Proceedings of the 25th

Forages at KCA

Presented by:

University of Kentucky
Kentucky Cattlemen's Association
Kentucky Forage and Grassland Council
Kentucky Master Grazer

Friday, January 17, 2020
Owensboro, KY

C. Teutsch, C. Forsythe, and C. Tarr-Janes, editors

Foreword

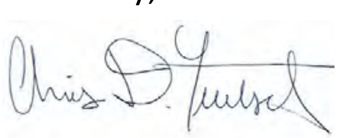
This marks the twenty-fifth consecutive year we have had a Forage Symposium at the Kentucky Cattlemen's Convention. We challenge you to consider the content of the proceedings and the discussions of the day in light of your overall forage program. It is our hope you will go away with at least one idea or practice that you can implement to improve the profitability of your operation.

On behalf of the program committee, I want to thank Mr. Dave Maples and his staff at Kentucky Cattlemen's Association for their support, assistance, and encouragement. In addition, I want to thank the Kentucky Forage and Grassland Council and the Master Grazer program for their support of this session and continued efforts to advance grazing management in the Commonwealth through high quality educational programs. I would like to express sincere gratitude to our speakers for taking time out of their busy schedules to spend the afternoon with us and share their knowledge and insights.

A very special thanks is extended to Drs. Ray Smith and Jimmy Henning for their assistance in planning this program and to Christi Forsythe and Carrie Tarr-Janes for assembling and printing these proceedings.

I encourage you to stay up-to-date with the latest forage research in Kentucky by subscribing to our on line newsletter, Forage News, by visiting www.uky.edu/ag/forage. In addition, you will find a wealth of publications and other resources to help you better manage your forage resources.

Sincerely,



Chris D. Teutsch, Program Chair

Forages at KCA

Tall Fescue: Past, Present, and Future

January 17, 2020
2:00 to 4:00 PM
Owensboro Convention Center, East Ballroom D

AGENDA

1:55 to 2:00 PM	Welcome-Dr. Chris Teutsch, UK Grain and Forage Center of Excellence
2:00 to 2:45 PM	The History of Tall Fescue-Dr. Garry Lacefield, UK Research and Education Center, Emeritus
2:45 to 3:00 PM	Tall Fescue Variety Update-Dr. Ray Smith, Plant and Soil Sciences
3:00 to 3:30 PM	Tall Fescue Toxicosis Research Update-Dr. Michael Flythe, USDA Forage-Animal Production Research Unit
3:30 to 4:00 PM	Practical Considerations for Utilizing Tall Fescue in Grazing Systems-Dr. Chris Teutsch, UK Grain and Forage Center of Excellence

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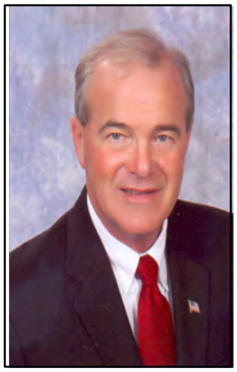
Our Speakers…

Dr. Ray Smith, Extension Professor, Univeristy of Kentucky

Dr. Ray Smith is a native of Georgia and received his undergraduate degree from Asbury University in Kentucky in 1983. After teaching high school biology for two years he entered a graduate degree program in Agronomy and Plant Breeding at the University of Georgia. From 1991-2001, Ray held a research, teaching and extension position at the University of Manitoba, Canada with a focus on alfalfa and native grass breeding, seed production and forage management. He was the Forage Extension Specialist at Virginia Tech from 2001-2004 and is now the lead faculty advisor for the UK Forage Variety testing program coordinated by Gene Olson. It is the largest forage variety testing program in the country. Ray is also the current chair of the Continuing Committee for the International Grassland Congress and past President of the American Forage and Grassland Council. He has published 43 articles in refereed journals, presented 165 papers at professional conferences, written over 120 extension publications, and given over 670 extension presentations. Ray has been the advisor for 16 master's students, 4 PhD's, 5 Post-docs, and 26 senior research students. His current extension activities include working closely with county agents and producers; conducting applied forage research for Kentucky and the transition zone; helping organize state, regional, national, and international forage conferences; and writing applied agricultural publications. His current research projects include: evaluating forage varieties for grazing tolerance and yield, developing forage production systems, pasture evaluation methods, and developing computer and time-lapse photography teaching tools.

Chris D. Teutsch, Associate Extension Professor and Forage Specialist at UK Research and Education Center Princeton, KY

Dr. Chris Teutsch grew up on a small crop and livestock farm in northeastern Ohio. After high school he spent four years in the United States Navy. Following his military service, he participated in an exchange program with Germany. During his year in Germany, he attended agricultural school and lived and worked on a German dairy farm. After returning to the United States, he completed a bachelor's and master's degree at The Ohio State University specializing in forage management. He then moved onto the University of Kentucky where completed a doctorate of philosophy in forage management and physiology. In 2000, Dr. Teutsch was a hired by Virginia Tech's Southern Piedmont Agricultural Research and Extension Center where he developed a nationally recognized research and extension program. In January 2017, Dr. Teutsch joined the extension faculty at the University of Kentucky as the new forage extension specialist located at the Research and Education Center at Princeton. Since that time he has developed the KYForages YouTube Channel and initiated the Kentucky Fencing Schools. Dr. Teutsch has received numerous awards for his work with the forage and livestock industry in Virginia and nationwide.



Dr. Garry D. Lacefield, Professor Emeritus, University of Kentucky
Dr. Lacefield is a native of McHenry, Kentucky (Ohio County) and grew up on a crop-livestock farm in the Western Kentucky Coal Field Area. After graduation from Centertown High School, he entered the U.S. Army and served 2.5 years in Germany. He received his B.S.(1970) and M.S. (1971) degrees from Western Kentucky University with a major in Agriculture and Biology. He received the Ph.D. degree from the University of Missouri in 1974.

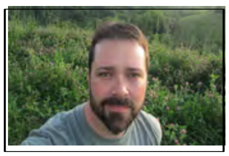
Dr. Lacefield joined the University of Kentucky staff in 1974 as Extension Forage Specialist. He retired from U.K. in March 2015 after a 41 year career.

He has authored and co-authored over 300 extension publications, papers, articles and book chapters. He is co-author of the books "Southern Forages, The Wondergrass and Forages Quotes and Concept." He developed and was senior author of a monthly newsletter and wrote a monthly column for the Kentucky . Cattlemen until his retirement. He organized the Kentucky Alfalfa Conference in 1980 and served as Chairman each year. The 35th Annual Conference was held in February 2015.

Dr. Lacefield is a member of many professional organizations including ASA, CSSA, CAST and AFGC. He serves on the Advisory Board of the Oregon Tall Fescue Commission, Oregon Clover Commission, Oregon Orchardgrass Commission and Oregon Ryegrass Commission. He received the Merit Certificate, Medallion and President's Award from the American Forage and Grassland Council, Public Service to Forage Award from the Kentucky Forage and Grassland Council and the U.K. Outstanding Extension Specialist award. He is a "Fellow" in the American Society of Agronomy and Crop Science Society of America. He was selected 1989 Alumnus of the Year by the College of Agriculture, Western Kentucky University. He received the 1991 Alfalfa Extension Award from the Certified Alfalfa Seed Council. In 1992, he received the American Society of Agronomy Agronomic Extension Education Award. He was selected as Progressive Farmer's "1993 Man of the Year in Agriculture". He was inducted into the Western Kentucky University "Hall of Distinguished Alumni" in October 1995. The Certified Alfalfa Seed Council honored him in 2001 with their Distinguished Service Award. In recognition of his leadership in the Kentucky Alfalfa Program, the Public Service to Alfalfa Award was named in his honor in 2000 by the Kentucky Forage & Grassland Council. Dr. Lacefield was inducted as an Honorary Member of the North American Alfalfa Improvement Conference in 2002 making the third Extension Forage Specialist ever inducted. The CSREES/USDA presented him with the 2008 Regional Award for Excellence in Extension and the 2015 Farm Bureau Communications Award. In 2019 he received the National Hay Associations highest award (Haymaker) and the "Voice of the Industry award" from the Oregon Seed league.

Dr. Lacefield serves on a number of state and National boards and committees and is Past President of the American Forage and Grassland Council. Dr. Lacefield has traveled and lectured throughout the U.S. and abroad. During his career he has traveled and/or lectured in all 50 states and 57 countries.

In addition to professional responsibility, he is in demand as a banquet speaker. Garry is married to the former Cheryl Cavender and has two sons, two daughter-in-laws, two granddaughters, and two grandsons.



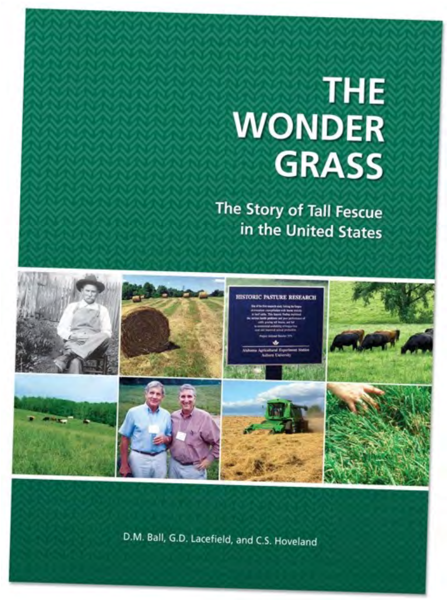
Dr. Michael Flythe is the Research Leader of the USDA-ARS Forage-Animal Production Research Unit, which is located on the University of Kentucky campus.

Michael is a rumen microbiologist and his teammates are both animal and plant scientists. Together they work with researchers at the University of Kentucky and beyond to understand and improve the health and productivity of cattle and other animals that rely on forage. Michael has a Ph.D. in microbiology from Cornell University. He is a member of the American Society for Microbiology, American Society for Animal Science and the American Forage and Grasslands Council.

The History of Tall Fescue

Dr. Garry Lacefield, Professor Emeritus, University of Kentucky
glacefie@uky.edu or 270 339-2273

In the first edition of Southern Forages we discussed over 60 different species of grasses and legumes. The only species that was given an entire chapter was Tall Fescue. Since then, Drs. Don Ball, Carl Hoveland and I have discussed the need for and desire to write a practical history of this unique grass. We waited until all three of us had retired before we finally decided to tackle this important project. We knew it would not be an easy task as much of the history has never been documented and available in University libraries. Collecting the materials required visits to Menifee County, visits with county agents, farmers, retired University professors, industry personal, magazine, newspaper articles and many discussions with individuals who had experiences with Tall Fescue over the years. After collecting and assembling information over three years the book was published during the summer of 2019 by the Oregon Tall Fescue Commission. While each person attending today's Forages at KCA will receive a complimentary copy of the "Wonder Grass," the initial News Release is included below with ordering information. From its origins in Europe, its unlikely beginnings in the United States, the controversy surrounding its initial release and issues with fescue toxicosis, "The Wonder Grass" is a fascinating examination of the history and modern uses of forage tall fescue.



The book was written by former Auburn University Professor Don Ball, former University of Kentucky professor Garry Lacefield and former University of Georgia professor Carl Hoveland. It takes a comprehensive look at the species, starting with how in 1893, a farmer in the mountains of eastern Kentucky noticed that a grass on his farm remained green during cooler months when most other plants were dormant and brown."It was a perennial, it persisted well, and his cattle readily ate it," the authors write of that first discovery of what would later become Kentucky 31 tall fescue.

The authors attribute much of the species' initial popularity to the work of William Johnstone, who served as a University of Kentucky extension agent and statewide field agent in agronomy between 1923 and 1952 and who encouraged its use on Kentucky farms. "It became clear to William Johnstone that tall fescue offered just what farmers needed:: wide adaptation, easy establishment, dependability, a long growing season, grazingtolerance, suitability for use as either a pasture or a hay crop, as well as suitability for stockpiling," the authors write. "Because of these many advantages, it eventually came to be widely referred to as The Wonder Grass."

The authors devote several pages to the controversy that surrounded the original release of the variety. And they take a close look at a subsequent issue, which was given the name fescue toxicosis and which for many years stumped researchers as to why cattle that fed on tall fescue came down with certain maladies, including "summer slump," which resulted in poor weight gain and low reproductive efficiency.
In the epilogue, the authors write: "The rich and interesting history of this grass in the United States is unique and multi-faceted, and it explains an important development in American agriculture.....Tall fescue has had an astonishing impact on our nation. It is, indeed, a Wonder Grass!"

"The Wonder Grass" was published earlier this year by the Oregon Tall Fescue Commission. To purchase the book, ($29.00 which includes postage) go to www.oregontallfescue.org/wondergrass or call the commission at 503-364-2944.

Tall Fescue Variety Update

Ray Smith
University of Kentucky Plant and Soil Sciences Department
raysmith1@uky.edu or (859) 323-1952

Tall fescue (*Festuca arundinacea*) is a productive, well-adapted, persistent, soil-conserving, cool-season grass grown on approximately 5.5 million acres in Kentucky. This grass, used for both hay and pasture, is the forage base of most of Kentucky's livestock enterprises, particularly beef cattle.

Much of the tall fescue in Kentucky is infected with an internal fungus (endophyte) that produces ergot alkaloids and results in decreased weight gains in growing ruminants and lower pregnancy rates in breeding stock, especially in hot weather. Varieties are now available that are free of this fungal endophyte or infected with a nontoxic endophyte. Varieties in the latter group are also referred to as "novel" or "friendly" endophyte varieties, because their endophyte improves stand survival without creating animal production problems.

Important Selection Considerations

Local adaptation and seasonal yield. Before purchasing tall fescue seed, make sure that the variety is adapted to Kentucky, as indicated by good performance across years and locations in replicated yield trials such as those presented in this publication. Choose high-yielding persistent varieties and varieties that are productive during the desired season of use.

Endophyte level. Seed with infection levels of less than 5 percent is regarded as endophyte-free. A statement to that effect will be displayed prominently on a green tag attached to the seed bag. If no tag is present, assume the seed is infected with the toxic endophyte. Several varieties, both with and without the endophyte, are adapted for use in Kentucky. With the new "novel endophyte" tall fescues, the seed tag should specify the infection level. Also, seed of these varieties should be handled carefully to preserve this infection, which means keeping seed cool and planting as soon as possible. "Novel endophyte" varieties need a high infection level to improve stand survival. Look for Alliance for Grassland Renewal seed quality assurance printed on each bag of novel fescue seed.

Seed quality. Buy premium-quality seed that is high in germination and purity levels and free from weed seed. Buy certified seed of improved varieties. An improved variety is one that has performed well in independent trials. The label also includes the test date (which must be within the previous nine months), the level of germination, and the amount of other crop and weed seed. Order seed well in advance of planting time to assure that it will be available when needed.

PR-774

University of Kentucky
College of Agriculture, Food and Environment
Agricultural Experiment Station

2019 Long-Term Summary of Kentucky Forage Variety Trials

G.L. Olson, S.R. Smith, J. C. Henning, and C.D. Teutsch, Plant and Soil Sciences

Introduction

Forage crops occupy approximately 7 million acres in Kentucky. Forages provide a majority of the nutrition for beef, dairy, horse, goat, sheep, and wildlife in the state. In addition, forage crops play an environmentally friendly role in soil conservation, water quality, and air quality. There are more than 60 forage species adapted to the climate and soil conditions of Kentucky. Only 10 to 12 of these species occupy the majority of the acreage, but within these species there is a tremendous variation in varieties.

This publication was developed to provide a user-friendly guide to choosing the best variety for producers based on a summary of forage yield and grazing tolerance trials conducted in Kentucky over the past 12 to 15 years. Detailed variety reports and forage management publications are available from your local county agent or at the University of Kentucky forage website at forages.ca.uky.edu by clicking on the "Forage Variety Trial" link.

Species in this Report

Red clover (*Trifolium pratense* L.) is a high-quality, short-lived, perennial legume that is used in mixed or pure stands for pasture, hay, silage, green chop, soil improvement, and wildlife habitat. This species is adapted to a wide range of climatic and soil conditions and therefore is versatile as a forage crop. Stands of improved varieties are generally productive for two to three years, with the highest yields occurring in the year following establishment. Red clover is used primarily as a renovation legume for grass pastures. It is a dominant forage legume in Kentucky because it is relatively easy to establish and has high forage quality and high yield.

White clover (*Trifolium repens* L.) is a low-growing, perennial pasture legume with white flowers. It differs from red clover in that the stems (stolons) grow along the surface of the soil and can form adventitious roots that may lead to the development of new plants. White clover is classified into ladino, Dutch, and intermediate types. The intermediate types combine the higher yield of ladino with the grazing tolerance of the Dutch types.

Alfalfa (*Medicago sativa*) has historically been the highest yielding, highest quality forage legume grown in Kentucky. It forms the basis of Kentucky's cash hay enterprise and is an important component in dairy, horse, beef, and sheep diets and wildlife habitat. Choosing a good alfalfa variety is a key step in establishing a stand of alfalfa. The choice of variety can impact yield, stand persistence, insect and disease resistance, and grazing tolerance.

Orchardgrass (*Dactylus glomerata*) is a high-quality, productive, cool-season grass that is well adapted to Kentucky conditions. This grass is used for pasture, hay, green chop, and silage, but it requires better management than tall fescue for higher yields, quality, and long stand life. It produces an open, bunch-type sod, making it very compatible with alfalfa or red clover as a pasture and hay crop or as habitat for wildlife.

Tall fescue (*Festuca arundinacea*) is a productive, well-adapted, persistent, soil-conserving, cool-season grass that is grown on approximately 5.5 million acres in Kentucky. This grass, used for both hay and pasture, is the forage base for most of Kentucky's livestock enterprises, particularly beef cattle. The predominant variety, KY31, was developed in Kentucky for long-term persistence but contains a fungal endophyte that produces alkaloids detrimental to livestock production and reproductive health. Endophyte-free tall fescue varieties produce no detrimental alkaloids, but UK research shows that they are less persistent than KY31. New novel endophyte tall fescue varieties contain safe endophytes, which enhance stand persistence but cause no detrimental animal symptoms.

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Annual ryegrass (*Lolium multiflorum*) and **perennial ryegrass** (*Lolium perenne*) are high-quality, productive, cool-season grasses used in Kentucky. Both have exceptionally high seedling vigor and are highly palatable to livestock. Annual ryegrasses (both Italian and Westerwolds type) are increasingly in use across Kentucky as more winter-hardy varieties are released and promoted. Annual ryegrass is productive for six to eight months when planted early fall (late August/September) and is used primarily for late fall and early to late spring pasture. Perennial ryegrass can be used as a short-lived hay or pasture plant and has growth characteristics similar to tall fescue. It is less persistent than other cool-season grass species. There are both diploid (two sets of chromosomes) and tetraploid (four sets of chromosomes) varieties of perennial ryegrass. Tetraploids have larger tillers and seedheads and wider leaves. Tetraploid types tend to be taller and less dense than diploid types, even in early stages of regrowth.

Diploid types produce more tillers, have better stand persistence, and are typically more tolerant to heavy grazing.

Timothy (*Phleum pratense*) is the fourth most widely sown cool-season perennial grass used in Kentucky for forage after tall fescue, orchardgrass, and Kentucky bluegrass. Timothy is primarily harvested as hay, particularly for horses. In Kentucky, timothy behaves like a short-lived perennial, with stands usually lasting two years.

Kentucky bluegrass (*Poa pratensis*) is a high-quality, highly palatable, long-lived pasture plant with limited use for hay. It tolerates close, frequent grazing better than most grasses. It has low yields and low summer production and becomes dormant and brown during hot, dry summers. Kentucky bluegrass is best suited for pastures where a dense sod is more important than high-forage production (e.g., horse pastures).

Festuloliums are hybrids between various fescues and ryegrasses with higher quality than tall fescue and improved stand survival over perennial ryegrass. Their use in Kentucky is limited because they do not survive as long as tall fescue. Newer varieties show promise where high quality and yield are more important than long-term persistence.

Bromegrasses have several advantages over tall fescue, including retaining quality as they mature and better growth during dry weather, but they are generally less well adapted in Kentucky.

Smooth bromegrass (*Bromus inermis Leyss*) is a perennial pasture and hay grass native to Europe. It has creeping underground stems or rootstocks from which the leafy stems arise. Smooth bromegrass is palatable to all classes of livestock, from emergence to the heading stage. Meadow bromegrass (*Bromus biebersteinii Roem. & Schult*) is a native of southeastern Europe and the adjacent Near East. It resembles smooth bromegrass but has only short rhizomes or none at all. Meadow bromegrass is densely tufted and has a similar growth habit to tall fescue. Hybrid bromegrasses are a cross between smooth and meadow bromegrasses. Alaska bromegrass (*Bromus sitchensis*), also called Sitka bromegrass, is a long-lived perennial bunchgrass that will actively grow at moderate rates during the spring and summer season. It does not spread by rhizomes and is more suited to environments with harsh winters. Prairie bromegrass (*Bromus wildenowii*) is a tall, cool-season, leafy short-lived, perennial, deep-rooted bunchgrass. It was introduced from South America. Seedheads are produced throughout the growing season, and to maintain productive stands for several years, it is necessary to manage at least one growth cycle each year for seed production and natural reseeding. Some prairie bromegrasses are susceptible to winterkill. Mountain bromegrass (*Bromus marginatus*) is native to North America from Alaska to northern Mexico, where it can be found in many types of habitat. It is a short-lived, perennial, cool-season, sod-forming grass.

Sudangrass *(Sorghum bicolor* ssp. *drummondi)* is a rapidly growing annual grass in the sorghum family. It is medium yielding and well suited for grazing or hay because of its smaller stem size. Sudangrass regrows quickly after harvest and can be grazed several times during summer and early fall.

Sorghum-sudangrass hybrids are more vigorous and slightly higher yielding than sudangrass. A larger stem size makes these hybrids less useful for hay; therefore, they are commonly used for baleage and grazing.

Forage sorghum is used primarily as silage for livestock and is typically a one cut crop. It grows 6 to 12 feet tall and is typically harvested when the seed is in the milk to soft dough stage.

Pearl millet *(Pennisetum glaucum)* is the most widely grown type of millet. It is well adapted to production systems characterized by drought, low soil fertility, and high temperature. It is higher yielding than foxtail millet and regrows rapidly after harvest if an 8- to 10-inch stubble height is left. Dwarf varieties, which are leafier and better suited for grazing, are available.

The brown midrib or BMR trait is outward expression of a genetic mutation in forage sorghum, sorghum-sudangrass, sudangrass, and pearl millet. In most cases, plants possessing the BMR trait contain less or altered lignin, making the plant more digestible and increasing animal production. Therefore, it is desirable to seed summer annuals that have the BMR trait in addition to other desirable characteristics like high yield. With BMR varieties, the midrib of the leaf appears brown or tannish in color.

Teff, also referred to as summer lovegrass (*Eragrostis tef*), is a warm-season annual grass native to Ethiopia and has been used as a grain crop for thousands of years. Recently, there has been considerable interest in teff as a forage crop. It is high quality, palatable, and fine stemmed and therefore makes excellent hay.

Crabgrass (*Digitaria sanguinalis*) is a warm season annual which propagates by seed. It is adapted to many soil types. Crabgrass can be utilized by either grazing or haying and is one of the highest quality warm season forages at a vegetative stage.

Important Selection Considerations

Local adaptation and seasonal yield. Choose a variety/species that is adapted to your region of Kentucky, as indicated by good performance across years and locations in replicated yield trials. Also, look for varieties that are productive in the desired season of use. For management recommendations, check with your county Extension agent or see the forage website at www.uky.edu/Ag/Forage.

The following comprehensive bulletins may be especially useful:

- Grain and Forage Crop Guide for Kentucky (AGR-18)
- Establishing Forage Crops (AGR-64)
- Rotational Grazing (ID-143)
- Extending Grazing and Reducing Stored Feed Needs (AGR-199)
- Forage Identification and Use Guide (AGR-175)
- Lime and Fertilizer Recommendations (AGR-1)
- Sudangrass and Sorghum-Sudangrass Hybrids (AGR-234)
- Pearl Millet (AGR-231)
- Forage Sorghum (AGR-230
- Crabgrass (AGR-232)

Seed quality. Buy premium-quality seed that is high in germination and purity and free from weed seed. Buy certified seed or proprietary seed of an improved variety. An improved variety is one that has performed well in independent trials. Other information on the label will include the test date (which must be within the past nine months), the level of germination, and the amount of other crop and weed seed. Order seed well in advance of planting time to assure that it will be available when needed.

Description of the Tests

Yield trials. Plots were seeded at the recommended seeding rate per acre and were planted into a prepared seedbed with a disk drill. Plots were 5 feet by 15 feet in a randomized complete block design with four replications. Grass plots were typically fertilized with 60 pounds of actual N per acre in March, after the first cutting, and again in late summer for a total of up to 180 pounds per acre per season. No nitrogen was applied to the legume trials. Other fertilizers (lime, P, and K) were applied as needed according to the University of Kentucky soil test recommendations. The tests were harvested using a sickle-type forage plot harvester to simulate a spring cut hay/summer grazing/fall stockpile management system. Fresh weight samples were taken at each harvest to calculate percent dry matter production. Management practices for establishment, fertility, weed control, and harvest timing were in accordance with University of Kentucky recommendations.

Grazing trials. Plots were 5 feet by 15 feet in a randomized complete block design, with each variety replicated six times. Plots were seeded at the recommended seeding rate per acre and were planted into a prepared seedbed using a disk drill. Grazing was continuous from April to October.

Plots were grazed down to below 4 inches quickly and were maintained at 2 to 4 inches (sometimes less) for the remainder of the grazing season. Supplemental hay was fed during periods of slowest growth. Visual ratings of percent stand were made in the fall several weeks after the cattle were removed to check stand survival after the grazing season and in the spring prior to grazing to check on winter survival and spring growth. Because trials were seeded in rows, persistence ratings were based on density within a row and not total ground cover. Grass plots were fertilized with 60 pounds of actual N per acre in the spring and 30 to 40 pounds of actual N in early November after cattle or horses were removed from the pasture. Other fertilizers (lime, P, and K) were applied as needed according to the University of Kentucky soil test recommendations. Management practices for establishment, fertility, and weed control were in accordance with University of Kentucky recommendations.

Results and Discussion

These tables summarize long-term yield and stand persistence data of commercial varieties that have been entered in the University of Kentucky trials. The data are listed as a percentage of the mean of the commercial varieties entered in each specific trial. In other words, the mean for each trial is 100 percent; varieties with percentages over 100 yielded better than average, and varieties with percentages less than 100 yielded lower than average. For the grazing trials, varieties with percentages over 100 persisted better than average, and varieties with percentages less than 100 persisted less than average. Also in the grazing trials, the alfalfa varieties were compared to Alfagraze, and the fescue varieties were compared to KY31+ instead of the mean of all the commercial varieties. In the horse grazing trials, the fescue varieties were compared to KY31- instead of the mean of all the commercial varieties. Direct, statistical comparisons of varieties cannot be made using the summary tables, but these comparisons do help to identify varieties for further consideration. Varieties that have performed better than average over many years and at several locations have very stable performance; others may have performed very well in wet years or on particular soil types. These details may influence variety choice, and the information can be found in the yearly reports. See the footnote in each table to determine which yearly report should be referenced.

Summary

Selecting a good forage variety is an important first step in establishing a productive stand of forage. Proper management, beginning with seedbed preparation and continuing throughout the life of the stand, is necessary for even the highest-yielding variety to produce to its genetic potential. For more detailed information on yield and grazing tolerance within species, go to individual 2019 reports on the forage website. See below for specific reports. The forage website (forages.ca.uky.edu) contains all reports from 2001 through 2019.

Yield and Grazing Tolerance Reports

Individual forage species reports can be found at www.uky.edu/Ag/Forage/ForageVarietyTrials2.htm.

- 2019 Alfalfa Report (PR-763)
- 2019 Red and White Clover Report (PR-764)
- 2019 Orchardgrass Report (PR-765)
- 2019 Tall Fescue and Bromegrass Report (PR-766)
- 2019 Timothy and Kentucky Bluegrass Report (PR-767)
- 2019 Annual and Perennial Ryegrass and Festulolium Report (PR-768)
- 2019 Alfalfa Grazing Tolerance Report (PR-769)
- 2019 Red and White Clover Grazing Tolerance Report (PR-770)
- 2019 Cool-Season Grass Grazing Tolerance Report (PR-771)
- 2019 Cool-Season Grass Horse Grazing Report (PR-772)
- 2019 Annual Grass Report: Warm Season and Cool Season (Cereals) (PR-773)
- 2019 Long-Term Summary of Kentucky Forage Variety Trials (PR-774)

About the Authors

G.L. Olson is a research specialist, S.R. Smith and J.C. Henning are Extension professors and forage specialists, and C.D.Teutsch is an Extension associate professor and forage specialist.

