AGRONOMIC MANAGEMENT AND FUNGICIDE EFFECTS ON OAT YIELD AND QUALITY IN WISCONSIN

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Introduction

Oat cultivation in Wisconsin has declined considerably in the last eight decades; nevertheless, it continues to be an important crop in the north central states where 65% of the oats harvested for grain in the United States each year are produced. Oats planted in Wisconsin totaled 255,000 acres in 2013 and grain production accounted for approximately 11% of the total oat production in the U.S. Planted acres in the 1930s to the 1960s exceeded 1.98 million in Wisconsin alone and 3.95 million nationwide (NASS, 2013). Primary uses for oat in Wisconsin are for establishing alfalfa underseedings, livestock forage and grain, and straw. The uses of oat also extends from livestock feed to use in human nutrition. Oats are highly nutritious with the highest protein quantity and quality of the cereal grains, the oil from oats has a highly desirable fatty acid composition, and the fiber (β-glucan) is beneficial in lowering cholesterol levels (Lockhart and Hurt, 1986). Along with high total grain yield, the nutritional quality of the grain is equally desirable for growers planning to market the crop for human consumption. High β-glucan content is desirable in the human diet (Peterson et al., 1995). It has been identified as a component that can lower serum cholesterol (Davidson et al., 1991; Klopfenstein and Hoseney, 1987). Oat varieties with a more concentrated soluble fiber may provide a sufficient amount of the β-glucan component. Therefore, β-glucan content has been proposed as a target for plant breeding programs (Lim et al., 1992; Peterson et al., 1995). Recent oat breeding efforts, such as those at UW-Madison, have focused on increasing yield and nutritional quality as well. The objectives of our studies were to examine the effect of various agronomic management practices on oat yield and quality. These practices included:

- **Varieties**
- **Seeding rates**
- **Chemical seed treatments**
- **Foliar fungicides**

Two separate trials were established in 2011 through 2013. The **Oat Management (OM)** trial evaluated two cultivars of oat across three management variables. The **Oat Fungicide (OF)** trial evaluated multiple cultivars with and without foliar fungicides. Both trials were planted at the Arlington Agricultural Research Station, Arlington, WI.

Oat Management (OM)

Four different factors were studied for their effect on yield and quality:

- **Two oat varieties:** Badger and Esker
- **Two seeding rates:** 1.2 and 1.5 million seeds/a
- **Three seed treatments:** No seed treatment, Rancona Pinnacle, and Rancona Crest
- **One foliar fungicide:** NTC and 9 fl oz/a of Headline at the Feekes 9 growth stage

During the three years of the oat management study, the Badger variety resulted in approximately 9 bu/a greater yield than the Esker variety. The seeding rate did not have a significant effect on yield while the seed treatment increased total yield compared to untreated seed. Rancona Crest seed treatment, which contains an insecticide in addition to the dual fungicide components, resulted in a 4 bu/a increase above the Rancona Pinnacle, but was not statistically significant (Figure 1).

Additionally, foliar fungicide application had no effect on oat yields compared to untreated plots (Figure 2). Nevertheless, growers should consider a foliar fungicide application if disease is expected to be present (Mourtzinis et al., 2014). Only light incidence of foliar disease was observed in 2011 and none in 2012 or 2013. The high seeding rate, as well as the two seed treatments, had no measurable impact on oat height and lodging during the three years of the experiment.

Figure 1. Mean total oat yield, groat percentage, test weight, and lodging between seed treatments in the Oat Management (OM) study. Different letters indicate significant difference between seed treatments within each measured variable.

