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Value of Fungicide Application in Wheat Production in Southwest Kansas, 2017 Report

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Summary

During the past several years, applying fungicide to wheat has become a more common practice. The availability of cost-effective generic fungicides, as well as the positive yield responses often reported, seem to be the potential drivers for the adoption of such practices by producers. A wheat fungicide trial was conducted in Garden City, KS, to answer the following questions: 1) Are fungicide applications profitable? and 2) Can remote sensing technology be used to quantify the efficacy of different fungicide products? The study consisted of two wheat varieties sown on September 30, 2016 (Oakley CL, highly resistant to stripe rust; and TAM 111, highly susceptible to stripe rust) and treated with different fungicide products. Stripe and leaf rust were the major fungal diseases impacting wheat yield in southwest Kansas in 2017. Wheat production in 2017 was impacted by dry planting conditions in late 2016, a winter ice storm in January, and a late snow storm on April 30, and severe wheat streak mosaic virus infestation. There were significant differences in grain yield among fungicide products for both TAM 111 and Oakley CL. The large changes in normalized difference vegetation index (NDVI) values suggest that multiple environmental factors were interacting to impact the wheat plant health. The benefit of fungicide application observed on yield was minimal under the environmental conditions of 2017.

Introduction

In recent years, producers are becoming interested in protecting wheat grain yield from major fungal diseases due to the availability of more affordable generic fungicides. However, it is important for producers to be aware that application of fungicides protects yield potential that is present at the time of application. Fungicides serve as yield protectors by enhancing the plant health. Therefore, it is common for producers to often associate delayed harvest with fungicide application. Fungicides allow plants to stay green and maintain their leaves longer, using more nutrients during the late development stages.

Previous research has reported variable results regarding the value of fungicide application in the Great Plains. In Kansas, several years of research have indicated that a single fungicide application to a susceptible variety, on average, could provide a 10% yield increase, relative to the untreated control (De Wolf, 2013). To maximize the benefit of a fungicide application, producers should know the vulnerability of the variety to be treated. Susceptible varieties are more likely to benefit from foliar fungicides as compared to varieties with moderate to high levels of resistance. It is also important to pay attention to weather conditions and scouting reports within a field, region, and even surrounding states to the south.

Rating the effectiveness of a foliar fungicide application on disease control is often tedious and very subjective. With the onset of remote sensing technology, there are great opportunities to develop more objective approaches for rating varietal resistance to diseases and the efficacy of fungicides. Measurements such as the normalized difference vegetative index (NDVI)–which combines wavebands in the red region of the spectrum that is controlled by the leaf pigment content, and wavebands in the near-infrared region of the spectrum that is controlled by the internal leaf structures–are strongly correlated with plant health. Application of fungicide is reported to enhance plant health that results in the plant staying green longer. Therefore, differences in NDVI before and after fungicide application relative to the control could be used to develop a more objective scale for rating fungicide efficacy.

The objectives of this study were to evaluate the value of variety selection and application of a foliar fungicide as part of an economically optimal disease management plan and to assess the potential for using remote sensing measurements such as NDVI as a tool for rating fungicide efficacy.

Experimental Procedures

An experiment was established at the Southwest Research-Extension Center in Garden City, KS, in fall 2016. The design of the experiment was a randomized complete block design with three replications consisting of eleven fungicide application treatments and two wheat varieties: Oakley CL (highly resistant to stripe rust) and TAM 111 (highly susceptible to stripe rust). The experimental treatments are summarized in Table 1. Experimental plots were sown on September 30, 2016, at a seeding rate of 120 lb/a, and were 7.5-ft wide × 30-ft long. The entire experimental area was fertilized with 100 lb of N/a at green-up in March of 2017, and plots were sprayed with a mixture of 0.4 pints of Starane, 0.375 quarts of MCPA, and 0.1 oz of Ally the first week of April for weed control. Fungicides were applied at a volume of 15 GPA with a CO_2 backpack sprayer when the flag leaf fully emerged and the ligule was visible (Feekes GS 9). A plot combine 7.5-ft wide was used to harvest 25 ft from each plot for yield. A subsample was collected from each plot to determine the test weight and moisture content. The yield was adjusted to 13% moisture.

NDVI was collected before and 15 and 30 days after the flag leaf fungicide application. A handheld Greenseeker sensor (Ntech Industries, Inc, Ukiah, CA) was used to measure the NDVI. The difference between the before and after NDVI values were used to assess the efficacy of the fungicide. The smaller the difference between the before and after application NDVI values of the treated compared to the control was indicative of the efficacy of the fungicide.

