Corn Planter Tune-ups: Why Bother?

R.L. (Bob) Nielsen
Dept. of Agronomy
Purdue University
West Lafayette, Indiana

Email: rnielsen@purdue.edu
Web: www.kingcorn.org

We've known for years that…

- Variable stands of corn are costly in terms of bushels and lost revenue.

1920

2004

Image source: http://www.kinzemfg.com

Image source: http://www.field-reporter.com/The_Green_Girl_2001/gg-01-08-01.htm

A Biblical reference…

- Parable of the sower (Matthew 13:3-8)
  - Seeds along path ⇨ bird feed
  - Seeds in rocky ground ⇨ scorched, withered
  - Seeds within thorns ⇨ choked by weeds
  - Seeds in good soil ⇨ **brought forth grain**

One man's opinion…

"The sins of planting will haunt you all season!"

-- *Ozzie Luetkemeier*
Former supt., Purdue Agronomy Farm

A Fact of Life…

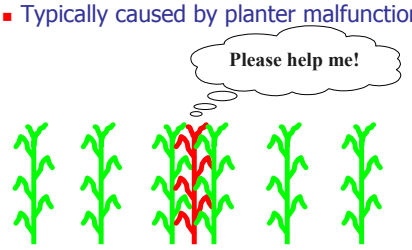
"A young field of corn can look pretty darn uniform from the seat of your pickup tooling down the blacktop at 60 mph."
-- Bob Nielsen

Variable stands may be …

- Plant spacing variability (PSV)
  - How uniformly were the seeds distributed within the row by the planter?

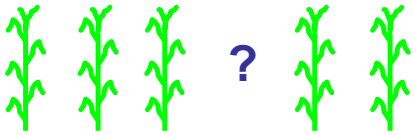
PSV may be …

- Very crowded plants here and there...
  - Typically caused by planter malfunction



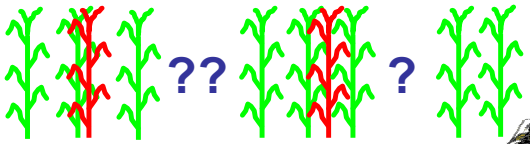
PSV may also be …

- Gaps between plants of various sizes caused by…
  - Planter malfunction and/or
  - Poor germination or survival of plants



PSV is often composed of …

- Mixtures of crowded plants and gaps between plants caused by…
  - Planter malfunction and/or
  - Poor germination or survival of plants



Effect of gaps on yield?

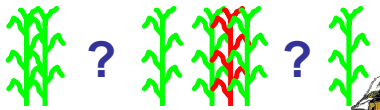
- No effect if surviving plant population is still within optimum range.
  - For many soils, "optimum" final stand ranges from about 28 to 32,000 ppa.
- Lower grain yield if surviving plant population is less than optimum.

Effects of doubles on yield?

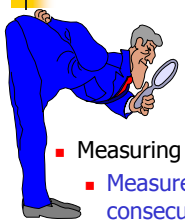
- If targeted seeding rate is below the optimum threshold, doubles may actually increase yield until that threshold is exceeded.
  - E. Nafziger, J. Prod. Ag. 9:238-240 (1996)
- Yields or standability may decrease at some point beyond optimum population threshold.

Effect of gaps **PLUS** doubles?

- When variable plant spacing is a **MIXTURE** of gaps and doubles…
  - Effect will usually be negative because the extra plants (doubles) and the plants adjacent to the gaps cannot make up for the grain yield loss caused by the missing plants.



How much yield loss?



- First, I have to explain how you measure and quantify the plant spacing problem.

- Measuring is simple…
  - Measure & record a "bunch" of consecutive plant-to-plant spacings at 2 or 3 locations around the field.
  - Repeat for each row unit of the planter.

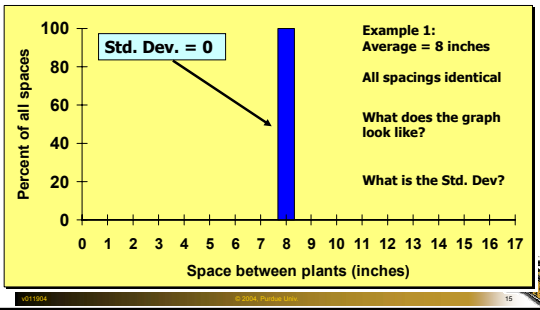
Quantifying the problem...

