2019 Report to KSGGA
UK Wheat Breeding Project
Dave Van Sanford

2019 Results

Purification and Increase: Working with Clements Ag Supply and Peterson Brothers, we grew a .88 acre increase of our most advanced wheat breeding line that will likely be the next Pembroke variety: KY07C-1145-94-12-5. The increase, grown near Springfield, KY, produced > 100 bu. This was an exciting result in that it represents the first time we used the Yuma, AZ increase to produce genetically pure breeder seed from headrows; Pembroke 2016 came from a Yuma increase but not at the headrow level and it was too expensive to be sustainable. Now we know that we need to increase the number of headrows grown in Yuma to produce sufficient seed so that we need just one farmer level increase before the variety is released to growers. In short, this year's increase allowed us to determine how many headrows to grow in Yuma so the system can be sustainable. Seed from Yuma headrows that were selected this year will be put into smaller increases of lines that are not as far along in testing but still show great promise.

Yield testing: Yields across our testing locations varied considerably this year, based mostly on time of harvest. Locations harvested early before the rains hit – Schochoh (97 bu/a) and Princeton (86 bu/a) – had excellent yields, while the two later harvested locations, Lexington (53 bu/a) and Woodford (74 bu/a), showed the impact of the rain on yield and test weight. The grain filling period was not shortened by a rapid increase in temperature, as was the case in 2018. Disease pressure was low, with little scab or stripe rust but lots of Septoria leaf blotch at Schochoh. We had a number of lines early in the testing phase that combined outstanding yield with excellent disease resistance; initial increases of these lines will be planted this fall.

Crossing: We produced a total of 475 crosses in the greenhouse this season, both single cross hybrids between 2 parental lines and 3-way crosses where we cross the hybrid with a third parent. The single cross hybrids will be planted in the greenhouse this fall for an additional round of crossing, while we will plant the 3-parent F_1 hybrids in the field at Lexington this fall to produce F_2 seed. One set of crosses was made on the basis of genomic and field performance information about the parents, using software that tells us which are the cross combinations that are most likely to produce high performing progeny. The majority of our crosses, though, are made on the basis of field performance combined with information about which disease resistance genes are present in which parents.

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Line development: We grew F_4 and F_5 headrows at Lexington in 2019; vigor and yield levels of the headrows were outstanding. About 1500 rows were selected based on height, maturity, clean leaves and heads, and overall vigor. Many of these lines will go into a Preliminary trial to be planted at Princeton and Lexington this fall. We also had some very high yielding scab resistant lines in our Advanced, Max and Supermax tests; these have been advanced to the next stages in the testing system.

Scab screening: Disease pressure was high in our scab nursery – the susceptible check variety was destroyed, and yet overall scab level in our breeding lines was lower than it has been in recent years. This could be a sign that the resistance we have been working on for years is more and more widespread in our material, and our lines are just more resistant than they were even several years ago. DON data from 2019 is not yet available.

Doubled Haploids and Speed Breeding: We have been excited about some of the doubled haploid lines in our breeding program in that they exceed our requirements for height, maturity, and disease resistance; a number of them in this year's Preliminary trial made the cut for additional testing. Doubled haploids save time by shortening the breeding process, but are very expensive. We are exploring speed breeding as an alternative that provides up to 3 generations per year which will still shave time off of the breeding process but at a much lower cost, so we can use it with many more crosses.

Genomic Selection: In 2019 we were able to use genomic selection to choose lines on the basis of genomic predictions and in doing so, were able to recover roughly 7 of the top 10 actual yielders in a given population. With this kind of data we are moving towards the goal of using genomic data to decide which lines to test in the field, which will save money and allow us to look at more potential lines because we will avoid testing lines that have no chance of performing well. To date this has been somewhat effective, but not perfect. The data from 2019 has prompted us to take some of our populations going into the Preliminary test and only test half of the lines, using genomic data to predict the other half. We are hopeful this will move us one step closer to our goal.

