# Using Maker-Assisted Selection to Improve FHB Resistance in Hard Winter Wheat

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# Acknowledgements

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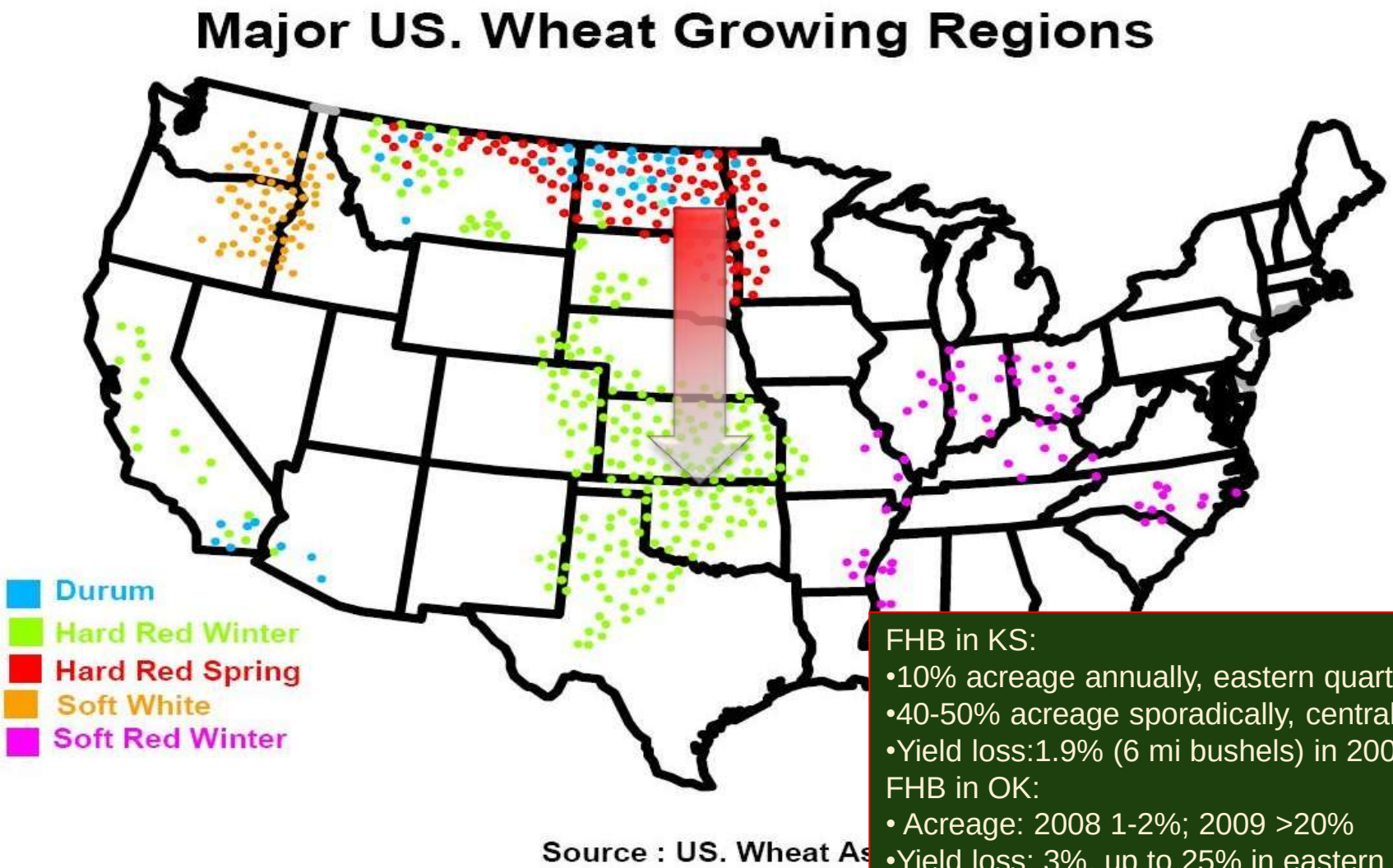
FHB in Hard Winter Wheat

