

# Foliar Fertilizer and Pyraclostrobin Fungicide Combinations for Corn

## Introduction

High yield corn production systems have integrated fungicide applications to maximize photosynthetic efficiency of the plant. In a study conducted from 2003-2007, median corn yields increased over 502 kg ha<sup>-1</sup> with a strobilurin fungicide such as pyraclostrobin (Headline<sup>®</sup>) (Nelson and Smoot, 2007). Largest yield increases due to fungicide applications have occurred in high yield environments, where there are few growth limiting factors.

Stimulation of growth by strobilurin fungicides has been related to lower incidences of disease as well as increased nutrient uptake and assimilation in small grains (Köhle et al., unpublished). Increased nutrient uptake following an application of a strobilurin fungicide would justify additional fertilizer at the time of application. Identifying fertilizer sources that would synergistically increase yield with a fungicide treatment would provide opportunities to manage disease, reduce application costs, and provide additional fertilizer when crop demand is greatest.

A link has established between plant nutrition and disease incidence. Nutrients such as K, Cl, Mn, B, and P seem to have disease suppressing effects (Fixen et al, 2004). Combining a foliar fertilizer with fungicide application may reduce application costs, improve disease suppression and nutrient response, and increase flexibility in managing crop response to environmental conditions during the growing season.

There was a large increase in the use of strobilurin fungicides in corn in 2007; however, there exists a need for the evaluation of interactions between foliar fertilizers and fungicide treatments. No research has been published on the effects of fungicide treatments on nutrient levels in corn plants in the field. This research will help farmers make informed decisions regarding fungicide-fertilizer interactions and how these applications affect productivity and profitability.

## **Objectives**

**1. To evaluate improvements in yield due to different foliar fertilizer** and pyraclostrobin fungicide combinations on corn in regions with different yield potentials.

2. To monitor changes of nutrient levels in corn plants due to the fungicide.

3. To assess changes in the disease suppressing effects of the fungicide in combination with different foliar fertilizers.

## Materials and Methods

A two-year field trial was initiated in 2008 at three sites in northeast (Novelty), in southeast (Portageville), and in northwest (Albany) Missouri. Treatments consisted of a factorial arrangement of 13 different commercially-available foliar fertilizers containing both macro- and micronutrients in combination with or without the fungicide, pyraclostrobin. These treatments were arranged in a randomized complete block design with three to five replications depending on the site.

Plot size was 3.1m x 12.2m (Four rows wide).

There is a claypan present at the Novelty site. Table 1.

selected based on previous research and local availability. crop death) at 7 and 14 days after treatment. 100% (complete infestation) 28 days after treatment.

after application.

• Center two rows were harvested for grain yield and moisture converted to 15% prior to analysis.

## 0.44 L ha -1, a nonionic surfactant at 0.25% v/v was added. Fertilizer (%N-%P<sub>2</sub>O<sub>5</sub>-%K<sub>2</sub>O-%S) ootassiumthiosulfate(0-0-25-1 potassiumthiosulfateplus ureatriazone (5-0-20-13) ussium chloride (00-62-0 5-0-0-0 controlled release nitrogen as methylene urea and diurea 24-0-1-0.6 slow release N with 0.25% B 22-0-2-1 with 0.25% Mn-chelate Fe-Mo-Mn-B-Zn (0.3%-0.01%-3.2%-0.2%-2.1%) premix 6-0-0-0 with 10% Ca

Table 2: Foliar fertilizers used with and without the fungicide pyracle

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- Soils were a Putnam silt loam (fine, smectitic, mesic Vertic Albaqualfs), Grundy silt loam (fine, montmorillonitic, mesic Aquic Argiudolls), and Tiptonville sandy loam (fine-silty, mixed, thermic Typic Argiudolls) at Novelty, Albany, and Portageville, respectively.
- Novelty and Albany were under sprinkler irrigation, while Portageville was flood irrigated. Irrigation was used so the experimental plots were high yield environments and moisture levels were favorable for fungal infection to develop. Field information about the locations and selected management practices is shown in
- The 13 different foliar fertilizers combinations (Table 2), were applied with a CO2 propelled boom at 28 L ha<sup>-1</sup>, to simulate an aerial application, at tasseling(Figure 1). The different fertilizers were
- Corn injury was rated 0 (no visual crop injury) to 100% (complete
- Foliar disease incidence was rated on a scale of 0 (no disease) to
- Ear leaf nutrient contents were intensively monitored for pyraclostrobin only and untreated treatments at each location from the time of application until black layer to build background information to target synergistic foliar nutrient applications. Corn ear leaf nutrient levels for all other treatments were monitored 7 days

bin. When combined with the fungicide, which was applied at							
Trade Name and Manufacturer	<b>Application Rate</b>						
NA-CHURS/ALPINE Solutions	18.7 L ha <sup>-1</sup>						
Double-OK, NA-CHURS/ALPINE Solutions	18.7 L ha <sup>-1</sup>						
KTS, Tessenderlo Kerley Inc.	9.4 L ha <sup>-1</sup>						
Trisert K+,TessenderloKerleyInc.	14.0 L ha <sup>-1</sup>						
PCS, Potash Corp.	2.8 kg ha <sup>-1</sup>						
CoRoN , Helena Chemical Co	28.1 L ha <sup>-1</sup>						
Pacer N, Crop Production Services	28.1 L ha <sup>-1</sup>						
Task Force Maize, Crop Production Services	9.4 L ha <sup>-1</sup>						
Nitamin, Georgia-Pacific Chemicals, LLC	9.4 L ha <sup>-1</sup>						
NA-CHURS/ALPINE Solutions	18.7 L ha <sup>-1</sup>						
NA-CHURS/ALPINE Solutions	18.7 L ha <sup>-1</sup>						
(MAX-IN, Winfield Solutions, LLC	9.4 L ha <sup>-1</sup>						
Nutri-Cal, CSI Chemical Corp	23.4 L ha <sup>-1</sup>						

