

Yield Gap Analysis

Update after first round of threshing

Sustainable Cropping Systems Lab UMN

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Deliverables: yield (kg ha) at “bin run” quality using hand harvest with quadrat for estimation

lbs / A = pounds per acre

Link to drive: <https://drive.google.com/drive/folders/1kydbCweD-InbtWBmElheSLFq6kMmdUsG>

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.

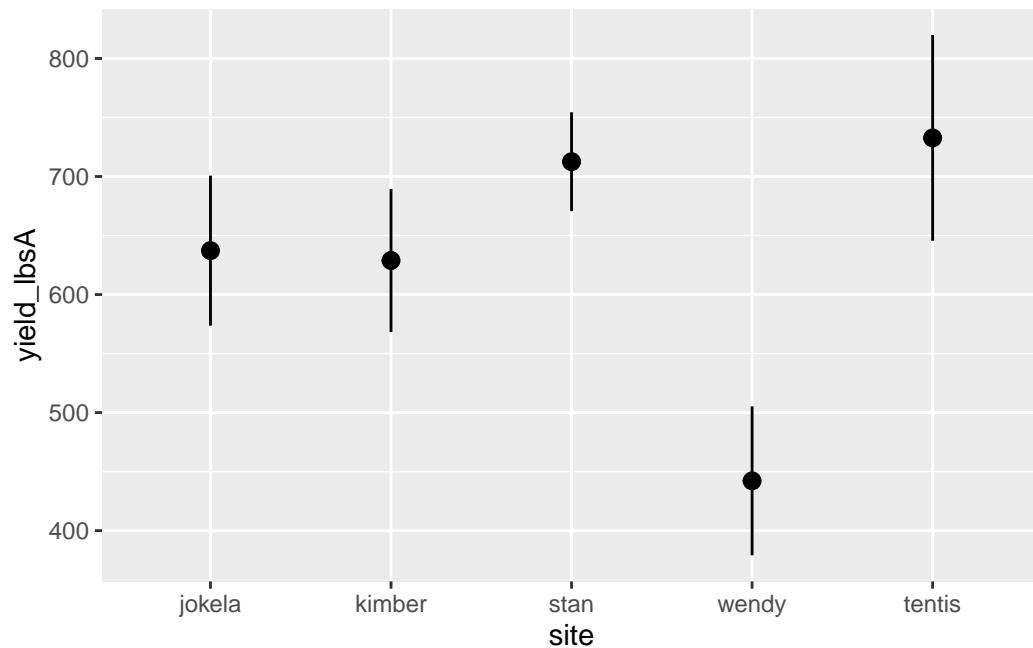
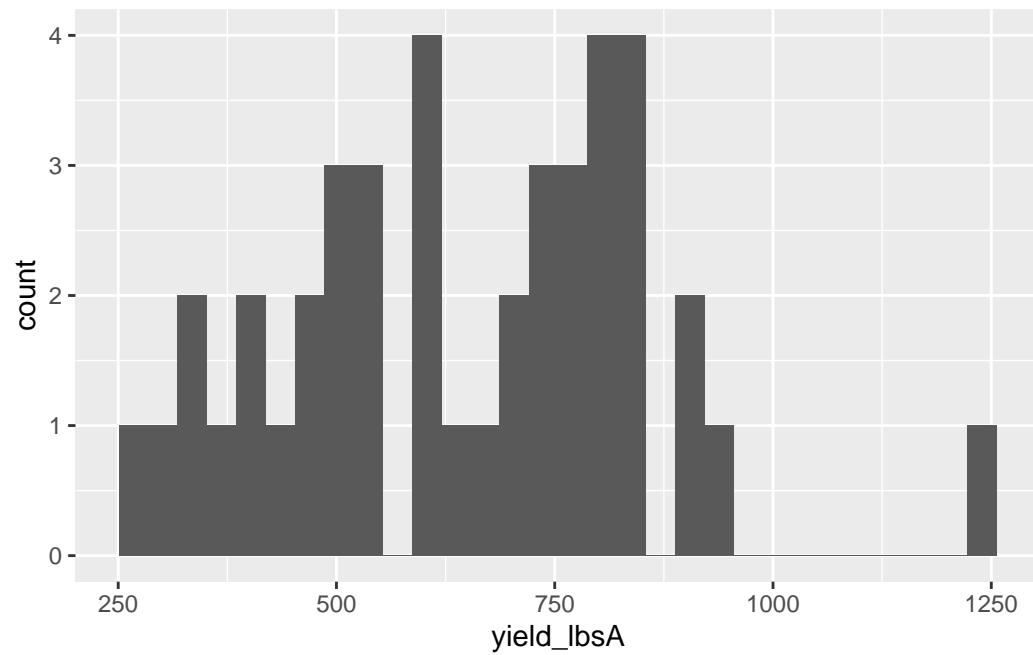
For most trials, ~0.5 square meters is typically used for estimating grain yield. So these samples are about 25% smaller than typical quadrats used for yield prediction. We opted for smaller quadrats in this trial over concern the paper bags would be too full to fully close with a 0.5m² sample which could cause parts of the sample to be lost when walking through the field and in transit to campus.