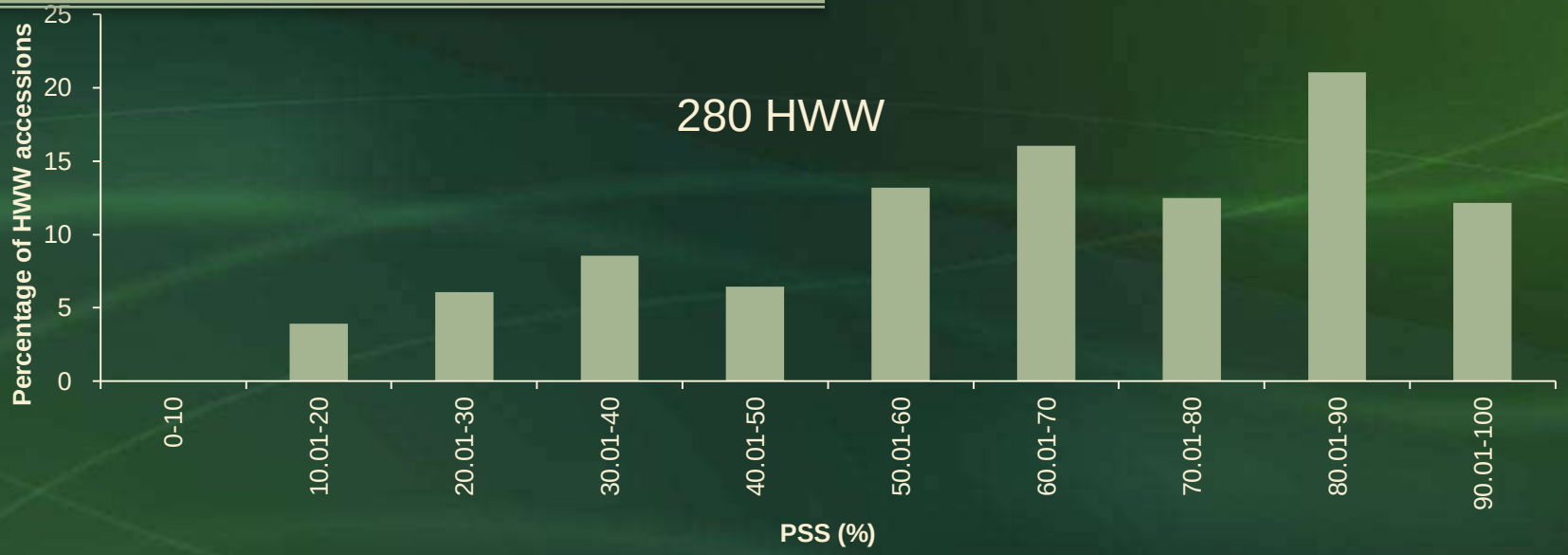
# FHB Moves to South in the Great Plains

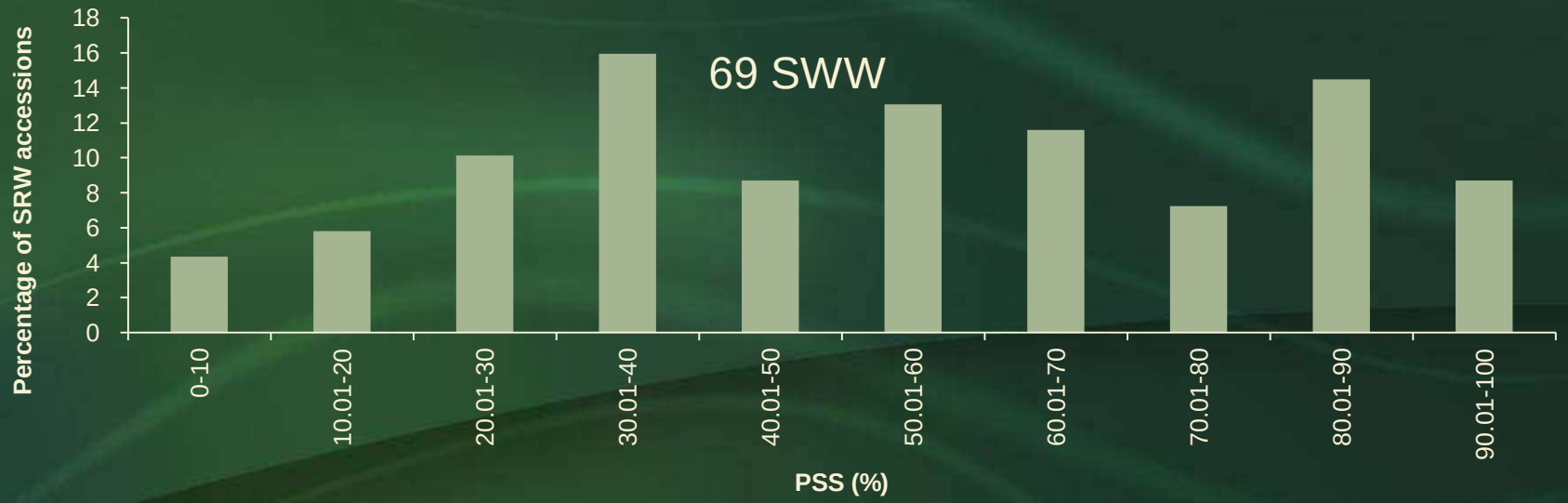



FHB in KS:
- 10% acreage annually, eastern quarter
- 40-50% acreage sporadically, central KS
- Yield loss:1.9% (6 mi bushels) in 2008

FHB in OK:
- Acreage: 2008 1-2%; 2009 >20%
- Yield loss: 3%, up to 25% in eastern districts

# FHB resistance evaluated in three greenhouse experiments



# Selected Hard Winter FHB Resistant Wheat Accessions

| Accession | PSS(GH) | PSS (F) |
|---|---|---|
| Heyne | 10.2 | 37.5 |
| SD08198 | 14.2 | 40 |
| OK05134 | 15.4 | 30.8 |
| T154 | 15.5 | 18 |
| SD05085-1 | 15.7 | 38.8 |
| Harry | 16.9 | 35 |
| NI04421 | 17.8 | 68.8 |
| SD05210 | 18.4 | 34.3 |
| Century | 18.9 | 51.5 |
| KS08FHB-78 | 19.4 | 11.3 |
| KS970093-8-9-#1 | 20 | 33.8 |
| Lyman | 21.4 | 23.8 |
| AP05T2413 | 22.1 | 42.5 |
| Hitch | 22.7 | 25 |

