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# Hindsight is 20/20: What Can Be Learned from 2015

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**Abstract**
As the saying goes, hindsight is 20/20; perfect vision. We often say "if we knew the weather, then we can provide the best recommendations". Usually, we do not know the weather or we do not have the appropriate tools in place, so the questions remain unanswered. Now that we know the weather, the next important question is to determine what could have been done differently in 2015. This is an important part of understanding and evaluating production and environmental performance of our crop management decisions. In this article, we leverage our knowledge of the 2015 weather and use the APSIM cropping system model as a framework to explore alternative management options to the cropping systems used in the Yield Forecast project in an effort to understand what could have helped improve corn and soybean yields more in 2015.

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# Hindsight is 20/20: What Can Be Learned from 2015

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As the saying goes, hindsight is 20/20; perfect vision. We often say "if we knew the weather, then we can provide the best recommendations". Usually, we do not know the weather or we do not have the appropriate tools in place, so the questions remain unanswered. Now that we know the weather, the next important question is to determine what could have been done differently in 2015. This is an important part of understanding and evaluating production and environmental performance of our crop management decisions. In this article, we leverage our knowledge of the 2015 weather and use the APSIM cropping system model as a framework to explore alternative management options to the cropping systems used in the Yield Forecast project in an effort to understand what could have helped improve corn and soybean yields more in 2015.

For the scenario analysis we used the eight cropping systems from the Yield Forecast Project (see table descriptions below for the default management practices) and the

APSIM model to evaluate the impact of changing the nitrogen rate, timing of nitrogen application, seeding rate, row spacing, crop maturity, and water supply through irrigation. By running the cropping system model with adjustments to crop management it can be determined if and how much grain yield, nitrogen loss, and net return could have been improved in 2015. This scenario analysis also shows the trade-offs that exist between profitability and environmental performance and provides an opportunity to identify those practices that could provide a win-win situation by reducing nitrogen losses to the environment and increasing net profits.

In the Ames corn cropping systems (Table 1), nitrogen losses were reduced by either applying nitrogen later in season (4 to 8 weeks after planting) or reducing nitrogen applications (scenarios 3, 6, and 7). However, reduced nitrogen application rates also resulted in a detrimental impact to both yield and net profits for both early and late planting dates. Changes to seeding rate and row spacing had little effect on yield, nitrogen loss, or net return. Increasing maturity increased both yield and net profits while having minimal reductions of nitrogen loss when no additional nitrogen was applied. The response to alternative management was different between early and late planting. This reveals the complexity that exists in the soil-crop-atmosphere system and that every field by management practice should be treated as a unique system. Among the scenarios evaluated, scenarios 2, 11, and 14 resulted in win-win situations (more profits with less environmental damage) for both early and late planting corn. These scenarios shifted the nitrogen application later, shifted from 30-inch to 20-inch row spacing, or used a longer maturity corn hybrid.

Table 1. Scenario analysis of Yield Forecast Project at Ames for corn early (April 23, 2015) and late (May 21, 2015) planting cropping systems. The impact of the scenarios is expressed as a percent difference from the default management practices used in 2015: 150 lb N / acre at planting; 107-day CRM; 32,000 seeds/acre; 30-inch row spacing. Click table for larger view.

| Ames – Corn | | Early Planted (April 23) | | | Late Planted (May 21) | | |
|---|---|---|---|---|---|---|---|
| Scenario Description | | Yield | N Loss | Net Return | Yield | N Loss | Net Return |
| 1 | Split 150 lbs N/acre at planting and 6th leaf stage | 0.4% | -17.3% | -1.8% | 0.0% | -19.8% | -2.3% |
| 2 | Applied 150 lbs N/acre 4 weeks after planting | 0.5% | -20.2% | 0.7% | 0.0% | -39.3% | 0.0% |
| 3 | Applied 150 lbs N/acre 8 weeks after planting | 0.8% | -69.8% | 1.0% | -6.7% | -30.3% | -8.7% |
| 4 | Applied additional 50 lbs N/acre at 6th leaf stage | 0.9% | 39.8% | -2.4% | 0.1% | 48.7% | -5.9% |
| 5 | Applied 100 lbs N/acre at planting | -11.1% | -29.4% | -10.8% | -3.4% | -23.4% | -0.8% |
| 6 | Applied 100 lbs N/acre 4 weeks after planting | -10.3% | -42.5% | -9.8% | -1.4% | -56.4% | 1.8% |
| 7 | Applied 100 lbs N/acre 8 weeks after planting | -8.4% | -76.4% | -7.3% | -7.2% | -66.9% | -5.7% |
| 8 | Increased seeding rate 15% | 0.0% | -6.9% | -2.8% | 1.2% | -4.6% | -1.4% |
| 9 | Increased seeding rate 15% and 15% more N | 1.6% | 7.6% | -2.4% | 1.2% | 15.0% | -3.0% |
| 10 | Decreased seeding rate 10% | -0.5% | 4.5% | -0.4% | -1.3% | 4.2% | -1.4% |
| 11 | Switched to 20-inch rows from 30-inch rows | 1.1% | -5.2% | 1.4% | 2.9% | -6.2% | 3.7% |
| 12 | 20-inch rows and 10% higher seeding rate and 15% more N | 3.3% | 4.9% | 0.7% | 0.0% | 24.9% | -3.5% |
| 13 | Shorter maturity (from 2500 to 2350 GDD) | -5.2% | -0.5% | -6.8% | -5.4% | 12.5% | -7.1% |
| 14 | Longer maturity (from 2500 to 2800 GDD) | 9.7% | -0.6% | 12.6% | 9.2% | -0.3% | 12.1% |
| 15 | Longer maturity with 15% more N | 13.5% | 15.0% | 16.0% | 9.3% | 22.1% | 10.5% |

