Yield Gap Analysis

Update after first round of threshing

Sustainable Cropping Systems Lab UMN

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Some samples are missing. They were likely stored with other projects and will emerge as we process samples from other projects.

lbs / A = pounds per acre

Link to data: https://docs.google.com/spreadsheets/d/1AG8SbE3liLRZ5mTV01j_G7iAxJ7xqVl9ZAQjE3jXGMc/edit?gid=0#gid=0

Conversions

Each sample is 2 meters of row at a given row spacing to represent an area

At 7 inch row spacing, 1 sample represents 0.35 square meters.

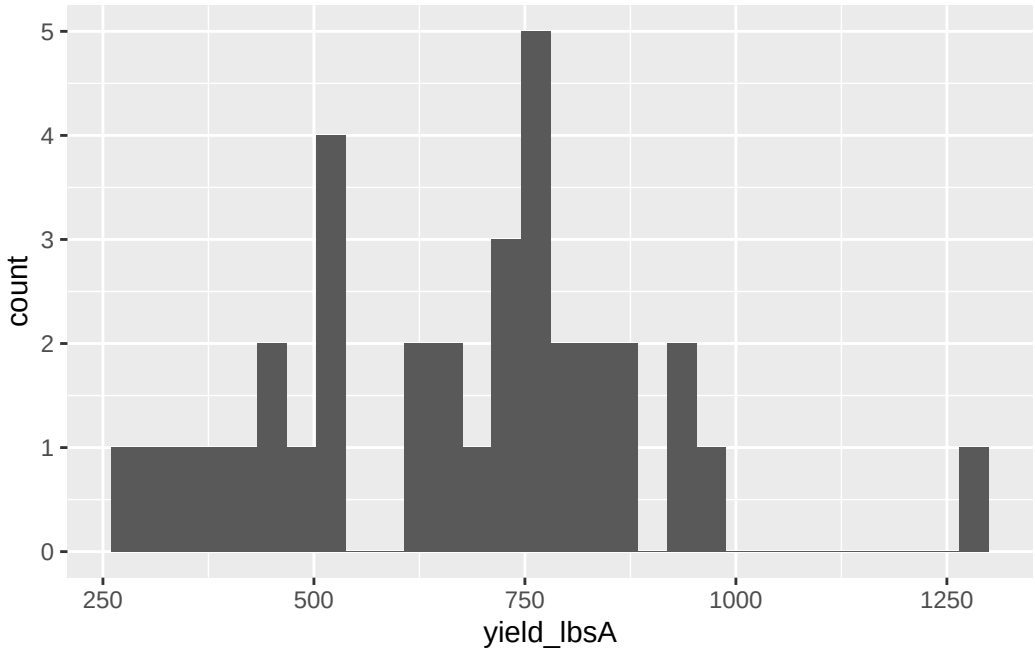
At 7.5 inch row spacing, 1 sample represents 0.38 square meters.

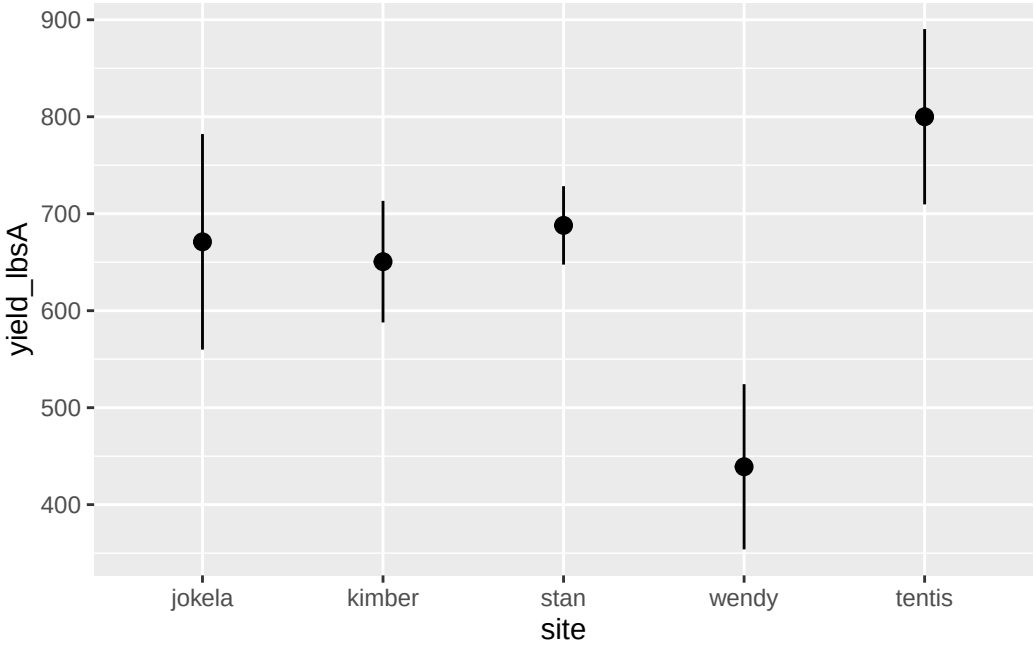
This difference in row spacing when predicting to lbs per acre is about 44 lbs per acre of error. We are assuming 7.25 inch row spacing for all sites for this preliminary report, a site with 7.5 inch row spacing we'd reduce our prediction by ~22 lbs A and a site with 7 inch row spacing we'd increase our prediction by 25 lbs A.

