How do we optimize yields?
- Identify the yield-influencing factors (YIFs) specific to our fields or operations.
  - A few may be “home runs”, others will be “base hits”, some will be “walks”.
- Then target those YIFs with appropriate agronomic management strategies.

Identifying YIFs...
- Takes time and is not necessarily easy.
  - If necessary & practical, invest in knowledgeable “hired guns” (aka CCAs).
- Remotely-sensed imagery and yield maps can help narrow the search.
- Try not to invest $$ into solutions for problems you don’t have.

Optimal grain yield requires...
- A photosynthetic plant “factory” capable of “harvesting” no less than 95% of the available sunlight during grain fill.
  - Possible ½ to ¾ percent yield increase for each percentage point increase in sunlight capture up to about 95% capture.
  - (Andrade et al., 2002)

Building a crop canopy
- Every agronomic decision you make potentially influences crop canopy development and the capacity to intercept sunlight.
- Not to mention the influences of weather, soils, and pests during canopy development.

Maintaining canopy health
- To maintain maximum photosynthetic output, the photosynthetic plant “factory” must remain healthy throughout grain fill.
  - Plant nutrition, diseases, insects, temperature, soil moisture.
- Canopy health during grain fill influences both kernel set and kernel weight.
Irrigation vs. Rainfall...

- Irrigation is simply captured rainfall re-applied to crops.
- Many of the production practices for high yielding corn under irrigation are very similar to high yielding corn grown under adequate rainfall.

Water management will affect success of other agronomic decisions

Source: Irrigation Management for Corn. Univ. Extension publication G1850 (Fig. 1)

Curve A (smooth) = Average water use, Curve B (jagged) = Example of actual fluctuation from average Nebraska conditions

Corn management decisions

- Water management
- Hybrid selection
- Nitrogen management
- Soil management
- Weed management
- Disease management
- Other soil nutrient mgmt.
- Insect management
- Seeding rate choice
- Row spacing choice

Essential

Important

Thoughts on Hybrid Selection

Wise hybrid selection...

- Requires a lot of research & homework.
- Can be challenging because multiple location data are often difficult to obtain.
- Can be challenging because yield data often require further analysis & scrutiny.
- Can dramatically improve net income due to higher and more consistent yields for growers.

Hybrid selection

- Can we agree that there is a lot of money to be made or lost in corn farming simply by how successfully you select hybrids?
- How do we know this?
  - Look at the range between the highest & lowest yielding entries in any variety trial.
  - Assuming that companies typically avoid entering crappy™ hybrids in variety trials.
**Range in Hybrid Yields**
(Highest yield minus lowest yield)

Purdue Univ. Corn Performance Trials
2009 Late-Season Maturity Results

At $3.50 corn, equal to $175 to $322 per acre spread in gross income!

**Bottom line...**

- There is no such thing as a perfect hybrid.
  - Else, there would not be so many in the marketplace.
- In the absence of stresses, hybrids yield differently because of genetic yield differences.
- **CONSISTENCY** of yield over years and across locations is based primarily on the abilities of hybrids to tolerate unforeseen stresses.
  - i.e., hybrid traits other than yield

**Stress Tolerance Traits**

- Diseases
- Insects (transgenic traits)
- Drought, excessive heat
- Soggy soils
- Soil compaction, “tight” soils
- Nutrient deficiencies
- Cold temperatures
- High plant populations

All of these stresses vary in frequency and severity within fields, among fields, among regions, and over years.

**Your challenge is...**

- To identify hybrids that will consistently yield well under all types of stress.
- The only way to do this is to evaluate the performance of hybrids over multiple locations.

**Multiple location testing...**

- Increases the odds that hybrids will be exposed to a diverse array of stresses within one or two years.
  - Thus, the value of multiple location variety testing for evaluating and predicting the **CONSISTENCY** of hybrid performance.
Sources of yield data…

- Seed company trial data.
- Your own on-farm trial data.
- Other, third-party trial data.
- University variety trial data.

Identify consistency

- Hybrids within the upper group of hybrids that cannot be differentiated from the highest yielding hybrid by the L.S.D. value of the trial are probably all fairly consistent.
  - Key is # of locations.

Another way to identify consistency

- RELATIVE hybrid yield performance across multiple trials.
  - Relative yield of a hybrid = Yield divided by the highest yield in the trial.
  - Example:
    - Top Hybrid = 220 bu/ac
    - My Hybrid = 200 bu/ac
    - My Hybrid = 91% of max. hybrid (200/220)

Consistency of Yield

- Aim to identify hybrids whose yields are consistently within 10% of the highest hybrid yield in every variety trial they are entered.

Unfortunately…

- Few variety trials publish data in terms of RELATIVE hybrid yield, so you need to calculate it yourself.
- Some seed companies do not publish results of variety trials for individual locations, so you cannot verify the CONSISTENCY of hybrid performance over locations.

Purdue trials

- Beginning with the 2009 trial data, we are providing RELATIVE hybrid yield as an alternative way to evaluate consistency among locations.
  - Only in interactive Web-based tables.
  - Four locations in each of geographic zone.

http://www.ag.purdue.edu/agry/PCPP
Avoid ... 
- Side-by-side comparisons, unless they are between pairs of hybrids you've already identified as top yielding genetics. 
- In other words, just because my hybrid yielded better than your hybrid in 12,089 side-by-side comparisons across 10 states, does not mean that either hybrid is a good hybrid!

Avoid ... 
- Choosing hybrids based on "percent wins against the competition". 
  - The companies rarely specify whether the "competition" includes competitors' top performers or competitors' "dogs". 
  - What growers need to know is the "percent wins" against the BEST of the competition!

