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Agronomic Practices for Irrigated Corn Production

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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.






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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.





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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)





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Building a crop canopy

- Every agronomic decision you make potentially influences crop canopy development and the capacity to intercept sunlight.

Hybrid	Seeding rate	Row width	Irrigation
Soil fertility	Weed control	Planting date	Foliar fungicide
- Not to mention the influences of weather, soils, and pests during canopy developmt.






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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.






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Irrigation vs. Rainfall...

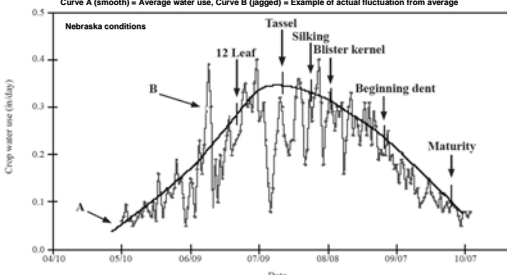
- Irrigation is simply captured rainfall re-applied to crops.
- Many of the production practices for high yielding corn under irrigation are very similar to high yielding corn grown under adequate rainfall.

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Water management will affect success of other agronomic decisions



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

Nebraska conditions

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

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Corn management decisions

- Water management
- Hybrid selection
- Nitrogen management
- Soil management
- Weed management

Essential

- Disease management
- Other soil nutrient mgmt.
- Insect management
- Seeding rate choice
- Row spacing choice

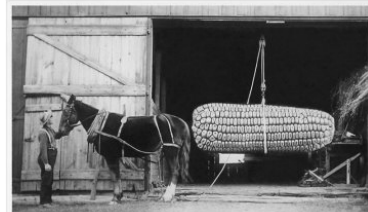

Important



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Thoughts on Hybrid Selection


CORN AS WE GROW IT IN NEBRASKA

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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.



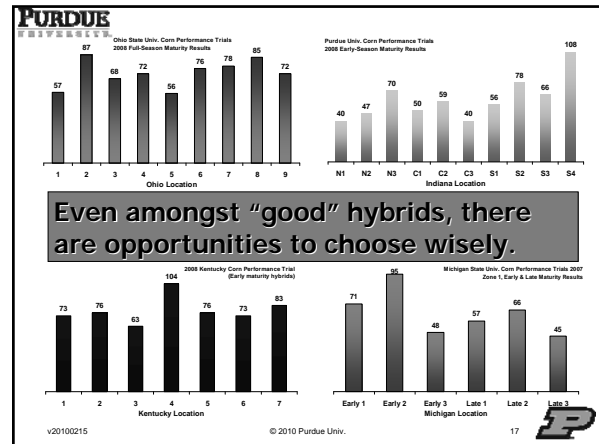
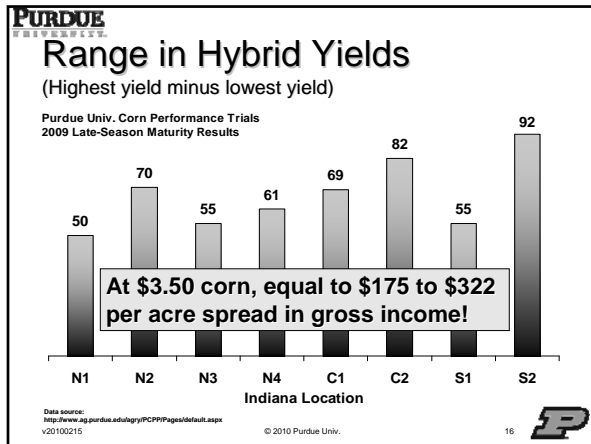
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Hybrid selection

- 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.

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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

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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.

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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.

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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.

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Sources of yield data...

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



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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.