In the Sutherland corn cropping systems (Table 2), the trends were the same for scenario impacts on both the early planted and late planted systems. Applying two third less nitrogen had minimal impacts on yield but reduced nitrogen losses and increased net profits. This is because at Sutherland the initial soil nitrate at planting time was exceptionally high (20 ppm $NO_3$-N at 1 feet). In contrast, at the Ames site, the soil nitrate at planting time was around 5 ppm $NO_3$-N. Reducing row spacing to 20-inches increased yields and net profits will reducing nitrogen losses. Irrigation had positive effects on yields and net profits but also increased nitrogen losses. And planting a longer maturity without additional nitrogen balanced yield and net return while not changing nitrogen losses.

Table 2. Scenario analysis of Yield Forecast Project at Sutherland for corn early (April 29, 2015) and late (May 19, 2015) planting cropping systems. The impact of the scenarios is expressed as a percent difference from the default management practices used in 2015: 200 lb N / acre on April 29, 2015; 107-day CRM; 32,000 seeds/acre; 30-inch row spacing. Click table for larger view.

| Sutherland – Corn | Early Planted (April 29) | | | Late Planted (May 19) | | |
|---|---|---|---|---|---|---|
| Scenario Description | Yield | N Loss | Net Return | Yield | N Loss | Net Return |
| 1 Split 200 lbs N/acre at planting and 6th leaf stage | 0.0% | -11.2% | -2.9% | 0.0% | -7.2% | -2.9% |
| 2 Applied 1/3 of nitrogen rate | -0.3% | -44.7% | 11.7% | 0.1% | -57.0% | 12.5% |
| 3 Increased seeding rate 15% | 1.0% | -5.6% | -2.2% | 1.1% | -9.3% | -2.2% |
| 4 Decreased seeding rate 10% | -1.2% | 5.0% | 0.7% | -0.1% | 16.5% | 2.4% |
| 5 Switched to 20-inch rows from 30-in rows | 2.0% | -5.5% | 2.9% | 1.4% | -8.0% | 2.0% |
| 6 Switched to 20-inch rows and increased seeding rate 10% | 3.0% | -8.9% | 1.8% | 3.1% | -3.7% | 2.0% |
| 7 1-inch irrigation at 6th leaf stage | 2.6% | 21.1% | 1.8% | 2.2% | 19.8% | 1.3% |
| 8 1-inch irrigation at 14th leaf stage | 1.6% | 11.6% | 0.5% | 2.1% | 23.5% | 1.2% |
| 9 1-inch irrigation at both 6th leaf stage and silking | 2.6% | 34.3% | 1.4% | 2.2% | 34.1% | 0.8% |
| 10 Shorter maturity (from 2500 to 2350 GDD) | -4.5% | -1.7% | -6.4% | -6.8% | 1.0% | -9.7% |
| 11 Longer maturity (from 2500 to 2800 GDD) | 2.5% | -0.7% | 3.6% | 1.7% | -0.1% | 2.5% |
| 12 Longer maturity and 1-inch irrigation at 6th leaf stage | 5.9% | 19.7% | 6.6% | 7.8% | 26.2% | 9.3% |

In the Ames soybean cropping systems (Table 3), the largest benefits came from reducing the row spacing from 30-inch rows to 15-inch rows (scenarios 5 and 6) and planting a later maturity in combination of a higher seeding rate and narrower row spacing (scenario 9). However, planting a shorter maturity soybean resulted not only in reduction in yield and net return but also increased nitrogen loss, especially for the late planting date. It is worth mentioning that the combination of late planting soybean and longer maturity substantially increased the risk of fall frost and delayed harvest. In 2015 this was not a problem, but in other years this could be a problem.

