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Key Crop Management Issues for Optimizing Grain Yield & Quality

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Links to this presentation can be found under "Presentations & Papers"

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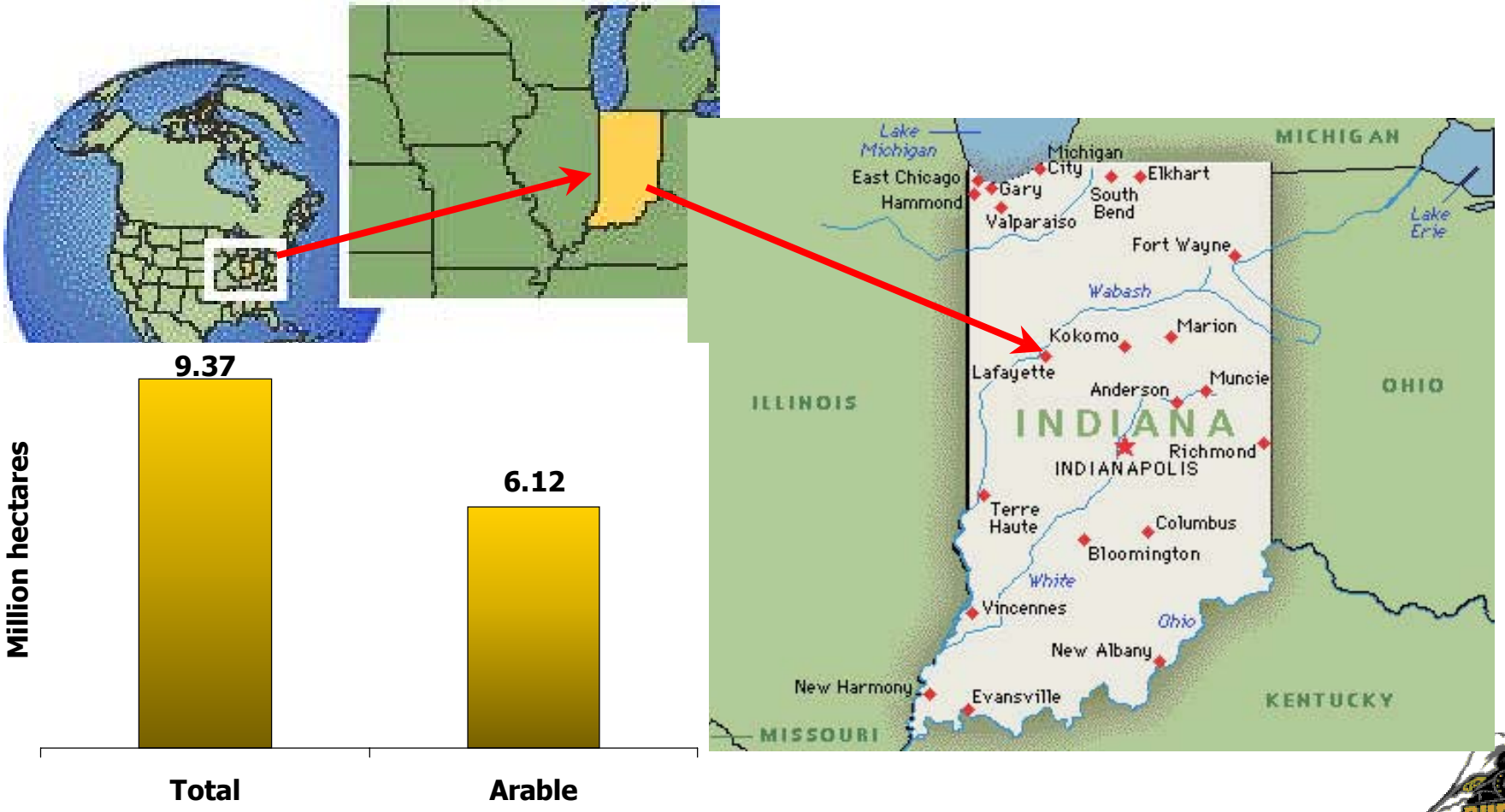
Purdue Univ., Indiana, USA



