GWAS of Morphological and Scab Resistance Traits in the Elite Eastern Wheat Mapping Panel

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Background

⇒ Fusarium head blight (FHB) is a destructive disease of wheat.

⇒ FHB losses stem from damaged kernels and toxin production (deoxynivalenol – DON).

⇒ Resistance genes have been identified, however due to incomplete resistance, morphological traits must be considered in breeding programs (Osman et al., 2015).

Objectives

✓ Phenotyping eastern panel of elite soft red winter wheat for morphological and scab traits.

✓ Conducting a genome wide association study (GWAS) to identify potential QTL for FHB resistance in morphological and scab traits.

Materials and Methods

- 262 wheat cultivars and breeding lines from the mapping panel (TCAP; https://www.triticeaecap.org/)

- Two experiments over two years (2015 and 2016) at Lexington – KY

- 1° study - Morphological characters:
  - Anther extrusion (2015)   -   Number of florets
  - Peduncle length (cm)   -   Spike inclination
  - Spike length (cm)

- 2 ° study – Disease evaluation in an inoculated and irrigated nursery:
  - Heading date   - FHB Index
  - Disease incidence (%)   - DON
  - Disease severity (%)   - Fusarium damaged kernels (%)
  - Rating (0 to 9)

- Analysis:
  - PROC GLM, PROC CORR - SAS
  - PROC VARCOMP - SAS
  - Association analysis - GAPIT

Results

Table 1. Pearson correlation coefficients for morphological and scab traits. Only statistically significant correlations displayed.

		AE	PL	SL	NF	SI
2015	HD	0.15*	.	0.38*	0.61**	.
	RAT	.	-0.38**	-0.16*	.	-0.17**
	SEV	0.14*	-0.32*	.	.	-0.14*
	INC	.	-0.41*	.	.	-0.21**
	IND	0.14*	-0.37**	.	.	-0.17**
	FDK	.	-0.32**	.	.	-0.20**
	DON	.	-0.30**	.	0.12*	-0.15*
2016	HD	.	0.34**	0.27**	0.23**	.
	RAT	.	-0.29**	-0.26**	-0.31**	.
	SEV	.	-0.28**	-0.29**	-0.31**	-0.15*
	INC	.	.	-0.13*	.	.
	IND	.	-0.22**	-0.30**	-0.21**	.
	FDK	.	-0.27**	-0.22**	-0.22**	-0.15*
	DON	.	-0.16**	.	-0.17**	-0.13*

* p< 0.05, ** p< 0.01. HD = heading date, RAT= rating, SEV = severity, INC = incidence, IND= index, FDK = Fusarium damage kernel, DON = deoxynivalenol, AE= anther extrusion, PL= peduncle length, SL = spike length, NF = number of florets, SI= spike inclination.

Table 2. Heritability for morphological and scab traits.

Trait	h^2
AE	0.93
PL	0.74
SL	0.59
NF	0.57
SI	0.45
HD	0.77
RAT	0.62
SEV	0.36
INC	0.30
IND	0.36
FDK	0.74
DON	0.79

AE= anther extrusion, PL= peduncle length, SL = spike length, NF = number of florets, SI= spike inclination, HD = heading date, RAT= rating, SEV = severity, INC = incidence, IND= index, FDK = Fusarium damage kernel, DON = deoxynivalenol,

➡ Genotypes were significantly different ($p < 0.05$) for all traits measured in this study (ANOVA results are not shown in this poster).

➡ PL, SL, NF, and SI had significant ($p < 0.05$) negative correlations with scab traits.

➡ Heritability was high for traits such as AE, PL, FDK and DON.

