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# Stand Establishment Issues & Concerns for No-Till Corn

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## A Common No-Till Lament....

- "Stand establishment with no-till soybeans is easy, but...
- **Stand establishment with no-till corn can be a royal pain in the rear!"**



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## Key points...

- Fast/uniform germination, emergence, and early development
  - Why these are important.
  - Discuss key factors required to achieve these.
- "Trashy" nature of early season no-till environment
  - Soil temperature & moisture
  - Planter challenges
  - Disease & insect pressure
- Agronomic & equipment decisions
  - Hybrid sel'n
  - Planting date
  - Seeding rate
  - Starter fert
  - Planter gadgets
  - Strip tillage



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## Stand establishment phase

- Germination & emergence (G & E)
  - Ideal conditions:
    Occurs less than 7 days after planting
  - Your experience says .....?


**Stand Establishment does not end with successful G & E, it also includes...**

- Establishment of nodal roots by leaf stage V6
  - Ideal conditions:
    V6 occurs 25 to 35 days after emergence
  - Your experience says .....?



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**Stand Establishment:**

## Why is "fast" desirable?

- Shorter exposure time to damaging soil-borne pathogens, insects or pesticides prior to full stand establishment.
  - Plus overall improved crop tolerance to stresses.
- Faster root development...
  - Hastens their encounter with soil nutrients.
- Increases the effective length of the available growing season.
  - Crop development remains on schedule.



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**Stand Establishment:**

## Why is "uniform" desirable?

- Stragglers in uneven stands are out-competed by healthier plants.
  - Yield less or not at all.
  - Effective plant population is reduced.

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Germination & Emergence:

## Fast & uniform G&E requires:

- Adequately warm soils
  - Consistently higher than 50° F (10° C)
  - Uniform temperature within the seed zone
    - Especially when soil temperatures are hovering around 50° F to begin with.




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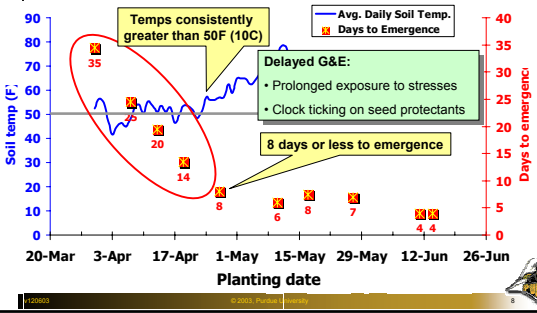
## Soil temperature & corn emergence



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## Variable seedbed temperature...

- Variable soil color, texture, & drainage
- Variable seeding depths
- Variable distribution of surface trash

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



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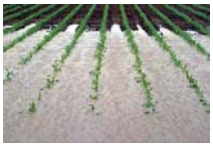
Germination & Emergence:

## Fast & uniform G&E requires:

- Adequately & uniformly moist soils
  - Too wet >> Drowning or death by disease
  - Too dry >> Inert seed (like in the bag)
  - Uneven >> Uneven germination





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## Variable seedbed moisture...

- Soil variability for texture and natural or artificial drainage
- Uneven seeding depths
- Uneven distribution of surface trash
- Soil drying patterns due to tillage traffic



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Germination & Emergence:

## Fast & uniform G&E requires:

- Adequate & uniform seed-to-soil contact
  - Imbibition of moisture req'd to begin germination
- Poor substitutes…
  - Seed-to-trash!
  - Seed-to-rock!
  - Seed-to-clod!

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## Variable seed-to-soil contact...

- Rough, cloddy seedbeds
- Uneven distribution of surface trash
- Coulters running too deep (air pockets)
- Incorrect furrow opener adjustment
- Incorrect closing wheels adjustment



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Germination & Emergence:

## Fast & uniform G&E requires:

- Pest-free conditions
  - Grubs, wireworms, seedcorn maggots
  - Seed rots and seedling blights
  - Prying agronomists!



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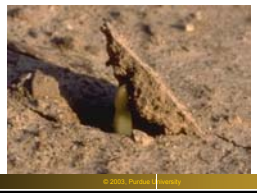
Germination & Emergence:

## Fast & uniform G&E requires:

- Surface soil free of crust or compaction that would interfere with the emergence of the coleoptile (spike)





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## When good fields turn bad

- Successful emergence (fast & uniform) does not guarantee successful stand establishment.
  - The next crucial phase is the establishment of a vigorous nodal root system, from about 2-leaf to 6-leaf stages of development.



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## Nodal root system

- Nodal roots originate from stalk nodes
  - One set of roots develops from every below-ground node plus 1 or more above ground nodes.
    - Nodal root sets develop sequentially over time.
  - Begin elongation shortly after seedling emergence.
    - First set is noticeable by 2-leaf collar stage
  - By 6-leaf collar stage, will be the main roots of plant if development has occurred normally.