Table 1. Summary of Kentucky white clover yield trials 2002-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

			Lexington																Princeton		Quicksand	Eden Shale	
			02[1,2]	03	04	06	07	08	09	10	11	12	13	14	15	16	17	18	03	05	03	03	Mean[3]
Variety	**Type**	**Proprietor**	3yr[4]	3yr	3-yr	2-yr	2-yr	3yr	2yr	3yr	3yr	2yr	3yr	3yr	2yr	3yr	3yr	2-yr	3yr	3-yr	2yr	2yr	(#trials)
Advantage	Ladino	Allied Seed, L.L.C.		125																		106	116(2)
Alice	Intermediate	Barenbrug USA												105	120	78	94	93		86			96(6)
Avoca	Dutch	DLF Pickseed				59														82			71(2)
Barblanca	Intermediate	Barenbrug USA		92																			–
Bombus	Ladino	Hood River														111	115						113(2)
Brianna	Ladino	DLF Pickseed														103	100						102(2)
CA ladino	Ladino	Public	100		124														103		98		106(4)
Colt	Intermediate	Seed Research of OR		90		57														114			87(3)
Common	Dutch	Public	100				53			98										78			82(4)
Companion	Ladino	Oregro Seeds						87	94	92													91(3)
Crescendo	Ladino	Cal/West Seeds	105			140														109			118(3)
Crusader II	Intermediate	Allied Seed, L.L.C.								90	50	54	75										67(4)
Excel	Ladino	Allied Seed, L.L.C.			100																		–
Domino	Ladino	Grassland Oregon												87									–
Durana	Intermediate	Pennington		94		94	88	82	85	97	93	84	97	89	78	99	89	73	87	83	101	95	89(18)
GWC-AS10	Ladino	Ampac Seed									102												–
Insight	Ladino	Allied Seed, L.L.C.				128																	–
Ivory	Intermediate	Cebeco	96																				–
Ivory II	Intermediate	DLF Pickseed					86			101	127												105(3)
Jumbo	Ladino	Ampac Seed	93																				–
Jumbo II	Ladino	Ampac Seed									121	101			99								107(3)
Kakariki	Ladino	Luisetti Seeds															108						–
Kopu II	Intermediate	Ampac Seed	97			97	95	95	103	96	80	90											94(8)
KY Select	Intermediate	KY Ag. Exp. Station									98	95											97(2)
Neches	Intermediate	Barenbrug USA													79								–
Ocoee	Ladino	Allied Seed, L.L.C.								89	74												82(2)
Patriot	Intermediate	Pennington		103		87	104	113	95	117	117	99	82	78	88	100	93	92	104	100	98	99	98(18)
Pinnacle	Ladino	Allied Seed, L.L.C.				120														111			116(2)
Rampart	Ladino	Allied Seed, L.L.C.					80	89	97	83													87(4)
Regal	Ladino	Public	99	96	92		125	100	116	118	129	147	123						107	100	104		112(13)
RegalGraze	Ladino	Cal/West Seeds				127	140	102	103						111	119	112	120					117(8)
Renovation	Intermediate	Smith Seed Services												83	85	91							86(3)
Resolute	Intermediate	Southern States				63																	–
RIVENDEL	–	DLF Pickseed														59	88						74(2)
Seminole	Ladino	Saddle Butte Ag. Inc			108	70	79							114									93(4)
Super Haifa	Intermediate	Allied Seed, L.L.C.			77																		–
Tillman II	Ladino	Caudill Seed	103																				–
WBDX	Dutch	Saddle Butte Ag. Inc									72												–
Will	Ladino	Allied Seed, L.L.C.	107			162	150	132	107	119	137	130	123	143	140	140	102	122		136			128(15)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2010 was harvested three years, so the final report would be "2012 Red and White Clover Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Mean only presented when respective variety was included in two or more trials.
4 Number of years of data.

Table 2. Summary of Kentucky red clover yield trials 2001-2019 (yield shown as a percentage of the mean of the named commercial varieties in the trial).

		Lexington															Princeton							Quicksand					Eden Shale			
		01[1,2]	02	03	04	06	08	09	10	11	12	13	14	15	16	17	03	05	08	09	11	13	15	01	03	05	08	10	03	08	10	Mean[3]
Variety	**Proprietor**	3yr[4]	3yr	3yr	3yr	2yr	3yr	2yr	3yr	3yr	2yr	3yr	3yr	3yr	3yr	2-yr	3yr	2yr	3yr	2yr	2yr	3yr	3yr	2yr	2yr	3yr	3yr	3yr	2yr	3yr	3yr	(#trials)
AA117ER	ABI Alfalfa					110												87								92						96(3)
Bearcat	Brett Young Seeds														122																	–
Cinnamon Plus	Southern States			97		109	112	123	117	94	116	101	98					112	102	102	100	100				103	108	124		108	122	108(19)
Common O	Public								96	97	63	84	92	70	49	80						67	91					72			77	78(12)
Dominion	Seed Research of OR					102												95	102							93				109		100(5)
Duration	Cisco Co.	86	100																					106								97(3)
Emarwan	Turf-Seed				91			117												106				101				99				103(5)
Evolve	DLF Pickseed USA													98	96	102							99									99(4)
FF9615	LaCrosse Seed														110	104																107(2)
Freedom!	Barenbrug USA	127	123	96	118	91	100	108	106	109	99	101	97	107	114	113	110	136	107	116	95	107	104	111	103	119	106	115	102	100	140	109(30)
Freedom!MR	Barenbrug USA		118	115	102	114	114		112								106	101		108					94	111		128	118		125	112(14)
FSG 402	Allied Seed											104										114										108(2)
FSG 9601	Allied Seed				89																											–
Gallant	Turner Seed											101		112		105						107	101									105(5)
GA9908	Smith Seed															93																–
Juliet	Caudill Seed							84											93	90										84	59	82(5)
Kenland (certified)[5]	KY Ag. Exp. Station	127	139	118	117	117	99	111	99	116	114	109	103	105	119	108	102	92	113	106	106	115	100	111	88	105	104	123	98	110	138	110(30)
Kenland (uncertified)	Public								82						41				74					83				67		66	92	72(7)
Kenton	KY Ag. Exp. Station	119	109	90	95	112	121										95	105	112	94				93	99	106	98		98			103(15)
Kenway	KY Ag. Exp. Station	111	134		97	119	118											94	106	103				100		103	94					107(11)
LS 9703	Lewis Seed										107											86										97(2)
Morning Star	Cal/West Seeds																		90											90		90(2)
Plus II	Allied Seed						130																				97					114(2)
Quinequeli	Caudill Seed							92												80											57	76(3)
Red Gold	Proseeds Marketing					81													89											102		91(3)
Red Gold Plus	Turner Seed	97			95																			98								97(3)
RedlanGraze II	Americas Alfalfa	91	104																					93								96(3)
Redland Max	ABI Alfalfa				95																											–
Robust	Blu Moon Farms															78																–
Robust II	Seed Research of OR																		110											108		109(2)
Rocket	Seed Research of OR																		106											108		107(2)
Rojo Diablo	Great Plains	99																						101								100(2)
Royal Red	Southern States		91																													–
Rustler	Oregro Seeds						83		101	84																	94	99			104	94(6)
Sienna	Great Plains	91																						106								99(2)
Solid	Production Service		98	84		79											87	86								76			84			85(7)
SS-0303RCG	Southern States												103	109	150	117						103	104									114(6)
Starfire	Ampac Seed		99																													–
Starfire II	Cal/West & Ampac						101		111				107						112								110	112		115	111	110(8)
Triple Trust 350	ABI Alfalfa					101												92								92						95(3)
Vesna	DLF-Jenks	53																						96								75(2)
Wildcat	Brett Young Seeds							101												107								98				102(3)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2010 was harvested three years, so the final report would be "2012 Red and White Clover Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Mean only presented when respective variety was included in two or more trials.
4 Number of years of data.
5 Kenland certified-variety guaranteed since seed tag labeled with blue certified seed tag. Kenland uncertified-likely common red clover seed since no blue certified seed tag.

Table 3. Summary of Kentucky alfalfa yield trials 2004-2019 (yield shown as a percentage of the mean of the commercial varieties in the test).

		Variety Characteristics[1]						Lexington								Princeton					
			Disease Resistance[2]					04[3,4]	06	08	11	12	15	16	17	05	08	09	11	13	
Variety	Proprietor	FD	Bw	Fw	An	PRR	APH	5yr[6]	7yr	6yr	6yr	6yr	5yr	4yr	3yr	5yr	5yr	6yr	4yr	3yr	Mean[5] (# trials)
A-4440	Producers Choice	4	HR	HR	HR	HR	HR			100						99					100(2)
A 5225	Producers Choice	5	HR	HR	HR	HR	R			104							107				106(2)
Adrenalin	Brett Young Seeds	4	HR	HR	HR	HR	HR											104			–
Ameristand 403T	America's Alfalfa	4	HR	HR	HR	HR	HR		99	91	102	94					100	101	107	99	99(8)
Ameristand 403T Plus	America's Alfalfa	4	HR	HR	HR	HR	HR						104	102	105			94			101(4)
Ameristand 407TQ	America's Alfalfa	4	HR	HR	HR	HR	HR											103	104		104(2)
Ameristand 427TQ	America's Alfalfa	4	HR	HR	HR	HR	HR						109								–
Anchormate	ProSeed Marketing	–	–	–	–	–	–			100											–
Arc (certified)	Public	4	LR	MR	HR	–	–	76			93	92				95	86			95	90(6)
Archer III	America's Alfalfa	5	HR	HR	HR	HR	HR											106			–
Baralfa 53HR	Barenbrug USA	5	HR	R	HR	HR	HR									104					–
Buffalo	Public	–	–	–	–	–	–	82	86	80	89		85			95	78	87		91	86(9)
Bulldog-505	Univ. of GA	5	–	HR	–	R	–					103		96	92			96		103	98(5)
Caliber	Beck's Hybrids	4	HR	HR	HR	HR	HR					99	105	97	101				99		100(5)
Charger	Beck's Hybrids	5	HR	HR	HR	HR	HR												106		–
Contender	Beck's Hybrids	5	HR	HR	HR	HR	HR						101	104	99						101(3)
DKA 43-13	Monsanto	4	HR	HR	HR	HR	HR			102											–
DKA 50-18	Monsanto	5	HR	HR	HR	HR	HR			110											–
DG4210	Crop Production	4	HR	HR	HR	HR	HR												101	103	102(2)
Dynagro Everlast	United Agr. Prod.	4	HR	HR	HR	HR	R									101					–
Enforcer	Southern States	4	HR	HR	HR	HR	HR	90													–
Evermore	Southern States	5	HR	HR	HR	HR	HR					100		102	106						103(3)
Expedition	NEXGROW	5	HR	HR	R	RR	R	107	112							96					105(3)
Feast +EV	NEXGROW	3	HR	HR	HR	R	HR	106													–
Fierce	Beck's Hybrids	4	HR	HR	HR	HR	HR						102		101						102(2)
FSG 403LR	Farm Sci. Genetics	4	HR	HR	HR	HR	HR													102	–
FSG 408DP	Allied Seeds	4	HR	HR	HR	HR	R	105									110				108(2)
FSG 415BR	Allied Seeds	4	HR	HR	HR	HR	HR							103							–
FSG 424	Farm Sci. Genetics	4	HR	HR	HR	HR	HR													109	–
FSG 426	Farm Sci. Genetics	4	HR	HR	HR	HR	HR						103								–
FSG 524	Farm Sci. Genetics	5	HR	HR	HR	HR	HR													96	–
FSG 528SF	Lewis Seed Co.	5	HR	R	HR	HR	R			107											–
GA-497HD	Legacy Seeds	5	HR	HR	HR	HR	HR							104							–
GA-535	Pref. Alf. Genetics	5	HR	HR	HR	HR	HR													107	–
Genoa	NEXGROW	4	HR	HR	HR	RR	HR	112		99						98	118				107(4)
Gunner	Croplan Genetics	5	HR	HR	HR	HR	HR												103		–
KingFisher 243	Cal/West	5	HR	HR	HR	HR	HR											98			–
Kingfisher 4020	Legacy Seeds	4	HR	HR	HR	HR	HR				101										–
L447HD	Legacy Seeds	4	HR	HR	HR	HR	HR		105												–
L449Aph2	Legacy Seeds	4	HR	HR	HR	HR	HR												97		–
L455HD	Legacy Seeds	4	HR	HR	HR	HR	HR													102	–
Lancer	Allied Seeds	4	HR	HR	HR	HR	HR												101		–
LegenDairy 5.0	Croplan Genetics	3	HR	HR	HR	HR	HR		99							103					101(2)
Mariner III	Allied Seeds	4	HR	HR	HR	HR	HR										99				–
Optimus	Brett Young Seeds		HR	HR	HR	HR	HR													98	–
PerForm	Dairyland Research	4	HR	HR	HR	HR	HR		106												–

Continued

Table 3. Summary of Kentucky alfalfa yield trials 2004-2019 (yield shown as a percentage of the mean of the commercial varieties in the test).

		Variety Characteristics[1]						Lexington								Princeton					
			Disease Resistance[2]					04[3,4]	06	08	11	12	15	16	17	05	08	09	11	13	Mean[5]
Variety	Proprietor	FD	Bw	Fw	An	PRR	APH	5yr[6]	7yr	6yr	6yr	6yr	5yr	4yr	3yr	5yr	5yr	6yr	4yr	3yr	(# trials)
PGI 459	Producers Choice	4	HR	HR	HR	HR	R			102											–
Phirst	UniSouth Genetics	4	HR	HR	HR	HR	R									105					–
Phoenix	Southern States	5	HR	HR	HR	HR	R	113	99	102		105					101		94		102(6)
Radiance HD	Ampac Seed/Cisco	4	HR	HR	HR	HR	HR					101						105	103		103(3)
Radiant-AM	Ampac Seed	4	HR	HR	HR	HR	HR		97												–
Rebound 5.0	Croplan Genetics	4	HR	HR	HR	HR	HR			103								103			103(2)
Rebound 6.0	Croplan Genetics	4	HR	HR	HR	HR	HR				104								101		103(2)
Rebound 6XT	Croplan Genetics	4	HR	HR	HR	HR	HR							102							–
Reward II	PGI Alfalfa	4	HR	HR	R	HR	R									103					–
Saranac AR (certified)	Public	4	MR	R	HR	LR	–	77	85	86	91	97	92	93	95	95	88	92	82	97	90(13)
TripleTrust 450	ABI Alfalfa	5	HR	HR	HR	HR	HR									100					–
TripleTrust 500	Central Farm Supply	5	HR	HR	HR	HR	HR				108										–
USG 681HY	UniSouth Genetics	6	HR	HR	HR	HR	–										113				–
Vernal	Public	2	R	MR	–	–	–									95					–
Withstand	Southern States	4	HR	HR	HR	HR	HR		100	90		96					100		87		95(5)
WL 343HQ	W-L Research	4	HR	HR	HR	HR	HR		101	110							100				104(3)
WL 354HQ	W-L Research	4	HR	HR	HR	HR	HR												115		–
WL 357HQ	W-L Research	5	HR	HR	HR	HR	HR	123								106					115(2)
WL 363HQ	W-L Research	5	HR	HR	HR	HR	HR			105	103							105			104(3)
WL 365HQ	W-L Research	5	HR	HR	HR	HR	HR							97							–
4030	Brett Young Seeds	4	HR	HR	HR	HR	HR					104									–
53H92	Pioneer	3	HR	HR	HR	HR	HR				95										–
54Q32	Pioneer	4	HR	HR	HR	HR	HR				99										–
55V48	Pioneer	5	HR	HR	HR	HR	HR				102										–
55V50	Pioneer	5	HR	R	Hr	HR	HR					110								105	108(2)
6400HT	NEXGROW	4	HR	HR	HR	HR	HR	108													–
6415	NEXGROW	4	HR	HR	HR	HR	HR									103					–
6417	NEXGROW	4	HR	HR	HR	HR	HR			105											–
6422Q	NEXGROW	4	HR	HR	HR	HR	HR				112							102			107(2)
6552	NEXGROW	5	HR	HR	HR	HR	HR			105											–

1 Variety characteristics: FD = fall dormancy, Bw = bacterial wilt, Fw = fusarium wilt, An = anthracnose, PRR = phytophthora root rot, APH = aphanomyces root rot. Information provided by seed companies.

2 Disease resistance: S = susceptible, LR = low resistance, MR = moderate resistance, R = resistance, HR = high resistance. More detailed disease and insect resistance ratings at www.alfalfa.org/pdf/2019_Alfalfa_Variety_Leafllet.pdf.

3 Year trial was established.

4 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific test. For example, the Lexington trial planted in 2008 was harvested for six years, so the final yield report would be "2013 Alfalfa Report" archived in the UK Forage website at forages.ca.uky.edu.

5 Mean only presented when respective variety was included in two or more trials.

6 Number of years of data.

Table 4. Summary of Kentucky Roundup Ready alfalfa yield trials 2011-2019 (yield shown as a percentage of the mean of the commercial varieties in the test).

		Variety Characteristics[1]						Lexington			Princeton			Quicksand	
			Disease Resistance[2]					12[3,4]	15	16	11	13	15	14	Mean[5]
Variety	**Proprietor**	**FD**	**Bw**	**Fw**	**An**	**PRR**	**APH**	**6yr[6]**	**5yr**	**3-yr**	**5yr**	**4yr**	**2yr**	**2yr**	**(# trials)**
Alfagraze 300 RR	America's Alfalfa	3	HR	R	HR	HR	HR	95	95	101	93	99	93		96(6)
Alfagraze 600 RR	America's Alfalfa	6		R	HR	R	R		99				85	93	92(3)
Ameristand 405T RR	America's Alfalfa	4	HR	HR	HR	HR	HR	100	101	91	97	100	98	93	97(7)
Ameristand 433T RR	America's Alfalfa	3	HR	R	R	HR	HR	92	98	100		95	96	107	98(6)
Ameristand 445TQ RR	America's Alfalfa	4	HR	HR	HR	HR	HR	105	104			100			103(3)
AphaTron RR	Croplan Genetics	4	HR	HR	HR	HR	HR	99				98			99(2)
Consistency 4.10 RR	Croplan Genetics	4	HR	HR	HR	HR	HR	101			102				102(2)
DKA-41-18 RR	Monsanto	4	HR	HR	HR	HR	HR	100			101		100		100(3)
DKA 44-16 RR	Monsanto	4	HR	HR	HR	HR	HR	104				100			102(2)
Stratica RR	Croplan Genetics	4	HR	HR	HR	HR	HR	97		104		96			99(3)
Tonnica RR	Crop Genetics	5	HR	HR	HR	HR	HR	105				101			103(2)
WL 355 RR	W-L Research	4	HR	HR	HR	HR	HR	99			102		110		104(3)
WL 356HQ RR	W-L Research	5	HR	HR	HR	HR	HR	100	98			96			98(3)
WL 372HQ RR	W-L Research	5	HR	HR	HR	HR	HR	102				106			104(2)
428 RR	Allied Seed	4	HR	HR	HR	HR	HR		99	99		104		111	103(4)
54R02 RR	Dupont Pioneer	4	HR	HR	HR	HR	HR	97	108	96	104		102	97	101(6)
55VR06 RR	Dupont Pioneer	5	HR	R	Hr	HR	HR		94					99	97(2)
55VR08 RR	Dupont Pioneer	5	–	HR	HR	HR	HR		104	109			110		108(3)
6516R RR	NEXGROW	5	HR	–	HR	HR	HR	106				109			108(2)

1 Variety characteristics: FD = fall dormancy, Bw = bacterial wilt, Fw = fusarium wilt, An = anthracnose, PRR = phytophthora root rot, APH = aphanomyces root rot. Information provided by seed companies.
2 Disease resistance: S = susceptible, LR = low resistance, MR = moderate resistance, R = resistance, HR = high resistance. More detailed disease and insect resistance ratings at www.alfalfa.org/pdf/2019_Alfalfa_Variety_Leaflet.pdf.
3 Year trial was established.
4 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific test. For example, the Princeton trial planted in 2011 was harvested for five years, so the final yield report would be "2015 Alfalfa Report" archived in the UK Forage website at forages.ca.uky.edu.
5 Mean only presented when respective variety was included in two or more trials.
6 Number of years of data.

Table 5. Summary of Kentucky tall fescue yield trials 2002-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

			Lexington											Princeton							Quicksand				
	Endophyte		03[2,3]	05	07	09	11	12	13	14	15	16	17	02	04	06	08	10	12	15	03	05	13	16	Mean[4]
Variety	Status[1]	Proprietor	2-yr[5]	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	2-yr	4-yr	3-yr	3-yr	(#trials)
Atlas Select	free	ProSeeds Marketing															95								–
Aprilia	free	ProSeeds Marketing															93								–
Baguala	free	Allied Seed									92									96					94(2)
BarElite	free	Barenbrug USA			96		100											92							95(3)
Bariane	free	Barenbrug USA	87	99																		95			94(3)
Barolex	free	Barenbrug USA		90																					–
BarOptima PLUS E34	novel	Barenbrug USA		122	99		107	108	102	99	113	99	91					99	100	96			93	118	103(14)
Bronson	free	Ampac Seed		88	97	105	102	99	99			100						101	91	103		102			99(11)
Brutus	free	Saddle Butte Ag. Inc.								90															–
Bull	free	Improved Forages	98	102				100						104					99		97		95		99(7)
Cajun II	free	Smith Seed Services					97		105	99	99	98	106					101		104			90	96	101(10)
Cowgirl	free	Rose-AgriSeeds						94									102	100	98						99(4)
Dominate	free	Allied Seed									90									99					95(2)
Drover	free	Barenbrug USA								105	120														113(2)
DuraMax GOLD	novel	DLF Pickseed					102									106									104(2)
Enhance	free	Allied Seed					93								107										100(2)
Estancia ArkShield	novel	Mountain View Seeds	102					106				96		101					102					103	102(6)
Festival	free	Pickseed West													102										–
Flourish	free	Allied Seed						92											101						97(2)
FSG 402TF	free	Farm Science Genetics									92									103					98(2)
Goliath	free	Ampac Seed				100			104									99							101(3)
HyMark	free	Fraser Seeds					91				104						102			103					100(4)
Jesup EF	free	Pennington Seed					98	105										103	100						102(4)
Jesup MaxQ	novel	Pennington Seed		98	101	110	103	100	93	106	102	111	107	94			95	100	98	98	100	102	100	116	102(19)
KENHY	free	KY Ag. Exp. Station													89										–
Kentucky 32	free	Oregro Seeds					93	94		101							98	94	101						96(6)
Kora Protek	novel	DLF Pickseed										101												86	94(2)
KY31+	toxic	KY Ag. Exp. Station	112	108	102	102	93	95	103	100	99	103	98	104		104	93	112	101	92	98	110	110	110	102(21)
Lacefield MaxQ II	novel	Pennington Seed			109				97	104	93	92	90			101	106			105			113	102	101(11)
Martin2 Protek	novel	DLF Pickseed					104					96												106	102(3)
Nanryo	free	Jap. Grassland ForageSeed/			96																				–
Noria	free	ProSeeds Marketing			98																				–
Payload	free	Brett Young										89												111	100(2)
RAD-ERF50	free	Radix Research, Inc.															113								–
Savory	free	DLF Pickseed														91									–
Seine	free	Advanta Seeds													96										–
Select	free	Southern States	94	99	99	98	90	100	97	103	97	102		97	105	102	105	99	100	99	102	91	99	86	98(21)
SS-0705TFSL	free	Southern States								99	99	106	107							103				101	103(6)
Stockman	free	Seed Research of OR	108												101	97					105				103(4)
Teton II	free	Mountain View Seeds					107	105		96		103							99					91	100(6)
Texoma MaxQ II	novel	Pennington Seed		95																					–
TF0203G	free	Seed Research of OR			87																				–

Continued

Table 5. Summary of Kentucky tall fescue yield trials 2002-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

			Lexington											Princeton							Quicksand				
			03[2,3]	05	07	09	11	12	13	14	15	16	17	02	04	06	08	10	12	15	03	05	13	16	
Variety	Endophyte Status[1]	Proprietor	2-yr[5]	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	2-yr	4-yr	3-yr	3-yr	Mean[4] (#trials)
Tower	free	DLF Pickseed										101												91	96(2)
Tower Protek	novel	DLF Pickseed					98					104												81	94(3)
Tuscany	free	Forage Genetics																							–
Tuscany II	free	Seed Research of OR						97								98			106						100(3)
5CAN	free	Brett Young				86																			–

1 Free varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
2 Year trial was established.
3 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested two years, so the final report would be "2015 Tall Fescue Report" archived in the UK Forage website at forages.ca.uky.edu.
4 Mean only presented when respective variety was included in two or more trials.
5 Number of years of data.

Table 6. Summary of Kentucky orchardgrass yield trials 2002-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

		Lexington											Princeton							Quicksand					
		2003[1,2]	2006	2007	2009	2011	2012	2013	2014	2015	2016	2017	2002	2004	2006	2008	2010	2012	2015	2003	2005	2010	2013	2016	
Variety	Proprietor	3-yr[4]	4-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	3-yr	4-yr	3-yr	3-yr	3-yr	Mean[3] (#trials)
Albert	Oregro Seeds										99													98	99(2)
Aldebaran	DLF Pickseed											103													–
Alpine II	Mountain View Seeds										106														–
Ambassador	DLF Pickseed													95											–
Ambrosia	American Grass Seed Prod.														90										–
Benchmark	Southern States												113												–
Benchmark Plus	Southern States		100	108	105	106	97	109	104				107		107	104	102	107		107	102	94	102		104(16)
Berta	Mountain View Seeds											88													–
Bounty	Allied Seed		101																		98				100(2)
Century	Seed Research of Oregon		98																		104				101(2)
Checkmate	Seed Research of Oregon			102			117											106							108(3)
Christoss	Proseeds Marketing			92																					–
Command	Seed Research of Oregon													87											–
Crown	Donley Seed				97								101			105									101(3)
Crown Royale Plus	Donley Seed												108							97					103(2)
Devour	Mountain View Seeds										98														–
Echelon	DLF Pickseed										99													113	106(2)
Elise	Rose-AgriSeed						86									98		98							94(3)
Endurance	DLF Pickseed										102				104									82	96(3)
Extend	Allied Seed					107								100			105					108			105(4)
Hallmark	James VanLeeuwen	102											103	98						96					100(4)
Harvestar	Columbia Seeds		91	97				94							106						100		102		100(6)
Haymaster	Southern States		94			102															97				98(3)
Haymate	Southern States												106							103					105(2)

Continued

Table 6. Summary of Kentucky orchardgrass yield trials 2002-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

		Lexington											Princeton							Quicksand					
		2003[1,2]	2006	2007	2009	2011	2012	2013	2014	2015	2016	2017	2002	2004	2006	2008	2010	2012	2015	2003	2005	2010	2013	2016	Mean[3]
Variety	**Proprietor**	3-yr[4]	4-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	3-yr	4-yr	3-yr	3-yr	3-yr	(#trials)
Icon	Seed Research of Oregon		105																		98				102(2)
Inavale	DLF Pickseed									99	94								97					106	99(4)
Intensiv	Barenbrug	102																							–
Lazuly	Proseeds Marketing															97									–
LG-31	DLF Pickseed													92											–
Lyra	Hood River Seed									90		80							97						89(3)
Megabite	Turf-Seed															106									–
Olathe	DLF Pickseed									111	104								112					89	104(4)
Paiute	DLF Pickseed			108																					–
Persist	Smith Seed	123	105	106	107	112	106	100	103	111	98	108		101			105	102	101	108	101	102	103	107	105(20)
Potomac	Public				103	96	97	103	116	100	94	99	98			108	101	98	102			94	111	99	101(16)
Prairie	Turner Seed		107	101	109	106	113	123	108	103	111	110	104		100	104	99	104	96	105	107	120	102	105	107(21)
Prodigy	Caudill Seed				101		99	97			97					103		101					95		99(7)
Profit	Ampac Seed			107	96	98	103	96	97	89						103	102	102	96			115	96		100(13)
RAD-LCF 25	Radix Research																99					102			101(2)
Rushmore II	Mountain View seeds										98	108												102	103(3)
Shawnee	Rose-AgriSeed															86									–
Shiloh II	Proseeds Marketing													117											–
SS0708OGDT	Southern States								91	105	101	105							100					99	102(6)
Takena	Smith Seed												100												–
Tekena II	Smith Seed	110	102											109						106	104				106(5)
Tekapo	Ampac Seed		91	81	82	78	82	76	80						98	86	92	82		105	91	81	89		86(15)
Treposno	Hood River Seed									92		99							99						97(3)
Tucker	Oregro Seeds					96									96	102	96					85			95(5)
Udder	Improved Forages	100	107										102							106	99				103(5)
Vailliant	Proseeds Marketing			96																					–

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested three years, so the final report would be "2015 Orchardgrass Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Mean only presented when respective variety was included in two or more trials.
4 Number of years of data.