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early (May 1, 2015) and late (June 1, 2015) planting cropping systems. The impact of the scenarios is expressed as a percent difference from the default management practices used in 2015: MG 2.6; 133,000 seeds/acre; 30-inch row spacing. Click table for larger view.

| Ames – Soybean | Early Planted (May 1) | | | Late Planted (June 1) | | |
|---|---|---|---|---|---|---|
| Scenario Description | Yield | N Loss | Net Return | Yield | N Loss | Net Return |
| 1 Increase seeding rate 15% | 2.2% | -3.7% | 0.9% | 2.1% | -1.9% | 0.9% |
| 2 Increase seeding rate 30% | 4.0% | -6.8% | 1.4% | 3.8% | -3.5% | 1.3% |
| 3 Decrease seeding rate 15% | -2.5% | 3.1% | -1.2% | -2.5% | 1.8% | -1.3% |
| 4 Switched to 20-inch rows from 30-inch rows | 3.1% | -5.1% | 3.4% | 4.0% | -2.9% | 4.4% |
| 5 Switched to 15-inch rows from 30-inch rows | 6.7% | -9.5% | 7.4% | 5.7% | -4.3% | 6.2% |
| 6 Switched to 15-inch rows and 30% higher seeding rate | 10.1% | -16.3% | 8.1% | 8.9% | -8.2% | 6.8% |
| 7 Shorter maturity (matured 1 week earlier) | -4.5% | 0.5% | -4.9% | -3.5% | 7.0% | -3.9% |
| 8 Longer maturity (matured 3 weeks later) | 2.6% | -0.7% | 2.8% | 2.7% | 5.3% | 3.0% |
| 9 Longer maturity and 15% higher seeding rate in 15-inch rows | 10.9% | -13.7% | 10.5% | 10.0% | -0.8% | 9.5% |

In the Sutherland soybean cropping systems (Table 4), results were very similar to that of the Ames soybean cropping systems. Soybean yield, net returns and nitrogen loss benefits were realized by reducing row spacing to both 15-inch and 20-inch row spacing (scenarios 4, 5 and 6) and by increasing soybean maturity in combination with increasing seeding rate and decreasing row spacing (scenario 9). Coincidentally, at Sutherland where rainfall was limited during a portion of the growing season (July), irrigation had only slight yield benefits but increased nitrogen loss (scenarios 10, 11, and 12).

Table 4. Scenario analysis of Yield Forecast Project at Sutherland for soybean early (April 30, 2015) and late (June 1, 2015) planting cropping systems. The impact of the scenarios is expressed as a percent difference from the default management practices used in 2015:  MG 2.2; 133,000 seeds/acre; 30-inch row spacing. Click table for larger view.

| Sutherland – Soybean | Early Planted (April 30) | | | Late Planted (June 1) | | |
|---|---|---|---|---|---|---|
| Scenario Description | Yield | N Loss | Net Return | Yield | N Loss | Net Return |
| 1 Increase seeding rate 15% | 2.5% | -2.9% | 1.3% | 2.3% | -10.7% | 0.3% |
| 2 Increase seeding rate 30% | 4.5% | -4.8% | 2.1% | 4.1% | -19.7% | 0.0% |
| 3 Decrease seeding rate 15% | -2.9% | 4.3% | -1.7% | -2.5% | 13.0% | -0.5% |
| 4 Switched to 20-inch rows from 30-inch rows | 10.0% | -9.3% | 11.0% | 11.1% | -44.4% | 12.9% |
| 5 Switched to 15-inch rows from 30-inch rows | 14.3% | -11.4% | 15.7% | 14.1% | -56.0% | 16.4% |
| 6 Switched to 15-inch rows and 30% higher seeding rate | 16.8% | -11.9% | 15.5% | 15.4% | -64.1% | 13.1% |
| 7 Shorter maturity (matured 1 week earlier) | -2.3% | 4.3% | -2.5% | -0.2% | -0.5% | -0.2% |
| 8 Longer maturity (matured 3 weeks later) | 1.6% | 2.9% | 1.7% | -0.7% | 0.8% | -0.8% |
| 9 Longer maturity and 15% higher seeding rate in 15-inch rows | 16.2% | -9.8% | 16.3% | 14.5% | -59.5% | 14.3% |
| 10 Single 1-inch irrigation on June 25 | 0.5% | 22.2% | -1.2% | 0.0% | 30.3% | -1.9% |
| 11 Single 1-inch irrigation on July 20 | 0.7% | 15.2% | -1.0% | 0.1% | 46.4% | -1.8% |
| 12 Single 1-inch irrigation on August 10 | 0.0% | 5.8% | -1.7% | 0.0% | 25.3% | -2.0% |

In summary, combined net benefits for yield, nitrogen loss, and net return in the corn cropping systems were realized from adjusting either the timing or rate of nitrogen application and by planting a slightly longer corn maturity. In the soybean cropping systems, the largest combined benefits resulted from narrower row spacing and fuller season soybean varieties.

This type of analysis offers unique opportunities to understand how the system responds to “what-if” management questions and provides the means to evaluate concurrently production and environmental performance of cropping systems. However, it should be noted that this analysis is specific for weather and management practices used in 2015.

Future management decisions should be made using pre-season decision support tools that include weather components that can factor in additional variability to ensure robust decision can be made.

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