Field Crop Dealer Meeting

November 21, 2011
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# 2011 FIELD CROP DEALER MEETING

**DEPARTMENTS OF:**

*Crop and Soil Sciences*
*Animal Science*
*Plant Breeding and Genetics*
*Plant Pathology and Plant-Microbe Biology*

**CORNELL COOPERATIVE EXTENSION**  
**IN COOPERATION WITH**  
**NEW YORK STATE COLLEGE OF AGRICULTURE AND LIFE SCIENCES**  
**CORNELL UNIVERSITY**  
**ITHACA, NEW YORK 14853**

**AGENDA**

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<thead>
<tr>
<th>TIME</th>
<th>TOPIC</th>
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<tbody>
<tr>
<td>9:50 a.m.</td>
<td>INTRODUCTION</td>
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<tr>
<td>10:00</td>
<td>Corn Silage and Soybean Variety Trials</td>
<td>W.J. Cox</td>
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<tr>
<td>10:35</td>
<td>Grass Management for Dairy Cattle</td>
<td>J.H. Cherney</td>
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<tr>
<td>11:10</td>
<td>Can New York Farmers Afford to Manage Alfalfa without Sulfur Addition?</td>
<td>Q.M. Ketterings</td>
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<td>11:45</td>
<td>Questions and Discussion</td>
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<td>12:00 p.m.</td>
<td>LUNCH</td>
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<td>12:45 p.m.</td>
<td>Weed Research Update</td>
<td>R.R. Hahn</td>
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<td>1:20</td>
<td>New Insights on the Epidemiology and Management of Wheat Scab</td>
<td>G.C. Bergstrom</td>
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<td>1:55</td>
<td>New Alfalfa and Small Grains Varieties for New York</td>
<td>M.E. Smith</td>
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<td>2:30</td>
<td>Using the Adapt-N Tool for Precise Nitrogen Management on Corn</td>
<td>H. M. van Es &amp; B.N. Moebius-Clune</td>
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<td>3:05</td>
<td>Questions and Discussion</td>
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<td>3:20</td>
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CORN AND SOYBEAN STUDIES

Bill Cox and Phil Atkins, Department of Crop and Soil Sciences

The 2011 growing season in New York was one of the most challenging in recent memory. In many regions, the April-May period was the wettest on record. Consequently, only 43% of the corn and 14% of the soybeans were planted in May. July was one of the hottest and driest on record at many locations in upstate NY so the May-planted corn encountered serious drought stress during the critical tasseling/silking period. The June-planted corn did not tassel and silk until early August in most locations and thus avoided serious drought stress at silking. Furthermore, in most regions of upstate NY, there was no killing frost until late October so the June-planted corn and soybeans attained physiological maturity and yielded well because of abundant rainfall in August and September. Unfortunately, some regions of the state suffered from severe wind, rain and flooding damage from a hurricane or tropical storm or both in early September and some corn fields suffered severe damage. In addition, October continued to be exceedingly wet so only 29% of the grain corn crop and 36% of the soybean crop was harvested by the end of October. Fortunately, dry conditions prevailed for the first half of November so most of the soybean crop and 70% of the grain corn crop was harvested by mid-November.

Average corn yields in NY as of November 1 are projected at 127 bushels/acre, which undoubtedly will be revised upward in the final January report because most of the June-planted corn will be accounted for. Likewise, average soybean yields in NY as of November 1 are projected to yield 43 bushels/acre, which probably will not change much in the final report. We planted our corn silage hybrids trials (85 day-115 day relative maturity) at the Aurora Research Farm in Cayuga County on 9 May, at Cornell’s T&R Center in Harford in Cortland County on 11 May, and at Sparta Farms in Groveland Station in Livingston County on 12 May. All three sites have excellent drainage so the excessive rains in the second half of May resulted in no stand damage or uneven crop growth. June turned dry and then excessively droughty at all three sites in July with only 0.85 inches of precipitation at Aurora, 0.61 inches of precipitation at Harford, and 1.05 inches of precipitation at Sparta Farms.

When average across hybrids, silage yields at the Aurora site averaged 17.7 tons/acre (65% moisture) for the 85-90 day relative maturity (RM) group, 17.8 for the 91-95 day RM, 17.6 tons/acre for the 96-100 day RM, 17.4 for the 101-105 day RM, and 18.3 tons/acre for the 111-115 day RM group. The Aurora site, however, was harvested over three separate dates over a 9-day period so comparisons among hybrid groups are not valid. At the other two sites, however, all hybrids were harvested on the same date (1 September at Sparta Farms, and 9 September at Harford) so average yield comparisons across hybrid maturity groups are valid. At Harford, average yields and moisture generally increased as RM increased with 19.8 tons/acre at 67.6% moisture for the 85-90 day RM, 20.2 and 68.0% for the 91-95 day RM, 21.4, and 69.4 for the 96-100 day RM, and 21.5 tons/acre at 70.4% moisture for the 101-105 day RM. We harvested Harford 3 days after the site received almost 7 inches of rain in the first week of September so the moisture values are high given the physiological state of corn because of rehydration after the heavy rains. At Sparta Farms, silage yields across RM were relatively flat but moistures increased as RM increased. The 96-100 day RM group averaged 24.0 tons/acre at 67.8% moisture, the 101-105 RM group averaged 23.5 and 68.8, the 106-100 day RM group averaged 24.0 and 69.9, and the 111-115 day RM group averaged 24.3 tons/acre and 69.9% moisture, respectively.
Table 1 shows the relative silage yield, milk/ton values (based on neutral detergent fiber or NDF, NDF digestibility, starch, crude protein, and ash concentrations), and calculated milk yield (from the MILK2006 program) in 2011 of hybrids that had above average milk yields compared to other hybrids in their RM group. When averaged across locations, 87S9 from LICA, WRV 2087L from Wolf River Valley, RPM 269HRQ from Doebler’s, HiDF 3290-9 from Dairyland Seed, and DKC40-22 GENSS and DKC38-89 VT3 from DEKALB had above-average calculated milk yields in the 85-90 day RM group (11 entries). In the 91-95 day RM (12 entries), 4217XRR from Growmark FS, P9917AM1 from Pioneer, 946LRR from LICA, TMF2L418 from Mycogen, DKC42-72VT3 from DEKALB, and NK N29T-3000GT from Syngenta had above average calculated milk yields. In the 96-100 day RM group (21 entries), RPM 472XRR from Doebler’s, TMF2L533 from Mycogen, HL S48 from Hyland Seeds, 478SL from Doebler’s, DKC49-94 GENSS from DKALB, 4811GT3 from Growmark FS, 99S7 from LICA, NG 6550 from Fielder’s Choice, TA477-31 from T.A. Seeds, F2F488 from Mycogen, and D39QN29 from Dyna-Gro had above-average calculated milk yields.

When averaged across locations, P0125HR from Pioneer, TA545-20 and TA557-00F from T.A. Seeds, 86T82-3000GT from Syngenta, DKC52-59 VT3 from DEKALB, HiDF 3702-9 from Dairyland Seed, 554GRQ from Doebler’s, P0448XR from Pioneer, NK 53W-3000GT from Syngenta, and Masters Choice 5250 from King’s Agriseeds had above-average calculated milk yields in the 101-105 day RM group (21 entries). In the 106-110 day RM (21 entries), P011XR from Pioneer, WRV 2114L from Wolf River Valley, P0210HR from Pioneer, 1084L HX from LICA, 5667GT from Growmark FS, 209-85VT3P from Channel Bio, Garst 85E98-3000 GT from Syngenta, D50N10 from Dyna-Gro, and Masters Choice 535 from King’s Agriseeds had above-average calculated milk yields. In the 111-115 day RM group (12 entries), 214-14VT3P from Channel Bio, DKC63-84 VT3 and DKC62-54 VT3 from DEKALB, V5294HTXRNS from Dyna-Gro, 6611GT3 from Growmark FS, and P1498HR had above-average calculated milk yields. When evaluating hybrids, I would give extra weight to hybrids that performed above-average at all three sites because it indicates yield stability across the droughty Aurora site, the warm Groveland Station site, and the cooler Harford site. Also, we recommend corn silage hybrids based on data across years and not just on 2011 data.

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<td>LICA</td>
<td>87S9</td>
<td>115</td>
<td>96</td>
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<td>HiDF 3290-9</td>
<td>103</td>
<td>102</td>
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<td>DEKALB</td>
<td>DKC38-89 VT3</td>
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<td>104</td>
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<tr>
<td>DEKALB</td>
<td>DKC40-22 GENSS</td>
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<td>105</td>
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<td><strong>91-95 day Relative Maturity</strong></td>
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<td></td>
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<td></td>
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<td>Growmark FS</td>
<td>4217XRR</td>
<td>108</td>
<td>102</td>
<td>111</td>
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<tr>
<td>Pioneer</td>
<td>P9917AM1</td>
<td>107</td>
<td>101</td>
<td>109</td>
<td>2</td>
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<tr>
<td>LICA</td>
<td>946L RR</td>
<td>108</td>
<td>99</td>
<td>108</td>
<td>2</td>
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</table>
We planted soybean variety trials (Group I and II Maturity Groups) at the Aurora Research Farm in Cayuga County on 13 May, on the Ron Robbins Farm at Sackets Harbor in Jefferson County on 3 June, and at the Neenan Brothers Farm at Lima in Livingston County on 6 June. Although the Aurora site was planted at the optimum date, average yields for the Group I (24 entries) and Group II (30 entries) were the lowest of the three sites with average yields of Maturity Group I at 37 and Maturity Group II at 38 bushels/acre. Although moisture conditions improved at Aurora in August, only 2.25 inches of precipitation were recorded through 25 August so varieties in both Maturity Groups encountered drought stress during the critical pod-filling period. In contrast, the
variety trials at Sackets Harbor and Lima received ample rain during pod-filling from mid-August through mid-September so yields were respectable at both sites. At Sackets Harbor, Group I varieties (21 entries) yielded 56 bushels/acre and Group II varieties (19 entries) averaged 53 bushels/acre. At Lima, Group I varieties (23 entries) averaged 58 bushels/acre and Group II varieties (28 entries) averaged 59 bushels/acre. At Lima, Group II varieties averaged 1 point higher in moisture (13.7%) compared with Group I varieties (12.7%) at harvest (12 October). At Sackets Harbor, Group II varieties averaged 4 points higher (13.0 and 17.2%, respectively) at harvest (13 October).

