

2016



KENTUCKY
Small Grain
GROWERS' ASSOCIATION

RESEARCH REPORT

25 Years of Growth



KySGGA
P.O. Box 90
Eastwood, KY 40018
1-800-326-0906
www.kysmallgrains.org

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Seed Program & Grower Education
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GROWING RESULTS: 25 Years of Research and \$2.5 Million in Funding

Don Halcomb, Chairman, Kentucky Small Grain Promotion Council

After 25 years of dedicating more than \$2.5 million to production research, Kentucky wheat production has increased 87%. And while 2016 was not a record production year, the average wheat yield of 80 bushels per acre was the highest recorded in Kentucky history. In fact, increases in average Kentucky wheat yields exceed that of corn for the same 25 year period. This tremendous growth is primarily due to the collaboration between farmers, the University of Kentucky's research and extension team, crop consultants, and end-users.

The Kentucky Small Grain Utilization Fund and our farmer-led Promotion Council was formed in 1991 to direct checkoff toward wheat and small grains research and grower education. UK's Wheat Science Group has worked to develop varieties that perform well under Kentucky conditions, and agronomic practices continue to be fine-tuned for the highest profitability. Much of our research centered on intensive management and no-till practices for many years, and now we are looking at technology and methods that may be considered beyond standard thinking: reducing the fragipan, soil irrigation, and disease control alternatives, to name a few.

As we are always looking for ways to increase profitability for small grain growers, we are seeing a potential in additional small grains for specialty products. I am proud and amazed of the work that has been done to develop a chia variety for Kentucky, and our organization gets countless requests from the growing brewing and distilling industry for barley and rye. We have worked for years with Virginia Tech on barley, and they recently became involved in a growing cooperative national research project that is studying winter malt barley. Trials are being conducted in Kentucky. Also, this year, we funded a project with UK to update management practices for barley and rye produced in the commonwealth. If you're involved with the barley or rye production or want to be, please don't hesitate to reach out to our organization to be a resource when introduction requests come our way.

Finally, sharing results with growers has always been a primary objective of our association. All the research project results can be found in this report and on our website, www.kysmallgrains.org, and growers may also attend the KySGGA-sponsored Continuing Education Series events hosted by the University of Kentucky in January and May. We also hope you will consider attending the Kentucky Commodity Conference on January 19 to learn more about our organization and talk with our leadership. We always welcome new ideas on how to serve our grain growers.

Annual Ky Small Grain Financial Report

From June 1, 2015 to May 31, 2016

Reviewed by Jones, Nale & Mattingly, PLC

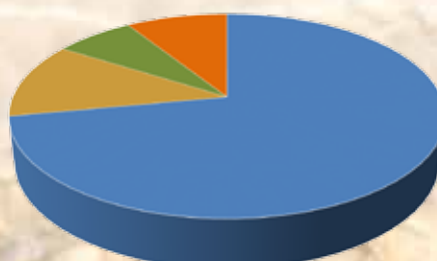
REVENUE

Checkoff Assessments	\$459,692
Producer refunds	\$24,078
Net Checkoff Income	\$435,614
Interest Income	\$1,069
Total Revenue	\$436,749

EXPENSES

Market Development	\$20,385
Research	\$203,715
Education	\$35,445
Administration	\$25,411
Total Expenses	\$284,956

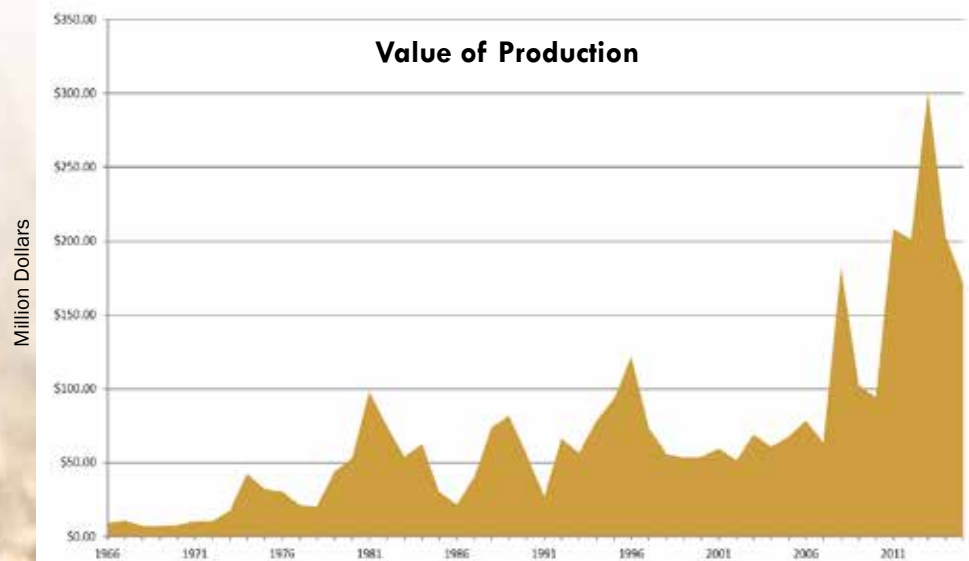
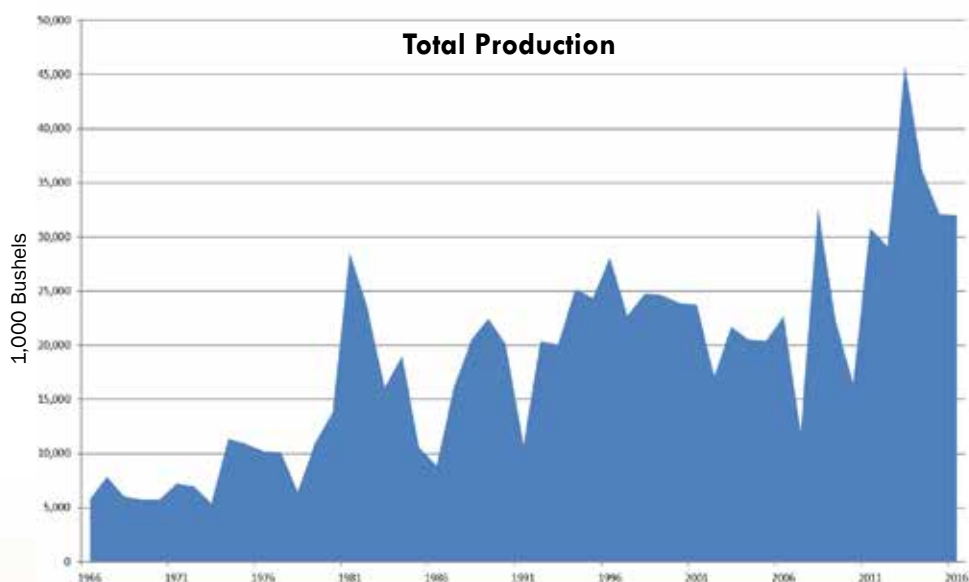
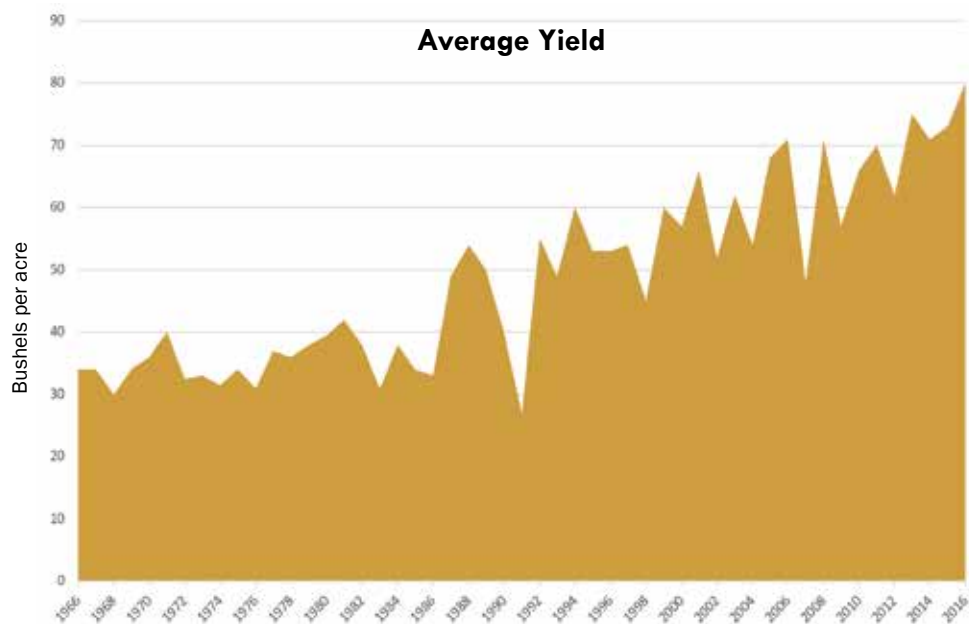
Distribution of Expenses



