

# Life's Little Corn Problems: Tips on Crop Diagnostics

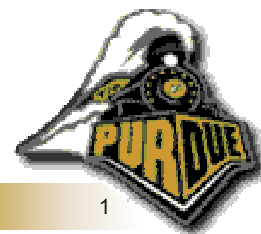


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# Basics of troubleshooting



## Always Remember:

Crop problem  
troubleshooting offers  
many teachable moments.

- Establish the facts
  - Records & recollections
- Identify & examine ALL clues
  - Evidence & diagnostics
- Eliminate possible causes
  - Reasoning & intuition
- Arrive at solution
  - Not always black & white



# What I'm gonna talk about...

- Prepare for upcoming season
- Sources of information
- Tools of the trade
- Working a troubleshoot
- Digital imagery
- Some of my cases

# Prepare for upcoming season

- Good diagnostic skills begin with serious pre-season homework on your part.
  - Impt because many of us 'flush' information from our brains one year to the next
  - Less chance you will be caught by surprise when problems arise
  - May allow you to warn your clientele of impending calamities (aka fearmongering)



# Pre-season homework...



- Refresh yourself on the basics.
- Attend winter conferences/seminars
- Identify and study ahead of time the common problems that can occur throughout the growing season.
- Become familiar with new pesticides, genetics, and other emerging technologies.



# Refresh yourself on...

- Crop growth and development
- Current crop varieties
- Insect & disease pests
- Nutrient deficiencies
- Weed identification
- Herbicide modes of action
- Herbicide crop injury symptoms
- Herbicide label restrictions, esp. relative to crop growth stage



# Sources of information

- Your personal library of crop production resources might include...
  - ASA's Corn & Corn Improvement
    - [www.agronomy.org](http://www.agronomy.org)  
(online store, monographs)
  - Modern Corn & Soybean Production
    - [www.mcsp-pubs.com/](http://www.mcsp-pubs.com/)
- Purdue's ID-179 Corn & Soy Field Guide
  - [Media.Order@ces.purdue.edu](mailto:Media.Order@ces.purdue.edu)
- Purdue's Corn (CD-AY-1, CD-AY-2) and Weed (CD-AY-3) CDs
  - [Media.Order@ces.purdue.edu](mailto:Media.Order@ces.purdue.edu)
- Nebraska's WeedSOFT™ software
  - [weedsoft.unl.edu/](http://weedsoft.unl.edu/)



# Sources of information

- The World Wide Web
  - My first source for information
    - Granted, I have T1 connections 24/7 on campus
    - Or, fast DSL connection at home
    - A 28 to 48k dialup is acceptable
    - Less than 28k is admittedly unsatisfactory
  - Is an overwhelming amount of information
    - That's why I've developed one-stop Web sites for crop production information...





# Web sites I recommend...

- [www.kingcorn.org](http://www.kingcorn.org) (THE Corn Site)
- [www.kingcorn.org/cafe](http://www.kingcorn.org/cafe) (timely info)
- [www.kingcorn.org/news/index-cnn.html](http://www.kingcorn.org/news/index-cnn.html)  
(my newsletter archives)
- [www.kingcorn.org/cgg6.htm](http://www.kingcorn.org/cgg6.htm) (references)
- [www.agry.purdue.edu/ext](http://www.agry.purdue.edu/ext)  
(for soybean, forages, small grains)
- [www.google.com](http://www.google.com) (search engine)





# Your traveling library...

- Establish a minimal set of references to carry in your vehicle all summer.
  - Weed, nutrients, insect & disease resources
    - APS' disease compendia for corn & soy
    - Purdue's ID-179 Corn & Soy Field Guide
  - Herbicides & herbicide pre-mix info and modes of action
    - [Iowa State Univ. Weed Sci](#) is a good source
  - Pertinent articles from recent newsletters
    - [www.kingcorn.org/cafe](#) is a good source
  - Phone lists of agronomic experts



# Encourage early diagnostics

- Remind your clientele that early identification and diagnosis of crop problems are important to sound crop management strategies.
  - 'Early season' because evidence quickly decomposes or disappears.
  - 'Early season' because sometimes damage-control steps can still be taken by the farmer.



# Encourage documentation

- Remind your clientele that thorough documentation of field operations, crop inputs and weather variables greatly improves the odds of accurate diagnoses of crop problems.
  - Desktop programs like Purdue's "WinMax"
    - [www.agry.purdue.edu/max](http://www.agry.purdue.edu/max)
  - Handheld programs like FarmWorks "TracMate"
    - [www.farmworks.com](http://www.farmworks.com)
  - At a minimum, pen & paper
    - [www.walmart.com](http://www.walmart.com)





# Tools of the trade

- Digger or trowel
- Knives (small & large)
- Spade or shovel
- Soil probe
- Plastic bag
- Soil sample bags
- Plastic bucket
- Magnifying lens
- Colored plot flags
- Colored flagging tape
- Garden stakes
- Magic markers
- Measuring tape
- (for me)
- (for roots)
- Cell phone
- Digital camera
- GPS + handheld PC
- Notepad + pencil or
- Voice recorder

**The most important tool:  
An open mind!**

Plastic storage box for your vehicle

Tool bag for the field



# Working the 'crime scene'...

- Homework before the visit
  - Establish the facts
  - Refresh your knowledge
- Detective work in the field
  - Big picture vs. details
  - Opinion vs. facts
- Establish field patterns with today's GPS 'toys'
  - Boundaries vs. data



# Pre-visit homework

- Obtain as much information as possible prior to visiting the field, including ...
  - Client's description of symptom.
  - When did symptom appear?
  - Client's opinion of cause.
  - Other players' opinions of cause.
  - Genetics involved in the case.
  - Cropping history, this year and last.
  - Identities and personal issues, if any, of other 'players'.



# Arrange for the field visit

- Arrange for as many of the 'players' as possible to meet at the field
  - Finger-pointing somewhat less likely
  - Answers to some questions more likely
- Ask that records be available that day
- Don't promise an answer or speculate prematurely about the causes of the problem over the phone.



# Prepare for the visit...

- Summarize weather data since planting
  - State climatology data or your own data
- Familiarize w/ pesticide labels, if necessary
- Familiarize w/ varieties, if necessary
- Browse recent or archived articles on similar symptomology
  - [www.kingcorn.org/cafe](http://www.kingcorn.org/cafe) (Chat 'n Chew Café)
- Check the condition of the batteries in all of your gadgets!



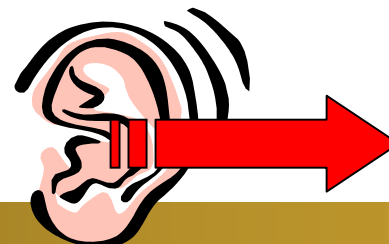
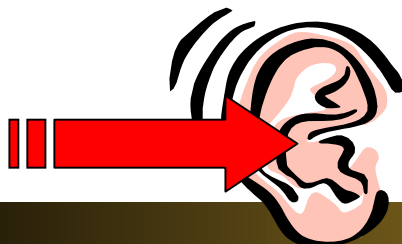
# At the field...

- Ask again for the background information and other details
  - Does today's story corroborate with the one you were told earlier on the phone?
- Any new developments since you were last contacted?
  - Are the symptoms worse or better?
  - Have they spread farther throughout field?



# Grains of salt...

- Often, there is no shortage of opinions from the 'players' assembled at the field
  - Some have positions to defend
  - Some have axes to grind (aka "axes of evil")
  - Some are misinformed
  - Some are thinking ahead to lawsuits
  - Some are simply ignorant



# Forest for the trees...

- Assess the 'big picture' first.
  - Are there obvious field patterns?
    - Man-made or naturally spatial?



# Manmade or natural?



# Forest for the trees...

- Assess the 'big picture' first.
  - Are there obvious field patterns?
  - Are there any odd variables or characteristics?
    - e.g., Planter ruts that suggest planting was done on the 'wet side'?
  - Are there obvious discrepancies with the story you've been told?
    - Small acreage affected, not the whole #%! field



# Closer look at the problem...

- Identify all symptoms, not just the ones described by the other 'players'.
  - Which plant parts are affected?
    - With leaf symptoms, older or newer leaves?
    - With early season problems, dig plants and assess condition of seed, roots, and mesocotyl (of corn).
  - Are symptoms on all plants in the field, only in an area, or just on randomly scattered plants?
    - Estimate percent field damage for calculating yield loss estimate later.

# Closer look at the problem...

- Crop developmental stage today
- Developmental stage at time of damage as suggested by symptomology
  - By which plant parts are affected
  - By recovery, or lack thereof, subsequent to damage
  - By your estimate of Vstage according to cumulative GDD since planting

[www.kingcorn.org/news/articles.01/Corn\\_Phenology-0423.html](http://www.kingcorn.org/news/articles.01/Corn_Phenology-0423.html)





# Plants can confirm...

- Plant injury by Hornet™ + 2,4-D herbicides
  - Lower 9 to 10 leaves appeared normal in color and size
  - Remainder of leaves, stalk, and tassel severely stunted and malformed
- Plant appearance + GDD data supported V9 or V10 as timing of application.
  - Beyond V5 or V6 label limits



# Closer look at the problem...



- Look at good areas of field, not just the bad
  - Partly to remind 'players' what 'normal' looks like
- Look at plants in adjacent fields
  - Sometimes the neighbor's 'good' field also has the symptoms.

