Uneven Stand Establishment in Corn

Each spring, growers strive for uniform corn plant spacing and emergence to maximize yield potential. Uneven emergence produces plants of differing growth stages and typically result in lower yields because the smaller, late-emerging plants cannot capture enough sunlight to produce a normal ear. They often contribute little to yield, and in fact act as a "weedy competitor" for moisture, nutrients, and space. Non-uniform plant spacing can result in skips or doubles in the seed row and lower yields by reducing ear consistency or the amount of harvestable ears. Demonstrations were conducted at the Monmouth Learning Center to quantify the effects of uneven stand establishment in corn.

Study Guidelines

Two demos were conducted at the Monmouth Learning Center to evaluate the importance of uniform stand establishment in corn. One demo evaluated erratic planting, and the second evaluated erratic emergence. Plots were planted 5/12/2011 and harvested 10/3/2011. The same 113 RM hybrid was used for each experiment. Each plot was 1000 ft^2 in size.

Treatments were the following:

Demo 1—Erratic Emergence

- **Target population of 36,000**
- **Target population of 44,000**
- **Target population of 36,000 with 25% of the plants planted at VE**
- **Target population of 36,000 with 25% of the plants planted at V1**
- **Target population of 44,000 with 25% of the plants planted at VE**
- **Target population of 44,000 with 25% of the plants planted at V1**

Demo 2—Erratic Planting

- **Target population of 36,000**
- **Target population of 44,000**
- **Target population of 36,000 (45,000 planting pop – 25% non-glyphosate tolerant seed)**
- **Target population of 44,000 (56,250 planting pop – 25% non-glyphosate tolerant seed)**

In the erratic emergence study, plots were planted at 75% of target population and the remaining 25% was hand planted at VE or V1. In the erratic planting study, Roundup® brand agricultural herbicide application was made at V1 to kill all non-glyphosate tolerant (conventional) plants; thus, simulating poor seed spacing.

Results

In order to provide data on how treatments were affecting yield at the individual plant level, ears from each treatment were collected from 1/1000th of an acre (17.5 ft). Ears were counted and separated into three categories (Figure 1):

1. **Normal**
2. **Harvestable Runts– determined as ears less than 1/3 the size of a normal ear**
3. **Ears immediately next to a runt(s)**

Ears were mechanically shelled and kernels were counted for each category.

Figure 1. Ear categories used in analysis.

Results - Yield:

Erratic Emergence. Overall, 44,000 plants per acre produced higher yields than 36,000 plants per acre (Figure 2). Partial delayed emergence at VE and V1 decreased yields by 13% and 12.5%, respectively, compared to the uniform stand of 36,000 plants per acre. At 44,000 plants per acre, yields declined similarly due to delayed emergence, with 11% and 13.5% decreases at VE and V1.

Erratic Planting. When conventional plants were chemically killed to simulate erratic planting, yields were decreased by 12% and 11% for 36,000 and 44,000 plants per acre, respectively (Figure 3). These demos show how yield decreases were similar regardless of delayed emergence or skips.

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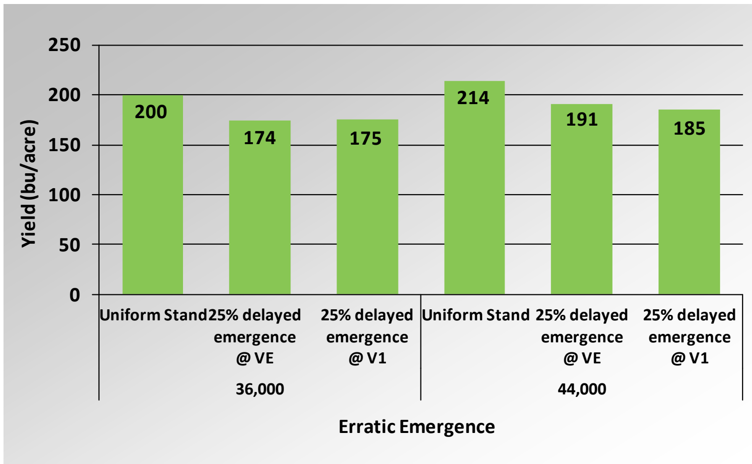

Figure 2. Effect of erratic emergence on corn production. Data Source: 2011 Monmouth Learning Center

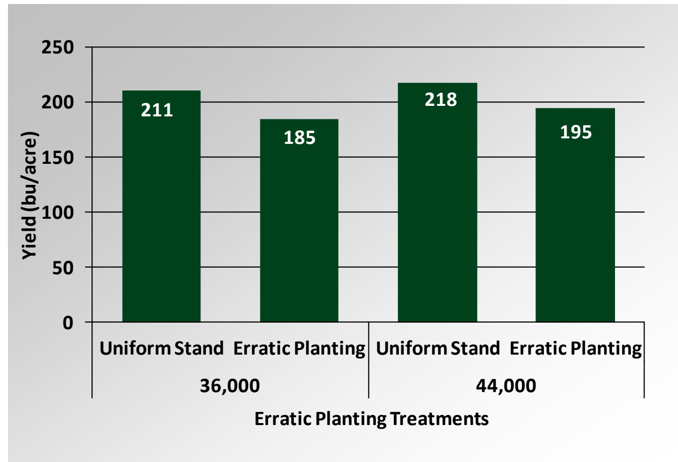

Figure 3. Effect of erratic planting on corn production. Data Source: 2011 Monmouth Learning Center