Research - 72%
Education - 12%
Market Development & Promotion - 7%
Administration - 9%

Kentucky Wheat Production (1966 - 2016)

Source: USDA-NASS



UK Winter Wheat Meeting

January 5, 2017

Bruce Convention Center

Hopkinsville, KY

Check kygrains.info for details.



Kentucky COMMODITY CONFERENCE

Thursday, January 19, 2017

Holiday Inn University Plaza,
Bowling Green, KY

Agenda (all times CDT)

- 8:30 am Registration & Trade Show Open
- 9:00 Marketing Session
- 11:00 Luncheon and Entertainment
- 1:15 Afternoon Break
- 2:30 Ky Soybean Association Annual Meeting
- 3:30 Ky Corn Growers Association Annual Meeting
- 4:30 Ky Small Grain Growers Association Annual Meeting
- 5:30 Reception
- 6:30 Awards Banquet
- 9:00 Hospitality

Additional details and registration information are available at www.kycommodityconference.org.

Research REPORT

The Kentucky Small Grain Growers Association dedicates the largest portion of its budget to small grain research that may help increase grower success and profitability. The following report lists projects that are complete or continuing. Data and more in-depth results can be found at www.kysmallgrains.org.

Soft Red Winter Wheat Breeding and Variety Development

By David Van Sanford, University of Kentucky

The goal of the University of Kentucky wheat breeding program is to increase profitability of Kentucky's wheat production by developing and releasing improved wheat varieties with high yields and test weights, enhanced scab resistance and overall disease resistance, increased lodging resistance and increased profitability. Significant progress towards these goals requires long term, sustained effort and commitment. To date, more than \$900,000 has been directed to Van Sanford's wheat breeding research. This is an ongoing project.

2016 Report

Pembroke 2016: Pembroke 2016, which was released last fall through collaboration with the KySGGA performed well in the state variety trial and very well in the Wheat Tech variety trial. This short-statured, lodging resistant variety has excellent yield potential, high test weight and good scab resistance. Farmers are not penalized for saving their own seed of Pembroke 2016, and seed may be sold in compliance with the Kentucky Seed Law.

Yield testing: Several of our advanced lines performed extremely well in our in state breeding line trials in 2016. These tests are grown in replicated plots across the state. The best performing lines will be moved to the state variety trial this fall and seed will be increased in Lexington and Yuma, AZ.

Scab screening: Each year we screen several thousand wheat varieties and breeding lines in our irrigated, inoculated scab nursery grown at Lexington. The average resistance level of the KY material is improving over time. Recent examples of this are Pembroke 2014 and Pembroke 2016. Both of these varieties show a high level of scab resistance which is an essential part of managing this devastating disease.

Crossing: In greenhouse crossing in 2016 we made a total of 500 successful crosses in which at least one parent had scab resistance. We try to combine this disease resistance with high yield, test weight and other traits important to farmers, such as lodging resistance. These crosses will give rise to breeding populations in which we hope to select, over time, a new and better wheat variety for Kentucky.

Field plots and headrows: We grew 12,900 plots in 2016, and more than 20,000 headrows (plots planted from the seed in a single wheat head). Plots were grown at Lexington, Woodford

Co., Schochoh, and Princeton; most of our headrows were grown at Princeton. Approximately the same number of plots and close to 30,000 headrows are being planted this fall. We plan to move our headrows from Princeton to Lexington and Woodford Co. because it will streamline our note-taking and harvest procedure; additional plots will be planted at Princeton in the area previously occupied by headrows.

Line development: Headrows were selected at Princeton based on maturity, height, freedom from scab and other diseases, and overall vigor. Seed from approximately 750 selected rows will be planted in Preliminary Trials this fall at Lexington and Princeton. More advanced breeding lines will be tested in trials planted at multiple locations within and outside of Kentucky. Their evaluation in these tests is part of the process of developing a new variety.

UK Evaluates Wheat Field School Feasibility

With support from the Kentucky Small Grain Growers Association, the University of Kentucky has evaluated the potential to create a Wheat Field School at the UK Research and Education Center in Princeton.

They had Wheat Science Group representatives travel to Purdue University's Crop Diagnostic Training and Research Center (DTC) last year to visit with leaders and gain an understanding of their operations, inputs, target audiences, and potential issues. This led to a trial run at UKREC this past spring.

The evaluation grant allowed the group to determine that a Wheat Field School at UKREC is feasible, and personnel are now working to develop the training program. The project's coordinator, Edwin Ritchey, says the UKREC Wheat Field School will be a benefit to wheat producers in Kentucky and will help bring prominence to the new UK Grain Crops Center of Excellence. Stay tuned.