# What else is going on?

- Are adjacent fields of same or different crops affected, regardless of similarity?
- Are the weeds in or adjacent to the field also affected?
- Are other fields of same variety or seed lot also affected?
- Are other fields of same planting date also affected?

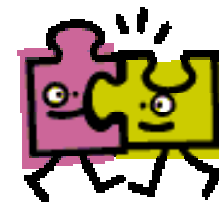
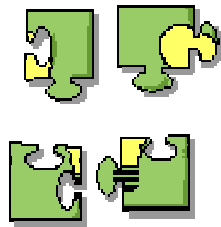
# Think like a detective...

- Success in troubleshooting crop problems often depends on your ability to ask the right questions.
- Asking the right questions often depends on your ability to identify and assimilate all of the evidence 'on the fly'.
  - Doing that homework before the field visit helps kick start the diagnostic process in your head.



# The missing puzzle piece...

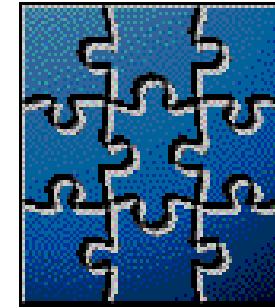
- Asking the right question can often lead you to that one missing piece of the puzzle that will diagnose the problem.
- Sometimes, the missing puzzle piece is never found.
- Sometimes, pieces of the puzzle don't match up with each other.



# Multiple puzzle pieces...

- Sometimes, there is more than one piece to the crop diagnostic puzzle.
  - i.e., Multiple stresses often interact to injure a crop.

On the other hand,  
**hot soils + dry soils + CRW injury  
+ soil compaction + sidewall  
compaction also = TROUBLE!**



- Consequently, sometimes the diagnosis is gray; not black and white.
  - Unfortunately, clients don't often like that answer, do they?



# 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



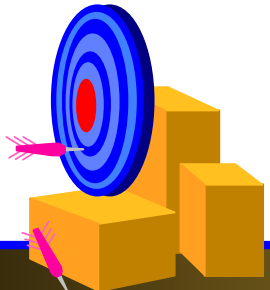
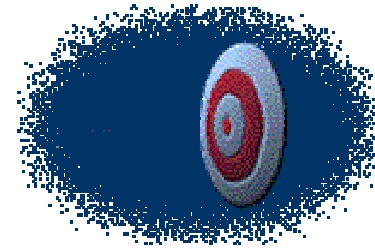
# Which YIFs Are Most Important?

This field?

Last year?

Next year?

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



That field?





# Identifying patterns...

- Today's handheld GPS mapping 'toys' offer opportunities for identifying recognizable patterns of symptoms across a field if they exist.
  - Compaq® iPAQ®
  - NavMan® GPS sleeve or TeleType® World Navigator® CF receiver (both WAAS-enabled)
  - Field mapping software (e.g., Farmworks® Site Mate®)

## Advantages:

Relatively cheap & extremely portable



## Disadvantages:

Handheld WAAS reception is not the most reliable.

# Simple boundaries...

- Spatial technologies create opportunities for mapping the pattern of a problem area in a field.
  - Handhelds + GPS
  - Remote sensing



**Typical Indiana soggy early season soils**

# Simple boundaries...

- Visually definable patterns lend themselves well to simple boundary mapping exercises.
  - Reasonably quick
  - By foot or by ATV



**Mapping soggy soil patterns**



# Simple boundaries...

- Mapping software designed for scouting allows for annotation of lines, points, or polygons.
  - Esri ArcPad®
  - HGIS StarPal®
  - FarmWorks Site Mate®



**Assign rating for soil moisture:  
1 = Moist, 2 = Soggy, or 3 = Standing water**

# Such simple maps may...

- Offer insight for current or future troubleshooting.
- Help interpret causes of spatial variability in yield maps.
- Guide current or future crop management decisions.



**Soggy soils (green) and water flow (purple)**

# Simple doesn't always suffice

- The problem's boundaries may not be clearly distinguishable.
- There may be a need to quantify the problem's severity as well as draw boundaries.
- There may be times where some carefully collected spatial data would help delineate the problem.

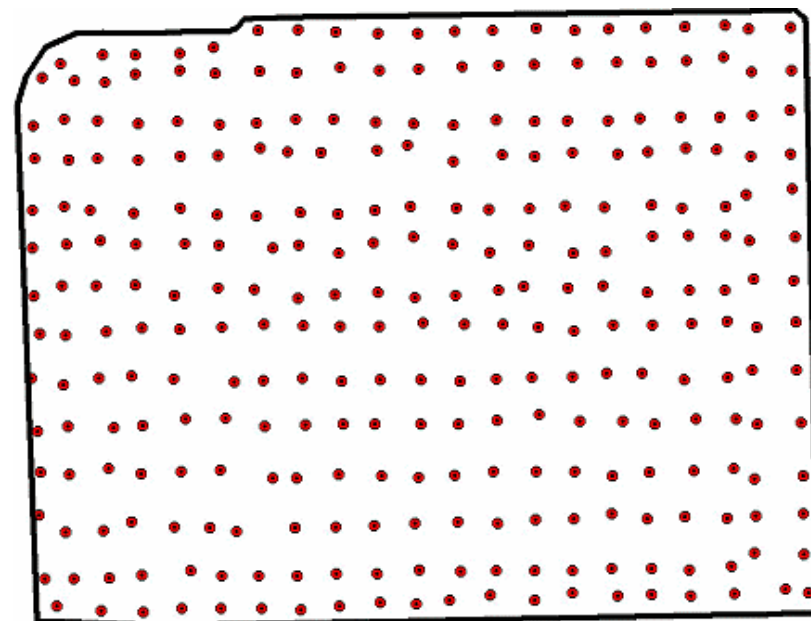


An Example:

Spatially Mapping Soybean Plant Populations

# Spatial plant count data...

- Approx. 10 plant population checks per acre on a fairly equal grid basis
  - Pre-planned grid
  - 292 total data points on 30 acres
  - Cost: Three bodies, two GPS units, one day

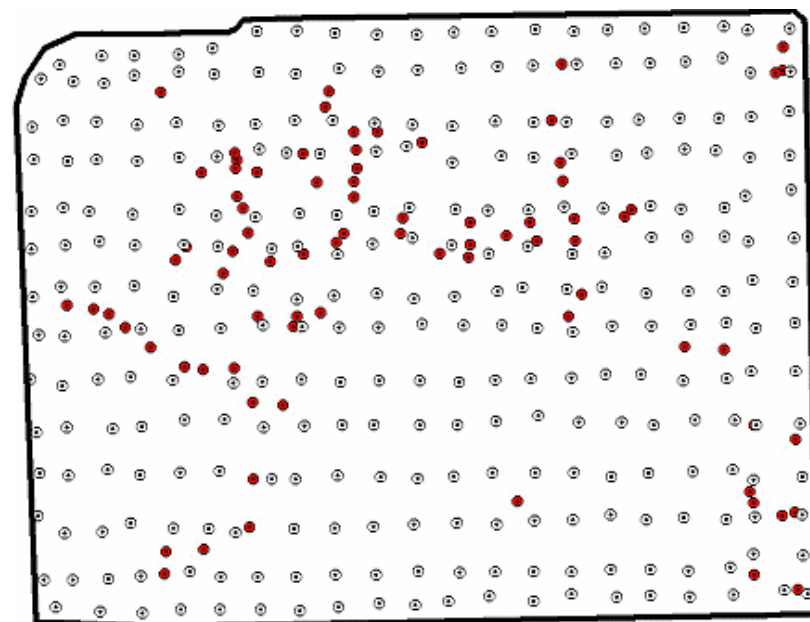


30-acre soybean field

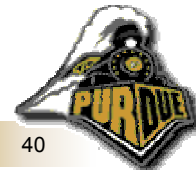


# Additional (directed) sampling

- Our eyeballs suggested a need for some add'l counts in 'odd' areas not covered by grid.
  - Add'l 80 counts
  - 372 data points
  - Cost: Included in first day's work



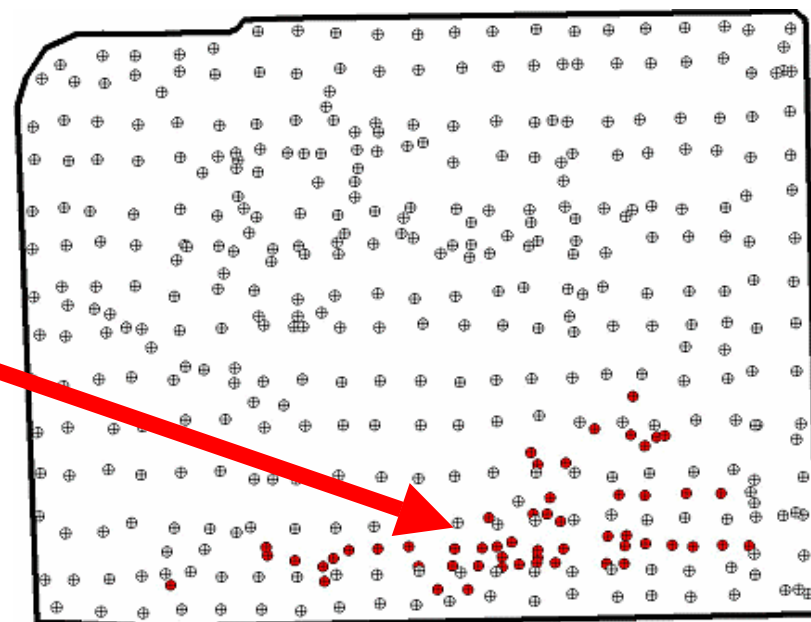
30-acre soybean field





# Revisited field, second day

- GIS map did not agree completely with what we remembered, so we revisited the field
  - Added another 54 population checks
  - Total of 426 data points on 30 acres
  - Cost: Three bodies, one GPS unit, one day