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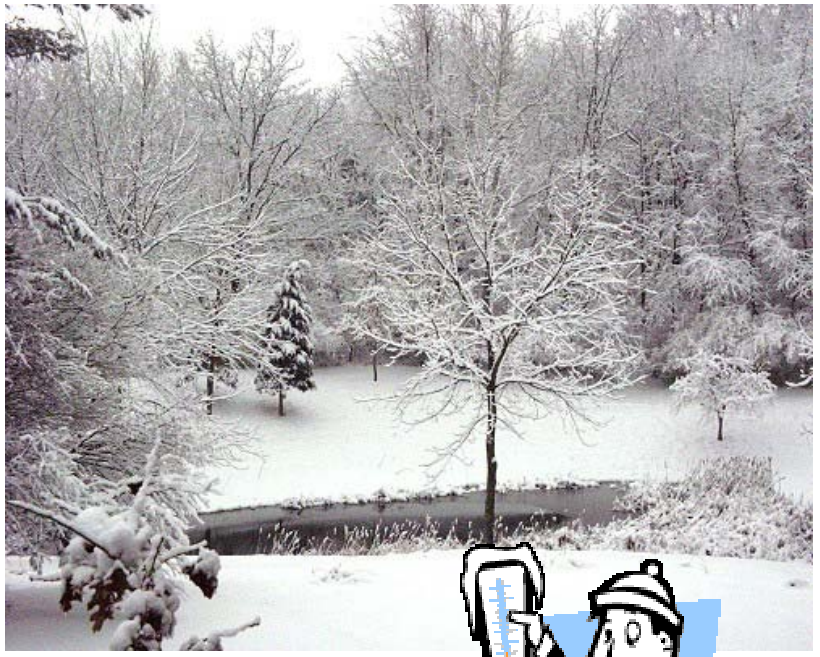
It's still winter in Indiana…



Low temp Jan 27 = -24C

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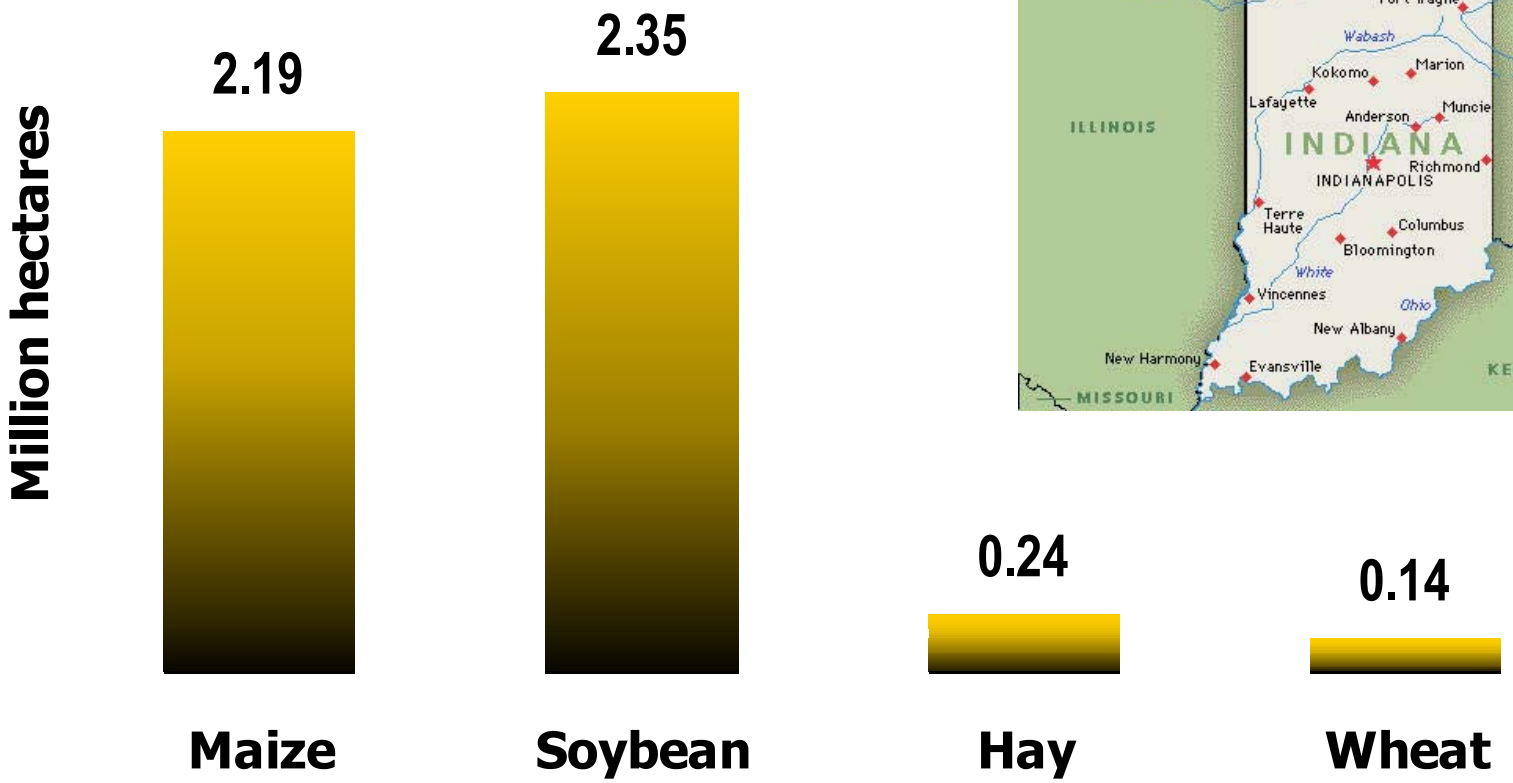
Source: Indiana Ag. Statistics Serv.