Understanding the Genetic Basis of Wheat Development

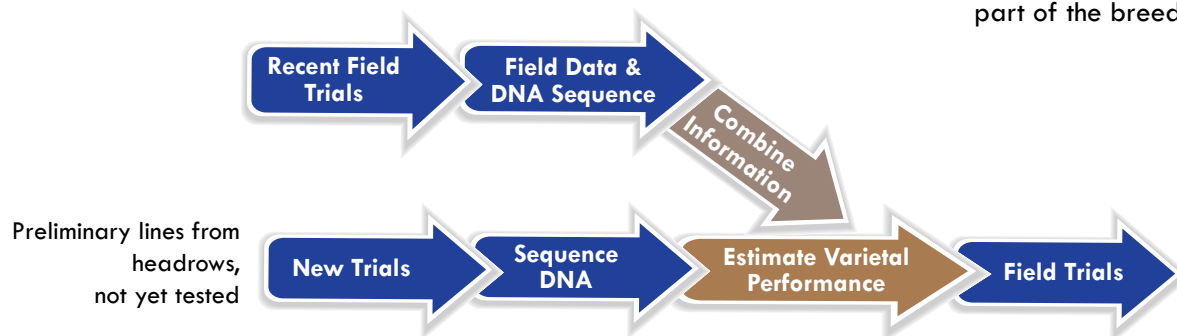
By David Van Sanford, University of Kentucky

What is genomic selection? The picture will help to illustrate the process:

There are two parallel tracks in the picture. The upper one represents lines that we have been testing in the field, AND we have also sequenced their genomes (all of their DNA). By knowing which lines performed well in the field, we can use software that tells us which DNA sequences are associated with high yields and good field performance, and which ones are associated with poor performance. We then apply that information to the lines in the lower track, the new lines from headrows (HR) and choose which ones we want to test in the field and which ones we want to discard. If the process works like we hope it will, we will be more efficient by not testing lines that do not have the genetic potential we need.

2016 Results

This was the first year of the study and so far our accuracy is about 45%, which is not bad but not as good as we would like it to be. There is much more analysis we need to do to determine the best way to use the genomic information so that it makes the breeding process more efficient. Our goal is to make genomic selection a routine part of the breeding program.



PEMBROKE

Certified Seed, No Strings Attached

Pembroke Varieties are developed by UK Wheat Science Group and released by KySGGA. Farmers, not KySGGA, profit from the release. Royalties go to UK to improve wheat technology. Buyers fully own the technology. Once you buy the certified seed, you own it - ALL OF IT. No strings attached.



www.kysmallgrains.org - 800.326.0906



SAVE IT

RESELL IT

REPRODUCE IT

Wheat Varietal Differences and Disease Reaction

By Bill Bruening, Research Specialist, University of Kentucky

Information on grain yield potential is the primary component sought after when using results from state variety testing programs. Productivity and profitability are directly related to grain yield and varietal selection is recognized as the simplest, most cost effective way to maximize production profitability. Secondary characteristics such as test weight, straw yield potential, plant height, stem strength, maturity and disease reaction are also important in wheat variety selection decisions.

Varietal disease reaction can be directly related to yield and profitability. A variety's susceptibility or resistance to a given pathogen can dramatically affect yield and grain quality. The University of Kentucky Small Grains Variety Testing Program annually evaluates the disease reaction among wheat varieties. The types of disease rated can vary annually depending on which pathogen is active in a given growing season/environment. In 2016, disease ratings were recorded for Stripe Rust, Leaf Rust, Septoria Leaf Blotch, and Powdery Mildew (Table 13).

Disease ratings data can be of value in variety selection decisions, but also in terms of disease management decisions during the growing season. No variety is resistant to all diseases, and it is important to know which varieties are susceptible to a particular disease during an unexpected outbreak. For example in 2016, there was a Stripe Rust outbreak in several regions of Kentucky. Stripe Rust is a pathogen that can rapidly destroy the foliage and dramatically affect grain yield. Growers can utilize variety test disease rating data to determine whether to spray or not spray. For example, in Table 13, CROPLAN 9201 was rated 8.3 (highly susceptible) to Stripe Rust and a foliar fungicide would likely be essential for areas with reported infection. CROPLAN 9203, on the other hand, was rated 1.7 (very resistant) and a fungicide would likely not be needed for this disease.

The decision to spray fungicide can affect production profitability, certainly in terms of protecting a susceptible variety, but also in terms of savings associated with withholding unneeded fungicide applications and eliminating application costs such as chemical, labor, equipment wear, as well as any environmental effects.

In Kentucky, Head Scab pressure in 2016 was minimal and visual field ratings were not taken. Varieties tested in the UK wheat variety testing program are also evaluated in the UK Fusarium Head Scab Nursery, where the research plots are inoculated with Head Scab pathogen and grown under mist irrigation to favor heavy infection pressure. Results indicating varietal susceptibility and resistance, as well as differences in vomitoxin (DON) levels are available online at the variety testing website (www.uky.edu/Ag/WheatVarietyTest). The devastating effects of Head Scab in wheat production is understood, and utilization of varieties with some level of resistance coupled with fungicide application during flowering is recognized as the best way to minimize yield loss and protect grain quality when environmental conditions favor Head Scab infection.

Results from the University of Kentucky Small Grains Variety Testing program are available online and printed annual reports are available at Kentucky county extension offices.



Table 13. 2016 Kentucky Wheat Disease Ratings.