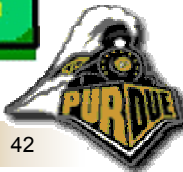
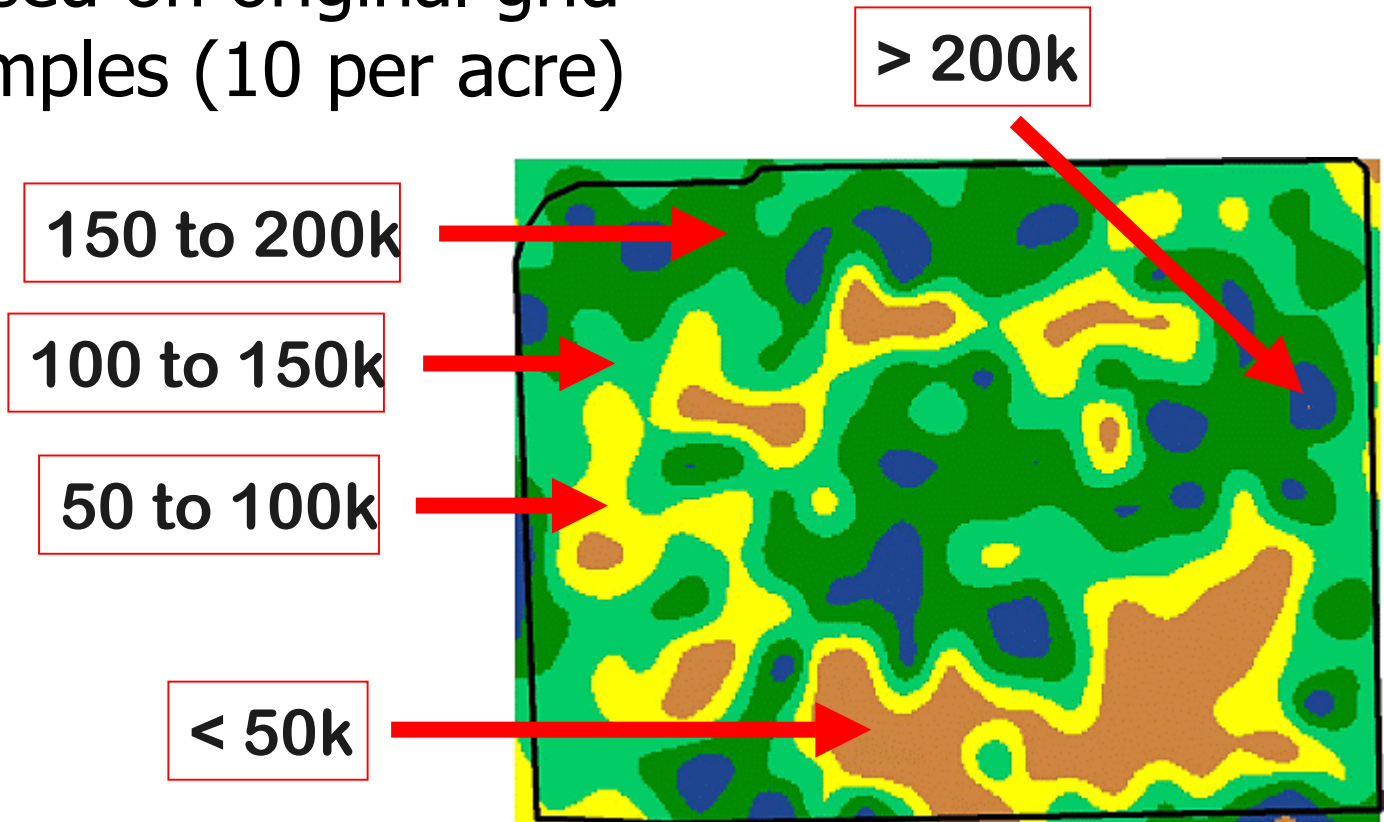


30-acre soybean field

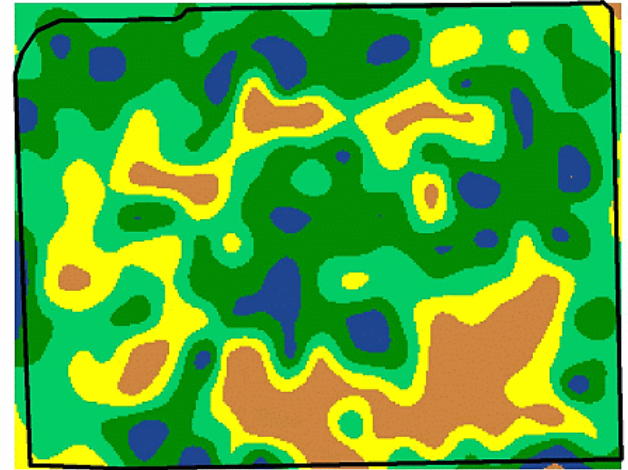


# Soy population map

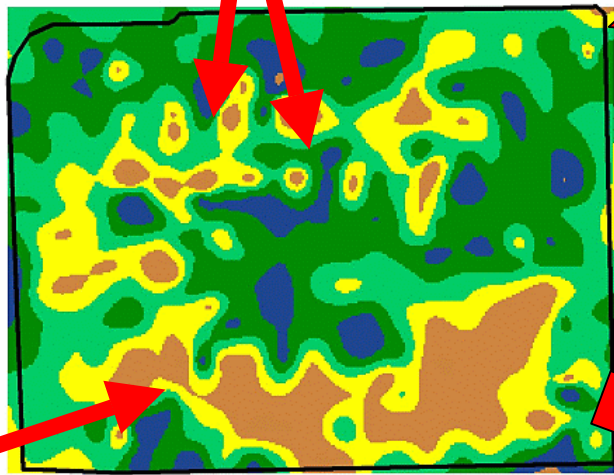
- Based on original grid samples (10 per acre)



# Did add'n'l sampling help?

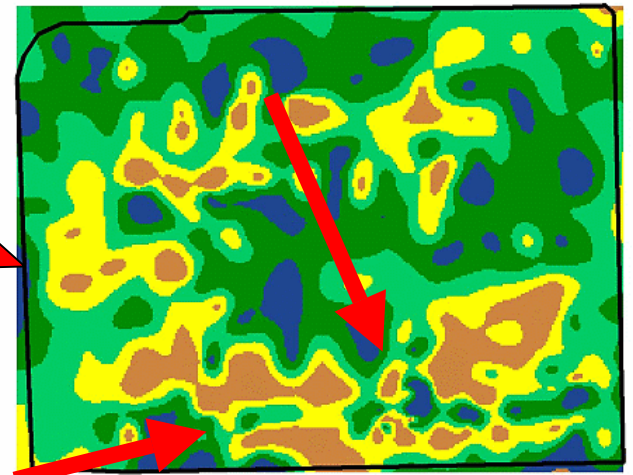


Original data



Original data plus  
directed samples  
on the fly

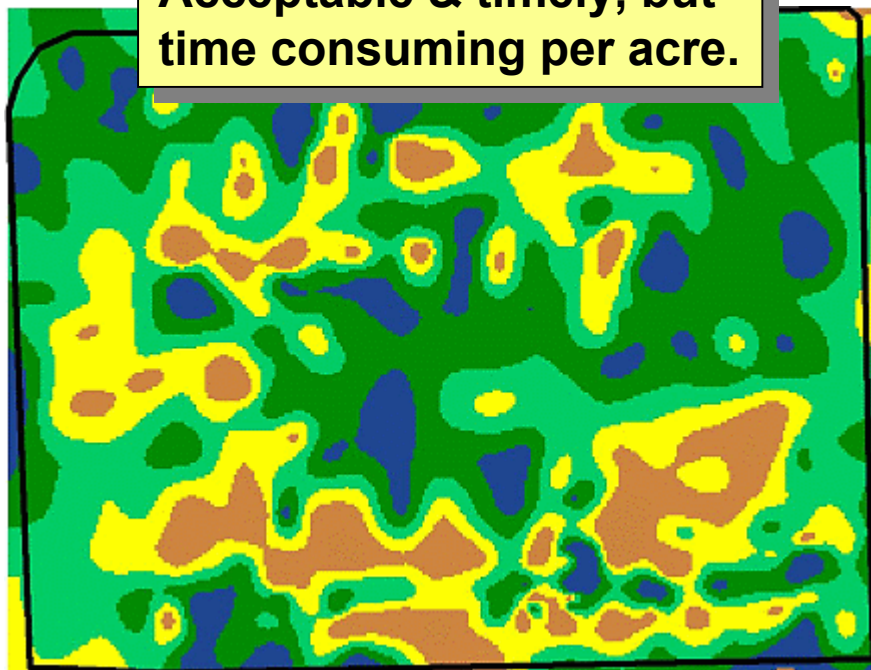
Minor, but potentially useful  
improvements if map were used to  
control a VR replanting operation.



