USING AN OPTICAL SEED SORTER TO SELECT FOR SCAB RESISTANCE IN WHEAT, 2016-2018

Jesse Carmack and Dave Van Sanford*
[1]Department of Plant and Soil Sciences, University of Kentucky, Lexington, KY 40546-0312
*Corresponding author, PH: (859) 218-0770, Email: dvs@uky.edu

For the past several years we have been using an optical sorter to select for scab resistance in genetically variable populations that come from crosses between resistant and susceptible parents. These populations are grown in our irrigated, inoculated scab nursery in 1 meter long rows. Each 1-meter row was hand harvested with sickles and all plants in each row were bundled together to avoid mixing populations. Each bundle was threshed separately, using a stationary threshing machine, and seed from all plants in the bundle were collected in bulk and sorted using an USDA/ARS and National Manufacturing Seed Sorter System (Figure 1). The optical seed sorter uses a high-throughput, high-resolution camera in combination with a computer and an air compressor to separate healthy from diseased grain. The camera can process 50-80 seeds per second per channel. Our sorter has 3 channels, and therefore can process 150-240 seeds/sec. Using common wheat as an example, about 25 lbs of grain per hour can be sorted. Once properly calibrated, the sorter can recognize undesirable seed based on color and generate a burst of air to cast discolored seeds into a collection vessel. Kernels that are deemed as acceptable accumulate in another separate collection vessel. A measure of Fusarium damaged kernels (FDK) based on optically-sorted grain was obtained by weighing the contents of each container, calculating the total mass, and dividing the mass of discarded kernels by the total. Only accepted grain was used to plant the next generation, and this process was repeated for three cycles of selection.

Figure 1. Optical Sorter

Step 1: Pour seed into the silver hopper at top right.

Step 3: Seed will start to flow down the ramp left of the hopper.

Step 4: As the grain reaches the end of the ramp the camera captures an image and relays information to the air nozzles.

Step 5: Bursts of air from the nozzles cast the damaged seed into the yellow bucket labeled rejected grain. Healthy grain does not receive a burst of air and the seed accumulates in the blue bucket labeled accepted grain.

Step 6: Weigh the contents of each bucket to arrive at an estimate of FDK.

Step 7: Set aside accepted grain for planting the next generation.

Two populations were used to evaluate the effectiveness of the optical sorter. Results of 3 years of selection are shown in Table 1. The C_0 is the base population with no selection, the C_1 indicates 1 cycle of selection and the C_2 indicates that 2 cycles of selection occurred. Because conditions differ each year, we standardized the data by expressing FDK as a percentage of the FDK value of our very resistant wheat check, KY02C-3005-25. In both populations the percentage of KY02C-3005-25 declined each cycle of selection, meaning that the population average was getting closer to the FDK value of KY02C-3005-25, or in other words, the population was becoming more resistant. This result gives us cautious optimism about the usefulness of the optical sorter and its future role in our fight to manage this very difficult disease.

Table 1. Effect of Using an Optical Sorter on Fusarium Damaged Kernels (FDK) in Three Selection Cycles, 2016-18

Population	Year	Selection Cycle Evaluated	Mean FDK (%)	Percent of KY02C-3005-25 (%)
2	2016	C0	12	278
2	2017	C1	17	250
2	2018	C2	18	158
5	2016	C0	12	270
5	2017	C1	13	194
5	2018	C2	16	138