Table 7. Summary of Kentucky timothy yield trials 2000-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

		Lexington														Quicksand		Princeton		
		00[1,2]	01	02	06	07	08	09	11	12	13	14	15	16	17	99	01	00	04	Mean[3]
Variety	**Proprietor/KY Distributor**	2yr[4]	3yr	4yr	3yr	3yr	3yr	3yr	3yr	3yr	3yr	3yr	3yr	3yr	2yr	2yr	2yr	3yr	2yr	(#trials)
Alma	Newfield Seeds/ Caudill Seed																		81	–
Anjo	Hood River Seed													81						–
Aurora	General Feed and Grain	100														98				99(2)
Barfleo	Barenbrug USA							95	91	101		108	80	97	98					96(7)
Barpenta	Barenbrug USA					74			82	82					98					84(4)
Clair	KY Ag. Exp. Station		104	113	107	95	107	104	112	99	97	111	107	88	94		106		122	104(15)
Classic	Cebeco International Seeds	100		86												86				91(3)
Climax	Canada Agr. Res. Station				79	102	104	98	102	100	82	96	90	102	94					95(11)
Colt	FS Growmark	105		100	90											112			99	101(5)
Common	Public		95																	–
Comtral	Caudill Seed									92	92									92(2)
Dawn	Hood River Seed														101					–
Derby	Southern States				112	111		106	112	108	112	119	123	112					124	113(10)
Dolina	DLF Pickseed	99		90																95(2)
Express	Seed Research of Oregon			95		91		97	95											95(4)
Hokuei	Snow Brand Seed	103																		–
Hokusei	Snow Brand Seed	96														99				98(2)
Joliette	Newfield Seeds/ Caudill Seed						86	89											90	88(3)
Jonaton	Newfield Seeds/ Caudill Seed																		84	–
KY Early	Smith Seed/Central Farm Supply	102	103	115			102				119				115	104	103			108(8)
Outlaw	Grassland West Company																	107		–
Richmond	Pickseed Canada Inc.	100														103				102(2)
Summergraze	Brett Young										96									–
Summit	Allied Seed, L.L.C.			112																–
Talon	Seed Research of Oregon				110	112		108	106	109										109(5)
Tenho	Barenbrug USA											84								–
Treasure	Seed Research of Oregon				103	115		103	101	108										106(5)
Tundra	DLF Pickseed	95																		–
Tuukka	Ampac Seed Company		94	88													91	93		92(4)
Varis	Mountain View Seeds											83								–
Zenyatta	DLF Pickseed										103			119						111(2)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested three years, so the final report would be "2015 Timothy and Kentucky Bluegrass Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Mean only presented when respective variety was included in two or more trials.
4 Number of years of data.

Table 8. Summary of Kentucky bluegrass yield trials at Lexington 2004-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

Variety	Proprietor/ KY Distributor	04[1,2] 3yr[4]	06 4yr	07 3yr	08 3yr	09 3yr	10 3yr	11 3yr	12 3yr	13 3yr	14 3yr	16 3yr	17 2yr	Mean[3] (#trials)
Adam 1	Radix Research	98												–
Balin	Pure Seed												99	–
Barderby	Barenbrug USA			94		101	91	98	87	103	101	103	123	100(9)
Big Blue	Rose-AgriSeed					82			95					89(2)
Common	Public		71	66	68									68(3)
Ginger	ProSeeds Marketing		118	119	114	118	112	107	110	107	95	101	117	110(11)
Kenblue	Public	102	133				96	95	118	95	100			106(7)
Lato	Turf Seed Inc.			122										–
Park (certified)	Public								90	95	104	117	84	98(5)
RAD-5	Radix Research		103											–
RAD-339	Radix Research		101											–
RAD-643	Radix Research		94											–
RAD-731zx	Radix Research		87											–
RAD-762	Radix Research		94											–
RAD-1039	Radix Research				118									–
Tirem	DLF Pickseed											79	77	78(2)

1 Year trial was established.

2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested three years, so the final report would be "2015 Timothy and Kentucky Bluegrass Report" archived in the UK Forage website at forages.ca.uky.edu.

3 Mean only presented when respective variety was included in two or more trials.

4 Number of years of data.

Table 9. Summary of Kentucky annual ryegrass yield trials 2003-2019 (yield shown as a percentage of the yield value of Marshall).

			Lexington[1]																		Mean[4]
Variety	Type	Proprietor	03[2,3]	04	05	06	07	08	09	10	10	11	12	12	13	14	15	16	17	18	(#trials)
Abundant	tetraploid	Ampac Seed				12															–
Acrobat	–	Proseeds Marketing						144													–
AE110	Westerwold tetraploid	Pickseed USA, Inc.										89	100								95(2)
Amp	Westerwold tetraploid	Columbia Seeds													75						–
Assist	Westerwold diploid	SaddleButte													88						–
Attain	Westerwold tetraploid	Smith Seed Services								111					52	69					90(2)
Baqeuano	Westerwold tetraploid	Smith Seed Services																		77	–
Barmultra II	Italian tetraploid	Barenbrug USA								133				103	95		125	108			117(4)
Big Bang	–	Brett Young														67					–
Big Boss	Westerwold tetraploid	Smith Seed Services								98				86	38	73					86(3)
Big Daddy	Westerwold tetraploid	FFR/Sou. St.								86	98	82									89(3)
Bill	Westerwold diploid	Smith Seed Services														62					–
Brangus	Italian tetraploid	KB SeedSolutions								94											–
Bruiser	Westerwold diploid	Ampac Seed						65	105	100		104	86		100	105	95	86	113		95(9)
Centurion	Westerwold diploid	Mountain View Seeds											97			132		100	117		112(4)
DH-3	Italian tetraploid	Allied Seed					91	27				89									69(3)
Diamond T	Italian tetraploid	Oregro Seeds				8															–
Dixie Gold	Westerwold tetraploid	Caudill Seed													19						–
DoubleDiamond	Westerwold tetraploid	Oregro Seeds																		84	–
Dyna-Gain	Westerwold diploid	Columbia Seeds													71						–
Ed	Westerwold diploid	Smith Seed Services								96					101	100					98(2)
Fantastic	Westerwold diploid	Ampac Seed				48	84														86(3)
Feast II	Italian tetraploid	Ampac Seed						35	113	109		81	93	71	47	56	88	80	87	65	80(11)
Flying A	Westerwold diploid	Oregro Seeds				39		59													–
Fox	Italian diploid	DLF Pickseed								109											–
Fria	Westerwold diploid	Allied Seed								95		87	89		104	81	85	98			89(6)
GR-AS10	Italian	Ampac Seed								113											–
Graze-N-Gro	Westerwold diploid	Seed Research of OR	114				67														91(2)
Green Farm	Westerwold diploid	Smith Seed Services														85					–
Gulf	Westerwold diploid	Public					67	26	87	78		76	72		27	69	60	87	87	56	70(11)
Hercules	Westerwold tetraploid	Barenbrug USA												91	68						–
HS-1	Italian diploid	KB SeedSolutions								72											–
Jackson	Westerwold diploid	The Wax Co.		66	100	62	103	59	101	99	106	106	91	77	69	100	99	97	105	95	94(15)
Jumbo	Westerwold tetraploid	Barenbrug USA	112																88	83	94(3)
KB Royal	Italian diploid	KB SeedSolutions								83											–
Koga	Westerwold tetraploid	Smith Seed Services																	94	96	95(2)
Kospeed	Westerwold diploid	Smith Seed Services														80	92				86(2)
Kowinearly	Westerwold diploid	Smith Seed Services														95	96				96(2)
LHT-102	Intermediate	Ampac Seed											100								–
Marshall	Westerwold diploid	The Wax Co.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100(16)
Master	Westerwold tetraploid	Smith Seed Services																		82	–
Maximo	Intermediate tetraploid	Pickseed USA, Inc.										101									–
Maximus	Westerwold tetraploid	Barenbrug USA																	63	84	74(2)
Melquatro	Italian tetraploid	Hood River Seed															135		72		104(2)
Meroa	Westerwold diploid	Smith Seed Services														93	102				98(2)
MX 108	Westerwold tetraploid	Pickseed USA, Inc.										95	114								105(2)
Nelson	Westerwold tetraploid	The Wax Co.									86			93	65	77	105	97	73	91	89(7)

Continued

Table 9. Summary of Kentucky annual ryegrass yield trials 2003-2019 (yield shown as a percentage of the yield value of Marshall).

			Lexington[1]																		
Variety	**Type**	**Proprietor**	**03[2,3]**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**10**	**11**	**12**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**Mean[4] (#trials)**
Oryx	Italian diploid	Hood River Seed															100				–
Primecut	Westerwold brand	Oregro Seeds										94									–
Spark	tetraploid	DLF Pickseed																			–
Stockaid	diploid	–				82															–
Striker	Westerwold tetraploid	Seed Research of OR					90														–
TAMTBO	Westerwold tetraploid	Tex. Ag Exp Sta.						47		101		108	95			79				91	87(6)
Tam 90	Italian diploid	Tex. Ag Exp Sta.						49								78					64(2)
TetraPrime	Italian tetraploid	Mountain View Seeds											101			96	104	91	99	90	97(6)
TetraPro	Italian tetraploid	Tex. Ag Exp Sta.						40													–
TillageRootMax	Westerwold diploid	Cover Crop Solutions										82	90								86(2)
T-Rex	Westerwold tetraploid	SaddleButte				11															–
Trinova	Westerwold tetraploid	Smith Seed Services																		78	–
Ugne	Italian tetraploid	Hood River Seed																102			–
Verdure	Westerwold tetraploid	Smith Seed Services								86					42	58					72(2)
Winterhawk	Westerwold diploid	Oregro Seeds								104		117	92			119			113	96	107(6)

[1] In annual ryegrass, low yielding varieties usually result from winterkill. Note: Due to severe winterkill, yield results from the 2006 and 2013 plantings were not included in the overall mean.
[2] Year trial was established.
[3] Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2015 was harvested one year, so the final report would be "2016 Annual and Perennial Ryegrass and Festulolium Report" archived in the UK Forage website at forages.ca.uky.edu.
[4] Mean only presented when respective variety was included in two or more trials.

Table 10. Summary of Kentucky perennial ryegrass yield trials 2000-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

			Lexington																Princeton		Bowling Green		
			01[1,2]	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**00**	**02**	**00**	**03**	
Variety	**Type**	**Proprietor**	**2yr[5]**	**2yr**	**3yr**	**3yr**	**2yr**	**3yr**	**3yr**	**3yr**	**2yr**	**3yr**	**3yr**	**3yr**	**2yr**	**2yr**	**3yr**	**2yr**	**2yr**	**3yr**	**2yr**	**2yr**	**Mean[3,4] (#trials)**
Aires	diploid	Ampac Seed	95																	93			94(2)
Albion	tetraploid	Grasslands Oregon													105	103							104(2)
Amazon	tetraploid	AgriBioTech			99															107			103(2)
Anaconda	tetraploid	Caudill Seed																	95		103		99(2)
Aubisque	tetraploid	Seed Research of OR		144																		99	122(2)
Bandit	tetraploid	Grassland West																	106		114		110(2)
Barvitra	diploid	Barenbrug USA														104							–
Bastion C-2	tetraploid	Seed Research of OR			91																		–
Bestfor	tetraploid	Improved Forages																	113	107	120		113(3)
Best for Plus	hybrid tetraploid	Improved Forages		116	108	118																136	120(4)
BG-34	diploid	Barenbrug USA				83	85				86		87	84	85	81		86					85(8)
Bison	hybrid tetraploid	International Seeds																				140	–
Boost	tetraploid	Allied Seed						130	125	120	143	110	103	102									119(7)
Boxer	tetraploid	AgriBioTech																	106				–
Calibra	tetraploid	DLF Pickseed							96	109	81	99	103	96	87	100	98	98		112			98(11)
CAS MP64	diploid	Cascade International	97																				–
Citadel	tetraploid	Ag Canada																	94	113	103		103(3)
Crave	tetraploid	Ampac Seed											95										–
Derby	–	Public																			74		–

Continued

Table 10. Summary of Kentucky perennial ryegrass yield trials 2000-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

			Lexington																Princeton		Bowling Green		
			01[1,2]	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	00	02	00	03	Mean[3,4]
Variety	**Type**	**Proprietor**	2yr[5]	2yr	3yr	3yr	2yr	3yr	3yr	3yr	2yr	3yr	3yr	3yr	2yr	2yr	3yr	2yr	2yr	3yr	2yr	2yr	(#trials)
Elena DS	tetraploid	Allied Seed											110				110						110(2)
Eurostar	tetraploid	Seed Research of OR						112															–
Everlast	diploid	Caudill Seed												104									–
Feeder	diploid	Seed Research of OR						76															–
Grand Daddy	tetraploid	Smith Seed	118				101	109		76	92	84	86		107					111			98(9)
Green Gold	tetraploid	Grasslands Oregon					96																–
Herbal	–	ProSeeds Marketing							77														–
Impressario	tetraploid	DLF Pickseed								107			92										100(2)
Kentaur	tetraploid	DLF Pickseed										106		117									112(2)
Lactal	tetraploid	Brett Young								102													–
Lasso	diploid	DLF Pickseed	98																				–
LHT-102	tetraploid	Ampac Seed											114										–
Linn (certified)	diploid	Public	98	98	102		98	85	84	101	92	93	80	95	83	89	83	78	87	88	77		90(18)
Manhatten	diploid	–																		85			–
Mara	diploid	Barenbrug USA																			85		–
Matrix	diploid	Cropmark seeds		77																		64	–
Maverick Gold	hybrid tetraploid	Ampac Seed	97																	71			84(2)
Melpetra	tetraploid	Hood River Seed															83						–
Orantas	diploid	DLF Pickseed								82													–
Ortet	tetraploid	Oregro Seeds							114														–
PayDay	tetraploid	Mountain View Seeds											101	103	99		87	107					99(5)
Polly II	tetraploid	FS Growmark																	110		125		118(2)
Polly Plus	hybrid tetraploid	Allied Seed		64																		60	62(2)
Power	tetraploid	Ampac Seed						110	103	102	100	109	104	95	101	107							104(9)
Polim	tetraploid	DLF Pickseed									106												–
Quartermaster	tetraploid	Radix Research				122																	–
Quartet	tetraploid	Ampac Seed	97			56		46												113			78(4)
RAD-CPS212	hybrid tetraploid	Radix Research				134																	–
RAD-MI125	hybrid tetraploid	Mountain View Seeds					120																–
Remington	tetraploid	Barenbrug USA													95	117	109	106					107(4)
Remington PLUS NEA2[6]	tetraploid	Barenbrug USA													119	99							109(2)
Sierra	diploid	Lewis Seed Co.				89																	–
TetraGain	tetraploid	Pure Seed											111										–
TetraMag	tetraploid	Mountain View Seeds											110		136		127	127					125(4)
TetraSweet	tetraploid	Mountain View Seeds															104	101					103(2)
Tonga	tetraploid	Kings AgriSeeds				96				103													100(3)
Verseka	tetraploid	Allied Seed											75										–
Victorian	diploid	Caudill Seed												104	83								94(2)
Yatsyn	diploid	Barenbrug USA																	89				–

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested three years, so the final report would be "2015 Annual and Perennial Ryegrass and Festulolium Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Mean only presented when respective variety was included in two or more trials.
4 In perennial ryegrass, low yielding varieties usually result from winterkill or summer mortality.
5 Number of years of data.
6 Remington PLUS NEA2 contains a non-toxic (novel) endophyte.

Table 11. Summary of Kentucky festulolium yield trials 2001-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).[1]

			Lexington												
			2001[3,4]	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Mean[5]
Variety	**Type[2]**	**Proprietor**	**2yr[6]**	**3yr**	**3yr**	**3yr**	**3yr**	**3yr**	**2yr**	**3yr**	**2yr**	**3yr**	**3yr**	**2yr**	**(#trials)**
Agula	MF x IR	Allied Seed					94								–
Barfest	MF x PR	Barenbrug USA					105	101	107	119	91	92	92		101(7)
Bonus	MF x IR	Allied Seed					93	46	32	34					51(4)
Duo	MF x PR	Ampac Seed		89	98	99	95	106	103	96	96	83	83	81	94(11)
Felina	(TF x IR) x TF	DLF Pickseed	104				132	118	134	114	96				116(6)
Fojtan	(TF x IR) x TF	DLF Pickseed					112	101	124	92	72	94	100	95	99(8)
Gain	MF x IR	Allied Seed					103	77	52	75					77(4)
Hostyn	MF xIR	DLF Pickseed							107	110	106		108		108(4)
Hykor	(TF x IR) x TF	DLF Pickseed					133	141	153	131	119	121	112		130(7)
InaMerlin	MF x IR	Hood River Seed											88		–
Kenfest	MFx AR	KY Ag. Exp. Station												100	–
Lofa	(TF x Int) x Int	DLF Pickseed					105	107	110	128	112	91	109	110	109(8)
Mahulena	(TF x IR) x TF	DLF Pickseed							131	109	107		111	100	112(5)
Meadow Green	–	Pure Seed							37	34					36(2)
Perseus	MF x IR	DLF Pickseed					132	114	126	123	110	109	105	113	117(8)
Perun	MF x IR	DLF Pickseed					127	114	107	131	110	102	99	114	112(8)
Rebab	(TFxIR) xTF	DLF Pickseed								94	77				86(2)
Spring Green	MF x PR	Turf-Seed	96	111	114	101	113	112	114	110	103	107	92	91	105(12)
Sweet Tart	MF x IR	ProSeeds Marketing			88		82	63	62						74(4)

1 The festuloliums were in fescue trials from 2001-2005 and in perennial ryegrass trials from 2008-2009.
2 MF = meadow fescue, TF = tall fescue, IR = Italian ryegrass, PR = perennial ryegrass, Int = intermediate ryegrass.
3 Year trial was established.
4 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested three years, so the final report would be "2015 Annual and Perennial Ryegrass and Festulolium Report" archived in the UK Forage website at forages.ca.uky.edu.
5 Mean only presented when respective variety was included in two or more trials.
6 Number of years of data.

Table 12. Summary of Kentucky bromegrass yield trials at Lexington 2006-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial.)

		Proprietor/	2006[1,2]	2008	2010	2012	2014	2015	2016	2017	Mean[3]
Variety	**Type**	**KY Distributor**	**4-yr[4]**	**3-yr**	**3-yr**	**3-yr**	**3-yr**	**3-yr**	**3-yr**	**2-yr**	**(#trials)**
AC Knowles	hybrid	Agriculture Canada	85		82	102	89				89(4)
Admiral	meadow	Cisco Seeds							104	108	106(2)
Arid	meadow	Mountain View Seeds							96	93	95(2)
Bigfoot	hybrid	Grassland Oregon	108	116	105						110(3)
Canterbury	mountain	Barenbrug USA		79							–
Carlton	smooth	Pickseed USA				82	95				91(2)
Doina	smooth	Barenbrug USA		114	108						111(2)
Fleet	meadow	Agriculture Canada	110			109					110(2)
Hakari	Alaska	Barenbrug USA		85	85						85(2)
MacBeth	meadow	Cisco Seeds		136	119	107	116	107	102	111	114(7)
Olga	smooth	Barenbrug USA		116	101						109(2)
Peak	smooth	Allied Seed		97		100		93	96	87	95(5)
Persister	prairie	DLF Pickseed		72							–
RAD-BI29	smooth	Columbia Seeds	96	86							91(2)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested three years, so the final report would be "2015 Tall Fescue and Brome Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Mean only presented when respective variety was included in two or more trials.
4 Number of years of data.

Table 13. Summary of Kentucky sudangrass yield trials 2008-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

Variety	Proprietor/ KY Distributor	Lexington												Princeton			Mean[3] (#trials)
		2008[1,2]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2017	2018	2019	
		All trials are 1 year yields															
AS9301 BMR[4]	Advanta Seeds/ Ramer Seed					118											–
AS9302 BMR (Brachytic Dwarf)	Advanta Seeds/ Ramer Seed										124	104	102	119	117	115	114(6)
Enorma BMR	Cal/West Seeds			99	94	92	91	83	91	98							93(7)
FSG 1000 BMR	Farm Science Genetics								101	124	110						112(3)
Hayking BMR	Central Farm Supply	111	112	91	97	97	96	92	94	90	80	109		99			97(12)
Monarch V	Public	104	96	102	97	93	98	110	99	82							98(9)
Piper	Public	90	91	97	94	104	105	89	94	85	81	86	93	86	99	88	92(15)
ProMax BMR	Ampac Seed	95	101	110	115	96	103	100	111	111	106	102	101	96	84	87	101(15)
SS130 BMR	Cal/West Seeds			101	103		107	106	110	109	99		93			97	103(9)
Trudan Headless	S & W Seed Company							118					112			113	114(3)

1 Establishment year.
2 Use this summary table as a guide in making variety decisions, but refer to specific tables in this report to determine statistical differences in forage yield between varieties.
3 Mean only presented when respective variety was included in two or more trials.
4 BMR (Brown Mid-rib) means that a variety has been developed to produce lower amounts of lignin which usually translates into higher quality.

Table 14. Summary of Kentucky sorghum-sudangrass yield trials 2008-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

Variety	Proprietor/KY Distributor	Lexington												Princeton			Mean[3] (#trials)
		2008[1,2]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2017	2018	2019	
		All trials are 1 year yields															
AS6401 BMR[4]	Advanta Seeds/ Ramer Seed												84			112	98(2)
AS6402 BMR (Brachytic Dwarf)	AdvantaSeeds/ Ramer Seed					91					78	82	67	98	98	91	86(7)
AS6503 BMR	Advanta Seeds/ Ramer Seed						96	103	90								96(3)
AS6504 BMR (Dry Stalk)	Advanta Seeds/ Ramer Seed										105	103		114	112		109(4)
Danny Boy II BMR	Dyna-Gro Seeds												117			110	114(2)
FSG 208 BMR	Farm Science Genetics			75													–
FSG 214 BMR	Farm Science Genetics						99	108	112					109	111		108(5)
FSG 215 BMR	Farm Science Genetics								112								–
Fullgraze II	Dyna-Gro Seeds												100			108	104(2)
Fullgraze II BMR	Dyna-Gro Seeds												97			106	102(2)
F75FS13	Dyna-Gro Seeds												94			76	85(92)
Greengrazer V	Farm Science Genetics			166			122	107	92	103	110						117(6)
GW300 BMR	Gayland Ward Seed				88	78	88	81	73	101	100	98		79			87(9)
HyGain	Turner Seed	104	105	118						110	127	117	121	130	108	121	116(10)
KFSugar-Pro55S	Byron Seed										110						–
MS 202 BMR	Farm Science Genetics			106													–
Nutra-King BMR	Gayland Ward Seed								110	108	96	113	118	108	114	105	109(8)
NutraPlus BMR	Public	106	97	94	103	106	109	106	96								102(8)
Sordan Headless	Chromatin							105									–
Special Effort	Public	109	110	93	94	115	120	91	111								105(8)
SS211	Southern States				104	93	114	103	118	111	121	118		109	87		108(10)
SS220 BMR	Southern States		107	84		112											101(3)
Sugar Graze II	Coffey Seed												110			110	110(2)
Surpass BMR	Turner Seed	81	80	64						79	84	75	75	88	97	74	80(10)
Super Sugar	Gayland Ward Seed				102	117	107		125	85				91			105(6)
Super Sugar BMR	Gayland Ward Seed									107							–
Super Sugar (Delayed Maturity)	Gayland Ward Seed							101	82		89	104		95	83		92(6)

Continued

Table 14. Summary of Kentucky sorghum-sudangrass yield trials 2008-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

Variety	Proprietor/KY Distributor	Lexington 2008[1,2]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Princeton 2017	2018	2019	Mean[3] (#trials)
		All trials are 1 year yields															
Super Sugar Sterile	Gayland Ward Seed							94									–
Super Sweet 10	Dyna-Gro Seeds												121			118	120(2)
Sweet-For-Ever	Gayland Ward Seed				110	107	81										99(3)
Sweet-For-Ever BMR	Gayland Ward Seed					78	70		77	104	106	83		77	82		85(8)
SweetSix BMR	Gayland Ward Seed						93	101		91							95(3)
SweetSix BMR (Dry Stalk)	Gayland Ward Seed								102		72	107		103	108		98(5)
Vita-Cane	Gayland Ward Seed					121											–
Xtragraze BMR	Coffey Seed												79			70	75(2)

[1] Establishment year.
[2] Use this summary table as a guide in making variety decisions, but refer to specific tables in this report to determine statistical differences in forage yield between varieties.
[3] Mean only presented when respective variety was included in two or more trials.
[4] BMR (Brown Mid-rib) means that a variety has been developed to produce lower amounts of lignin which usually translates into higher quality.

Table 15. Summary of Kentucky pearl millet yield trials 2013-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

Variety	Proprietor/ KY Distributor	Lexington 2013[1,2]	2014	2015	2016	2017	2018	2019	Princeton 2017	2018	2019	Mean[3] (#trials)
		All trials are 1 year yields										
Epic BMR[4]	Coffey Seed							97			99	98(2)
Exceed BMR	Coffey Seed							89			102	96(2)
FSG 300 Hybrid	Farm Science Genetics			109	99	109			117			109(4)
FSG 315 BMR (Dwarf)	Farm Science Genetics			101	102	81			97			95(4)
Leafy22 Hybrid	Turner Seed				105	124	108	108	115	100	116	111(7)
PearlMil	Dyna-Gro Seed							103			110	107(2)
Pennleaf Hybrid	Pennington Seed	93	91	94	96	87	98	100	84	93		93(9)
PP102M Hybrid	Cisco Seeds	93	93	90	79	90	91	97	77	104	95	91(10)
Prime360	Byron Seed							91			103	97(2)
SS1562M BMR	Southern States							103			95	99(2)
SS501	Southern States	90	99	96	86	94	94		89	96		93(8)
SS635	Southern States	108	112	101	116	94	110	108	107	115	105	108(10)
Sweet Summer	Cisco Seeds						86	95		85	104	93(4)
Tifleaf III Hybrid	Gayland Ward Seed	116	106	108	116	120	113	119	114	112	111	114(10)
Wonderleaf	Advanta Seed/Ramer Seed							98		100	107	102(3)

[1] Establishment year.
[2] Use this summary table as a guide in making variety decisions, but refer to specific tables in this report to determine statistical differences in forage yield between varieties.
[3] Mean only presented when respective variety was included in two or more trials.
[4] BMR (Brown Mid-rib) means that a variety has been developed to produce lower amounts of lignin which usually translates into higher quality.

Table 16. Summary of Kentucky forage sorghum yield trials 2013-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

		Lexington							Princeton			
		2013[1,2]	2014	2015	2016	2017	2018	2019	2017	2019[4]	2019	Mean[3]
Variety	Proprietor/KY Distributor	All trials are one-year yields										(#trials)
ADVF7232 BMR[5]	Advanta Seed/Ramer Seed							88		93	84	86(2)
AF7201 BMR	Advanta Seed/Ramer Seed	89	81	101	89			94		74	83	90(6)
AF7203 BMR (Brachytic Dwarf)								48	70			59(2)
AF7401 BMR (Brachytic Dwarf)	Advanta Seed/Ramer Seed	76	94	90	83	86	72	85	116	87	100	89(9)
AF8301	Advanta Seed/Ramer Seed							98		124	85	92(2)
Ensilemaster	Caudill Seed	125	90	101	106	111	129	118	171	77	85	115(9)
FSG114 BMR	Farm Science Genetics		94	128	93	125	91	76	71	89	79	95(8)
FSG115 BMR (Brachytic Dwarf)	Farm Science Genetics		51	31	72	81	74	67	72	60	74	65(8)
F74FS23 BMR	Dyna-Gro Seed							125		77	76	10192)
F74FS72 BMR	Dyna-Gro Seed							93		59	117	10592)
F75FS13	Dyna-Gro Seed							107		109	84	96(2)
GW2120	Gayland Ward Seed	117	89	113	84	107	88	102	85	98	115	100(9)
GW400 BMR	Gayland Ward Seed	93	79	128	78	91	88	83	42			85(8)
GW475 BMR	Gayland Ward Seed						80	99				90(2)
GW600 BMR	Gayland Ward Seed		107	111	90		90	100				100(5)
KFFiber-Pro70FS	Byron Seed					65	53		70			63(3)
NK300	S&W SeedCompany		126	110	101	116	135	84	119			113(7)
SD1741 BMR	S&W SeedCompany		133	92	103	81	84	95	94			97(7)
SilageKing BMR (Dwarf)	Gayland Ward Seed		48									–
SiloPro BMR (Brachytic Dwarf)	Gayland Ward Seed			24	74		63					54(3)
SP1615	S&W SeedCompany									164	170	–
SS1515	Southern States							125		97	75	100(2)
SS405	Chromatin		188	183	207	138	202	139	160	142	171	174(8)
Super Sile 20	Dyna-Gro Seed							107		106	124	116(2)
Super Sile 30	Dyna-Gro Seed							121		129	104	113(2)
TopTon	Dyna-Gro Seed							131		84	73	102(2)
XF7203 BMR (Brachytic Dwarf)	Advanta Seed/Ramer Seed					74	73					74(2)
1990	S&W SeedCompany		121	89	118	125	177	113	131			125(7)

1 Establishment year.
2 Use this summary table as a guide in making variety decisions, but refer to specific tables in this report to determine statistical differences in forage yield between varieties.
3 Mean only presented when respective variety was included in two or more trials.
4 This trial was sprayed with an aphicide and the results are not included in the overall mean.
5 BMR (Brown Mid-rib) means that a variety has been developed to produce lower amounts of lignin which usually translates into higher quality.