# FHB Resistance in HWW

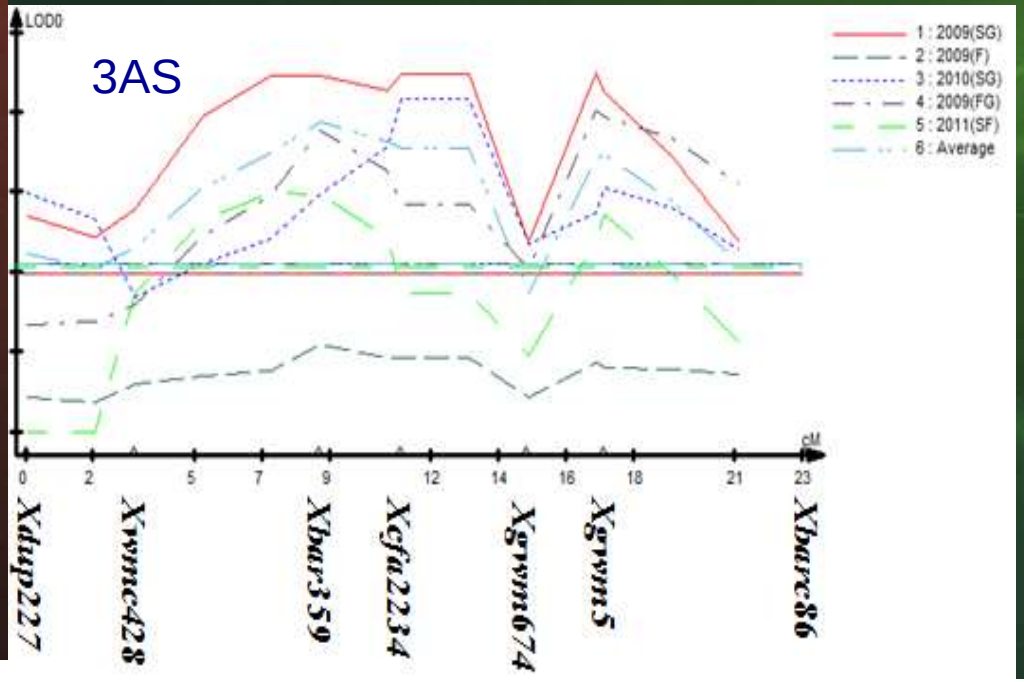
- Most HWW breeding lines/cultivars are MS to S
- *Fhb1* has be used in HWW breeding for more than 10 years, only a few elite lines have *Fhb1*
- Several HWW were identified with consistent resistance, but QTL have not been mapped in these accessions
- Some HWW show both type I and II resistance, they are valuable parents for improving HWW FHB resistance.

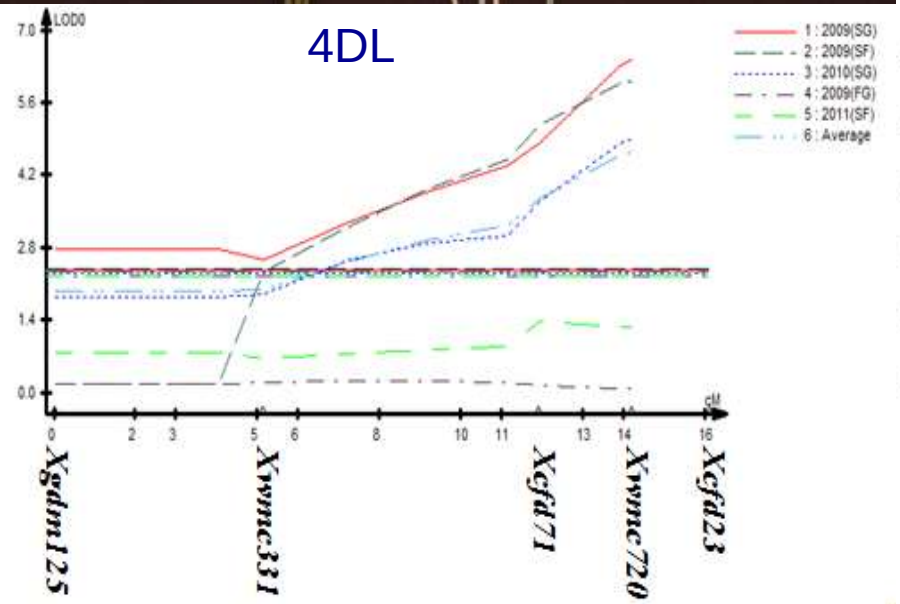
# FHB Resistance QTL in Chinese Sources and US Hard Winter Wheat