- Calculate a simple mathematical measure of variability called the **standard deviation.**
  - Large values equal large variability.
  - Most computer spreadsheet programs will easily allow you to calculate standard deviations from a list of values.

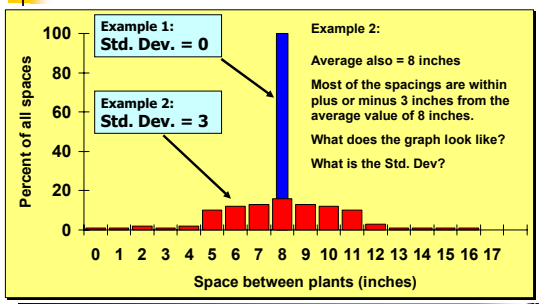
Mental anguish:

Simple to calculate, difficult to understand

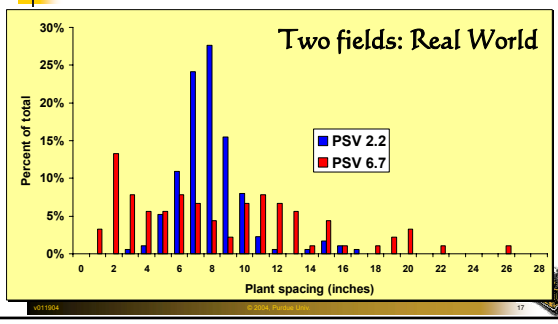
An illustration of uniformity…



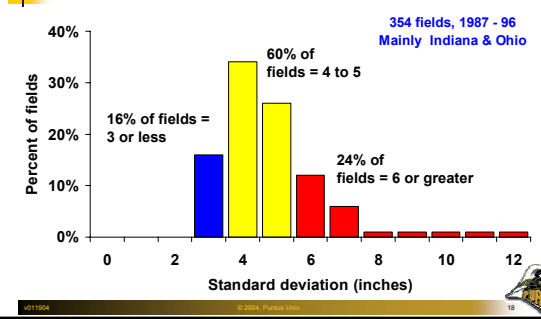
An illustration of variability…



Same populations, different PSVs



Plant spacing variability within commercial fields of corn



So, what's the yield loss?

Yield Loss:

2½ bushels for every one inch increase in standard deviation of plant-to-plant spacing!

- From my field research, 1987-93
  - Yield levels from 95 bu/ac to 200 bu/ac
  - Applicable to standard deviations between 2 and 12 inches

More recent research…

- Pioneer™ researchers reported very similar yield loss rates from four locations across the Midwest in 2000.
  - Three different genetic families.
  - Approximately 3.4 bushel decrease per inch increase in standard deviation of plant spacing.

Data source: Pioneer Hi-Bred Int'l
http://www.pioneer.com/growingpoint/agronomy/crop_insight/plantspacing.jsp

How good is good enough?

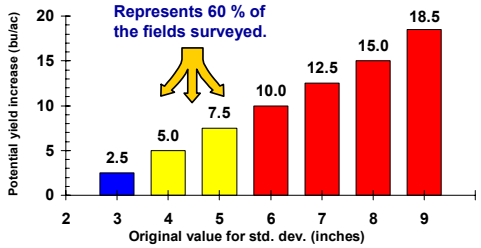
- When measuring **seed spacings**, aim for a target standard deviation of zero (0) inches.
  - Hard to achieve, but make it your goal.

How good is good enough?

- When measuring **plant spacings**, aim for a target standard deviation of two (2) inches, rather than zero.
  - For typical emergence percentages (90 to 95% of seeding rate), a standard deviation among PLANT spacings of 2 inches may be equivalent to perfect SEED spacing.

So, what do you gain?

Yield increases from reduced **plant** spacing variability



What causes variability?