Table 17. Summary of Kentucky teff yield trials 2008-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

	Lexington										Princeton			
	2008[1,2]	2009	2010	2011	2012	2013	2014	2015	2016	2019	2008	2009	2019	Mean[3]
Variety	All trials are one-year yields													(#trials)
Corvallis	81	101	91	101	96	100	110	96	102	110	94	112	99	99(13)
CW0604										101			97	99(2)
Dessie	99	92	96	94	95	97	101	104	105	89	102	87	101	98(13)
Excaliber	109	104	125	108	106	103					109	111		109(8)
Highveld	100	121	106	101	109	103	102				111	115		108(9)
HorseCandi	99	105	89	108	94	97	80	104	82	86	91	84	103	94(13)
Moxie						94	96	105	107	110			95	101(6)
Pharaoh	105	85	106	106	97	101	93	97	94	102	95	101	107	99(13)
Rooiberg	112	109	113	108	115	102	88				102	107		106(9)
Summer Delight		91	96	88	93	100	119	101	104	91		90	99	97(11)
Tiffany	102	93	82	93	102	98	104	97	105	110	102	106	104	100(13)
VA T1 Brown		99	87	91	94	98	104	97	101	100		89		96(10)
Velvet		100	97	98	95	103	95	99	100	101		94	96	98(11)
Witkope	93	101	115	103	101	104	107				94	100		102(9)

1 Establishment year.
2 Use this summary table as a guide in making variety decisions, but refer to specific tables in this report to determine statistical differences in forage yield between varieties.
3 Mean only presented when respective variety was included in two or more trials.

Table 18. Summary of Kentucky crabgrass yield trials 2016-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial).

Variety	Proprietor/ KY Distributor	Lexington			Princeton	Mean[3] (#trials)
		2016[1,2]	2018	2019	2019	
		All trials are one-year yields				
Impact	Barenbrug USA	107	107	108	105	107(4)
Quick-N-Big	Noble foundation	89	85	81	99	89(4)
Red River	Noble foundation	104	108	110	96	105(4)

[1] Establishment year.
[2] Use this summary table as a guide in making variety decisions, but refer to specific tables in this report to determine statistical differences in forage yield between varieties.
[3] Mean only presented when respective variety was included in two or more trials.

Table 19. Summary of Kentucky spring oats yield trials 2015-2019 (planted mid March to early April) [yield shown as a percentage of the mean of the commercial varieties in the trial].

Variety	Proprietor/ Distributor	2015[1,2]	2016	2017	2018	2019	Mean[3] (#trials)
		All trials are one-year yields					
CCSO-102	Caldbeck Consulting				95	102	99(2)
CCSO-120 (black hulled)	Caldbeck Consulting				106	106	106(2)
Common	Central Farm Supply	89					–
Excel	Ag. Alumni Seed, IN	120	101	111	107	115	111(5)
Haywire	Cisco Seeds					81	–
Jerry	Caudill Seed	107	93	103	99	95	99(5)
Persik (black hulled)	Caldbeck Consulting		112	114	127	106	115(4)
PST-241	Caldbeck Consulting	91	86	86	86		87(4)
PST5O200	Caldbeck Consulting	102	90	87	79		90(4)
PST5O-288C	Caldbeck Consulting	91	102	88	97		95(4)
Reins	Ag. Alumni Seed, IN	94			102		98(2)
Robust	Ag. Alumni Seed, IN	104	111	117	102	94	106(5)
Saber	Ag. Alumni Seed, IN	104			100	97	100(3)
VNK	Public		97	107	101	94	100(4)
021A17815	Ag. Alumni Seed, IN	97	108	87			97(3)

[1] Establishment year.
[2] Use this summary table as a guide in making variety decisions, but refer to specific tables in this report to determine statistical differences in forage yield between varieties.
[3] Mean only presented when respective variety was included in two or more trials.

Table 20. Summary of 2002-2019 Kentucky white clover grazing tolerance trials in Lexington (stand persistence shown as a percent of the mean of the commercial varieties in the test).

Variety	Type	Proprietor	2002[1,2] 2yr[6]	2004 4yr	2006[3] 2yr	2006 2yr	2008[4] 3yr	2008 4yr	2009 4yr	2010 4yr	2011 4yr	2012 4yr	2013 4yr	2014 3yr	2015 4yr	2016 3yr	2017 2yr	Mean[5] (#trials)
Alice	Intermediate	Barenbrug USA		59	98									93	71	91	96	85(6)
Barblanca	Intermediate	Barenbrug USA		118	91	151												120(3)
Canterbury	Dutch	Allied Seed											51	93				72(2)
Colt	Intermediate	Seed Research of OR		114	134	122												123(3)
Crescendo	Ladino	Cal/West	84			72												78(2)
Durana	Intermediate	Pennington		83	105	103		115	102	107	126	86	81	113	152	107	87	105(13)
GWC-AS10	–	Ampac Seed								77								–
Insight	Ladino	Allied Seed				77												–
Ivory	Intermediate	DLF Pickseed	132	142														137(2)
Ivory II	Intermediate	DLF Pickseed					102											–
Kakariki	Ladino	Luisetti Seeds															110	–
Kopu II	Intermediate	Ampac Seed			77	122	96		93	113	112	86	106	93	87	95		98(11)
KY Select	Intermediate	KY Agr Ex. Sta.						105		83								94(2)
Neches	–	Barenbrug USA													104			–
Patriot	Intermediate	Pennington		110	137	122		100	111	110	123	102	132	109	123	98	114	115(13)
Pinnacle	Ladino	Allied Seed									87							–
Rampart	–	Oregro Seeds						90										–
Regal	Ladino	Public	92		57	54		93		103								80(5)
Regal Graze	Ladino	Cal/West			84	87	105	90	87	93	72	94	81	102	87	98	87	88(13)
Renovation	Intermediate	Smith Seed											102	100	55		92	87(4)
Resolute	Intermediate	Southern States			101	106					65							91(3)
Seminole	Ladino	Saddle Butte Ag. Inc.		75		97	91						89	85				97(5)
Tillman II	Ladino	Caudill Seed	92															–
WBDX	Dutch	Saddle Butte Ag. Inc.								70								–
Will	Ladino	Allied Seed			117	87	107	105	108	143	115	133	157	111	120	109	114	117(13)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in stand persistence between varieties. To find actual persistence ratings, look in the yearly report for the final year of each specific test. For example, the trial planted in 2010 was grazed for four years so the final persistence report would be "2014 Red and White Clover Grazing Tolerance Report" archived in the UK Forage website at forages.ca.uky.edu.
3 This trial was planted in the spring of 2006 due to poor establishment of the fall 2005 planting.
4 This trial was planted in the spring of 2008 due to poor establishment of the fall 2007 planting.
5 Mean only presented when respective variety was included in two or more trials.
6 Number of years of data.

Table 21. Summary of Kentucky alfalfa grazing trials 1998-2019 (stand persistence shown as a percent of the grazing tolerant Alfagraze).

		Variety Characteristics[1]						Lexington																
			Disease Resistance[2]					1998[3,4]	2000	2000	2001	2004	2005	2006	2008	2009	2010	2011	2012	2013	2014	2016	2017	
Variety	Proprietor	FD	Bw	Fw	An	PRR	APH	3yr[6]	2yr	3yr	3yr	4yr	4yr	3yr	4yr	4yr	4yr	4yr	4yr	4yr	3yr	3yr	2yr	Mean[5] (#trials)
ABT 350	W-L Research	3	HR	HR	HR	HR	HR			46														–
ABT 405	W-L Research	4	HR	HR	HR	HR	R			46	100													73(2)
Alfagraze	America's Alfalfa	2	MR	R	MR	R	–	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100(16)
Alfagraze 300 RR	America's Alfalfa	3	HR	R	HR	HR	HR											110						–
Alfagraze 600 RR	America's Alfalfa	6	–	R	HR	R	R														12			–
Amerigraze 401+Z	America's Alfalfa	4	HR	HR	HR	HR	R	56	26	85	125													73(4)
Ameristand 403T	America's Alfalfa	4	HR	HR	HR	HR	HR						141	144	50		91		144	118	65			108(7)
Ameristand 403TPlus	America's Alfalfa	4	HR	HR	HR	HR	HR									133		90				130	128	120(4)
Ameristand 407TQ	America's Alfalfa	4	HR	HR	HR	HR	HR						136			50		80						89(3)
Apollo	America's Alfalfa	4	R	R	R	R	–	47	17	31	25		36	27	25	17	27	70	55	86	24			37(13)
Archer III	America's Alfalfa	5	HR	HR	HR	HR	HR									33		83						58(2)
Baralfa 54	Barenbrug USA	–	R	HR	HR	HR	HR	78																–
Bulldog-505	Univ. of GA	5	–	HR	–	R	–												144	100	57			100(3)
FK 421	Donley Seed Co.	4	HR	H	H	H	H				100													–
Feast	Garst Seeds	3	HR	HR	HR	HR	R		87	92														90(2)
Gold Plus	PGI Alfalfa	4	HR	HR	HR	HR	R	81																–
Grazeking	Southern States	5	MR	HR	HR	R	S				50													–
Haygrazer	Great Plains Research	4	HR	HR	R	R	MR			38														–
Integrity	PGI Alfalfa	4	HR	HR	HR	HR	HR						172											–
LegenDairy5.0	Croplan Genetics	3	HR	HR	HR	HR	HR								0			87						44(2)
PGI 424	Producers Choice	4	HR	HR	HR	HR	HR										45							–
PGI 459	Producers Choice	4	HR	HR	HR	HR	HR									17		93						55(2)
Pioneer 98	Pioneer	3	HR	R	HR	R	–	56																–
ProGro	MBS Inc.	4	HR	HR	R	HR	MR	81																–
Rebel	Target Seed	4	HR	HR	HR	HR	HR							79										–
Rugged	Target Seed	3	HR	HR	HR	HR	HR							146										–
Saranac AR (cert.)	Public	4	MR	R	HR	LR	–				100													–
Spredor 3	Syngenta	1	HR	HR	R	MR	S	75					68											72(2)
Spredor 4	Syngenta	2	HR	HR	HR	HR	R								25									–
TS 4007	Producers Choice	4	HR	R	HR	HR	HR										82							–
TS 4010/A4535	Producers Choice	4	HR	R	HR	HR	HR									83	145	120						116(3)
Triple Trust 450	ABI/America's Alfalfa	5	HR	HR	HR	HR	HR						145											–
Wintergreen	ABI Alfalfa	3	HR	HR	HR	HR	R	72																–
WL 326GZ	W-L Research	4	HR	HR	HR	HR	HR	88																–
115 Brand	Monsanto	3	HR	HR	R	HR	R		56	85														71(2)
5432	Pioneer	4	HR	HR	–	MR	–					51												–

1 Variety characteristics: FD = fall dormancy, Bw = bacterial wilt, Fw = fusarium wilt, An = anthracnose, PRR = phytophthera root rot, APH = aphanomyces root rot. Information provided by seed companies.
2 Disease resistance: S = susceptible, LR = low resistance, MR = moderate resistance, R = resistance, HR = high resistance. More detailed disease and insect resistance ratings at www.alfalfa.org/pdf/2019_Alfalfa_Variety_Leaflet.pdf.
3 Year trial was established.
4 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in stand persistence between varieties. To find actual persistence ratings, look in the yearly report for the final year of each specific test. For example, the Lexington trial planted in 2011 was grazed for four years so final persistence report would be "2015 Alfalfa Grazing Tolerance Report" archived in the UK Forage website at forages.ca.uky.edu.
5 Mean only presented when respective variety was included in two or more trials.
6 Number of years of data.

Table 22. Summary of 2000-2019 Kentucky tall fescue grazing tolerance trials (stand persistence shown as a percent of the stand rating of KY 31+).

			Lexington																	Princeton	
	Endophyte		2000[2,3]	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2002	Mean[4]
Variety	Status[1]	Proprietor	4yr[5]	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	3yr	4yr	(#trials)
Advance MaxQ	novel	Pennington Seed							94												–
Baguala	free	Allied Seed																99			–
Bariane	free	Barenbrug USA				89		75	47	29											60(4)
BarElite	free	Barenbrug USA								96											–
Barolex	free	Barenbrug USA						78	101	86											88(3)
BarOptima PLUS E34	novel	Barenbrug USA						100		97			98	100	98	100	100	100	99		99(9)
Bronson	free	Ampac Seed										98	98						100		99(3)
Bull	free	Caudill Seed														96			100		98(2)
Cajun II	free	Smith Seed Services											98				97	100	100		99(4)
Cattle Club	free	Green Seed	93	91																	92(2)
Carmine	free	DLF-Jenks		90																	–
Cowgirl	free	Rose Agri-Seed					99								99						99(2)
Dominate	free	Allied Seed																99			–
Drover	free	Barenbrug USA																99			–
Festival	free	Pickseed West		100	101															89	97(3)
FSG 402TF	free	Farm Service Genetics																99			–
Flourish	free	Allied Seed													98						–
Goliath	free	Ampac Seed											98						100		–
Hoedown	free	DLF-Jenks	88																		–
HyMark	free	Fraser Seeds									95			100							98(2)
Jesup MaxQ	novel	Pennington Seed			103	97		68	102	97	97	99	98	100	99	99	99	100	100	105	98(15)
Johnstone	free	Proseeds		92																	–
KY31+	toxic	KY Ag. Exp. Station	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100(18)
KY31-	free	KY Ag. Exp. Station		98	103	98	100	83	101	100	98	99	99	100	100	99	100	100	100	105	99(17)
Kokanee	free	Ampac Seed	43																		–
Lacefield MaxQ II	novel	Pennington Seed						82	102	99	98	98	97			100	99	100	100		98(10)
Maximize	free	Rose Agri-Seed		99																	–
Nanryo	free	Japanese Grassland For. Seed								100											–
Orygun	free	–			99																–
Resolute	free	Ampac Seed		23																	–
Select	free	Southern States	107	101	100	100		67	100	93	95	97	100	100	99	99	99	101		98	97(16)
SS0705TFSL	free	Southern States															100	100	100		100(3)
Stargrazer	free	Southern States	86	89																	88(2)
Stockman	free	Seed Res. of OR					102														–
Texoma MaxQ II	novel	Pennington Seed						88	100	98											95(3)
Tuscany II	free	Seed Res. of OR							101												–
Verdant	free	Am.Grass Seed							97												–

1 Free varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
2 Year trial was established.
3 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in stand persistence between varieties. To find actual persistence ratings, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in in 2010 was grazed four years so the final report would be "2014 Cool-Season Grass Grazing Tolerance Report" archived in the UK Forage website at forages.ca.uky.edu.
4 Mean only presented when respective variety was included in two or more trials.
5 Number of years of data.

Table 23. Summary of 2000-2019 Kentucky orchardgrass grazing tolerance trials (stand persistence shown as a percent of the mean of the commercial varieties in the trial).

		Lexington															Princeton	
		2000[1,2]	2001	2002	2003	2004	2005[3]	2007	2009	2010	2011	2012	20133	2014	2015	2016	2002	Mean[4]
Variety	Proprietor	4yr[5]	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	3yr	4yr	(#trials)
Abertop	Pennington Seed			38														–
Albert	Univ. of Wisconsin		115															–
Amba	DLF-Jenks		71															–
Ambrosia	Pennington Seed							94										–
Athos	DLF-Jenks		93				60											–
Benchmark	Southern States	118	123	114													133	122(4)
Benchmark Plus	Southern States			120			152	135	106	106	108	115	146	154			133	122(8)
Boone	Public	102																–
Command	Seed Research of OR					81												–
Crown Royale	Donley Seed		100															–
Crown Royale Plus	Donley Seed			124													83	104(2)
Devour																125		–
Elise	Pure Seed											97				74		86(
Hallmark	James VanLeeuwen		115		113												83	86(2)
Harvestar	Columbia Seeds							75		89	94		51	34		81		71(6)
Haymate	Southern States	53	115	100	118												83	94(5)
Intensiv	Barenbrug USA				51													–
Mammoth	DLF-Jenks		115															–
Megabite	Turf Seed		77															–
Niva	DLF-Jenks			76													83	80(2)
Persist	Smith Seed						138	107	103	100	96	115	102	123	104	109		18(8)
Potomac (certified)	Public			116		119									109	103	117	113(5)
Prairie	Turner Seed	127	121								94		131	90	97	106	83	103(7)
Prodigy	Caudill Seed												109	119		99		109(2)
Profile	Scott Seed			116														–
Profit	Ampac Seed								95	99	102	94	95	90	82			94(6)
Tekapo	Ampac Seed		55	74	118		50	103	95	105	106	80	66	63	77		100	84(13)
Takena	Smith Seed		99															–
Seco	Southern States							85										–
SS0708OGDT	Southern States													128	131	102		120(3)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in stand persistence between varieties. To find actual persistence ratings, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2010 was grazed four years so the final report would be "2014 Cool-Season Grass Grazing Tolerance Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Due to high variation during 2005 and 2013 trials these values are not included in the overall mean
4 Mean only presented when respective variety was included in two or more trials.
5 Number of years of data.
Stand thinning may have been greater for preferred varieties due to closer grazing. See individual trial tables for preference ratings.

Table 24. Summary of 2000-2019 Kentucky perennial ryegrass and festulolium (FL) grazing tolerance trials in Lexington (stand persistence shown as a percent of the mean of the commercial varieties in the trial).

Variety	Type	Proprietor	2000[1,2] 4yr[4]	2001 3yr	2003 4yr	2007 4yr	2008 4yr	2010 4yr	2011 4yr	2012 4yr	2013 4yr	2014 4yr	2015 4yr	2016 3yr	Mean[3] (#trials)
AGRLP103	–	AgResearch USA	128		86										107(2)
Albion	tetraploid	Grassland Oregon											120		–
Aries	diploid	Ampac Seed		139											–
Barfest (FL)	MF x PR[6]	Barenbrug USA						116	112						114(2)
Barvitra	diploid	Barenbrug USA											35		–
BG-34	diploid	Barenbrug USA											83		–
Boost	tetraploid	Allied Seed					101	83	95	104					96(4)
Calibra	tetraploid	DLF International								120		88	97	108	103(4)
Citadel	tetraploid	Donley Seed	107												–
Duo (FL)	MF x PR[6]	Ampac Seed	116				95	72	90	115			70	67	89(7)
Lasso	diploid	DLF-Jenks		130											–
Linn (certified)	diploid	Public	112	129	63		95	108	95	103	96	80	74	96	96(11)
Maverick	tetraploid	Ampac Seed		36											–
Meadow Green (FL)	MF x IR[6]	Pure Seed								15					–
Melpetra	tetraploid	Hood River Seed												106	–
PayDay	tetraploid	Mountain View Seeds									101	85			93(2)
Polly II	tetraploid	FS Growmark	36	68											52(2)
Power	tetraploid	Ampac Seed				158		107	112	109	89	79	83		105(7)
Quartet	tetraploid	Ampac Seed		77		59									68(2)
Remington	tetraploid	Barenbrug USA			151							138	180	135	151(3)
Remington PLUS NEA2[5]	tetraploid	Barenbrug USA										145	171		158(3)
Spring Green (FL)	MF x PR[6]	Rose Agri-Seed	101				109	115	115	120			87	89	105(7)
TetraGain	tetraploid	Pure Seed								112					–
Victorian	diploid	Caudill Seed									114				–

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in stand persistence between varieties. To find actual persistence ratings, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2010 was grazed four years so the final report would be "2014 Cool-Season Grass Grazing Tolerance Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Mean only presented when respective variety was included in two or more trials.
4 Number of years of data.
5 Remington PLUS NEA2 contains a non-toxic (novel) endophyte.
6 MF = meadow fescue, PR = perennial ryegrass, IR = Italian ryegrass.

Table 25. Summary of 1999-2019 Kentucky tall fescue horse-grazing tolerance trials with three or more years of data in Lexington (stand persistence shown as a percent of the stand rating of the endophyte free variety KY 31-).

Variety	Endophyte Status[1]	Proprietor/ KY Distributor	1999[2,3] 3-yr[5]	2001 4-yr	2002 4-yr	2003 4-yr	2004 4-yr	2005 4-yr	2006 4-yr	2007 4-yr	2008 4-yr	2009 4-yr	2010 4-yr	2011 4-yr	2012 4-yr	2013 4-yr	2014 4-yr	2015 4-yr	2016 3-yr	Mean[4] (#trials)
BarOptima PLUS E34[6]	novel	Barenbrug USA								107			101	101	95	104	99	99	101	101(8)
Bronson	free	Ampac Seed	80																	–
Cajun II	free	Smith Seed Services														96			101	99(2)
Cattle Club	free	Green Seed	95																	–
Cowgirl	free	Rose Agri-Seed									105				99					102(2)
Festorina	free	Advanta Seed	102																	–
Jesup MaxQ	novel	Pennington Seed			98			78			104	97	100	101	97	105	98	100	99	98(11)
Johnstone	free	ProSeeds Marketing		88																–
KY31+	toxic	KY Agri. Exp. Sta.		105				102	109	120	107	101	101	101	99	105	99	100	101	104(13)
KY31-	free	KY Agri. Exp. Sta.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100(17)
Lacefield MaxQ II	novel	Pennington Seed							105	110		98				104		100	100	103(6)
Nanryo	free	Japanese Grassland Forage Seed								72										–
Seine	free	Seed Research of Oregon					135													–
Select	free	Southern States	82		109	94	99	73	104	76	108	98	100	101	98	98	97	100		96(15)
SS0705TFSL	free	Southern States															98	100	100	99(3)
Stargrazer	free	Southern States	70																	–
Stockman	free	Seed Research of Oregon					125													–

1 Free varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
2 Year trial was established.
3 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in stand persistence between varieties. To find actual persistence ratings, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2010 was grazed four years so the final report would be "2014 Cool-Season Grass Horse Grazing Tolerance Report" archived in the UK Forage website at forages.ca.uky.edu.
4 Mean only presented when respective variety was included in two or more trials.
5 Number of years of data.
6 BarOptima PLUS E34 is not recommended for pregnant mares because it produces low levels of the alkaloid ergovaline.

Table 26. Summary of 1999-2019 Kentucky orchardgrass horse-grazing tolerance trials with three or more years of data in Lexington (stand persistence shown as a percentage of the mean of the commercial varieties in the trial).

Variety	Proprietor/ KY Distributor	1999[1,2] 3-yr[5]	2000 4-yr	2001 4-yr	2002 4-yr	2005[3] 4-yr	2006 4-yr	2009 4-yr	2010 4-yr	2011 4-yr	2012 4-yr	2013 4-yr	2014 4-yr	2015 4-yr	2016 3-yr	Mean[4] (#trials)
Albert	Univ. of Wisconsin			95												–
Ambrosia	Amer.Grass Seed Prod.						61									–
Benchmark	Southern States	104			85											95(2)
Benchmark Plus	Southern States				111	157	139	111	114	121	121	137	105			120(8)
Crown Royale	Grassland Oregon			95												–
Crown Royale Plus	Grassland Oregon				97											–
Elise	Pure Seed										87					–
Haymate	Southern States	96	85		97											93(3)
Persist	Smith Seed Services					114		103	101	92	112	146	95	123	127	112(8)
Potomac	Public				117											–
Prairie	Turner Seed			100										92	91	92(2)
Prodigy	Caudill Seed											54				–
Profit	Ampac Seed							93	86		92		108			95(4)
SS-0708OGDT	Southern States									104			92	77	90	91(4)
Tekapo	Ampac Seed	101	115		93	30		92	100	83	87	63		108		94(9)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in stand persistence between varieties. To find actual persistence ratings, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2010 was grazed four years so the final report would be "2014 Cool-Season Grass Horse Grazing Tolerance Report" archived in the UK Forage website at forages.ca.uky.edu.
3 Due to high variation during 2005 these values are not included in the overall mean.
4 Mean only presented when respective variety was included in two or more trials.
5 Number of years of data.

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2019 Tall Fescue and Bromegrass Report

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Introduction

Tall fescue (*Festuca arundinacea*) is a productive, well-adapted, persistent, soil-conserving, cool-season grass grown on approximately 5.5 million acres in Kentucky. This grass, used for both hay and pasture, is the forage base of most of Kentucky's livestock enterprises, particularly beef cattle.

Much of the tall fescue in Kentucky is infected with an internal fungus (endophyte) that produces ergot alkaloids and results in decreased weight gains in growing ruminants and lower pregnancy rates in breeding stock, especially in hot weather. Varieties are now available that are free of this fungal endophyte or infected with a nontoxic endophyte. Varieties in the latter group are also referred to as "novel" or "friendly" endophyte varieties, because their endophyte improves stand survival without creating animal production problems.

Smooth bromegrass (*Bromus inermis Leyss*) is a perennial pasture and hay grass native of Europe. It has creeping underground stems or rootstocks from which the leafy stems arise. Smooth bromegrass is palatable to all classes of livestock, from emergence to the heading stage. Meadow bromegrass (*Bromus biebersteinii Roem & Schult*) is a native of southeastern Europe and the adjacent Near East. It resembles smooth bromegrass but has only short rhizomes or none at all. Meadow bromegrass is densely tufted and has a similar growth habit to tall fescue and has the advantage of greater seedling vigor than smooth bromegrass. Hybrid bromegrasses are a cross between smooth and meadow bromegrasses that combine the vigorous growth of smooth bromegrass with the leafiness and good regrowth of meadow bromegrass. Alaska bromegrass (*Bromus sitchensis*), also called Sitka bromegrass, is a long-lived perennial bunchgrass that will actively grow at moderate rates during the spring and summer season. It does not spread by rhizomes and is more suited to environments with harsh winters.

