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## What Determines Corn Yield?

### Seven Wonders: A Ranking of Top Factors

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#### Defining a wonder or factor

Some practices are clearly important, but I don't consider them as yield wonders because they are either one-time improvements (tile drainage), they protect rather than increase yield (weed or pest control) or they involve decisions that don't need to be made every year (soil pH and nutrient levels). In my mind, good weed control, along with proper soil pH and adequate levels of phosphorus and potassium, are prerequisites for crop production. They're necessary to allow the seven wonders to express their positive impact on grain yield.

Each factor can either magnify or lessen a wonder's impact on yield. As a rough rule, **the higher the ranking of a particular wonder, the more control it can exert over the wonders below it.** Understanding a wonder's ranking, and its interaction with other wonders, gives farmers an opportunity to further increase grain yields through crop management. Because the bushel-values are averages of ranges, farmers could experience different values in their geographical locations.



**1. Weather *Weather trumps all*** Unfortunately, the first wonder of the corn yield world is the one over which farmers have the least control: the weather. Whether in the form of rainfall or temperature, weather is a major determinant of when the crop can be planted. And weather has a huge impact on grain yield. Even with the other yield wonders optimized and constant, our research shows a 70-plus bushel variation in grain yield due to weather. Weather reacts strongly with other yield wonders, and all farmers realize weather can circumvent their best management plans.

**2. Nitrogen (N) Fertilization** Weather especially affects nitrogen (N) fertilization. The ability to apply N, its availability or susceptibility to loss and its impact on grain yield are all heavily impacted by weather. Because N fertilizer increases grain yield by an average of 70 bushels, and since most of the other yield wonders also can impact the availability or the use of N, nitrogen fertilizer management continues to receive considerable attention in the research world.

**3. Hybrid Selection *The seeds of potential*** Nitrogen use also interacts strongly with the third wonder of the corn yield world, hybrid selection. There's considerable interest in improving the efficiency of N use with genetics or biotechnology. Hybrid selection is probably the most important decision farmers make. Most don't realize the large difference in yield potential among elite commercial hybrids. Arrays of commercial hybrids, grown under conditions where the other wonders are presumed to be optimized, typically exhibit a 50-bushel range in grain yield. Hybrid selection will become even more important in the future, when biotechnology adds stress and input traits like drought tolerance and improved N use.

**4. Previous Crop** This is becoming more an issue lately as continuous corn acreage has steadily increased. This is despite the 25 bushel-per-acre yield penalty associated with continuous corn and the higher input cost, especially for N. Previous crop clearly interacts with the first and second wonders. If sufficient N is available in a good growing year, the continuous-corn yield penalty can be reduced or eliminated. While it makes sense that some hybrids might perform better than others under continuous corn, our research has not shown this. We find the best hybrid on a farmer's rotated land is also the best one for continuous-corn ground.

**5. Plant Population** *What's maximum occupancy?* All farmers know plant population has increased steadily over the last 20 years. What they probably don't know is how well modern hybrids can flex their ear components (such as kernel number and weight) to account for differences in plant stand. Because of this, we find similar yields between 28,000 and 40,000 plants per acre, although there is a big difference in the size of individual kernels. Thus, most of the 20-bushel yield benefit we see from plant population comes from correcting stands that are too low.

Of course, plant population interacts heavily with weather: High plant populations are particularly susceptible to unfavorable conditions. Contrary to what many people think, however, we don't see an interaction between plant population and N. There's no need for more N fertilizer at higher plant populations.

**6. Tillage** *To plow or not* Tillage comes in varying degrees or in differing times. Both degree and timing aspects interact heavily with the other yield wonders. The relative advantages or disadvantages of a particular tillage system or time depend largely on the weather. Tillage also interacts with N availability and hybrid. The degree and timing of tillage can make a big difference with the previous crop because most of the yield penalty associated with continuous corn is due to the residue. Similarly, the tillage system can have a big impact on plant population. Overall, our research shows a 15-bushel range of yield due to the various tillage systems.

**7. Chemicals** The seventh wonder is a catch-all that I call chemicals. This includes plant growth regulators and compounds that exert growth-regulator-like effects that lead to a positive change in growth or yield determination. Late-season leaf-greening from certain foliar fungicides and new technologies that make the plant less sensitive to environmental stresses fit into this category. While the overall average is a positive 10 bushels, the success of these compounds depends highly on the other yield wonders, especially weather and hybrid. This category has the widest range.

**The sum total** They all add up. By optimizing all of the seven wonders, grain yields of 260 bushels should be possible. This total doesn't take into account interactions among the wonders, which in some cases could drive yields even higher. By the same token, a nonoptimized yield wonder lowers yield.

Although I realize the seven wonders concept is a vast oversimplification of all the complicated factors that make a high yielding corn crop, it should give you a better perspective on how your management decisions can impact grain yield.

**[Editor's Note]** The author states that a 260 B/A capability with optimizing the seven wonders of corn yield:

1. 70 B/A	3. 50 B/A	5. 20 B/A	7. 10 B/A
2. 70 B/A	4. 25 B/A	6. 15 B/A	

260 bushels per acre, but every area is different for yield capability. If you take the above seven wonders and convert them to percentage of yield, it should not matter as far as importance of one of the seven wonders whether you're capable of producing 260 bushels, 160 bushels, or 60 bushels.

By converting to a percentage, this is what it looks like:

1. 27%	3. 18%	5. 8%	7. 4%
2. 27%	4. 10%	6. 6%	

**Looking at it this way, just the first three wonders of corn yields equates to 72% of the yield.**



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