



Uneven emergence in corn

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If soil conditions are not ideal at planting, corn may emerge unevenly. You might eventually get a full stand, but competition from the larger, early-emerging plants will decrease the yield of smaller, late-emerging plants. This publication will help you evaluate whether you'll gain more by protecting small plants, replanting stands, or filling in poor stands.

Why corn emerges unevenly

The most common cause of uneven emergence in corn is dry soil. If the soil is too dry at or shortly after planting, seedlings will emerge at different times. Emergence time may vary between parts of fields, from one row to the next, or from one plant to the next. Soil moisture can differ within a field because of differences in soil type or topography, or from uneven distribution of moist and dry soils by secondary tillage. Cloddy seedbeds caused by working the ground when it's too wet can mean poor contact between seed and soil. As a result, some seeds absorb enough moisture to germinate while others remain dry. In many cases, seeds placed in dry soil don't germinate and emerge until after rainfall. This produces a mixture of larger and smaller plants, with plant size differences depending on time from planting to rainfall.

Uneven soil temperature is another cause of uneven corn emergence. Seed-depth soil temperatures can vary if crop residues from reduced tillage systems aren't distributed evenly, if seed depths vary, and if soil within fields varies in type and topography.

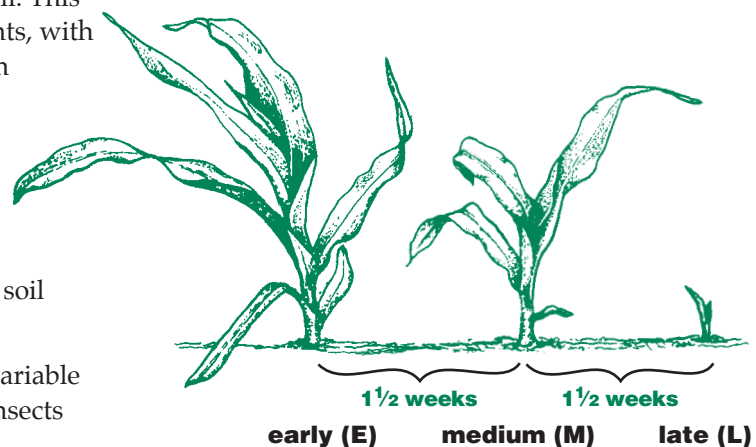
Corn may also emerge unevenly because of variable soil crusting, herbicide injury, or because of insects or diseases.

Finally, uneven corn emergence occurs when corn growers, with stand loss or uneven stands, replant by "filling in" the existing stand, rather than tearing up the field and starting over.

How uneven emergence affects grain yield

University researchers from Wisconsin and Illinois conducted a study to examine yield loss, stand loss, and relative yield contribution from delayed plants. [The study used two types of hybrids, one that was less able to expand ear size ("fixed-ear type") and one that was better able to expand ear size ("flex-ear type") at low plant densities. No differences were observed between ear types.] To imitate emergence delays, corn was planted at the optimum, early date (E) and again 1½ weeks (M) and 3 weeks (L) later.

Figure 1. Comparison of height and growth stage of early plants with seedlings delayed in planting by 1½ and 3 weeks



The plots were seeded using the following patterns:

- Full stands of 26,100 plants/a with even emergence but early, medium, and late planting dates.
- Full stands of 26,100 plants/a with various combinations of uneven emergence across-row or within-row with one-fourth, one-half, and three-fourths delayed plants.
- Reduced stands with one-fourth, one-half, and three-fourths stand loss.

To evaluate the effect of uneven across-row emergence, rows were alternately planted early and delayed. Figure 1 shows the relative height and growth stage of early plants compared to seedlings delayed in planting by 1½ and 3 weeks. The results are presented in table 1 and figure 2.

You can assess the benefit of late-emerging plants within a stand by comparing yield percentages of uneven emergence vs. stand loss (table 1), and by observing yield contributions of early vs. delayed plants (figure 2). For example, in table 1, when one-fourth of the plants emerged 3 weeks late, yields were about 90% of maximum—the same yield obtained without the late plants. This indicates that the presence of late plants will not help or hurt overall yields. The situation changes when half of the

planting is affected: There was a 10% yield difference in fields where half of the seeds emerged 3 weeks late compared to fields where half the plants were missing.

Yield contribution from delayed plants

Delayed plants contributed to total grain yield for all within-row uneven emergence patterns (figure 2). For example, the yield contribution from 3-week late plants in the same row as early plants ranged from 4% when only one-fourth of the plants were late (EEEL) to 58% of the total yield when three-fourths of the plants were late (ELLL).

Legend

Grain yields in table 1 and figure 2 are shown as percentages of the maximum yields of 187 bu/a obtained with even emergence of a full stand (26,100 plants/a) with early planting.