Prairie bromegrass (*Bromus wildenowii*) is a tall, cool-season, leafy, short-lived, perennial, deep-rooted bunchgrass. It was introduced from South America. Seedheads are produced throughout the growing season, and to maintain productive stands for several

Table 1. Temperature and rainfall at Lexington, Kentucky, in 2017, 2018, and 2019

	2017				2018				2019[2]			
	Temp		Rainfall		Temp		Rainfall		Temp		Rainfall	
	°F	DEP[1]	IN	DEP	°F	DEP	IN	DEP	°F	DEP	IN	DEP
JAN	40	+9	6.81	+3.95	31	0	2.01	-0.85	33	+2	4.11	+1.25
FEB	47	+12	4.46	+1.25	45	+10	9.77	+6.56	42	+7	7.64	+4.43
MAR	48	+4	3.34	-1.06	42	-2.	5.16	+0.76	43	-1	3.44	-0.91
APR	62	+7	4.17	+0.29	50	-5	5.52	+1.64	54	+4	4.76	+0.88
MAY	66	+2	7.74	+3.27	73	+9	8.39	+3.92	69	+5	4.49	+0.02
JUN	73	+1	7.68	+4.02	76	+4	6.42	+2.76	73	+1	6.13	+2.47
JUL	76	0	4.49	-0.51	77	+1	6.15	+1.15	79	+3	3.30	-1.70
AUG	74	-1	6.66	+2.73	77	+2	6.45	+2.52	77	+2	2.42	-1.51
SEP	69	+1	4.72	+1.52	74	+6	12.88	+9.68	77	+9	0.18	-3.02
OCT	60	+3	6.06	+3.49	59	+2	6.54	+3.97	61	+4	8.15	+5.58
NOV	47	+2	3.09	-0.30	42	-3	5.64	+2.25				
DEC	35	-1	2.66	-1.32	40	+4	7.35	+3.37				
Total			61.88	+17.33			82.28	+37.73			44.67	+7.49

1 DEP is departure from the long-term average.
2 2019 data is for ten months through October.

Table 2. Temperature and rainfall at Quicksand, Kentucky, in 2017, 2018, and 2019

	2017				2018				2019[2]			
	Temp		Rainfall		Temp		Rainfall		Temp		Rainfall	
	°F	DEP[1]	IN	DEP	°F	DEP	IN	DEP	°F	DEP	IN	DEP
JAN	43	+12	4.61	+1.32	31	0	1.71	-1.58	37	+6	4.93	+1.64
FEB	46	+13	2.27	-1.33	48	+15	7.56	+3.96	45	+12	8.15	+4.55
MAR	48	+7	4.13	-0.21	44	+3	5.90	+1.56	44	+3	2.15	-2.19
APR	62	+9	4.23	+0.13	52	-1	4.07	-0.03	58	+5	2.55	-1.55
MAY	65	+3	6.33	+1.85	71	+9	5.28	+0.80	68	+6	3.91	-0.57
JUN	71	+1	5.82	+2.00	75	+5	5.47	+1.65	72	+2	8.35	+4.53
JUL	76	+2	5.76	+0.51	76	+2	5.39	+0.14	77	+3	6.32	+1.07
AUG	73	0	6.59	+2.58	75	+2	3.23	-0.78	75	+2	1.57	-2.44
SEP	68	+2	2.57	-0.95	74	+8	8.70	+5.18	74	+8	0.04	-3.48
OCT	59	+5	5.56	+2.65	59	+5	4.54	+1.63	60	+6	6.80	+3.89
NOV	47	+5	1.33	-2.55	43	+1	5.03	+1.15				
DEC	37	+4	3.28	-0.86	41	+8	7.07	+2.93				
Total			52.48	+5.14			63.95	+16.61			44.77	+5.45

1 DEP is departure from the long-term average.
2 2019 data is for the ten months through October.

Table 3. Temperature and rainfall at Princeton, Kentucky, in 2018 and 2019

	2018				2019[2]			
	Temp		Rainfall		Temp		Rainfall	
	°F	DEP[1]	IN	DEP	°F	DEP	IN	DEP
JAN	32	-2	4.28	+0.48	36	+2	3.62	-0.18
FEB	45	+7	9.50	+5.07	43	+5	11.14	+6.71
MAR	47	0	9.53	-1.41	44	-3	3.34	-1.60
APR	53	-6	4.90	+0.10	59	0	4.50	-0.30
MAY	74	+7	4.69	-0.27	69	+2	5.61	+0.05
JUN	78	+3	7.80	+3.95	73	*2	4.33	+0.48
JUL	78	0	2.58	-1.71	77	-1	3.12	-1.17
AUG	77	0	2.68	-1.33	76	-1	6.31	+2.30
SEP	74	+4	5.61	+2.28	75	+4	0.34	-2.99
OCT	61	+2	2.96	-0.09	59	0	6.36	+3.31
NOV	42	-5	4.77	+0.14				
DEC	42	+3	5.45	+0.41				
Total			58.75	7.62			48.67	+7.21

1 DEP is departure from the long-term average.
2 2019 data is for the ten months through October.

years, it is necessary to manage at least one growth cycle each year for seed production and natural reseeding. Some prairie bromegrasses are susceptible to winterkill. Mountain bromegrass (*Bromus marginatus*) is native to North America from Alaska to northern Mexico, where it can be found in many types of habitats. It is a short-lived, perennial, cool-season, sod-forming grass. Leafy growth and a deep, well-branched root system give protection on erodible slopes. It is similar to California bromegrass (*Bromus carinatus*), and some consider them to be synonymous.

All bromegrasses have several advantages over tall fescue, including retaining quality as they mature and better growth during dry weather, but they are generally less well adapted in Kentucky.

This report provides current yield data on tall fescue varieties and similar grass species in trials in Kentucky as well as guidelines for selecting tall fescue varieties. Tables 16 and 17 show a summary of all tall fescue and bromegrass varieties tested in Kentucky for the past 17 years. The UK Forage Extension website at forages.ca.uky.edu contains electronic versions of all forage variety testing reports from Kentucky and surrounding states, and a large number of other forage publications.

Important Selection Considerations

Local adaptation and seasonal yield. Before purchasing tall fescue seed, make sure that the variety is adapted to Kentucky, as indicated by good performance across years and locations in replicated yield trials such as those presented in this publication. Choose high-yielding persistent varieties and varieties that are productive during the desired season of use.

Tall fescues are often classified as either "Mediterranean" or "continental" types according to the area from which the parental material for the variety originated. In general, the Mediterranean types (e.g., cajun and fawn) are more productive in the fall and winter than the continental types (such as Kentucky 31). Although they mature earlier in the spring, the Mediterranean types become dormant and nonproductive during the summer in Kentucky and are more susceptible than continental varieties to leaf diseases such as helminthsporium and rhizoctonia. Therefore, Mediterranean varieties are less preferred for use in Kentucky than continental types. Because Mediterranean varieties mature earlier in the spring, first-cutting yields are generally higher when the two types are harvested at the same time. However, the continental types produce more in the summer, allowing for extended grazing.

Endophyte level. Seed with infection levels of less than 5 percent is regarded as endophyte-free. A statement to that effect will be displayed prominently on a green tag attached to the seed bag. If no tag is present, assume the seed is infected with the toxic endophyte. Several varieties, both with and without the endophyte, are adapted for use in Kentucky. With the new "novel endophyte" tall fescues, the seed tag should specify the infection level. Also, seed of these varieties should be handled carefully to preserve this infection, which means keeping seed cool and planting as soon as possible. "Novel endophyte" varieties need a high infection level to improve stand survival. Look

Table 4. Descriptive scheme for the stages of development in perennial forage grasses

Code	Description	Remarks
	Leaf development	
11	First leaf unfolded	Applicable to regrowth of established (plants) and to primary growth of seedlings. Further subdivision by means of leaf development index (see text).
12	2 leaves unfolded	Further subdivision by means of leaf development index (see text).
13	3 leaves unfolded	
•	• • • • •	
19	9 or more leaves unfolded	
	Sheath elongation	
20	No elongated sheath	Denotes first phase of new spring growth after overwintering. This character is used instead of tillering which is difficult to record in established stands.
21	1 elongated sheath	
22	2 elongated sheaths	
23	3 elongated sheaths	
•	• • • • •	
29	9 or more elongated sheaths	
	Tillering (alternative to sheath elongation)	
21	Main shoot only	Applicable to primary growth of seedlings or to single tiller transplants.
22	Main shoot and 1 tiller	
23	Main shoot and 2 tillers	
24	Main shoot and 3 tillers	
•	• • • • •	
29	Main shoot and 9 or more tillers	
	Stem elongation	
31	First node palpable	More precisely an accumulation of nodes. Fertile and sterile tillers distinguishable.
32	Second node palpable	
33	Third node palpable	
34	Fourth node palpable	
35	Fifth node palpable	
37	Flag leaf just visible	
39	Flag leaf ligule/collar just visible	
	Booting	
45	Boot swollen	
	Inflorescence emergence	
50	Upper 1 to 2 cm of inflorescence visible	
52	¼ of inflorescence emerged	
54	½ of inflorescence emerged	
56	¾ of inflorescence emerged	
58	Base of inflorescence just visible	
	Anthesis	
60	Preanthesis	Inflorescence-bearing internode is visible. No anthers are visible.
62	Beginning of anthesis	First anthers appear.
64	Maximum anthesis	Maximum pollen shedding.
66	End of anthesis	No more pollen shedding.
	Seed ripening	
75	Endosperm milky	Inflorescence green
85	Endosperm soft doughy	No seeds loosening when inflorescence is hit on palm.
87	Endosperm hard doughy	Inflorescence losing chlorophyll; a few seeds loosening when inflorescence hit on palm
91	Endosperm hard	Inflorescence-bearing internode losing chlorophyll; seeds loosening in quantity when inflorescence hit on palm.
93	Endosperm hard and dry	Final stage of seed development; most seeds shed.

Source: Smith, J. Allan, and Virgil W. Hayes. 1981. p. 416-418. 14th International Grasslands Conference Proc. 1981. June 14-24, 1981, Lexington, Kentucky.

Table 5. Dry matter yields, seedling vigor, maturity, and stand persistence of tall fescue and meadow fescue (MF) varieties sown September 7, 2016, at Lexington, Kentucky

Variety	Endophyte Status[1]	Seedling Vigor[2] Oct 16, 2016	Maturity[3] 2017 May 3	Maturity[3] 2018 May 11	Maturity[3] 2019 May 9	Percent Stand 2016 Oct 5	Percent Stand 2017 Mar 14	Percent Stand 2017 Oct 31	Percent Stand 2018 Mar 15	Percent Stand 2018 Oct 19	Percent Stand 2019 Mar 22	Percent Stand 2019 Oct 17	Yield (tons/acre) 2017 Total	Yield (tons/acre) 2018 Total	Yield (tons/acre) 2019 May 9	Yield (tons/acre) 2019 Jun 24	Yield (tons/acre) 2019 Total	3-year Total
Commercial Varieties-Available for Farm Use																		
Jesup MaxQ	novel	4.8	56.5	54.5	57.5	100	100	100	100	100	100	100	5.95	3.44	0.93	1.28	2.20	11.59*
SS0705TFSL	free	3.9	56.0	54.0	56.5	100	100	100	100	100	100	99	6.08	3.06	0.78	1.17	1.95	11.09*
Tower Protek	novel	3.0	51.0	46.3	49.8	99	100	100	100	100	100	98	5.95	2.97	0.84	1.09	1.93	10.86*
Teton II	free	3.8	57.0	56.0	56.0	100	100	100	100	100	100	96	6.13	2.96	0.75	1.01	1.76	10.84*
KY31+	toxic	4.0	52.0	49.0	53.0	100	100	100	100	100	100	98	6.25	2.96	0.68	0.90	1.58	10.78*
Select	free	3.9	55.5	53.5	56.5	100	100	100	100	100	100	94	5.93	2.95	0.83	0.94	1.78	10.65*
Kora Protek	novel	3.5	51.0	51.0	48.8	100	100	100	100	100	100	99	5.64	3.30	0.85	0.82	1.68	10.62*
Tower	free	2.5	53.5	35.5	47.5	99	100	100	100	100	100	96	6.35	2.32	0.70	1.15	1.85	10.53*
Bronson	free	3.5	55.5	51.8	55.5	100	100	100	100	100	100	100	5.50	3.04	0.93	0.97	1.90	10.44*
BarOptima PLUS E34	novel	3.1	51.0	46.3	45.0	100	100	100	100	100	100	99	5.54	2.90	0.90	1.03	1.93	10.38*
Cajun II	free	4.4	55.5	55.0	57.0	100	100	100	100	100	100	100	4.97	3.01	1.15	1.15	2.30	10.28*
Estancia Arkshield	novel	4.1	54.0	53.0	56.0	100	100	100	100	100	100	100	4.98	3.13	1.03	0.94	1.97	10.08*
Martin2 Protek	novel	3.5	57.0	54.5	56.5	100	100	100	100	100	100	91	5.49	2.78	0.75	0.99	1.74	10.01*
Lacefield MaxQII	novel	4.1	53.0	52.5	52.0	100	100	100	100	100	100	99	5.06	2.99	0.76	0.84	1.60	9.65
Payload	free	3.9	56.0	52.5	54.5	100	100	100	100	100	100	100	4.92	2.62	0.85	0.92	1.77	9.31
Cosmonaut (MF)	free	4.1	50.0	29.0	47.8	100	100	97	96	95	79	48	5.05	1.57	0.56	0.68	1.23	7.85
Experimental Varieties																		
KYFA1531	free	4.5	54.0	49.8	55.0	100	100	100	100	100	100	100	6.59	3.20	0.95	1.18	2.13	11.92*
KYFA1537	free	4.9	54.5	52.0	55.0	100	100	100	100	100	100	100	6.28	3.36	0.83	1.04	1.86	11.50*
IS-FTF 70	free	3.3	53.0	50.3	50.5	100	100	100	100	100	100	96	6.00	3.10	1.05	1.20	2.25	11.35*
TFCB4C2	free	2.9	55.0	55.0	57.5	100	100	100	100	100	100	100	6.08	3.32	1.01	0.90	1.91	11.31*
KYFA1533	free	4.6	54.0	52.3	54.5	100	100	100	100	100	100	100	5.96	3.11	1.02	1.03	2.04	11.11*
KYFA1536	free	4.4	55.0	53.0	54.5	100	100	100	100	100	100	100	5.81	3.16	1.07	0.93	1.99	10.96*
TFCB3C2	free	3.3	56.5	54.0	57.0	100	100	100	100	100	100	99	5.57	3.20	1.05	1.07	2.12	10.89*
RAD-HAN33	free	3.1	55.5	54.0	55.0	100	100	100	100	100	100	99	5.78	2.86	0.96	1.22	2.18	10.82*
TFSoft	free	3.8	54.5	55.5	56.0	100	100	100	100	100	100	96	5.53	2.98	0.90	1.38	2.28	10.79*
KYFA9304	free	4.8	52.0	51.5	54.0	100	100	100	100	100	100	97	5.87	2.92	0.90	1.02	1.92	10.71*
KYFA1303	free	4.6	51.0	52.0	52.5	100	100	100	100	100	100	100	5.86	3.25	0.62	0.94	1.56	10.68*
KYFA1532	free	4.4	54.5	51.0	54.0	100	100	100	100	100	100	100	5.68	2.87	0.80	1.25	2.05	10.61*
TFCB5C2	free	3.8	54.5	50.8	56.0	100	100	100	100	100	100	100	5.79	2.95	0.71	1.11	1.81	10.56*
KYFA9611	free	2.4	52.0	41.0	48.5	98	99	100	100	100	99	97	6.38	2.59	0.56	1.01	1.57	10.53*
KYFA1535	free	4.6	55.0	53.5	56.0	100	100	100	100	100	100	100	5.59	3.42	0.61	0.81	1.42	10.43*
KYFA1201	free	4.1	55.5	52.0	56.0	100	100	100	100	100	100	98	5.49	3.12	0.88	0.89	1.77	10.37*
TFCB1bC2	free	3.3	53.5	48.8	54.0	100	100	100	100	100	100	100	5.57	3.16	0.71	0.87	1.58	10.31*
KYFA9732/AR584	novel	4.4	53.0	46.3	53.0	100	100	100	100	100	100	98	5.98	2.85	0.60	0.87	1.47	10.29*
RAD-HAN19	free	3.1	53.0	51.5	53.5	100	100	100	100	100	100	98	5.24	3.18	0.78	1.09	1.87	10.28*
KYFA1534	free	4.5	56.0	53.5	56.0	100	100	100	100	100	100	100	5.77	2.74	0.81	0.84	1.64	10.15*
DLFPS-FTF93	free	3.8	57.5	56.0	58.0	100	100	100	100	100	100	98	5.24	2.63	1.03	0.93	1.97	9.84
TF0503	free	4.0	55.0	50.5	56.0	100	100	100	100	100	100	100	5.28	2.65	0.84	0.98	1.82	9.75
KY31-	free	4.1	53.5	51.5	54.5	100	100	100	100	100	100	99	4.82	3.09	0.77	0.96	1.73	9.64
PPG-FTF112	free	3.1	52.5	38.3	49.3	100	100	100	100	100	100	100	5.30	2.68	0.69	0.91	1.60	9.58
IS-FTF54 Protek	novel	3.0	57.5	56.0	58.0	100	100	100	100	100	100	100	5.12	2.59	0.93	0.94	1.87	9.57
DLFPS-FTF96	free	3.5	53.0	53.5	53.5	100	100	100	100	100	100	100	5.07	2.64	0.79	1.03	1.82	9.53
IS-FTF73	free	3.1	51.5	45.3	47.5	100	100	100	100	100	100	100	5.19	2.50	0.69	0.91	1.60	9.28
SLTF10-3	free	3.1	53.5	50.0	49.5	100	100	100	100	100	100	94	5.07	2.32	0.64	0.94	1.57	8.96
KYFP0901 (MF)	free	4.4	50.0	35.3	52.0	100	100	100	99	97	96	61	4.26	1.64	0.69	0.68	1.37	7.27
15610912	free	2.8	52.5	50.8	55.0	98	98	68	63	63	53	48	2.26	1.52	0.41	0.46	0.87	4.64
Mean		3.8	54.0	50.2	53.7	100	100	99	99	99	98	95	5.53	2.86	0.82	0.98	1.80	10.19
CV,%		12.9	3.2	7.5	3.8	1	1	4	3	3	5	7	17.22	17.84	24.80	22.49	18.50	13.59
LSD,0.05		0.7	2.4	5.3	2.9	1	0	6	5	5	7	9	1.33	0.71	0.28	0.31	0.44	1.94

1 Free-varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.

2 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.

3 Maturity rating scale: 37=flag leaf emergence, 45=boot swollen, 50=beginning of inflorescence emergence, 58=complete emergence of inflorescence, 62=beginning of pollen shed. See Table 4 for complete scale.

*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

for Alliance for Grassland Renewal seed quality assurance printed on each bag of novel fescue seed.

Seed quality. Buy premium-quality seed that is high in germination and purity levels and free from weed seed. Buy certified seed of improved varieties. An improved variety is one that has performed well in independent trials. The label also includes the test date (which must be within the previous nine months), the level of germination, and the amount of other crop and weed seed. Order seed well in advance of planting time to assure that it will be available when needed.

Description of the Tests

Data from nine studies are reported. Tall fescue varieties were sown at Lexington (2016, 2017, and 2018), Princeton (2017) and Quicksand (2016 & 2018). The bromegrass trials were sown in Lexington in 2016, 2017, and 2018. The soils at Lexington (Maury), Princeton (Crider) and Quicksand (Nolin) are well-drained silt loams. They are well suited for tall fescue and bromegrass production.

Seedings were made at the rate of 25 pounds per acre for tall fescue and 20 pounds per acre for bromegrass into a prepared seedbed with a disk drill. Plots were 5 feet by 20 feet in a randomized complete block design with four replications with a harvested plot area of 5 feet by 15 feet. Nitrogen was topdressed at 60 pounds per acre of actual nitrogen in March, after the first cutting, and again in late summer, for a total of 180 pounds per acre over the season. The tests were harvested using a sickle-type forage plot harvester to simulate a spring cut hay/summer grazing/fall stockpile management system. The first cutting was harvested when all tall fescue and bromegrass varieties had reached at least the boot stage. Fresh weight samples were taken at each harvest to calculate dry matter production. Management practices for these tests regarding establishment, fertility (P, K, and lime based on regular soil tests), weed control, and harvest timing were in accordance with University of Kentucky recommendations.

Results and Discussion

Weather data for Lexington, Quicksand, and Princeton are presented in Tables 1 through 3.

Ratings for maturity (see Table 4 for maturity scale), stand, and dry matter yields (tons/A) are reported in Tables 5 through 13. Yields are given by cutting date for 2019 and as total annual production. Stated yields are adjusted for percent weeds, therefore the tonnage given is for crop only. Varieties are listed by total yield in descending order. Experimental varieties are listed separately at the bottom of the tables.

Statistical analyses were performed on all data to determine if the apparent differences are truly due to varietal

Table 6. Dry matter yields, seedling vigor, maturity, and stand persistence of tall fescue and meadow fescue (MF) varieties sown September 8, 2017, at Lexington, Kentucky

			Maturity[3]		Percent Stand					Yield (tons/acre)				
			2018	2019	2017	2018		2019		2018	2019			
Variety	Endophyte Status[1]	Seedling Vigor[2] Oct 12, 2017	May 8	May 6	Oct 12	Mar 14	Oct 19	Mar 22	Oct 17	Total	May 6	Jun 24	Total	2-year Total
Commercial Varieties-Available for Farm Use														
Jesup MaxQ	novel	4.0	54.0	55.5	100	100	100	100	100	5.38	1.09	1.07	2.16	7.55*
SS0705TFSL	free	4.0	51.0	53.5	100	99	99	99	99	5.42	1.18	0.92	2.10	7.52*
Cajun II	free	3.9	52.5	55.5	99	99	99	99	100	5.29	1.18	1.02	2.19	7.49*
KY31+	toxic	4.3	46.3	51.5	100	100	100	100	100	5.32	0.85	0.75	1.60	6.92*
BarOptima PLUS E34	novel	3.3	45.0	48.8	99	95	98	98	100	4.59	1.00	0.78	1.78	6.37*
Lacefield MaxQII	novel	4.0	46.3	53.0	100	100	100	100	100	4.77	0.67	0.91	1.59	6.36*
Pradel (MF)	free	3.9	45.0	45.0	100	100	100	98	51	4.13	0.66	0.62	1.28	5.41
Experimental Varieties														
KYFA1305	free	4.0	45.0	53.3	100	100	100	100	100	5.54	0.71	1.06	1.77	7.31*
KYFA1306	free	3.8	49.3	49.8	78	100	100	100	100	5.44	0.88	0.80	1.68	7.13*
FTF94	free	2.1	52.5	56.0	86	86	89	89	95	4.78	0.98	1.13	2.10	6.88*
KYFA1304	free	2.9	49.8	53.5	91	90	91	91	94	5.07	0.97	0.80	1.77	6.83*
KYFA9304	free	4.0	48.5	52.0	99	99	99	99	99	4.85	0.87	1.09	1.96	6.80*
KYFA1405	free	2.8	46.3	52.0	83	83	87	95	96	4.85	1.05	0.91	1.95	6.80*
KYFA1404	free	2.9	45.0	50.3	98	98	98	99	99	4.60	1.02	1.02	2.04	6.64*
STF50	free	2.3	52.5	53.0	93	91	93	93	93	4.49	1.17	0.84	2.01	6.50*
RAD-ERF37	free	3.3	51.5	56.0	97	96	97	98	98	4.48	1.13	0.88	2.01	6.49*
KY31-	free	3.5	50.3	52.5	100	100	100	100	100	4.38	0.83	0.96	1.79	6.17
KYFP1301 (MF)	free	3.8	45.0	45.0	98	98	98	97	81	4.42	0.69	0.77	1.46	5.87
BARFA6BTR179	free	3.3	45.0	46.8	98	98	99	98	96	3.86	0.82	0.81	1.63	5.49
KYFA1606	free	1.0	45.0	52.3	63	51	53	65	59	3.49	0.72	0.60	1.31	4.87
Mean		3.3	48.3	51.8	94	94	95	96	93	4.77	0.92	0.89	1.81	6.59
CV,%		18.4	4.5	5.2	14	10	8	8	9	16.33	26.45	26.23	19.60	14.29
LSD,0.05		0.9	3.0	3.8	19	13	11	11	11	1.11	0.35	0.33	0.50	1.35

1 Free-varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence . but is not toxic to cattle.
2 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
3 Maturity rating scale: 37=flag leaf emergence, 45=boot swollen, 50=beginning of inflorescence emergence, 58=complete emergence of inflorescence, 62=beginning of pollen shed. See Table 4 for complete scale.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 7. Dry matter yields, seedling vigor, maturity, and stand persistence of tall fescue and festulolium (FL) varieties sown September 4, 2018, at Lexington, Kentucky

Variety	Endophyte Status[1]	Seedling Vigor[2] Sep 28, 2018	Maturity[3] 2019 May 6	Percent Stand 2018 Sep 28	Percent Stand 2019 Mar 22	Percent Stand 2019 Oct 17	Yield (tons/acre) 2019 May 6	Yield (tons/acre) 2019 Jun 24	Yield (tons/acre) 2019 Total
Commercial Varieties-Available for Farm Use									
Cajun II	free	4.9	56.5	100	100	100	1.68	1.69	3.37*
KY31+	toxic	4.9	55.5	100	100	100	1.61	1.63	3.23*
Bull	free	4.5	57.5	100	100	100	1.69	1.47	3.15*
Estancia Arkshield	novel	4.3	56.5	100	100	100	1.60	1.55	3.15*
Lacefield MaxQII	novel	4.4	55.5	100	100	100	1.48	1.58	3.07*
Jesup MaxQ	novel	4.8	56.5	100	100	100	1.55	1.40	2.95*
SS0705TFSL	free	4.8	56.5	100	100	100	1.45	1.24	2.69*
Kentucky 32	free	4.9	56.0	100	100	100	1.33	1.32	2.65*
BarOptima PLUS E34	novel	4.8	52.0	100	100	100	1.30	1.30	2.60
Experimental Varieties									
KYFA9304	free	4.9	55.0	100	100	100	1.49	1.70	3.19*
BARFAF137	free	4.5	51.5	100	100	100	1.41	1.64	3.05*
KYFA9821/AR584	novel	4.8	56.0	100	100	100	1.58	1.45	3.04*
B-18.1787	free	4.5	57.5	100	100	100	1.57	1.42	2.99*
KY31-	free	5.0	55.0	100	100	100	1.35	1.60	2.95*
FTF2(FL)	free	4.8	56.5	100	100	100	1.39	1.49	2.88*
BARFAF135	free	4.9	53.0	100	100	100	1.34	1.52	2.87*
KYFA9611	free	4.6	52.0	100	100	100	1.21	1.62	2.83*
KYFA1704	free	4.8	54.0	100	100	100	1.20	1.53	2.72*
7016	free	4.9	56.0	100	100	100	1.48	1.23	2.70*
FTF89	free	4.9	57.0	100	100	100	1.47	1.18	2.65*
7FACF82	free	5.0	51.0	100	100	100	1.20	1.41	2.62
BARFAF131	free	3.4	55.0	100	100	100	1.44	1.15	2.59
BARFABTR7NEA23	novel	3.9	54.0	100	100	100	1.24	1.27	2.50
RADMRF20	free	4.8	54.5	100	100	100	1.27	1.22	2.49
BARFA6BR-179	free	4.3	50.5	100	99	99	0.95	1.31	2.26
SLTF10-3	free	4.6	54.5	100	100	100	0.90	1.19	2.09
Mean		4.6	54.8	100	100	100	1.39	1.43	2.82
CV,%		6.2	2.0	0	0	0	22.45	16.76	18.22
LSD,0.05		0.4	1.6	0	1	1	0.44	0.34	0.72

1 Free-varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
2 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
3 Maturity rating scale: 37=flag leaf emergence, 45=boot swollen, 50=beginning of inflorescence emergence, 58=complete emergence of inflorescence, 62=beginning of pollen shed. See Table 4 for complete scale.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

differences or just to chance. In the tables, varieties that are not significantly different from the top variety in the column for that characteristic are marked with one asterisk (*). To determine if two varieties are truly different, compare the difference between them and the LSD (least significant difference) at the bottom of the column. If the difference is equal to or greater than the LSD, the varieties are truly different when grown under the conditions at the given locations. The coefficient of variation (CV) is a measure of the variability of the data and is included for each column of means. Low variability is desirable, and increased variability within a study results in higher CVs and larger LSDs.

Tables 14 and 15 show information about proprietors/distributors for all varieties included in the tests discussed in this report. Varieties are listed in alphabetical order by species, with the experimental varieties at the bottom. Remember that experimental varieties are not available for farm use; commercial varieties can be purchased from agricultural distributors. Remember to consider the relative spring maturity and the distribution of yield across the growing season when evaluating productivity of tall fescue and bromegrass varieties (Tables 5 through 13).

