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KEYS TO PROFITABLE CORN PRODUCTION IN 2004

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Not all farmers are out to set a yield record, but most are trying to get the best yields possible with their management systems. Lots of factors affect the ultimate yield of corn, but the main question always seems to be, “What key factors most affect crop yield in the field?”

Agronomists and farmers have many key management practices they consider to be important. Everybody’s list is different and often practices ranked differently in importance. Some management practices impact potential yield more than other management practices. A combination of weather, climate, soils and agronomic management of inputs constitutes the environment and potential yield of a plant. Ultimately the plant produces yield by integrating its genetic potential with its environmental constraints.

Achieving high yields requires managing unusually high levels of inputs. Additional yield may not be worth additional cost, since extra inputs bring diminishing returns. For example, when considering soil fertility and addition of plant nutrients, maximum profits usually occur somewhere between 80 and 90 percent of maximum yield potential for a field.

Management inputs and decisions have consequences that act directly on yield and combine with other factors to affect yield in more subtle and less understood ways. The objective of this paper is to review key management factors and assess their direct impact on corn yield and profitability.

Relative Impact of Management Decisions on Grain Yield in Wisconsin

- **Hybrid**: Top to bottom ranking = 0 to 30% change
  - Presence or absence of genetic traits = 0 to 100% change
- **Date of Planting**: May 1 to June 1 = 0 to 30% change
  - Also need to add moisture penalty
- **Plant Density**: 32,000 to 15,000 plants/A = 0 to 22% change
- **Row Spacing**: 30-inches to 15-inches = 0 to 5% change
- **Rotation**: Continuous v. Rotation = 5 to 30% change
- **Soil Fertility**: 160 v. 0 lb N/A = 20 to 50% change
- **Pest Control**: Good v. Bad = 0 to 100% change
  - Cultivation: Yes v. No = 0 to 10% change
- **Harvest Timing**: Oct. 15 to Dec. 1 = 0 to 20% change

Production costs

The first step in profitable corn production is getting a handle on input costs so that the impact from management changes on grower return can be determined. Table 1 shows costs and returns for growers in the Top 20% and Bottom 20% of the UW Agronomy Department PEPS contest.
Acre costs are similar between the Top and Bottom groups ranging from $11-$19 per acre difference, but yield varies considerably resulting in diverse grower returns. Thus, both groups have similar costs, but differences in weather and the management of when and how inputs are applied have significant impact on grower return.

Table 1. Differences between Top 20% and Bottom 20% profit groups in PEPS (1987-2002)

<table>
<thead>
<tr>
<th>Cash Corn</th>
<th>Livestock Corn</th>
<th>Soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 20%</td>
<td>Bottom 20%</td>
<td>Top 20%</td>
</tr>
<tr>
<td>Grain yield (bu/A)</td>
<td>187</td>
<td>148</td>
</tr>
<tr>
<td>Grain moisture (%)</td>
<td>20.1</td>
<td>22.7</td>
</tr>
<tr>
<td>Acre cost ($/A)</td>
<td>$266</td>
<td>$285</td>
</tr>
<tr>
<td>Bushel cost ($/bu)</td>
<td>$1.44</td>
<td>$1.99</td>
</tr>
<tr>
<td>Grower return ($/A)</td>
<td>$149</td>
<td>$40</td>
</tr>
</tbody>
</table>

Set realistic yield goals

A number of sources of information can be used to set realistic yield goals for a farm. Historical records for the farm and USDA county yields are places to start. Many farms have access to field yield maps over numerous years. Often insight and opportunities may be gleaned from these maps. One way to get the upper potential for a county is to review data from yield contests such as PEPS and the National Corn Growers Association yield contest (Figure 1). These contests provide an upper limit as to what could be reasonably produced. Regardless, each field will have a different yield potential. The art of farming is applying and integrating the scientific agronomic knowledge needed to maximize performance of the crop grown in a field.
Hybrid selection

In most hybrid trials, a 30 percent difference in yield between the best- and worst-performing hybrids is typically observed. In the University of Wisconsin hybrid trial program we have seen on average a difference of 63 bushels per acre between the top and bottom hybrids since 1973. In addition the presence of or lack of a key genetic trait, such as gray leaf spot tolerance can mean the difference between reasonable yields and virtually no yield in some years.