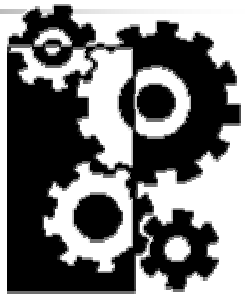
- Germination of the seed (minor issue)
- Planter malfunction...
  - Worn out planter parts
  - Incorrect planter settings and adjustments
  - Operator error
    - Otherwise known as that "loose nut behind the wheel"
      - So says Larry Cline (Deere & Co.)

Source of image: http://www.usda.gov/oc/photo/01di1431.htm

Don't forget Mother Nature…

- Irregular patterns of plant death by hail, frost, insects, disease can cause PSV.
  - Make sure you diagnose the cause(s) of stand variability early to determine whether to blame the planter or Mother Nature!

Let's Change Gears...



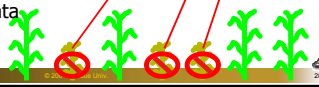
Variable stands can also be..

- Variability for time of seedling emergence throughout the field

Germination & Emergence:

Why is uniform desirable?

- Delayed plants cannot compete with older, more established plants.
  - At best, delayed emergers will contribute little to yield.
- Potential yield losses...
  - 8 to 20 % loss if 25 % or more of stand is 2 or more leaf stages "behind"
    - Univ. of IL data



Causes of delayed emergence...

- Variability in soil moisture
  - Soil variability for texture and natural or artificial drainage
  - Uneven seeding depths
  - Uneven distribution of crop residues
  - Soil drying patterns due to tillage traffic

Causes of delayed emergence...

- Variability in seedbed soil temperature
  - Variable soil color and texture
  - Variable seeding depths
  - Variable distribution of crop residues

- Especially important when soil temps. are hovering around 50F (10C).

PURDUE UNIVERSITY

Causes of delayed emergence...

- Uneven seed to soil contact
  - Rough, cloddy seedbeds
  - Uneven distribution of crop residues
  - Coulter running too deep
  - Incorrect furrow openers adjustment
  - Incorrect furrow closers adjustment

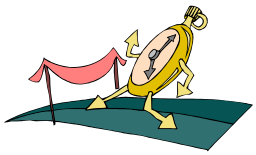
PURDUE UNIVERSITY

Minimize uneven stands...

- With just a little effort and common sense on your part!
  - Offseason care of planter
  - Replacing worn parts
  - Making planter adjustments and operating the planter as soil & weather conditions dictate

PURDUE UNIVERSITY

Don't let time run away...



- Take the time to inspect & service your planter on your own, or...
- Let your local planter dealer do it for you.

PURDUE UNIVERSITY

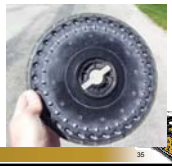
After planting is completed...

- Clean planter inside and out.
  - Remove all seed from hoppers and metering units.
  - Don't let it sit in the hoppers and rot or attract rodents for months.

PURDUE UNIVERSITY

After planting is completed...

- Remove seed discs from vacuum planter.
  - Else rubber seals remain compressed and will fail sooner than otherwise.
  - Hang on wall, not stacked on workbench, to avoid warping.
  - Store where temps remain above freezing.



PURDUE UNIVERSITY

After planting is completed...

- Lubricate all chains and bearings.
  - If practical, remove the chains and soak in oil all winter.
- Protect the planter from the elements.
  - Preferably inside.
  - Or outside but protected.

Pre-season maintenance…

- Check and replace all worn out parts.
  - Seed meter components, chain links, disc openers, hydraulic hoses, seed tubes, etc.
- Ensure that coulters and disc openers are aligned accurately.
  - Proper alignment improves accuracy of seed furrow opening.

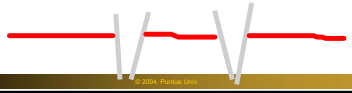
Pre-season maintenance…

- Ensure disc openers and furrow closers are aligned accurately.
  - Affects furrow closing efficiency.
- With Case IH Cyclos, replace worn seals and check trueness of fit of seed drum against firewall.

Image source: http://www.caseih.com

Pre-season maintenance…

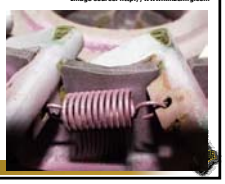
- Adjust or replace worn disc openers.
  - Worn openers cut "W" furrows rather than "V".
    - Closing wheels may not completely firm soil around seed.
  - Adjust shims so that bottoms touch.
    - Replace openers when no longer possible.
      - Some say replace when 1 inch of wear occurs.



