Efficacy of Miravis Ace® for FHB and DON Management across Environments and Grain Market Classes: A progress report

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OBJECTIVES

1. Evaluate the integrated effects of fungicide treatment and genetic resistance on FHB and DON in all major grain classes, with emphasis on a new fungicide, Miravis Ace.
2. Compare the efficacy of Miravis Ace when applied at heading or at anthesis to that of a standard anthesis application of Prosaro or Caramba.

INTRODUCTION

Results from previous uniform fungicide trials (UFTs) and management coordinated projects (IM_CP) showed that Demethylation Inhibitors (DMI) fungicides such as Prosaro® and Caramba® are the most effective against FHB and DON. Applications made at or up to 6 days after anthesis to moderately resistant cultivars provide more than 70% reduction of both FHB index and DON, relative to a non-treated, susceptible check (2,4,7). Results from UFTs also showed that Quinone Outside Inhibitor (QoI) fungicides consistently led to an increase in DON accumulation in harvested grain, particularly when applied close to anthesis (3). Based on these findings, DMIs are the most widely used fungicides for FHB and DON management, but this is not a good fungicide resistance management strategy. Isolates of *Fusarium graminearum* with resistance to tebuconazole have been reported (1,5), and a recent quantitative synthesis of 20 years of data from UFTs (Madden et al. *personal communication*) suggests that the efficacy of this and other DMIs may be declining in some areas. Preliminary results from a few pilot studies showed that Miravis Ace, a new Succinate Dehydrogenase Inhibitor + propiconazole fungicide, provides comparable levels of FHB and DON reduction to that of Prosaro and Caramba when applied at anthesis (Feekes 10.5.1). Moreover, this new fungicide is reported to be just as effective as the industry standards when applied at Feekes 10.3.

MATERIALS AND METHODS

Two sets of field experiments were conducted in 11 US wheat-growing states in 2018 to evaluate the performance if Miravis Ace. **For objective #1 (IM_CP)**, fungicide treatments (sub-plot) consisting of a non-treated check (**CK**), Prosaro at 6.5 fl. oz./A applied at 50% early anthesis (**I**), and Miravis Ace at 13.7 fl. oz./A applied at 50% early anthesis (**II**) or at 50% heading (Feekes 10.3, **III**) were applied to replicate plots (3-6 blocks) of susceptible (S), moderately susceptible (MS), and moderately resistant

(MR) cultivars (whole-plot). **For objective #2 (UFT)**, plots of a susceptible cultivar were planted in 3-6 replicate blocks and subjected to various combinations of the following fungicide programs: **1**) a non-treated check; **2**) Miravis Ace at 11.5 fl. oz./A (low rate) at Feekes 10.3-10.5; **3**) Miravis Ace at 13.7 fl. oz./A (high rate) at Feekes 10.3-10.5; **4**) Miravis Ace at 11.5 fl. oz./A at anthesis; **5**) Miravis Ace at 13.7 fl. oz./A at anthesis; **6**) Prosaro at 6.5 fl. oz./A at anthesis; and **7**) Caramba at 13.5 fl. oz./A at anthesis. In addition, we evaluated two-treatment programs consisting of an application of Miravis Ace (at low or high rate) at anthesis followed by an application of Prosaro at 6.5 fl. oz./A (**8)**, Caramba at 13.5 fl. oz./A (**9)**, or Folicur at 4 fl. oz./A (**10**) at 3-5 days post anthesis. Separate post-anthesis (3-5 days) applications of Prosaro at 6.5 fl. oz./A (**11**) and Miravis Ace at 13.7 fl. oz./A (**12**), and a pre-anthesis (Feekes 10.3-10.5) application of Prosaro (**13**) were also included in some trials.

All plots were artificially inoculated with either *F. graminearum*-colonized grain spawn or a spore suspension of the fungus sprayed approximately 24-36 hours after the anthesis treatments were applied. Some locations were naturally infected. FHB index (IND) was rated or calculated as previously described (6) on 60-100 spikes per plot at approximately Feekes 11.2. Grain samples were 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 management program and treatment effects.

RESULTS AND DISCUSSION

DON data were not available for some environments at the time of this report. For **objective 1**, trial-level mean IND and DON in the non-treated susceptible check (S_CK) ranged from 2.3 to 46.4 % and 0.5 to 8.6 ppm, respectively. All cultivar x fungicide treatment combinations had significantly ($p < 0.05$) lower mean IND (**Fig. 1A**) and DON (**Fig. 1B**) than S_CK. When applied at 13.7 fl. oz/A at Feekes 10.5.1 (**II**) or at Feekes 10.3-10.5 (**III**), Miravis Ace was not significantly different from Prosaro at 6.5 fl oz/A applied at anthesis (**Fig. 1A** and **B**).

For **objective 2**, trial-level mean IND and DON in the non-treated check (CK) ranged from 0.22 to 42.1 % and 1.3 to 38.7 ppm, respectively. All fungicide programs that included an anthesis application resulted in significantly ($p < 0.05$) lower mean IND and DON than the check (**Fig. 2**). For IND, means were not significantly different among Prosaro, Caramba, and Miravis Ace, and applications made at Feekes 10.3-10.5 were not significantly different from those made at 50% Feekes 10.5.1, or 4 days after 50% early anthesis, in the case of Miravis Ace. Two-treatment programs consisting of Miravis Ace applied at 50% early anthesis followed by Prosaro, Caramba, or Folicur applied 4 days after resulted in the lowest overall mean IND, with the Miravis Ace + Folicur and Miravis Ace + Caramba combinations having significantly lower means than the anthesis-only Prosaro or Caramba treatments (**Fig. 2A**). Two-treatment programs also outperformed all other tested programs in terms of mean DON reduction, however, treatments applied at between Feekes 10.3 and 10.5 (MIR_H and PRO_H) were not significantly different from the non-treated check (**Fig. 2B**). In particular, the anthesis and post-anthesis applications of Miravis Ace (MIR_A and MIR_A+4) had significantly lower mean DON than MIR_H. Although based on a relatively small sample size (6-16 trials for the MGMT_CP and 2-12 for the UFT, depending on the treatment and the response), these results are very promising. When applied at anthesis, Miravis Ace was just as effective as Prosaro and Caramba in terms of FHB and DON reduction. However, when applied between Feekes 10.3 and 10.5, the performance of this new fungicide was not consistent between the MGMT_CP and the UFT in terms of efficacy against DON. A second year of data will be collected in 2019, and a more complete set of analyses will be performed.

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