VARIETY	Stripe Rust	Leaf Rust	Leaf Blotch	Powdery Mildew	VARIETY	Stripe Rust	Leaf Rust	Leaf Blotch	Powdery Mildew
Ag 2650	1.7	2.7	4.5	8.5	L11425	8.3	3.3	4.3	5.8
AgriMAXX 415	2.3	3.7	4.5	5.0	L11541	1.3	1.0	2.8	1.3
AgriMAXX 438	1.7	5.7	6.5	7.8	PEMBROKE 2008	3.0	3.7	8.5	3.0
AgriMAXX 444	3.0	2.7	4.5	5.3	PEMBROKE 2014	1.3	4.7	5.5	2.0
AgriMAXX 446	3.3	4.3	4.8	6.8	PEMBROKE 2016	5.3	1.7	4.8	4.8
AgriMAXX 452	8.3	1.3	4.5	6.5	Pioneer variety 25R32	1.0	3.0	4.3	3.3
AgriMAXX 454	7.7	3.3	4.5	7.5	Pioneer variety 26R10	3.0	6.0	6.5	5.5
AgriMAXX 463	2.3	2.7	4.0	5.5	Pioneer variety 26R41	1.0	1.7	5.3	4.5
AgriMAXX 490	7.0	1.3	4.5	4.8	Pioneer variety 26R53	1.3	2.0	4.3	5.0
AgriMAXX Exp. 1670	8.7	7.0	4.8	7.3	Pioneer variety 26R59	2.3	4.3	3.8	1.8
AgriMAXX Exp. 1674	3.7	3.3	3.0	2.8	Pioneer variety XW13W	2.7	1.3	4.3	8.3
ARMOR ARW1513	7.0	4.3	3.8	7.3	PROGENY P 243	6.0	3.3	3.0	5.5
ARMOR ARW1516	1.3	3.0	4.8	6.8	PROGENY P 357	4.0	5.0	5.5	7.0
ARMOR ARW1521	1.7	1.7	4.8	5.5	PROGENY P 870	1.3	2.7	4.8	5.3
ARMOR ARW1551	1.3	1.0	3.8	1.5	PROGENY PGX 15-10	1.3	1.7	4.0	3.5
ARMOR INFERNO	2.0	5.0	6.3	7.0	PROGENY PGX 15-12	3.3	1.3	3.5	3.5
ARMOR RUMBLE	3.0	1.3	4.3	6.8	PROGENY PGX 15-14	3.3	4.0	3.0	3.0
BECK 114	6.0	2.0	4.5	6.3	PROGENY PGX 15-16	1.7	1.0	4.3	2.8
BECK 120	1.0	3.3	4.8	4.3	SC 1315-15™	5.0	1.7	6.0	6.0
BECK 123	5.0	3.7	3.3	4.3	SC 1325-15™	7.0	2.3	5.0	6.3
BECK 125	5.7	1.3	5.3	5.5	SC 1335-15™	6.0	1.3	6.0	5.3
BECK 128	7.7	4.3	4.3	7.8	SC 13526™	8.3	4.0	4.5	8.5
Clark	5.7	5.7	8.3	7.5	SC EXP102™	1.7	3.7	4.5	6.3
CROPLAN 9101	3.7	1.0	6.3	5.8	SC EXP142™	5.0	1.0	5.8	4.5
CROPLAN 9201	8.3	3.0	5.0	3.3	SS 8340	2.3	5.0	4.5	5.8
CROPLAN 9203	1.7	4.7	6.5	8.5	SS 8360	2.3	4.7	4.8	6.8
CROPLAN SRW 9415	3.0	4.3	5.3	7.0	SS 8513	2.3	6.0	3.3	2.0
Dyna-Gro 9223	2.0	5.7	6.3	7.8	SS 8530	4.3	1.3	3.3	4.0
Dyna-Gro 9522	2.0	3.7	5.0	5.3	SS 8700	3.3	4.7	3.8	3.3
Dyna-Gro 9591	3.3	1.7	6.0	5.8	STEYER EVANS	1.7	3.7	5.0	5.5
Dyna-Gro 9600	7.0	1.7	4.5	3.3	STEYER MORRIN	2.7	2.0	3.5	7.5
Dyna-Gro 9692	7.0	4.3	4.3	7.0	STEYER Stet141	7.3	4.3	4.5	7.5
Dyna-Gro WX15742	4.7	1.0	6.3	4.3	STEYER Stet142	5.3	2.0	7.3	4.5
Dyna-Gro WX16771	2.0	1.7	5.8	5.8	STEYER Stet155	1.0	3.0	5.0	6.0
Equity Brand Butler	3.0	1.0	4.0	6.0	SYNGENTA BRANSON	3.3	2.3	5.3	3.5
EXP DEI 16098	5.3	2.7	4.5	4.8	SYNGENTA SY 007	2.0	3.0	8.3	3.0
EXP1052	4.3	4.0	5.8	3.0	SYNGENTA SY 483	3.0	3.3	5.0	2.5
EXP1053	4.3	1.3	7.0	4.3	SYNGENTA SY 547	4.7	1.7	3.3	2.0
EXP1060	8.3	3.0	4.3	4.3	SYNGENTA SY HARRISON	3.0	5.7	4.3	7.0
EXP1072	5.7	2.0	5.5	2.8	SYNGENTA VIPER	1.7	4.7	4.0	5.0
EXP1074	6.0	1.7	6.0	3.5	TN1102	8.7	2.0	6.5	2.8
EXP1078	3.7	1.7	4.3	5.0	Truman	3.0	3.3	7.3	4.8
EXP1081	6.7	2.3	6.3	2.8	USG 3013	1.0	6.3	7.0	8.5
EXP1083	7.3	3.0	4.3	2.0	USG 3197	5.7	1.0	7.0	5.3
HILLIARD	2.7	1.0	4.0	1.5	USG 3404	2.7	3.3	4.8	5.0
KAS Liberty IV	2.3	8.7	7.5	3.8	USG 3895	1.0	1.0	5.5	4.8
KAS Lowery	8.3	1.0	5.0	6.3	VA 12W-72	1.0	1.0	4.0	1.5
KAS S1200	1.3	2.7	4.8	5.3	AVERAGE	4.0	3.0	5.0	5.0
KAS S2500	8.0	3.7	4.3	7.0	Powdery mildew rated at Woodford Co. location Septoria leaf blotch, leaf and stripe rust rated at Logan Co. Disease Rating scale: 1 = resistant; 9 = susceptible				
KY06C-1178-16-10-3	7.0	2.7	4.3	2.8					
L11419	6.0	4.7	4.5	4.0					

Research on managing Fusarium head blight (scab) of wheat and barley with foliar fungicides

By Carl A. Bradley, Kelsey Mehl, and Jafe Weems, Department of Plant Pathology
University of Kentucky Research & Education Center

Research trials funded by the Kentucky Small Grain Growers Association were conducted on soft red winter wheat and winter barley during the 2015-16 growing season at the University of Kentucky Research & Education Center in Princeton, KY. The overall objective of the research trials were to develop the best recommendations for managing Fusarium head blight (FHB; also known as scab) and the associated mycotoxin deoxynivalenol (DON; also known as vomitoxin) with foliar fungicides. The specific objective of each trial differed, and details and results of these trials are provided below.

Soft Red Winter Wheat Trial

The objective of the soft red winter wheat trial was to determine if sequential applications of fungicides would provide better control of FHB and DON compared to a single application of a foliar fungicide. The treatments consisted of the fungicides Prosaro (applied at 6.5 fl oz/acre), Caramba (applied at 13.5 fl oz/acre), or Folicur (applied at 4 fl oz/acre) applied at Feekes growth stage 10.5.1 (beginning flowering) or sequential applications of Prosaro (Feekes 10.5.1) followed by Folicur (four days later), Caramba (Feekes 10.5.1) followed by Folicur (4 days later), or Folicur (Feekes 10.5.1) followed by Folicur (4 days later). A nontreated check also was included as a treatment. Each treatment was replicated four times, and a mist-irrigation system was used to help provide an environment that would be favorable for FHB. The FHB-susceptible variety Agripro W1566 was used for this trial.