Plus revisit

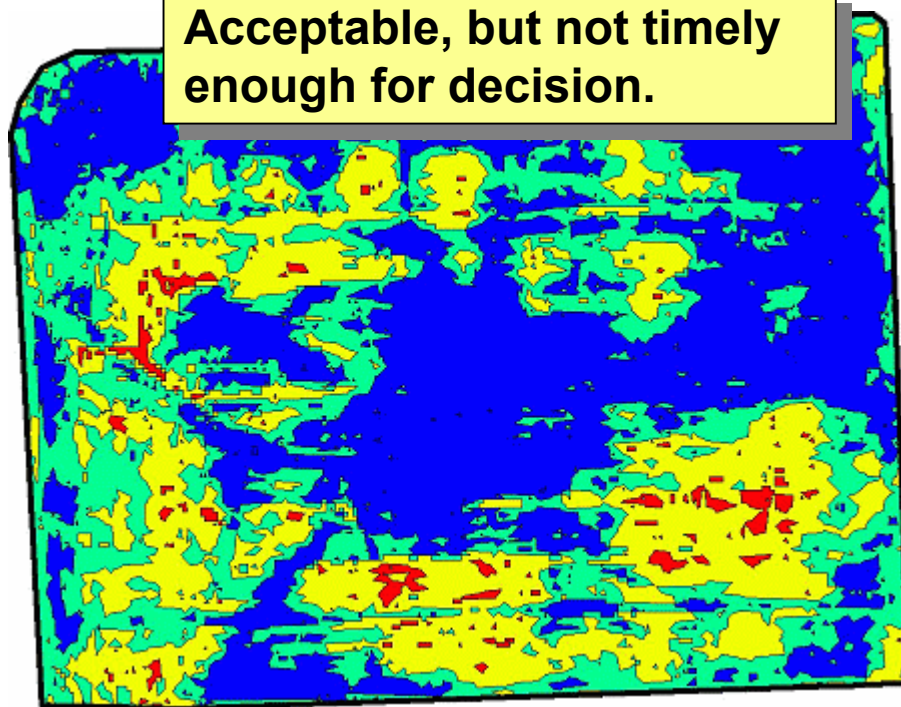
# How accurate were we?

Acceptable & timely, but  
time consuming per acre.



Our map of populations (17 June)

Acceptable, but not timely  
enough for decision.



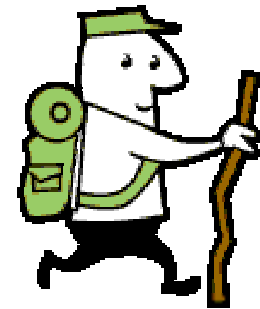
Green vegetation index (NDVI)  
from IR aerial image (8 July)

# So, are these 'toys' worth it?

- Spatial mapmaking can easily lengthen the troubleshooting process.
  - Clientele may not have the patience.
  - You may not have the time.
- No guarantee of providing an answer.
  - Same is true for our other shenanigans.
- But, 'seeing' the pattern is often what we desire when troubleshooting.







# Take a hike...

- Find the opportunity to walk away from the rest of the 'players' and study the problem by yourself.
  - This is why I suggest assembling a 'cast of players' to visit the field



V111702

- Let your eyes wander casually for overlooked symptoms or patterns
- Let your mind wander over the possibilities

# Find time to re-visit fields...

- Illustrates your concern about the farmer's problem.
- Verifies whether your diagnosis was correct.
  - Reinforces your confidence (and the client's) in your troubleshooting skills.
- Documents whether the problem(s) worsened or improved.
- Documents recovery of damaged plants.
  - Esp plants that you marked on 1st trip
- A handheld GPS (e.g. Garmin eTrex Legend) is good for marking the field location for future visits.



# Photographic evidence...



- Useful for future personal reference and use in newsletters, Web-based image libraries, and con't education programs.
- Can help you focus on the details of the problem.
- Traditional 35mm cameras or today's digital cameras





# Advantages to digitals?

- Early digitals were 'toys', today's digitals are tools.
- Quicker transition from field to newsletters (esp Web-based), laptop presentations, and image databases.
- No more wasted film, take as many shots as memory card will store.
- Image editing software offers tremendous power in working with images.



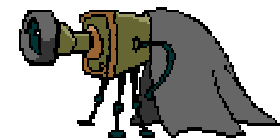
# What I look for in a digital...

- Megapixel rating
  - No less than 2.5M
- Resolution
  - 1738 x 1368 pixels
- Macro capability
  - Down to 1-inch from subject
- Through the lens metering
  - Better WYSIWYG
- Camera body with good grip for one-handed shots
- Decent battery life
- Spot metering
  - Dark subjects and light background
- Decent flash
- Optical zoom
  - No less than 3X
- Image storage
  - CF card (same as used for my handhelds)



# Camera accessories

- 6-inch ruler for perspective on size
- Small tripod for macro or long shutter speeds
- Image backgrounds
  - Blue or black cloth or black rubber truck floor mat
- Extra batteries & charger
- Extra CF memory card(s)
  - About 90 images per 64MB card
- PCMCIA adapter for CF card or CF card reader
- Padded Cordura camera case

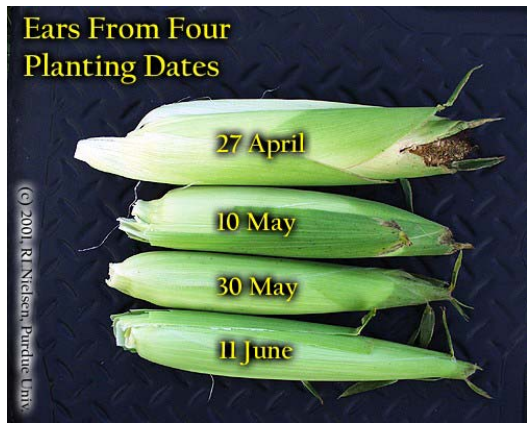


# Capturing the scene...

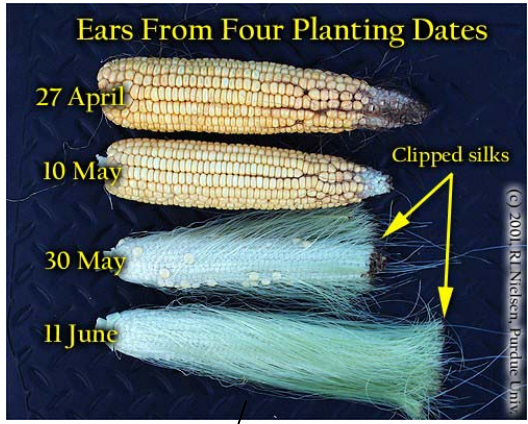


- Capture all aspects of the problem.
- Compose sequential shots.
  - Whole field down to super macro
  - Severity of damage, including normal
- Take full advantage of super macro setting.
  - Close-up details of symptoms
- Use flash and/or spot metering for dark subjects against light or bright backgrounds.
  - Image editing software can further enhance underexposed images

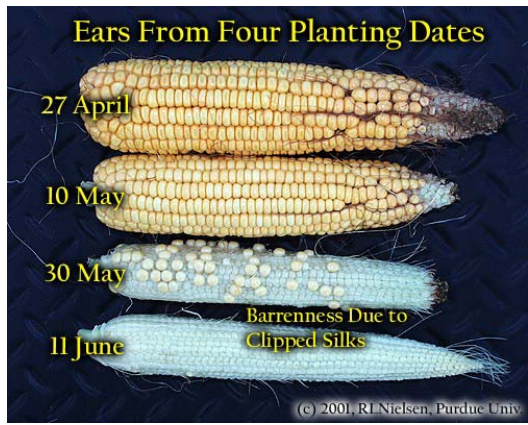
# Sequential imaging...



Ears with husks



Ears without husks, but with attached silks



Ears without husks or silks

**Cause:**  
WCRW beetles attracted to late silking plants



# Document those images!

- Document the details of the images you take on a troubleshoot.
  - Esp if you suffer from 'Sometimers' disease!
- Alternatives include
  - Handheld voice recorders
  - Pen & notepad, or
  - The audio recording capability of some newer digital cameras.



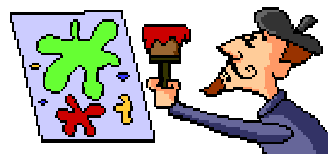
## Remember:

Also document other aspects of your field visit!



