



# High Yield Input Systems and Impact on Yield and $\beta$ -glucan Levels

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# Introduction

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- Oat is highly nutritious, with the greatest protein quantity and quality of the cereal grains, the oil from oat has a highly desirable fatty acid composition, and the fiber ( $\beta$ -glucan) is beneficial in lowering cholesterol levels. (Lockhart and Hurt, 1986)
- Value of  $\beta$ -glucan for WI growers versus international market
  - In terms of human consumption, high  $\beta$ -glucan content is desirable. (Peterson et al., 2004)
  - It has been identified as a component that can lower serum cholesterol. (Davidson et al., 1991; Klopfenstein and Hosney, 1987)
  - In oats grown for livestock feed, low  $\beta$ -glucan content is preferred. (Peterson et al., 2004)



# Objective

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- The objective of this study was to examine the effect of agronomic practices:
  - Seeding rate
  - Chemical seed treatments
  - Foliar fungicides

on oat grain and groat yield,  $\beta$ -glucan content, and lodging of five oat cultivars grown in Wisconsin from 2011-2013.



**Mourtznis et al. 2014. Agronomic Management and Fungicide Effects on Oat Yield and Quality. Crop Sci. In Review.**

# Materials and Methods

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- Two separate trials were established adjacent to each other in each of three successive years (2011 through 2013) using similar procedures.
  1. The Oat Management (OM) trial evaluated two cultivars of oat across three management variables
  2. The Oat Fungicide (OF) trial evaluated five cultivars with and without foliar fungicides



# Materials and Methods *cont.*

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## Oat Management Trial (OM)

- Treatments were arranged in a completely randomized design with four replications.
- Cultivars used were Badger and Esker. Both are considered grain types, and they are classified as early- and mid-maturing, respectively.
- Two seeding rates treatments of  $2.96 \times 10^6$  [standard] and  $3.70 \times 10^6$  [high] kernels  $\text{ha}^{-1}$  were used.



# Materials and Methods *cont.*

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## Oat Management Trial (OM)

Seed treatments consisted of:

- Non-treated control
- Rancona Pinnacle® [Chemtura] (ipconazole [0.00091 mg a.i. seed<sup>-1</sup>] and metalaxyl [0.00122 mg a.i. seed<sup>-1</sup>])
- Rancona Crest® [Chemtura] (ipconazole [0.00091 mg a.i. seed<sup>-1</sup>], metalaxyl [0.00122 mg a.i. seed<sup>-1</sup>] and imidacloprid [0.03052 mg a.i. seed<sup>-1</sup>])



# Materials and Methods *cont.*

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## Oat Management Trial (OM)

Foliar fungicide treatments consisted of:

- Non-treated control
- Headline® at 0.165 kg a.i. ha<sup>-1</sup> (BASF) pyraclostrobin (carbamic acid, [2-[[[1-(4-chlorophenyl)-1H-pyrazol-3-yl]oxy]methyl]phenyl]methoxy-, methyl ester) at the Feekes 9 growth stage



# Materials and Methods *cont.*

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## Oat Fungicide Trial (OF)

- Treatments were arranged in a split plot design with four replications. The whole plot treatment was randomized in each replicate and consisted of five cultivars each year.
- Cultivars used all three years were Badger, Esker, Excel, Ogle, and BetaGene.
- Badger, Esker, Excel, and Ogle are all used regularly throughout Wisconsin whereas BetaGene is a new release.



# Materials and Methods *cont.*

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## Oat Fungicide Trial (OF)

Foliar fungicide treatments consisted of:

- a non-treated control and
- an application of 0.165 kg a.i. ha<sup>-1</sup> Headline at the Feekes 9 growth stage.

All plots were seeded at 2.96 x 10<sup>6</sup> kernels ha<sup>-1</sup>.