- E early plants (seeded approx. May 1)
- M planting 1½ weeks after early planting
- L planting 3 weeks after early planting
- X missing plants

Figure 2. Grain yield contributions of early and delayed plants in within-row mixtures

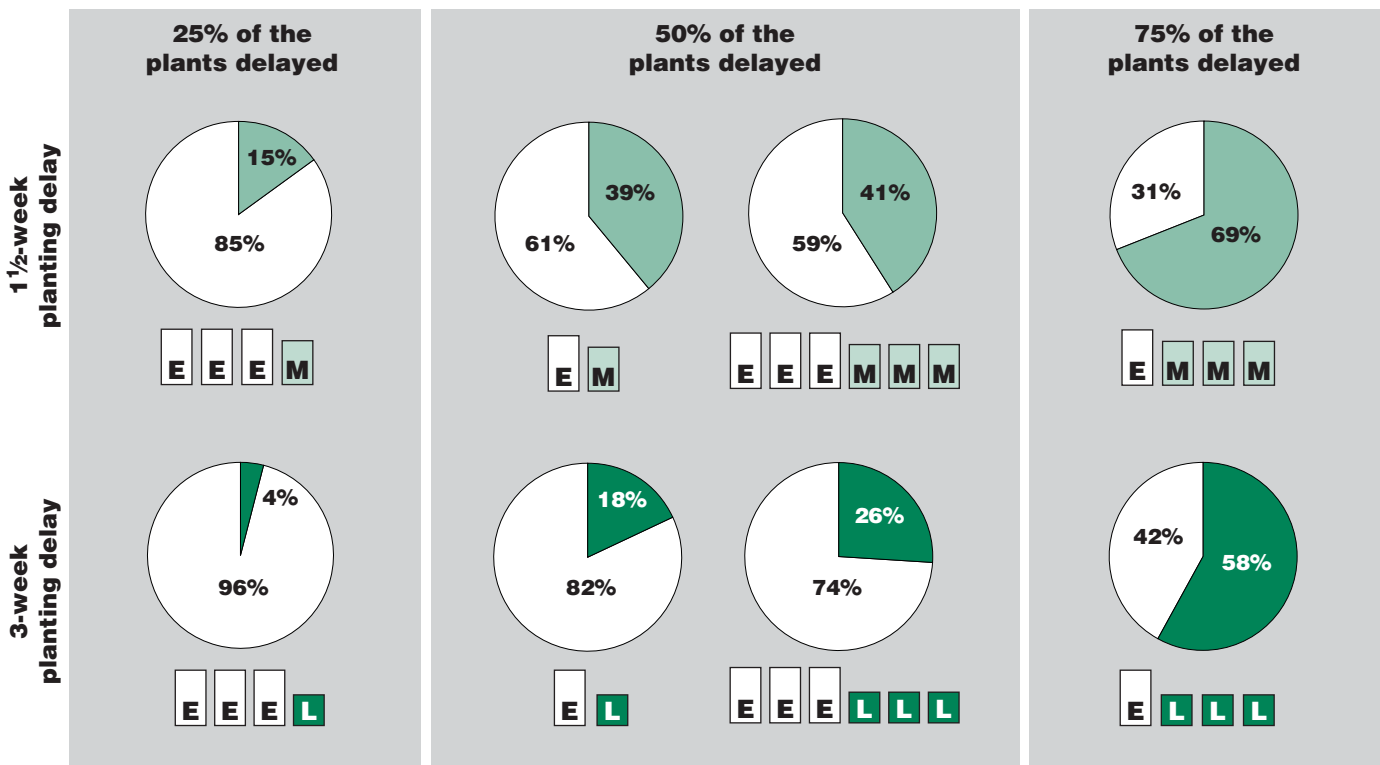


Table 1. Effect of uneven emergence on corn grain yield

Emergence pattern, % of maximum yield		% delayed plants	Notes	
Even emergence				
EEEE	100	0	Each field was seeded for uniform emergence at the three planting dates: early (E), 1½ weeks late (M), and 3 weeks late (L).	
MMMM	95	100		
LLLL	88	100		
Uneven emergence within rows				
1½-week delay	EEEM	94	25	1½-week delay When the planting delay was 1½ weeks, mixed early and delayed plantings within a row decreased yield by 6–9%. This was nearly the same yield loss as with a 1½-week delay in planting the entire stand (5% yield loss).
	EM	91	50	
	EEEMMM	93	50	
	EMMM	93	75	
3-week delay	EEEL	90	25	3-week delay When the planting delay was 3 weeks, mixed early and delayed plantings within a row decreased yield by about 10% when one-fourth of the plants were delayed. This was similar to the 12% yield loss for delayed planting of the entire stand by 3 weeks. Yield loss was 20–22% when one-half to three-fourths of the plants were late. This loss was nearly double that of the 3-week late planting of the entire stand.
	EL	79	50	
	EEELLL	80	50	
	ELLL	78	75	
Uneven emergence across rows				
E-M-E-M	94	50	1½-week delay Alternating rows of corn planted on time and delayed by 1½ weeks gave about the same yield loss (6%) as when planting of the entire stand was delayed 1½ weeks (5% yield loss).	
E-L-E-L	85	50		
Stand loss (plants missing)				
EEEX	90	25	Fields with one-fourth of the plants missing had a 10% yield loss, the same as in fields where one-fourth of the seeds were delayed 3 weeks. When half of the plants were missing, yields dropped to 70% of maximum—a 10% yield difference compared to fields with half the plants delayed by 3 weeks.	
EX	71	50		
EEEXXX	69	50		
EXXX	49	75		