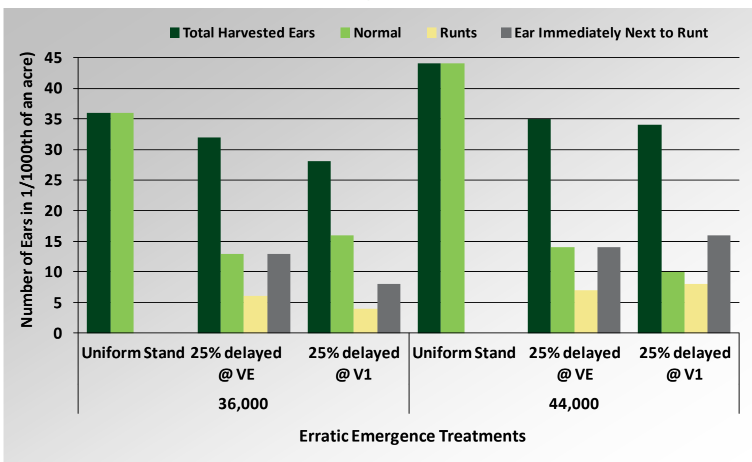

Figure 4. Effect of erratic emergence on corn ear counts. Data Source: 2011 Monmouth Learning Center

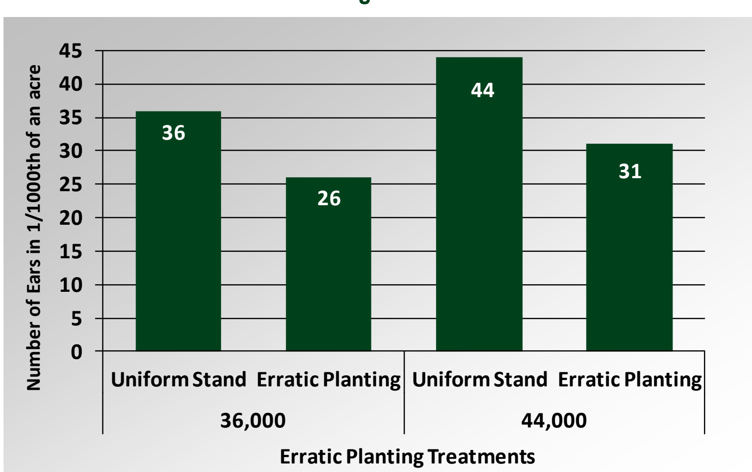

Figure 5. Effect of erratic planting on corn ear counts. Data Source: 2011 Monmouth Learning Center

Results - Corn Kernel and Ear Counts:

Erratic Emergence. Total harvested ears equates to the number of "normal" ears in the untreated 36,000 and 44,000 plant populations (Figure 4). This is because the baseline for what a normal ear looks like is established from the uniform stands of 36,000 and 44,000. The total harvested ears decreased as emergence was delayed. Harvested ears at 36,000 plants per acre decreased 11% and 22% at VE and V1 delayed emergence, and declined 20% and 23% at VE and V1 with 44,000 plants per acre. Additionally, the number of runts and ears immediately next to runts increased as emergence was delayed. The percentage of runts in the total number of harvested ears ranged from 14 to 24% in the delayed emergence demos. These results illustrate how erratic emergence can impact corn ear counts.

Numerous times runts failed to produce an ear and acted like a weed; therefore, they were not included in either the overall ear count or counted as a runt. On the graphs, this explains the difference between harvested ears on the target populations of 36,000 and 44,000 plants per acre and their treatments.

Erratic Planting. In the erratic planting demo, poor seed spacing resulted in 28% and 30% fewer ears for 36,000 and 44,000 plants per acre, respectively (Figure 5).

The effect of uneven emergence and planting on kernel counts was also examined. In the uneven emergence trial,

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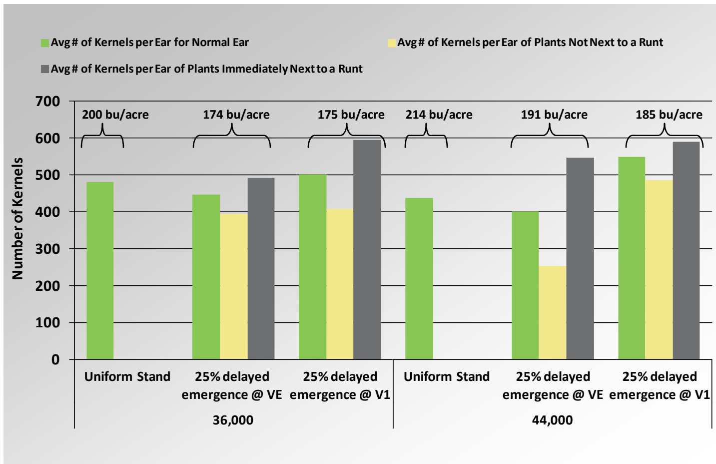