Tables 16 and 17 are summaries of yield data from 2000 to 2019 for tall fescue and from 2006 to 2019 for bromegrass commercial varieties that have been entered in the Kentucky trials. The data is listed as a percentage of the mean of the commercial varieties entered in each specific trial. In other words, the mean for each trial is 100 percent—varieties with percentages over 100 yielded better than average and varieties with percentages less than 100 yielded lower than average. Direct statistical comparisons of varieties cannot be made using the Table 16 and 17 summaries, but these comparisons do help to identify varieties for further consideration. Varieties that have performed better than average over many years and at several locations have very stable performance, while others may have performed very well in wet years

Table 8. Dry matter yields, seedling vigor, maturity, and stand persistence of tall fescue varieties sown September 22, 2017, at Princeton, Kentucky

Variety	Endophyte Status[1]	Seedling Vigor[2] Nov 14	Maturity[3] 2019 May 7	Percent Stand 2017 Nov 14	2018 Apr 5	2018 Oct 11	2019 Apr 3	2019 Nov 4	Yield (tons/acre)[4] 2019 May 7	Jun 21	Aug 14	Total
Commercial Varieties-Available for Farm Use												
Lacefield MaxQII	novel	3.4	56.0	99	95	96	99	99	1.71	0.98	0.58	3.27*
Cajun II	free	2.9	56.5	98	91	93	99	99	1.83	1.01	0.46	3.24*
SS0705TFSL	free	3.5	56.0	100	98	98	100	100	1.52	1.05	0.65	3.22*
Jesup MaxQ	novel	3.8	56.5	100	99	99	100	100	1.50	1.13	0.44	3.19*
BarOptima PLUS E34	novel	3.5	53.5	100	98	98	98	98	1.59	1.01	0.56	3.16*
KY31+	toxic	3.5	54.5	100	99	100	99	99	1.46	0.98	0.47	2.91
Experimental Varieties												
KYFA1405	free	3.0	56.0	99	98	98	99	98	1.69	1.11	0.71	3.51*
FTF94	free	2.6	57.5	95	86	86	96	96	1.90	0.84	0.55	3.29*
KY31-	free	3.8	54.5	100	98	98	99	99	1.55	1.03	0.67	3.24*
KYFA1304	free	3.0	57.5	96	88	88	98	94	1.73	0.96	0.51	3.20*
STF50	free	3.4	57.0	100	97	98	99	99	1.85	0.89	0.43	3.18*
RAD-ERF37	free	3.3	57.5	99	87	88	97	93	1.86	0.87	0.44	3.17*
KYFA1305	free	3.6	54.5	100	96	96	99	99	1.58	1.00	0.56	3.15*
KYFA1404	free	3.0	55.5	99	95	96	98	76	1.71	0.95	0.31	3.01*
KYFP1301	free	4.1	52.5	100	99	93	84	61	1.19	1.15	0.37	2.89
KYFA1306	free	3.4	54.5	100	98	98	77	100	1.53	1.00	0.22	2.82
KYFA9304	free	3.0	54.5	98	95	94	99	99	1.40	0.95	0.39	2.80
KYFA1606	free	3.0	57.0	99	28	30	24	24	0.66	1.15	0.72	2.53
Mean		3.3	55.6	99	91	91	92	91	1.57	1.00	0.51	3.11
CV,%		17.3	2.0	2	9	9	12	13	14.64	18.61	41.03	12.04
LSD,0.05		0.8	1.6	3	11	12	15	17	0.33	0.27	0.30	0.56

1 Free-varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
2 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
3 Maturity rating scale: 37=flag leaf emergence, 45=boot swollen, 50=beginning of inflorescence emergence, 58=complete emergence of inflorescence, 62=beginning of pollen shed. See Table 4 for complete scale.
4 Due to mechanical and other issues, the 2018 yield data is not reported.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 9. Dry matter yields, seedling vigor, and stand persistence of tall fescue varieties sown September 2, 2016, at Quicksand, Kentucky

Variety	Endophyte Status[1]	Seedling Vigor[2] Nov 3, 2016	Percent Stand 2016 Nov 3	2017 Mar 24	2017 Nov 8	2018 Apr 4	2018 Oct 5	2019 Mar 15	2019 Oct 23	Yield (tons/acre) 2017 Total	2018 Total	2019 Apr 30	2019 Jun 27	2019 Sep 15	2019 Total	3-year Total
Commercial Varieties-Available for Farm Use																
BarOptima PLUS E34	novel	4.9	100	100	100	100	100	99	97	6.90	3.72	1.19	1.25	0.47	2.92	13.54*
Jesup MaxQ	novel	4.1	99	99	99	99	100	100	100	6.88	3.42	0.92	1.09	0.92	2.93	13.22*
Payload	free	4.0	98	98	98	98	98	98	98	6.19	3.82	0.87	1.05	0.77	2.69	12.70*
KY31+	toxic	3.3	98	97	98	98	98	98	98	5.87	3.51	1.00	1.33	0.86	3.19	12.57*
Martin2 Protek	novel	4.1	98	98	98	98	98	99	99	6.65	3.12	0.99	0.92	0.49	2.40	12.17*
Estancia Arkshield	novel	4.4	100	100	100	99	99	99	99	6.14	3.15	0.71	1.10	0.67	2.49	11.78*
Lacefield MaxQII	novel	4.3	100	100	100	100	100	100	100	5.67	3.33	0.78	1.09	0.84	2.71	11.71*
SS0705TFSL	free	2.4	95	95	95	96	96	97	97	6.25	2.98	0.62	1.07	0.59	2.29	11.52*
Cajun II	free	3.0	97	96	97	97	97	98	93	5.99	2.62	0.84	1.02	0.55	2.41	11.02*
Tower	free	2.0	91	90	94	93	93	91	83	5.54	2.92	0.76	0.95	0.27	1.98	10.45*
Teton II	free	3.3	99	98	98	97	98	99	98	5.44	2.75	0.79	0.83	0.62	2.24	10.43*
Select	free	2.8	96	96	96	96	96	97	96	5.12	2.40	0.84	0.86	0.66	2.35	9.87
Kora Protek	novel	4.4	100	100	100	100	100	100	99	5.57	2.39	0.59	0.93	0.36	1.89	9.84
Tower Protek	novel	2.8	99	96	98	98	98	98	96	5.09	2.13	0.51	0.93	0.56	2.00	9.21
Experimental Varieties																
TF0503	free	3.6	98	97	98	98	98	99	99	6.62	3.95	0.92	1.32	0.86	3.10	13.67*
KY31-	free	3.5	98	97	98	98	99	99	99	5.94	3.53	0.74	1.06	1.10	2.90	12.37*
PPG-FTF112	free	2.6	90	89	91	94	94	91	88	5.01	2.46	0.76	0.98	0.44	2.18	9.64
SLTF10-3	free	3.5	97	96	96	95	95	95	88	5.02	2.02	0.64	0.84	0.37	1.85	8.89
Mean		3.5	97	97	97	97	97	97	96	5.88	3.01	0.80	1.03	0.63	2.47	11.37
CV,%		28.0	3	4	3	2	2	3	5	18.01	25.19	24.81	24.42	38.74	22.30	17.41
LSD,0.05		1.4	4	5	4	3	3	3	7	1.50	1.08	0.28	0.36	0.35	0.78	2.81

1 Free-varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
2 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 10. Dry matter yields, seedling vigor and stand persistence of tall fescue and festulolium (FL) varieties sown September 7, 2018, at Quicksand, Kentucky

			Percent Stand			Yield (tons/acre)			
		Seedling	2018	2019		2019			
Variety	Endophyte Status[1]	Vigor[2] Oct 5	Oct 5	Mar 15	Oct 23	May 1	Jun 26	Sep3	Total
Commercial Varieties-Available for Farm Use									
KY31+	toxic	4.9	100	100	100	0.99	1.66	0.83	3.48*
Jesup MaxQ	novel	4.1	100	100	100	0.82	1.65	0.87	3.33*
Cajun II	free	4.5	100	100	100	0.71	1.34	1.06	3.11
SS0705TFSL	free	4.1	100	100	96	0.73	1.44	0.93	3.11
Lacefield MaxQII	novel	4.4	100	100	98	0.62	1.50	0.97	3.10
BarOptima PLUS E34	novel	4.0	100	100	91	0.57	1.28	0.74	2.59
Experimental Varieties									
KYFA9821/AR584	novel	4.5	100	100	99	1.18	1.80	1.51	4.49*
B-18.1787	free	4.0	100	100	100	1.12	1.58	1.37	4.07*
KYFA9611	free	4.6	100	100	99	0.85	1.92	1.10	3.87*
KYFA9304	free	4.8	100	100	100	0.94	1.64	1.11	3.68*
BARFAF131	free	3.5	94	99	96	0.70	1.58	1.10	3.38*
FTF89	free	4.9	100	100	100	0.87	1.55	0.91	3.33*
KY31-	free	4.6	99	100	100	0.78	1.55	0.97	3.31*
7016	free	4.4	100	100	99	0.91	1.38	0.86	3.15
KYFA1704	free	5.0	100	100	100	0.81	1.31	0.84	2.95
BARFA6BR-179	free	3.9	100	97	65	0.49	0.98	1.27	2.74
BARFAF137	free	4.6	100	100	94	0.72	1.19	0.69	2.61
FTF2(FL)	free	4.0	98	100	96	0.51	1.20	0.81	2.52
7FACF82	free	4.6	100	100	67	0.36	0.99	0.70	2.05
RADMRF20	free	4.8	100	100	100	0.36	0.86	0.82	2.04
BARFAF135	free	4.6	100	100	95	0.35	0.84	0.64	1.84
BARFABTR7NEA23	novel	4.0	100	88	87	0.30	0.86	0.58	1.74
Mean		4.4	100	99	94	0.71	1.37	0.94	3.02
CV,%		11.5	2	5	14	42.01	26.99	37.03	27.72
LSD,0.05		0.7	3	8	18	0.42	0.52	0.49	1.18

[1] Free-varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
[2] Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

or on particular soil types. These details may influence variety choice, and the information can be found in the yearly reports. See the footnotes in Tables 16 and 17 to determine the yearly report that should be referenced.

Summary

Selecting a good variety of tall fescue and bromegrass is an important first step in establishing a productive stand of grass. Proper management, beginning with seedbed preparation and continuing throughout the life of the stand, is necessary for even the highest-yielding variety to produce to its genetic potential.

The following is a list of University of Kentucky Cooperative Extension publications related to tall fescue management available from your county Extension office and are listed in the "Publications" section of the UK Forage website, forages.ca.uky.edu:

- Lime and Fertilizer Recommendations (AGR-1)
- Grain and Forage Crop Guide for Kentucky (AGR-18)
- Tall Fescue (AGR-59)
- Establishing Forage Crops (AGR-64)
- Tall Fescue in Kentucky (AGR-108)
- Forage Identification and Use Guide (AGR-175)
- Rotational Grazing (ID-143)

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Table 11. Dry matter yields, seedling vigor, maturity, and stand persistence of bromegrass varieties sown September 8, 2016, at Lexington, Kentucky

Variety	Type	Seedling Vigor[1] Oct 15, 2016	Maturity[2] 2017 Apr 20	Maturity[2] 2018 May 9	Maturity[2] 2018 Jun 15	Maturity[2] 2019 May 2	Maturity[2] 2019 Jun 6	Percent Stand 2016 Oct 5	Percent Stand 2017 Mar 14	Percent Stand 2017 Oct 31	Percent Stand 2018 Mar 15	Percent Stand 2018 Oct 10	Percent Stand 2019 Mar 22	Percent Stand 2019 Oct 18	Yield (tons/acre) 2017 Total	Yield (tons/acre) 2018 Total	Yield (tons/acre) 2019 May 2	Yield (tons/acre) 2019 Jun 6	Yield (tons/acre) 2019 Aug 12	Yield (tons/acre) 2019 Total	3-year Total
Commercial Varieties-Available for Farm Use																					
Admiral	meadow	4.6	56.0	55.5	60.0	55.0	60.0	97	98	98	98	98	96	96	5.73	3.45	0.50	1.04	1.33	2.87	12.05*
MacBeth	meadow	4.1	56.0	54.5	60.0	54.0	60.0	97	99	99	99	99	98	98	5.75	3.44	0.56	0.97	1.15	2.67	11.87*
Arid	meadow	3.8	48.5	52.0	29.0	45.0	60.0	94	94	96	96	96	96	96	4.98	3.58	0.61	0.98	1.17	2.75	11.31*
Peak	smooth	3.4	45.0	52.5	59.5	46.3	60.0	93	92	93	94	86	94	94	4.87	3.51	0.55	1.05	1.16	2.76	11.14*
Mean		4.0	51.4	53.6	52.1	50.1	60.0	95	96	96	96	97	96	96	5.33	3.49	0.55	1.01	1.20	2.76	11.59
CV,%		20.6	4.2	3.1	1.0	3.5	0.0	4	2	2	2	2	2	2	10.19	12.59	21.65	15.49	18.62	15.50	3.67
LSD,0.05		1.3	3.5	2.6	0.8	2.8	0.0	6	4	3	3	3	4	4	0.87	0.70	0.19	0.25	0.36	0.69	1.29

1 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
2 Maturity rating scale: 37=flag leaf emergence, 45=boot swollen, 50=beginning of inflorescence emergence, 58=complete emergence of inflorescence, 62=beginning of pollen shed. See Table 4 for complete scale.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 12. Dry matter yields, seedling vigor, maturity, and stand persistence of bromegrass varieties sown September 8, 2017, at Lexington, Kentucky

Variety	Type	Seedling Vigor[1] Oct 12, 2017	Maturity[2] 2018 May 8	Maturity[2] Jun 15	Maturity[2] 2019 May 2	Maturity[2] Jun 6	Percent Stand 2017 Oct 12	Percent Stand 2018 Mar 14	Percent Stand Oct 18	Percent Stand 2019 Mar 22	Percent Stand Oct 18	Yield (tons/acre) 2018 Total	Yield (tons/acre) 2019 May 2	Yield (tons/acre) Jun 6	Yield (tons/acre) Aug 12	Yield (tons/acre) Total	2-year Total
Commercial Varieties-Available for Farm Use																	
Macbeth	meadow	2.9	55.0	29.0	56.0	60.0	98	92	97	94	94	5.70	0.87	0.93	1.20	3.00	8.70*
Admiral	meadow	4.0	55.0	29.0	56.0	60.0	100	96	99	97	97	5.71	0.79	0.83	1.10	2.72	8.43*
Arid	meadow	2.1	46.3	29.0	45.0	60.0	94	88	92	93	95	4.38	0.82	0.76	1.32	2.90	7.28
Peak	smooth	2.9	48.0	29.0	45.0	60.0	98	95	97	97	97	4.58	0.63	0.76	0.86	2.25	6.83
Experimental Varieties																	
MB1303	meadow	3.1	56.0	29.0	56.5	60.0	99	98	99	97	98	5.77	0.82	0.89	1.36	3.07	8.85*
MB1302	meadow	3.0	54.5	29.0	53.5	60.0	98	95	97	95	95	5.86	0.90	0.89	1.02	2.81	8.67*
Mean		3.0	52.5	29.0	52.0	60.0	98	94	97	95	96	5.33	0.81	0.84	1.14	2.79	8.12
CV,%		17.0	3.4	0.0	1.9	0.0	1	6	3	3	2	10.70	21.73	16.56	19.81	16.38	11.45
LSD,0.05		0.8	2.7	0.0	1.5	0.0	2	9	4	4	3	0.86	0.26	0.21	0.34	0.69	1.35

1 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
2 Maturity rating scale: 37=flag leaf emergence, 45=boot swollen, 50=beginning of inflorescence emergence, 58=complete emergence of inflorescence, 62=beginning of pollen shed. See Table 4 for complete scale.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 13. Dry matter yields, seedling vigor, maturity, and stand persistence of bromegrass varieties sown September 5, 2018, at Lexington, Kentucky

Variety	Type	Seedling Vigor[1] Sep 28, 2018	Maturity[2] 2019 May 2	Maturity[2] 2019 Jun 6	Percent Stand 2018 Sep 28	Percent Stand 2019 Mar 22	Percent Stand 2019 Oct 18	Yield (tons/acre) 2019 May 2	Yield 2019 Jun 6	Yield 2019 Aug 12	Yield 2019 Total
Commercial Varieties-Available for Farm Use											
Arsenal	meadow	3.9	57.5	44.5	94	97	97	1.98	0.82	1.25	4.05*
Admiral	meadow	4.3	56.0	44.5	96	98	98	2.02	0.95	1.07	4.04*
Peak	smooth	4.6	49.0	29.0	98	98	98	1.91	0.87	1.17	3.96*
Macbeth	meadow	3.4	55.0	52.3	92	97	97	1.72	0.89	1.22	3.83*
Artillery	meadow	4.8	46.3	29.0	97	98	98	1.78	0.68	1.32	3.78*
Carlton	smooth	4.0	45.0	60.0	95	95	97	0.81	1.05	0.99	2.85
Mean		4.2	51.6	38.0	95	97	98	1.75	0.87	1.18	3.80
CV,%		14.1	3.6	0.0	3	2	1	15.25	15.39	19.13	8.37
LSD,0.05		0.9	2.8	0.0	4	3	2	0.40	0.20	0.36	0.48

1 Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
2 Maturity rating scale: 37=flag leaf emergence, 45=boot swollen, 50=beginning of inflorescence emergence, 58=complete emergence of inflorescence, 62=beginning of pollen shed. See Table 4 for complete scale.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 14. Proprietors of tall fescue varieties in current trials

Variety	Endophyte Status[1]	Proprietor/KY Distributor
Commercial Varieties-Available for Farm Use		
BarOptima PLUS E34	novel	Barenbrug USA
Bronson	free	Ampac Seed
Bull	free	Improved Forages
Cajun II	free	Smith Seed Services
Estancia Arkshield	novel	Mountain View Seeds
Kentucky 32	free	Oregro Seeds
Kora Protek	novel	DLF-Pickseed
KY31+	toxic	Ky Agric. Exp. Station/Public
Jesup MaxQ	novel	Pennington Seed
Lacefield MaxQ II	novel	Pennington Seed
Martin 2 Protek	novel	DLF-Pickseed
Payload	free	Brett Young
Select	free	Southern States
SS-0705TFSL	free	Southern States
Teton II	free	Mountain View Seeds
Tower	free	DLF-Pickseed
Tower Protek	novel	DLF-Pickseed
Experimental Varieties[1]		
BARFABTR7NEA23	novel	Barenbrug USA
BARFAF131	free	Barenbrug USA
BARFAF135	free	Barenbrug USA
BARFAF137	free	Barenbrug USA
BARFA6BTR179	free	Barenbrug USA
B-18.1787	free	Blue Moon Farms
DLFPS-FTF-93	free	DLF-Pickseed
DLFPS-FTF-96	free	DLF-Pickseed
FTF89	free	DLF-Pickseed
FTF94	free	DLF-Pickseed
IS-FTF 54 Protek	novel	DLF-Pickseed
IS-FTF 70	free	DLF-Pickseed
IS-FTF 73	free	DLF-Pickseed
KY31-	free	KY Agric. Exp. Station
KYFA1201	free	KY Agric. Exp. Station

continued

Table 14. continued

Variety	Endophyte Status[1]	Proprietor/KY Distributor
KYFA1303	free	KY Agric. Exp. Station
KYFA1304	free	KY Agric. Exp. Station
KYFA1305	free	KY Agric. Exp. Station
KYFA1306	free	KY Agric. Exp. Station
KYFA1404	free	KY Agric. Exp. Station
KYFA1405	free	KY Agric. Exp. Station
KYFA1531	free	KY Agric. Exp. Station
KYFA1532	free	KY Agric. Exp. Station
KYFA1533	free	KY Agric. Exp. Station
KYFA1534	free	KY Agric. Exp. Station
KYFA1535	free	KY Agric. Exp. Station
KYFA1536	free	KY Agric. Exp. Station
KYFA1537	free	KY Agric. Exp. Station
KYFA1606	free	KY Agric. Exp. Station
KYFA1704	free	KY Agric. Exp. Station
KYFA9304	free	KY Agric. Exp. Station
KYFA9611	free	KY Agric. Exp. Station
KYFA9732/AR584	novel	KY Agric. Exp. Station
KYFA9821/AR584	novel	KY Agric. Exp. Station
PPG-FTF 112	free	Mountain View Seeds
RAD-ERF37	free	Radix Research
RAD-HAN19	free	Radix Research
RAD-HAN33	free	Radix Research
RADMRF20	free	Radix Research
SLTF10-3	free	Oregro Seeds
STF50	free	Smith Seed Services
TFCB1bC2	free	USDA-ARS
TFCB3C2	free	USDA-ARS
TFCB4C2	free	USDA-ARS
TFCB5C2	free	USDA-ARS
TF Soft	free	USDA-ARS
TF0503	free	USDA-ARS
7016	free	KY Agric. Exp. Station
7FACF82	free	Barenbrug USA

1 Experimental varieties are not available commercially, but provide an indication of the progress being made by forage breeding companies.

Table 16. Summary of Kentucky tall fescue yield trials 2002-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial)

Variety	Endophyte Status[1]	Proprietor	Lexington											Princeton							Quicksand				Mean[4] (#trials)
			03[2,3]	05	07	09	11	12	13	14	15	16	17	02	04	06	08	10	12	15	03	05	13	16	
			2-yr[5]	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	3-yr	3-yr	3-yr	3-yr	3-yr	3-yr	2-yr	2-yr	4-yr	3-yr	3-yr	
Atlas Select	free	ProSeeds Marketing															95								–
Aprilia	free	ProSeeds Marketing															93								–
Baguala	free	Allied Seed									92									96					94(2)
BarElite	free	Barenbrug USA			96		100											92							95(3)
Bariane	free	Barenbrug USA	87	99																		95			94(3)
Barolex	free	Barenbrug USA		90																					–
BarOptima PLUS E34	novel	Barenbrug USA		122	99		107	108	102	99	113	99	91					99	100	96			93	118	103(14)
Bronson	free	Ampac Seed		88	97	105	102	99	99			100						101	91	103		102			99(11)
Brutus	free	Saddle Butte Ag. Inc.								90															–
Bull	free	Improved Forages	98	102				100						104					99		97		95		99(7)
Cajun II	free	Smith Seed Services					97		105	99	99	98	106					101		104			90	96	101(10)
Cowgirl	free	Rose-AgriSeeds						94									102	100	98						99(4)
Dominate	free	Allied Seed									90									99					95(2)
Drover	free	Barenbrug USA								105	120														113(2)
DuraMax GOLD	novel	DLF Pickseed					102									106									104(2)
Enhance	free	Allied Seed					93								107										100(2)
Estancia ArkShield	novel	Mountain View Seeds	102					106				96		101					102					103	102(6)
Festival	free	Pickseed West													102										–
Flourish	free	Allied Seed						92											101						97(2)
FSG 402TF	free	Farm Science Genetics									92									103					98(2)
Goliath	free	Ampac Seed				100			104									99							101(3)
HyMark	free	Fraser Seeds					91				104						102			103					100(4)
Jesup EF	free	Pennington Seed					98	105										103	100						102(4)
Jesup MaxQ	novel	Pennington Seed		98	101	110	103	100	93	106	102	111	107	94			95	100	98	98	100	102	100	116	102(19)
KENHY	free	KY Agric Exp Sta.													89										–
Kentucky 32	free	Oregro Seeds					93	94		101							98	94	101						96(6)
Kora Protek	novel	DLF Pickseed										101												86	94(2)
KY31+	toxic	KY Agric Exp Sta.	112	108	102	102	93	95	103	100	99	103	98	104		104	93	112	101	92	98	110	110	110	102(21)
Lacefield MaxQ II	novel	Pennington Seed			109				97	104	93	92	90			101	106			105			113	102	101(11)
Martin2 Protek	novel	DLF Pickseed					104					96												106	102(3)
Nanryo	free	Jap. Grassland ForageSeed/			96																				–
Noria	free	ProSeeds Marketing			98																				–
Payload	free	Brett Young										89												111	100(2)
RAD-ERF50	free	Radix Research, Inc.															113								–
Savory	free	DLF Pickseed														91									–
Seine	free	Advanta Seeds													96										–
Select	free	Southern States	94	99	99	98	90	100	97	103	97	102		97	105	102	105	99	100	99	102	91	99	86	98(21)
SS-0705TFSL	free	Southern States								99	99	106	107							103				101	103(6)
Stockman	free	Seed Research of OR	108												101	97					105				103(4)
Teton II	free	Mountain View Seeds					107	105		96		103							99					91	100(6)
Texoma MaxQ II	novel	Pennington Seed		95																					–
TF0203G	free	Seed Research of OR			87																				–
Tower	free	DLF Pickseed										101												91	96(2)
Tower Protek	novel	DLF Pickseed					98					104												81	94(3)
Tuscany	free	Forage Genetics																							–
Tuscany II	free	Seed Research of OR						97								98			106						100(3)
5CAN	free	Brett Young				86																			–

1 Free-varieties that do not contain an endophyte. Toxic-KY31+ contains a toxic endophyte. Novel-varieties that contain an endophyte that aids persistence but is not toxic to cattle.
2 Year trial was established.
3 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested 2 years, so the final report would be "2015 Tall Fescue Report" archived in the UK Forage website at <forages.ca.uky.edu>.
4 Mean only presented when respective variety was included in two or more trials.
5 Number of years of data.

Table 15. Proprietors of bromegrass varieties in current trials

Variety	Type	Proprietor/KY Distributor
Commercial Varieties-Available for Farm Use		
Admiral	meadow	Cisco Seeds
Arid	smooth	Mountain View Seeds
Arsenal	meadow	Barenbrug USA
Artillery	meadow	Barenbrug USA
Carlton	smooth	Pickseed USA
MacBeth	meadow	Cisco Seeds
Peak	smooth	Allied Seed
Experimental Varieties[1]		
MB1302	meadow	Allied Seed
MB1303	meadow	Allied Seed

1 Experimental varieties are not available commercially, but provide an indication of the progress being made by forage breeding companies.

Table 17. Summary of Kentucky bromegrass yield trials at Lexington 2006-2019 (yield shown as a percentage of the mean of the commercial varieties in the trial)

Variety	Type	Proprietor/KY Distributor	2006[1,2] 4-yr[4]	2008 3-yr	2010 3-yr	2012 3-yr	2014 3-yr	2015 3-yr	2016 3-yr	2017 2-yr	Mean[3] (#trials)
AC Knowles	hybrid	Agriculture Canada	85		82	102	89				89(4)
Admiral	meadow	Cisco Seeds							104	108	106(2)
Arid	meadow	Mountain View Seeds							96	93	95(2)
Bigfoot	hybrid	Grassland Oregon	108	116	105						110(3)
Canterbury	mountain	Barenbrug USA		79							–
Carlton	smooth	Pickseed USA				82	95				91(2)
Doina	smooth	Barenbrug USA		114	108						111(2)
Fleet	meadow	Agriculture Canada	110			109					110(2)
Hakari	Alaska	Barenbrug USA		85	85						85(2)
MacBeth	meadow	Cisco Seeds		136	119	107	116	107	102	111	114(7)
Olga	smooth	Barenbrug USA		116	101						109(2()
Peak	smooth	Allied Seed		97		100		93	96	87	95(5)
Persister	prairie	DLF Pickseed		72							–
RAD-BI29	smooth	Columbia Seeds	96	86							91(2)

1 Year trial was established.
2 Use this summary table as a guide in making variety decisions, but refer to specific yearly reports to determine statistical differences in forage yield between varieties. To find actual yields, look in the yearly report for the final year of each specific trial. For example, the Lexington trial planted in 2012 was harvested 3 years, so the final report would be "2015 Tall Fescue and Brome Report" archived in the UK Forage website at <forages.ca.uky.edu>.
3 Mean only presented when respective variety was included in two or more trials.
4 Number of years of data

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11-2019

Tall Fescue Toxicosis Research Update

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Background

It has long been recognized that cattle on common tall fescue (i.e., Kentucky 31) can be impacted by a summer performance slump that is related to toxins in the tissue of the plant. The role of the fungal endophyte (currently called Epichloë coenophiala) in fescue toxicosis was first established by Dr. Charles Bacon with USDA-ARS with the Toxicology and Mycotoxins Research Unit in Athens, Georgia. We now know that fescue toxicosis is a type of ergot toxicity, similar in some ways to ergotism caused by other types of fungal contaminants of cereal grains.

The endophyte lives in the plant tissue where it produces ergot alkaloids, contributes to insect pest-resistance and generally improves the persistence of the grass. However, exposure to the ergot alkaloids causes the toxicosis in grazing animals. Work by our research group, the USDA-ARS Forage-Animal Production Research Unit in Lexington, Kentucky, has shown that ergovaline is the particular ergot alkaloid that is responsible for vasoconstriction. Vasoconstriction is the decrease in blood vessel diameter that is behind exacerbated heat stress. When the blood vessels in the periphery of the body are constricted the cattle cannot dissipate heat properly. Thus, we see panting on mild days, wading in stock ponds and decreased grazing in favor of lying in the shade. Conversely, vasoconstriction in cold weather can lead to "fescue foot" and gangrenous loss of tail switches. As serious as these latter symptoms can be, new research shows that vasoconstriction in fescue toxicosis has impacts beyond the animal's extremities.

Vasoconstriction; it causes more problems than you think

Increased heat stress is just the beginning of problems caused by vasoconstriction from ergot alkaloids. It is well known that horses have reproductive problems related to fescue toxicosis, but ruminants are also susceptible. Former USDA-ARS scientist, Dr. Glen Aiken, in collaboration with Clemson University showed that the testicular arteries of bulls constricted during fescue toxicosis. Lower semen quality and sperm counts were noted when the blood flow to the testis was restricted. These results indicate that fescue toxicosis could result in poorer coverage of cow herds by affected bulls.