Pre-season maintenance…

- For finger-pickup type planters.
  - Check seed meter backplates.
    - Rust buildup
    - Seed treatment residues
    - Worn down 'dimples'

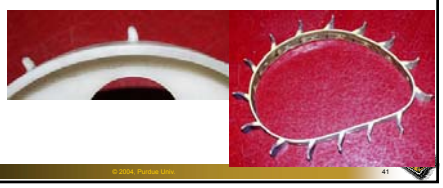
Image source: http://www.kinzemfg.com



Pre-season maintenance…

- Check condition of seed conveyor belt.
  - Age + seed treatment = brittleness
- Check condition of drive sprocket teeth.
  - Wear & tear eventually affects operation.

Image source: http://www.kinzemfg.com



Pre-season maintenance…

- Inflate tires to correct pressure.
- Clean seed tubes and monitor sensors .
- Replace seed tubes if excessively worn at bottom.
- **CALIBRATE THE PLANTER!**

Calibrate the planter

- For air or vacuum planters:
  - Calculate & record the seed weight for each seed lot you intend to plant.
  - Identify & record the correct pressure (air or vacuum) for the calculated seed weight.
  - Identify & record the correct seed disc (or drum) for the calculated seed weight.

Calibrate the planter…

- Calibrate the radar.
  - Ensures accurate speed and distance measurement.
- Identify the correct transmission setting for the desired seeding rate.
  - Use the operators manual.

A real operators manual!

Calibrate the planter…

- Calibrate actual seed drop with...
  - Planter transmission settings
  - Planter monitor readouts

Image source: http://www.dickey-john.com

Calibrate the planter…

- Calibrate at normal planting speeds and seeding rates in as close to field conditions as possible.
  - Don't calibrate the planter in the farm lane.
  - Else cannot account for wheel slippage and row unit bounce.

While you're at it...

- Calibrate pesticide and fertilizer planter attachments at same time…
  - Application rates can easily change from year to year.
  - Also check position of attachments relative to planter unit itself.
    - Especially starter fertilizer attachments.

Is the planter level?

- Check that the planter units are parallel or level to the ground when the planter is in operation, because that affects...
  - Disc opener depth
  - Press wheel efficiency
  - Seed to soil contact

Level planter unit…

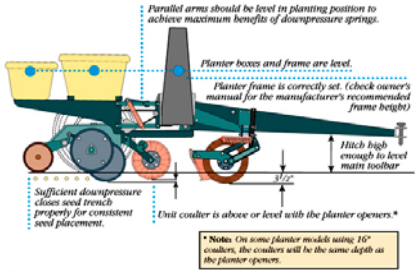


Image source: http://www.yetterco.com/help/plantguide.html

Planter unit not level…

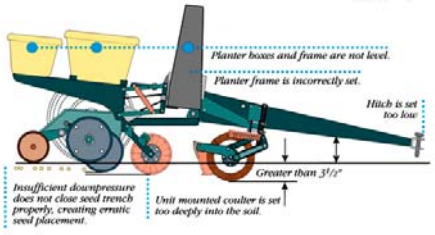


Image source: http://www.yetterco.com/help/plantguide.html

Watch the down pressure…

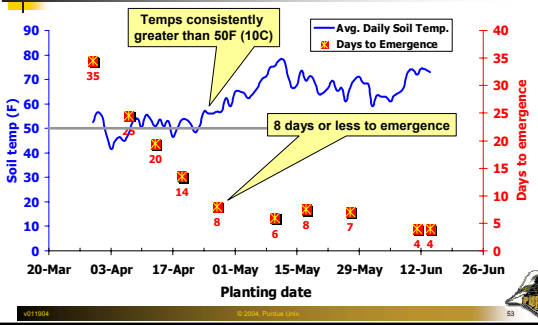
- Remember that excessive down pressure at the parallel linkages can lift the planter frame AND the drive wheels.
  - i.e., heavy-duty no-till springs

Image source: http://customer.johndeere.com

Finally, the day of seeding…

- Remember that rapid and uniform corn germination and emergence will not occur at soil temperatures less than 50° F.
  - Seedling establishment will also not occur rapidly & uniformly if soil temperatures remain cold.
- Cool soils especially likely when planting early and/or in no-till with heavy surface trash.

