Fusarium Head Blight Management Coordinated Project: Integrated Management Trials 2018-2019

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Introduction: Efforts to evaluate integrated management strategies for Fusarium head blight (FHB) and deoxynivalenol (DON) management in wheat and barley continued in 2018 and 2019. The focus of this round of integrated management coordinated project (IM_CP) was Miravis Ace, a new Succinate Dehydrogenase Inhibitor (SDHI; Adepidyn - Pydiflumetofen) + Demethylation Inhibitor (DMI; Propiconazole) premix fungicide that was recently labeled for managing diseases of wheat, barley, and other small grain crops. Preliminary results from a limited number of trials showed that when applied at early anthesis (Feekes 10.5.1) or within the first 6 days after early anthesis, Miravis Ace was just as effective as Prosaro and Caramba (3,4,5). This suggested that like the latter two fungicides, this new fungicide alone will not be sufficient to manage FHB and DON. Based on results from previous IM_CP, we hypothesized that Miravis Ace will be most valuable for FHB management when combined with other management strategies such as genetic resistance, tillage, and crop rotation as part of an integrated management program (1,4,7). **The objective of this study was to evaluate the integrated effects of fungicide programs (products and timings) and genetic resistance on FHB and DON in all major grain classes, with emphasis on the new fungicide, Miravis Ace**.

Materials and Methods: To accomplish the aforementioned objective, field experiments were conducted in 22 US wheat-growing states in 2018 and 2019. The standard protocol consisted of the application of fungicide treatment programs (sub-plot; **Table 1**) to plots of cultivars (whole-plot) with different level of resistance to FHB - susceptible (S), moderately susceptible (MS), and moderately resistant (MR). The experimental design was a randomized complete block, with at least 4 replicate blocks. In most experiments, plots were spray inoculated with a spore suspension of the fungus approximately 24-36 h after the anthesis treatments were applied, with or without mist-irrigation. Trials were naturally infected at some locations. FHB index (IND) was rated or calculated as previously described (2,6) on 60-100 spikes per plot at approximately Feekes 11.2. Plots were harvested and a sample of grain from each experimental unit was sent to a USWBSI-supported laboratory for mycotoxin analysis. Linear mixed models (multi-location) were fitted to the pooled arcsine square root-transformed IND and log-transformed DON data to evaluate the main and interaction effects of fungicide treatment and genetic resistance on IND and DON. Overall percent control/reduction relative to the nontreated susceptible check was also estimated for each management program as a measure of efficacy.

Table 1. The following core treatments were randomly assigned to experimental units. All fungicide treatments were applied along with a nonionic surfactant

Treatment[a]	Product/inoculation	Rate	Timing
1 (CK)	Untreated check, inoculated	…	…
2 (I)	Prosaro, inoculated	6.5 fl oz/A	Anthesis
3 (II)	Miravis Ace, inoculated	13.7 fl oz/A	Anthesis
4 (III)	Miravis Ace, inoculated	13.7 fl oz/A	Feekes 10.3
5 (PRO_A)	Prosaro, non-inoculated	6.5 fl oz/A	Anthesis
6 (CK0)	Untreated, non-inoculated	…	…

Results and Discussion: Mean Fusarium head blight index (IND) and deoxynivalenol (DON) grain contamination data from 31 environments (trial x state x year combinations), representing different wheat market classes, are summarized for different cultivar resistance x fungicide program combinations in Figure 1 and 2. Averaged across management combinations, mean IND ranged from 0 to 74% and DON from 0 to 57 ppm.

FHB index: Mean IND was more variable across environments on S (interquartile range [IQR] 9 to 25%) and MS (IQR 4 to 12%) cultivars, than on MR (2 to 10%) cultivars. This in part reflects the fact that there were fewer environments with S and MS cultivars than with MR cultivars (**Fig. 1A**). The susceptible, nontreated check (S_CK) had the higher mean IND (22.6 %), whereas the application of Prosaro or Miravis Ace at anthesis to a moderately resistant cultivar resulted in the lowest means, 2.9 and 2.5% for MR_I and MR_II, respectively (**Fig. 2A**). For all tested resistance classes, all fungicide programs resulted in significantly lower mean IND (on the arcsine square root-transformed scale) than the nontreated check, and differences between pairs of fungicide programs were statistically significant. The only exceptions were for comparisons between Prosaro and

Miravis Ace at anthesis on MR cultivars and between Prosaro at anthesis and Miravis Ace at Feekes 10.3-5 on MS and S cultivars.