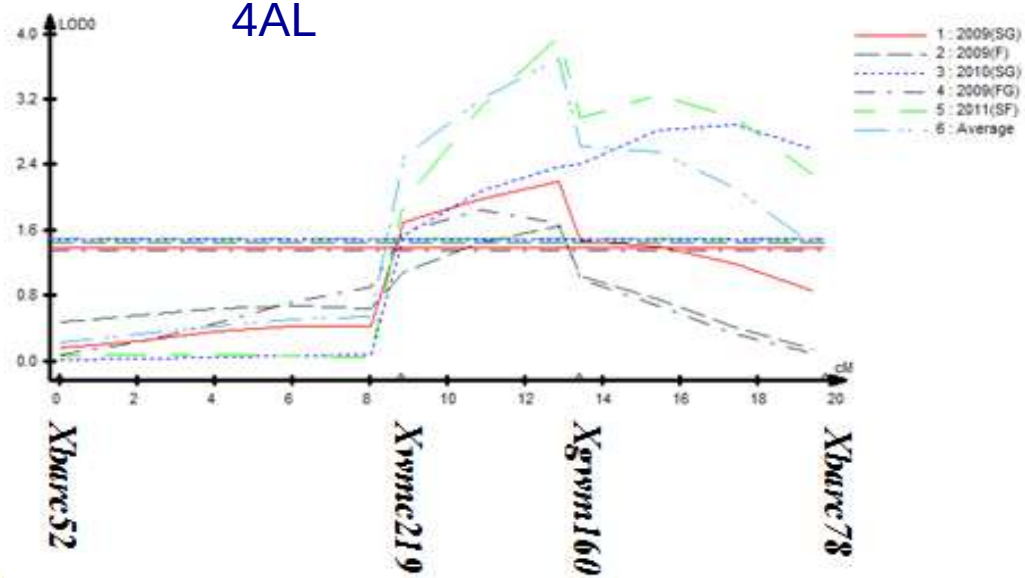
# Resistance Sources Used for QTL Mapping

| Cultivar | PSS(GH) | PSS(F) |
|---|---|---|
| Chinese sources | | |
| Ning7840 | 9 | 11 |
| Chinese Spring Sumai3 7A substitution line | 9 | 33 |
| Wangshuibai | 10 | 11 |
| Huangcandou (HCD) | 14 | 10 |
| Haiyanzhong(HYZ) | 9 | 15 |
| Huangfangzhu(HFZ) | 13 | 12 |
| Baisanyuehuang(BSYH) | 7 | 11 |
| US native source | | |
| Heyne (HWW) | 10 | 38 |
| Duster (HWW) (S) | 82 | 93 |

