

Supplemental Table S1 Environmental statistics of 2015 fall and 2016 spring greenhouse experiments (GH_Fall and GH_Spring) and field experiments conducted in Manhattan (2016MH) and Hays (2016Hays), KS, USA in 2015-2016 growing season

Experiment	Day Temp.[†]	Night Temp.	Day length (h)
GH_Fall	25.0 ± 5.0 °C	20.0 ± 2.0 °C	12
GH_Spring	22.0 ± 3.0 °C	17.0 ± 2.0 °C	12
	Max. Temp.^{††}	Min. Temp.	Precip. (cm)
2016MH	35.0 °C	5.6 °C	15.8
2016Hays	35.0 °C	3.2 °C	7.9

[†] Greenhouse day/night temperature (°C) is expressed as mean ± standard deviation

^{††} Field temperature range (°C) and precipitation are calculated from May 1 to June 15 in 2016. Max. Temp. = maximum temperature, Min. Temp. = minimum temperature, Precip. = precipitation. Data is from www.usclimatedata.com.

Supplemental Table S2 List of KASPar primers used for genotyping and marker-assisted selection

Primer name	Position	Primer sequence (5'-3')	Reference
SNP.646_T [†]	<i>TaPHS1</i>	GGTGGAACAGATGCAACTAAAGG	Liu et al. 2015
SNP.646_S	<i>TaPHS1</i>	GGTGGAACAGATGCAACTAAAGA	
SNP.646_R	<i>TaPHS1</i>	GTGAGTGTTATATGAAACT	
SNP.666_T	<i>TaPHS1</i>	GTGAGTGTTATATGAAACTAATGATCCATTA	Liu et al. 2015
SNP.666_S	<i>TaPHS1</i>	GTGAGTGTTATATGAAACTAATGATCCATTT	
SNP.666_R	<i>TaPHS1</i>	ACCGGGTGGAAACAGATGCAACTAAA	
KASP3743_T	<i>Phs1</i>	TCAGTTTGGCCAACCATGTT	Lin et al. 2016
KASP3743_S	<i>Phs1</i>	TCAGTTTGGCCAACCATGTC	
KASP3743_R	<i>Phs1</i>	TCTTGTCCTACCTCCAAAC	
MKK_KASP_T	<i>TaMKK</i>	TTTTTTGCTTCGCCCTTAAGG	Torada et al. 2016
MKK_KASP_S	<i>TaMKK</i>	TTTTTTGCTTCGCCCTTAAGT	
MKK_KASP_R	<i>TaMKK</i>	AGGCTGTGACCTGATGTGTT	

[†]T: Forward primer with alleles in tolerant parental genotypes (Tutoumai A & AUS1408); S: Forward primer with alleles in susceptible genotype (NW97S186); R: Reverse primer

Supplemental Fig. S1 A workflow diagram of the backcrossing project to transfer quantitative trait loci (QTLs) on 3AS and 4AL from Tutoumai A and AUS1408 to NW97S186