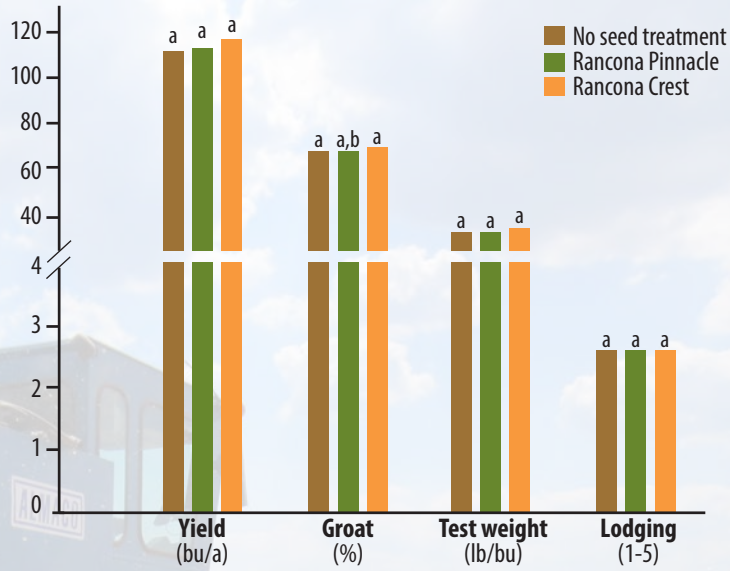
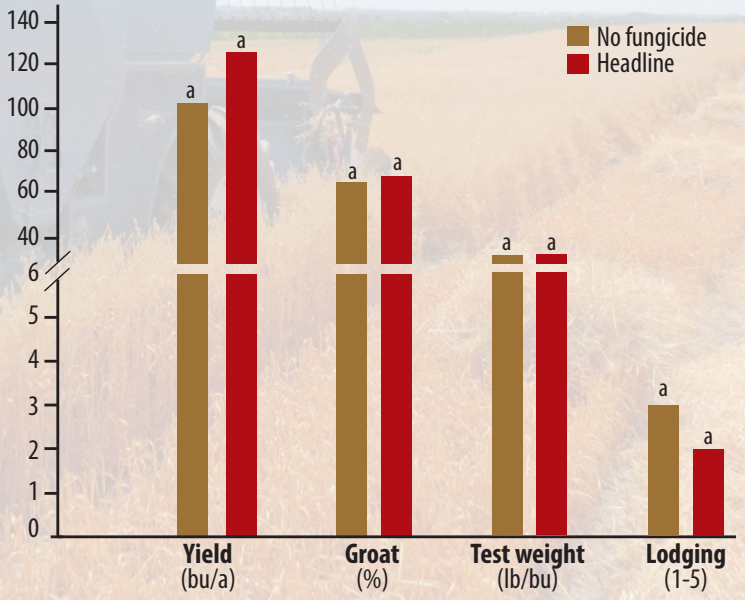


Figure 2. Mean total oat yield, groat percentage, test weight, and lodging between fungicide treatments in the Oat Management (OM) study. Different letters indicate significant difference between fungicide treatments within each measured variable.



Oat Fungicide (OF)

Five oat varieties (Badger, BetaGene Esker, Excel and Ogle) were compared for their response to a foliar fungicide treatment of Head¬line at the Feekes 9 growth stage. During the three years of the experiment, all the varieties resulted in similar yields apart from the significantly reduced yield of the Ogle cultivar (Figure 3). Ogle is an older variety which was released in 1981 and newer genetics have surpassed it in yielding ability. The use of Headline foliar fungicide resulted in an average yield increase of 22 bu/a across varieties compared to the non-treated oat yield (Figure 4).

The 3-year average groat yield was not statistically different among the five varieties (Figure 3). Similarly to the total yield response, the use of a foliar fungicide significantly increased groat portions of all five varieties. The BetaGene variety was developed specifically to result in high β-glucan content and increase the quality of the oat yield. The BetaGene variety yielded the highest β-glucan proportion compared to the other varieties. Although, during the three years of the experiment the use of Headline foliar fungicide significantly increased total oat yield and groat proportion, no effect on β-glucan content was detected (Figures 4 and 5). The effect of the variety x foliar fungicide interaction was not significant on β-glucan content. This is a desirable attribute of a foliar fungicide; that is, to be able to increase total yield and groat portion without impacting the quality of the final product. The use of Headline foliar fungicide significantly increased total β-glucan per acre; however, since there was no effect of fungicide on the percentage of β-glucan, this increase was attributed to the significant effect of fungicide in increasing total yield (data not shown).

Figure 3. Mean total oat yield, groat percentage, and test weight among varieties in the Oat Fungicide (OF) study. Different letters indicate significant difference between varieties within each measured variable.