0 20 40 60 80 100
Percent of maximum yield



Figure 3. Early plants mixed with 3-week delayed plants in the season

Recommendations

The first step in using the following recommendations is to determine the general pattern of emergence. This will vary both from field to field and within parts of fields. Thus, you can change management for particular fields or parts of fields depending on the most prevalent emergence pattern.

Should you protect late-emerging plants during row cultivation?

- If late-emerging plants are within 1½ to 2 weeks of those emerging early, avoid burying them during cultivation.
- Protect plants emerging 3 weeks late if at least half of the plants in the stand are late-emergers.
- If less than one-fourth of the stand is emerging 3 weeks late or later, it probably won't pay to encourage their survival. Yields will be about the same whether or not these delayed plants are buried.

Should you replant stands with uneven emergence?

- If unevenness is mostly row-to-row, replanting will probably not increase yield.
- If the delay in emergence is less than 2 weeks, replanting will increase yields less than 5%, regardless of the pattern of unevenness.

- If at least half of the plants in the stand emerge 3 weeks late or later, then replanting may increase yields up to 10%. To decide whether to replant in this situation, estimate both the expected economic return of the increased yield compared to your replanting costs and the risk of emergence problems with the replanted stand.

Should you fill-in a poor stand?

When replanting a poor stand (three-fourth stand loss or greater), you can either tear up the stand and replant the whole field, or fill-in the existing stand and create uneven emergence.

- If you replant within 2 weeks of planting the original stand, filling-in the existing stand may be an option. Yields will be similar to those from a uniform-emerging, replanted stand, if you can get relatively uniform plant spacing within the row between old and new plants. However, within 2 weeks of planting, it may be too early to determine what the final stand will be.
- If you replant 3 weeks after the initial planting, yield potential is about 10% greater if you tear up the field and start over with an even-emerging stand. Balance this possible yield increase against the additional cost of tillage, seed, pesticide, and dryer fuel.

Other considerations

- It may be useful to evaluate non-uniform emergence by comparing growth stage differences between early and delayed emerging plants rather than time differences. The 1½- and 3-week planting delays described in this bulletin resulted in similar time delays in emergence. However, emergence delays may vary with different environments and the actual time delays may not be known. You can use figures 1 and 3 to help relate growth-stage and appearance differences between uneven emerging plants to the time delays described in this bulletin. For example, at emergence of plants delayed in planting by 1½ weeks, there were four to five visible leaves on early plants. When plants delayed 3 weeks in planting emerged, there were seven to nine visible leaves on early plants.
- If plant-to-plant competition is low, late-emerging plants will yield more. For example, at plant densities under 20,000 plants/a, late-emerging plants will probably contribute more to yield than the proportions shown in figure 2. However, when plant densities are below 20,000 plants/a, fields will not produce top yields.
- In this study, the uneven emerging stands yielded less primarily because of direct competition of plants of two different ages next to one another. Older plants generally have an advantage in obtaining light, water, and nutrients. In some cases, late-emerging plants could be more vulnerable to silk clipping by corn rootworm beetles. Beetles may attack fresh silks of late-silking plants, cutting the silks as soon as they emerge, preventing pollination and reducing kernel set.
- Late-emerging plants had higher grain moisture content at harvest. This could result in grain with varying moisture levels, which would increase kernel damage and drying costs. They also often had smaller stems, weaker stalks, and fewer brace roots, so they lodged more. Also, at harvest it's difficult to adjust combines for the variable ear sizes between early and late plants. These problems would be minimal with a 1½-week delay, but could be serious with a 3-week delay.

Avoiding uneven emergence

Corn sometimes emerges unevenly because of environmental factors that corn growers can't control. Nevertheless, the following management practices can help you avoid uneven stands:

- Avoid excessive tillage trips which dry or compact the seedbed.
- Remember that tilling when soils are too wet can produce cloddy soils, a major cause of uneven stands.
- Dig up some seeds during planting to monitor seed placement. If contact between seed and soil is poor or seeding depth isn't uniform, adjust seed openers and/or press-wheel tension. Secondary tillage operations may need to be changed to improve soil conditions for more uniform planting.
- If you are using a tillage system that retains substantial crop residue on the soil at planting, adjust tillage and planting equipment so residue cover over the row area is uniform after planting.
- Follow recommended herbicide application guidelines to avoid injuring corn.
- After planting, closely monitor corn emergence and use a rotary hoe if a soil crust is keeping corn from emerging uniformly.

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