Major Indiana crops:



Source: http://www.nass.usda.gov/in/pressrel/pr011003.txt

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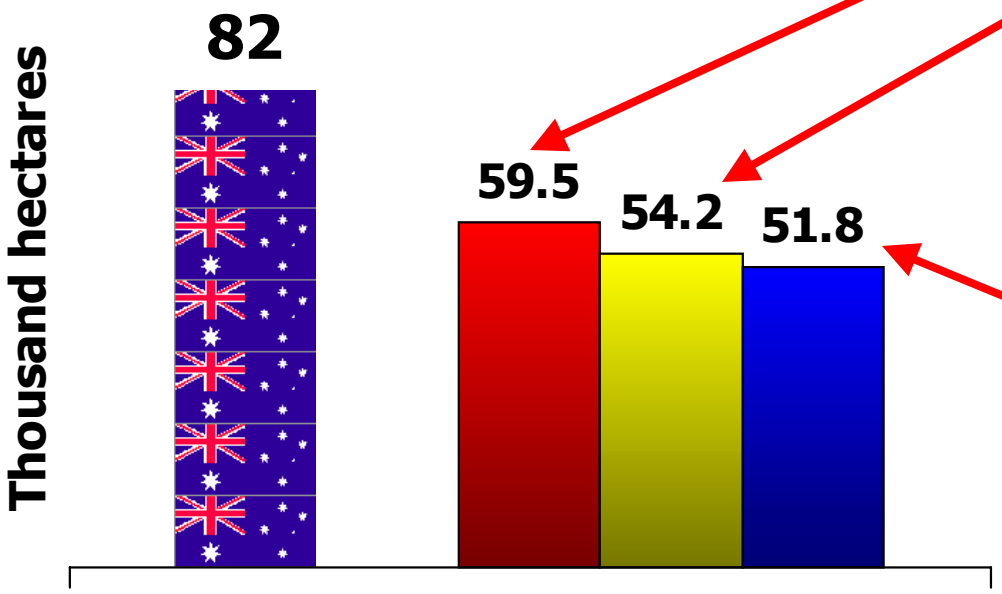
Maize land area…