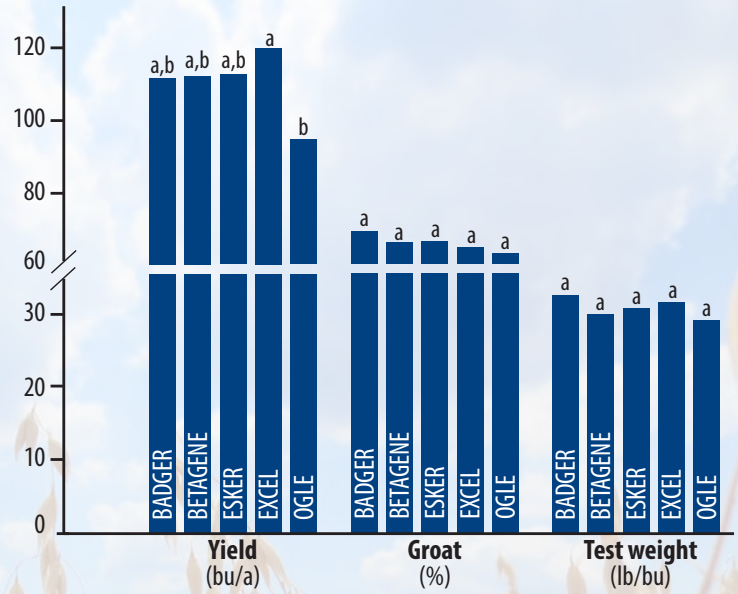


Figure 4. Mean total oat yield, groat percentage, test weight, β-glucan percentage, and lodging between fungicide treatments in the Oat Fungicide (OF) study. Different letters indicate significant difference between fungicide treatments within each measured variable.

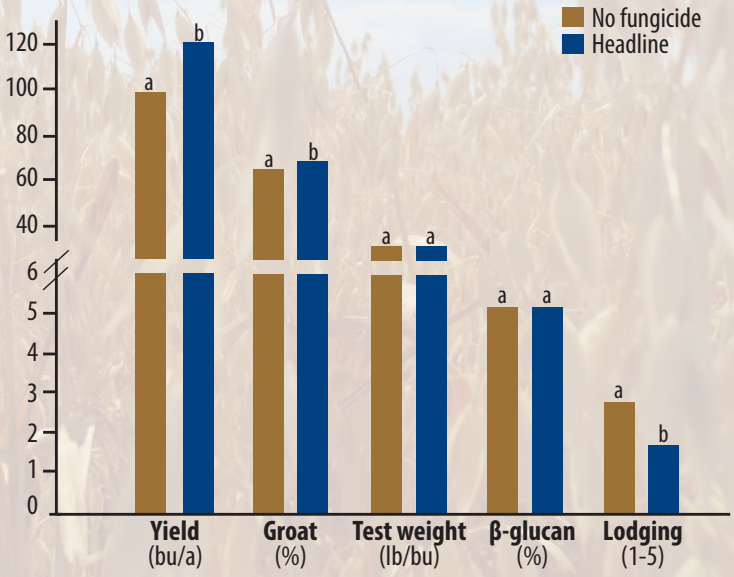
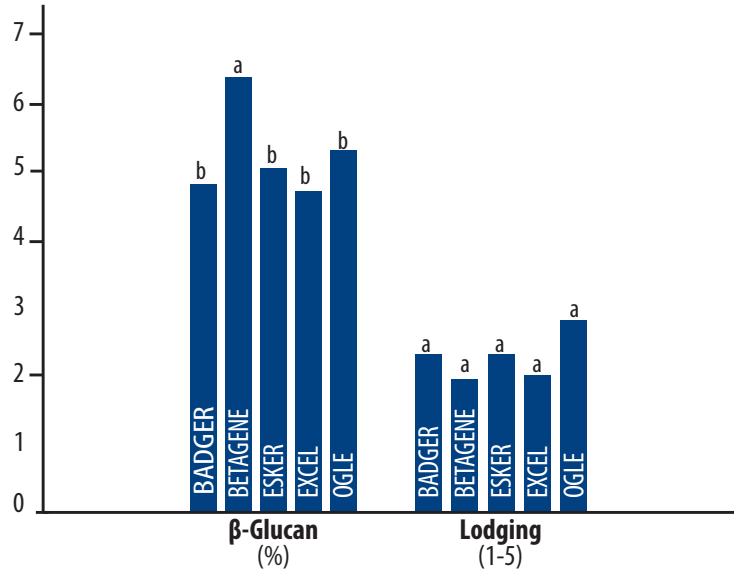
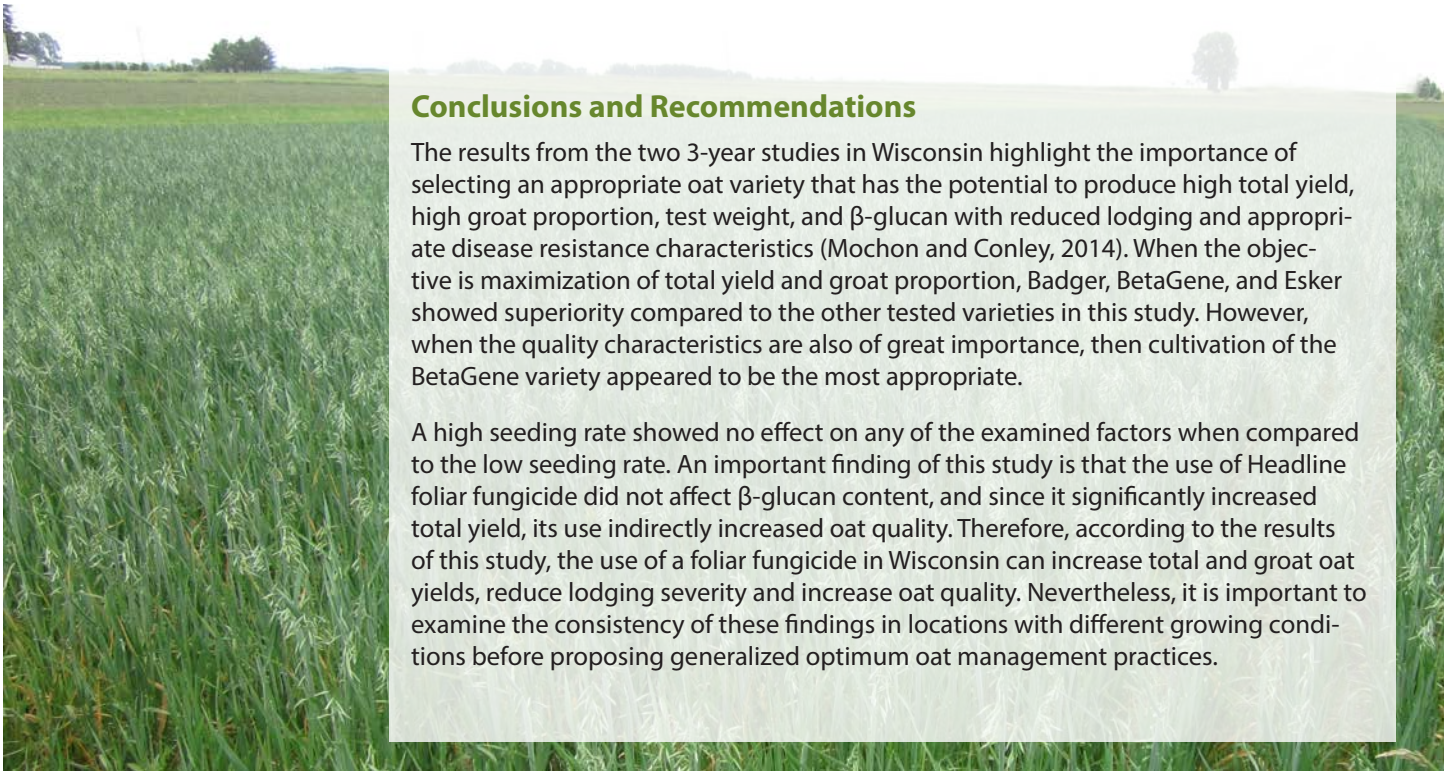


Figure 5. Mean β-glucan (%) and lodging among varieties in the Oat Fungicide (OF) study. Different letters indicate significant difference between varieties within each measured variable.





Conclusions and Recommendations

The results from the two 3-year studies in Wisconsin highlight the importance of selecting an appropriate oat variety that has the potential to produce high total yield, high groat proportion, test weight, and β-glucan with reduced lodging and appropriate disease resistance characteristics (Mochon and Conley, 2014). When the objective is maximization of total yield and groat proportion, Badger, BetaGene, and Esker showed superiority compared to the other tested varieties in this study. However, when the quality characteristics are also of great importance, then cultivation of the BetaGene variety appeared to be the most appropriate.

A high seeding rate showed no effect on any of the examined factors when compared to the low seeding rate. An important finding of this study is that the use of Headline foliar fungicide did not affect β-glucan content, and since it significantly increased total yield, its use indirectly increased oat quality. Therefore, according to the results of this study, the use of a foliar fungicide in Wisconsin can increase total and groat oat yields, reduce lodging severity and increase oat quality. Nevertheless, it is important to examine the consistency of these findings in locations with different growing conditions before proposing generalized optimum oat management practices.

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