)

PAR in Perennial Ryegrass

- Reduction in PAR to ryegrass seed head decreased yields up to 16% (Trethewey et al.)
- Strong correlation for seed yield and light interception at flag leaf
- Ryegrass seed yield increased 26.7#/A for each 1% increase in PAR

Chlorophyll Meter
Growth Regulator & Pollination
Perennial Ryegrass Spike Morphology Influenced by Growth Regulators

Chastain et al, 2003
Lodging in Perennial Ryegrass

Growth Regulators

- U of MN trials - average yield increase over 200#/A
- Early lodging promotes vegetative tillering (Rolston 2007)
- Growth regulator improved yields 30-50% (Rolston 2004)
- Seed yield increased 19.7#/A for each delay in days to 50% lodging (Trethewey et.al)
- Days to 50% lodging good predictor of ryegrass yield
Perennial Ryegrass Seed Weight Influenced by Shading

1,000 Seed Wt. (g)

- Stem Wrapped
- Heads Wrapped
- Flag Removed
- Flag Attached
- Unlodged Tiller

Trethewey et al, 2010
Growth Regulator Research

- Apogee (*Prohexadione calcium*)
- Palisade (*Trinexapac-ethyl*)
- Both products reduce lodging by a reduction in cell elongation (gibberellin)
Growth Regulator Research in Ryegrass

- Reduce lodging
- Better pollination
- Increase tillering
- Improved seed set
- More efficient swathing/harvesting
- Reduction in small seed/fines
Grass Seed Stages for Apogee

- Flag Leaf
- Head Emerging
- Base of Seed Head
- 4th Node
- 3rd Node
- 2nd Node
- 1st Node
WH X TQ Perennial Ryegrass
David Dahlgren Farm. Roseau, MN.

Seed Yield, lbs/A

Lodging (0-10)

LSD Yield = 26.4
Lodging = 1.1

Apogee @ 16 oz/A + 0.25% NIS + 2 pts 28% UAN. Palisade @ 1.5 pt/A. 2,4-D + Banvel @ 0.75 pints each. Puma @ 10 oz/A
Apogee Applied at 2-3 node

UTC

4 oz

8 oz

12 oz
BASF Sponsored Data

Headline on Perennial Ryegrass
Average of 2 University of MN locations.
Roseau & Lake of the Woods, MN. 2006

- Apogee rate = 13 oz/A
- Headline rate = 5 fl oz/A

- 1860 lbs UTC
- 1164 lbs Apogee early
- 1206 lbs Apogee late
- 1369 lbs Headline early
- 1307 lbs Headline late
- 1441 lbs Headline
- 1538 lbs Apogee + Headline
Leaf and Stem Rust in Ryegrass
What do we know about Rust?

Disease Triangle

Puccinia Pathway

Wheat Production and the Annual Spread of Rust Epidemics

1 dot = 5000 acres
Crown Rust on Perennial Ryegrass
Powdery Mildew
Fungicide Trial 2010, D. Pieper

- Treatments applied 6/22/2010
- Heavy rust pressure
- Folicur & Absolute applied with spray additive
- LSD (0.05) = 238
- Local infection?
Wild Oat and Barnyardgrass Seed

- Normal cleanout approximately 20%
- Wild oat and Barnyardgrass seed will increase cleanout an additional 5-10%
- 800 # yield = $40/acre
- 1200#yield = $60/acre
- Mow low areas
- Keep weed seed out of good seed
What is the major factor/s limiting perennial ryegrass seed production on your farm?
Summary

- Ryegrass is a profitable crop
- Know your cost of production
- Yields drive profits
- Understand perennial ryegrass growth patterns, stages and pest patterns (GDD model, pest scouting, newsletters)
- Details matter – timing is critical
- Nitrogen, growth regulators, fungicides are key factors to maximize yields, assuming good ryegrass stands
- If mother nature smiles, 1,500 # perennial ryegrass yields are possible