Results and Discussion

The 2017 wheat crop overcame many challenges, including a late winter snowstorm that covered the wheat in more than 20 inches of snow for three days, mild leaf and stripe rust, wetter than normal conditions in March and April, and warmer temperatures were the main environmental conditions for the 2016–2017 wheat crop.

The results of this study showed that the effect of fungicide on yield differed significantly among products and across both resistant and susceptible varieties. The variability in response to the fungicide applications may be attributed to the impact of environmental stress on wheat as well as the later application of the fungicide at Feekes 10 compared to Feekes 9 in 2016. Compared to the results of 2016, TAM 111 (the susceptible variety) once again out-yielded the resistant variety Oakley CL. Similar to 2016, lodging was again a problem for the Oakley CL variety (Table 3). The generic fungicide was the most consistent in producing a net return, with a net benefit of $3.45 for TAM 111 and $9.64 for Oakley CL. Oakley CL is not resistant to leaf rust, so a mild infestation of this fungus likely justified justifying the greater net returns as compared to TAM 111.

In 2016, Foster et al. (2017) reported differences of 0.07 in NDVI 30 days after application in the check TAM 111 plot, but in 2017 differences in NDVI for the check TAM 111 plot were 0.07 15 days after application, and 0.32 30 days after application (Table 3). Contrary to 2016, the changes in NDVI indicated significant differences in efficacy among the different fungicides 15 and 30 days after application for both TAM 111 and Oakley CL. The large changes in NDVI and the significant difference in efficacy among the fungicides in 2017 may be attributed to the later application timing, the impact of the April 30 snowstorm, other diseases (mild infestation of leaf rust), lodging, warmer temperatures in May and June, and the effect of the crop approaching physiological maturity at the time of the 30 day NDVI sampling.

Conclusion

The results of 2017 demonstrate the complexity of environmental conditions on wheat management. Therefore, it is important for producers to manage each crop independently, taking into consideration the environmental condition of that year in making decisions on fungicide application. Scouting the crop and gathering information about the condition of the crop is vital to making an optimal decision. Clearly, in 2017 the challenge of getting fungicide applied on time was a factor. In these situations, a good decision is to go with the generic products to minimize the potential for economic losses. The results observed in 2017 in no way should be interpreted outside of context of the particular growing season from which data were collected–that is, without considering the environmental conditions under which the wheat was grown. Fungicide decisions should take into consideration the current crop growing condition and yield potential, inoculum present in the field or neighboring fields, and weather conditions during that particular growing season. Remote sensing technology shows potential in quantifying the efficacy of different fungicides. However, the result was most beneficial when compared to the control, which might offer some challenges in real-world application.

References

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Chemical Disclaimer

Fungicide pricing used in this report maybe higher or lower. Brand names appearing in this report are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Person using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

Table 1. Fungicide rate, time and growth stage of application for each treatment in the 2016–2017 growing season at the Southwest Research–Extension Center, Garden City, KS

Treatment	Product	Time of application	Product rate	Stage of application	Date applied	Growth stage (GS)
			fl oz			
1	Control	NA	NA	NA	NA	NA
2	Aproach Prima	Spring	6.8	Flag leaf	May 9	Feekes, GS 10
3	Tebustar	Spring	4	Flag leaf	May 9	Feekes, GS 10
4	Absolute Maxx	Spring	4	Flag leaf	May 9	Feekes, GS 10
5	Prosaro	Spring	5	Flag leaf	May 9	Feekes, GS 10
5	Nexicor	Spring	7	Flag leaf	May 9	Feekes, GS 10
6	Absolute Maxx	Spring	5	Flag leaf	May 9	Feekes, GS 10
6	Twinline	Spring	9	Flag leaf	May 9	Feekes, GS 10
7	Trivapro	Spring	2	Flag leaf	May 9	Feekes, GS 10
8	Alto	Spring	2	Flag leaf	May 9	Feekes, GS 10
9	Aproach	Spring	3	Jointing	May 9	Feekes, GS 10
9	Aproach Prima	Spring	6.8	Flag leaf	April 11	Feekes, GS 7
10	Priaxor	Spring	2	Flag leaf	May 9	Feekes, GS 10

NA = Not applicable.

Table 2. Precipitation and temperature data for the 2016–2017 wheat growing season at the Southwest Research–Extension Center, Garden City, KS

	Average temperature (°F)		Rainfall (in.)	
Month	2016–2017	30-year average	2016–2017	30-year average
September	71	68	0.14	1.42
October	61	55	0	1.21
November	47	42	0.06	0.55
December	27	31	0.23	0.59
January	31	30	1.53	0.46
February	41	34	0	0.55
March	47	43	2.75	1.31
April	54	52	4.37	1.74
May	60	63	1.08	2.98
June	75	73	1.14	3.12
July	79	78	2.08	2.8
Annual	54	52	13.38	16.73

[1] 30-year averages are for the period 1985-2014.