Figure 6. Effect of erratic emergence on corn yield and kernel counts. Data Source: 2011 Monmouth Learning Center

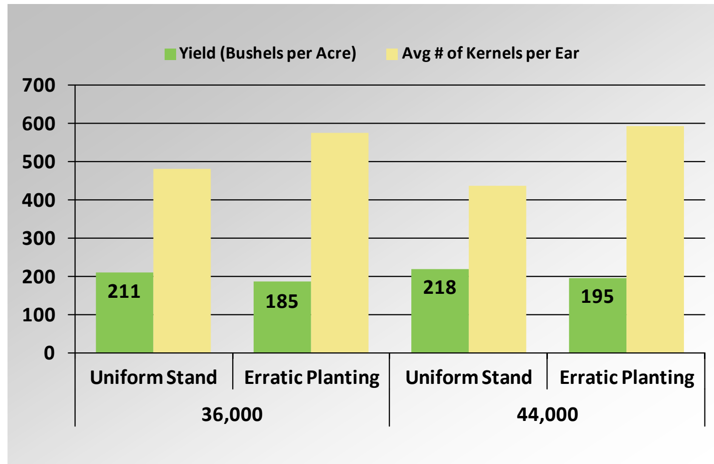

Figure 7. Effect of erratic planting on corn yield and kernel counts. Data Source: 2011 Monmouth Learning Center

there were more kernels per ear for plants immediately next to a runt than for plants not next to a runt (Figure 6). The results from both erratic emergence and erratic planting demos showed there is no relationship between kernel number per ear and an increase in yield in these demos (Figures 6 and 7). The number of kernels per ear did not compensate for a lack of ears per acre, and the importance of uniform stand establishment is supported.

Summary Comments

- Data herein supports the importance of uniform plant spacing and emergence.
  - — Uniform stands provided the highest overall yields for both the erratic emergence and erratic planting demonstrations.
- For uneven emergence:
  - — Most of the delayed plants resulted in a runt ear which reduced yields by 12-14%.
    - ♦ Roughly 15-25% of final ear counts were runts in each treatment.
    - ♦ Yields were nearly identical between delayed plants at VE and V1.
      - This finding is similar to Carter et al., 1989 who found 10% yield reductions when 25% of the plants were delayed at planting.
  - — Ears immediately next to a runt were larger and had the greatest number of kernels per ear, but ears were not large enough to make up for runt plants and overall yield was reduced.
    - ♦ This finding is similar to Nafziger, 1996.
- For erratic planting:
  - — Skips in the seedbed reduced yields by the same 12-14% as noted above.
  - — Ears next to a skip were larger then a normal ear, but not large enough to make up for missing ears.
  - — Together these findings agree with those above and with Carter et al., 1989 and Nafziger, 1996.
- Corn yield depends on the number of ears per acre, number of kernels per ear, and average weight per kernel.
- Numerous sources have described negative yield effects associated with uneven emergence and within row plant spacing variation[1,2,3]
- Uniform emergence and stand establishment can be increased by:
  - — Planting into soil with adequate and uniform moisture in the seed zone.
  - — Planting into soils with temperatures greater than 50°F.
  - — Maintaining good soil to seed contact while planting.
    - ♦ Clearing the seed furrow of residue.
  - — Preparing a proper seedbed free of soil clods, compaction, and soil crusting.

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Figure 8. Erratic emergence demo - Uniform Stand. 36,000 plants per acre. 2011 Monmouth Learning Center

Figure 9. Erratic emergence demo - 25% seeds delayed at VE. 36,000 plants per acre. 2011 Monmouth Learning Center

— Planting at proper speeds.

— Using products to minimize early season insect damage:
- Seed treatments
- Biotechnology traits
- Insecticides

Sources: [1]*Carter, P.R., E.D. Nafziger, and J.G. Lauer. 1989. Uneven emergence in corn. North Central Regional Extension Pub. No. 344.*

[2]*Nafziger, E.D. 1996. Effects of missing and two-plant hills on corn grain yield. Journal of Production Agriculture 9:238-240.*

[3]*Nielsen, R.L. 2001. Stand establishment variability in corn. AGRY-91-01, Department of Agronomy, Purdue Univ., W. Lafayette, IN.*

Additional reference used in the development of this publication: Nielsen, R.L. 2010. Requirements for uniform germination and emergence of corn. Corny News Network, Purdue Univ. [On line]. Available at http://www.agry.purdue.edu [URL accessed November 2011].

The information discussed in this report is from a single site, non-replicated, one-year demonstration. This informational piece is designed to report the results of this demonstration and is not intended to infer any confirmed trends. Please use this information accordingly.