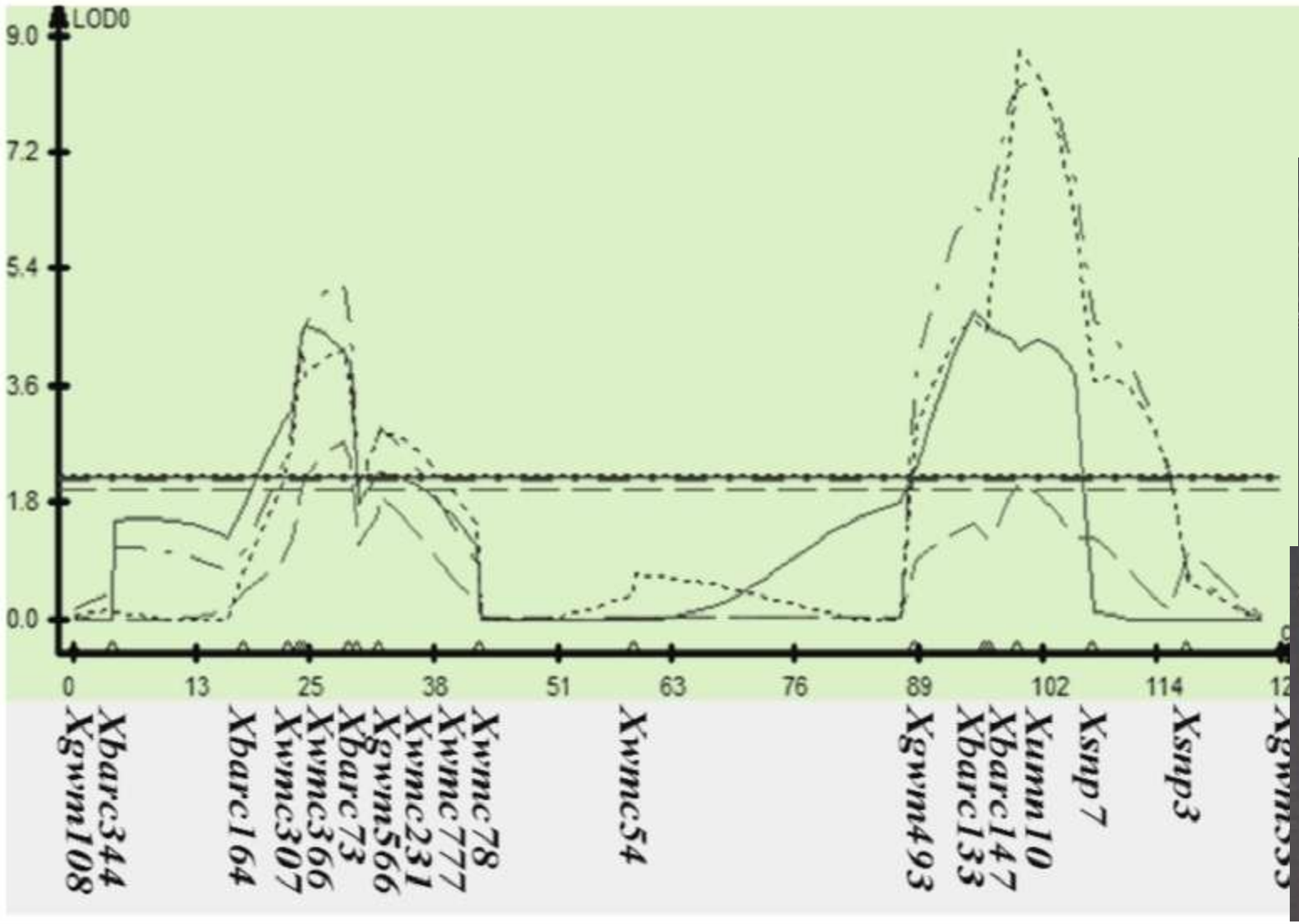
# Fhb1 does not Present in HWW Heyne



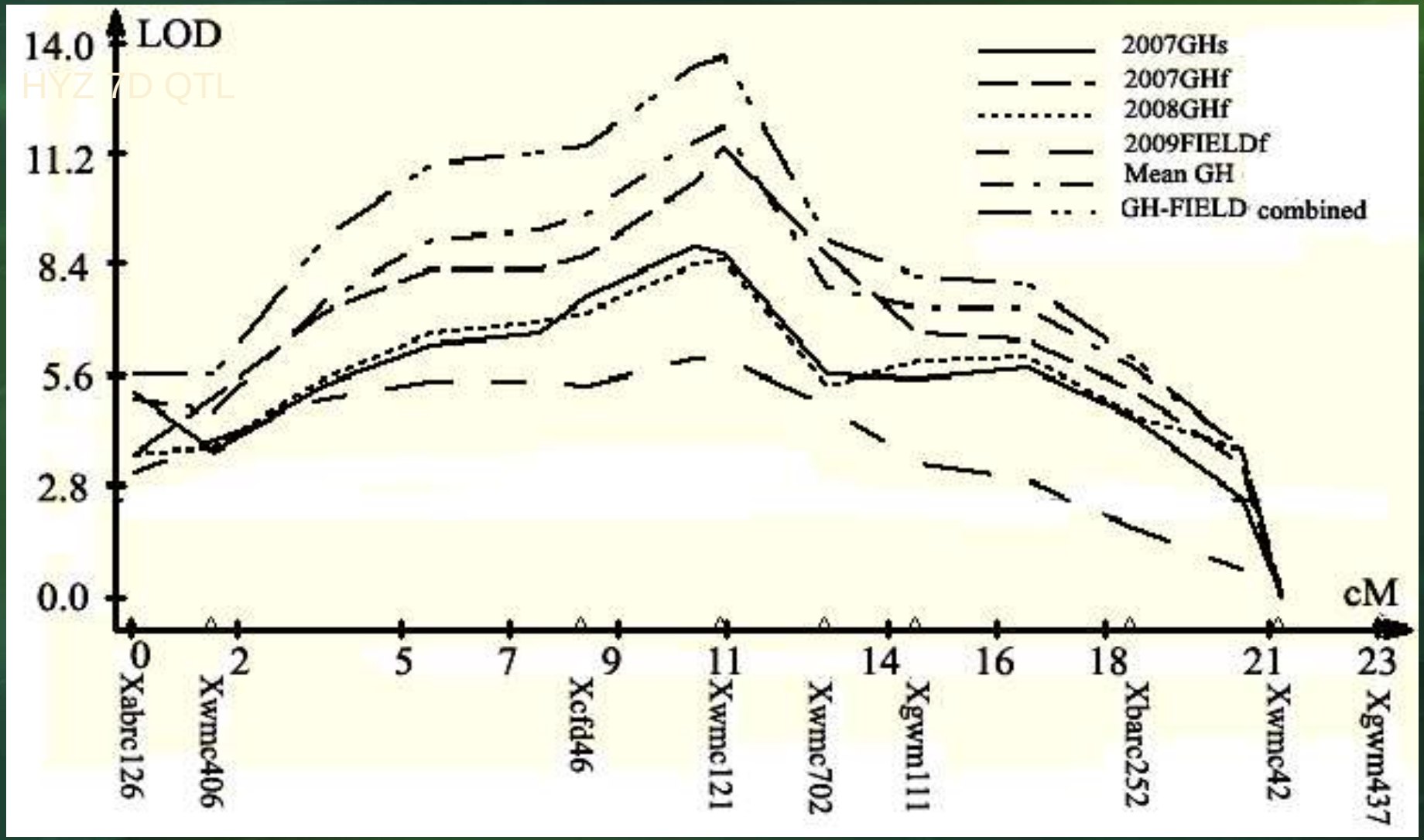