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## Growth stage VE (Emergence)

Seminal (seed) roots

Swelling of 1st nodal roots

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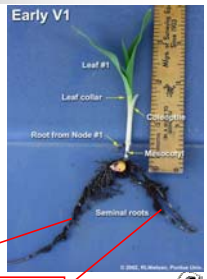
## Seminal (seed) roots…

- Originate from the node located within the seed embryo.
  - Composed of the radicle root and lateral seminal roots.
  - Serve mainly to anchor seedling.
  - Take up minimal amounts of water & nutrients.
  - Cease new growth shortly after seedling emergence.




Radicle

Lateral seminal



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## Nodal roots at V2…


Lowermost two leaves with visible leaf collars.





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## Nodal roots at V5





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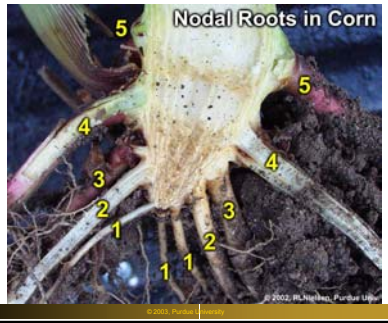
## Nodal root morphology…



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## Until nodal roots are established…

- Seedlings depend primarily on the energy reserves of the kernel…
  - Translocated from the kernel through the connecting mesocotyl "pipeline" to the young stalk and leaf tissues.



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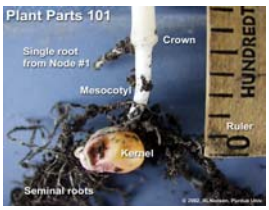
## Mesocotyl?

- Tubular, white, stemlike tissue that connects the kernel and base of coleoptile (the "crown").
  - Mesocotyl cell elongation elevates coleoptile to soil surface during emergence.



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## From emergence to knee-high…

- Damage to the **kernel or mesocotyl** prior to establishment of nodal root system will stunt or kill the seedling
  - Most sensitive from emergence to about 3-leaf collar stage of development
  - Stresses include fertilizer salt injury, seedling diseases, insect feeding damage, excessively wet or dry soils



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## Insect injury to kernel…



Injured plant technically alive, but severely stunted.



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## Seedling blight…





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## From emergence to knee-high

- Damage or stress to the 1st few sets of **nodal roots** can severely stunt or delay a corn plant's development.
  - Most sensitive from emergence to about 6-leaf collar stage of development
  - Fertilizer salt injury, seedling diseases, herbicide injury, insect feeding damage, excessively wet or dry soils, soil compaction (tillage or planter)



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## Bottom Line...

- Regardless of tillage, uneven stand establishment in corn reduces yield potential early in the ballgame.
  - Yield losses can easily approach 7 to 15 bu./ac.
  - This yield loss cannot be recovered.
- No-till environments are often less friendly to stand establishment than conventional tillage.



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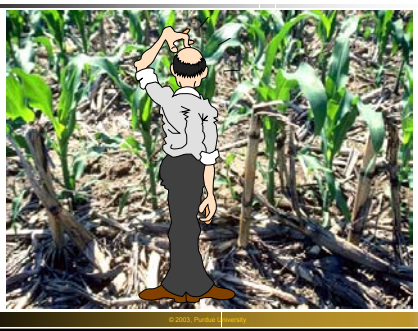
## So, why less friendly?



## Trash, trash, and more trash!

- **TRASH:** Stover, stubble, and other plant materials left from previous crops or weeds that directly or indirectly interferes with corn germination, emergence, & seedling growth.
- **RESIDUE:** Stover, stubble and other plant materials left from previous crops or weeds that conserve soil moisture and improve soil tilth.



## Surface trash…

- Delays soil drying and warmup, which then…
  - Delays or causes uneven germination.
  - Delays early root & shoot growth.
- Harbors disease inoculum that can cause…
  - Seedling blights
  - Leaf diseases
  - Root, stalk, & ear rots

- Favors bothersome pests…
  - Slugs
  - Seedcorn maggot
  - Brown stinkbug
  - Stalk borer
- Hinders planter operation, especially when coupled with wet soils.
  - Depth control
  - Seed-soil contact



## Planter challenges…

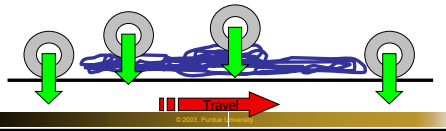
- Hairpinning of wet trash into seed furrow
  - Wet trash is difficult for coulters to slice.
  - Wet, soft soil acts like a sponge-like cutting board.
  - Dull coulters do not help!





