University of Wisconsin · Agronomy Department
1575 Linden Drive · Madison, WI · 53706 · (608) 262-1390

Agronomy Advice

http://corn.agronomy.wisc.edu

August 2015 Field Crops 28.8 - 125

When is Yield "Determined" for Corn Grain Production?

Joe Lauer, *Corn Agronomist*

Numerous in-season management decisions need to be made during the corn growing season. Some inputs are relatively easy decisions to make and must be legally followed, i.e. pesticide applications. Other decisions are more difficult with no clear guidelines due to the unpredictability of the environment. Not only is the environment fickle, but the plant must be able to respond to the input.

Grain yield in corn is comprised of the yield components: ears per unit area, kernel number per ear consisting of kernel rows and kernels per row, and kernel weight (Figure 1). Each of these yield components is determined at different stages in the lifecycle of the plant. The plant "adjusts" yield components according to environment and management influences during the growing season.

The plant has the "potential" to produce more ears and kernels than what is "actually" harvested. For example, the corn plant typically produces 6 to 10 ear shoots, but only one ear (at most two) actually develops. In some years, hybrids may produce 20 rows of kernels on an ear, but most of the time only 12 to 16 rows of kernels develop. If you were to examine the ear shoot at the V18 stage (just prior to tasseling) using a microscope, you could count 50 to 60 kernel ovules in a kernel row. Multiplying the number of kernel ovules by the number of kernel rows indicates that 600 to 1200 kernels could potentially grow on an ear. Usually only 400 to 600 kernels develop on the ears. Table 1 describes when yield components are at their greatest potential and when under normal conditions are actually determined and are not further affected under typical conditions. For example, the potential number of ears per unit area is largely determined by the number of seeds planted, how many germinate, and eventually emerge. Attrition through disease, insects, unfurling underground, animal damage, chemical damage, mechanical damage, and lodging all will decrease the actual number of ears that can be produced. Likewise, kernel number is at its greatest potential slightly before R1, the actual number of kernels formed is determined by pollination of the kernel ovule. After pollination, the only yield component remaining with some flexibility is kernel weight. For the first 7 to 10 days after pollination of an individual kernel, cell division occurs in the endosperm. The potential number of cells that can accumulate starch is determined. At black layer formation (R6) no more material can be transported into the kernel and yield is determined.

The objective of this study was to identify when grain yield was determined during the corn life cycle and whether or not yield could be increased by adding

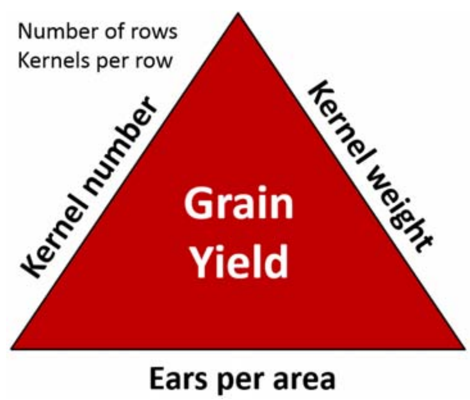

Figure 1. Grain yield components of corn.

Table 1. Corn growth and development stages when yield components are at maximum potential and actually determined (105 day hybrid).

Growth Stage	GDUs required	Yield components: Potential	Yield components: Actual
VE	125	Ears/area	-----
V6	470	Rows/ear	"Factory"
V12	815	-----	Rows/ear
V18	1160	Kernels/row	-----
R1	1250	Kernel weight	Kernel number Ears/area
R6	2350	-----	Kernel weight

resources. From 2009 to 2015 at Arlington, every other plant was removed at different growth stages in plots and later harvested for grain and yield components. The control was an untreated check (UTC) plot.

Grain yield was greatest in UTC plots. The lowest yield was corn thinned at R6 (maturity) and was usually half the yield of UTC plots. For thinned plots, removing every other plant up to V6-V8 did not change yield. After V8 grain yield gradually declined. Grain yield was no longer affected by thinning after R4.