# Image editing...

- Why edit?
  - To improve or enhance image appearance or particular details of image.
- Are many software choices, I happen to use:
  - Adobe Photoshop & ULead Photoimpact
  - Each has own strengths and weaknesses
- Useful features
  - Cropping to remove unwanted parts of image
  - Focus or sharpening to improve clarity
  - Contrast & color enhancement
  - Re-sizing to match intended use
  - Optimizing or reducing file size for faster Web downloads
  - Inserting text & symbols



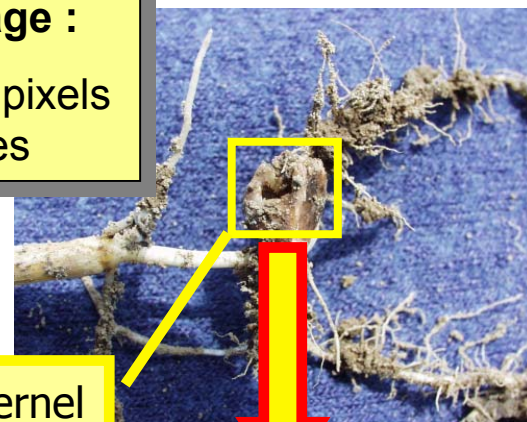


# Virtual closeups w/ cropping...

- Because the true size of a high resolution image is immense, cropping a small area results in a net gain in magnification.
- Image details become visible that could not be seen easily with the naked eye.

**Original image :**

1738 x 1368 pixels  
24 x 19 inches

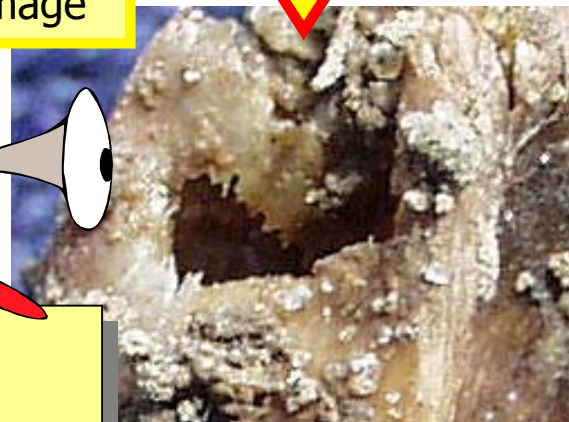


Crop just the kernel area of the image



**Cropped image :**

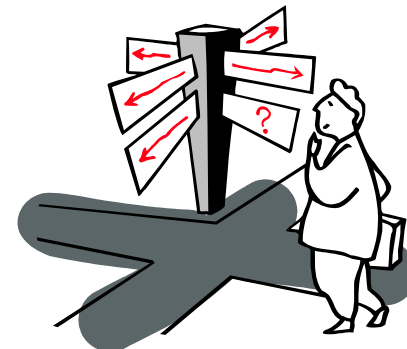
Amazing details of kernel damage by seed-corn maggot





# Managing images...

- Managing thousands of images, whether digital or slide, is an immense challenge.
  - Image details
    - Where, what, & why?
  - Image location
    - Where did I file that?
  - Image matches
    - All frost damage images in my collection?



# An image database I like...

- IMatch™ image management database
  - [www.photools.com](http://www.photools.com)
  - Folder management-like interface
  - Allows annotation of each image
  - Allows assignment of categories to images
  - Does more than I yet understand
  - Unbelievably cheap (\$49.95)

# Three interesting cases...

- When good corn fields turn bad (2000)
- Unsuccessful sex in the corn field (2001)
- Sidewall compaction (2002)



# Seedling Blight in Corn

- Example of a field of corn in northwest Indiana planted mid-April 2000 under “good” conditions.
  - Emergence described as uniform and acceptable
  - Early seedling development described as uniform and acceptable

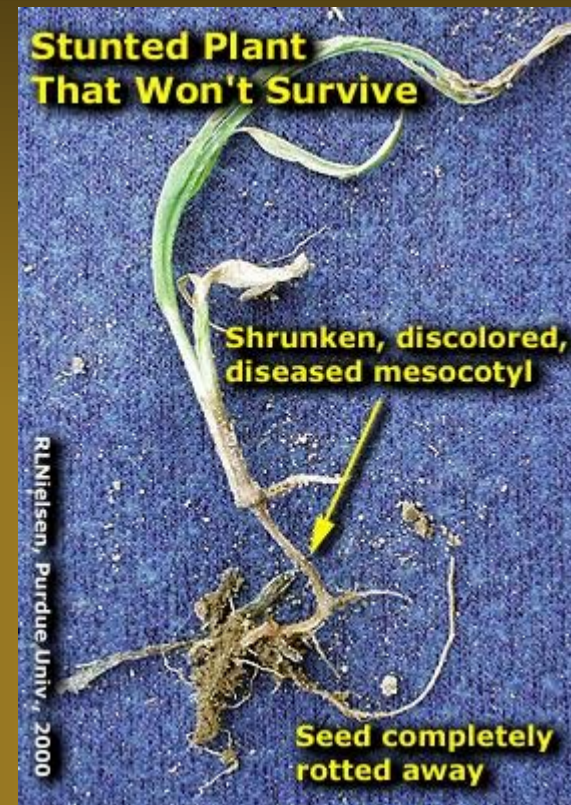


# Stunting & death of plants

- Areas of fields with significant plant stunting or death developed 4 to 6 wks after planting
  - Often on 'higher' and 'lighter' areas of field
    - Not where you would expect seedling blight

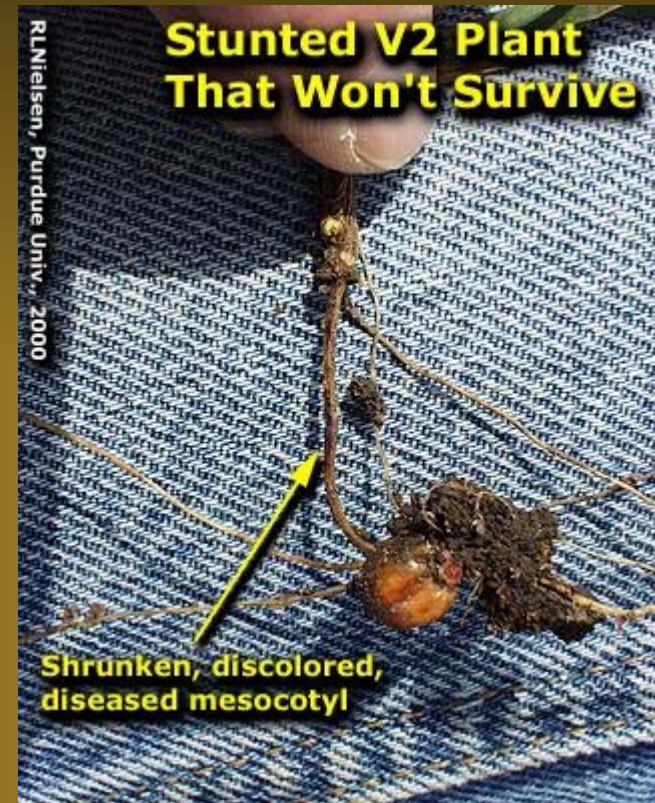


# 'Normal' and stunted plants





# Seedling blight on young corn



# Farmer: Why seedling blight?

- After all, seed fungicide treatments are better than ever!
  - Captan®, Maxim®, Apron®
- Furthermore, problems were not always occurring in lower wetter areas of fields.
  - Where we usually worry about disease
  - Rather, on the higher & lighter soils





# Purpose of seed treatments?

- Obviously, to protect seed and seedling from early fungal diseases.
  - *Pythium, rhizoctonia, etc.*
- More specifically, protection until the plants' permanent (nodal) roots are well established.
  - Generally 'in place' by V4 to V6.



# Fungicidal seed treatments

- Sadly, the life span of seed treatments is typically no longer than 2 to 3 weeks after planting.
- Furthermore, once seed coat breaks due to germination, fungicidal protection is often compromised.