Australia vs. Top 3 Indiana Counties



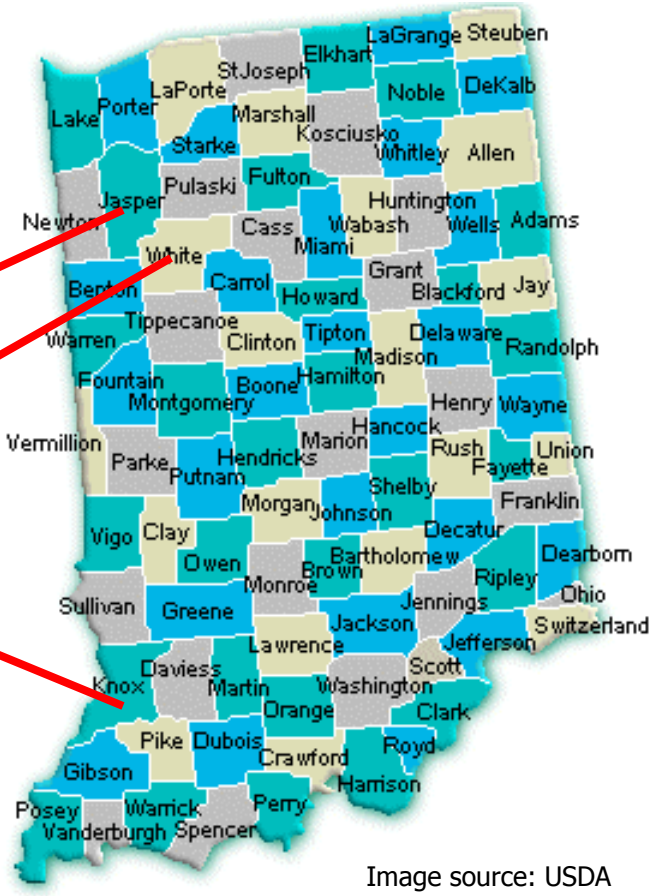


Image source: USDA

Sources: Australian Bureau of Statistics & USDA-Nat'l Ag Statistics Service

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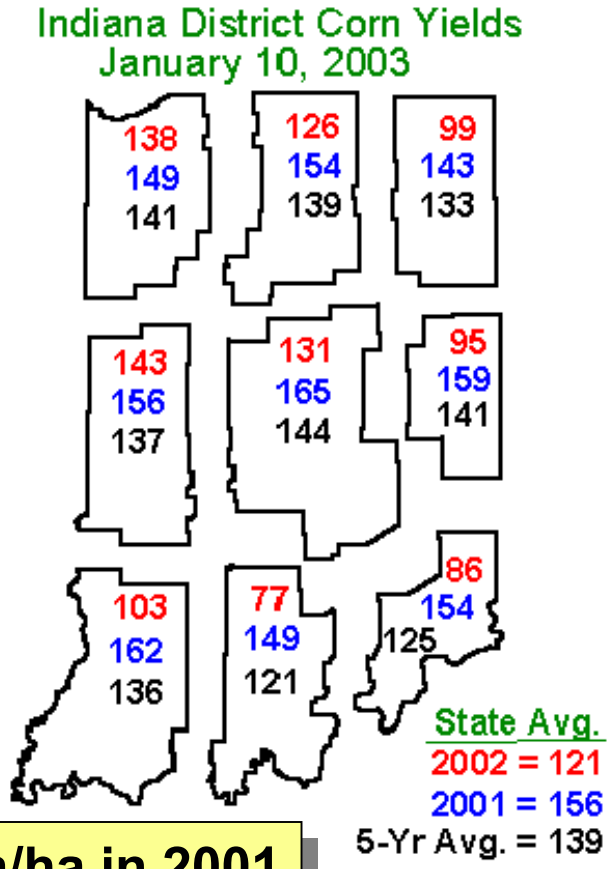
Indiana maize:

Current state yield estimate:

- Current estimate of 7.6 ton/ha is about 14 % below historical trend yield of 8.8 ton/ha (140 bu/ac).
  - Wet spring, delayed planting
  - Soil compaction
  - Subsequent dry weather



~ 7.6 ton/ha in 2002 vs. ~ 9.8 ton/ha in 2001

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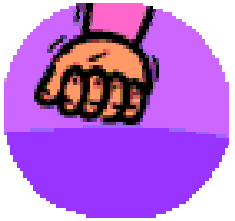
Maize yield and grain quality

- Both are important goals of maize production.
- Both are influenced by your management decisions and an array of other yield influencing factors (YIFs).
- Spatial & temporal consistency of optimum yield and quality requires a combination of good agronomic management on your part and good luck.

Consistent High Yields & Grain Quality:

Skill versus luck?