When averaged across locations, S17-F3 from Syngenta, HS19A02 and HSX 1.9 from Growmark FS, and 1805R2 from Channel Bio had much-above average yields in the Group I Maturity Group tests. In addition, H16-10R2 from Hubner Seed, AG1832 from Asgrow, 1719R2 from T.A. Seeds, AG1931 from Asgrow, HS 17A12 from Growmark FS, and RPM DB1711RR from Doebler’s had above-average yields. At Aurora, S17-F3 and HS 19A02 had exceptional yields, whereas AG 1031 from Asgrow had an exceptional yield at Sackets Harbor in the Group I Maturity Group.

When averaged across locations, AG2232, AG2031, and AG2430 from Asgrow, and S21-N6 and S20-Y2 from Syngenta had much-above average yields in the Group II Maturity Group tests. In addition, HS21A12 from Growmark FS, SG2410, SG2111, and SG2018 from Seedway, H210-12R2 from Hubner Seed, 34Y27, V25N9RR, and 38RY23 from Dyna-Gro, 2400R2 and 2800R2 from Channel Bio, and 2229R2 from T.A. Seeds had above-average yields. At the Aurora site, AG2431 had an exceptional yield whereas AG2031 and AG2232 had exceptional yields at Sackets Harbor. I would give extra weight to varieties that performed above-average at three locations because they performed well in the droughty environment at Aurora, the warm site at Lima, and the cooler site at Sackets Harbor. Again, recommended soybean varieties will be based on data across years and not just 2011.
Table 2. Yield of above-average Group I and Group II soybean varieties at two or three sites in New York in the 2011 growing season.

<table>
<thead>
<tr>
<th>VARIETY</th>
<th>AURORA</th>
<th>LIMA</th>
<th>SACKETS HARBOR</th>
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<tr>
<td></td>
<td>---bushels/acre---</td>
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<tr>
<td>S17-F3</td>
<td>46</td>
<td>58</td>
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</tr>
<tr>
<td>HS19A02</td>
<td>45</td>
<td>58</td>
<td>60</td>
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<tr>
<td>HSX 1.9</td>
<td>42</td>
<td>62</td>
<td>59</td>
</tr>
<tr>
<td>1805R2</td>
<td>39</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>H16-10R2</td>
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<td>60</td>
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<td>AG1832</td>
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<td>57</td>
<td>57</td>
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<tr>
<td>1719R2</td>
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<tr>
<td>AG1931</td>
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<td>61</td>
<td>54</td>
</tr>
<tr>
<td>S19-A6</td>
<td>41</td>
<td>55</td>
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</tr>
<tr>
<td>HS17A12</td>
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<td>56</td>
<td>56</td>
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<tr>
<td>RPM DB1711RR</td>
<td>38</td>
<td>56</td>
<td>60</td>
</tr>
<tr>
<td>TEST AVG.</td>
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<td>56</td>
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GROUP II

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<th>VARIETY</th>
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<th>SACKETS HARBOR</th>
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<tr>
<td>AG2232</td>
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<td>64</td>
<td>62</td>
</tr>
<tr>
<td>S21-N6</td>
<td>41</td>
<td>61</td>
<td>-</td>
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<tr>
<td>AG2031</td>
<td>35</td>
<td>61</td>
<td>64</td>
</tr>
<tr>
<td>S20-Y2</td>
<td>39</td>
<td>63</td>
<td>-</td>
</tr>
<tr>
<td>AG2430</td>
<td>41</td>
<td>61</td>
<td>56</td>
</tr>
<tr>
<td>HS 21A12</td>
<td>39</td>
<td>62</td>
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<td>SG2410</td>
<td>41</td>
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<tr>
<td>H20-12R2</td>
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<tr>
<td>34Y27</td>
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<tr>
<td>TEST AVG.</td>
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We also evaluated two corn hybrids (P0125HR from Pioneer and DKC51-86 GENSS from DEKALB) at four seeding rates (25,000, 30,000, 35,000, and 40,000 kernels/acre) at two sidedress N rates (100 and 150 lbs N/acre in addition to the 25 lbs N/acre in the starter fertilizer) when following soybean in the rotation at the Aurora Research Farm in 2010 and 2011. Despite the very different growing season and 40% yield differences across growing seasons, results were remarkably similar. In both years, the recommended N rate of 125 lbs N/acre sidedress and 30,000 kernel/acre seeding rate resulted in optimum yields (Table 3). In 2011, however, the Smartstax hybrid, DKC51-86 GENSS, had a significant 5.8% yield advantage when averaged across seeding and N rates, perhaps due to better drought tolerance (as the slides during the presentation will illustrate). Consequently, based on the results of this study, we will continue to recommend seeding rates of about 30,000 kernels/acre for grain corn.
Table 3. Grain yield of a DeKalb and a Pioneer hybrid at four seeding rates and two N rates in a field following soybeans at the Aurora Research Farm in Cayuga Co., NY (bold values represent optimum values based on regression analyses) in the 2010 and 2011 growing seasons.

<table>
<thead>
<tr>
<th>RATE k/acre</th>
<th>DKC51-86 125N</th>
<th>DKC51-86 175N</th>
<th>DKC51-86 AVG.</th>
<th>P0125XRR 125N</th>
<th>P0125XRR 175N</th>
<th>P0125XRR AVG.</th>
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<td>264</td>
<td>267</td>
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<tr>
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<tr>
<td>2011</td>
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<tr>
<td>25,000</td>
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<td>180</td>
<td>181</td>
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<td>169</td>
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<tr>
<td>LSD 0.05</td>
<td>NS</td>
<td>NS</td>
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We initiated field-scale studies at five farms in 2011, however, to validate the results of this small-plot study to see if indeed the new trait-stacked hybrids only require seeding rates of about 30,000 kernels/acre to optimize yield. Our field-scale studies evaluated two hybrids (P9807HR and DKC49-94 GENSS) planted at four seeding rates (25,000, 30,000, 35,000, and 40,000 kernels/acre) on the Lott Farm in Seneca Co (planted 11 May) and the Ron Grushow Farm in Livingston Co. (planted on 1 June) in 30-inch rows. In addition, we evaluated the same two hybrids at the same seeding rates on the Todd Roberts Farm in Orleans Co. in twin rows (planted on 6 June) and the Todd DuMond Farm in Cayuga Co. (planted on 28 May) in 20-inch rows. In addition, we planted a 96-day Channel Bio hybrid in 20-inch rows on the Bruce Austic Farm in Seneca Co., also in 20-inch rows. As of November 13, we have only harvested at the Todd Roberts Farm where there was a hybrid x seeding rate interaction. The Pioneer hybrid, P9807HR, which yielded 4.5% more than DKC-49-94 GENSS (188 vs. 180 bushels/acre, respectively) showed a negative linear response to seeding rates (192, 191, 186, and 182 bushels/acre as seeding rates increased), whereas DKC49-94 GENSS showed a flat response to seeding rates (178, 178, 183, and 179 bushels/acre as seeding rates increased). We are scheduled to harvest at the Ron Grushow and Bruce Austic farms on November 14 and Rodman Lott farm on November 15 so hopefully we will have more data to share with you during the presentation. Please keep in mind that this is just the first year of this two-year study at five locations in NY.
Table 4. Grain yield and plant populations at the 4th leaf stage (V4) of a DEKALB and Pioneer hybrid planted on the 6 June at the Todd Roberts Farm (Orleans Co.) in 2011 in twin rows (7.5 inch twins in 30-inch rows).

