Effect of Fungicide Applications on Plant Health in Louisiana Grain Sorghum

Dan Fromme[1], Josh Lofton[2], and Trey Price[2]
LSU AgCenter
Alexandria[1] and Winnsboro[2], Louisiana, respectively

Abstract

Based on recommendations from fungicide manufacturers, producers are applying fungicides to grain sorghum to enhance plant health and to increase yields, even in the absence of foliar disease symptoms. To address this practice, two foliar fungicide trials were conducted in Central Louisiana. The objective of these two studies was to determine if there was a yield increase or economic benefit of applying a fungicide to grain sorghum in the absence of disease pressure. Foliar fungicide applications were made when grain sorghum reached 25% bloom. Fungicides evaluated in these studies included Headline® (pyraclostrobin), Quadris® (azoxystrobin), and Topguard® (flutriafol). Beginning at 25% bloom, leaf temperature and chlorophyll measurements were taken to determine if there were differences between the fungicide treatments. These measurements were taken on a weekly basis until grain sorghum reached physiological maturity. At harvest, percent lodging, percent grain moisture, bushel weight, and grain yield were measured. Following harvest, grain samples were evaluated to see if differences in surface grain mold could be measured. Foliar fungicide applications did not increase grain yields and no differences were found in the other variables that were measured .

Introduction

The use of foliar fungicides on grain sorghum has increased greatly over the past 3-4 years throughout the state of Louisiana. Fungicides are typically used in grain sorghum to control foliar diseases when the potential for yield loss is significant. However, some suggest fungicides should be used to improve plant health regardless of the presence of disease. This preemptive application is thought to improve the physiological function of the plant, improve stress tolerance and standability of the crop. Modern hybrids with high yield potential and new fungicide active ingredients with effects on crop physiology have been given as possible motivations for increased fungicide application in corn (1). In particular, based on bioassays and studies conducted under controlled conditions, quinone outside inhibitor (QoI) fungicides have been show to induce physiological and developmental changes in plants, including retardation of senescence due reduced oxidative stress (2), increased photosynthetic capacity, transient inhibition of respiration, inhibition of ethylene biosynthesis (3), and reduction of stomatal aperture and water loss through transpiration (4,5). These changes are believed to translate into greater stress tolerance and higher yields . The actual benefits of these applications in commercial grain sorghum fields are uncertain and producers question if spending between $22.00 to $38.00 an acre + application costs for these fungicides is profitable.

Objectives

1. To determine if there was a yield increase or economic benefit of applying a fungicide to grain sorghum in the absence of disease pressure.
2. To determine if differences in plant health could be measured.

Materials/Methods

Two studies were implemented to evaluate the effect of foliar fungicide applications on grain sorghum yields and overall plant health at the Dean Lee Research and Extension Center located at Alexandria, Louisiana. Studies were planted on April 4, 2014. Previous crop was cotton. Two different grain sorghum hybrids were planted. The hybrids planted included DKS 5400 and DKS 53-67. Seeding rates were 80,000 seed per acre. At planting, 2.4 pints of guardsman slider atz + 2.7 ounces of outlook was applied for preemerge weed control. Phosphorus and potassium fertilizer was broadcast during the month of November, 2013 at a rate of 27 and 54 pounds per acre, respectively. Nitrogen fertilizer was knifed in following sorghum emergence at a rate of 150 pounds per acre. Soil type was a Coushatta silt loam. Both studies were grown under dryland conditions. Row spacing was 38 inches. Fungicide applications were made at the 25% bloom stage on June 23, 2014. Plot sizes were 4 rows by 50 feet in length. Experimental design was a randomized complete block. Number of replications was four. Fungicides evaluated included Headline® (pyraclostrobin) at 12 oz/acre, Topguard® (flutriafol) at 14 oz/acre, and Quadris® (azoxystrobin) at 14 oz + COC at 1% v/v. A Lee spider sprayer was utilized to apply the fungicides. Fungicides were applied in 15 GPA at 25 psi and 8003xr spray tips were used. Ground speed was 5 mph. Leaf temperature and chlorophyll measurements were taken on a weekly basis until grain sorghum reached physiological maturity. A Raytek ST Pro™ (laser point) temperature gun was used to record leaf temperatures. Chlorophyll measurements were recorded with a Spad 502 chlorophyll meter. On August 4, glyphosate was applied at 48 oz/acre for ease of threshing and faster dry down. Percent lodging ratings were made on the day prior to harvest. Harvest dates were August 18, 2014. Yield was determined by harvesting the middle two rows with a two row small plot combine. Percent moisture and bushel weight were recorded after each plot was threshed. Grain sorghum samples were assessed to determine if there were any differences in grain mold. Also, additional samples were to sent to the Texas A&M AgriLife Extension Service soils lab to determine total nitrogen and percent crude content of the seed (data not shown in results). No disease pressure (leaf blight, anthracnose, zonate leaf spot, sooty stripe, target leaf spot, and rust) was observed throughout the duration of the two studies.

Results

Leaf temperature and chlorophyll measurements were not affected by the fungicide applications. At harvest, there were no differences in lodging. Yield, bushel weight, and percent moisture were not affected. There were no differences in grain mold ratings or no pre-harvest development of grain mold symptoms.