# Results

## Oat Management study

	Variety			Seeding Rate		
	Badger	Esker	P>F	Low	High	P>F
Yield (kg ha <sup>-1</sup> )	4256	3928	0.006	4074	4110	0.615
Groat (kg ha <sup>-1</sup> )	2917	2663	0.120	2764	2815	0.322
Test weight (kg m <sup>-3</sup> )	416	398	0.299	405	409	0.032
Height (cm)	90	99	0.155	95	94	0.479
Lodging	2.3	2.7	0.191	2.5	2.5	0.293

- Badger exhibited the highest yield
- High seeding rate had no effect apart from a slight increase in test weight



# Results *cont.*

## Oat Management study

	Seed Treatment				Foliar Fungicide		
	Non-Treated	Rancona Pinnacle	Rancona Crest	P>F	Non-Treated	Headline	P>F
Yield (kg ha <sup>-1</sup> )	3997	4071	4208	0.161	3701	4483	0.131
Groat (kg ha <sup>-1</sup> )	2714 b	2754 a,b	2901 a	0.076	2491	3090	0.141
Test weight (kg m <sup>-3</sup> )	404	405	411	0.173	405	409	0.211
Height (cm)	94	94	95	0.204	94	95	0.351
Lodging	2.5	2.5	2.5	0.652	3.0	2.0	0.268

- Rancona Crest® increased groat
- Foliar fungicide increased yields but the effect was not statistically significant (alpha=0.1)



# Results *cont.*

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## Oat Management Trial (OM)

- The majority of the two-way interactions between the examined factors were not statistically significant ( $p > 0.1$ )
- The only significant interaction effect:
  - Use of foliar fungicide on the Badger variety exhibited the highest yield compared to the other levels of Variety x Foliar Fungicide interaction by 110-530 kg ha<sup>-1</sup> ( $p = 0.095$ ).



# Results *cont.*

## Oat Fungicide study

	Variety					Foliar Fungicide			V x FF	
	Badger	BetaGene	Esker	Excel	Ogle	P>F	Non-Treated	Headline	P>F	P>F
Yield (kg ha <sup>-1</sup> )	3990 a,b	4005 a,b	4000 a,b	4256 a	3405 b	0.082	3532	4330	0.003	0.807
Groat (kg ha <sup>-1</sup> )	2817	2712	2756	2920	2203	0.125	2361	3002	0.001	0.875
Test weight (kg m <sup>-3</sup> )	419	385	390	406	378	0.285	393	399	0.302	0.862
β-glucan (g kg <sup>-1</sup> )	48 b	64 a	50 b	47 b	53 b	0.017	52	52	0.972	0.815
β-glucan (kg ha <sup>-1</sup> )	193	266	218	216	194	0.156	207	227	0.002	0.156
Height (cm)	89 b	98 a	97 a	96 a,b	95 a,b	0.048	94	96	0.411	0.916
Lodging	2.3	2	2.3	2	2.8	0.408	2.8	1.7	0.008	0.639

- All varieties resulted in similar yields apart from Ogle; BetaGene variety yielded the highest β-glucan (g kg<sup>-1</sup>)
- Fungicide increased grain and groat yield, reduced lodging, no effect on β-glucan content; however increased β-glucan yield (kg ha<sup>-1</sup>)



\*Avenanthramide

# Conclusions

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- The results from the two 3-yr studies in Wisconsin highlight the importance of selecting an appropriate oat variety that has the potential to produce high yields and  $\beta$ -glucan content with reduced lodging and appropriate disease resistance characteristics.
- When the objective is maximization of total yield, Badger, Excel, and BetaGene varieties showed superiority compared to the other tested varieties



# Conclusions *cont.*

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- 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. This finding can have significant impacts on reducing planting associated seed costs.
- In general, treated seed exhibited superior yields compared to untreated seeds.



# Conclusions *cont.*

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- The use of Headline® foliar fungicide did not affect  $\beta$ -glucan percentage; however, it increased oat quality by increasing  $\beta$ -glucan ( $\text{kg ha}^{-1}$ ).
- According to the results of this study, the use of a foliar fungicide in Wisconsin can increase oat yields without reducing the crops' quality characteristics.
- It is important to examine the consistency of these findings in locations with different growing conditions.



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