<table>
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<tr>
<th>GRAIN YIELD</th>
<th>PLANTS/ACRE</th>
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<tr>
<td>RATE</td>
<td>DKC49-94 P9807R</td>
</tr>
<tr>
<td>kernels/acre</td>
<td>--------bu/acre-------</td>
</tr>
<tr>
<td>25,000</td>
<td>178 192</td>
</tr>
<tr>
<td>30,000</td>
<td>178 191</td>
</tr>
<tr>
<td>35,000</td>
<td>183 186</td>
</tr>
<tr>
<td>40,000</td>
<td>179 182</td>
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</tbody>
</table>

Finally, we completed the second year of two field-scale studies (Neenan Brothers Farm in Livingston County and the Aurora Research Farm in Cayuga County) in 2011 where we evaluated the response of one soybean variety (AG2002) planted in three row spacings (7.5 inch planted with a drill, and 15, and 30-inch rows with a row crop planter) at two seeding rates (~125,000 and ~175,000 seeds/acre). In Lima, the drilled beans yielded more than 30-inch row spacing in 2010 and the drilled and 30-inch beans yielded more than the 15-inch beans in 2011. At Aurora, there were no statistical differences in yield associated with row spacing in either year of the study but the 175,000 seeds/acre yielded more than 125,000 seeds/acre in 2011. We did observe some depressed yields in a couple of passes of the 7.5 inch drilled beans because of mechanical damage when Roundup was applied at the R1 stage. This may partially explain the lack of the typical 5-10% yield increase for drilled beans that we observe in small plot studies where wheel tracks do not go through the harvested area of the plots.
Table 5. Row spacing and seeding rate effects on yield of AG2002 soybean variety in field-scale studies on farms in Livingston (LIVING.) and Cayuga Counties in 2010 and 2011.

<table>
<thead>
<tr>
<th>SPACING/RATE (Seeds/acre)</th>
<th>LIVING. 2010</th>
<th>CAYUGA</th>
<th>LIVING. 2011</th>
<th>CAYUGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5 INCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125,000</td>
<td>63</td>
<td>50</td>
<td>59</td>
<td>45</td>
</tr>
<tr>
<td>170,000</td>
<td>65</td>
<td>52</td>
<td>62</td>
<td>46</td>
</tr>
<tr>
<td>Avg.</td>
<td>64</td>
<td>51</td>
<td>61</td>
<td>46</td>
</tr>
<tr>
<td>15 INCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125,000</td>
<td>62</td>
<td>52</td>
<td>59</td>
<td>45</td>
</tr>
<tr>
<td>170,000</td>
<td>63</td>
<td>54</td>
<td>57</td>
<td>46</td>
</tr>
<tr>
<td>Avg.</td>
<td>63</td>
<td>53</td>
<td>58</td>
<td>46</td>
</tr>
<tr>
<td>30 INCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125,000</td>
<td>61</td>
<td>54</td>
<td>61</td>
<td>42</td>
</tr>
<tr>
<td>170,000</td>
<td>62</td>
<td>56</td>
<td>61</td>
<td>46</td>
</tr>
<tr>
<td>Avg.</td>
<td>62</td>
<td>55</td>
<td>61</td>
<td>44</td>
</tr>
</tbody>
</table>
CAN NEW YORK FARMERS AFFORD TO MANAGE ALFALFA WITHOUT SULFUR ADDITION?
Q. M. Ketterings
Department of Animal Science

In this session, I will talk about trends in sulfur deposition over the past decade and summarize laboratory and field trials on sulfur management for alfalfa and tools for management (soil and tissue testing). I will also introduce a new project for which we are looking for participation by New York farms and farm advisors.
Sulfur for Field Crops

There are 18 essential nutrients for plant growth meaning these nutrients are needed for plants to complete their life cycle (from seed to seed). These essential nutrients can be divided into two main groups; macronutrients (9) and micronutrients (9), based on the amount required by plants; macronutrients are needed in larger quantities than micronutrients. Sulfur (S) is one of the nine macronutrients.

Sulfur is a component of numerous protein enzymes that regulate photosynthesis and nitrogen fixation. Sulfur deficiency can lead to a crude protein deficiency, and reduce milk production and overall feed efficiency on dairy farms. Sulfur is a main component of the amino acids methionine, cysteine, and cystine. Animals need to consume methionine in their diet as they cannot generate it from other compounds (it is an essential amino acid for dairy cattle). Furthermore, sulfur deficiency will result in greater import of feeds onto the farm, a costly practice that negatively impacts farm profitability and long-term sustainability.

In this fact sheet we describe the sulfur cycle and give guidance for sulfur management for field crops.

Sulfur Deficiency
Sulfur deficiency looks similar to nitrogen deficiency (yellowing and interveinal chlorosis), but because sulfur is not very mobile in the plant, the younger leaves will show the deficiency first versus the older leaves in the case of a nitrogen deficiency (Figure 1).

Sulfur Cycle
Figure 2 shows a simplified version of the sulfur cycle. Sulfur can appear in many forms in the environment. The major forms of sulfur present in the atmosphere include sulfur dioxide (SO$_2$) and hydrogen sulfide (H$_2$S). Both forms of sulfur enter the atmosphere from natural events like volcanic eruptions or man made activities such as the burning of fossil fuels. In the soil, S can be found as organic sulfur compounds, sulfides (S$^-$), elemental sulfur (S), and sulfate (SO$_4^{2-}$), the latter of which is the form required for plant uptake.

Sulfur deficient plants will grow slower and have a delayed maturity. The plants tend to develop thin stems and petioles, and become spindly. Sulfur deficiency could occur early in the season when soils are still cold and in younger plants before their root systems have fully developed but if a limited root mass and organic matter mineralization cause sulfur deficiency, the plants will likely overcome the sulfur deficiency later in the season when soil mineralization rates increase and a larger root system allows the plants to explore a greater volume of soil.

Sulfur Cycle

Figure 2: Schematic of the sulfur cycle.

Most of the sulfur in soil is in the soil organic matter and unavailable to the plant. This organic sulfur will slowly go through a process
called mineralization to become available to the plant in the sulfate form. Sulfur enters the soil by deposition through rainwater and plant and animal residues. Sulfur can leave the soil profile as a result of plant uptake, leaching, and volatilization which increases with increased soil disturbance. Overall, sulfur moves from one form to another in a cycle very similar to nitrogen (see Agronomy Fact Sheet #2: Nitrogen Cycle) and can leach easily through sandy soils.

**Reduced Sulfur Supply**

Work in the ‘80s in New York showed no response of alfalfa, wheat or corn to sulfur addition, indicating that sufficient amounts were available through organic matter mineralization, manure addition, use of P fertilizers that contained S (superphosphates), and atmospheric deposition.

Since the Clean Air Act was passed in 1970, emissions of sulfur dioxide have decreased dramatically resulting in reduced sulfur deposition in many parts of the state. For trends in sulfur deposition in New York see the New York State DEC website [http://www.dec.ny.gov/chemical/29847.html](http://www.dec.ny.gov/chemical/29847.html). In addition, the fertilizer market shifted towards more concentrated fertilizers such as monoammonium and diammonium phosphates (MAP and DAP). Also, some sulfur-containing pesticides that were once readily used (e.g. fungicidal copper sulfate), have been replaced by organic materials that do not contain sulfur.

Reduced use of sulfur containing fertilizers and pesticides, decreased sulfur deposition, and increased yields through improved management and crop varieties, raise questions about the sulfur status of New York soils and sulfur management options.

**Sulfur Management**

**Crop removal**

Because of the role of sulfur in N fixation, it is needed at higher levels for legumes like alfalfa and soybeans than for grass hay and corn. Higher yielding fields have a higher rate of sulfur removal when compared with lower producing fields. Sulfur removal rates for most common field crops grown on dairy farms in New York are listed in Table 1. Using the average values in Table 1, a 20 ton/acre corn silage crop (35% DM) would remove almost 14 lbs S/acre while a 4 ton alfalfa hay crop would remove about 20 lbs S/acre.

<table>
<thead>
<tr>
<th>Crop</th>
<th>S removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn silage</td>
<td>0.693 lbs S/ton of silage (35% DM)</td>
</tr>
<tr>
<td>Shell corn*</td>
<td>0.048 lbs S/bu of grain (85% DM)</td>
</tr>
<tr>
<td>Ear corn*</td>
<td>0.057 lbs S/bu of grain (85% DM)</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>4.88 lbs S/ton of hay (90% DM)</td>
</tr>
<tr>
<td>Alfalfa silage</td>
<td>1.72 lbs S/ton of silage (35% DM)</td>
</tr>
<tr>
<td>Grass hay</td>
<td>3.11 lbs S/ton of hay (90% DM)</td>
</tr>
<tr>
<td>Grass haylage</td>
<td>1.44 lbs S/ton of silage (35% DM)</td>
</tr>
<tr>
<td>Soybeans*</td>
<td>0.16 lbs S/bu of soybean (87% DM)</td>
</tr>
</tbody>
</table>

*Assuming a test weight of 56 lbs/bu for shelled corn, 68 lbs/bu for ear corn, and 60 lbs/bu for soybeans.

**Fields to watch**

The risk for sulfur deficiency varies with soil type, the crops grown on the soil, the manure history, and the level of organic matter in the soil. A deficiency is more likely to occur on acidic, sandy soils, soils with low organic matter levels and high nitrogen inputs, and soils that are cold and dry in the spring which decreases sulfur mineralization from soil organic matter. Manure is a significant supplier of sulfur and manured fields are not likely to be S-deficient; however sulfur content in manure can vary.

Fields containing crops with the higher removal rates combined with less than ideal organic matter levels and coarser (sandy) soils are the most likely candidates for sulfur deficiencies.

**Sulfur sources**

If sulfur is deficient, it can be applied as ammonium sulfate or other S-containing fertilizers. As mentioned earlier, manure is also a good source of sulfur.

