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Key Crop Management Issues for Optimizing Grain Yield & Quality

R.L. (Bob) Nielsen
Agronomy Department
Purdue University, Indiana, U.S.

Email: rnielsen@purdue.edu
Web: www.kingcorn.org/rln-bio.htm



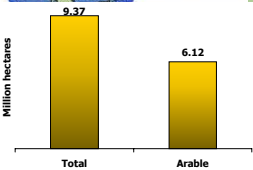
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Purdue Univ., Indiana, USA


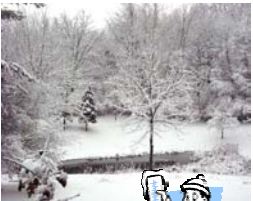




Category	Million hectares
Total	9.37
Arable	6.12


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It's still winter in Indiana...

Low temp Jan 27 = -24C


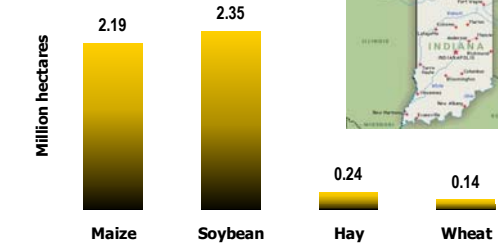


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Source: Indiana Ag. Statistics Serv.

Major Indiana crops:

Crop	Million hectares
Maize	2.19
Soybean	2.35
Hay	0.24
Wheat	0.14

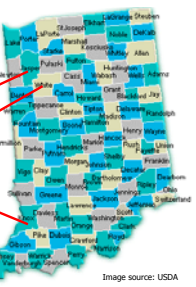
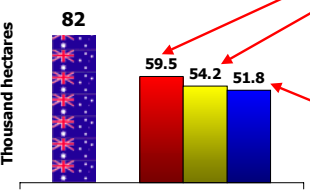
Source: <http://www.nass.usda.gov/IN/pressrel/pr011003.txt>

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Maize land area...

Australia vs. Top 3 Indiana Counties

Country/County	Thousand hectares
Australia	82
Wayne County, IN	59.5
Madison County, IN	54.2
DeKalb County, IN	51.8

Image source: USDA

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

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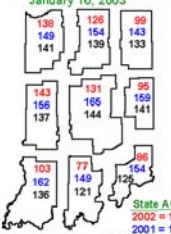
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Indiana maize:

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

Indiana District Corn Yields January 10, 2003



District	Yield (ton/ha)
1	138
2	149
3	141
4	126
5	154
6	139
7	99
8	143
9	133
10	143
11	156
12	137
13	131
14	105
15	144
16	95
17	159
18	141
19	88
20	154
21	125
22	103
23	77
24	149
25	121
26	162
27	136
28	154
29	125
30	139

State Avg. 2002 = 121
2001 = 156
5-Yr Avg. = 139

~ 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.


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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...

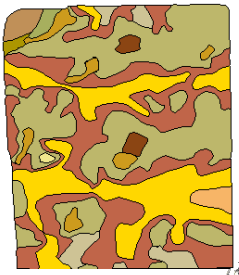


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'Perennial' YIFs

- 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?

Last year? This field?

Next year? That field?



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




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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.




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Key Agronomic Concepts

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/ncccec/>




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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>




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Key Agronomic Concepts

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




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Key Agronomic Concepts

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




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Key Agronomic Concepts

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.

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Key Agronomic Concepts

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

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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
 - 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...

<ul style="list-style-type: none"> ■ Desired kernel characteristics for flaking grits include... <ul style="list-style-type: none"> ■ Harder endosperm <ul style="list-style-type: none"> ■ Hybrid selection ■ Larger-sized kernels <ul style="list-style-type: none"> ■ Hybrid selection, lower plant density, minimal stress during grain fill 	<ul style="list-style-type: none"> ■ Uniform kernel size <ul style="list-style-type: none"> ■ Uniform stand establishment ■ Minimal stress during pollination & early kernel development ■ Few kernel stress cracks <ul style="list-style-type: none"> ■ Minimal stress during grain fill ■ Lower temp drying ■ Higher protein contents <ul style="list-style-type: none"> ■ Hybrid selection, N fertilization, yield level
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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

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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
 - www.maizeaustralia.com.au/
- New South Wales Agriculture
 - www.agric.nsw.gov.au/
- Grains Research & Development Corp.
 - www.grdc.com.au/

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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...

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>

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A Final Thought...

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



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