As observed in Figure 1, all treatments significantly reduced FHB compared to the nontreated check. Although Folicur applied once at Feekes 10.5.1 reduced FHB compared to the nontreated check, all other treatments had significantly lower FHB index values when compared statistically. The sequential applications of Prosaro/Folicur, Caramba/Folicur, and Folicur/Folicur did not provide a greater level of control of FHB compared to single applications of Prosaro or Caramba.

As observed in Figure 2, all treatments significantly reduced DON compared to the nontreated check. None of the sequential application treatments provided a significantly lower DON level than Prosaro or Caramba applied once at Feekes 10.5.1 when compared statistically.

Conclusions. Prosaro or Caramba fungicide applied at the Feekes 10.5.1 growth stage

reduced FHB and DON compared to the nontreated check, and sequential fungicide applications did not provide any additional control of FHB or DON compared to Prosaro or Caramba applied once. Although this research should be repeated before strong recommendations can be made, it appears that sequential fungicide applications for control of FHB and DON will not provide a benefit to wheat producers in Kentucky beyond what a single application can provide.

Winter Barley Trial

The objective of the winter barley trial was to determine the best growth stage to apply a foliar fungicide to achieve the best control of FHB and DON. Prosaro (6.5 fl oz/acre), Caramba (13.5 fl oz/acre) or Folicur (4 fl oz/acre) was applied at either the boot stage, heading stage, or five days after heading. A nontreated check also was included as a treatment. Each treatment was replicated four times, and a mist-irrigation system was used to help provide an environment that would be favorable for FHB. The FHB-susceptible variety Thoroughbred was used for this trial.

As observed in Figure 3, the only treatments that had a significantly lower FHB index than the nontreated check was Caramba applied at heading or five days after heading, Prosaro applied five days after heading, and Folicur applied five days after heading. In general, the lowest FHB index values were achieved when Prosaro or Caramba were applied five days after heading. As observed in Figure 4, the only treatment that had a significantly lower DON value than the nontreated check was Caramba applied five days after heading.

Conclusions. To draw firm conclusions, it is important that this trial be repeated to ensure that the effects of the treatments evaluated are consistent. From this one year of research, it appears that an application of an effective foliar fungicide should be made at five days after heading to achieve the best control of FHB and DON. However, it is important to note that environment and barley variety may affect when flowering occurs. The flowering stages of small grain crops is considered the most critical period when plants are susceptible to FHB. Therefore, it is critical that this study be conducted over multiple environments (and possibly additional varieties) before strong recommendations on fungicide application timing can be made.

Figure 1

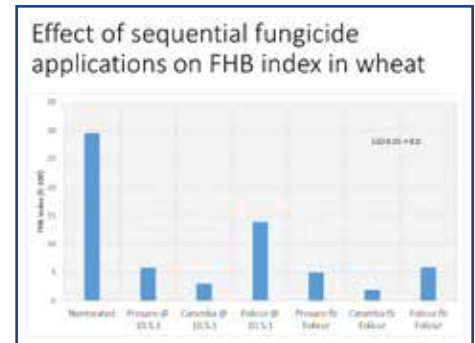


Figure 2

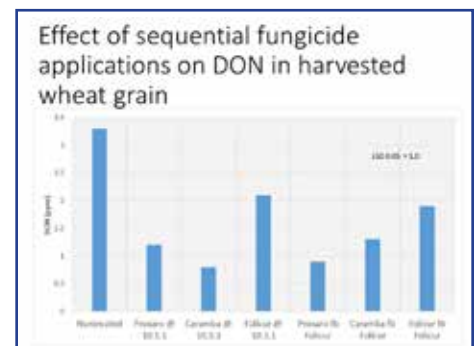


Figure 3

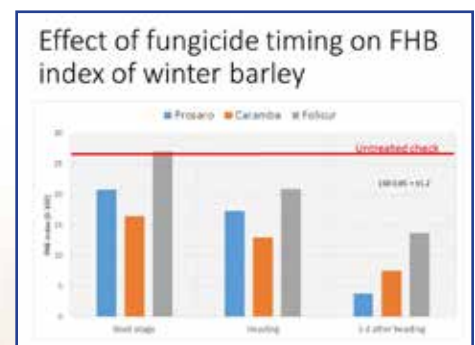
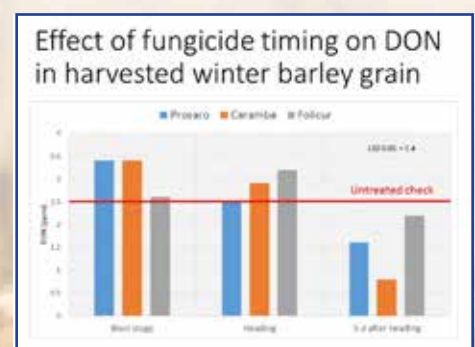


Figure 4



2016 Fragipan Remediation

By A.D. Karathanasis, Chris Matocha, John Grove, Lloyd Murdock
University of Kentucky, Plant and Soil Sciences

The fragipan is a naturally occurring soil horizon that virtually stops water movement and root growth through the soil. Its depth averages about 20-24 inches in the soil types in which it occurs. The layer is due to the cementation of the soil particles with a silicate rich amorphous aluminosilicate binding agent. The fragipan is present in about 2.7 million acres of Kentucky soils and about 50 million acres in the U.S. Fragipan soils reduce yields of crops for two reasons: 1) limited water holding capacity due to limited soil depth 2) water saturated soil conditions during wet periods.

The research on the fragipan by the research team is proceeding faster than originally expected. There is one plant and potentially four compounds that have been found to be effective in breaking apart the fragipan. They are annual ryegrass, potassium chloride, potassium sulfate, sodium fluoride and sodium nitrate. Previous research in Illinois offers additional support for the effectiveness of ryegrass.

Ryegrass has been chosen as the central focus of the greenhouse and field research. Annual ryegrass roots apparently contain exudates that have a degrading effect on the fragipan. The deep root penetration also increases soil porosity and facilitates the leaching of the four effective compounds down to the fragipan. We are presently looking for varieties of annual ryegrass that are more effective in breaking down the fragipan and varieties that are more easily killed by glyphosate.

We have gained enough confidence in the ryegrass treatment as a fragipan remedy and its yield increase potential, that we have begun cooperating with a few farmers across the state to establish on-farm trials.