Dataset summary

abridged summary of the following file “yieldGapAnalysis_datasetForAnalysis_9Jan2025.csv”

site	sample	spacing	wet_bag_seedheads_grams
jokela:9	1	: 5	7 : 9 Min. :133.8
kimber:9	2	: 5	7.5:33 1st Qu.:180.2
stan :9	3	: 5	Median :212.1
wendy :6	4	: 5	Mean :236.5
tentis:9	5	: 5	3rd Qu.:296.8
	6	: 5	Max. :430.9
	(Other):12		NA's :24
dry_bag_seedheads_grams		dry_nobag_threshed_grams	notes
Min.	:102.7	Min. :11.50	Length:42
1st Qu.	:131.6	1st Qu.:21.15	Class :character
Median	:141.4	Median :27.15	Mode :character
Mean	:153.8	Mean :27.07	
3rd Qu.	:170.7	3rd Qu.:32.12	
Max.	:295.5	Max. :53.00	
yield_gm2	yield_kgha	yield_lbsA	
Min. : 30.18	Min. : 301.8	Min. : 269.3	
1st Qu.: 55.51	1st Qu.: 555.1	1st Qu.: 495.3	
Median : 72.70	Median : 727.0	Median : 648.6	
Mean : 72.20	Mean : 722.0	Mean : 644.2	
3rd Qu.: 88.61	3rd Qu.: 886.1	3rd Qu.: 790.6	
Max. :139.11	Max. :1391.1	Max. :1241.1	

Figures



Tables

Table 1: Predicted kernza grain yields in lbs per acre. Combined across all sites. Bin run quality. Estimated from 2 meters of row length at a minimum of 6 points in the field.

n	mean	sd	cv	max	min
42	644	204	32	1241	269

Table 2: Predicted kernza grain yields in lbs per acre. Separated by site. Bin run quality. Estimated from 2 meters of row length at a minimum of 6 points in the field.

site	n	mean	sd	cv	max	min
jokela	9	637	191	30	932	365
kimber	9	629	182	29	909	405
stan	9	713	126	18	843	474
wendy	6	442	155	35	630	269
tentis	9	733	261	36	1241	340

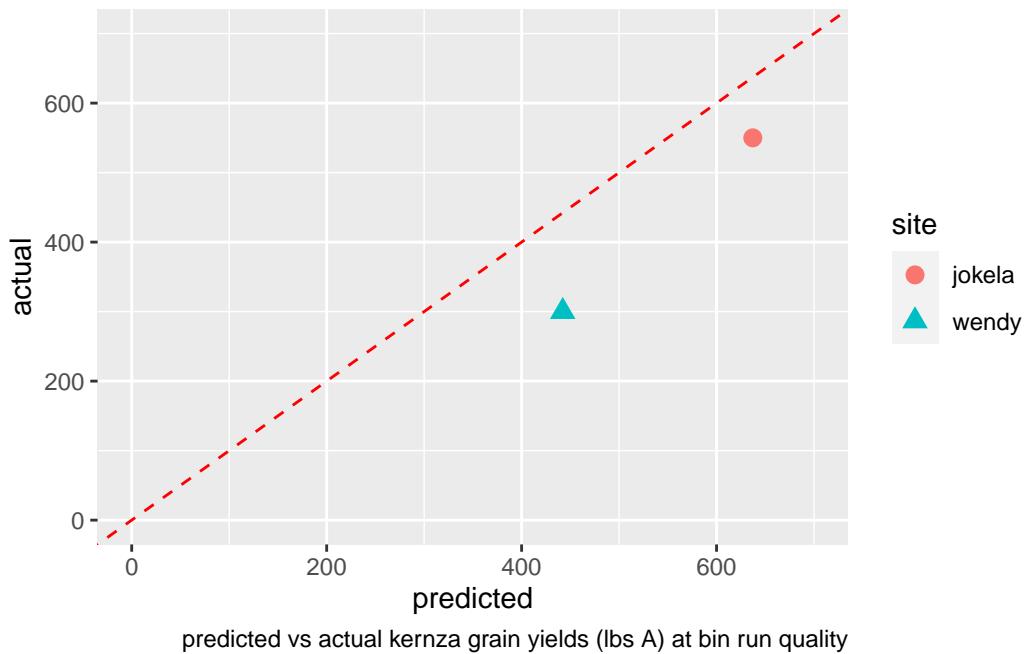
Notes

- 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 at “bin run” quality. The amount of clean naked seed is less.
- As I (Jesse) 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.

Predicted vs actual

Table 3: predicted vs actual kernza grain yields (lbs A)

site	quality	predicted	actual
jokela	bin run	637.1964	550
kimber	bin run	628.8704	NA
wendy	bin run	442.1867	300
kimber	clean	NA	200



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 4: 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	791	0
1 day storage in lab, humidity gain	34.1	799	1
light sieving to remove obvious stems, spikelets	32	749	-5
standard sieving, removing empty stems	29.3	686	-13
aggressive sieving, removing most hulls	25.5	597	-24.6
including hulls with seed			
smaller sieve, primarily naked seed remains	23.5	550	-30.5



Figure 1: Sample after direct combine



Figure 2: Sample after standard threshing, sieving and aspirating. Quality = “bin run”. 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.