Brand-hybrid	Yield bu/acre	Moist. %	Lodg. %
Campbell Seed X656-98	244*	23.3	3
EBBERTS X2007	243*	22.9	4
WELLMAN W2007 VT3	243*	23.2	3
EBBERTS 296VT3	241*	26.4	4
Stewart Seeds IT530	241*	25.9	1
Kruger K-6107VT3	239*	24.7	2
Dyna-Gro 57140	238*	23.2	4
DEKALB DKC59-64	237*	26.0	1
ICORN.com 108.1R	237*	25.7	1
ICORN.com 109.9VT3	237*	25.5	1
Bio Gene BG79V10	235*	27.2	2
Bio Gene BG76V10	234*	23.2	4
Kruger K-6101VT3	234*	25.9	4
Wabash Valley TLX3344	234*	26.6	2
Campbell Seed 85-76VT3	232*	25.9	1
Specialty 6399 VT3	232*	25.2	1
BECKXLS 5354HXR(TM)	231*	25.4	0
Dairyland Stebb 9410	231*	26.6	1
ICORN.com 110.2VT3	231*	24.4	2
Rupp XR8439 VT3	231*	21.9	10
Seed Consultants 11HR00	231*	28.5	0
DEKALB DKC59-35	230*	25.7	1
ICORN.com 109.5VT3	230*	25.7	6
Kruger K-6400VT3	230*	25.5	3
Wyckoff 2599	230*	26.4	1
Campbell Seed 591-76VT3	229	25.3	1
Kruger K-6410VT3	229	24.1	5
Bio Gene BG80W10	228	23.8	5
	228	26.4	2

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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

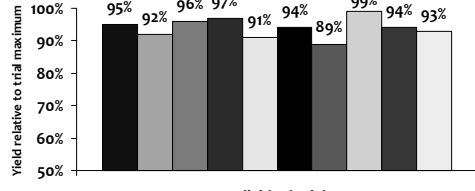
My Hybrid = 91% of max. hybrid (200/220)

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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.



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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.

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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>

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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!





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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!




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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.





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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.





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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?




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Wise hybrid selection...

- Requires a lot of research & homework.
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- 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.



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Thoughts on Seeding Rates for Corn

Bottom line w/ corn...

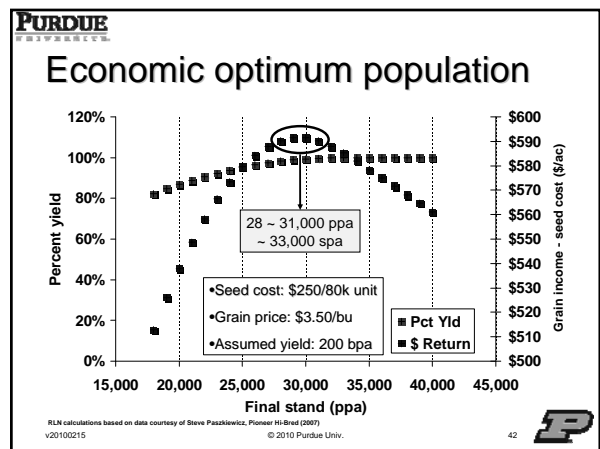
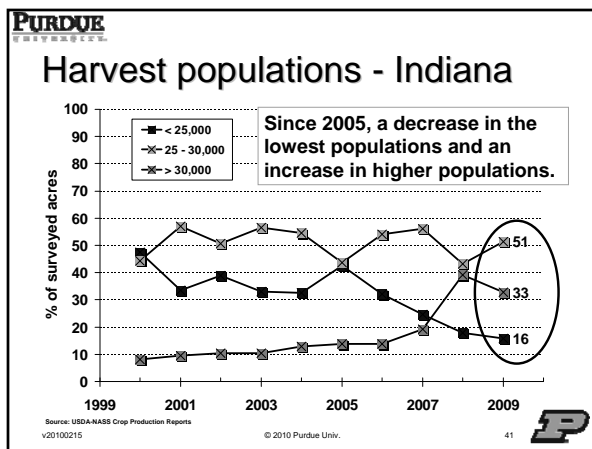
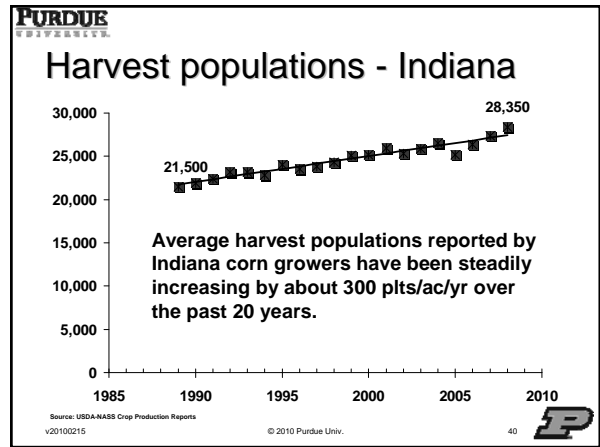
- Current data suggest that many growers should be targeting **economic FINAL stands** no less than ~ 30,000 ppa; equal to a seeding rate of ~ 33,000 spa.
- Exceptions being...
 - Lower yielding environments (e.g., 130 bpa or less) where growers should target final populations between ~ 24 to 30,000 ppa.
 - More northern areas where final stands may need to be 33,000 ppa or greater.