Data Tables: Data tables and charts are presented on the next four pages to provide a sense of the kind of data we are collecting in our routine yield trials and in our genomic selection projects.

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Super Max Trial, 2019 grown at Schochoh, Princeton, Woodford and Lexington. Yield, test weight, height, scab traits and genomic predicted yield are presented.

		Yield (bu/a)			Rank		Test Wt	Height	Scabby Seed	DON	Predicted Yield
entry	Line	2 loc ave	3 loc ave	4 loc ave	3 locations	4 locations	lb/bu	In.	%	ppm	bu/a
5	X11-0170-52-3-3	100.6	96.4	87.8	1	1	58.6	36.3	7.5	1.05	63.9
3	AMAX 438	100.0	92.6	83.2	3	2	58.9	38.2	15	1.055	
7	X11-0374-104-13-5	100.2	93.0	83.2	2	3	62.2	35.7	5	1.3	79.2
13	X12-619-205-5-3	94.4	91.3	82.4	4	5	62.5	34.1	4	0.81	65.4
24	X12-3010-4-4-1	97.6	89.9	81.8	6	6	61.2	39.0	5	0.905	94.0
9	X11-0414-117-12-5	94.3	89.4	81.7	7	7	61.4	40.3	10	0.885	83.6
14	X12-619-205-7-1	92.4	88.9	81.2	8	8	60.5	35.9	5	0.815	59.9
30	X10-0594-7-1-3	95.5	85.7	80.3	19	9	59.7	35.5	10	2.4	77.5
15	X12-619-205-14-1	89.2	88.0	80.2	10	10	61.3	34.7	5	0.61	61.2
10	X11-0420-120-13-3	92.6	88.4	80.0	9	11	61.1	38.5	7.5	1.655	75.6
16	X12-619-205-20-3	89.0	87.8	79.9	11	12	61.7	36.1	5	1.24	69.8
27	X12-3010-3-5-3	95.6	86.8	79.8	15	13	60.6	33.7	10	1.6	88.9
18	X12-3010-2-12-1	91.9	86.3	79.3	18	14	59.3	34.4	4	0.805	80.4
11	X11-3004-149-11-5	94.5	87.8	78.3	12	15	61.0	35.8	12.5	1.85	76.4
21	X12-3010-3-1-1	96.4	87.5	78.1	13	16	58.5	32.2	12.5	2.55	74.5
8	X11-0414-116-11-3	96.9	87.4	77.7	14	17	59.7	38.7	12.5	1.6	79.2
26	X12-3016-1-5-3	94.2	86.7	77.6	16	18	58.7	38.9	7.5	1.5	81.1
17	X12-3010-2-10-1	95.3	86.6	77.5	17	19	59.4	37.1	15	3.3	86.5
6	X11-0170-52-18-3	88.8	84.6	77.0	20	20	58.8	39.1	15	2.1	
28	X12-3010-3-6-3	89.5	84.5	76.5	21	21	57.4	33.2	5	0.615	81.2
1	PEMBROKE16	84.8	82.3	76.4	24	22	62.5	34.1	10	1.35	
4	TRUMAN	83.6	79.2	74.8	28	23	60.1	42.3	3.5	1.2	
25	X12-3010-4-6-1	90.0	83.0	74.8	23	24	59.6	32.0	7.5	1.8	78.0
22	X12-3010-3-6-1	85.7	80.7	74.3	25	25	59.9	30.7	7.5	0.8	81.1
23	X12-3010-3-15-1	95.0	84.2	73.7	22	26	59.1	30.9	15	0.875	84.5
19	X12-3010-2-13-1	88.1	80.4	72.9	26	27	59.8	33.2	12.5	1.75	81.3
29	X12-050-214-2-3	83.7	79.6	71.9	27	28	61.9	39.1	7.5	1.15	76.3
20	X12-3010-2-18-1	87.5	78.2	69.0	29	29	61.4	36.3	7.5	1.6	93.8
2	PIONEER 26R41	80.2	73.5	60.9	30	30	59.5	32.7	22.5	2.25	