In addition to the four compounds that have shown promise in reducing the fragipan strength, we are continuing to experiment with other materials and additives that can accelerate the breakdown of the fragipan. The ones showing possible promise now are humates. They will be researched in combination with a ryegrass cover crop in the greenhouse and the field.

We are also finding an enrichment in some organic compounds in the fragipan horizons undergoing degradation where ryegrass is present when compared to the control. We suspect that these compounds are exudates released from the ryegrass roots which induce the fragipan degradation. If this turns out to be true, it will greatly aid in this effort and may lead us to a quicker and more effective method to remediate the fragipan.

The average yield increase of corn and soybeans over a three-year field research period for an annual ryegrass cover crop compared to no cover crop is an average of 9.8% per year on a fragipan soil at Princeton, Kentucky.

The average yearly increase of corn grown after an annual ryegrass cover crop on a fragipan soil in southern Illinois is 3.7 bushels per acre per year over a 15-year period. The increase is accumulative resulting in an increase of 55 bushels per acre the 15th year. This results in an increased return of \$1,686 per acre over those 15 years for using annual ryegrass as a cover crop. This is calculated using \$5 per bushel for corn and an expense of \$36.50 per acre for planting and killing the cover crop. For 1,000 acres the increased return would be \$1,686,000 over those 15 years.

With these limited results, it appears that it might be possible to increase yields of corn and soybeans by 25% on the fragipan soils by using a ryegrass cover crop. We also expect to improve the yields of wheat. A 25% increase would result in \$500,000,000 in increased returns to Kentucky producers per year or \$5,000,000,000 over a 10 year period on the 1.5 million acres of cropable fragipan soils in Kentucky. There is 2.7 million acres of total fragipan soils in Kentucky. Kentucky has only a small portion of the fragipan soils in the U.S. There is about 50 million acres of fragipan soils in the U.S.

Irrigating the Soil to Maximize the Crop

By Ole Wendroth, Javier Reyes,
Xi Zhang, and Chad Lee
University of Kentucky

Crop irrigation has become a serious consideration of many farmers in Kentucky to avoid the consequences of dry weather during the growing season such as in the year 2012. For economical and for environmental reasons, functional soil properties and their spatial variability in farmers' fields need to be known as well as possible for better managing the timing and the amount of irrigation.

The objectives of this project are to identify a way to derive field-scale soil hydraulic properties and their variability in combination of remote sensing and soil measurements, to implement this information in a computer-based management system, and to scale-up the information from the point and field scale to the watershed and regional scale. The expected results are a better site-specific knowledge of soil hydraulic properties to irrigate according to the local soil conditions and plant needs, and a computer-based system that supports soil and crop water management.

Summary of Results obtained in Year 2:

- Reducing the sampling density from 1 sample per acre to 1 sample per 5 acres did not substantially reduce the information and precision of the clay content map as long as VERIS EC measurements were included in the mapping.
- A wireless accessible network of soil moisture sensors was installed across the field at 46 nodes with sensors at three soil depths at each node. Soil water potential data can be downloaded and are available on an hourly basis.
- Spatial differences in soil hydraulic properties cause different infiltrability for natural rainfall and irrigation water. In clayey zones, the soil permeability is not large enough and irrigating with 7/10 of an inch rate causes surface runoff.
- Currently, our recommendation is to irrigate clayey zones more frequently and at a lower rate to achieve water infiltration into the soil profile.

Visit www.kysmallgrains.org for the complete research report.

Improved Chia Production & Product Usage

By David Hildebrand, University of Kentucky

Work conducted at the University of Kentucky by Tim Phillips and David Hildebrand, and also by Chris Kummer on his farm in Simpson Co. indicates that chia, *Salvia hispanica*, can be an economically viable new crop for Kentucky farmers but further research and development is needed.

The main needs are to develop new chia lines with improved yield and other agronomic performance characteristics by traditional breeding, particularly seed retention and lower lodging. Larger seed size with higher oil and omega-3 ($\omega 3$) contents is also valuable for chia production and marketing. Another round of mutagenesis was done and mutants with improvements in such have been screened and chia lines with reduced shattering, stronger stems/reduced lodging, larger seeds and lower density/higher oil contents are being evaluated. Chia genetics is being developed for the determination of the molecular genetic basis of long day flowering for more efficient breeding/genetic improvement.

The most promising chia germplasm from around the world has been assembled and our most promising line was subjected to a further round of mutagenesis. Lines with larger seed, higher oil, reduced lodging and lower shattering are being grown out in 2016. Breeding for higher yielding chia lines that can set seed in Kentucky is continuing by crossing with the best additional chia genetic materials. The oil and protein contents of the harvested seeds as well as fatty acid composition will also be determined.

For commercialization of these lines as a high $\omega 3$ oil, in addition to whole seeds, we are further screening and selecting lines for higher oil and $\omega 3$ levels. We have established a very efficient screen for higher oil chia lines and have found considerable variability for oil content. Thus we will be able to readily develop new higher oil lines. NMR and NIR calibrations that have been developed will be applied to selecting higher oil and protein chia lines. NIR moisture calibrations have also been developed and added. Further work is being conducted on processing and marketing chia for new commercialization opportunities for KY growers for food, health and renewable chemical markets. The chemical processes for converting chia oil into a high value renewable lubricant/motor oil and fuel cell energy source are being further developed.

Chris Kummer's on-farm research is focusing on planting times, planting density, herbicides, fertility and desiccants. The best planting times for the best current long-day flowering chia lines are late May to mid-June. Optimum planting densities are 200,000 to 400,000 plants/acre. Two herbicides are submitted for IR4 registration. Low levels of nitrogen, e.g. 40 lbs/acre and foliar boron is beneficial, and desiccant application when seeds are mostly mature. A killing frost, that is not in the near-term forecast, can reduce seed loss when harvesting. Chris has been marketing a brand of chia he is producing. As the production and marketing are developed he would like to work with other growers.



Can Wheat Yield and Grain Fill Duration be Increased by Decreasing Wheat Canopy Temperature?

By Carrie Knott, Grain Crops Agronomy, University of Kentucky

In 2015, the Kentucky Small Grain Growers' Promotion Council, Kentucky Corn Growers' Promotion Council, and the Kentucky Soybean Promotion Board worked together to provide funds for the University of Kentucky to purchase a 460-ft lateral irrigation system at the Research and Education Center in Princeton. The T&L system, equipped with a variable rate irrigation system, was installed in September 2015.

Prior to initiating any research project, it was necessary to calibrate and optimize the system and to characterize the soil profile

of the 10-acre area. The spring and summer of 2016 received frequent and heavy rains, therefore the irrigation system could not be tested until fall of 2016. Beginning in September more than 180 man hours have been devoted to monitoring, calibrating and optimizing the lateral irrigation system to allow research programs to be initiated for the 2017 growing season. A majority of that time was spent ensuring that the amount of water programmed was actually applied. This involved establishing more than 1,300 catch-cans in the field, which were Solo cups in rows that were 5 feet apart.

