

# GENOMIC SELECTION IN THE WHEAT BREEDING PROGRAM

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## OBJECTIVE

Plant breeding is a very expensive area of research, and we are constantly looking for ways to be more efficient and cost effective. Our most expensive activity is the testing of breeding lines in the field at multiple locations to determine whether they should be released as new varieties.

Genomic selection is a new plant breeding tool that offers a way to reduce that cost. The figure below illustrates how genomic selection works.

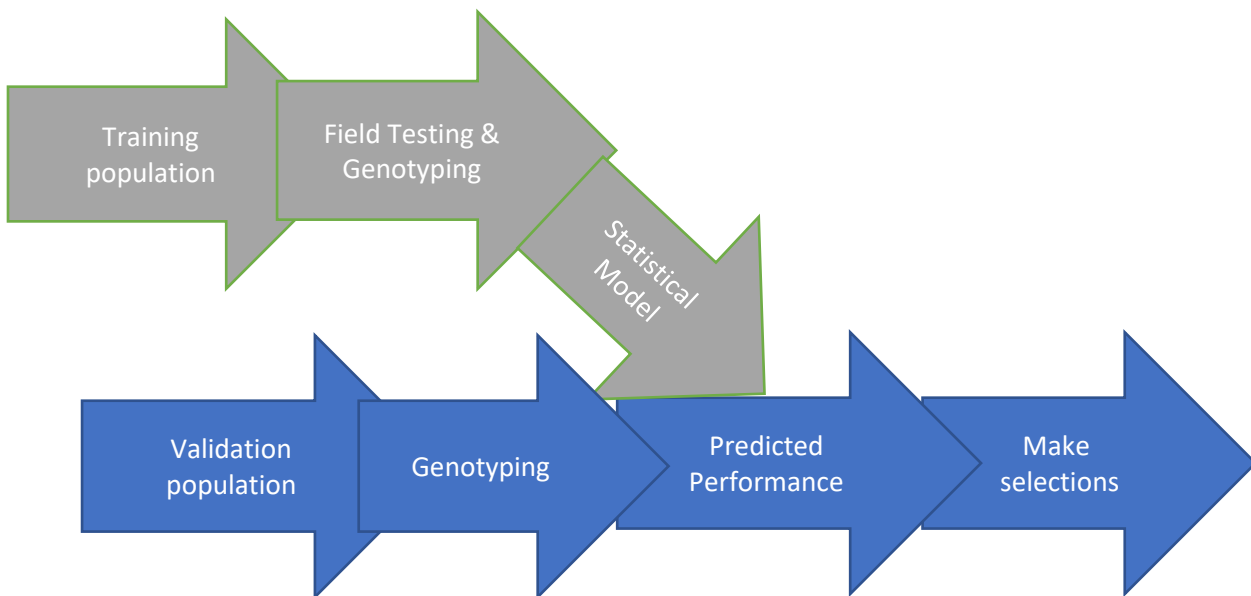


Figure 1. Flow chart of genomic selection in a wheat breeding program.

## METHODS & MATERIALS

We start off with a Training Population, a collection of lines and varieties that have been widely tested in the field and have also had their genomes sequenced. The Validation Population is a set of breeding lines whose genomes have been sequenced but **which have not yet been tested in the field**. These lines are related to the lines in the training population by pedigree, so they share some of the same genes. We use a statistical model that takes into account these shared genes *and* the performance data of the lines in the Training Population and that model will predict yield, test weight, height, heading date and scab resistance of the lines that have not yet been tested in the field (Table 1). Based on these predictions, we select lines to test in the field. The efficiency payoff comes from the fact that we do NOT test lines in the field that have very low predicted values.



Figure 2. Wheat breeding lines grown in single rows

Table 1. Predicted agronomic and scab traits in breeding lines grown in single rows.

ENTRY	PREDICTED YIELD (BU/A)	PREDICTED TWT (LB/BU)	PREDICTED HEAD DATE APR.1 = 1	PREDICTED HEIGHT (IN)	PREDICTED DON (PPM)
X18-1214-174-1-1	94.0	58.9	30.7	40.7	8.2
X18-1214-174-6-5	90.8	59.1	30.1	39.3	6.2
X18-1214-174-2-3	89.1	57.8	30.0	37.5	5.3
X18-1214-174-6-1	94.1	59.0	31.6	40.6	8.8
X18-1079-150-15-3	94.7	58.5	33.2	39.5	9.0
X18-1079-69-7-3	87.3	58.5	30.2	35.9	5.6
X18-1178-2-18-5	92.0	57.5	31.8	37.8	8.1
X18-1214-174-16-1	90.5	58.6	31.5	37.2	7.7
X18-1079-69-2-1	90.8	58.7	28.6	38.1	9.6
X18-1215-52-5-1	89.8	58.8	30.0	39.7	7.2
X18-1079-69-6-1	90.0	58.4	27.4	37.3	9.7

## **RESULTS AND DISCUSSION**

The question that most people ask is how can you be sure that the predictions are accurate? We have tested the accuracy for 6 years prior to committing to genomic selection at the single row stage. The models are not 100% accurate but overall we have found that this method is more accurate than growing the preliminary lines in a single plot at one location and basing a testing decision on that data.