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Advanced Trial 1, 2019 grown at Schochoh, Princeton, Woodford and Lexington. Yield, test weight, height, and scab traits are presented.

entry	Line	Yield ave. Schochoh - PRN bu/a	AveRank	Yield ave. Schochoh - PRN - Woodford AveLSM	Test Weight lb/bu	Height in	DON ppm
1	Pembroke 16	100.2	11	81.1	60.7	35.0	0.96
2	Amax 438	102.0	2	88.2	59.7	37.8	1.03
3	Pioneer 26R41	96.5	9	81.7	59.7	32.9	3.7
4	Truman	98.1	13	79.3	60.8	43.1	0.88
5	X12-3049-57-3-3	90.9	26	75.7	61.5	33.8	0.665
6	X12-3077-56-19-3	90.2	29	75.3	60.8	33.6	0.93
7	X12-3041-70-17-5	85.0	34	72.5	59.8	35.5	0.86
8	X12-3072-55-3-3	105.7	5	84.5	62.2	35.5	2.35
9	X12-3048-52-4-3	86.7	35	71.9	59.1	33.3	2.85
10	X12-3050-30-18-5	90.5	33	73.0	61.4	34.9	0.9
11	X12-3072-55-2-3	93.1	25	75.8	62.0	34.9	0.52
12	X12-3104-64-18-1	94.0	31	74.0	61.5	35.7	1.45
13	X12-3104-64-17-1	97.5	17	78.8	61.7	34.2	1.6
14	X12-3034-49-3-3	95.4	22	77.2	61.7	34.9	2.15
15	X12-3035-50-4-5	92.6	28	75.3	59.6	43.0	1.58
16	X12-3110-40-19-5	99.4	6	83.5	63.8	37.3	1.15
17	X12-3053-54-11-5	97.8	18	78.7	61.4	35.8	0.52
18	X12-3034-49-4-3	98.5	12	80.6	62.2	36.2	1.75
19	X12-3110-40-19-1	107.6	4	86.3	62.7	38.1	0.77
20	X12-3062-61-3-5	102.4	8	81.8	61.3	36.4	2
21	X12-3035-50-2-3	104.2	3	86.3	62.0	35.5	1.145
22	X12-3077-56-18-5	95.3	19	78.6	61.9	34.8	1.355
23	X12-3035-50-4-3	101.4	7	82.5	63.0	36.2	1.2
24	X12-3077-56-17-3	91.8	24	75.9	61.5	33.7	1.65
25	X12-3035-50-3-3	115.5	1	91.1	62.6	35.5	1.4
26	X12-3035-50-1-3	93.1	27	75.7	62.2	35.4	1.55
27	X12-3077-56-12-5	97.6	10	81.2	61.9	35.2	1.55
28	X12-3049-57-2-3	95.3	21	77.2	60.9	34.2	2.15
29	X12-3049-57-1-5	94.2	30	74.8	59.7	35.4	1.9
30	X12-3035-50-7-5	93.3	23	77.1	62.6	34.9	1.025
31	X12-3035-50-6-5	98.8	16	78.8	61.9	35.3	1.6
32	X12-3072-55-3-5	99.6	15	79.0	61.8	36.7	1.4
33	X12-3072-55-19-5	95.5	14	79.0	62.7	36.0	1.2
34	X12-3041-70-14-5	82.7	36	65.6	60.1	34.9	0.925
35	X12-3001-42-1-3	90.1	32	73.4	60.1	30.4	1.6
36	X12-3072-55-19-3	94.9	20	78.2	61.7	34.8	1.85

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Max Trial 2, 2019 grown at Schochoh, Woodford and Lexington. Yield, test weight, height, and scab traits are presented.