**Disclaimer**

This fact sheet reflects the current (and past) authors’ best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

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For more information

Nutrient Management Spear Program
[http://nmsp.css.cornell.edu](http://nmsp.css.cornell.edu)

Sara Place, Tom Kilcer, Quirine Ketterings, Debbie Cherney, Jerry Cherney

2007
Contact Information

Name: ____________________________ Company/Department: ____________________________
Address: ____________________________ Telephone: ____________________________
City: ____________________________ Fax: ____________________________
State & Zip: ____________________________ Email: ____________________________

Sample Information

Sample Description ____________________________ Submission Date ___/___/___
Number of Samples ______ Sampling Density: Soil cores per acre__________

Sequentially, enter unique identification code used on submitted sample containers
(Attach additional sheets, if needed):

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
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<td>1:</td>
<td></td>
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<td>13:</td>
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<tr>
<td>2:</td>
<td>8:</td>
<td></td>
<td>14:</td>
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<td>3:</td>
<td>9:</td>
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<td>15:</td>
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<td>29:</td>
</tr>
<tr>
<td>6:</td>
<td>12:</td>
<td>18:</td>
<td>24:</td>
<td>30:</td>
</tr>
</tbody>
</table>

Analysis Information

☐ Illinois Soil Nitrogen Test (ISNT), includes soil organic matter .................................$ 12.50
☐ Corn Stalk Nitrate Test (CSNT) ........................................................................................................$ 10.00
☐ Illinois Soil Nitrogen Test (ISNT) + Corn Stalk Nitrate Test (CSNT)..............................$ 22.50
☐ Soil Sulfur Analysis for Alfalfa........................................................................................................ $ 10.00

Payment Information

Total Amount Owed: $________
Total Amount Enclosed: $_______ Check or account order number: ____________________________

Please make checks out to: Cornell University

Signatures

Signature of customer shipping or delivering samples ____________________________ Date ____________________________

Signature of NMSP staff receiving samples ____________________________ Date ____________________________
GRASS MANAGEMENT FOR DAIRY CATTLE
J.H. Cherney and D.J.R. Cherney
Department of Crop and Soil Sciences

The Northeast USA has near ideal growing conditions for cool-season grasses, and most of the alfalfa grown in NYS is seeded with a perennial grass. Most of the perennial grasses used are not native to North America, but were introduced from Eurasia or North Africa several centuries ago. Grasses have advantages when it comes to nutrient management. Compared to alfalfa, grasses have a greater response to manure, which can be applied multiple times during the season. Grasses use large quantities of nutrients, minimizing the risk of nutrient leaching or runoff. Cool-season perennial grasses provide a significant portion of the forage for dairy cows in the New York State.

Over the past 20 years we have conducted a range of applied experiments, including dairy feeding trials, to evaluate the use of perennial grass as lactating dairy cow forage. This information has been summarized in a grass management for dairy cattle manual, which will be available on-line. Topics include species selection, cultivar selection, establishment, fertilization and management. Forage quality and anti-quality components of forages are discussed. Several chapters on feeding grass to lactating and dry cows are also included. Alfalfa-grass mixtures are discussed, as well as annual grasses for emergency or supplemental uses.

In addition to 16 chapters, the site will include 36 new Grass Information sheets, and several grass management tools for NDF estimation and some economic assessment of alfalfa-grass and grass diets. The new manual will be located at www.forages.org.
Kixor Products Added to Guidelines

Kixor, the active ingredient saflufenacil, was introduced as a component in several new herbicide products at the Field Crop Dealer Meetings in 2010. You’ll recall that Kixor is a PPO inhibitor (Group 14 herbicide) or cell membrane disrupter. It provides rapid burndown and has residual activity on a variety of broadleaf weeds including velvetleaf, redroot/smooth pigweed, common ragweed, common lambsquarters, wild buckwheat, and wild mustard, but does not control annual grasses. Kixor powered products include Sharpen and Verdict (a premix of Kixor and Outlook) for corn and soybeans, and OpTill (a premix of Kixor and Pursuit) for soybeans only. The premix products, Verdict and OpTill, provide residual control of many weedy grasses along with the broadleaf weed control provided by Kixor. Because of their burndown activity, these products can only be applied preplant or preemergence (PRE) before corn or soybeans emerge. These products have been positioned for burndown and/or residual control of labeled weeds in planned sequential or two-pass control programs.

Corn trials at Aurora the past two years have focused on PRE residual activity of Verdict alone and with sequential glyphosate applications. The main PRE comparison has been between Verdict and Lumax in combinations with AAtrex 4L. Common ragweed and giant foxtail have been the dominant weeds. In 2010, ratings made 3 weeks after treatment (WAT) showed 99 and 96% ragweed control for PRE applications of 13 fl oz/A Verdict plus 1 pt/A AAtrtex 4L or of 2.5 qt/A Lumax plus 1 pt/A AAtrex 4L respectively. Ragweed control 10 WAT was also similar for these treatments and averaged 93%. Giant foxtail control with these tank mixes was similar and averaged 97 and 89% 3 and 10 WAT respectively. In 2011 rainfall totals for the first and second WAT were 0.71 and 0.07 inch respectively with the largest event being 0.27 inch recorded 5 days after treatment (DAT). Ragweed control for tank mixes of 15 fl oz/A Verdict plus 1 pt/A AAtrex 4L or 2.5 qt/A Lumax plus 1 pt/A AAtrex 4L 4 WAT was 100 and 93% respectively and this level of control was maintained through 8 WAT. Giant foxtail control was similar for these two tank mixes and averaged 95 and 62% 4 and 8 WAT respectively.

Soybean trials with Kixor powered products in 2009 and 2010 focused on burndown and residual activity of early preplant (EPP) applications in combination with 22 fl oz/A Roundup PowerMax in zone-tillage soybeans. At application, the dominant weeds were common ragweed, giant foxtail, and wild mustard. Burndown ratings 12 DAT in 2010 showed a difference in the speed of ragweed burndown between applications of Roundup alone or with 1 pt/A Solve 2,4-D LVE (average rating of 81%) and applications of Roundup with 1 fl oz/A Sharpen or with 2 oz/A OpTill (average rating of 97%). Control ratings made 5 WAT, just prior to sequential mid-postemergence (MPO) applications, provided insight into the residual activity of Sharpen and OpTill. Ragweed control 5 WAT with Roundup alone or with 2,4-D was 65 and 70% respectively when averaged over the 2009 and 2010 trials. Residual ragweed control with Roundup plus Sharpen or plus OpTill was 85 and 89% respectively when averaged over the two trials. Broad spectrum residual activity was achieved with Roundup plus OpTill which provided 91% foxtail control 5 WAT. A 2011 trial with conventional tillage examined the residual activity of PRE applied Kixor powered products. Residual annual broadleaf weed control 4
WAT was similar for applications of 1 fl oz/A Sharpen or 2 oz/A OpTill with averages of 96, 100, and 90% for ragweed, lambsquarters, and Venice mallow respectively. While Sharpen provided no giant foxtail control 4 WAT, foxtail control with OpTill was 96%. The other Kixor powered premix, Verdict, did not perform as well as OpTill, especially on the annual broadleaf weeds. Control with Verdict was 50, 72, 47, and 86% 4 WAT for ragweed, lambsquarters, Venice mallow, and giant foxtail respectively.

Changes in Soybean Weed Control
Common lambsquarters recommendations for glyphosate-resistant soybeans continue to evolve. With lambsquarters more than 3 or 4 inches tall, the recommendation has been to use 1.5 times the normal rate of glyphosate or to tank-mix 1/8 oz/A Harmony SG or 1/12 oz/A Unity WDG with the glyphosate. A new option for a one-pass program is to apply 3 to 3.75 pt/A Flexstar GT, a premix of glyphosate and fomesafen (Reflex). This premix has provided 95+% lambsquarters control with EPO, MPO, and late postemergence (LPO) applications the past 2 years. Additional options for two-pass programs (PRE followed by POST glyphosate) have also been added to the recommendations for lambsquarters control. In the past, PRE applications of Python, Linex 4L/Lorox DF, or Prefix have proven helpful in controlling or suppressing lambsquarters growth prior to POST glyphosate applications. New options for two-pass programs include EPP or PRE applications of Valor SX, Valor XLT, or OpTill. In addition to providing residual activity for a number of annual grass and broadleaf weeds, these products provide valuable burndown activity in no-/zone-tillage fields and have been added to the burndown options in the Guide.

Dandelion Management in Zone-Tillage Corn and Soybeans
A rotation experiment was established at Aurora, NY in 2010 to determine the value of reduced rates of residual herbicides in preventing dandelion encroachment into zone-tillage corn and soybeans. The field was fall plowed in 2009 to eliminate established dandelions. Five crop rotations serve as main plots (12 rows by 300 ft) of corn or soybeans as shown in Table 1. Each rotation is replicated five times.

Table 1. Crop rotations for zone-tillage dandelion experiment established at Aurora, NY in 2010.