➡ ## Association study (GWAS)

Peduncle length (PL)

Spike inclination (SI)

Number of florets (NF)

DON
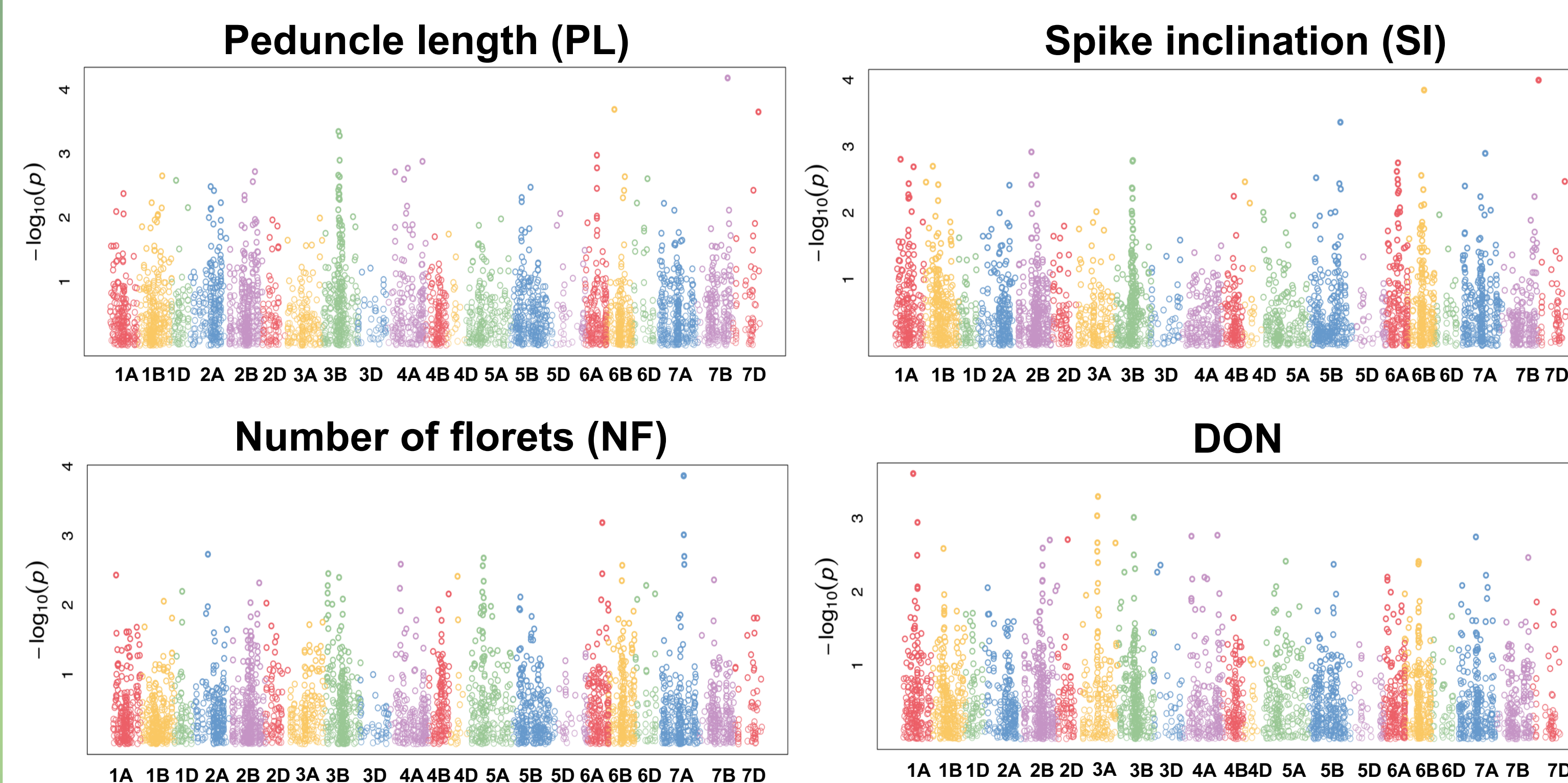
Conclusions

✓ PL, NF and SI had high h^2 (Table 2) and were negative correlated to FHB (Table 1) making these traits promising for selection of resistance to FHB.

✓ QTL for PL, NF, SI, DON might be useful in genomic selection programs.

Future steps

✓ Explore the relationship between morphological and disease traits by using GWAS for a better understanding of traits related to FHB resistance.

Reference

Osman, M. et al., (2015) Phenotypic and genotypic characterization of CIMMYT's 15th international Fusarium head blight screening nursery of wheat. *Euphytica*, 205:521-537 doi: 10.1007/s10681-015-1425-0

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