New results indicate that female ruminants also have reproductive impacts from exposure to ergot alkaloids in fescue toxicosis. USDA-ARS scientist, Dr. James Klotz collaborated with Clemson University to show that fetal development in pregnant ewes was impacted by ergot alkaloid exposure. When ewes were exposed to ergot alkaloids during gestation the birthweight of lambs was approximately 25% less than the lambs of unexposed ewes. Umbilical arteries were brought into the laboratory and it was shown that they constricted when exposed to ergot alkaloids. These results indicate that poor blood flow from vasoconstriction contributes to low birthweights. Clearly, reproductive effects of toxic tall fescue should be a consideration in our region.

Four basic approaches to contend with fescue toxicosis

When you identify that your herd has a problem with fescue toxicosis there are four basic approaches to solving the problem: establish a new forage, change the physiology of the forage you have, incorporate less susceptible genetics into your herd or change the physiology of the animals you have. Renovating to replace toxic tall fescue is the best way to eliminate fescue toxicosis. This option includes alternative cool season grasses, such as orchardgrass and Kentucky bluegrass. Warm season perennial grasses and the often high-yielding warm season annuals are options for later grazing. Novel endophyte fescues combine some of the benefits of common tall fescue without the concern of fescue toxicosis. Novel endophyte fescue varieties will be discussed in another part of this symposium.

The physiology of toxic tall fescue can be changed through chemical seedhead suppression. The toxic alkaloids are concentrated in the seeds, and it has long been recognized that mowing to reduce seedheads makes the forage less toxic. Similarly, herbicides that reduce seedhead emergence also decreases the concentration of ergot alkaloids. This approach has the added benefit of maintain the grass in the vegetative state, which is higher quality that the mature forage.

It has been shown that Brahman-influenced cattle are less susceptible to fescue toxicosis. Moreover, many have observed that cattle raised in the fescue belt are less sensitive than cattle purchased and brought in from other regions. Ongoing research indicates that genotypes within any breed might be more ergot alkaloid-tolerant through differences in liver enzymes and blood vessel receptors. Research by Dr. Brittany Harlow at the USDA-ARS Forage-Animal Production Research Unit indicates that rumen bacteria of some cattle break down the ergot alkaloid, ergovaline, more rapidly than others. The cattle with faster degrading rumen bacteria seem to become less vasoconstricted when suffering from fescue toxicosis.

Our research group has also identified a way to alter the physiology of animals in fescue toxicosis. The incorporation of clovers into tall fescue pastures has long been an approach to mitigate fescue toxicosis. It was thought that clovers diluted the amount of ergot alkaloids in the diet by providing an alternative forage. In fact, clovers and other legumes produce a group of compounds called isoflavones. A number of different experiments have shown that isoflavones act as vasorelaxants, that is, they have the opposite effect of the ergot alkaloids, which cause vasoconstriction. The research indicates that modest intake of red clover can reverse vasoconstriction in fescue toxicosis. Collaborators at the University of Tennessee have also shown feed intake recovers when cattle in fescue toxicosis receive red clover isoflavones.

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Practical Considerations for Utilizing Tall Fescue in Grazing Systems

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Tall fescue (*Schedonorus arundinaceus* (Schreb.) Dumort., nom. cons.) is the most important cool-season grass in the transition area between the temperate northern and subtropical southern United States. In most unimproved pastures, tall fescue is infected with a fungal endophyte that imparts tolerance to abiotic and biotic stresses. While this mutualistic relationship improves persistence in low input grazing systems, it also results in the production of alkaloids that cause tall fescue toxicosis. While there are a number of grotesque symptoms associated with this syndrome such as fescue foot, fat necrosis, and loss of ear tips and tall switches, symptoms that are not readily observed are the costliest. These include vasoconstriction resulting in high body temperature, lower forage intake, lower milk production, lower growth rates and weaning weights, compromised immune system, and lower conception/calving rates (Roberts and Andrae, 2004). This article will provide some practical approaches to mitigating the negative impact of tall fescue in grazing systems.

Assess endophyte levels

The first step in managing tall fescue toxicosis is to access the levels of endophyte in pastures. Since the endophyte cannot be seen with the naked eye, tiller samples must be collected and sent into a lab for screening. In Kentucky, the Division of Regulatory Services at the University of Kentucky provides this service. More information on collecting samples can be obtained by contacting your local extension office or consulting the following publication, *Sampling for the Tall Fescue Endophyte in Pastures and Hay Stands,* PPA-30.

Develop a management strategy

Once level of endophyte infection is known, an appropriate management strategy can be developed (Figure 1). If the infection level is above 20 to 25%, then replacement of the stand is recommended. However, there are a number of factors that should be considered prior to replacement. For example, if the pasture is rented on a year to year lease, then investment in a novel endophyte tall fescue may not be wise. Other important considerations can be found in Figure 1.

Replacement of toxic stands

In cases where it is feasible to replace toxic stands with novel endophyte tall fescue, there are two approaches. The first is Spray-Wait-Spray. In this method tall fescue pastures are grazed or harvested for hay in the spring to keep viable seed from being produced. Pastures are then allowed to regrow (vegetative) and sprayed with a non-selective herbicide in mid-summer. Pastures are sprayed a second time with a non-selective herbicide just prior to planting in late summer. The second approach is Spray-Smother-Spray.

In this method, pastures can be grazed in early spring and allowed to regrow. They are then sprayed with a non-selective herbicide in late spring and a summer annual smother crop is planted (sorghum-sudangrass or pearl millet). The smother crop can be grazedor hayed during the summer months. In late summer, pastures are sprayed a second time with a non-selective herbicide and the novel endophyte tall fescue is planted.

Managing existing tall fescue stands

In some cases, even with high infection rates, it may not make sense to replace tall fescue stands. These stands may be on land with short-term leases or high erosion potential (Figure 1). In these cases, managing existing stands may be the most practical approach. There are a number of management practices that can be implemented to mitigate the negative impacts of the toxic endophyte and together they can improve animal performance to a level almost equal to endophyte free or novel endophyte tall fescue (Figure 2).

Dilution with other forages

The negative impact of the endophyte can be mitigated by adding non-toxic forages to pastures (Figure 3). Red and white clover can be frost seeded into tall fescue pastures in late winter. For more information on frost seeding please see the following Master Grazer video https://forages.ca.uky.edu/file/frost-seeding-clover. Pastures can also be interseeded with other cool- and warm-season grasses. Crabgrass can be incorporated into thinning tall fescue pastures to provide non-toxic forage during the summer months. For more information on crabgrass please see Crabgrass, AGR-232.

Clipping seedheads

Seedheads can contain five times more ergovaline (toxin in tall fescue) than leaf blades (Figure 4). Clipping seedheads in tall fescue pastures not only maintains forage quality, but also decrease ergovaline levels. Seedheads can also be controlled by plant growth regulators. Applied at the proper time, some herbicides can almost eliminate seedhead formation.

Strategic avoidance

Avoiding tall fescue pastures during critical times of the year such as the summer months or late fall can reduce the negative impacts of the endophyte. For example, a summer annual or perennial could be incorporated into the grazing system, allowing cattle to avoid tall fescue during the summer months. Another example would be feeding hay during late fall to allow ergovaline levels in stockpiled tall fescue to decrease to a safe level (Figure 5).

Use local animal genetics

Herds that have been developed in the fescue belt have been indirectly selected for tolerance to tall fescue toxicosis. It is important to recognize that although some animals may have increased tolerance to tall fescue toxicosis it is not and will most likely never be complete tolerance. Genetic testing for tolerance to tall fescue toxicosis is in its infancy and one commercially available test is currently being marketed.

Supplement tall fescue pastures

Supplementation with energy and protein has been shown to partially alleviate tall fescue toxicosis (Figure 6), although the impact can be marginal, especially at lower supplementation levels. The impact of supplementation is likely two-fold. The first is decreased dietary toxins due to dilution and the second is increased levels of protein and energy in the diet. As with other management strategies, there is a cost for both the supplement and feeding it.

Summary and Conclusions

Tall fescue toxicosis is one of the costliest livestock disorders in the southeastern United States. Its impacts often go undetected on many livestock operations. Developing a management strategy starts with testing pastures for the endophyte. Once this is accomplished, appropriate management strategies can be implemented. While management strategies can mitigate impacts, the only way to completely eliminate the harmful effects of endophyte on livestock is to replace infected stands with other forages or novel endophyte tall fescue.

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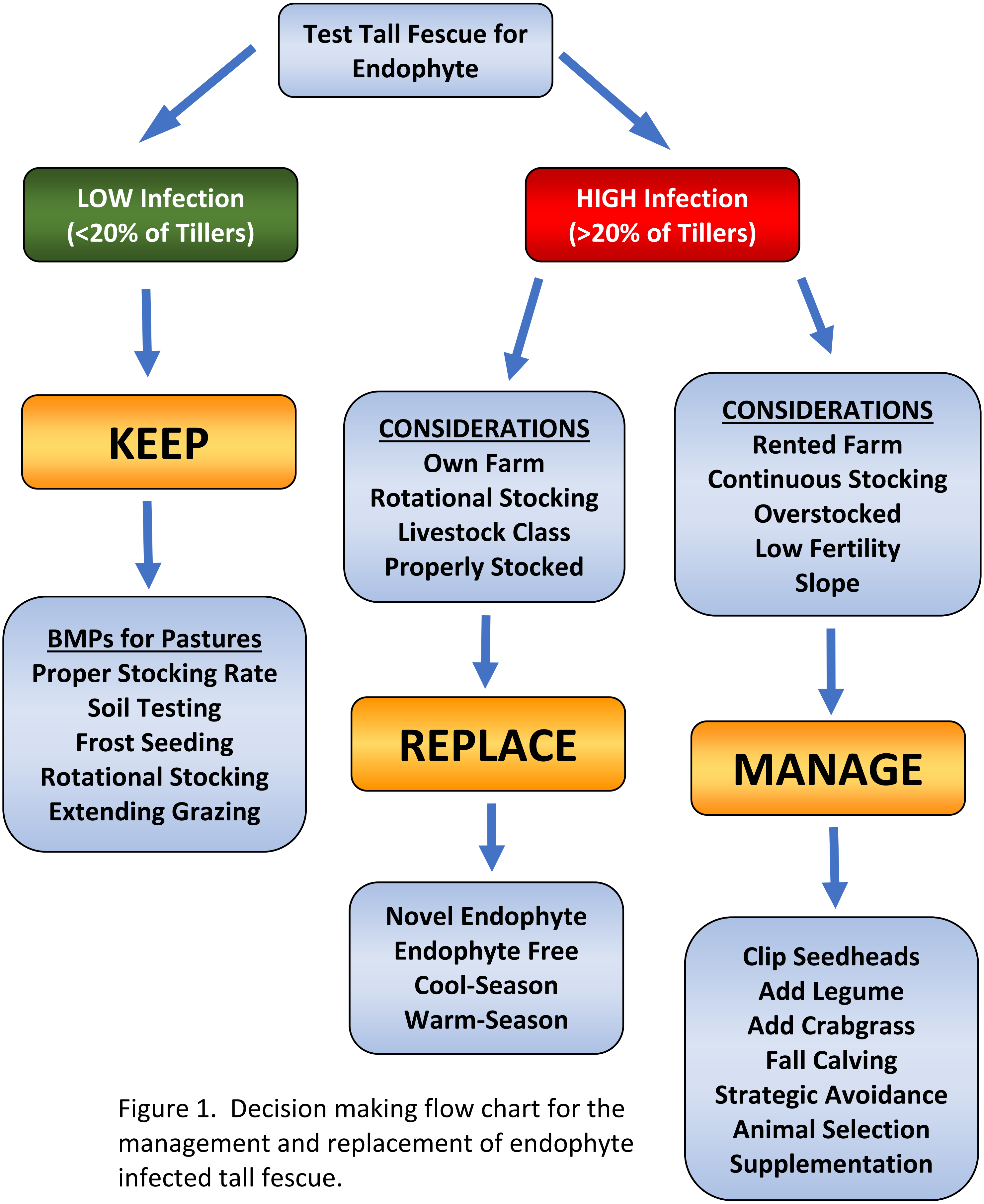


Figure 1. Decision making flow chart for the management and replacement of endophyte infected tall fescue.

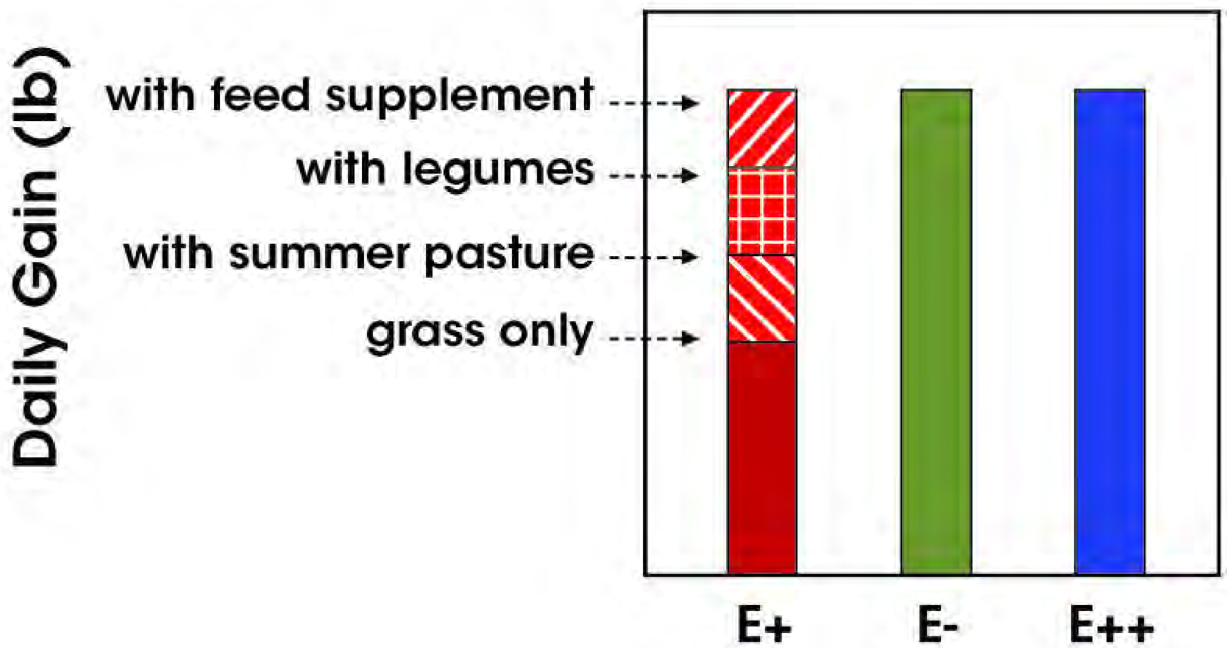


Figure 2. Incremental gains with multiple management inputs. Although production levels similar to novel endophyte tall fescue can be achieved, the cost of production can be high (*Roberts and Andrae, 2004*).

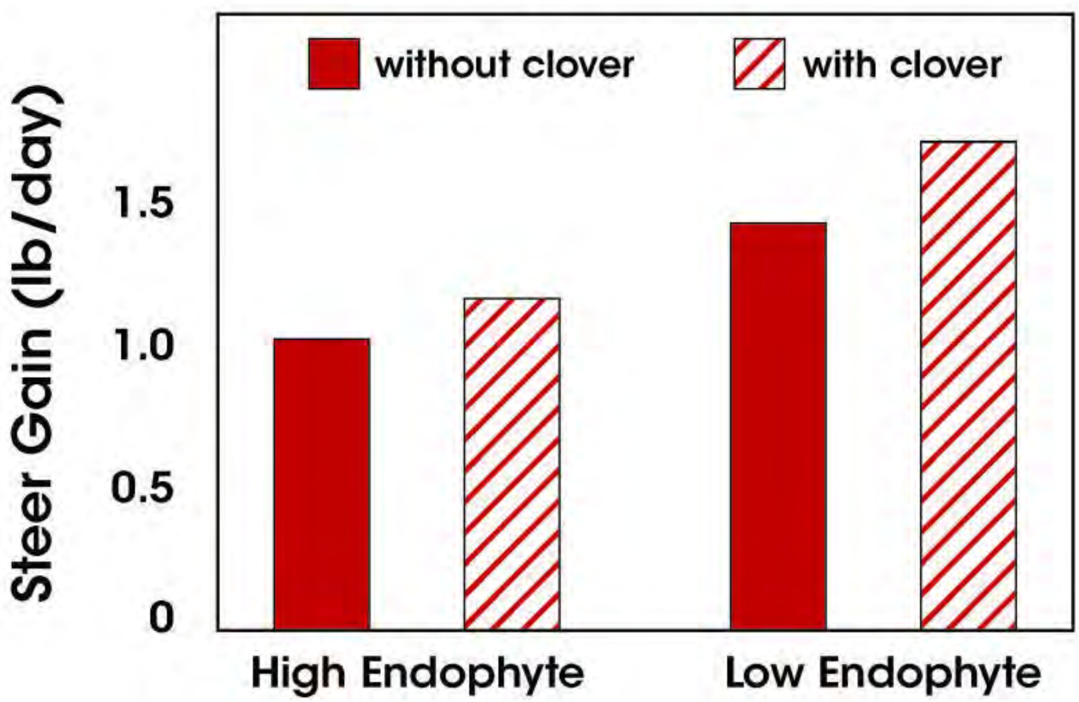


Figure 3. Impact of adding clover to high and low endophyte pastures. Adding clover increased production regardless of endophyte status (Thompson et al., 1993).

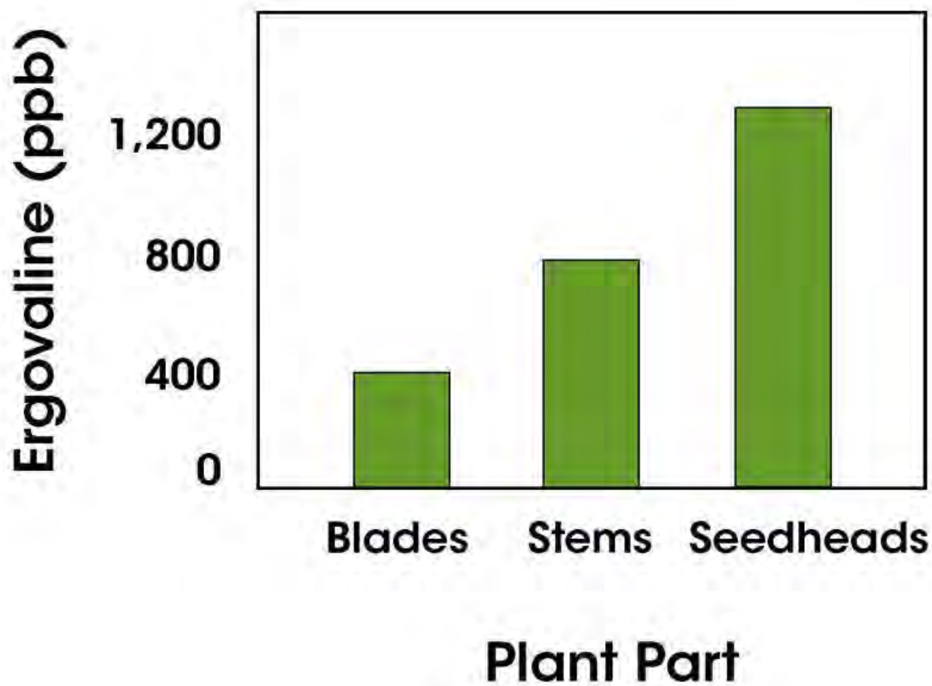


Figure 4. Ergovaline levels in leaf blades, stems, and seedheads of tall fescue (Rottinhaus et al., 1991).

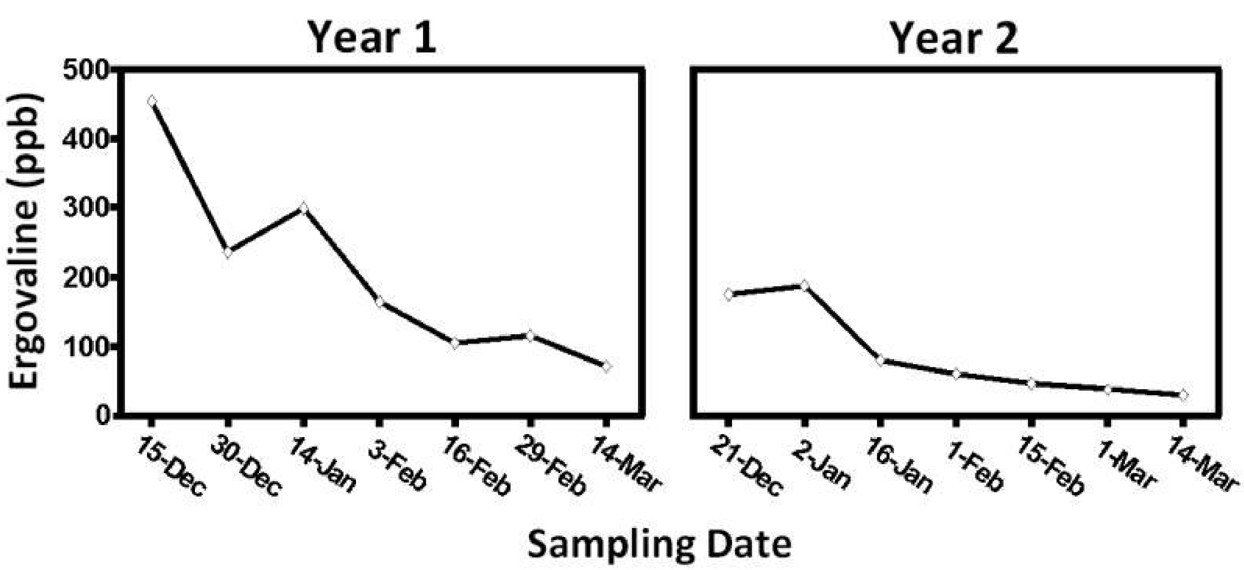


Figure 5. Ergovaline in stockpiled tall fescue as impacted harvest date (Kallenbach et al., 2003).

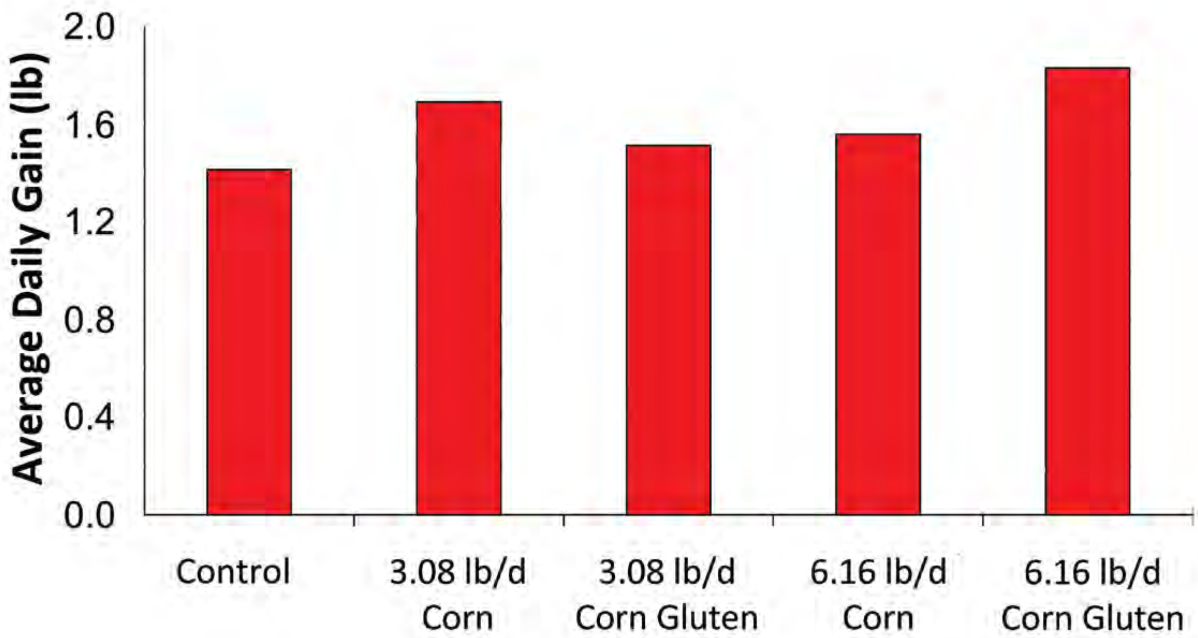


Figure 6. Impact of supplementation on average daily gain (Elizadle et al., 1998).

PPA-30

University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service

Sampling for the Tall Fescue Endophyte in Pasture or Hay Stands

P. Vincelli, Plant Pathology, S.R. Smith, Plant and Soil Sciences; and Tina Tillery, Regulatory Services

Most of the tall fescue growing in Kentucky is colonized by the tall fescue endophyte, a fungus which causes disorders in livestock that feed on the infected grass. The animal disease syndrome is called fescue toxicosis, which some researchers estimate may cost Kentucky producers over $200 million yearly. This problem can be greatly reduced by identifying the infected fields and replacing them with endophyte-free or novel endophyte tall fescue varieties or by managing them in a way to minimize the impact of the endophyte on herd productivity. One of the simplest ways to reduce toxicity symptoms in cattle is add red and white clover to existing tall fescue stands.

Endophyte Testing in Kentucky

The best ways to determine the level of infection within a stand is to examine individual tall fescue tillers sampled from the field microscopically for evidence of the fungus or to use a recently developed immunoblot laboratory procedure. In Kentucky, the Division of Regulatory Services, located at the University of Kentucky, offers a service to test tall fescue infection level. To obtain useful information samples must be collected in accordance with the guidelines given here.

Figure 1. Tillers must be cut at the soil surface.

Selecting Stands to be Sampled

Only fields of the same seeding date and management unit should be included under the same field designation. The fungus is spread through seed, and since fescue seed can be moved in many different ways, the variation in endophyte level between fields can be great. However, before spending money on sampling, farmers should consider that most fields will be highly infested. Several extensive surveys conducted by UK researchers found that in more than 50 percent of the stands in Kentucky 80 percent of the plants are infected. Only about 7 percent of the stands in Kentucky have fewer than 25 percent of the plants infected. **Note:** New tall fescue varieties such as MaxQ contain a novel or non-toxic endophyte that cannot be distinguished from other infected stands using currently available commercial laboratory procedures. Therefore, fields planted to novel endophyte fescue should not be sampled.

When to Sample

Specimens must be collected during periods when the fungus is most likely to be present in the tillers. Specimens should be collected when plants have been growing well for at least a month, for best assurance of finding the endophyte. The optimum collection times in Kentucky appear to be late April to early June and October through November, based on University of Kentucky tests. Specimens collected at other times can give erratic results. Check with the local county extension office before sampling the site.

Collecting the Specimens

A sample consists of tillers (stems) of plants that have been cut with a razor blade or sharp knife at the soil surface. (**Note:** It is very important to cut the tiller at the soil surface! See Figure 1.) Avoid taking stems that have seed heads on them, but do not take small or immature tillers either; tillers with stems $\frac{1}{8}$-inch thick or thicker work best. Take about 10 to 20 more tillers than necessary to ensure a good working sample for the laboratory. Measure up about 4 inches from the base of the stem and cut the remaining plant tissue distant from the stem base. Save the stem bases but discard the tissue containing the leaves. Place the stem pieces into a plastic zip lock bag. Put a damp (not wet) paper towel in the bag to prevent drying of the tissues.

Representative Samples

Make sure you take your tiller samples while walking back and forth across your field so you get roughly the same number of tillers from all sections of the field. (See Figure 2.) It is critical that the specimens collected be representative of the field at large. The specimens should be taken at random, by walking a zigzag pattern about the field. Avoid collecting from ditches, pond areas, feeding sites and borders, unless these areas make up more than 20 percent of the stand. These areas have often been destroyed and reseeded through natural processes and can produce misleading data.

Field Size Affects Specimen Number

The number of specimens to collect is determined by field size (see Table 1).

Table 1. Sampling recommendations

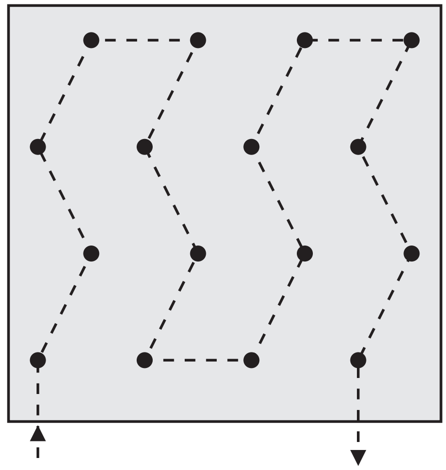
Number of acres	Number of specimens
Less than 5	20
5 to 10	40
More than10	At least 50, with higher numbers for larger fields

Note: These sampling recommendations are estimates; more or fewer plugs may be necessary to accurately represent the areas of concern. Large fields of variable terrain should be divided into smaller sampling blocks.