<table>
<thead>
<tr>
<th>Rotation #</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Residual Regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corn</td>
<td>Corn</td>
<td>Corn</td>
<td>Corn</td>
<td>With residual herbicides</td>
</tr>
<tr>
<td>2</td>
<td>Corn</td>
<td>Soybeans</td>
<td>Corn</td>
<td>Soybeans</td>
<td>Residual herbicides in both</td>
</tr>
<tr>
<td>3</td>
<td>Soybeans</td>
<td>Corn</td>
<td>Soybeans</td>
<td>Corn</td>
<td>Residual herbicides in both</td>
</tr>
<tr>
<td>4</td>
<td>Corn</td>
<td>Soybeans</td>
<td>Corn</td>
<td>Soybeans</td>
<td>Residual herbicides in corn only</td>
</tr>
<tr>
<td>5</td>
<td>Soybeans</td>
<td>Corn</td>
<td>Soybeans</td>
<td>Corn</td>
<td>Residual herbicides in corn only</td>
</tr>
</tbody>
</table>

Sub-plots (12 rows by 75 ft) within crops are treated with glyphosate alone or in combination with one-half, two-thirds, or full labeled rates of residual herbicides. Corn sub-plots were treated EPO with 22 fl oz/A Roundup PowerMax alone or tank-mixed with 1.25, 1.66, or 2.5 qt/A Lumax. Soybean main plots were split into six-row strips so two residual programs could be
compared. In one program, sub-plots received no residual or 1.125, 1.5, or 2.25 oz/A Canopy PRE followed by 22 fl oz/A Roundup MPO. In the other program, soybean sub-plots received no residual or 1.4, 1.87, or 2.8 oz/A Enlite PRE followed by 22 fl oz/A Roundup alone or tank-mixed with 0.19, 0.25, or 0.375 oz/A Synchrony XP MPO. Corn (DKC 4272) and soybeans (AG 2130) were planted May 17 and 25, 2010 respectively. EPO corn herbicides were applied June 15 to 7-inch corn. PRE soybean herbicides were applied May 27 and MPO applications made June 23 to 6-inch soybeans.

Dandelions were counted in a 7.5 by 75 ft area in the center of each sub-plot May 2, 2011. Counts for corn sub-plot treatments were averaged across rotations since all were treated the same in 2010. The dandelion count for corn sub-plots with EPO Roundup alone was 182/1,000 sq ft (Table 2). Tank-mixing 1.25, 1.66, or 2.5 qt/A Lumax with EPO Roundup applications resulted in 3, 2, and 1 dandelion/1,000 sq ft respectively the spring following application. There were no differences in dandelion counts between the two residual soybean programs (Table 2). Dandelions averaged 80/1,000 sq ft in soybean sub-plots following MPO Roundup only. The one-half, two-thirds, and full rates of the two residual soybean programs resulted in an average of 4, 1, and 2 dandelions/1,000 sq ft respectively the spring following application. Even half rates of the residual programs were effective in preventing dandelion establishment after one year of zone-tillage corn or soybeans.

Table 2. Dandelion counts May 2, 2011 following Roundup alone or in combinations with residual herbicides applied in a corn/soybean rotation experiment near Aurora, NY in 2010.

<table>
<thead>
<tr>
<th>Crops and Herbicides</th>
<th>Rate Amt/A</th>
<th>When Applied</th>
<th>Dandelion/ 1,000 sq ft</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corn</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roundup PM</td>
<td>22 fl oz</td>
<td>EPO</td>
<td>182</td>
</tr>
<tr>
<td>+ Lumax</td>
<td>1.25 qt</td>
<td>EPO</td>
<td>3</td>
</tr>
<tr>
<td>+ Lumax</td>
<td>1.66 qt</td>
<td>EPO</td>
<td>2</td>
</tr>
<tr>
<td>+ Lumax</td>
<td>2.5 qt</td>
<td>EPO</td>
<td>1</td>
</tr>
<tr>
<td><strong>Soybeans – Canopy followed by Roundup Program</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roundup PM</td>
<td>22 fl oz</td>
<td>MPO</td>
<td>75</td>
</tr>
<tr>
<td>Canopy*</td>
<td>1.125 oz</td>
<td>PRE</td>
<td>4</td>
</tr>
<tr>
<td>Canopy*</td>
<td>1.5 oz</td>
<td>PRE</td>
<td>1</td>
</tr>
<tr>
<td>Canopy*</td>
<td>2.25 oz</td>
<td>PRE</td>
<td>2</td>
</tr>
<tr>
<td>*Followed by 22 fl oz/A of Roundup PM MPO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soybeans – Enlite followed by Synchrony XP plus Roundup Program</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roundup PM</td>
<td>22 fl oz</td>
<td>MPO</td>
<td>85</td>
</tr>
<tr>
<td>Enlite fb</td>
<td>1.4 oz</td>
<td>PRE</td>
<td>3</td>
</tr>
<tr>
<td>Synchrony XP*</td>
<td>0.19 oz</td>
<td>MPO</td>
<td></td>
</tr>
<tr>
<td>Enlite fb</td>
<td>1.87 oz</td>
<td>PRE</td>
<td>1</td>
</tr>
<tr>
<td>Synchrony XP*</td>
<td>0.25 oz</td>
<td>MPO</td>
<td></td>
</tr>
<tr>
<td>Enlite fb</td>
<td>2.8 oz</td>
<td>PRE</td>
<td>2</td>
</tr>
<tr>
<td>Synchrony XP*</td>
<td>0.375 oz</td>
<td>MPO</td>
<td></td>
</tr>
<tr>
<td>*Applied with 22 fl oz/A of Roundup PM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Once dandelions become established in no-/zone-tillage fields, different control measures are needed. Current recommendations for corn include tank-mixes of glyphosate plus 2,4-D LVE or of Express plus 2,4-D. Current dandelion recommendations for soybeans are complicated and confusing. Field trials are conducted each year to provide options for both crops that are effective and straightforward. In 2011, EPP applications of 22 fl oz/A Roundup PowerMax plus 1 pt/A Solve 2,4-D LVE controlled only 47 and 63% of established dandelions in zone-tillage corn and soybeans respectively 5 to 6 WAT making this a mediocre recommendation. Results in recent years have shown Express to be effective against this simple perennial weed and efforts continue to refine the rate needed for good control. Tank mixes of 0.375 oz/A Express plus 1 pt Solve 2,4-D LVE controlled an average of 95% of established dandelions 5 to 6 WAT in corn and soybeans in 2011. There was no advantage of using the 0.5 oz/A rate of Express in combination with 2,4-D. Combinations of 22 fl oz/A Roundup plus 0.375 oz/A Express averaged 98% dandelion control in these 2011 corn and soybean experiments.
Fusarium head blight (FHB) or scab, caused by the fungus *Gibberella zeae* (*Fusarium graminearum*), is the most damaging disease of wheat in New York largely because infected grain may be contaminated with the toxin deoxynivalenol (DON) which prevents its sale to flour mills if DON levels exceed 2 ppm. Successful management of FHB and DON requires an integrated approach that utilizes cultural practices, partially resistant wheat varieties, and sometimes fungicides applied at crop flowering. We will discuss new evidence from epidemiology research that identifies the utility of cultural practices that avoid crop contact with fungal spores from local crop residues. We will also review the latest research evidence supporting the combined use of resistant varieties and triazole fungicides for disease management in New York.

**Inoculum sources and cultural control practices**

Reduction or elimination of within-field sources of spores of *G. zeae* is the basis for cultural control measures for FHB such as crop rotation sequences in which cereals follow non-cereal crops. In microplot experiments conducted in twenty-one winter wheat fields over five states in 2009 and 2010, DON level differed significantly between corn debris and no debris microplots in only one location, strongly suggesting that regional atmospheric inoculum is the strongest contributor to infection even when corn debris is present in a wheat field. Small areas of debris, however, may result in an underestimation of the contribution of spores from a larger field of corn debris to FHB and DON. The goal of our current research project in seven states is to provide realistic estimates of ‘DON reduction’ that can be expected from cultural controls that reduce within-field inoculum sources. We utilized moldboard plowing of corn debris as a proxy for planting after a non-cereal crop to compare directly with wheat planted no-till into corn debris in commercial-scale wheat fields planted following grain corn harvest in Illinois, Kentucky, Michigan, Missouri, Nebraska, New York, and Vermont. Following corn harvest in 2010, replicated wide (60 ft) strips were moldboard plowed or left non-plowed prior to sowing wheat over the entire field with a no-till drill. Wheat in each strip was monitored for FHB and sampled for laboratory quantification of head infection by *G. zeae* and contamination of grain by DON in 2011.

Results from year one of this research project with winter wheat in six states (IL, KY, MI, MO, NE, and NY) and spring wheat in one state (VT) are shown in Fig. 1. FHB symptoms at soft dough stage were low to moderate at every location except Missouri. Yet, at crop maturity, a high percentage of wheat heads was found to be infected by *G. zeae* in all locations except Nebraska and Vermont. Measurable DON was found in grain from every environment and the levels were lowest in Vermont and highest in Kentucky and Nebraska. Moldboard plowing resulted in a significant decrease in FHB index in four environments (IL, MO, NY, MI), though the magnitude of the difference was large only in Missouri. In Nebraska, FHB index was significantly higher in the moldboard-plowed treatment in which the wheat crop matured earlier than in the no-till corn debris treatment. Moldboard plowing was associated with a small but
significant decrease in recovery of *G. zeae* from mature heads in three environments (IL, MI, NY). There was no significant effect of plowing on DON level in five environments (IL, KY, MO, NY, VT) and there were small, but significant decreases in toxin in moldboard-plowed compared to no-till strips in two environments (MI and NE). An additional treatment of minimum tillage (chisel plow) was added in the Michigan experiment; DON levels in the minimum-till plots were intermediate between moldboard and no-till but not significantly different from no-till. There is a strong trend in year one data suggesting that inoculum from area atmospheric sources exerts a far greater effect than inoculum from in-field corn residue on the level of DON contamination. A second year of experimentation in seven additional wheat environments in 2012 will provide increased evidence of the magnitude of the effect of corn residue management on DON reduction.