- Sound agronomic skills & knowledge will help you…
  - Identify negative and positive YIFs
  - Develop strategies to mitigate or prevent negative YIFs and enhance or promote positive YIFs.
- Plenty of luck is required if the important YIFs are unknown, unidentified, or not quantified.



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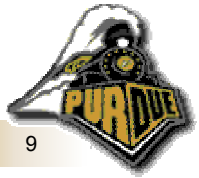
Yield influencing factors

- Crops are influenced by vast array of yield influencing factors (YIFs)
  - Some influence yield directly
  - Some interact with others
  - Some occur every year, others do not
  - Some influence different crops differently
  - Weather interacts with most of them

Identifying YIFs can be difficult…



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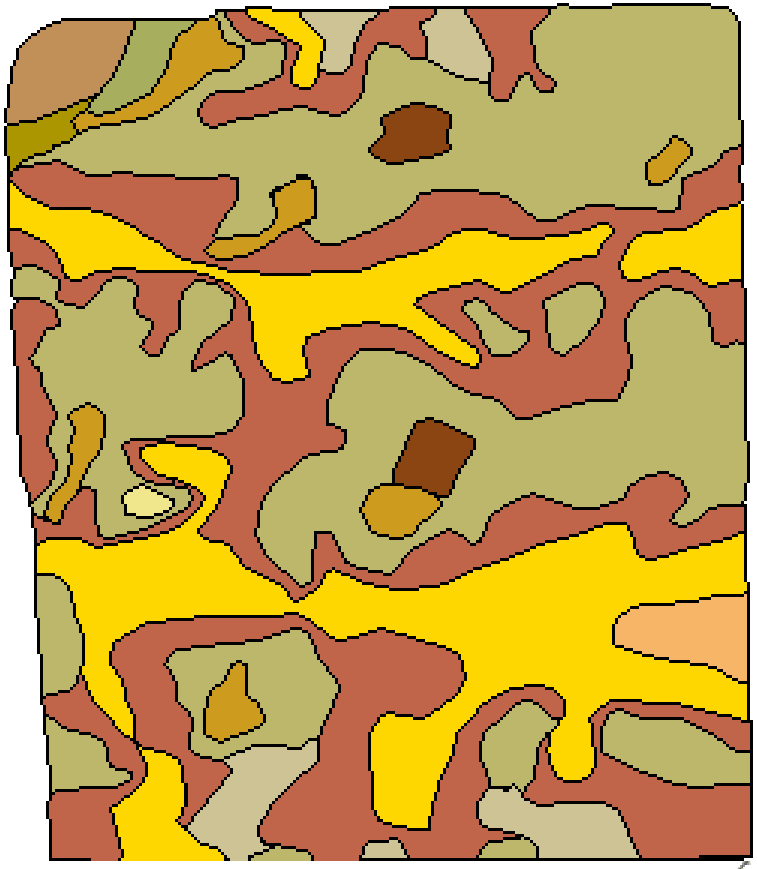
'Perennial' YIFs

- Spatial variability for some yield influencing factors is reasonably constant from year to year.
  - Soil fertility or pH patterns
  - Soil drainage patterns
  - Patterns of perennial weed growth
- These patterns can be described with site-specific technology and consequently used for YIF management.



Soil mapping units

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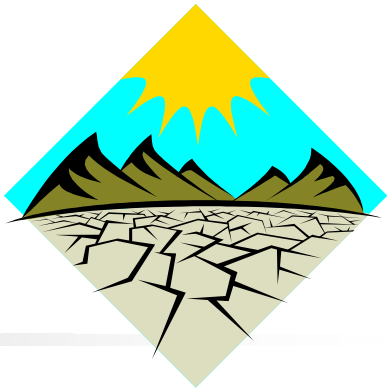
'Sporadic' YIFs



- Other yield influencing factors occur sporadically over the years...
  - Diseases & insects, even fertility problems are greatly dependent on weather
    - 'Abnormal' weather seems to be the norm!
- Site-specific technology can help identify these problems when they occur, but not necessarily prevent their reoccurrence.

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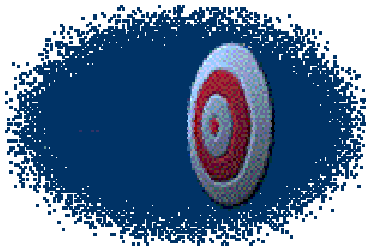
Which YIFs Are Most Important?