Image source: <http://www.webwhispers.org/news/csp05target.jpg>
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Balancing act for 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.


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Image: <http://scanemondry.files.wordpress.com/2007/07/balancing-act-001.jpg>

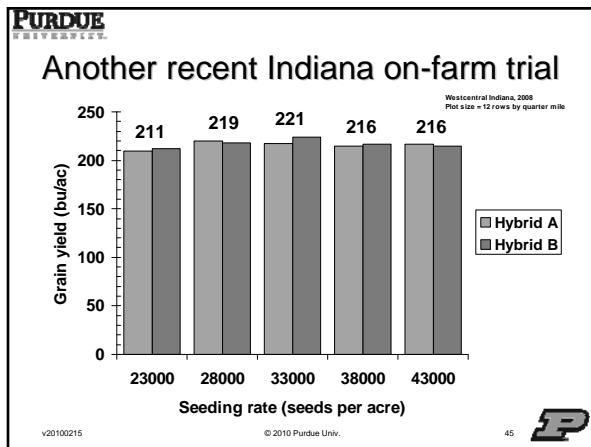
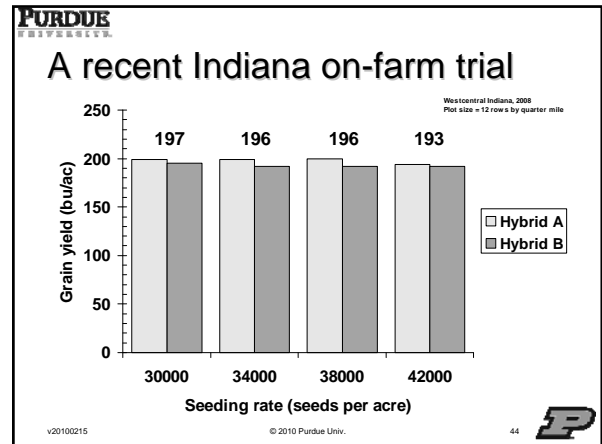


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Recent university data...


- 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.

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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.


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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.



v20100215 © 2010 Purdue Univ. Image: <http://i2c.commodity.files.wordpress.com/2007/07/halanting-act-001.jpg> 47 

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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.






Image source: http://www.sl.si.edu/maggaaxy/ImageGallery_SearchResult.cfm
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Bottom line w/ corn...



- 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.

Image source: <http://www.webhelpers.org/ghewspic/apr05/target.jpg>

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On-farm research...




- 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 use develop these independent sets of results.

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Thoughts on Row Spacing for Corn



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Bottom line on row spacing...

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




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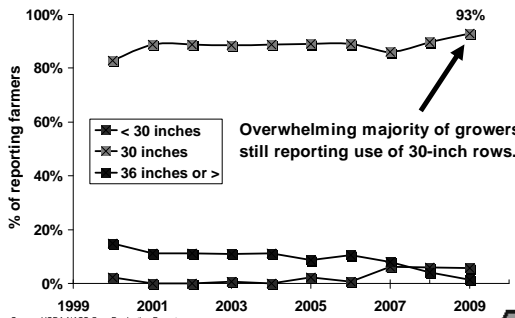
The move to 30-inch rows...

- 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?
 - Garners a lot of attention in the farm press.

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Corn row spacing - Indiana



Overwhelming majority of growers still reporting use of 30-inch rows.

Year	< 30 inches	30 inches	36 inches or >
1999	15%	82%	3%
2001	12%	88%	0%
2003	11%	88%	1%
2005	10%	88%	2%
2007	8%	87%	5%
2009	5%	93%	2%



Source: USDA-NASS Crop Production Reports

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Row spacing decisions...

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






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Row spacing decisions...


- Are 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 ½ to ¾ percent yield increase for each percentage point increase in sunlight capture up to about 95% capture.
 - (Andrade et al., 2002)



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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.

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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.

Image source: <http://www.answers.com/topic/corn-belt>
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Bottom line on row spacing...

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



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