Key Crop Management Issues for Optimizing Grain Yield & Quality

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Links to this presentation can be found under “Presentations & Papers”

It’s still winter in Indiana...

Low temp Jan 27 = -24°C

Major Indiana crops:

- Maize: 2.19 million hectares
- Soybean: 2.35 million hectares
- Hay: 0.24 million hectares
- Wheat: 0.14 million hectares

Source: Indiana Agricultural Statistics Service

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
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.

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.

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

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

'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.

Which YIFs Are Most Important?

- Always Remember: Stress upon stress reduces the crop’s ability to tolerate more stress.
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**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

**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.

**Hybrid Selection Strategy:**
- 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.

**Important factors for...**
- 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
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**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.
- 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).
  - Seedling 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
- Minimal stress throughout grain fill.
  - Ensures max. kernel weight.
  - Ensures max. grain quality.
  - Minimizes risk of root and stalk rot development.
- Moderate day/night temperatures (30/18°C).
  - Plenty of solar radiation.
  - Minimal interference of pollination by silk clipping insects.
- Healthy crop canopy able to intercept 95% or more solar radiation.
  - 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.
- Minimal stress from moisture deficits.
  - Stored soil moisture
  - Rainfall
  - Irrigation
  - Moisture conservation by zero tillage
  - Moderate day/night temperatures (30/18°C).
  - 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).
- 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.
- Strategic harvest of crop.
  - Minimize consequences of stalk rots or insect-damage by strategically harvesting severely affected fields early.
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

Key word is “relevant”:
What works in Indiana will not necessarily work in QLD or NSW.

Sources of information...

- KingCorn – The Corn Grower’s 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?

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

Example of Understanding End Use Characteristics:

Desired kernel characteristics for flaking grits include...

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

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.

Post Harvest Grain Quality & Stored Product Protection Program
  - pastur.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

Corn Quality for Industrial Uses (Univ. of Nebraska):
  - http://www.ianr.unl.edu/pubs/fieldcrops/g1115.htm

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Sources of information...
- Pioneer Hi-Bred Int’l Agronomy & Nutrition
  - www.pioneer.com/usa/agronomy/index.htm
- Maize Assoc. of Australia
- New South Wales Agriculture
- Grains Research & Development Corp.
- 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

Hungry for More?
- Check out one of these fine Web sites...
  - Welcome to ...
  - KingCorn.org
  - The Corn Growers’ Guidebook
  - Chat ‘n Chew Café
    - Where the coffee is strong
    - and the gossip is fresh!
    - http://www.kingcorn.org/cafe

A Final Thought...
"Farming is a kind of continual miracle wrought by the hand of God."
-- Benjamin Franklin