This field?



Last year?

Always Remember:
Stress upon stress reduces the crop's ability to tolerate more stress.

Next year?

That field?

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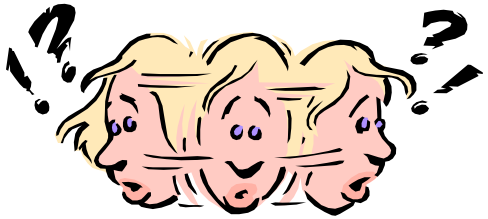
Consistent High Yields & Grain Quality:

Agronomic choices abound…

- Tillage type and timing
- Hybrid type
- Seeding rate
- Planting date
- Row spacing
- Fertilizer type, appl'n timing, placement
- Insect control
- Weed control
- Crop rotation
- Disease control
- Irrigation amount and timing
- Harvest timing rel. to grain moisture, mechanical kernel damage, and mechanical harvest loss



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Key agronomic practices?

- Rather than identifying specific practices for maximizing yields consistently…
  - …you need to understand key agronomic concepts related to optimum yields…
  - …then seek practices that are available and adaptable to your specific situations (YIFs).

I cannot give you a list of specific practices to optimize your maize yields because I am nearly clueless about Australian YIFs for maize.

Hybrid performance…

- High-yielding hybrids well-adapted to YIFs common in your farming operation.
  - Look for hybrids that yield consistently well across a diverse set of conditions in your area, especially weather and disease.
    - Requires comparative hybrid performance data across multiple locations, not simply performance on your farm.

Northcentral U.S. Hybrid Performance Data:

http://www.ksu.edu/kscpt/nccec/

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Hybrid Selection Strategy:

After identifying hybrids…

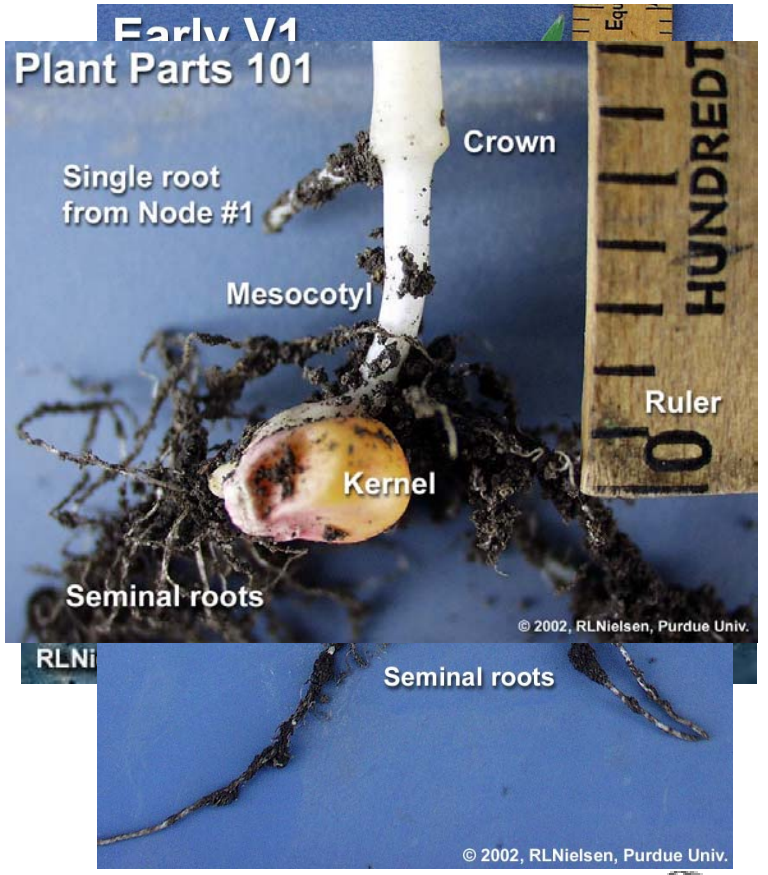
- Eliminate hybrids with weaknesses for specific traits important to your farming operation.
  - e.g., specific disease tolerance, root & stalk strength, emergence vigor, etc.
  - Info about hybrid characteristics can be found on many seed company Web sites.