Deoxynivalenol: DON contamination results were somewhat different from those observed for IND. For instance, MS_III (application of Miravis Ace to an MS cultivar at Feekes 10.3-5) had the highest mean DON across trials, whereas management combinations consisting of a Prosaro or Miravis Ace application at anthesis to an MR (MR_I and MR_II) or S (S_I and S_II) cultivar had the lowest overall mean levels of the toxin (**Fig. 1B and 2B**). For all tested resistance classes, treatments applied at anthesis resulted in significantly lower mean DON (on the log-transformed scale) than the nontreated check and the Feekes 10.3-5 application of Miravis Ace.

As additional data become available, a more complete set of analyses will be performed. However, the results summarized herein suggest that while a Feekes 10.3-5 application of Miravis Ace may suppress FHB IND to levels comparable to those achieved with an anthesis application of Miravis Ace or Prosaro, such an early application is considerably less effective than the anthesis applications in terms of DON suppression.

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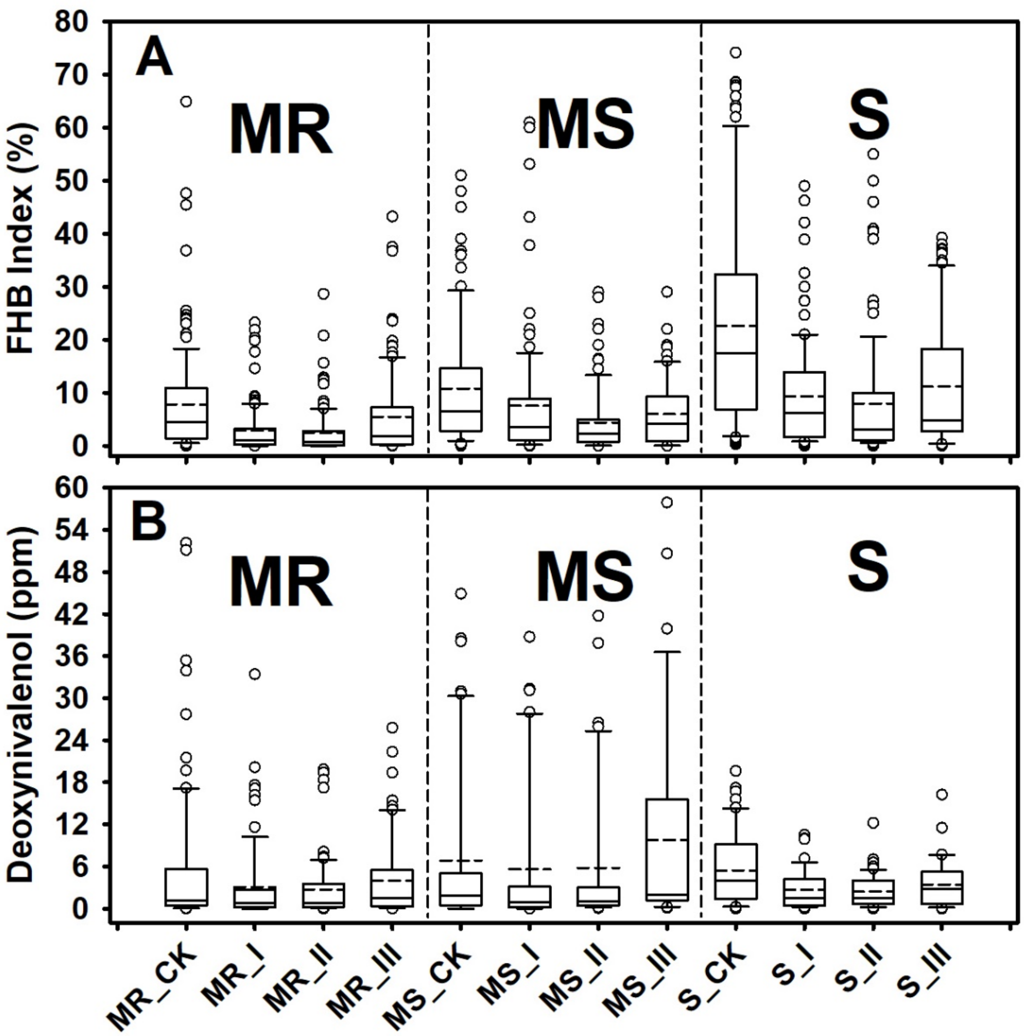

Fig. 1. Boxplots showing the distribution of **A**, mean Fusarium head blight index and **B**, deoxynivalenol grain contamination for different fungicide program x cultivar resistance management combinations. **S**, **MS**, and **MR** represent susceptible, moderately susceptible, and moderately resistant, respectively, whereas **CK** = nontreated, **I** = treated

with Prosaro (6.5 fl. oz.) at Anthesis, **II** = treated with Miravis Ace (13.7 fl. oz.) at anthesis and **III** = treated with Miravis Ace (13.7 fl. oz.) between Feekes 10.3 (early head emergence) and 10.5 (complete head emergence).

