Developing a fast method to appraise alfalfa for multi-peril crop insurance

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North Dakota Alfalfa Production

- Alfalfa only: 413,028 acres
- Alfalfa/grass mixtures: 159,938 acres
- Pasture <25% alfalfa: 819,457 acres
- Total: 1,392,423 acres

NASS, 2012
Alfalfa Production Acreage

National Ranking
State Ranking Among All Field Crops

National Alfalfa & Forage Alliance
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St. Paul, MN 55126
651.484.3888
nafa@comcast.net

2013 NCIS MN/ND/SD Annual Meeting, 8 January, Fargo, ND
What affects alfalfa yield?

- Stand age
- Plant/stem density
- Water
- Diseases
- Soil fertility
Yield and age of stand

Effect of stand age in alfalfa yield 1971-present

Undersander, 2008
Seeding rates and yield

$y = 5.72 + 0.252x - 0.0166x^2 + 0.00031x^3$

$r^2 = 0.94$

8 lbs/acre

Meyer, 2007
No differences in **yield** in the seeding year with seeding rates from **6 to 18 lbs/acre** (Hall et al., 2010)
Alfalfa yield in years 3-5 (Hall et al., 2012)
Seeding rate during years 3-5

(Hall et al., 2012)

7-10 pl/ft²

6-8 pl/ft²

5-7 pl/ft²
Plant and stem density and yield

Alfalfa stem count and yield potential

40 stems/ft² may be adequate

Volenec et al.
Objectives

• 1) Determine the relationship between plant and stem density, and forage yield in glyphosate-tolerant as alfalfa stands age in North Dakota.

• 2) Develop an accurate and efficient method to appraise alfalfa for multi-peril insurance.
Materials and Methods

• Three experiments

• Exp 1. Seeding rate study
  – Established at Fargo, Prosper, and Carrington, ND, in 2013.

• Exp. 2 Plant and stems density on forage yield
  – Established in a 3-year old glyphosate-tolerant alfalfa in Prosper, ND

• Exp. 3. Plant and stems density on forage yield
  – Established in a 7-year-old glyphosate-tolerant alfalfa in Fargo, ND
Experiment 1

- A replicated experiment was established at three locations Fargo, Prosper, and Carrington. The experimental design is an RCBD with six seeding rates:
- 1, 5, 10, 15, 20, and 25 kg pure live seed/ha
Experiment 2

• Established in June 2011.
• Glyphosate-tolerant alfalfa cultivars:
  – MaxiPro 3.10 RR
  – Consistency 4.10 RR
  – Graze -N-Hay 3.10 RR
• Plant densities:
  – T1, low < 10 plants/m²
  – T2, 11-26 plants/m²
  – T3, 28-49 plants/m²
  – T4 > 50 plants/m².
Experiment 3

Established in March 31st 2007
Cultivar DKA34-17RR.
CRD, 5 reps

Plant densities:
T1 < 31 plants/m²
T2 32-39 plants/m²
T3 40-47 plants/m²
T4 48-52 plants /m²
• T5 > 53 plants/m²
Materials and Methods

Plot planter- 8 rows at 6 inches apart. Plots 1.5 m wide x 6 m long.
Materials and Methods

Forage harvester- Carter flail harvester 3 ft. wide, scale incorporated for whole plots, and by hand in 1m² plot

Seeding year: two harvests at late bud to 10% bloom

Production years: three or four harvest at late bud to 10% bloom

Plant and stem density was taken in 1m²
Results Exp. 1
Yield vs. seeding rate

Maximum yield with approx. 13 lbs/acre
**Results Exp. 1 - Seeding year**

Fargo and Prosper maximum yield with approx. **10 plants/ft²** and **50 stems/ft²**
Carrington maximum yield with approx. **5 plants/ft² and 37 stems/ft²**
Exp. 1 combined across locations

Forage yield (tons/acre) vs. Stem density (stems/m²)

\[ y = -5E-06x^2 + 0.0058x + 1.19 \]

\[ r^2 = 0.99 \]

Forage yield (tons/acre) vs. Plant density (plants/m²)

\[ y = -0.0001x^2 + 0.0231x + 1.69 \]

\[ r^2 = 0.98 \]

Forage yield (tons/acre) vs. Seeding rate (kg/ha)

\[ y = -0.0022x^2 + 0.0867x + 1.9 \]

\[ r^2 = 0.91 \]

40-50 stems/ft²
7-8 plants/ft²
10-13 lbs/acre
What seeding rate is economical in the seeding year?

<table>
<thead>
<tr>
<th>Seeding rate (lbs/acre)</th>
<th>Forage yield (tons/acre)</th>
<th>Seed cost/acre ($@6.50/lb)</th>
<th>Seed cost/acre ($@4.00/lb)</th>
<th>Gross revenue ($200/ton)</th>
<th>(Y_max - Y_x)*</th>
<th>@ $6.5</th>
<th>@ $4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.99</td>
<td>6</td>
<td>4</td>
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<td>208</td>
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<td>18</td>
<td>532</td>
<td>74</td>
<td>45</td>
<td>56</td>
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<tr>
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<td>2.69</td>
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<tr>
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<td>574</td>
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<td>-55</td>
<td>-22</td>
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<td>89</td>
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<td>4</td>
<td>-141</td>
<td>-85</td>
</tr>
</tbody>
</table>

*Note: Y_max is the maximum forage yield, and Y_x is the actual forage yield achieved.*

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Results Exp. 2 and 3

Year 3-6
55-60 stems/ft²
4-5 plants/ft²

Seeding year
40-50 stems/ft²
7-8 plants/ft²
Conclusions

Increasing seeding rate above 13 lbs/acre does not increase the forage yield in the seeding year.

The cost of additional seed is greater than the increment in yield above 9 lbs/acre.
## Conclusions

<table>
<thead>
<tr>
<th>Seeding year</th>
<th>Year 3-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-50 stems/ft²</td>
<td>55-60 stems/ft²</td>
</tr>
<tr>
<td>7-8 plants/ft²</td>
<td>4-5 plants/ft²</td>
</tr>
<tr>
<td>10-13 lbs/acre</td>
<td><strong>In older stands stem density predicts slightly better the yield potential.</strong></td>
</tr>
</tbody>
</table>

Stem density and plant density are both closely correlated with forage yield in the seeding year. Both could be used to estimate yield potential. As plants get older they have more stems per plant independent the density.
Thank you for your attention and interest

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http://www.ag.ndsu.edu/plantsciences/research/forages
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