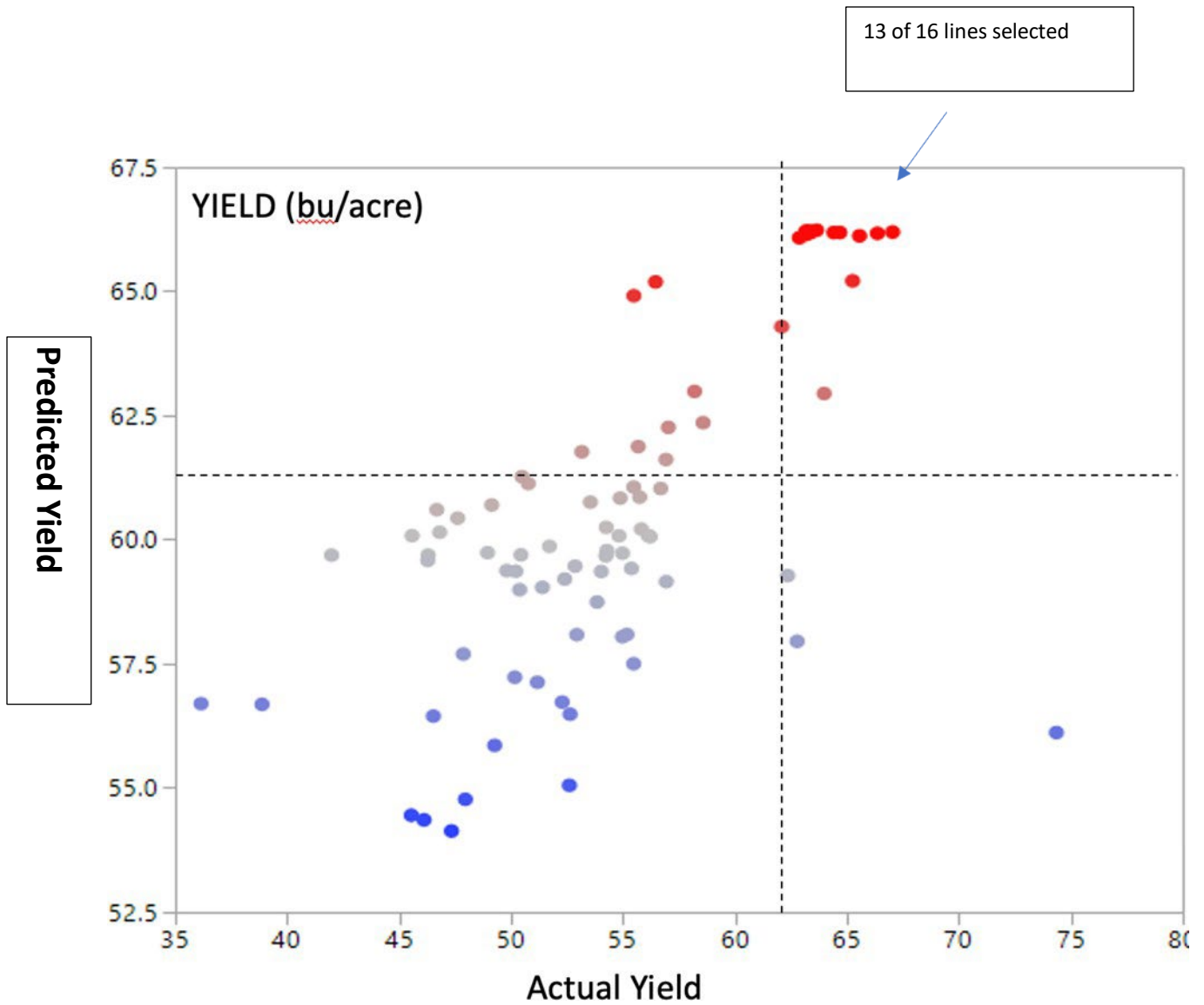


Figure 3. Actual vs Predicted Yield in a set of wheat breeding lines, Lexington, 2021.

### CONCLUSION

In Figure 3, the most important take-home is that based on genomic predictions, we would have selected 13 of the 16 lines that we would have selected based on actual performance. We are now 2 years into using this method as a mainstay of the breeding program and the lines we are testing look very promising.

### ACKNOWLEDGEMENTS

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