Links to Seed Company Web Sites:

http://www.agry.purdue.edu/links/national/commercial-ag.htm

Successful stand establishment…

- Rapid & uniform stand establishment
  - Germination & emergence
  - Establishment of nodal root system
  - Minimizes duration of exposure to pest & weather stresses while young plants are dependent on kernel reserves.
  - Increases ability to tolerate later stresses.



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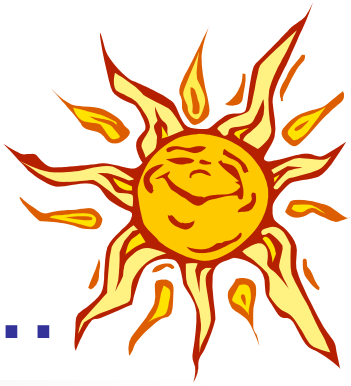
Important factors for…

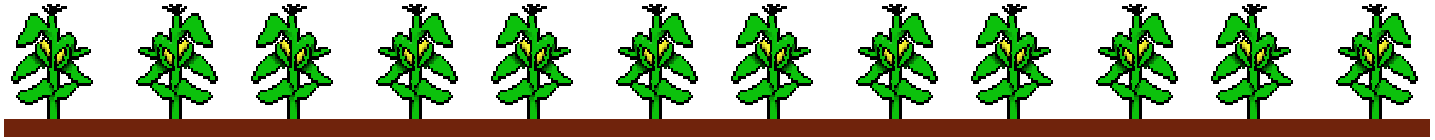
Successful stand establishment…

- Excellent seed quality
  - Indicated by warm or cold germination ratings
- Excellent genetic seedling vigor
  - Company ratings
- Seed protection from insects or diseases
  - Seed treatments
- Surface soil free of crust or compaction
- Availability of soil nutrients
  - Starter fertilizer (esp N)
- Error-free seeding
  - Planter maintenance
  - Planter adjustments
  - Planting speed
- Adequate & uniform
  - Soil temperatures
  - Soil moisture
  - Seed-soil contact



Construction of "factory"…

- Vigorous growth between "knee-high" and pollination ("grand growth period").
  - Ensures successful ear size determination.
  - Completes establishment of whole root system.
- Aim for maximum canopy development by at least two weeks prior to flowering.
  - Ensures nearly complete interception of solar radiation during pollination and grain fill.



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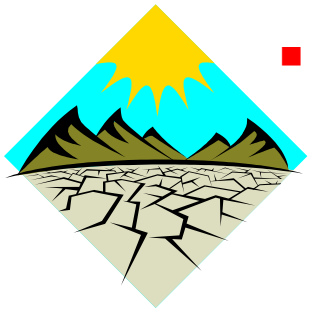
Important factors for…

Construction of "factory"…

- Rooting profile free of soil compaction or other rooting restrictions.
- Minimal stress from moisture deficits.
  - Stored soil moisture
  - Rainfall
  - Irrigation
  - Moisture conservation by zero tillage



- Availability of soil nutrients (esp N).
- Seeding rates & row spacing sufficient to achieve full canopy closure 2 weeks prior to pollination.
  - Indiana: 74,000/ha and 76-cm row spacing
- Minimal competition from weeds, insects, or diseases

Pollination & grain fill…

- Successful pollination and early grain fill.
  - Ensures maximum kernel set on ears.
  - Minimizes abortion risk.
- Minimal stress throughout grain fill.
  - Ensures max. kernel weight.
  - Ensures max. grain quality.
  - Minimizes risk of root and stalk rot development.

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Important factors for…

Pollination & grain fill…

- Minimal stress from moisture deficits.
  - Stored soil moisture
  - Rainfall
  - Irrigation
  - Moisture conservation by zero tillage
- Moderate day/night temperatures (30/18C).
- Plenty of solar radiation.
- Minimal interference of pollination by silk clipping insects.
- Rooting profile free of soil compaction or other rooting restrictions.
- Healthy crop canopy able to intercept 95% or more solar radiation.