# Fhb1 and QTL 3BSC Present in BSYH, HCD & WSB

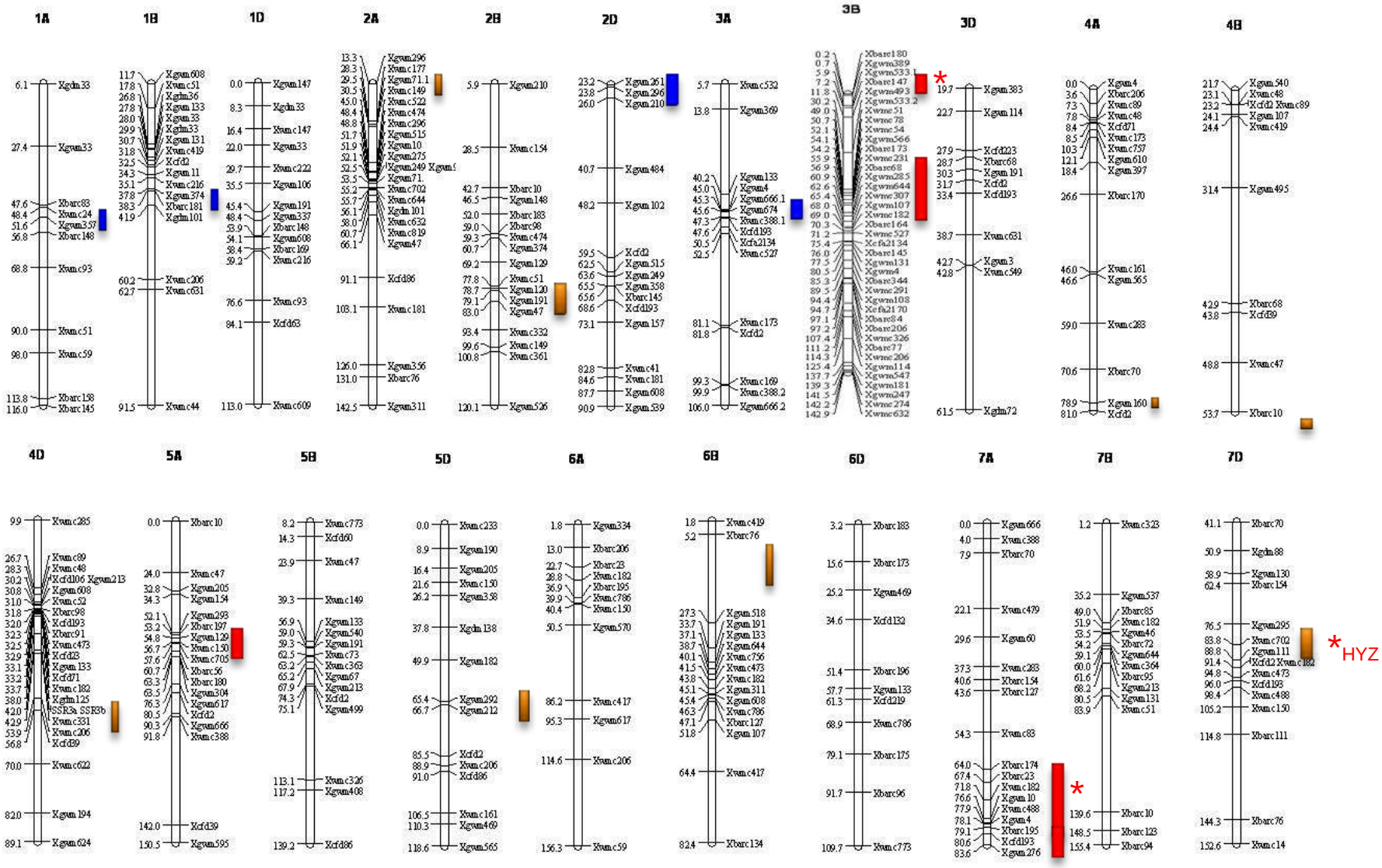