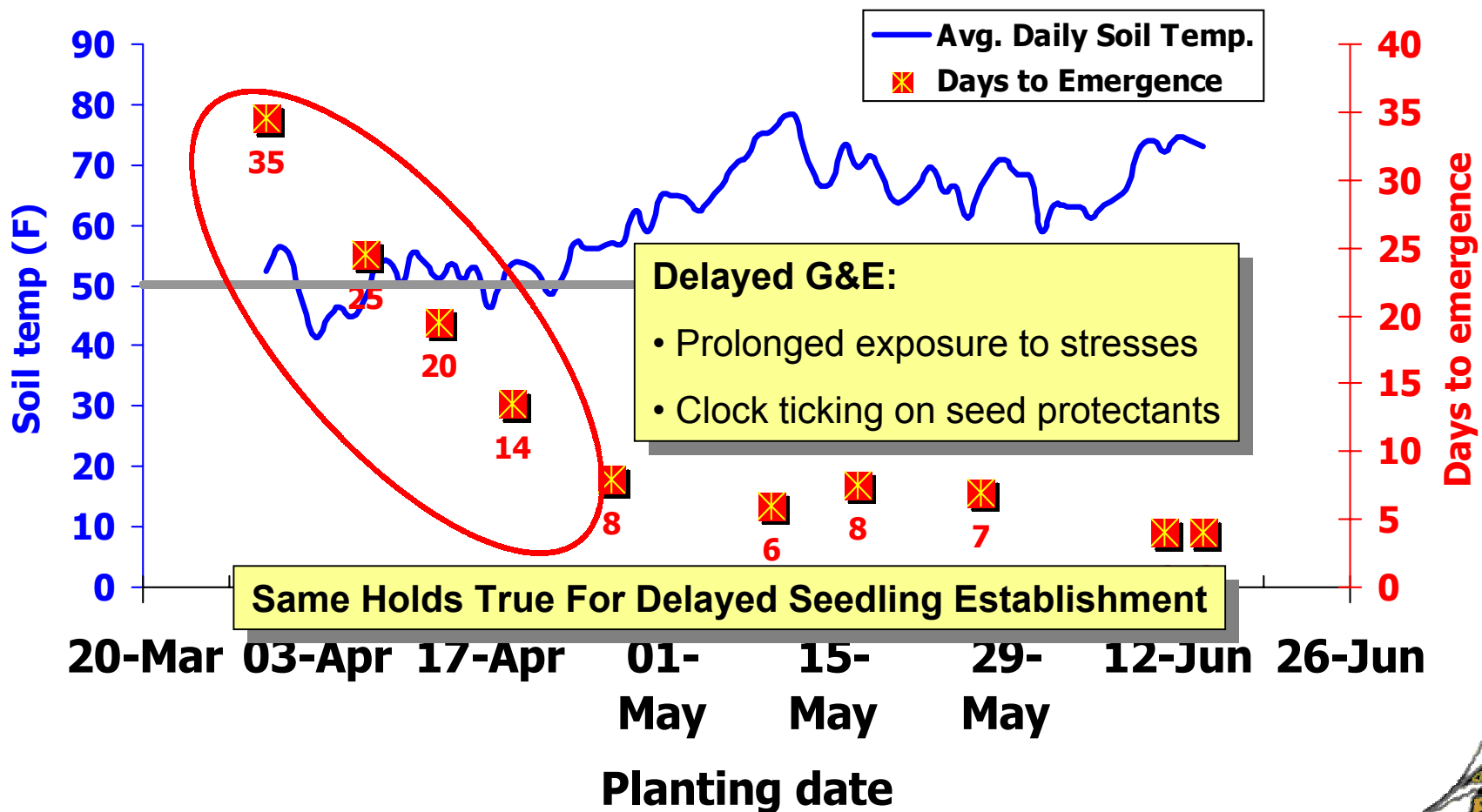


# So, why seedling blight?

- Early planting, cool soils, slow G&E
  - Pronounced on lighter colored soils
- Cool soils for 4 to 6 wks after planting
  - Pronounced on lighter colored soils
  - Slow corn seedling development
    - Including nodal root development
- Seed treatment eventually 'gives up ghost'
  - Pathogens 'move in for the kill'



# Soil temperature & corn emergence



Unsuccessful Corn Field Sex:

# Pollination & Kernel Set Problems

- Numerous reports of poor kernel set, poor tip fill, and kernel abortion in 2001.
- Classic example of similar symptoms with multiple causes.



Causes of Poor Kernel Set:

# Typically, we think of...

- Persistent silk clipping by insects during pollen shed.
- Silk delay from drought stress.
- Silk dessication by heat & low humidity.
- Herbicide injury to tassel or ear development.
- Silk 'balling' or 'knotting up' inside the husk leaves



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# How to decide?

---

- Pollination evidence
  - Aborted ovules vs unfertilized kernels
  - Spent anthers on ground, leaves, and behind leaf sheaths
  - Presence of pollen as indicated by discolored areas (decomposing pollen) behind leaf sheaths
  - Tassel appearance
  - Silk length or absence
  - Presence of CRW or Japanese beetles



# How to decide?

---

- Symptom patterns in the field
  - Herb. applic. spray boom patterns
  - Soil type patterns
  - Topography patterns
  - Hybrid variability for symptoms
  - Field pattern; edges vs. middle or N-S-E-W differences



# In 2001, we considered...

- Aggressive silk clipping by CRW beetles and Japanese beetles
  - Esp in odd-ball planting dates

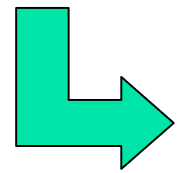
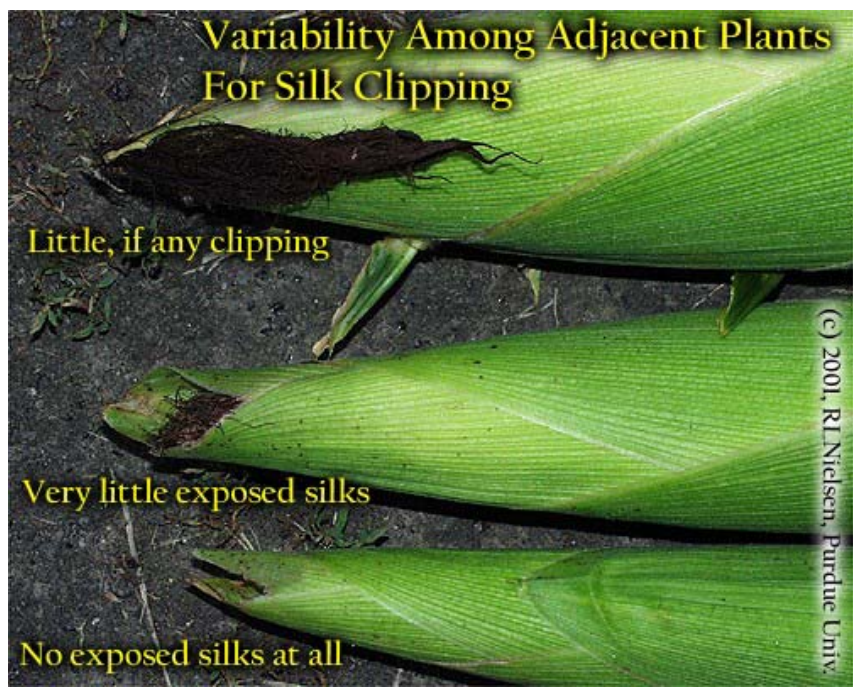
**Half of Indiana's corn crop was planted over a seven-day period from Apr 29 to May 6!**

- Esp in fields with delayed emergers
  - Perhaps only days difference!



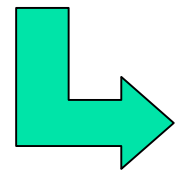
# Uneven silk emergence & CRW

**Beetles were attracted to late emergers like Cornhusker fans are to football games!**

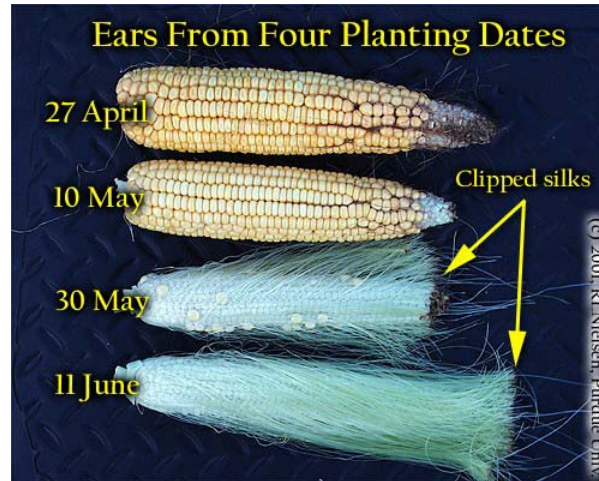
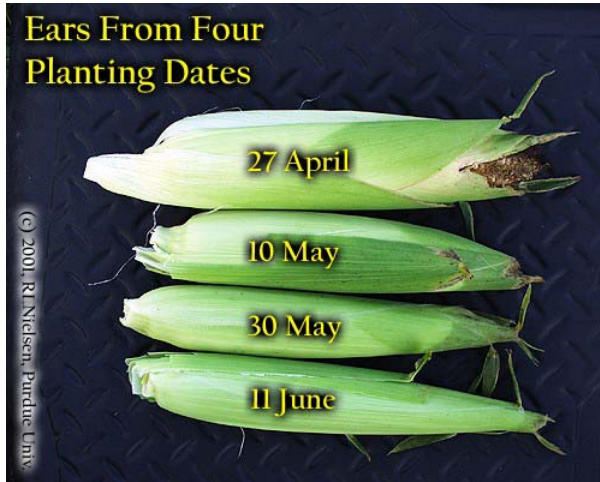




# Another example of CRW...



# Silk clipping by planting date



# In 2001, we also considered...

- Silk emergence delay or dessication due to drought & heat stress near pollination
  - Not many areas of Indiana, but occurred elsewhere in the Midwest



# In 2001, we also considered...

- Consequences of silk clipping or drought in hybrids produced via male-sterile systems and marketed with high percent male sterile seed.
  - Probably cannot be discounted as a contributing factor for some pollination failure situations.
  - But, difficult to prove in the field.





# In 2001, we also considered...

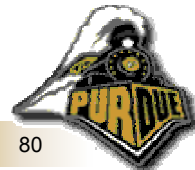
- Some unidentified 'weakness' in particular genetic lines that responded to certain stresses in terms of defective anthers or ovules; or kernel abortion.
  - Again, probably cannot be discounted.
  - But, difficult to prove in the field.





## In 2001, we also considered...

- Herbicide injury to developing anthers or ovules resulting from off-label post-emergence applications, even on tolerant hybrids.
  - Evidence supported this in some fields, but by no means all situations.
  - Remember that herbicide 'tolerant' hybrids are not herbicide 'resistant'.



