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Fusarium head blight resistance in modern winter wheat: association of plant morphological traits with resistance and relation of resistance to *F. graminearum* with resistance to *F. sporotrichioides*

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Abstract

While resistance of wheat to DON (deoxynivalenol) producing *Fusarium* species (*e.g. F. graminearum, F. culmorum*) has been well studied, the resistance response to T2/HT2 producers (*e.g. F. sporotrichioides*) is much less investigated. Likewise, while the role of DON in the pathogenesis process has been confirmed, a potential role of T2/HT2 as aggressiveness factors is currently unknown. We therefore performed artificial inoculation trials at three locations (two in France, one in Austria) during two seasons with 40 (2011) or 96 (2012) wheat lines or cultivars using *F. graminearum, F. sporotrichioides* or a mix of both species. The wheat lines comprised mainly current cultivars from France and Austria and several experimental lines.

We scored Fusarium head blight (FHB) visual symptoms and other morphological traits such as plant height, heading date and the extent of anther extrusion during flowering. Based on two year results we found that (1) there was a large genetic variation in FHB resistance among current cultivars, ranging from moderately resistant to highly susceptible; (2) Experimental lines which were selected for high FHB resistance have been confirmed; (3) Resistance to both investigated *Fusarium* species was highly correlated with $r = 0.78$ to 0.92 in 2012 and 2011, respectively, indicating a common mechanism of resistance against DON and T2/HT2 producers; (4) The extent of anther extrusion was negatively correlated with FHB severity: $r = -0.59$ (2012) to -0.76 (2011), which is in full agreement with previous results by SKINNES et al. (2010). Anther extrusion may thus be a suitable trait for indirect selection. FHB severity was negatively associated with plant height: $r = -0.72$ (in both seasons) and weakly positively with heading date: $r = 0.15$ (2011) to 0.38 (2012). Trials to re-evaluate these findings are underway.

Recent publications have shown that the widely used dwarfing genes *Rht-B1* (syn. *Rht1*) and *Rht-D1* (syn. *Rht2*) are associated with FHB resistance. The semi-dwarf allele *Rht-D1b* and to a lesser extent *Rht-B1b* appear to increase FHB susceptibility in wheat (MIEDANER and VOSS 2008, HOLZAPFEL et al. 2008, SRINIVASACHARY et al. 2009). In order to further evaluate the effects of these alleles we (1) developed and tested back-cross derived sister lines differing in their *Rht* alleles in a highly FHB resistant recipient line and (2) evaluated one doubled haploid population segregating at both loci. On average across seven NIL-pairs for *Rht-B1* we found that lines with the semi-dwarf allele *Rht-B1b* showed about 90% increased FHB severity compared to their sister lines which had the tall allele *Rht-B1a*. The difference was even more pronounced for *Rht-D1*, where on average across six NIL-pairs lines with the semi-dwarf allele *Rht-D1b* had about 160% higher FHB severity compared to lines with the *Rht-D1a* allele. Similarly in the DH population *Rht-D1b* lines were significantly higher diseased than *Rht-B1b* lines. Our data are in agreement with previous findings that semi-dwarfing alleles reduce FHB resistance and that *Rht-B1b* is less damaging than *Rht-D1b*. However, the negative effect of the semi-dwarf alleles can be balanced by selecting lines with other known or unknown FHB resistance QTL in their genome. Therefore, selection of semi-dwarf cultivars with good FHB resistance is difficult but feasible, and *Rht-D1b* should be avoided if high FHB resistance is desired.

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