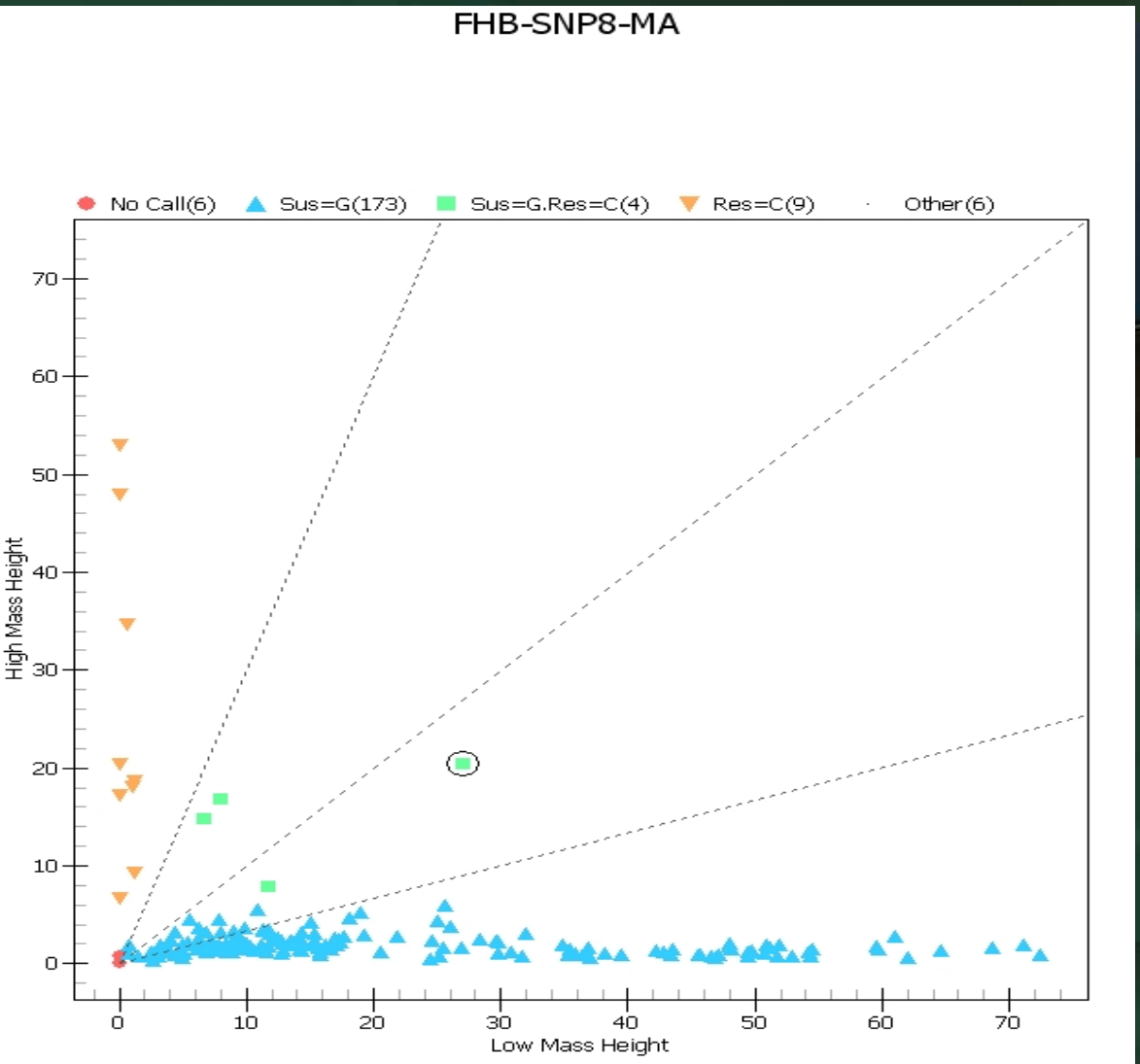
# HYZ does not Have Fhb1, but a New Major QTL on 7D