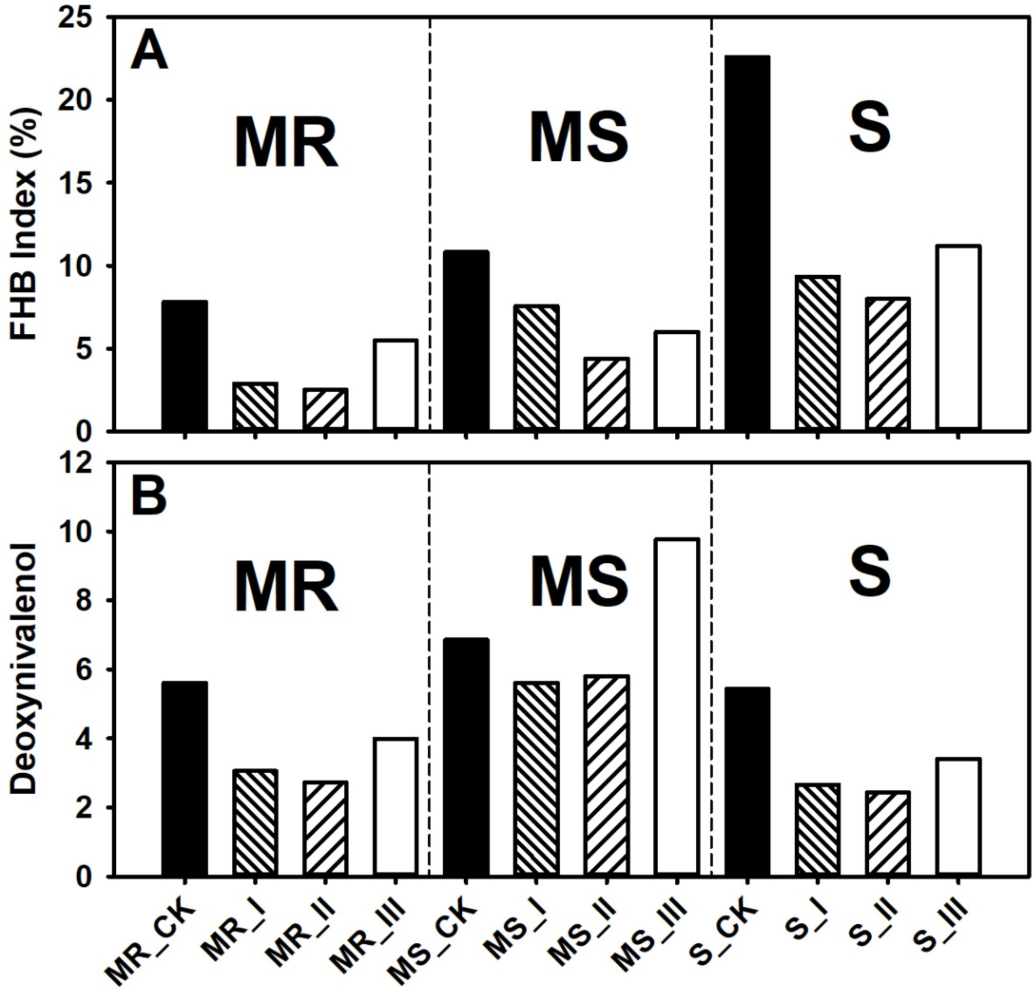

Fig. 2. Mean **A**, Fusarium head blight index and **B**, deoxynivalenol grain contamination for different fungicide program x cultivar resistance management combinations. **S**, **MS**, and **MR** represent susceptible, moderately susceptible, and moderately resistant, respectively, whereas **CK** = nontreated, **I** = treated with Prosaro (6.5 fl. oz.) at Anthesis, **II** = treated with Miravis Ace (13.7 fl. oz.) at anthesis and **III** = treated with Miravis Ace (13.7 fl. oz.) between Feekes 10.3 (early head emergence) and 10.5 (complete head emergence).