In October 2016, one acre of Pembroke 2016 was planted under the lateral irrigation system. The study to examine the effect of wheat canopy temperature on final grain yield will be conducted in the 2017 growing season.





Improvement and Development of Barley for Use in Feed, Malt, and Fuel

By W.S. Brooks and C.A. Griffey, Virginia Polytechnic Institute

The Virginia Tech barley-breeding program is significantly diverse and the largest public program in the eastern United States.

The primary objective of this project is to improve yield and other value-added traits in barley to enhance its production and economic profitability.

The other objective of this project is to incorporate malting quality into our high yielding winter barley varieties to provide growers with a profitable and competitive crop option. Success and expansion of the current winter malt barley industry in Virginia and the eastern U.S. will largely depend on efforts made in breeding, evaluation, and production of winter malt barley and also sound management practices and control of economically devastating diseases.

This goal is currently being accomplished by testing breeding lines and cultivars at multiple locations in State Variety Trials and in regional tests where winter barley is currently being produced and where there is interest and potential for malt barley production. Breeding populations derived from crosses with barley lines introduced from various sources; including lines from the Winter Malt Barley Trial (WMBT) and the Barley Coordinated Agricultural Project (Barley CAP) are being evaluated and advanced in the program.

New barley lines derived from crosses made between superior barley breeding lines from our program with outstanding breeding lines from other programs are being developed and evaluated in the program.

Last season (2015-2016), we evaluated over 700 pure lines in replicated yield tests at multiple locations in Virginia in order to identify potential high yielding varieties. We also evaluated 48 malt barley Double haploid (DH) lines in an observation test at Blacksburg and Warsaw, VA. In addition, approximately 10 to 25 advance barley lines were evaluated in replicated yield tests at locations in neighboring states (North Carolina, Kentucky, Ohio, and Pennsylvania).

Recent interest in local and regional production of winter malt barley by producers and the malting industry has encouraged our program to expand efforts to develop malt barley cultivars adapted to the mid-Atlantic and south eastern United States. As a result, we are currently involved in a cooperative national winter malt barley research project that includes collaborative trials grown at 20 locations in 17 states (Washington, Oregon, Idaho, Utah, Nebraska, North Dakota, Minnesota, Wisconsin, Montana, New York, Texas, North Carolina, Kentucky, Ohio, Pennsylvania, Vermont, and Virginia). There is great interest in this nursery and the number of cooperators will likely expand in the next 2-3 years to include additional nurseries in other states.

We are also planning on initiating a regional mid-Atlantic Uniform Winter Malt Barley Trial with neighboring states to facilitate collaborations and enhance cultivar development. The Virginia Tech breeding program will continue to work with interested parties in evaluating the potential of barley for these and other diverse purposes. This research will help initiate and subsequently expand winter malt barley production into areas where previous production has been considered too risky or not feasible.

The Virginia Tech barley-breeding program is the largest and one of only a few surviving winter barley programs in the eastern United States. The barley program is significantly diverse with breeding efforts focused on development of superior, widely adapted, high yielding winter barley cultivars and a major focus on incorporation of value-added traits geared towards development of new markets.

Hulless Barley: Three-year average (2014, 2015 and 2016) grain yield for Doyce hulless barley in Virginia was 72 bushels per acre (bu/A) with test weight of 54.2 pounds per bushel (lb/bu). Average grain yield of Eve was 68 bu/A with test weight of 57.1 lb/bu. Grain yield of Dan averaged 79 bu/A and test weight was

57.0 lb/bu. Dan had the highest average test weight (58.9 lb/bu) that was 1.3 lb/bu higher than Amaze 10 (57.6 lb/bu), 1.9 lb/bu higher than Eve and 4.7 lb/bu higher than Doyce (54.2 lb/bu). Meanwhile, the hulless barley experimental line VA07H-35WS had the highest three-year average grain yield (80 bu/A) that was 2 bu/A higher than that of Amaze 10 (78 bu/A), 6 bu/A higher than Dan, 8 bu/A higher than Doyce, 12 bu/A higher than Eve, and 5 bu/A more than the test average.

Hulled Barley: Three-year average (2014, 2015 and 2016) grain yield of Thoroughbred hulled barley was 101 bu/A with average test weight of 47.7 lb/bu compared to the mean yield of 91 bu/A and test weight of 46.7 lb/bu for the mean of all cultivars tested. Three-year average grain yield of Secretariat (102 lb/bu) was 1 bu/A higher than Thoroughbred, 6 bu/A higher than Atlantic (96 bu/A), 10 bu/A higher than Price, 14 bu/A higher than Callao and 25 bu/A higher than Nomini. At the same time, the hulled barley experimental line VA12B-8 had the highest three-year average grain yield (102 bu/A) that was similar to that of Secretariat 1 bu/A higher than Thoroughbred, 6 bu/A higher than Atlantic, 10 bu/A higher than Price, and significantly higher than Callao and Nomini.

Malt Barley: In 2015 crop season, the winter barley check variety McGregor was the highest yielding (130 bu/A) winter barley variety among 24 entries and yielded 45 bu/A higher than the winter malt barley check variety Charles, and 28 bu/A more than the overall test average. Two other malt barley varieties Flavia and Calypso ranked 2nd and 3rd respectively in grain yield. The malt barley variety Violetta ranked 5th in average grain yield and also had the highest average test weight (49.1 bu/A) that was 12.4 lb/bu higher than Charles and 5.9 lb/bu higher than the test average (43.2 pounds per bushel). In addition, Violetta also has better resistance (0 = no disease, and 9 = severe infection) to leaf rust (1) and BYDV (1) than Charles (6 and 4 respectively).

Updating Barley and Rye Management Guidelines in Kentucky

By Chad Lee, Kathleen Russell and James Dollarhide, University of Kentucky

The boom in distilleries and growing public interest in locally grown foods has combined to generate much interest in barley and rye for Kentucky. These crops have not been studied extensively since intensive wheat management was developed in Kentucky.

In 2015-2016, the Kentucky Small Grain Growers funded a project where we investigated seeding rates and nitrogen (N) rates on barley, rye and hybrid rye. For that study we included two varieties of each crop with seeding rates of 0.5, 0.75, 1.0, 1.25 and 1.5 million seeds per acre. In the nitrogen rate study, we included rates of 0, 30, 60, 90 and 120 lb N per acre. All of these trials were conducted at Spindletop Farm near Lexington, Ky. This farm is very close to most of the distilleries and answers questions about these small grains in this climate.