# Map Locations of QTL from 7 Chinese lines



# SNP for FHB Resistance QTL *Fhb1*

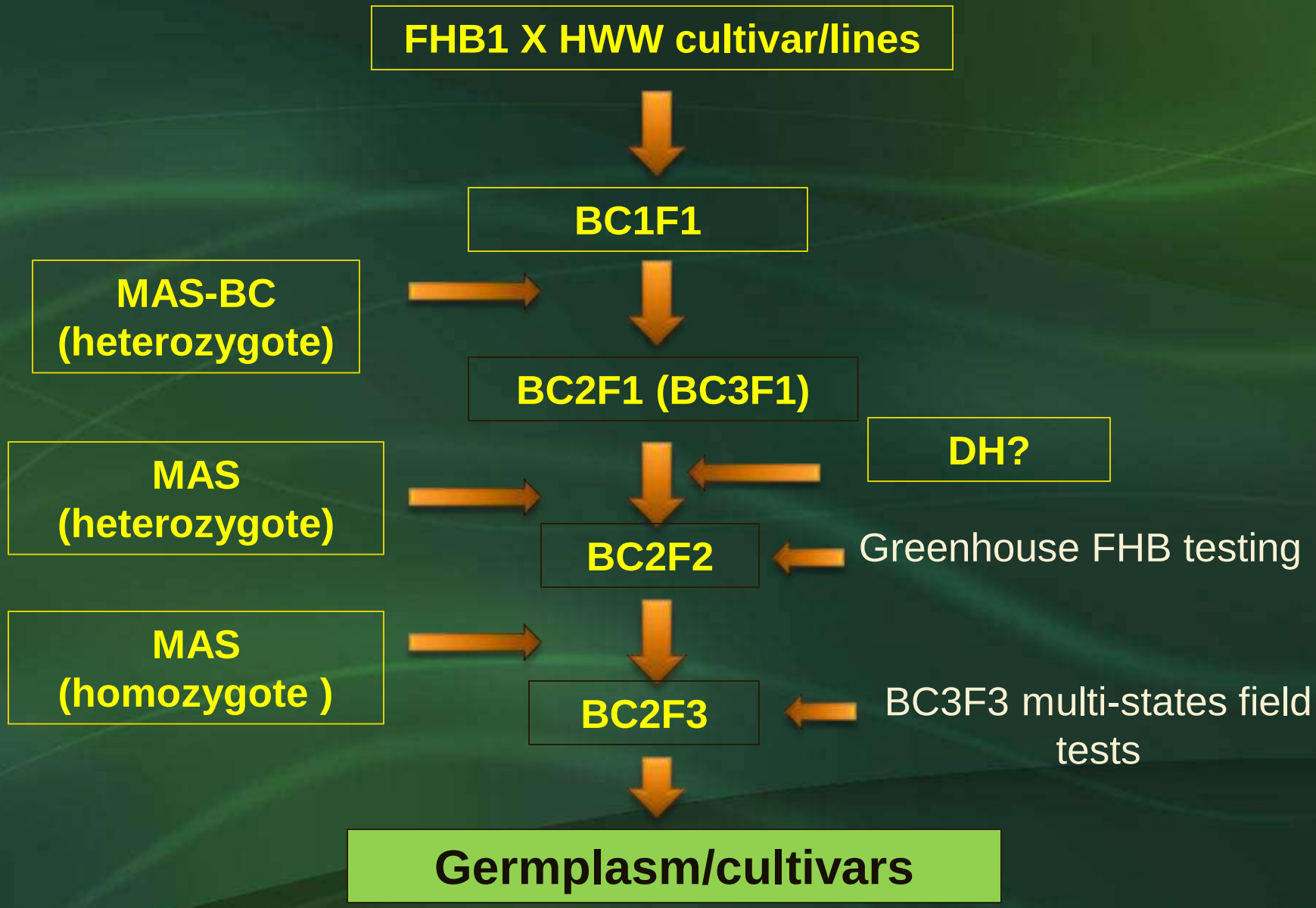




# Summary

- Most repeatable QTL reported to date can be found in Chinese sources
- QTL on 3BS(2), 5AS, 7AL detected in multiple populations, and should be stable QTL for breeding. Fhb1 is the QTL with the largest effect mapped to date
- A consensus map is being constructed using 6 populations and meta-analysis of all QTL will be conducted for the 6 populations
- SNP8 is a good SNP for *Fhb1* and multiplex SNP for other QTL is developing for Sequenom MassArray

# Marker-Assisted Backcross to Transfer *Fhb1* into HWW can Significantly Enhance HWW FHB Resistance


FHB1 X HWW cultivar/lines
BC1F1
MAS-BC (heterozygote)
BC2F1 (BC3F1)
DH?
MAS (heterozygote)
BC2F2
Greenhouse FHB testing
MAS (homozygote )
BC2F3
BC3F3 multi-states field tests
Germplasm/cultivars

# PSS for Fhb1 in Wesley, Trego, and Harding

| Pedigrees of selected *Fhb1* lines | PSS(GH) | PSS reduction |
|---|---|---|
| 262(ND2928/Wesley*2)F3/WesleyF4 | 0.079 | |
| 267(ND2928/Wesley*2)F3/WesleyF4 | 0.090 | |
| 568(ND2928/Wesley*2)F3/WesleyF4 | 0.192 | (Mean=0.12) |
| Wesley | 0.584 | 0.46 |
| 277(ND2710/Trego*2F3//TregoF4 | 0.324 | |
| 219(ND2710/Trego*2F3//TregoF4 | 0.253 | |
| 27(ND2710/Trego*2F3//TregoF4 | 0.203 | (Mean=0.26) |
| Trego | 0.722 | 0.46 |
| 167(Harding*2/Sumai3)F3Harding/F4 | 0.534 | |
| 61(Harding*2/Sumai3)F3Harding/F4 | 0.580 | |
| 31(Harding*2/Sumai3)F3Harding/F4 | 0.350 | (Mean=0.49) |
| Harding | 0.607 | 0.12 |

# Infected Spikes of Wesley Fhb1 vs Wesley in GH

# Infected WesleyFhb1-Wesley-WesleyFhb1 in Field

# Infected Spikes of Trego vs TregoFhb1 in GH

# Mean PSS of Bc2F2 in Overland, Jagger and Overley Backgrounds

| Pedigree | No. lines | PSS |
|---|---|---|
| ***Overland*** | | **0.35** |
| ***{Overland***3/[(7840/Jagger//Chokwang/JaggerF2)/Jagger]}F2* | ***179*** | **0.15** |
| ***Jagger*** | | **0.80** |
| *[**Jagger***3/(7840/Jagger//Chokwang/JaggerF2)/]F2* | ***162*** | **0.3** |
| ***Overley*** | | **0.94** |
| ***{Overley***3[(7840/Jagger//Chokwang/JaggerF2)/Jagger]}/F2* | ***71*** | **0.44** |

# FHB in Clark-*Fhb1* (BC7F7) NILs

| | GH | Field | | | |
|---|---|---|---|---|---|
| | KS | 2010 KS | 2011 KS | 2011 IL | Mean |
| NIL75(R) | 0.07 | 0.10 | 0.05 | 0.16 | 0.11[a] |
| NIL78(R) | 0.15 | 0.14 | 0.05 | 0.18 | 0.13[a] |
| NIL80(R) | 0.30 | 0.10 | 0.05 | 0.26 | 0.15[a] |
| NIL90(R) | 0.13 | 0.16 | 0.05 | 0.27 | 0.16[a] |
| Clark(S) | 0.89 | 0.76 | 0.49 | 0.66 | 0.62[b] |

# *Fhb1* Did not Cause Significant Yield Drag

| | 2010 KS | 2011 KS | 2011 IL | Mean |
|---|---|---|---|---|
| NIL75(R) | 351.24 | 503.05 | 442.08 | 432.12 |
| NIL78(R) | 426.04 | 508.72 | 550.28 | 485.81 |
| NIL80(R) | 350.64 | 469.72 | 514.45 | 445.02 |
| NIL90(R) | 344.70 | 467.02 | 465.56 | 425.76 |
| Clark(S) | 373.71 | 479.45 | 534.17 | 462.44 |

# Summary

- *Fhb1* significantly increased type II resistance in most HWW, but using recurrent parents with native resistance can significantly improve resistance level of BC progenies.

- *Fhb1* gives enough protection for HWW when it combines with native resistance and MAB can be a quick solution to moving Fhb1 to HWW

- Highly FHB resistant WesleyFhb1 NIL is a better donor of *Fhb1* for MAB in HWW than Chinese lines.

- *Fhb1* NIL available in HWW:
  Now: Wesley, Trego and Harding
  Next summer: Overland, Jagger and Overley
  2 years from now: 11 new cultivars from five states

# Thank You