		AVE YIELD	Ave	Location	Yield	Test Wt	Height	Location	Yield	Location	Yield	Scabby Seed	DON
entry	Line	bu/a	RANK	LOC	bu/a	lb/bu	In	LOC	bu/a	LOC	bu/a	%	ppm
9	X11-0357-24-13-5	89.0	1	HAL	118.1	59.8	35.4	WOD	84.89	LEX	64.11	5	1.11
3	AMAX 438	88.0	2	HAL	110.0	58.2	38.3	WOD	86.80	LEX	67.26	15	3.7
22	AC-8-4-1-1	85.6	3	HAL	111.3	60.7	35.1	WOD	80.17	LEX	65.26	5	0.54
19	AC-2-17-5-5	85.1	4	HAL	118.2	63.2	35.5	WOD	77.92	LEX	59.21	5	1.2
15	X11-0130-13-2-3	84.8	5	HAL	114.1	62.4	36.3	WOD	83.09	LEX	57.27	5	0.7
5	X11-0249-17-5-5	84.7	6	HAL	107.6	62.5	35.9	WOD	80.66	LEX	65.88	12.5	1.6
4	TRUMAN	84.6	7	HAL	111.6	62.5	43.1	WOD	79.10	LEX	63.03	7.5	1.01
1	PEMBROKE16	84.2	8	HAL	107.7	60.0	35.8	WOD	82.48	LEX	62.31	12.5	1.75
16	X11-0130-14-10-3	82.9	9	HAL	107.3	61.0	37.0	WOD	85.05	LEX	56.37	7.5	0.865
20	AC-7-7-3-3	82.4	10	HAL	103.8	61.6	33.5	WOD	76.23	LEX	67.04	15	2.15
7	X11-0308-19-7-1	80.8	11	HAL	104.6	61.8	32.7	WOD	81.86	LEX	56.05	12.5	1.1
11	X11-3296-39-1-1	80.4	12	HAL	114.1	60.5	36.4	WOD	79.49	LEX	47.76	15	1.47
12	X11-0081-8-7-1	80.3	13	HAL	98.7	58.8	34.9	WOD	80.40	LEX	61.93	7.5	1.35
21	AC-7-12-5-5	80.3	14	HAL	104.9	61.9	35.8	WOD	82.13	LEX	53.88	10	1.8
23	AC-8-18-1-1	80.2	15	HAL	106.1	63.4	34.0	WOD	74.49	LEX	59.88	10	1.2
17	153_UX1105-13-26-8-1	79.8	16	HAL	108.4	60.8	37.5	WOD	73.88	LEX	57.01	10	1.22
10	X11-0386-26-9-5	78.8	17	HAL	114.7	58.4	35.4	WOD	67.92	LEX	53.95	15	1.18
13	X11-0081-8-10-3	76.6	18	HAL	94.5	58.2	38.6	WOD	76.63	LEX	58.67	12.5	1
8	X11-0308-19-10-5	75.0	19	HAL	103.9	62.3	33.6	WOD	73.33	LEX	47.72	12.5	1.15
24	AC-12-16-5	74.9	20	HAL	97.32	61.34	31.92	WOD	69.21	LEX	58.31	5	1.235
6	X11-0249-17-17-3	74.2	21	HAL	100.6	61.9	31.9	WOD	65.18	LEX	56.80	10	1.45
18	AC-2-14-3-3	72.9	22	HAL	95.9	62.3	36.1	WOD	68.56	LEX	54.13	7.5	1.225
2	PIONEER 26R41	68.2	23	HAL	111.0	60.6	34.5	WOD	66.64	LEX	27.09	7.5	1.85
14	X11-0091-10-14-3	65.8	24	HAL	74.7	60.3	39.1	WOD	68.31	LEX	54.45	7.5	1.23