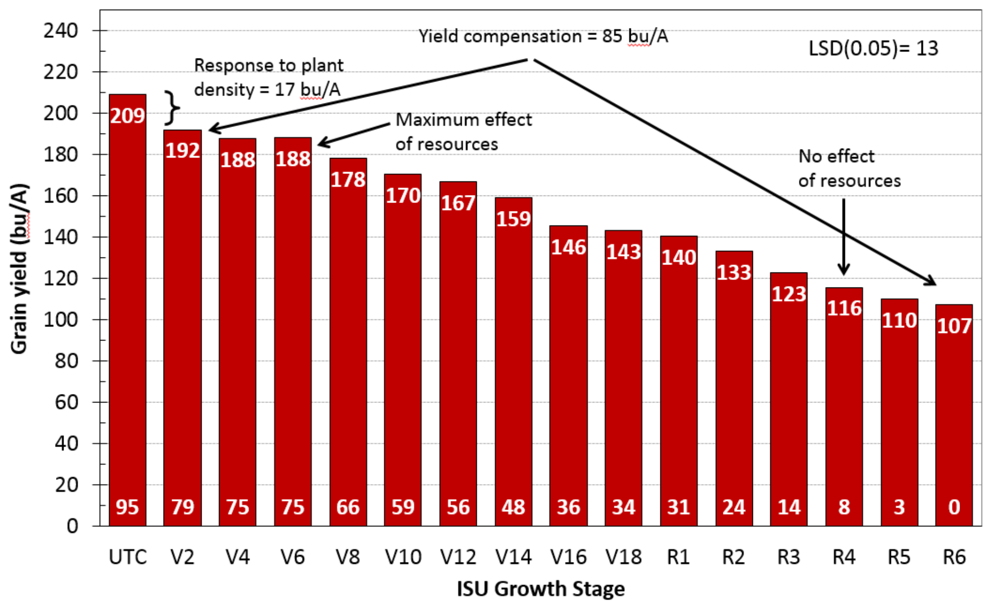

Figure 2. Grain yield of corn when every other plant is removed at various growth stages.

Increasing resources to the plant by thinning between V2 to V6 maximized row number per ear (Figure 3). Row number per ear was not further affected after V6. Kernel number (kernels per row and kernels per ear) was maximized between V2 to V14. Kernel number per ear was not changed after R2. Kernel mass was maximized with increasing resources between V2 and V12, and was not further affected after R4.

Environment and management differences for the timing of resource effects on grain yield response are observed (Table 2). By late grain-filling (after R4) all yield components were determined and increasing resources did not affect grain yield, so most management decisions that could increase yield need to occur before the R4 stage and are best applied by V6.

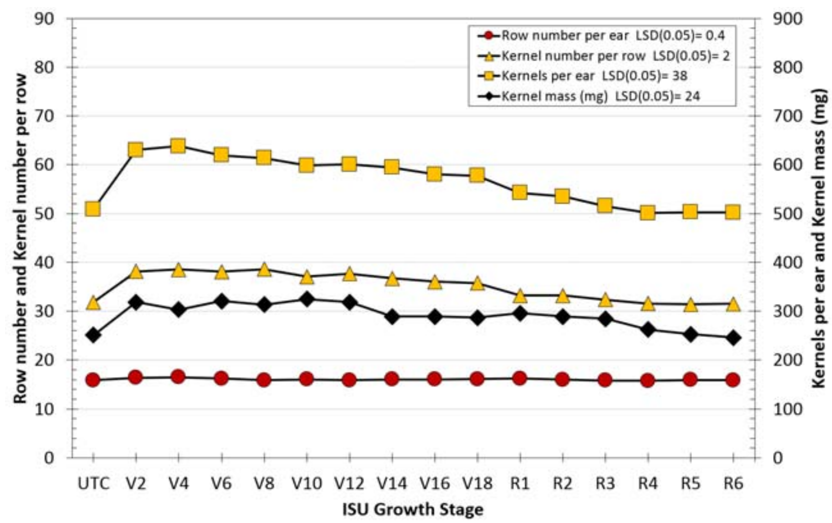

Figure 3. Grain yield components of corn when every other plant is removed at various growth stages.

Table 2. Corn yield response when every other plant is removed at various growth stages.

Year	Hybrid	UTC Grain yield	UTC Plant density	Response to plant density	Yield compensation	Maximum effect of resources	No effect of resources
		Bu/A	Plants/A	Bu/A	Bu/A		
2014	Pioneer P0062AM	207	52,200	-19	127	V4	R5
2013	G2 Nu Tech 5H-399	172	42,000	-11	93	V8	R3
2012	Dekalb DKC53-78	239	42,300	18	86	V6	R2
	Pioneer 36V53	211	41,200	8	87	V6	R2
2011	Dekalb DKC52-59	197	34,500	2	92	V10	R4
	Pioneer 35F44	236	34,700	58	62	V10	V18/VT
2010	Dekalb DKC52-59	226	36,300	23	92	V12	R3
	Pioneer 33F44	246	33,800	60	58	V12	R3
2009	Dekalb DKC52-59	191	30,900	40	55	V10	R2
	Overall	**217**	**40,900**	**17**	**102**	**V6**	**R4**