Table 3. Wheat yield, test weight, and normalized difference vegetative index (NDVI) measured before and after fungicide application, and the difference in NDVI based on the fungicide treatments and wheat variety for the 2016–2017 wheat growing season at the Southwest Research–Extension Center, Garden City, KS

	Yield		Test weight		Lodging		NDVI_Diff @ 15DAA		NDVI_Diff @ 30DAA	
Treatments	TAM	OAK	TAM	OAK	TAM	OAK	TAM	OAK	TAM	OAK
	------ bu/a ------		----- lb/bu -----		-------- % --------					
Control	74	53	56	55	44	98	0.07	0.07	0.32	0.19
Aproach Prima	79	61	59	56	58	98	0.05	0.07	0.17	0.14
Tebustar	78	59	59	57	34	99	0.05	0.07	0.19	0.16
Absolute Maxx	85	59	59	56	55	83	0.05	0.06	0.15	0.12
Prosaro	86	57	58	55	31	85	0.05	0.07	0.17	0.14
Nexicor	80	56	58	56	63	100	0.05	0.06	0.15	0.14
Absolute Maxx	80	56	58	56	36	89	0.05	0.06	0.16	0.14
Twinline	76	55	59	57	63	100	0.04	0.06	0.16	0.14
Trivapro	80	53	58	57	26	99	0.05	0.07	0.18	0.16
Alto	76	53	58	57	40	90	0.05	0.06	0.17	0.15
Aproach/Aproach Prima	85	53	58	56	23	90	0.05	0.07	0.15	0.13
Priaxor	79	49	59	56	30	95	0.04	0.06	0.15	0.14
LSD (0.05)	10	9	1.4	2			0.05	0.01	0.02	0.02
CV	9	11	1.6	2			8	6	8	7
ANOVA (P >F)	0.5	0.08	0.15	0.59			<0.001	0.002	<0.001	<0.001

DAA = days after application.
TAM = TAM 11. OAK = Oakley CL.

Table 4. Net return on investment for different fungicide treatments on Oakley CL (OAK) and TAM 111 (TAM) wheat varieties for the 2016–2017 growing season Southwest Research–Extension Center, Garden City, KS

Treatments	Cost of fungicide[1]	Cost of application	Total cost of treatment	Yield		Value of production		Added return to treatment		Net return to treatment		Value of production treatment cost	
				TAM	OAK	TAM	OAK	TAM	OAK	TAM	OAK	TAM	OAK
	$/gal	$/pass	$/a	------- bu/a -------		---------- $/a ----------							
Control	0.00	0.00	0.00	74	53	222.78	159.00	0.00	0.00	0.00	0.00	222.78	159.00
Aproach Prima	15.41	6.50	21.91	79	61	236.97	183.71	14.19	24.71	(7.72)	2.80	215.06	161.80
Tebustar	1.56	6.50	8.06	78	59	234.30	176.71	11.52	17.71	3.45	9.64	226.24	168.64
Absolute Maxx	9.69	6.50	16.19	85	59	226.24	176.57	30.94	17.57	14.75	1.38	237.54	160.38
Prosaro	11.33	6.50	17.83	86	57	253.72	171.75	35.23	12.75	17.40	(5.08)	240.19	153.92
Nexicor	11.48	6.50	17.98	80	56	240.71	168.07	17.92	9.07	(0.06)	(8.92)	222.72	150.08
Absolute Maxx	12.11	6.50	18.61	80	56	241.42	167.80	18.64	8.80	0.03	(9.81)	222.81	149.19
Twinline	11.60	6.50	18.10	76	55	229.16	164.31	6.38	5.31	(11.72)	(12.79)	211.06	146.21
Trivapro	2.73	6.50	9.23	80	53	239.10	159.74	16.32	0.74	7.08	(8.49)	229.87	150.51
Alto	2.34	6.50	8.84	76	53	227.66	159.22	4.88	0.22	(3.96)	(8.63)	218.82	150.37
Aproach/ Aproach Prima	23.53	13.00	36.53	85	53	254.04	158.14	31.26	(0.86)	(5.27)	(37.39)	217.51	121.61
Priaxor	8.98	6.50	15.48	79	49	236.06	147.25	13.28	(11.75)	(2.21)	(27.23)	220.58	131.77

(), negative return to treatment.

[1]Actual cost of fungicide may vary from those used in table.