## Planter challenges …

- Uneven seed depth in seedbed…
  - Caused by uneven distribution of surface trash and/or excessive planting speeds
  - Depth gauge wheels technically work properly, but relative to surface they are riding over (which may not be soil surface).





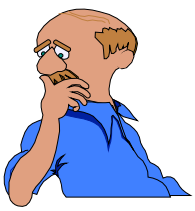

## Planter challenges …

- Optimizing closing wheel pressure can be more challenging in no-till environments, especially if seed bed conditions are extremely variable.
  - Insufficient down pressure = Open planter slots
  - Excessive down pressure = Compacted furrow



## Assist stand establishment…

- Manage planting dates wisely
- Choose hybrids wisely
- Use pre-applied seed treatments wisely
- Use starter fertilizer wisely
- Invest wisely in planter gadgets
- Consider fall/spring strip tillage



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## Planting date management…

- How many no-till corn growers plant as early or earlier than in conventional tillage?

After all, no-till ground supports equipment better than conventional till!



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## No-till corn planting dates?

- Maybe…..... we should be planting a little later?
  - Let the soil dry some.
  - Let the soil warm some.
- Maybe…..... we should plant no-till soybeans before no-till corn?
  - Soybean establishment seems to be easier.

**Unfortunately, corn yield drops off sooner w/ delayed planting than soybean.**



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## Hybrid selection for no-till...

- Identify consistently superior yielding hybrids, regardless of tillage system.
  - Good hybrids in conventional tend to also be good in no-till.
  - Emphasize multiple location or year performance data.
    - Look for consistency across environments.
    - Performance on "My" farm should NOT be given the highest priority!

Purdue crop variety trials: www.agry.purdue.edu/ext



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## Hybrid traits for no-till...

- Within that group of superior hybrids, select those with characteristics important for no-till…
  - Cold tolerance for germination/emergence
  - Strong seedling vigor or early growth habits
  - Disease tolerance or resistance

This information available from seed company literature or sales folk.



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## Seed quality is important...

- Seed quality has greater potential impact in no-till than in conventional tillage because of no-till's generally "crappier" stand establishment environment.
  - The best hybrid in the world may fall apart in no-till if its seed quality is mediocre!
  - Seed quality can vary from year to year, seed lot to seed lot, company to company.



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## Seed quality indicators…

- Warm germination ratings…
  - Listed on seed tag by law.
  - Recognize that most hybrids sold are rated 95% germination or greater.
  - Nonetheless, target seed lots w/ superior warm germ. ratings for earlier planting.
    - Good warm germination scores tend to be related to good seedling vigor.

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## Seed quality indicators…

- Cold germination ratings…
  - Cold germination test simulates ability of a seed lot to germinate under "crappy" cold, wet soil conditions.
  - Cold germination ratings are not listed on the seed tag, but are often performed by the seed company for their own information.
    - Seed lots less than 85% typically not sold.



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## Cold germination tests…

Ask for "extended" cold germination test ratings.

- Standard cold test
  - ~50F for 7 days, then
  - ~77F for 4 - 6 days
- Extended cold test
  - High soil moisture
  - ~50F for 14 days
  - ~68 for 7 days

Note: There is no single standardized cold germination test procedure, so hybrid ratings should only be compared within an individual seed company's lineup.



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## Use cold germ. ratings…

- Plant better cold germ. seed lots (90% or higher) where conditions are most severe…
  - High trash levels
  - Earlier plantings
  - Anticipated cold and wet conditions after planting.

- Plant mediocre cold germ. seed lots (less than 90%) where conditions are less severe…
  - Low trash levels
  - Later plantings
  - Drier & warmer soils.



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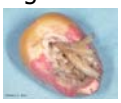
## Pre-applied seed treatments

- Insecticidal treatments applied during seed processing and targeted at secondary insect pests.
  - Wireworms, seedcorn maggots, white grubs, flea beetles, and black cutworms



- Primarily Cruiser™ and Poncho™
  - Offer systemic seedling protection.
  - Cost ranges from $4 to $6 per acre.

Images from http://www.ent.iastate.edu/imagegal/



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## Mixed thoughts…

- University entomologists are uncertain in their support for these products.
  - Claim insufficient data on efficacy to date.
  - Pests are not a problem in every field, so "blanket" use of product runs counter to IPM concepts.
  - Fields with historical pest problem will likely benefit most from the use of these products.
- YieldGard™ Rootworm hybrids will be marketed with one or the other of these products by default.

Image from http://www.ent.iastate.edu/imagegal/



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## Starter fertilizer …

- Success with starter fertilizer means…
  - Maximizing the probability of getting a response and
  - Maximizing the potential size of the response if it occurs.
- Probability of response often greater for no-till (colder, wetter) versus conventional till corn.
- Aim for the biggest bang for your fertilizer dollar.

