USING MORPHOLOGICAL TRAITS TO SELECT FOR SCAB RESISTANCE IN WHEAT

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Fusarium head blight (FHB) or head scab is a very destructive disease of wheat and other small grains. We know that varietal resistance is one of the key tools available to growers to reduce the likelihood that scab will affect the profitability of their wheat crop. In addition to the genetic sources of resistance that we routinely use, breeders have wondered if morphological traits – plant height, head length, etc. can act as barrier between the fungus and the plant to provide a passive form of resistance to the disease.

To evaluate this possibility, we grew a large diverse group of 250 soft red winter wheat (SRWW) breeding lines and varieties from the SRW wheat region in the eastern US and measured the following morphological traits in 2015-16 at Lexington, KY: plant height (PH), peduncle length (PL) (the part of the stem between the base of the flag leaf and the base of the head), head length (HL), spikelet number (SN), head density (HD), head inclination (HI). Scab traits were: scab rating, scab severity, scab index, Fusarium damaged kernels (FDK) and deoxynivalenol (DON) concentration. There were significant (p<0.01) differences among genotypes for all morphological traits measured. Moderate heritabilities (0.41-0.66) for head traits were estimated, meaning that we could successfully breed for them. Morphological and scab traits were generally negatively correlated (Table 1).

DON or vomitoxin is the trait with the biggest potential impact on wheat profitability in a year with heavy scab pressure. In our study, the three morphological traits significantly correlated with DON were plant height, peduncle length and head inclination with respective correlations of -0.25, -0.26 and -0.17 (Table 1). All three were negatively correlated meaning that taller plants with long peduncles and more inclined heads (parallel to the soil surface) were more likely to have low vomitoxin levels. One explanation for head inclination is that an inclined head, bent over will allow more air flow between spikelets and create a less favorable disease environment than a head that is totally upright. The negative correlation with height was expected: if you have a group of varieties under heavy scab pressure, those with heads above most of the canopy will be less likely to be infected with the fungus than the shorter types with heads closer to the ground, where many of the spores come from, after overwintering on corn stubble. For breeders this means that we have to select plants that are as tall as possible yet unlikely to lodge.

This study demonstrates the importance of morphological traits to scab resistance. Despite their small effects, we pay attention to these traits when we are evaluating and selecting plants in populations. Scab is such a complex disease that we need to rely on every possible means of reducing its impact on the farmer and the wheat industry. Most of that reliance is centered on resistance genes that we know to be effective, but if the morphological traits will add a little more, we will certainly take it.

Table 1. Correlations Between Plant Traits and Scab Traits, Lexington, KY 2015-16

		Scab Traits			
Plant Traits†	Scab Rating	Scab Severity	Scab Index	FDK	DON
Plant Height	-0.51**	-0.32**	-0.34**	-0.46**	-0.25**
Peduncle Length	-0.41**	-0.35**	-0.37**	-0.35**	-0.26**
Head Length	-0.32**	-0.18**	-0.20**	-0.14*	0.03ns
Spikelet Number	-0.32**	-0.17**	-0.14*	-0.15*	0.01ns
Head Density	0.02ns	-0.01ns	-0.05ns	0.03ns	0.05ns
Head Inclination	-0.24**	-0.22**	-0.23**	-0.23**	-0.17**

† Peduncle is the portion of the stem from the base of the flag leaf to the head.

** Correlation is significant at the 1% level.