**Integrated management results in 2011**

We continued our multiple-year assessment of the individual and combined effects of partially resistant varieties and fungicide application on FHB and DON under two environments at the Musgrave Research Farm in 2011. The four soft red winter wheat cultivars were ‘Pioneer 25R47’ (susceptible to FHB), ‘SW 80’ (susceptible to FHB), ‘Otsego’ (classified initially as moderately resistant to FHB), and ‘Truman’ (established as moderately resistant to FHB). The two experimental environments were characterized by the planting of winter wheat no-till into 1) soybean residue and 2) corn residue in immediately adjacent parcels of land. Each experimental design was a split-split plot with four wheat cultivars as whole plots, inoculation treatment as subplot, and fungicide treatment as sub-subplot, in four replicate blocks. Main plots were planted with a 10 ft wide commercial grain drill. Spray treatments applied at Feekes GS10.5.1 on 6/3/11 were 1) non-sprayed, non-inoculated 2) Prosaro 6.5 fl oz/A & Induce 0.125%, non-inoculated 3) non-sprayed and inoculated with *F. graminearum*; and 4) Prosaro 6.5 fl oz/A & Induce 0.125% and inoculated with *F. graminearum*. Treatments 3 and 4 were inoculated with a conidial suspension of *F. graminearum* (40,000 conidia/ml) on the same day as the Prosaro application after the fungicide had dried and in early evening to provide a better environment for infection.

Results are summarized for the effects of treatment (Table 1) and wheat cultivar (Table 2). Flowering occurred simultaneously in both environments during a relatively dry period, considered low risk for FHB infection. The average incidence of FHB in the experiment following corn was 7% in non-inoculated plots, 15% in inoculated plots, and 11% overall. The average incidence of FHB in the experiment following soybean was 3% in non-inoculated plots, 11% in inoculated plots, and 7% overall. This suggests that the corn residue provided a slightly more favorable environment and/or higher background inoculum for FHB development. This pattern was observed also for FHB index and DON contamination. The average FHB index and DON contamination in the experiment following corn were 2% and 0.6 ppm in non-inoculated plots, 5% and 1.2 ppm in inoculated plots, and 3% and 0.9 ppm overall. The average incidence of FHB and DON levels in the experiment following soybean were 1% and 0.1 ppm in non-inoculated treatments, 4% and 0.7 ppm in inoculated plots, and 2% and 0.4 ppm overall. The DON contamination exceeded the 2 ppm threshold for sale at flour mills more frequently in the experiment following corn but only in the non-sprayed, inoculated plots. DON concentrations exceeding the threshold occurred in Otsego, Pioneer 25R47, and SW 80 in the environment following corn and in SW 80 in the environment following soybean. Interestingly, while the
disease pressure was greater in the experiment following corn, average yields were lower in the experiment following soybean. This is likely to due to greater weed pressure and deer feeding observed in the wheat plots following soybean.

In general, there were no differences in cultivar response to inoculation between the two environments with the exception of a significantly higher FHB index for Pioneer 25R47 in the corn debris environment. Significant differences in FHB index between the treatments were observed in two, SW 80 and Otsego, of the four cultivars in both environments. FHB index was significantly greater than all other plots in the non-sprayed, inoculated plots of SW 80 following corn and both cultivars following soybean. For Otsego following corn, FHB index in the two non-sprayed plots were significantly higher than in the two Prosaro plots. When compared to the non-sprayed, inoculated plots, either Prosaro application (with and without inoculation) significantly decreased the FHB index. Due to low levels of natural disease, the Prosaro applications did not always significantly decrease the FHB index compared to the non-sprayed, non-inoculated plots. For Pioneer 25R47 and Truman in both environments and Otsego following corn, there was no significant increase in FHB index due to inoculation.

DON contamination was significantly greater than all other plots in the non-sprayed, inoculated plots of SW 80 and Otsego following corn and all three cultivars following soybean. While not statistically significant, plots treated with Prosaro were generally higher yielding. Only Truman had statistically significantly lower levels of DON contamination in the corn debris environment. In the soybean debris environment, SW 80 was the only cultivar that had significantly higher FHB indices and DON concentrations. In summary, SW 80 demonstrated susceptibility in both environments, Pioneer 25R47 demonstrated susceptibility and Otsego demonstrated moderate resistance in the higher disease pressure environment (following corn), and Truman demonstrated moderate resistance in both environments. Although not always statistically significant, the FHB susceptible cultivars had higher yields than the moderately resistant varieties in both environments under the fairly mild disease conditions encountered in 2011.

Acknowledgements
We thank our collaborators at Cornell (R.J. Richtmyer and R.R. Hahn) and in six other states (C.A. Bradley, A.L. Hazelrigg, D.E. Hershman, M. Nagelkirk, L.E. Sweets, and S.N. Wegulo). We acknowledge financial support from Cornell Hatch Project NYC153433 and the U.S. Wheat and Barley Scab Research Initiative of USDA-ARS. Any opinions or recommendations expressed are those of the authors and do not necessarily reflect views of the USDA.
Figure 1. Effects of corn debris management by plowing on FHB parameters in wheat (FHB index at soft dough stage; incidence of infection by *G. zeae* in mature heads; and deoxynivalenol contamination in harvested grain) in experiments in seven states in 2011.
Table 1. Main effect of treatment on grain yield, Fusarium head blight index, and deoxynivalenol contamination at Aurora, NY.

<table>
<thead>
<tr>
<th>Treatment:</th>
<th>Adjusted grain yield (bu/A)</th>
<th>Fusarium head blight index (%)</th>
<th>Contamination of grain by DON (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>After corn</td>
<td>After soybean</td>
<td>Average</td>
</tr>
<tr>
<td>Non-sprayed</td>
<td>71</td>
<td>55</td>
<td>63</td>
</tr>
<tr>
<td>Prosaro</td>
<td>73</td>
<td>60</td>
<td>66</td>
</tr>
<tr>
<td>Non-sprayed, inoculated</td>
<td>68</td>
<td>53</td>
<td>61</td>
</tr>
<tr>
<td>Prosaro, inoculated</td>
<td>72</td>
<td>57</td>
<td>65</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table 2. Main effect of cultivar on grain yield, Fusarium head blight index, and deoxynivalenol contamination at Aurora, NY.

<table>
<thead>
<tr>
<th>Treatment:</th>
<th>Adjusted grain yield (bu/A)</th>
<th>Fusarium head blight index (%)</th>
<th>Contamination of grain by DON (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>After corn</td>
<td>After soybean</td>
<td>Average</td>
</tr>
<tr>
<td>Otsego</td>
<td>69</td>
<td>52</td>
<td>61</td>
</tr>
<tr>
<td>Pioneer 25R47</td>
<td>76</td>
<td>62</td>
<td>69</td>
</tr>
<tr>
<td>SW 80</td>
<td>73</td>
<td>57</td>
<td>65</td>
</tr>
<tr>
<td>Truman</td>
<td>65</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
New Insights on the Epidemiology and Management of Wheat Scab

Gary C. Bergevin
Cornell University
Department of Plant Pathology and Microbiology

Fusarium Head Bight (scab)

Causal fungus is Gibberella zeae (Fusarium graminearum)

Deoxynivalenol = DON = Vomitoxin

What are the predominant sources of spores for FHB?

- Spores from crop debris within a field?
- Spores in the atmosphere originating outside the field? Near or far?
- Adherence of inoculum (spores) is the basis for cultural management

Why do answers to these questions matter?

- Aid in developing or excluding strategies for FHB management in individual fields and over regions (especially related to crop rotational sequence, crop debris management and disease risk prediction)
- Provide clues about pathways for introduction and spread of new variants of G. zeae (virulence and mycotoxin profiles)

Aerobiology studies in the Finger Lakes Region of Central New York
**Former Ph.D. students on the aerobiology & epidemiology of Gibberella zeae project at Cornell**

- John W. Halsey
- David S. Shih
- Gary J. Zill</p>

**Dr. Elson Shields, Pioneer in Aerobiology**

- Image of Dr. Elson Shields
- Image of aerobiology equipment

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**Libration: How far?**

Forcible discharge of ascospores of G. zeae

- Ascospores discharged up to 10 mm (avg. 4-5 mm) in still air
- Large percentage of ascospores may be whirled past surface boundary layer during day/night hours, and become available for horizontal transport
- Small of ascospores unlikely at night

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**Libration: When?**

Hourly ascospore discharge from perithecia on maize stalks, and associated conditions

- Temperature (°C)
- Humidity (%)
- Rainfall (mm)
- Number of ascospores

---

**Horizontal transport: The potential for long-distance transport of G. zeae**

- Image of ascospores in flight
- Image of an aircraft

---

**Horizontal transport: When?**

- All times of day and night at 60 meters (planetary boundary)

---

**Source:**

Horizontal transport: How far?

> 1 km from land

Spore collecting flight over Cayuga Lake

Deposition:
Landing of viable spores of G. zeae in rotational wheat and corn fields

When?

In what magnitude?