Avoid ... 
- Hybrids without documented yield performance data over multiple locations. 
  - Growers should NOT buy simply based upon advertising or the fact that the hybrid is "new"! 
  - Today’s rapid “cycling” of new genetics to the marketplace makes it harder for growers to wisely select new hybrids because widespread performance data are often more limited.

After you identify a group of consistent high yielders... 
- Then further "weed out" those hybrids with low ratings for traits important to your farming operation.

Hybrid traits 
- Many to consider, but not all are important for your specific farming operation. 
- Do you know what are your most common important yield limiting factors? 
  - Diseases? Which ones? 
  - Insects? Which ones? 
  - Poorly-drained soils? 
  - Sandy, drought-prone soils?

Wise hybrid selection... 
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- Can be challenging because multiple location data are often difficult to obtain. 
- Can be challenging because yield data often require further analysis & scrutiny. 
- Can dramatically improve net income due to higher and more consistent yields for growers.
Thoughts on Seeding Rates for Corn

Current data suggest that many growers should be targeting **economic **stands no less than ~ 30,000 ppa; equal to a seeding rate of ~ 33,000 spa.

Exceptions being...

- Lower yielding environments (e.g., 130 bpa or less) where growers should target final populations between ~ 24 to 30,000 ppa.
- More northern areas where final stands may need to be 33,000 ppa or greater.

Bottom line w/ corn...

- More plants per unit area equals more ears per unit area. (that’s good)
- But, ear size per plant decreases with increasing plant density. (that’s not good)
- The optimum final stand is that which best balances the decrease in ear size per plant with the gain in ears per unit area.
- Furthermore, stalk health & integrity at higher populations sometimes falters.

Balancing act for corn...

Harvest populations - Indiana

Average harvest populations reported by Indiana corn growers have been steadily increasing by about 300 plts/ac/yr over the past 20 years.

Economic optimum population

Since 2005, a decrease in the lowest populations and an increase in higher populations.

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Recent university data...

- Iowa: Suggests optimum final stands level out beginning at about 30,000 ppa.
- Northern IL: Suggests optimum final stands near 35,000 ppa.
- Southern IL: Suggests optimum final stands closer to 24,000 ppa (more challenging soils).
- Michigan: Suggests optimum final stands range from 33 to 36,000 ppa.

A recent Indiana on-farm trial...

- Grain yield (bu/ac) vs. Seeding rate (seeds per acre)
- Hybrid A and Hybrid B

Today’s elite hybrids?

- Some claim that today’s elite multiple biotech trait hybrids respond better to higher seeding rates than today’s elite non-biotech or simply RR hybrids.
  - However, there is little, if any, public data to support the claim.
  - Today's hybrids are simply more stress tolerant across the board than those of 20 years ago.

Seeding rate decisions...

- Are not influenced very much by hybrid.
- Today’s hybrids in general have much better population tolerance than their predecessors.
  - Improved ability to maintain ear size at higher plant densities.
  - Less tendency to remobilize stored stalk carbohydrate reserves during stressful grain fill; thus less tendency for stalk lodging at higher plant densities.

Stalk health concern...

- Remains an issue for hybrids with moderate or worse stalk strength or stalk rot resistance.
- Such hybrids should be planted at more moderate seeding rates to minimize the risk of severe stalk lodging prior to harvest.
Current data suggest that many growers should be targeting economic FINAL stands no less than ~ 30,000 ppa; equal to a seeding rate of ~ 33,000 spa. Exceptions being...
- Lower yielding environments (e.g., 130 bpa or less) where growers should target final populations between ~ 24 to 30,000 ppa.
- More northern areas where final stands may need to be 33,000 ppa or greater.

We are looking for volunteers to help us evaluate nitrogen fertilizer rates, corn seeding rates, or soybean seeding rates. Contact your local Extension educator if you would like to help develop these independent sets of results.

Traditional 30-inch rows are not a primary yield limiting factor for corn production today.

The move to 30-inch rows... Was accompanied by a good consensus by public researchers throughout the Corn Belt that 30-inch rows would yield 6 to 7 percent better than 36- or 38-inch row spacings. But, what about a move from 30-inch to 20- or 15-inch or twin rows today? Gamers a lot of attention in the farm press.
Row spacing decisions...

- Are influenced by machinery issues:
  - Equipment tire size
  - Planter design
  - Combine headers
  - Row irrigation considerations
  - Compatibility with other crops

- Also influenced by the crop’s yield response to narrower rows:
  - Primarily related to plant-to-plant competition for available water, nutrients, and light.
  - If more than enough water, nutrients, & light, then NOT likely to see a significant response to narrower rows.

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Response to row spacing...

- Is also related to whether the crop canopy is "capturing" at least 95% of the available sunlight during grain fill.
- Possible 1/2 to 3/4 percent yield increase for each percentage point increase in sunlight capture up to about 95% capture.
  - (Andrade et al., 2002)

Consequently...

- Narrow rows may be most beneficial where canopy development & yield are challenged by marginal soils or climates.
  - Northern climates (cooler, less growth).
  - Nutrient deficient soils (esp. nitrogen).
  - Sandy, non-irrigated, often droughty soils.
  - Shorter-season hybrids.
  - Smaller, shorter, less leafy hybrids.

Most public research...

- Indicates that row spacings less than 30 inches result in small (2 to 4%) and, more importantly, inconsistent yield increases across the central Corn Belt.
  - Most have found that optimum seeding rates are similar for different row widths.
- Profitability depends on costs to change, acreage, potential yield, & grain price.

Bottom line on row spacing...

- Traditional 30-inch rows are not a primary yield limiting factor for corn production today.