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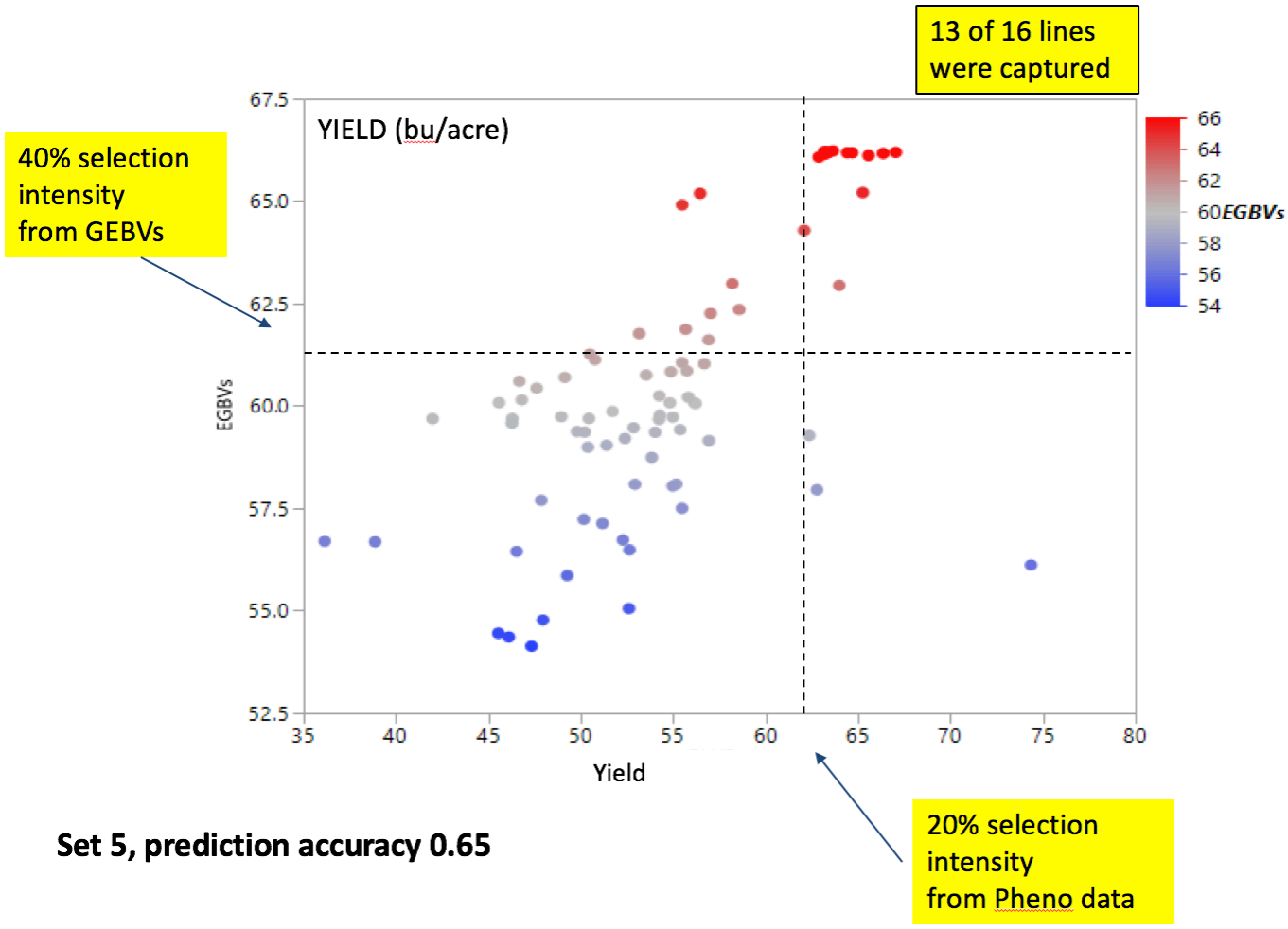
Graph of actual yield (x axis) and predicted yields (y axis). In this set of families, the accuracy of genomic predictions was about 65%. This meant that if we had ONLY relied on genomic predictions, we would have selected 13 of the 16 highest yielding lines.



Set 5, prediction accuracy 0.65