Deposition of viable spores of G. zeae in wheat fields

- Majority deposited on plates above wheat canopies at night
- Ascospores predominated among propagules caught above wheat canopy, sometimes macroconidia
- Viable spores deposited in high numbers also during rain events, day or night
- Spatial patterns of spore deposition were predominantly random
- Temporal patterns of spore deposition were unique for each day or night sampling period
- Magnitude of spore deposition was similar over diverse local landscapes (wheat, fallow corn stubble, soybean, alfalfa hay)

Diurnal dynamics in the lower atmosphere

Extensive vertical mixing up to the clouds

Gravitational settling of spores

Shallow turbulent layer near ground

Temporal uncoupling of peak liberation and peak deposition of spores

Implications of aerobiology findings for FHB epidemiology

- Atmospheric inoculum prevalent when cereals flower in eastern U.S.
- Atmospheric populations of G. zeae well mixed and genetically diverse, coming from local and distant sources
- Temporal uncoupling of spore discharge and deposition allows for long distance movement (spores survive hours to days)
- Local management of inoculum, and prediction of inoculum based on local conditions may be insufficient
- Potential for rapid spread/recombination of variant strains of G. zeae is great

From Lloyd and Saxe, 2014.
Mycotoxin genotypes of Fusarium graminearum in wheat in 2007:

- 3-ADON strains produce DON and some 3-ADON
- 15-ADON strains produce DON and some 3-ADON
- 15-ADON strains produce 15-ADON only

NY, PA, KY, VA, NC

Possible relevance of mycotoxin genotypes of Fusarium:

- 3-ADON strains may produce higher total toxin levels in grain and may be more aggressive than 15-ADON strains.
- Nivalenol has greater toxicity per ppm than does deoxynivalenol, and grain in North America is not routinely tested for nivalenol.
- So far, plant varietal resistance to FHB appears to hold against strains of every trichothecene genotype.

Corn residues: Largest regional source of airborne Gibberella zeae ascospores

What are the mycotoxin consequences of having corn residues in your wheat field?

Fifteen corn debris microplot experiments in winter wheat fields in New York (2008-2010)

Contribution of corn residue in microplots to incidence of Gibberella zeae in mature spikes in 15 commercial New York wheat fields

Corn residue resulted in a significantly higher percentage of heads infected in 5 out of 12 fields.
**Contribution of corn residue in microplots to DON contamination in 15 commercial New York wheat fields**

Corn residue resulted in a significantly higher level of DON in 5 out of 15 fields.

**Twenty-one corn debris microplot experiments in winter wheat fields in five states (2009-2010)**

Collaborators: Carl Bradley, David Schrame, Laura Sweets, Stephen Wegulo

Plus nine satellite experiments in Michigan, Vermont, Ontario, and Quebec.

Collaborators: Ann Hao, Martin Nagelekin, Albert Tenuta, Pierre Filion, Sylvie Rieux

**Fusarium Head Blight Index**

Corn residue resulted in significantly more scalp symptoms in 3 out of 21 fields in the USWESI microplot study.

**DON Concentration in Mature Grain**

Corn residue resulted in a significantly higher level of DON in only 8 out of 41 fields with microplots:
1. Michigan
2. New York
3. Ontario

**Commercial-scale wheat after corn strip trials (no-till vs moldboard-plowed) in seven states (2011 & 2012)**

Collaborators: Carl Bradley, Ann Hao, Ann Hao, Martin Nagelekin, Laura Sweets, Stephen Wegulo
Elements of integrated management of Fusarium head blight / DON

- Choose adapted wheat cultivars with moderate resistance to FHB and low potential for DON accumulation (based on multi-year data from a trusted source).
- Plant more than one cultivar and/or more than one species to achieve diversity of flowering dates.

Winter wheat varieties with moderate resistance to FHB

- Truman
- Oseo
- Brenfield
- AWA
- Pioneer 25 WBA
- S&PA

http://www.wheat.catskills.psu.edu/PAPAP/WHA/WHA.html
Elements of integrated management of Fusarium head blight / DON

- Decision to apply a triazole fungicide at early flowering.
- Determination of Fusarium infection risk.
- Risk of ear, stem, and fungal leaf blight.
- Yield potential and grain price.
- Timely access to fungicides and spray equipment.

Triazole fungicides that suppress FHB and lower DON

- **GROUP 3 FUNGICIDE**
  - Triazoles, DMI sterol inhibitors, Disrupt fungal membranes
  - Metconazole (6.6%)
  - Prothioconazole (19%)
  - Teloconazole (10%)

Materials of choice for head emergence to flowering application

Caramba and Prosaro control fungal diseases on flag leaves

... in addition to Fusarium head blight and glume blotch.

Effects of Flowering Stage Application of Fungicides on DON Contamination in Four Wheat Cultivars

- **Maugrae Farm, Aurora NY 2010**

- **Contamination of Grain by DON (ppm)**

- **Environment 1**
  - Power
  - Tumer
  - Jersey
  - Roland

- **Environment 2**
  - Power
  - Tumer
  - Jersey
  - Roland

Effects of Flowering Stage Application of Prosaro Fungicide on DON Contamination of Four Wheat Cultivars

- **Maugrae Farm, Aurora NY 2011**

- **Contamination of Grain by DON (ppm)**

- **Following year**
  - Power
  - Tumer
  - Jersey
  - Roland

- **Following year**
  - Power
  - Tumer
  - Jersey
  - Roland
Effects of Flowering Stage Application of Procon Fungicide on Yield of Four Wheat Cultivars, Murrain Farm, Ascona NY 2011

- Assume Fusarium head blight during grain development.
- Percentage of heads with symptoms atthesis stage.
- Rainfall may be needed even after heads have been formed.
- Determine need for a pre-harvest inoculum (DON) test.

Harvest management

- Timely harvest at acceptable moisture level
- Combine adjustment (high fan)
- Arrangements for grain drying and custom cleaning

Marketing of DON – contaminated wheat

- Usually rejected for four above 2 parts per million, especially if bran cereal market
- Usual rejection at set food mills
- May be rejected at ethanol plants
- Beef cattle are tolerant; dairy cows and poultry are tolerant of moderate levels

Thank you for your attention!
A new high-quality alfalfa variety, N-R-GEE, was selected by Cornell’s forage breeding project for increased neutral detergent soluble fiber (NDSF) concentration in order to improve forage quality. NDSF consists mostly of pectin, a cell wall polysaccharide that serves as “cellular glue”. Pectin has the same rapid and extensive degradation characteristics of nonstructural carbohydrates, thus providing a rapid energy source for animals, but without the propensity to lower rumen pH or cause lactic acidosis. N-R-GEE has proven to be agronomically competitive and has shown good yields. During spring 2011, N-R-GEE was compared to a standard industry check (not high forage quality), Vernal, in a lamb feeding trial. Hay samples were analyzed and found to differ, as expected, in ADF and NDF (N-R-GEE lower), non-fiber carbohydrates, which includes pectin and other energy sources for the animal (N-R-GEE higher), and relative feed value (N-R-GEE higher). More detailed results from the feeding study will be presented.

Another new alfalfa variety developed at Cornell, Ezra, is a fall dormancy 3 type alfalfa with good yield potential in New York and Pennsylvania. Ezra traces part of its pedigree back to Seedway 9558. Data on the performance of Ezra in New York trials will be shared.

Several new winter and spring grain varieties have been bred or selected by Cornell’s small grains breeding project. These include new soft white winter wheats Medina, Saranac, and Hopkins. All three show good yield potential and test weight, good lodging resistance, and resistance to both wheat spindle streak and wheat soilborne mosaic viruses. Medina has very good pre-harvest sprouting resistance. Otsego, a new soft red winter wheat variety bred in Ohio, has been a top yielder in New York over the past four years. It has good test weight, scab tolerance, lodging resistance, and resistance to wheat soilborne mosaic virus. A new oat variety, Corral, was selected based on evaluations conducted in New York. It was bred in Illinois, but shows excellent yield and test weight, along with very good lodging resistance in our environments. Additional details of the performance of these new small grains varieties will be presented.
USING THE ADAPT-N TOOL FOR PRECISE NITROGEN MANAGEMENT ON CORN
H.M. van Es, J.J. Melkonian, B.N. Moebius-Clune, A.T. DeGaetano and L. Joseph
Department of Crop and Soil Sciences

Abstract

Losses of nitrogen may occur from complex interactions among weather, soil hydrology, crop water and N uptake, and management practices, and result in high variability in annual crop N needs in corn production. Weather impacts the soil N pool early in the growing season and contributes to the well-documented variability in economic optimum in-season N rates for corn. Increased climate extremes will make the need for adaptive N management even more compelling. Higher precision in N management for corn in humid regions may be achieved through in-season N applications that are based on information on early-season N dynamics. We developed the Web-based Adapt-N tool, which is based on the Precision Nitrogen Management model and high resolution climate data. It simulates soil N transformations and soil N/water transport and corn N uptake in near-real time using soil and management information, and generates recommendations that allow for greatly increased precision of N management.

Introduction

In a recent policy report, Ribaudo et al. (2011) emphasized the significant role of corn in the nitrogen problem: “Corn is the most widely planted crop in the United States and the most intensive user of nitrogen. In 2006, corn accounted for an estimated 65 percent of the total quantity of nitrogen applied to major U.S. field crops. Corn also accounted for half of all nitrogen-treated crop acres that were not meeting the rate, timing, or method of application criteria used in this analysis to define acceptable nitrogen management […]]. In addition, recent demand pressures due to the biofuels mandate, as well as increasing international demand for feed grains, suggests that corn acreage and the intensity of corn production are likely to increase. Together, these factors increase the importance of raising the nutrient use efficiency in corn production in the United States, especially on farms that raise livestock and apply manure to their fields.” Improved N use efficiency from cropping systems has become a compelling issue with increased N fertilizer prices and concerns about environmental impacts. Excessive nitrate levels in groundwater and N-induced hypoxia in estuarine areas from agricultural sources (McIsaac et al., 2002) are persistent concerns, as well as the high energy consumption for N fertilizer manufacturing and greenhouse gas impacts from soil N2O losses (Smith and Conen, 2004).