For most trials, ~0.5 square meters is typically used for estimating grain yield. So these samples averaging around 0.38 m2 are 25% smaller than typical quadrats used for yield prediction.

Since row spacing will not be known for all sites until farmer interviews, here we are assuming 7.25 inch row spacing for all sites. This provides an average magnitude of error of 50 lbs per acre. For example, we predict Wendy at 7.25 inch row spacing at 550 lbs A, but at 7.5 inch row spacing would be 525 lbs A.

Figures


count
yield_lbsA
0
1
2
3
4
5
250
500
750
1000
1250


yield_lbsA
site
400
500
600
700
800
900
jokela
kimber
stan
wendy
tentis

Tables

Table 1: Predicted kernza grain yields in lbs per acre. Combined across all sites. Assuming 7.25inch row spacing

n	mean	sd	cv	max	min
35	673	213	32	1284	279

Table 2: Predicted kernza grain yields in lbs per acre. Seperated by site. Assuming 7.25inch row spacing

site	n	mean	sd	cv	max	min
jokela	5	671	248	37	964	378
kimber	9	651	188	29	940	419
stan	9	688	121	18	814	458
wendy	4	439	170	39	652	279
tentis	8	800	256	32	1284	351

Notes

- These predicted kernza yields are somewhat high. I was expecting around 400-100 lbs A, especially for stands in their second and third year of production with shattering. Even minimum values are mostly above 300 lbs A. Why are we predicting such high grain yields?
  - Sample collection error (sampling a larger area than stated in protocol or sampling only high yielding areas) is unlikely across so many different sites and collectors.
  - Sample processing error is more possible. We followed the standard threshing protocol, but it is imperfect. Our final samples still contain some empty hulls and stems. We could dry samples further and attempt to thresh again to break down spikelets and stems into smaller pieces for further sieving and aspirating. This would reduce our predicted grain yield, but samples are already about as clean as most combines would achieve. These predicted grain yields are for uncleaned seed. The amount of clean naked seed is less.
- As I collected samples from both Stan and Tentis, I am very surprised we predicted higher yields for Tentis. I am not surprised the variation for Stan is much lower.

Sample processing note

All samples were processed using our standard protocol of threshing, sieving and aspirating. The quality of these samples were about as pure as samples that come directly out of the wintersteiger plot combine we use. They contain stems, empty hulls, spikelets and seeds that are both naked and within a hull. As a result, their weight represents the amount we expect to leave a field, "bin run". These samples would require further cleaning and the amount of pure seed in the sample is likely ~20-30% less of the "bin run" yields predicted.

Table 3: Changes in sample weight and the corresponding predicted yield of sample 9 from Tentis / white barn.

Processing step	sample weight (g)	predicted yield (lbs A)	change from reported value (%)
standard threshing, sieving, aspirating	33.8	819	0
1 day storage in lab, humidity gain	34.1	826	1
light sieving to remove obvious stems, spikelets	32	775	-5
standard sieving, removing empty stems	29.3	710	-13
aggressive sieving, removing most hulls including hulls with seed	25.5	618	-24.6
smaller sieve, primarily naked seed remains	23.5	569	-30.5

Figure 1: Sample after direct combine

Figure 2: Sample after standard threshing, sieving and aspirating. Stems and empty hulls remain, resulting in overprediction of clean grain weight.

Figure 3: Sample after additional sieving resulting in a 30% reduction of predicted “bin run” yield.