Harvest of crop…

- Physiological maturity occurs at ~ 30% GMC.
  - Corresponds to kernel black layer development.
- Timely harvest of crop.
  - Balance between kernel damage from harvesting excessively wet grain (mid- to high 20's) and mechanical harvest loss from harvesting excessively dry grain (mid-teens).
- Strategic harvest of crop.
  - Minimize consequences of stalk rots or insect-damage by strategically harvesting severely affected fields early.

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Important factors for…

Harvest of crop…

- Optimal grain moisture content?
  - Low 20's considered to be GMC for optimum combine efficiency.
    - Least kernel damage
    - Least mechanical harvest loss.
- Some research suggests possibility of kernel dry matter loss in mature corn grain as it continues to dry naturally in the field.
  - As great as 1% per point of GMC.

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Base agronomic decisions on…

- Intimate knowledge of your own farming system and yield influencing factors.
  - Thorough and timely crop record keeping
  - Crop scouting and monitoring (YIF identification)
  - Major soil types & their characteristics
  - Climatic factors, especially water availability
  - Historical yield data on field basis
  - Historical yield monitor data on site-specific basis

Base agronomic decisions on…

- Intimate knowledge of own farming system and yield influencing factors
- Quality requirements of grain buyer and end-user markets
  - Protein, oil, endosperm (starch) characteristics, kernel integrity (disease, stress cracks, etc.), transgenic acceptance.
  - Work closely with your grain buyer to identify desired characteristics.

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Example of Understanding End Use Characteristics:

Corn for dry milling…

- Desired kernel characteristics for flaking grits include…
  - Harder endosperm
    - Hybrid selection
  - Larger-sized kernels
    - Hybrid selection, lower plant density, minimal stress during grain fill
  - Uniform kernel size
    - Uniform stand establishment
    - Minimal stress during pollination & early kernel development
  - Few kernel stress cracks
    - Minimal stress during grain fill
    - Lower temp drying
  - Higher protein contents
    - Hybrid selection, N fertilization, yield level

Corn Quality for Industrial Uses (Univ. of Nebraska):

http://www.ianr.unl.edu/pubs/fieldcrops/g1115.htm

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Base agronomic decisions on…

- Intimate knowledge of own farming system and yield influencing factors
- Quality requirements of grain buyer and end-user markets
- Solid understanding of…
  - Fundamental agronomic principles
  - Crop growth & development
  - Latest relevant (climate, soil, YIFs) research

Key word is "relevant":

What works in Indiana will not necessarily work in QSLD or NSW.

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Purdue University:

Sources of information…

- KingCorn – The Corn Growers' Guidebook
  - Corn production information from throughout the U.S.
  - www.kingcorn.org
- Agronomic Links Across the Globe
  - Links to useful sites from all over the world
  - www.agry.purdue.edu/links
- Corn Growth & Development: What Goes On From Planting to Harvest?
  - www.agry.purdue.edu/ext/pubs/AGRY-97-07_v1-1.pdf

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Purdue University:

Sources of information…

- Post Harvest Grain Quality & Stored Product Protection Program
  - pasture.ecn.purdue.edu/~grainlab/
- Quality Grain Needs TLC
  - www.agcom.purdue.edu/AgCom/Pubs/GQ/GQ-23.html
- Stand Establishment Uniformity
  - www.agry.purdue.edu/ext/pubs/AGRY-91-01_v5.pdf

Sources of information…

- Pioneer Hi-Bred Int'l Agronomy & Nutrition
  - www.pioneer.com/usa/agronomy/index.htm
- Maize Assoc. of Australia
  - www.maizeaustralia.com.au/
- New South Wales Agriculture
  - www.agric.nsw.gov.au/
- Grains Research & Development Corp.
  - www.grdc.com.au/

Sources of information…

- Corn Quality for Industrial Uses (Univ. of Nebraska).
  - www.ianr.unl.edu/pubs/fieldcrops/g1115.htm
- Intrinsic Value of Nebraska Corn: 1995 Crop Year Report (Univ.of Nebraska)
  - foodsci.unl.edu/OnlineEdu/Grains/CORN1995.html

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Hungry for More?

- Check out one of these fine Web sites…

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A Final Thought...

"Farming is a kind of continual miracle wrought by the hand of God."

-- Benjamin Franklin