Field information and management practices	Novelty	Portageville	Albany
Previous crop	Corn	Soybean	Soybean
Planting date	May 19	May 1	May 21
Fertilizer rate (N-P-K kg ha <sup>-1</sup> )	258-78-112	179-0-0	179-67-90
Hybrid	DK63-42	P33N58	DK62-43
Seeding rate (seeds ha <sup>-1</sup> )	86,500	86,500	69,200
Fungicide and foliar fertilizer application date	July 23	July 9-10	July 16
Air temperature (C)	26	24	32
Relative humidity (%)	50	80	70
Height (cm)	245	305	305
Harvest date	Oct. 10	Sep. 22	Nov. 21
Departure from 30 year avg rainfall Apr-Sep(mm)	+456	-152	+80
Soil test information			
P (mg kg <sup>-1</sup> )	17.5	17	31
K (mg kg⁻¹)	144	97.5	117
pH (0.01 M CaCl <sub>2</sub> )	6.0	6.2	5.8
CEC (cmol <sub>c</sub> kg <sup>-1</sup> )	14.9	9.7	18.8
Mg (mg kg <sup>-1</sup> )	183.5	94.5	448
Ca (mg kg <sup>-1</sup> )	1800	1526	2618
Organic matter (%)	2.0	1.3	2.6



Figure 1: CO2 propelled boom for application.





## Results and Discussion

- Incidence of disease less than 5% at all locations (Table 3).
- Slight reduction of grey leaf spot at Albany, no other reductions
- Increased grey leaf spot at Portageville with 0-0-30-0 and 0-0-25-17. Increased common rust at Albany with 24-0-1-0.6.
- In general, little or no change in the effectiveness of the fungicide.
- Foliar injury was less than 10% at all locations (Table 3).
- Injury was increased from 0.3% to 0.5% at Novelty and Portageville, but there was no increase at Albany. Increase in injury was most likely due to the presence of surfactant with the combinations.
- The only foliar fertilizer with consistent injury at all three locations was 0-0-30-0, which ranged from 2% to 7%.
- Grain yield was increased by 691 kg ha<sup>-1</sup> with the Pyraclostrobin at both Novelty and Portageville. There was no change in yield in Albany.
- No significant increases in yield with any of the fertilizers or fertilizer fungicide combinations (Figure 2).
- A reduction in grain yield with 0-0-25-17 at Novelty and 6-0-0-0 at Portageville was related to foliar injury specific to the fertilizer treatments (Table 3 and Figure2).
- Grain yields at Albany were reduced with 3-18-18-0, 6-0-0-0, B, and a premix of Fe-Mo-Mn-B-Zn when compared to the non-treated control.
- Several significant differences with nutrient levels in plant from application to black layer, but none were consistent across all locations.

### pressure and injury for all the fertilizer-fungicide combinations. ANTH= anthracnose, CR= common rust, GLS=grey leaf spot, and NCLB= northern corn leaf blight east significant difference at $p \le 0.05$ ; NS= not significant

Fertilizer treatment	Novelty					Portageville		Albany		
	GLS*	CR	NCLB	Injury	GLS	ANTH	Injury	GLS	CR	Injury
						%				
Non-treated	1	0.3	0	0	1	1.3	0	0	2.3	0
3-18-18-0	1	0.2	0	0	1	1	0	0	3	0
0-0-30-0	1	0.1	0	7	1.7	1	2	0.1	2.4	5
22-0-2-1, 0.25% B	1	0.1	0	0	1	1	0	0.3	2.8	2
24-0-1-0.6,0.25%B	1	0	0.1	0	1.2	1	0	0.2	4.2	0
25-0-0-0, 0.01% Cl	1	0.6	0	0	1	1	0	0.2	2.4	0
0-0-25-17	1	0.3	0	10	1.7	1	0	0.1	1.6	0
5-0-20-13	1	0.1	0	9	1.2	1	0	0.1	2.4	0
0-0-62-0	1	0.4	0	0	1	1	0	0.1	3	0
30-0-0-0	1	0.2	0	0	1	1	0	0.2	2.5	0
6-0-0-0, 10% Ca	1	0.1	0.1	1	1	1	1	0	1.8	0
Boron	1	0.1	0.1	0	1.2	1	0	0	2.1	0
Fe-Mo-Mn-B-Zn	1	0.1	0.1	0	1	1	0	0	1.7	0
Mn-chelate	1	0.4	0	0	1	1	0	0	2.2	0
LSD** (P<0.05)	NS	NS	NS	1.3	0.3	0.2	0.5	NS	1.7	1









Figure 5: Earleaf copper levels for each location. vraclostrobin= treatments with fungicide only and Non-treated= non-treated treatments. nutrient levels where there is a significant ifference p≤0.05.











• There were no significant increases in grain yield when foliar fertilizers were applied to corn at tasseling. Some foliar fertilizers reduced grain yield when compared to the non-treated control in 2008. There were also no significant increases with the fertilizer-fungicide

combinations when compared to the fungicide only treatments. Pyraclostrobin increased grain yield when compared to the

non-treated control at 2 of the 3 sites.

• There were several differences in various nutrient levels between the fungicide and non-treated control, however there were no consistent differences between the locations.

Incidence of disease was minimal at all three locations and the effect of pyraclostrobin on disease was minimal when disease pressure was

• The incidence of disease was not affected by fertilizer treatments at Novelty or Albany while there was an inconsistent effect of fertilizer treatments on the incidence of disease at Portageville.

Many differences between the sites can be explained by varied site characteristics and management practices.



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