# One situation w/ HT hybrid...

- Ear symptoms

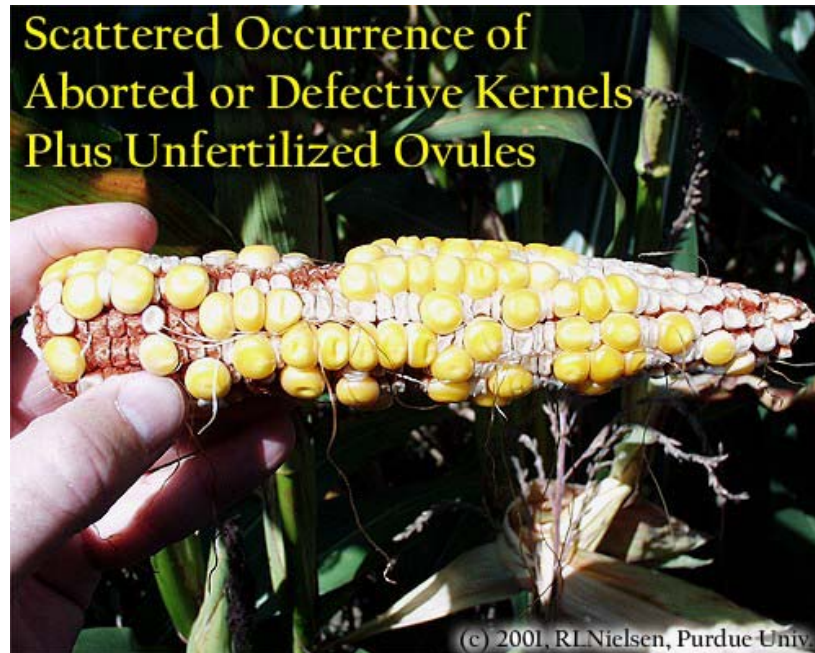
- Random aborted or defective kernels & unfertilized ovules
- Silk length normal

- Plant appearance

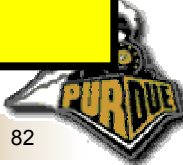
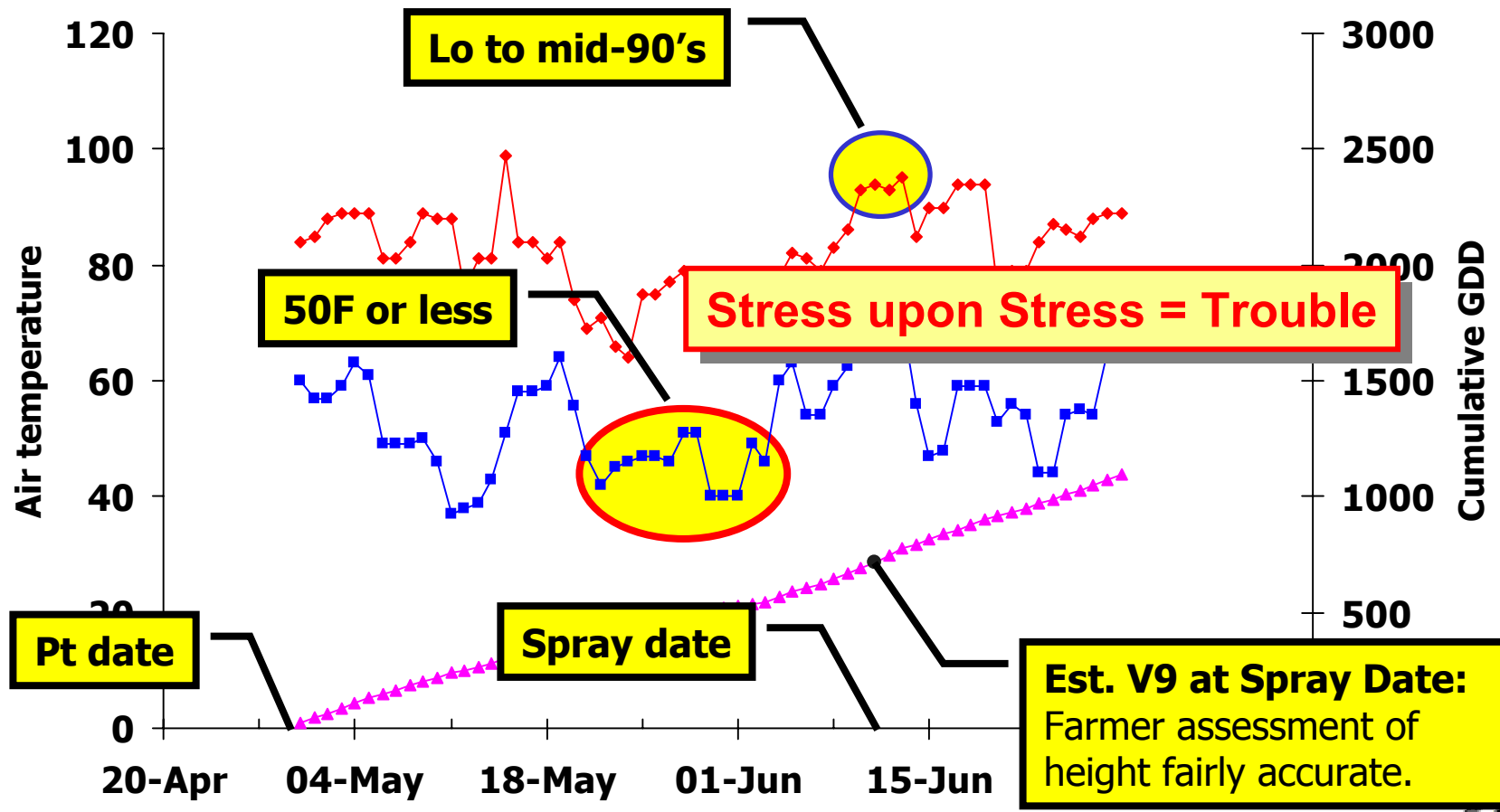
- Normal, except in affected areas where 'tight' tassels were found w/o apparent anther exertion

- Farmer recollection

- Waist high at appl'n
- No drops on sprayer

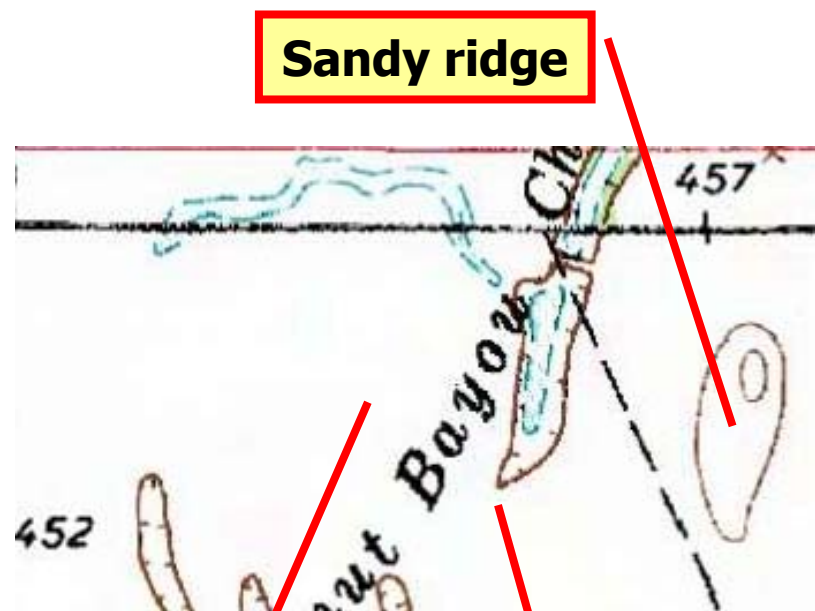


# Appl'n timing, Vstage, temps



# Field evidence...

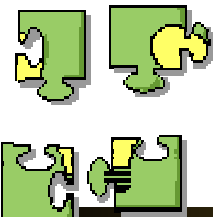
- Worse where spray passes overlapped first 20' beyond end rows into bulk of field.
- Normal ears in swale. Affected ears found elsewhere at varying frequencies. **Why?**



**In Between**

**Farmer's recollection about low-lying swale:**  
Ponded earlier in season, corn development delayed.

**Swale**



# Conclusions in this field?

- Herbicide injury to either tassel or ear development prior to pollination, encouraged by...
  - Stress on crop from 14 days of sub-50F daily low temperatures ending one week prior to application
  - Stress on crop from mid-90's temperatures at time of application
  - Off-label application of chemical (over the top beyond rated label height)
  - Spray boom overlap extending out from end rows



# Conclusions in 2001?

- Was likely no single cause of the pollination failure reported in 2001.
- Many situations in Indiana were the result of aggressive beetle silk clipping.
- Herbicide injury, primarily off-label applications, was to blame in some fields.
- Hybrid responses to stressful growing conditions likely contributed to the problem.
- Some fields suffered from multiple causes.