The approach to how a farmer selects hybrids often means the difference between profit and loss (Figure 2). For example, a farmer conducting his own on-farm trial has a 71% chance the following year to beat the trial average for a group of hybrids. A farmer who selects hybrids using multi-location averages from 1- or 2-years of data has an 82-86% chance of beating the trial average. Farmers who are “sold” random hybrids or who pick average hybrids only have a 50:50 chance of beating the trial average the next year. Not only does the approach matter for predicting next year’s performance, but also impacts how long a farmer should continue to plant a hybrid.

![Figure 2. Hybrid Selection Strategies Using WI Hybrid Trial Results 1973-1998 (L=Location, Z=Zone)](image)

Plant arrangement in the field

Planting on May 1 versus June 1 can result in an average 30 percent swing in yield (Lauer et al., 1999). All growers must wrestle with when to begin planting. Corn planted early faces cool, damp soils that invite disease, but late planting raises chances that drought will stress the plant during the critical pollination period, in addition to the risk that the plant will not be mature when the first fall killing frost occurs and the additional drying costs imposed. A longer-season hybrid generally takes advantage of a longer growing season to produce higher yield. High nighttime temperatures can hamper grain fill. Shifting the planting date earlier sometimes can reduce this stress. Historical climate records and modeling are tools for making planting date and maturity decisions.
Row spacing narrower than 30-inches can result in a 3-5 percent yield increase (Widdicombe and Thelen, 2002).

Plant populations of 32,000 plants per acre may have 22 percent more grain than at 15,000 plants per acre. The recommended optimal plant population at harvest is about 30,000 plants per acre for the average field, although this is a moving target. Newer hybrids seem to perform well as populations continue to edge higher.

Figure 4. Corn response to plant density in Wisconsin during 2002.
Crop rotation

On average corn when rotated with soybean have 16-19% greater yield than continuous corn (Porter et al., 1997). Depending upon year, continuous corn may yield anywhere from 5 percent to 30 percent less per acre than corn following soybeans (Figure 4). In stressful years, the advantage for rotated corn is greater. In good years, differences between continuous and rotated corn are minimal.

![Figure 5. Relationship between Rotated Corn Yield and Continuous Corn Yield Environments.](image)

Soil fertility

You can’t ignore soil fertility. Managing nutrients — nitrogen, phosphorus and potassium — makes a tremendous difference in ultimate yield. Yield swings of 20 to 50% are observed when applying either 0 or 160 lbs N/A.

Control pests

Once the corn is in the ground, consider the in-season challenges. Failure to control weeds, pests and diseases can lead to loss of nearly 100 percent of yield. Many times applying an herbicide or pesticide makes all the difference. Be diligent and scout fields for potential stresses. Insects such as corn rootworm and corn borers can flare up in specific years in specific locations and devastate a corn crop. Transgenic resistance and hybrid tolerance can help limit the impact of many insects and diseases on yield.

Harvest carefully

It does very little good to grow a bumper crop if you can’t get it in the bin. Harvest timing and combine settings are critical. Typically a 20 percent swing in yield based on harvest timing can occur. The difference between an Oct. 15 harvest and a Dec. 1 harvest can be incredible. The longer the crop is in the field, the more likely you’ll lose yield. You lose ears and you lose grain off of ears.
The above discussion might suggest it takes near-perfect management to get close to maximum yields. In truth, seldom do all these factors work significantly against you in a single season. Still, some factors will combine in any year to chip away at yield potential. That's how the promise of high yields turns into lower than expected yields. The real message is high yields are the result of a combination of weather and management factors growers must manage for each year. Many fields are capable of achieving high yields. Our objective is to understand how to consistently achieve profitable yields on these fields.

**Literature Cited**