Precise estimation of the optimum N fertilizer rates is critical to reducing N leaching losses. Studies by van Es et al. (2002) reported rapid increases in nitrate leaching with N rates above the “optimum” and highlighted the importance of precise estimation of seasonal fertilizer N needs. Similar concerns with N management have also been raised in the context of greenhouse gas emissions. Hoben et al. (2010) determined that nitrous oxide (N2O) losses increased exponentially when crops are fertilized beyond crop uptake needs. The global warming impact of this is very significant and for corn this
accounts for a disproportionate contribution to total agricultural greenhouse gas emissions (Ribau et al., 2011).

**Estimating Optimum N Rates**

Historically, the mass-balance approach has been the most widely-used method for making N fertilizer recommendations (Stanford, 1973). It is generally based on a yield goal and associated N uptake, minus credits given for non-fertilizer N sources such as mineralized N from soil organic matter (SOM), preceding crops, and organic amendments. Several studies have documented, however, that the relationship between yield and economic optimum N rate is very weak or non-existent for humid regions (Lory and Scharf, 2003).

Another approach is the use of soil tests to estimate crop N needs. Magdoff et al., (1984) developed the pre-sidedress nitrate test (PSNT), which can be used to estimate crop N availability and allows for adjustment of in-season N applications. It is generally recognized as being successful in identifying N-sufficient sites and in some cases for making N fertilizer rate recommendations when soil nitrate levels are low. Concerns are the extensive sampling requirement during a short time window, and its sensitivity to early-spring weather conditions.

Recent advances in remote and proximal crop sensing are applied for estimation of crop N status during the growing season. Multi-band aerial or in-field sensing (Sripada et al., 2006) are used for assessing leaf or canopy N status, typically for the purpose of mid-season N applications. Effective use of the method is best obtained for late applications during the V10 to R1 stages of corn development, which implies the use of high-clearance fertilizer application equipment or overhead fertigation, although earlier sensing may provide guidance on yes/no decisions for supplemental fertigation. The methodology generally requires a reference strip that has received high levels of N fertilization. A concern is that some yield potential may already be lost by the time the N stress can be effectively measured, and current research has shown limited success thus far with the use of this technology.

**Annual Variability**

Corn generally shows high variability in N response, and economically optimal N rates (EONR) may range from zero to 250 kg N ha⁻¹ (Scharf et al., 2006). The need for precise management of N fertilizer is compelling, but the ability to estimate the true optimum N rate has remained elusive. Multiple N sources may contribute to corn N uptake. Mineralization of SOM can supply a significant fraction, with a typical value of 100 lbs/ac for Midwestern soils (Cassman et al., 2002), and lower estimated values (average of about 70 lbs/ac) for soils in the eastern USA (Ketterings et al., 2003). The difference between the crop requirement and the soil supply is ideally provided by fertilizer. But the precise estimation of this differential and the associated fertilizer use efficiency remains a challenge due to numerous sources of variability. Improving the current in-season N recommendations for corn is critical to the credibility of fertility recommendation systems. Increased N use efficiency is expected to reduce unused N that becomes either stored in SOM or lost to other parts of the environment during the fall-winter-early spring period (van Es et al., 2002).

Current in-season N recommendations for corn production in most states are static and do not take into account the dynamic behavior of soil N. Although mid- and late-season weather may still affect corn yields, early-season events appear to be the strongest determinant for N availability
This is a critical period for N losses and seasonal N availability. If excessive rainfall occurs during this time, significant N losses may occur from leaching or denitrification (with warm soil). Losses are also affected by the accumulation of heat units over the first months of a growing season, which interact with the occurrence of precipitation events, as well as management factors like date-of-planting, early fertilization, manure application, tillage, rotation, etc. The end result is that the supplemental N fertilizer rate varies greatly depending on management as well as water and temperature conditions during the early season.

When corn N fertilizer recommendations are based on average crop response, this will generally result in excessive fertilization in years with dry springs, and inadequate fertilization in years with wet springs and high early season N losses. An analogous process occurs when organic N inputs are applied, as is often the case with livestock farms. Organic N (manure, etc.) is commonly applied based on expected N release and maize N uptake during the following season (Figure 1b). This results in even higher N accumulations in the late spring and a greater potential for loss from excessive soil wetness. Livestock farmers then often face the challenge to decide on applying expensive supplemental sidedress N.

Adapt-N Tool

More precise management of N in corn production in humid regions requires the explicit consideration of several interacting factors, including weather, into the recommendation system. Early-spring N applications cannot be precise, even with slow-release or nitrification-inhibition technology, and early season soil testing can only achieve limited accuracy. Also, tools like lower-stalk nitrate tests are only useful as after-the-fact evaluations of crop N sufficiency and have limited use for predictive purposes.

We have developed the Web-based Adapt-N tool (http://adapt-n.cals.cornell.edu, Figure 1) to provide improved in-season N recommendations based on simulation of soil N dynamics and maize N uptake. In 2010, the tool was available for fields in the Northeast USA and Iowa, and will be available for the entire eastern USA by the 2012 growing season. It is based on the Precision Nitrogen Management (PNM) model (Melkonian et al., 2007) and input of high-resolution climate data. Figure 2 shows a schema for the model implementation infrastructure. The Adapt-N tool was developed based on field work and modeling efforts over 20 years.

In order to effectively simulate N processes, the Adapt-N tool requires user information on relevant soil and crop input data, including soil textural class (fine, medium, coarse), drainage class, slope, tillage practices, organic matter content, timing and amounts of previous N inputs (fertilizer, manure, sod, compost, etc.), crop maturity class, crop density, and tillage and planting dates (http://adapt-n.cals.cornell.edu; Fig. 1). This also allows for site-specific management by performing simulations for areas with different soil organic matter contents and drainage and textural classes in a field (Graham et al., 2011).

High Resolution Climate Data

The Adapt-N tool automatically accesses the most up-to-date high-resolution climate data as...
input information by asking the user to provide latitude and longitude information for the fields 
under consideration. The availability of such high-resolution data is essential to the successful 
adoption of adaptive N management strategies, because spatial patterns of precipitation 
(epecially) and temperature during growing seasons are highly variable at short distances. The 
Northeast Regional Climate Center (NRCC) has developed methods to produce and distribute 
high resolution (4 x 4 km gridded) temperature and precipitation data for the Northeast. These 
data are updated daily on advanced database servers and can be automatically accessed by the 
Adapt-N tool (Figure 2). The high resolution temperature data are being derived from processing 
routines using the National Oceanic & Atmospheric Administration's (NOAA) Rapid Update 
Cycle (RUC) weather forecast model and data obtained from ACIS (Belcher and DeGaetano, 
2005). The high resolution precipitation data are being developed from data obtained from 
NOAA's operational Doppler radars and data obtained from ACIS (Wilks, 2008).

Adapt-N Outputs

The Adapt-N tool provides a multitude of outputs that provide specific N management 
recommendations, as well as additional simulation results that offer insights into various 
process components that affect N dynamics. The results page (Fig. 2b) shows an N rate 
recommendation (in case of a deficit) or an estimate of excess N in the soil crop system, as well 
as the components of the N budget from which they are derived. In addition, profile water 
availability is provided. The report function (Fig. 2b) generates a statement that includes 
input information, recommendations, and graphical simulation results in pdf format, which is 
useful for record keeping. Graphs that are generated include the following: 1. cumulative N 
mineralization, 2. cumulative N uptake by the crop, 3. cumulative total N losses (gaseous and 
leaching) from the root zone (Fig. 4), 4. cumulative N leaching losses from the root zone (Fig. 
4), 5. nitrate N in the root zone (real time LSNT), 6. inorganic N in the root zone, 7. growing 
season daily and cumulative rainfall, 8. post-emergence growing degree days, 9. corn 
vegetative stage, and 10. growing season daily average temperature. These graphical results 
allow users to gain additional insights into N dynamics for the growing season at any time.
New features for the Adapt-N tool in 2012 include automated email or texting alerts, and 
incorporation of irrigation and cover crop inputs.

Conclusion

The optimum N rate for any field is not a fixed quantity, but varies as a result of several 
interacting factors. The most significant among those are early-season weather (precipitation 
and temperature), N mineralization from organic sources, and crop development. Most 
currently-used N fertilizer recommendation systems ignore these dynamic processes, and are 
therefore inherently limited in achieving precision. We promote an adaptive N management 
approach that incorporates the complex interactive processes that affect soil mineral N 
availability. The Adapt-N tool uses process-based dynamic simulation of soil-crop processes and 
inputs of high-resolution climate data towards this goal and allows for the incorporation of 
multiple interacting processes.
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References


Figure 1. Web user interface for the Adapt-N tool: One of the input tabs (a) and the results tab (b).
Figure 2. *Adapt-N* model infrastructure for use of near-real-time N recommendations.
Figure 3. Example graphical results from Adapt-N tool.
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