

Wheat Breeding Progress, 2020-21

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2021 Results

Increase and New Release: This was the first year that our new variety, Pembroke 2021, released exclusively to the KSGGA was grown in farmers' fields. Based on variety trial results from UK and Wheat Tech, it got off to a great start. But the focus of the breeding program is always on "what's next?" and so we increased two lines this year that had performed well in the 2020 state variety trial: X12-3010-4-4-1 and X11-0170-52-3-3. The former was grown by our project at Spindletop Farm in Lexington and the latter was increased by Wheat Tech in strips next to our plots at Schochoh. We are planning to work with Pat Clements increase X12-3010-4-4-1 this fall.



Figure 1. Increase strips of experimental line X11-0170-52-3-3, Schochoh, KY 2021.

Yield testing: 2021 was a phenomenal year in terms of wheat yields and test weights across the state, thanks to the cool weather during grain fill and the absence of any serious problems with head scab or spring freeze damage. Princeton was our highest yielding location, and yields were high enough at Lexington, our main seed increase location, that we came into the fall in good shape as far as seed supplies go. Table 1 contains data from the Supermax trial, our most advanced trial before lines are put in the state variety trial. The experimental KY lines fared very well against the commercial check varieties and we will begin the seed increase process for a number of them this fall.



Figure 2. Harvesting plots at Schochoh, KY, 2021.

Table 1. Supermax Test Over 4 KY Locations, 2021

ENTRY NAME	YIELD (bu/a)	HDATE Apr1=1	HEIGHT (in)	TWT (lb/bu)
PEMBROKE 2021	89.9	31.5	32.3	61.0
X12-974-18-1-3	89.3	31.5	33.9	57.9
X12-3034-49-4-3	87.4	33.6	33.7	59.2
X12-3072-55-3-3	86.6	32.7	30.7	57.7
X12-3072-55-13-5	86.6	33.0	34.5	61.1
X12-3114-65-7-1	85.9	32.1	33.3	58.0
X12-3014-46-7-3	85.9	33.3	35.7	57.9
X12-3035-50-6-5	84.0	33.0	34.8	57.6
X12-156-9-19-3	83.5	32.5	34.6	59.2
X12-3110-40-19-1	83.3	32.1	35.1	59.7
X12-3035-50-4-3	83.2	33.1	35.2	58.1
X12-3072-55-13-3	83.2	32.7	34.1	59.4
X12-3072-55-18-3	83.2	33.1	37.4	58.0
X12-3005-20-18-1	82.9	34.3	34.8	57.4
X12-974-18-13-3	82.6	31.2	36.0	58.3
X12-3035-50-2-3	82.2	32.9	35.9	58.9
X12-3035-50-3-3	82.0	33.1	34.9	52.8
X12-3048-52-17-5	81.9	32.5	36.2	55.6
X12-3116-66-18-5	81.5	33.6	34.5	57.2
X12-3014-46-8-5	81.4	33.5	33.4	58.4
X12-3072-55-3-5	80.5	33.3	35.1	57.5
X12-3051-53-18-3	79.2	33.9	34.8	55.4
X12-052-1-17-3	79.0	33.2	35.3	58.0
PIONEER 26R10	79.0	33.5	33.8	57.7

CV (%) 8.4

LSD (0.05) 9.5

Crossing: We produced approximately 400 crosses in the greenhouse this season, both single cross hybrids between 2 parental lines and 3-way crosses in which we cross the hybrid with a third parent. We are planting the single cross hybrids in the greenhouse this fall for an additional round of crossing; they will go into the vernalization chamber in the next week. The 3-parent F₁ hybrids produced in the greenhouse will be planted in the field at Lexington this fall to produce F₂ seed. To design some crosses, we will use genomic crossing software that predicts the most productive crosses to be made, based on genomic and field performance information from the parents. The majority of our crosses, though, will be made on the basis of field performance combined with information about which disease resistance genes are present in which parents.



Figure 3. Wheat plants in greenhouse for crossing.

Line development: F₄ and F₅ headrows at Lexington came through the winter in good shape and produced a decent amount of seed that will allow us to test their progeny in plots this fall. About 780 rows were selected based on plant height, clean leaves and heads, and overall vigor as well as maturity. These lines will go into trials this fall at up to 3 locations. These lines have been genotyped so we used genomic predictions as well as overall vigor, height, maturity and clean leaves to make our selections.

Scab screening: Early spring gave us very cool weather that stymied the scab fungus; this was followed by hot and dry conditions which further slowed infection. We were able to take scab ratings but the infection levels were modest. However, the samples that were sent off for vomitoxin (DON) analysis showed high levels in some cases, which indicates a late infection. The good news is that we have genomic predictions of scab resistance on most of our lines which is like having another set of data to help us make decisions.



Figure 4. Irrigated, Inoculated Scab Nursery, Lexington, KY 2021.

Speed Breeding: We acquired more high intensity LED lights this year and put them in the greenhouse to increase our speed-breeding effort. We planted one cycle of material that came out of speed breeding in the field adjacent to the greenhouse and got modest amounts of seed back, enough to go into mini-plots this fall. The whole objective here is to reduce the number of years required to develop a variety.

Genomic Selection: In 2021 we finally “pulled the trigger” on genomic selection in that we made the predictions the main basis of selection of headrows; in previous years this material has been grown in plots which is very expensive and resource intensive. So, this year we planted the material in what we call our PT Rows and in the coming year we will test these selected lines in replicated plots and will see how well the predictions performed. It has taken us 5 years to get to this point so I am confident that savings we achieve in time and resources will validate this decision.