The small grains were seeded into a minimally tilled field following corn. All small grains received 30 pounds N per acre (lb N/A) in the fall to stimulate tillering. The previous corn crop was outstanding



and we assumed no nitrogen carryover. The nitrogen rates in the spring were split with 30 lb N/A at Feekes 3 and the remaining amount applied at Feekes 5. For the nitrogen rate studies, all small grains were seeded at 1.25 million seeds per acre. For all seeding rate trials, 90 lb N/A (30/60 split application) was used.

Six-Row Barley: The two barley varieties tested were Thoroughbred and Casino. Both of these are six-row barleys commonly grown in this region. Preliminary yields reached a maximum of 119 bushels per acre (bu/A) and a minimum of 37 bu/A (with no nitrogen applied). For six-row barley the ideal seeding rate for the 2015-2016 season was 1.0 to 1.25 million seeds per acre and the ideal spring nitrogen rate was 120 lb N/acre.

Hybrid Rye: Rye hybrids Guttino and Brasetto were tested. No lodging was observed and yields ranged from 58 to 91 bu/A. The ideal agronomic seeding rate was 1.5 million seeds per acre and the ideal agronomic spring nitrogen rate was 90 lb N/acre.

Rye: Rye varieties Maton and Elbon were tested. Lodging was severe throughout the trial and final yields ranged from 33 to 43 bu/acre. There were no significant differences in yield for any of the treatments, implying that 500,000 seeds per acre yields just as well as 1.5 million seeds per acre and 120 lb N/acre resulted in yields similar to applying no nitrogen fertilizer at all. Again, lodging was the primary issue with rye varieties.

Conclusions: For one season, optimal seeding rates and nitrogen rates were within the general parameters for wheat. Six-row barley required a little more nitrogen and fewer seeds per acre than hybrid rye. Cereal rye lodged severely and confounded any effect of nitrogen and seeding rate.

Figure 1. Seed Rate Effect on Barley, Hybrid Rye and Rye. (Note the change in scales for yield.)

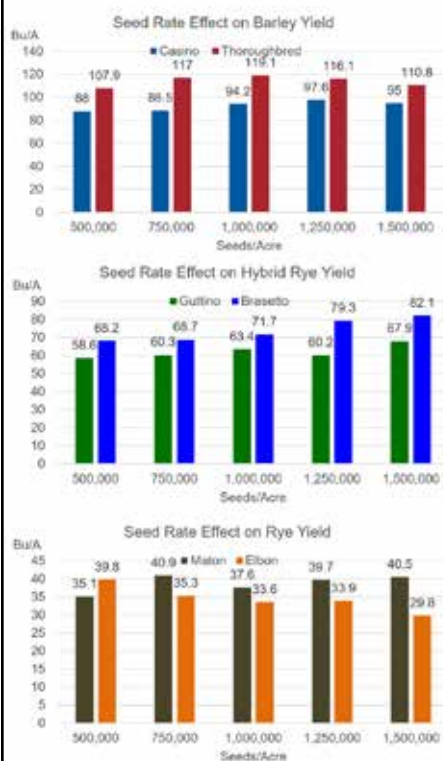
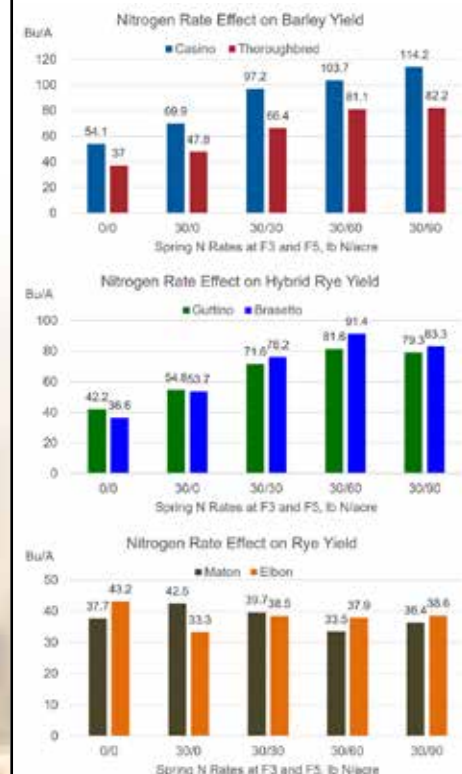


Figure 2. Nitrogen rate effect on barley, hybrid rye and rye yields. (Note the change in scales for yield.)



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2016 Research Report

Kentucky Wheat Yield Contest Winners Announced

The University of Kentucky has announced the winners of the 2016 Kentucky Wheat Yield Contest.

The top wheat yield in Kentucky, **123.01** bushels per acre, was achieved by **Kyle Bugg in Graves Co.** Bugg planted AgriMaxx 446 seed and used conventional tillage practices.

The top no-till yield was **115.94** bushels per acre submitted by **Ryan Bivens of Fresh Start Farms in LaRue Co.** Bivens planted Southern States 8340 seed.

Area winners were George Fox of Todd Co., Hendrickson Farms of Union Co., Gary Summers of Simpson Co., and Drew Langley of Hardin Co.

Full results of the contest including herbicide, fungicide, and insecticide information can be found at www.kysmallgrains.org.

State and Area winners will be recognized at the Kentucky Commodity Conference on January 19, 2017 in Bowling Green, Kentucky. Each will receive a trophy and monetary prize from the Kentucky Small Grain Growers Association.



Gifts of Grain

Donate Grain for the Small Grain Research Endowment Fund at University of Kentucky

The Kentucky Small Grain Growers Association (KySGGA) has an established research endowment fund at the University of Kentucky (UK) to ensure the advancement of production research crucial to Kentucky's grain farmers.

"To date we have directed \$2.5 million toward small grain research, and we expect that sum will continue to grow in the future," said Don Halcomb, chairman of the Kentucky Small Grain Promotion Council. "This research fund guarantees that small grain research will continue to be a priority at the University of Kentucky. Our leadership has been extremely pleased with the quality of research conducted at UK, and growers have benefited greatly from the results. The fund works only to improve our successful partnership."

Individual growers and businesses may donate to the fund, and KySGGA will match the sum of donations up to \$50,000. In addition to cash, growers and businesses may make an above the line

deductible donation of grain. Donations should be made directly to the University of Kentucky College of Agriculture for the Kentucky Small Grains Growers Association Research Endowment. Checks can be mailed to:

University of Kentucky College of Agriculture
Marci Hicks, Director of Development
E S Good Barn
1451 University Drive
Lexington, KY 40546-0097

For more information on how to make a gift of grain, contact Marci Hicks at 859.257.7200. For more information about the fund, please contact KySGGA Executive Director Laura Knoth at 800.326.0906 or by email at laura@kysmallgrains.org.