When Good Fields Turn Bad: Another Example

# Sidewall compaction - 2002

- Lengthy, wet spring delayed field work
- Tillage often done on the “wet side”
  - Shallow horizontal compaction
- Corn often planted on the “wet side”
  - Sidewall compaction
- Followed by rapid onset of drought conditions during early nodal root development





# Stunted Growth

Caused by tillage compaction,  
sidewall compaction, and  
drought conditions



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**Root System Limited  
by Soil Compaction**

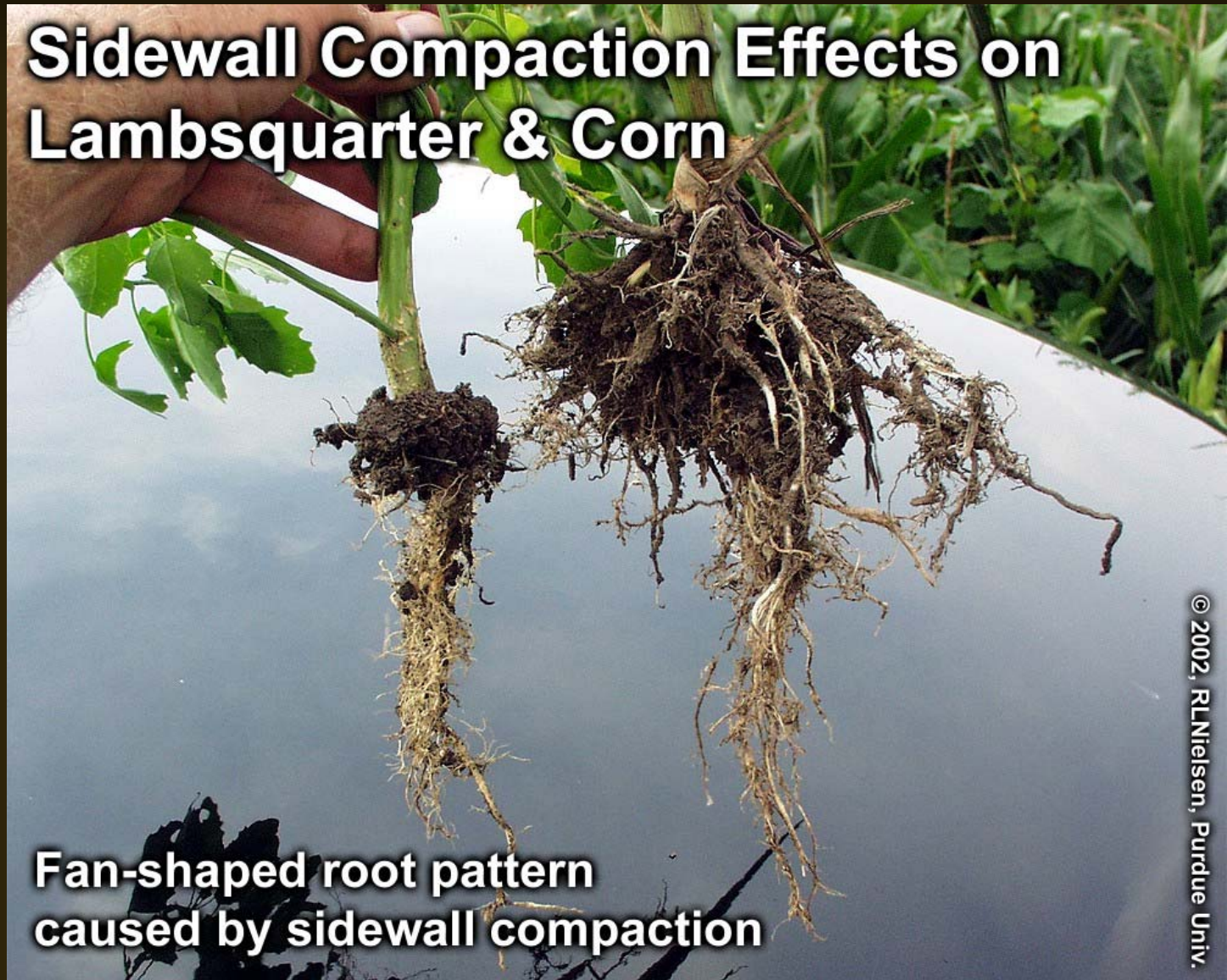
**Tillage compaction  
2 to 3 inches below surface**

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# Sidewall Compaction Effects on Lambsquarter & Corn

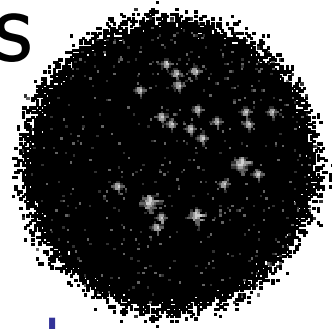


**Fan-shaped root pattern  
caused by sidewall compaction**

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# Key factors influencing injury

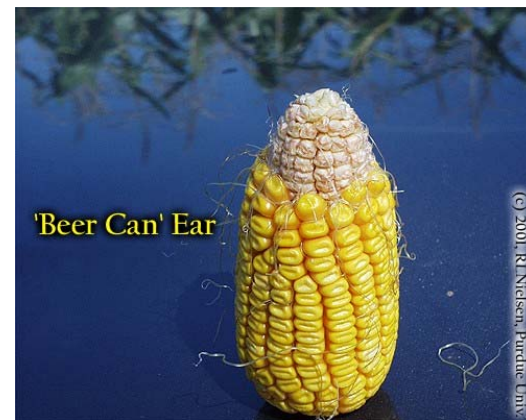
- The unusual timing of the stresses relative to crop growth stage (aka the “alignment of the stars”)
  - Early stages of nodal root formation +
  - Sidewall compaction +
  - Tillage compaction +
  - Onset of severe soil drying +
  - Onset of unusual heat



When Good Fields Turn Bad: Another Example

# Beer cans & hand grenades...

- This unusual form of arrested ear development was observed again in 2001 in northeast Indiana.
  - Nearly normal row number on lower half of ear
  - Ear development totally arrested beyond that
  - Hybrid variability observed in a company hybrid research plots.



# Past occurrences...

- This phenomenon has been reported off and on for more than 10 years throughout the U.S. Midwest and East.
- No consensus yet on the cause of the symptom.
  - Nutrient, pH, tillage, plant population, and disease have all been investigated to no avail.





# One dummy's theory...



- The complete arrest of ear development suggests a single stress event that simply stopped further development, not a lingering or cumulative form of stress.
- Possible causes?
  - Herbicide injury? No common links among affected fields.
  - Chilling injury?





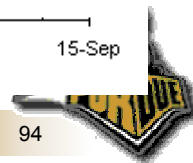
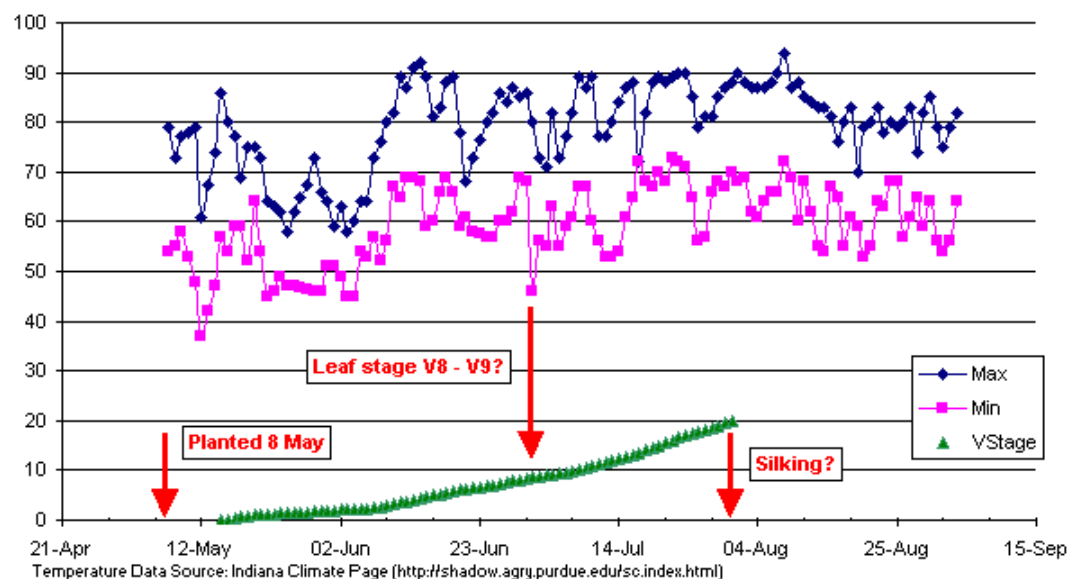
# What does the ear tell us?

- Appears that ear development is arrested  $\frac{1}{4}$  to  $\frac{1}{2}$  of the way through the process.
  - About V9 or so

## The 2001 Episode:

A single chilling event (40's) occurred in NE Indiana at about the time that this field was estimated to be at leaf stages V8 to V9.

Air Temperatures & Estimated Corn Growth Stage  
Bluffton, IN, 2001



# Chilling as a culprit?

- Similar chilling events have occurred at about the right leaf stage for other years' beer canning events.
- Belgium research documents potential for ear abortion and tassel deformation due to chilling injury at about V5.
- We aim to investigate this potential culprit with upcoming growth chamber studies using a frequently affected hybrid pedigree.



# What I talked about...

- Prepare for upcoming season
- Sources of information
- Tools of the trade
- Working a troubleshoot
- Digital imagery
- Some of my cases



# Hungry for More?

- Or didn't catch what I said the first time?



## Chat 'n Chew Café

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<http://www.kingcorn.org/cafe>

*Corny News Network*

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