Soil temperature & corn emergence



The day of seeding…

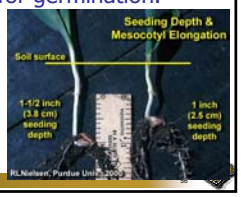
- Adjust air or vacuum planters according to seed size or weight.
  - Seed plates, discs, or drums
  - Air or vacuum pressure
- Remember to re-adjust as necessary when you switch hybrids or seed lots.
  - Failure to do so can cost you dearly at harvest!

The day of seeding…

- Remember graphite with finger-pickup meters: 1 tablespoon per bushel of seed.
  - If you discover that seed treatment is building up on the fingers or backplate, then use more graphite.
- Remember talc with vacuum meters: 1 cup per bushel to prevent sticky seed.
  - More under humid conditions.

The day of seeding…

- Choose an appropriate seeding depth.
  - Depends on field conditions & weather.
  - Aim for a depth that will ensure uniform availability of soil moisture for germination.
    - No less than 1 ½ inches.
    - As deep as 2 or 3 inches if necessary to reach adequate soil moisture.

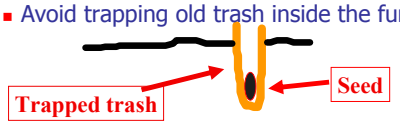


The day of seeding…

- Check the actual depth of seeding frequently from field to field or day to day.
  - Actual seeding depth can vary from targeted planter setting as soil conditions change.

The day of seeding…

- Adjust the depth and tension of no-till coulters from field to field, day to day.
  - Do not cut deeper with the coulter (in line with the disc opener) than the depth of seeding.
  - Avoid trapping old trash inside the furrow.



The day of seeding…

- Adjust the tension of the furrow closing wheels according to the conditions of the soil.
  - Remember, excessive pressure can compact the soil above the seed and restrict emergence.

Image source: http://www.kinzemfg

The day of seeding…

- Planting speed should not exceed the manufacturer's recommendations.
  - Generally, the optimum range of speeds is 5 to 6 miles per hour.

Planting speed…

- A form of operator error that…
  - Diminishes the capability of the metering unit to singulate individual kernels.
  - Interferes with the seed travel to the furrow when row units bounce excessively.
  - Often results in uneven seed to soil contact.

The potential yield effect...

- Yield losses can approach 2 to 5 bushels per acre for every 1 mph increase.
  - Based on my on-farm research with 22 farmers across Indiana, Illinois and Iowa in 1993.
  - The severity of the yield loss likely depends on the condition (maintenance) of planter.

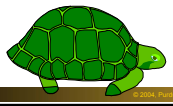
Keep speed in perspective...

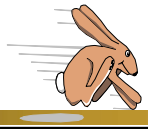
6 miles per hour equals: ??

8.8 Feet per second

At that planting speed, a seeding rate of 30,000 seeds per equals a metering rate of: ??

15.2 Seeds per second





The day of seeding…

- Diligently lubricate the chains and bearings.
  - Best done at the end of a planting day when the chains and bearings are warm.
  - Use multi-purpose spray lubricant, not chain lube or old motor oil.
    - Dries better, less sticky
    - Less of a dirt magnet

Image source: http://www.kinzemfg.com

The End of my Sermon...

- The Bad News…
  - The loss in yield potential from uneven stand establishment in corn begins as early as the day you plant the field!
  - The loss in yield potential can easily be as great as 7 to 15 bushels per acre.

The End of my Sermon...

- The Good News…
  - Adjustments and repairs to planters plus the proper operation of the planter can easily prevent these losses from occurring!

PURDUE UNIVERSITY

Welcome to ...

KingCorn.org

The Corn Growers' Guidebook

Down at the ...

Chat 'n Chew Café

http://www.kingcorn.org/cafe

PURDUE UNIVERSITY

A Final Thought...

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

-- Benjamin Franklin