Based on the results of these studies, only apply fungicides when disease is present and has crossed established agronomic and economic thresholds. Strobilium fungicides are very effective in controlling labeled diseases. Fungicides applied to improve plant health may result in a better looking crop; however, the applications are not justified if disease is not present and significant yield losses are not eminent.

Acknowledgements

Appreciation is expressed to Dr. Daniel Stephenson, State Weed Specialist for his assistance in the harvesting of these two studies.

References

1. Munkvold, G.P., Doerge, T., and Bradley, C. 2008. IPM is still alive for corn leaf diseases: look before you spray. In: Proc. 62nd Annu. CornSorghum Res. Conf. Chicago. CD-ROM, American Seed Trade Association, Alexandria, Va.
2. Wu, Y.X., and von Tiedemann, A. 2001. Physiological effects of azoxystrobin and epoxiconazole on senescence and the oxidative status of wheat. Pest Biotechnol. Phys. 71:1-10.
3. Gross, K., and Retzlaff, G. 1997. Bioregulatory effects of the fungicide strobilurin kresoxim-methyl in wheat (*Triticum aestivum*). Pestic. Sci 50: 11-20.
4. Grossman, K., Kwiatkowski, J., and Caspar, G. 1999. Regulation of phytohormone levels, leaf senescence and transpiration of the strobilurin kresoxim-methyl in wheat (*Triticum aestivum*). J. Plant Physiol. 154:805-808.
5. Nason, M.A, Farrar, J., and Bartlett, D. 2007. Strobilurin fungicides induce changes to photosynthetic gas exchange that do not improve water use efficiency of plants grown under condtions of water stress. Pest Manage. Sci. 63:1191-1200.

Table 1. Results for DKS 54-00 Hybrid Alexandria, Louisiana

Treatment	Oz./Acre	Leaf Temp.[2] (°F)		Chlorophyll[2]		% Lodging[3]		Grain Mold[4]		Moisture (%)		Bushel Weight		Yield[5] (lbs./acre)	
Headline	12	87.81	a	45.56	a	0		2.25	a	13.98	b	54.98	a	8074	a
Quadris[1]	14	88.55	a	45.06	a	0		2.25	a	14.65	a	52.88	a	7613	a
Topguard	14	87.77	a	45.61	a	0		2.25	a	13.73	b	54.75	a	7788	a
Untreated	---	88.13	a	46.13	a	0		2.25	a	13.53	b	54.33	a	7740	a
Mean	---	88.06		45.59		0.0		2.25		13.97		54.23		7803	
P>F	---	0.2895		0.5041		1.0000		1.0000		0.0192		0.2262		0.4423	
LSD (P=.05)	---	NS		NS		NS		NS		0.663		NS		NS	
STD DEV	---	0.5961		0.9546		0.00		0.312		0.414		1.426		391.83	
CV%	---	0.68		2.09		0.0		13.86		2.97		2.63		5.02	

Means in a column followed by the same letter are not significantly different by ANOVA.
[1]A crop oil concentrate (1% v/v) was added to the Quadris treatment.
[2]Based on the average of a six week period. Readings were taken on a weekly basis.
[3]Percent lodging out of 100 plants.
[4]Grain mold ratings are based on 1-5 scale. 1=seed bright with no mold and discoloration, 5=seed was covered entirely with mold and is deteriorated and looks dead.
[5]Adjusted to 14% moisture

Table 2. Results for DKS 53-67 Hybrid Alexandria, Louisiana

Treatment	Oz./Acre	Leaf Temp.[2] (°F)		Chlorophyll[2]		% Lodging[3]		Grain Mold[4]		Moisture (%)		Bushel Weight		Yield[5] (lbs./acre)	
Headline	12		a	45.39	a	0.0	a	1.50	a	15.02	a	57.46	a	8400	a
Quadris[1]	14		a	44.26	a	0.0	a	1.50	a	14.18	a	57.10	a	8260	a
Topguard	14		a	45.08	a	0.0	a	1.50	a	14.12	a	57.82	a	8313	a
Untreated	---		a	44.94	a	0.0	a	1.75	a	14.50	a	56.40	a	8279	a
Mean	---	88.57		44.92		0.0		1.56		14.45		57.20		8313	
P>F	---	0.3613		0.6176		1.0000		0.7623		0.3102		0.2176		0.9660	
LSD (P=.05)	---	NS		NS		NS		NS		NS		NS		NS	
STD DEV	---	0.6227		1.2119		0.00		0.400		0.689		0.882		424.62	
CV%	---	0.7		2.7		0.0		25.58		4.77		1.54		5.11	

Means in a column followed by the same letter are not significantly different by ANOVA.
[1]A crop oil concentrate (1% v/v) was added to the Quadris treatment.
[2]Based on the average of a six week period. Readings were taken on a weekly basis.
[3]Percent lodging out of 100 plants.
[4]Grain mold ratings are based on 1-5 scale. 1=seed bright with no mold and discoloration, 5=seed was covered entirely with mold and is deteriorated and looks dead.
[5]Adjusted to 14% moisture.