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## Starter fertilizer decisions …

- High soil P & K + warm seedbed

- Probability of yield response to starter is low and…
- Size of expected response is low, so…
- Little yield risk if you decide to forego the use of starter.



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## Starter fertilizer decisions …

- High soil P & K, but cold, crappy conditions for germination and seedling growth

- Probability of yield response to starter P & K is low but…
- Probability of yield response to starter N is high, so…
- Use starter N and aim for no less than 20 lbs N per acre.



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## Starter fertilizer decisions …

- Low soil P + cold, crappy conditions for germination and seedling growth

- Probability of yield response to starter P and N is high, so…
- Apply N-P mix but still aim for no less than 20 lbs starter N per acre.
  - 50:50 UAN + 10-34-0



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## 2 x 2 versus "pop-up" …

- Rates of starter fert. placed in-furrow (aka "pop-up") are limited because of the risk of "salt" injury to the seed or seedling…
  - Rates of "pop-up" considered "safe" are no more than 5 to 8 lbs per acre of actual N + K.
- Higher "safe" rates allowed with 2 x 2 increases probability of yield response.

**In-furrow or "pop-up" starter fertilizer placement is attractive because of low rates & simple planter attachments.**



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## Planter gadgets…

- May help manage trash and wet, cold soils.
- Some move trash from the planter row area.
  - May warm & dry row zone
  - May aid planter operation

- Some cheat & do a little row zone tillage.
  - Before or during planting
  - May warm & dry row zone
  - May aid planter operation
- Some give the closing wheels some help.
  - Firming knives or blades
  - In-furrow firming wheels
  - Furrow sidewall shavers
  - Furrow finger fluffers



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## Trash removal or zone tillage…

- Beneficial for…
  - Early planting (cold soils)
  - Poorly drained soils
  - High trash loads
    - Continuous corn
    - Winter cover crops
    - Unevenly distributed soy stubble
  - Cooler climates (e.g., northern Corn Belt)

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## Seed firming contraptions…

- Trap & firm seeds in furrow.
- Useful for situations where seed-to-soil contact is inadequate due to poor slot closure.
  - One could sarcastically argue that some of these situations are wet seedbeds where you have no business being with the planter anyway!

Seed firmer image source: http://www.martinandcompany.com/keeton.htm



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## So, planter gadgets…

- May improve seed placement uniformity.
  - Planter sees "conventional" seedbed.
- May improve germination success.
  - Improved seed-to-soil contact.
  - Warmer, drier seed zone.
- May improve early root development.
  - Warmer rooting zone.



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## The "Nu-Till" system: A collection of gadgets…

- Concept promoted by Ag Spectrum (Dewitt, IA)
- The system is composed of:
  - Case IH depth gauge wheels
  - Martin row cleaners
  - Martin spading closing wheels
  - Drag chains to break clods
  - Liquid N banded 4 – 6 inches from seed furrow
  - Keeton seed firmer w/ starter fert applicator tubes
    - Application of proprietary phosphorus starter fertilizer & micronutrient "enhancement" formulation

Image source: http://www.martinandcompany.com/SCW70/72.htm



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## Strip tillage as alternative…

- Narrow-width tilled strips, fall or spring, often coupled with in-row application of dry P & K fertilizers and/or anhydrous ammonia.
  - Approx. 6 inch wide strips
  - Tilled 4 to 8 inches deep
  - Slightly raised "berm"
  - 15 – 20 hp required per row

Images source: http://www.extension.iastate.edu/Publications/PM1901C.pdf



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## Strip tillage benefits…

- Fewer tillage trips.
  - Less compaction?
- Lower potential for erosion & runoff than conventional tillage.
- Residue-free "berms" encourage faster drying of seedbed which allows for earlier planting.



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## Strip tillage benefits…

- Residue-free "berms" encourage warmer seedbeds that facilitates faster corn germination, emergence, and initial seedling development.
- Allows for deep banding of P and K that may mitigate nutrient stratification concerns in no-till.

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## Strip tillage challenges…

- Weather and soil conditions after harvest may limit your ability to complete strip till operation in the fall with suitable soil moisture conditions.
  - Risk of soil compaction and/or clod formation if soils are wet.
- Labor availability may be limited during fall harvest.
- Not suitable for HEL fields w/ steep slopes because of erosion potential in tilled strips.



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## Strip tillage challenges…

- Fall-applied anhydrous not recommended in southern half of Indiana.
- Accurately matching up planter row units to strips can be challenging.
  - Opportunity for GPS autosteer systems.
- Yield advantage (C/B) over conventional or no-till **NOT** consistent year to year.
  - But, usually yields no less than no-till.



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## A Parting Thought...

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

**-- Benjamin Franklin**