Protecting the Samples

After collecting, place the specimens with a cold pack in a sturdy, plastic-lined box and take them to the county extension office or send overnight express directly to the testing laboratory. Refrigerated storage after sampling is best to ensure sample quality, but when not available, do not let the container sit in the sun or get too hot. Deliver or send the specimens early in the week so they will arrive in the lab without delay. Weekend mail may sit along the route in hot trucks!

Figure 2. Collect specimens randomly from the site using a zig-zag pattern.



Results

The laboratory's findings will be reported to the person who submitted the sample with a copy to the county extension agent when requested. The report will indicate the percentage of tillers submitted that were infected with the endophyte. No recommendation as to how this level of infection will affect animals will be included. This is because the acceptable level of infection is highly dependent upon the particular farming system involved. After receiving the results you are encouraged to meet with your county agent to discuss management options. The publications listed at the end of this publication provide more information.

Mention or display of a trademark, proprietary product, or firm in text or figures does not constitute an endorsement and does not imply approval to the exclusion of other suitable products or firms.

Cost

A fee is necessary to partially cover the cost of lab testing. Contact the Regulatory Services Seed Lab (859-218-2468) for current pricing. Each field should be submitted as a separate sample. A billing statement of charges will be mailed after the laboratory analysis is completed. Checks should be made payable to: University of Kentucky.

Mailing Samples

If tillers were collected from more than one stand, mark each group of specimens with a unique name for identification. Place all specimens from each sample inside a single plastic bag, loosely seal and put into a box or padded envelope with a cold pack. Multiple samples can be included in the same box as long as individual samples are clearly marked. A sample submittal form or a letter from the county extension agent for agriculture clearly identifying the sample and number of specimens should accompany each sample submitted to the lab. Enclose the letter or form inside the package or box but outside the plastic bag that contains the samples. Samples should be shipped overnight to: Seed Laboratory, Division of Regulatory Services, 103 Regulatory Services Bldg., University of Kentucky, Lexington, KY 40546-0275.

Additional Information

Publications available at your county extension office or at www.uky.edu/Ag/Forage.

- *Tall Fescue* (AGR-59)
- *Alternatives for Fungus Infected Tall Fescue* (AGR-119)
- *Renovating Hay and Pasture Fields* (AGR-26)
- *Tall Fescue Endophyte Concepts* at http://www.uky.edu/Ag/Forage/Tall%20Fescue%20Endophyte%20Concepts%20for%20Web.pdf.

UPCOMING EVENTS

February 20	**KY Alfalfa and Stored Forage Conference**	**Elizabethtown, KY**
March 19	**Novel Tall Fescue Renovation Workshop**	**Lexington, KY**
April 14	**Kentucky Spring Fencing School**	**Glasgow, KY**
April 16	**Kentucky Spring Fencing School**	**Grand Rivers, KY**
April 21-22	**Kentucky Spring Grazing School**	**Princeton, KY**
May 19	**Kentucky Spring Fencing School**	**Frankfurt, KY**
May 21	**Kentucky Spring Fencing School**	**Campton, KY**

39th Annual

Kentucky Alfalfa and Stored Forage Conference

Please join the University of Kentucky and the Kentucky Forage and Grassland Council for the 39th Annual Kentucky Alfalfa and Stored Forage Conference. This day long conference focuses on maximizing alfalfa and stored forage production and utilization.

When: Thursday, February 20th, 2020
7:30 am - 3:45 pm (EST)

Where: Hardin County Extension Office
111 Opportunity Way
Elizabethtown, KY 42701

Registration: www.KYAlfalfa2020.eventbrite.com
Before February 13th: $30
After February 13th: $40
Add KFGC membership for $15 more!

For those without internet access, please send check made out to "KFGC".
KY Alfalfa Conference
N-222C Ag. Science North
University of Kentucky
Lexington, KY 40546-0091

Sponsorship Exhibit booths: $250 - includes one registration
www.KYAlfalfa2020.eventbrite.com

Highlights

- Educa
  Presenta s
- Company Exhibits
- Silent Auc
- Awards

University of Kentucky
College of Agriculture, Food and Environment

Kentucky Alfalfa and Stored Forage Conference

Schedule of Events (All Times Eastern)

7:30	**Registration and Exhibits**
8:30	**Welcome and overview for the day** *Dr. Ray Smith, University of Kentucky*
9:00	**Getting the full benefit of your fertilizer dollar** *Dr. John Grove, University of Kentucky*
9:45	**Don't let insects eat your alfalfa profit** *Dr. Ric Bessin, University of Kentucky*
10:15	**Break, Exhibits and Silent Auction**
10:45	**Fertilizing profitable high yield alfalfa** *Dr. Josh McGrath, University of Kentucky*
11:15	**Getting the upper hand on diseases of alfalfa and grasses** *Dr. Kiersten Wise, University of Kentucky*
11:45	**Lunch, Alfalfa awards, Silent auction results**
1:15	**Updates on an online alfalfa management tool under development** *Travis Howle, Ballard County alfalfa producer*
1:30	**What's new in alfalfa weed control** *Dr. J. D. Green, University of Kentucky*
2:00	**Advances in hay mechanization** *David O'Toole, McHale*
2:45	**Making a profit with a cash hay alfalfa operation—Integrating all the pieces** *Clayton Geralds, Hart County hay producer and KFGC President*
3:30	**Final Comments and Survey Collection**
3:45	**Adjourn**

University of Kentucky
College of Agriculture, Food and Environment

2020 Novel Tall Fescue Renovation Workshop

8:30—4:30 Thursday, March 19, 2020

UK Veterinary Diagnostic Lab 1408 Bull Lea Rd.
Lexington, KY 40511

Toxic tall fescue reduces livestock weight gains and lowers reproductive performance. This one day workshop will give you the tools and information needed to remove toxic tall fescue and replace it with novel tall fescue varieties. Speakers include local producers, company representatives and extension specialists and researchers from across the country.

Topics include:

- Fescue toxicosis
- Economics
- Testing
- Establishment
- Management
- Products
- Incentives

All 2020 Workshops:

Middleburg, VA	March 10
Mt. Ulla, NC	March 12
Watkinsville, GA	March 16
Spring Hill, TN	March 18
Lexington, KY	March 19
Harrison, AR	March 24
Mt. Vernon, MO	March 25

Alliance for Grassland Renewal

For more info, visit forages.ca.uky.edu or www.grasslandrenewal.org

Alliance Partners and Contributors includes university extension and research, seed companies and agribusiness, non-profit organizations and government institutions and forage and livestock producers.

Register online at http://TallFescueKY2020.eventbrite.com

Registration:
$65 before March 11
$80 After March 11
Includes lunch, refreshments and proceedings

Complete the form on the back and mail to:
Krista Lea, University of Kentucky
N-222C Ag. Science Center North
Lexington, KY 40546

Questions: *Contact us at UKForageExtension@uky.edu or (859) 257-0597*

University of Kentucky
College of Agriculture, Food and Environment

Novel Tall Fescue Renovation Workshop

Organized by the Alliance for Grassland Renewal

Photo:
Noble Research Institute

Agenda (All times are CDT)

8:30 am	Registration
9:00	Welcome, Dr. Ray Smith
9:10	Tall Fescue Toxicosis: Symptoms and Causes *Dr. Craig Roberts - University of Missouri*
9:35	Profitable Animal Production *Dr. Jeff Lehmkuhler - University of Kentucky*
10:00	Break and Demo: Endophytes Under Microscope *Dr. Carolyn Young - Noble Research Institute*
10:20	Establishment & First Year Management *Dr. John Andrae - Clemson University*
11:00	Management: Novels and Toxic Paddocks *Dr. Ray Smith - University of Kentucky*
11:40	Producer Economics *Darrel Franson - Producer*
12:00	Seed Quality and Endophyte Testing *Nick Hill - Agrinostics & Chris Agee - Pennington Seed*
12:15	Lunch and Microscope Demo
1:00	Calibrating a Seed Drill *Dr. Chris Teutsch - University of Kentucky*
1:45	Tour Plots at UK Research and Education Center *Gene Olson & Dr. Ray Smith- University of Kentucky*
3:00	Break and Microscope Demo
3:15	Company Product Highlights: *Peter Ballerstedt - Barenbrug USA* *Jerome Magnuson - DLF* *Mark Thomas - Mountain View Seed* *Chris Agee - Pennington Seed*
4:00	Cost-Share Incentive Programs *Adam Jones - USDA NRCS*
4:15	Producer Panel: On-Farm Success with Novel Tall Fescue *Jesse Ramer and Kevin Laurent*
5:00	ADJOURN

ALLIANCE for GRASSLAND RENEWAL

see blue.

CCA credits have been requested

2020 Kentucky Fencing Schools

Organized and Sponsored by the Kentucky Forage and Grassland Council, UK Cooperative Extension Service, and the Master Grazer Program

helping producers learn the newest fencing methods and sound fencing construction with classroom and hands-on learning

WHEN:

April 14 Glasgow, KY
April 16 Grand Rivers, KY
May 19 Frankfort, KY small ruminants
May 21 Campton, KY

WHERE:

Barren County Office
1463 West Main Street
Glasgow, KY 42141

Grand Rivers Community Ctr
155 W. Cumberland Ave.
Grand Rivers KY 42045

Wolfe County Ext. Office
20 North Washington Street
Campton, KY 41301-0146

Kentucky State University
1525 Mills Lane
Frankfort, Ky. 40601

COST: $30/p ipant -- includes notebook, refreshments, and lunch

Program Registration – DEADLINE is 2 weeks prior to workshop Online Registration with CREDIT CARD at www.2020KYFencingSchool.eventbrite.com

Location you are registering for: _____ **Frankfort, KY**

_____ **Glasgow, KY** _____ **Grand Rivers, KY** _____ **Russellville, KY**

LIMITED TO 30 PARTICIPANTS!

Registration by U.S. Mail: **Carrie Tarr-Janes**
UK Research and Educ on Center
1205 Hopkinsville St.
Princeton, KY 42445

Name: ____

Street: ____

City: __________________________________ State: _________ Zip code: __________

Email: ____

Cell Phone: ____

Number of p cipants _________ x $30 per par cipant = ________ Total Amount to Enclose

Make CHECKS payable to: <u>KFGC</u>

The KENTUCKY Forage and Grassland COUNCIL | College of Agriculture, Food and Environment — Grain and Forage Center of Excellence | KADF Kentucky Agricultural Development Fund | Kentucky Master Grazer Educational Program | KBN Kentucky Beef Network, LLC

More infor on is available at h p://forages.ca.uky.edu or Rehanon.Pampell@uky.edu

2020 Kentucky Fencing School Agenda

7:30 Registration and Refreshments

8:15 Welcome and Overview of the Day

8:30 Fencing Types and Costs - *Morgan Hayes, UK*

9:00 Fence Construction Basics - *Clay Brewer, Stay-Tuff*

- Perimeter fences vs. cross fences
- Fencing o ns on rented farms
- Proper brace cons on
- Line posts and fence cons on

9:45 Break – visit with sponsors and presenters

10:15 Overview of Kentucky Fence Law - *Clint Quarles, KDA*

11:00 Electric Fencing Basics - *Jeremy McGill, Gallagher*

- Proper energizer sel on and grounding
- Proper high tensile fence cons on and wire in-su
- Electric o et wires for non-electric fences
- Underground wires and jumper wires

11:45 Innovations in Fencing Technologies - *Josh Jackson, UK*

- wireless fences, fence monitoring

12:15 Catered Lunch - visit with sponsors

1:00 Hands-on Fence Building - *Clay Brewer, Stay-Tuff; Jeremy McGill, Gallagher; and Jody Watson, ACI*

- Safety, fence layout, and post driving demo, *Jody Watson, ACI*
- H-brace cons on, *Jeremy McGill, Gallagher and Clay Brewer, Stay-Tuff*
- Knot tying, splices, and insulator installa n, *Jeremy McGill and Clay Brewer, Stay-Tuff*
- Installa of Stay-Tu Knot Fence, *Clay Brewer, Stay-Tuff*
- Installa of High Tensile Fencing, *Jeremy McGill, Gallagher*

4:30 Questions, Survey and Wrap-up

Spring 2020 Kentucky Grazing School

helping producers lean the newest grazing methods with classroom and hands-on learning

WHEN: April 21-22, 2020

WHERE: UK Research and Education Center
348 University Drie
Princeton, KY 42445

LIMITED TO 45 PARTICIPANTS!!

COST: $50/p   ipant -- includes all materials, grazing manual, breaks, and lunch both days

Program Registration – DEADLINE is <u>April 7, 2020</u>

Online Registration with CREDIT CARD at
www.2020SpringKYGrazing.eventbrite.com

Registration by U.S. Mail:

Carrie Tarr-Janes
UK Research and Education Center
348 University Drive, Princeton, KY 42445
Email: Carrie.tarr-janes@uky.edu
Phone: 270-963-8351

Name: ____

Street: ____

City: ____

State: ___________   Zip code: __________

Email: ____

Cell Phone: ____

Number of p   cipants _______ x $50 per p   cipant = ______ Total Amount

Make CHECKS payable to: <u>KFGC</u>

A list of nearby lodging can be found at   p://wkrec.ca.uky.edu/dir   ns

Sponsors:

The KENTUCKY Forage and Grassland COUNCIL

UK College of Agriculture, Food and Environment — Grain and Forage Center of Excellence

KADF — KENTUCKY AGRICULTURAL DEVELOPMENT FUND

Kentucky Master Grazer Educational Program

KBN — KENTUCKY BEEF NETWORK, LLC

More informa   on is available at h   ://forages.ca.uky.edu or 270-365-7541.

Spring 2020 Kentucky Grazing School

helping producers learn the newest grazing methods with classroom and hands-on learning

Emphasis on ruminants – beef, dairy, sheep, & goats

Tuesday April 21, 2020

7:30 on & Refreshments

8:00 Introdu on of sta and cipants

8:15 Bene ts of Rot onal Grazing – Dr. Ray Smith

8:35 Me g Nu onal Needs on Pasture-Dr. Donna Amaral-Phillips

9:05 Grazing Math Concepts/ Introduce Field Exercise- Dr. Lehmkuhler

9:45 Break & Travel to Field Demon on Area

10:10 Introdu n to Temporary Fence- Jeremy McGill

10:30 Portable/Seasonal Water Systems- Dr. Je Lehmkuhler

10:50 Methods to Assess Pasture Produ on and Determine Stocking Rate- Dr. Ray Smith

11:30 Hands-on Building a Ro onal Grazing System in the Field: ng up Small Paddocks- Ray Smith, Je Lehmkuhler, & Chris Teutsch

12:20 Lunch

1:00 Fence building: Understanding How to Build and Use Temporary Fencing and High Tensile Fencing – Jeremy McGill

2:30 Break and Travel to Teaching Facility

3:00 Growth of Grasses and Legumes with Response to Grazing- Dr. Ray Smith

3:45 Making Tall Fescue Work on Your Farm- Dr. Jimmy Henning

4:15 Economics of Grazing- Dr. Je Lehmkuhler

5:00 Discussion

5:30 Adjourn for the day

Supper on your own

Wednesday April 22, 2020

7:30 Refreshments

8:00 Forage Species for a Comprehensive Grazing System- Dr. Chris Teutsch

8:45 General Management Consid ons for Grazing Livestock- Dr. Donna Amaral-Phillips

9:15 Using KY GRAZE to plan your Grazing Program - Adam Jones

10:00 Break

10:30 Fundamentals of Laying out a Grazing System - Kevin Laurent

11:00 Case Study: Design an on Farm Grazing System (Group Project)

11:45 Case Study Presenta

12:30 Lunch

1:15 How I made grazing work on the farm- Producer Speaker

1:45 Rejuv ng Run down Pastures - Dr. Chris Teutsch

2:30 Evalu on- All P cipants

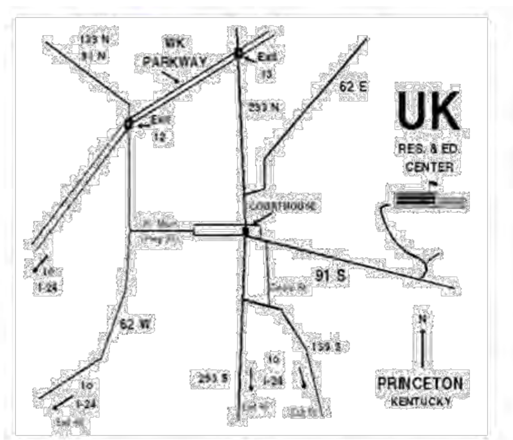
2:45 Break & Travel to Field Demo Area

3:10 Field Exercise. Observe grazed paddocks and hear reports of each group. Tour demon on plots showing warm and cool season annual to extend the grazing season, renova p ons and the ects of ro onal grazing.

5:00 Adjourn

Where is Princeton, KY?

Take Exit 12 or 13 off the West Kentucky Parkway or Exit 45 or 56 from I-24.



*All es are Central Time

MANAGING SUGARCANE APHID IN FORAGE SORGHUM: CULTIVAR AND APHICIDE IMPACTS

C.D. Teutsch, R.T. Villanueva, Z.J. Viloria, G.L Olson, and S.R. Smith, *University of Kentucky*

INTRODUCTION

- Corn silage yield is sensitive to temperature and water stress
- Forage sorghum has a higher level of drought tolerance
- Sugarcane aphid (*Melanaphis sacchari*) could restrict its use

OBJECTIVES

To document the tolerance of forage sorghum cultivars to the sugarcane aphid and the efficacy of an aphicide for aphid control on these cultivars.

MATERIALS AND METHODS

- Conducted at UKREC, Princeton
- RCB with split block treatment arrangement and four replications
  - ➢ Whole plot: APHICIDE
  - ➢ Split plot: VARIETIES
- Planted in 30 in rows in late-May
- 150 lb N/A at planting
- Sivanto at 6 oz/A on 19-Aug-19
- Plots rated for aphid damage on a scale of 1 to 9 (Sharma et al., 2013)
- Plots harvested on 26-Sep-19
- Subsampled for dry matter and nutritive value

Figure 1. Plots were harvested using a modified John Deer silage chopper equipped with load cells for weighing individual plots.

Contact: C.D. Teutsch, chris.teutsch@uky.edu

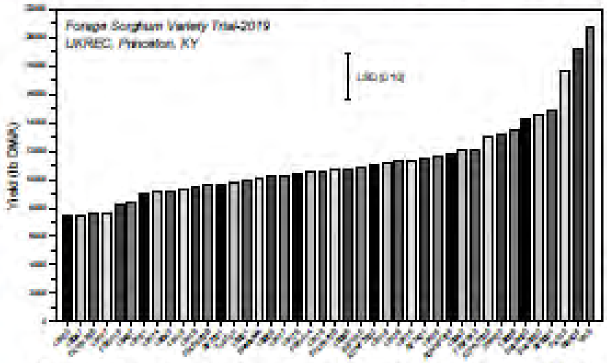


Figure 2. Dry matter yield averaged over aphicide applications for 42 forage sorghum varieties grown in Princeton, KY in 2019. Plots were harvested on 26-Sep-19 using a self-propelled John Deer silage chopper that was equipped with load cells for weighing individual plots.

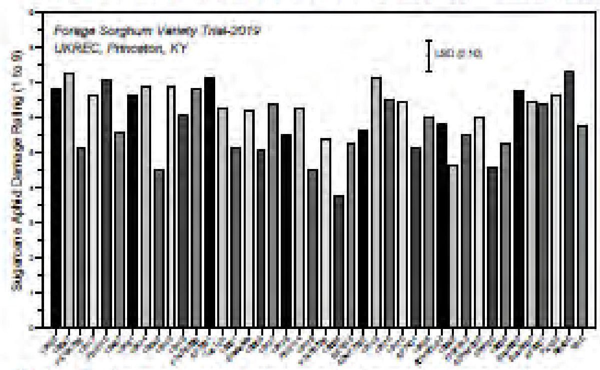


Figure 3. Sugarcane aphid damage rating averaged over aphicide applications for 42 forage sorghum varieties grown in Princeton, KY in 2019. The upper one-third of the canopy was rated on a scale of 1 to 9, with 1 being no damage and 9 being severe damage.

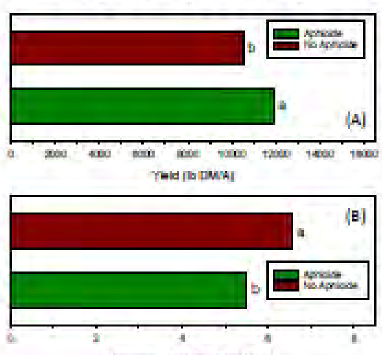


Figure 4. Yield (A) and sugarcane aphid damage rating (B) averaged over varieties as impacted by aphicide application at Princeton, KY in 2019. The upper one-third of the canopy was rated on a scale of 1 to 9, with 1 being no damage and 9 being severe damage.

SUMMARY

- Aphid damage differed between cultivars ($P < 0.01$)
- Aphid damage was reduced in treated plots ($P < 0.02$)
- No aphicide x cultivar interaction occurred ($P > 0.32$)
- Although levels of beneficial insects were high, they were unable to control aphids
- In the short-term, aphicides will likely be needed
- In the long-term, selection of cultivars that have tolerance may provide a simple and cost-effective approach

Figure 5. Sugarcane aphid damage. The untreated plots are on the left and the untreated on the right.

Figure 6. Beneficial insects were present at high rates. In this photo lady bug and lacewing larvae are preying in the aphids.

COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT
Grain and Forage Center of Excellence
University of Kentucky

Optimal Nitrogen Use on Summer Annual Forage Mixtures

Kelly Mercier, Chris Teutsch, Ray Smith, Edwin Ritchey, Kenny Burdine, and Eric Vanzant
University of Kentucky

Introduction

- Increasing biodiversity has often been linked to increased productivity, especially when including legumes
- However, legumes in annual systems may not always supply N to associated plants during the growing season
- Therefore, there is uncertainty when making N recommendations on diverse summer annual forage mixtures

Objective

To evaluate the response of botanically diverse forage mixtures to increasing rates of N fertilizer

Materials & Methods

- Three forage mixtures planted
  - **MONOCULTURE** = sudangrass (SG)
  - **SIMPLE MIXTURE** = SG, pearl millet, & soybean
  - **COMPLEX MIXTURE** = Simple + corn, sudangrass, crabgrass, cowpea, sunn hemp, Korean lespedeza, forage rape, daikon radish, & sunflower
- Total N rates of **0 – 200 lb N/A** was split-applied at planting & after 1st and 2nd harvests
- RCBD with 4 reps at 2 locations
  - Lexington, KY (Maury silt loam)
  - Princeton, KY (Zanesville silt loam with a fragipan)
- Harvested 3x each in 2018 & 2019

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Ramer Seed, Sharon Grove, KY
A special thank you to Jesse Ramer for supplying the seed for this study.

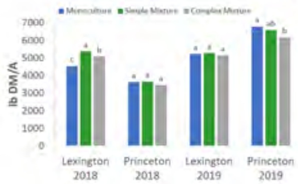


Figure 1. Impact of mixture on annual forage yield for each environment. Treatments within an environment with the same letter are statistically similar (α = 0.05).

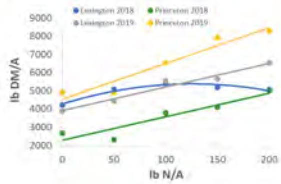
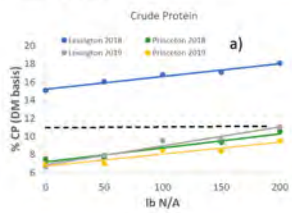
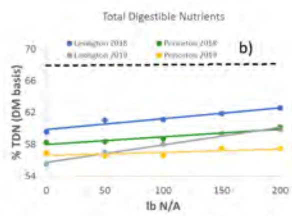


Figure 2. Impact of N rate on annual forage yields for each environment.





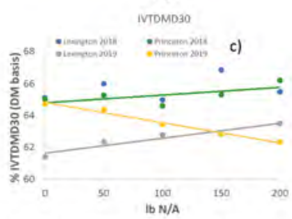


Figure 3. Impact of N rate on forage nutritive characteristics: a) crude protein, b) total digestible nutrients, and c) 30 h *in vitro* true dry matter digestibility. Dashed line denotes requirement for a 650 lb steer to gain 1.7 lb/d.

Table 1. Regression equations and R^2 values for Figures 2 and 3.

	Regression Equation	R^2
Figure 2		
Lexington 2018	$y = -0.0698x^2 + 17.58x + 4270$	0.31
Princeton 2018	$y = 12.89x + 2281$	0.55
Lexington 2019	$y = 12.94x + 3910$	0.59
Princeton 2019	$y = 19.61x + 4549$	0.68
Figure 3a		
Lexington 2018	$y = 0.0141x + 15.20$	0.45
Princeton 2018	$y = 0.0154x + 7.19$	0.76
Lexington 2019	$y = 0.0205x + 6.93$	0.64
Princeton 2019	$y = 0.0131x + 6.75$	0.41
Figure 3b		
Lexington 2018	$y = 0.0137x + 59.86$	0.29
Princeton 2018	$y = 0.0096x + 57.98$	0.60
Lexington 2019	$y = 0.0216x + 55.79$	0.68
Princeton 2019	$y = 0.0040x + 56.58$	0.13
Figure 3c		
Lexington 2018	ns	---
Princeton 2018	$y = 0.0048x + 64.80$	0.08
Lexington 2019	$y = 0.0090x + 61.69$	0.20
Princeton 2019	$y = -0.0127x + 64.82$	0.25

Figure 4. Impact of N rate on botanical composition of simple and complex mixtures.

Results

- Year x location interactions were observed; results are presented by environment
- Yields were more variable in Princeton as compared to Lexington
- N application increased yield in a linear trend in 3 out of 4 environments
- Limited yield response to N in Lexington 2018 possibly due to more plant available N in soil
- Mixture had limited effects on nutritive characteristics (data not shown)
- Increasing N had stronger correlations for yield & CP than TDN & IVTDMD30
- Forage quality was only slightly improved with increasing N
- Both mixtures were dominated by sudangrass
- Crabgrass filled in lower canopy of complex mixtures and provided 500-600 lb DM/A at both locations
- Several species did not perform well in complex mixtures (Fig. 4)

Summary & Implications

- Yield benefits when growing diverse forage mixtures were only observed in one out of four environments
- Applying N to summer annual mixtures is recommended, even if legumes are included
- N application shows more promise for increasing yields as compared to improving forage quality of summer annuals
- Additional cost of seed for mixtures most likely will not pay off, but other environmental benefits may be observed
- If choosing to plant a mixture, only include species with compatible growth habits

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IMPACT OF DEFOLIATION HEIGHT ON CROWN AND SOIL TEMPERATURE

Garrett J. Hatfield and Chris D. Teutsch
Iowa State University and University of Kentucky

Introduction

- In 2018, global temperatures were 1.42°F higher than the 20th-century average
- Higher summer temperatures in the transition zone of the U.S. may make cool-season grasses less well adapted, especially under poor management
- Increased defoliation height may moderate crown and soil temperature leading to enhanced persistence

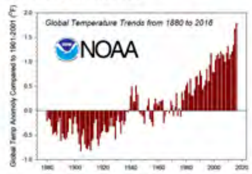

Figure 1. Global temperature trends from 1880 to 2016 (https://www.ncdc.noaa.gov/cag/).

Objective

To evaluate the impact of defoliation height on soil and crown temperatures in an established tall fescue stand

Materials & Methods

- Conducted at UK Research and Education Center located near Princeton, KY
- Experimental design was a RCB with four reps
- Plot size was 10 x 10 ft
- An established tall fescue sod was utilized
- Plots were defoliated weekly to 1.0 and 4.5 inches and monthly to 4.5 inches (Figs. 6 and 7)
- Crown and soil temperature were measured at 15 minute intervals using HOBO MX2303 loggers
  - Crown: sensor placed in the crown of plant
  - Soil: sensor placed at a soil depth of 4 inches
- A pivot table was used to calculate daily minimum, maximum, and average temperatures
- Daily data were analyzed using the General Linear Model procedure (SAS Institute, Cary, NC)

Acknowledgement

We would like to thank USDA-NIFA for funding this undergraduate research project and travel to the 2020 AFGC Annual Conference in Greenville, SC.

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Results

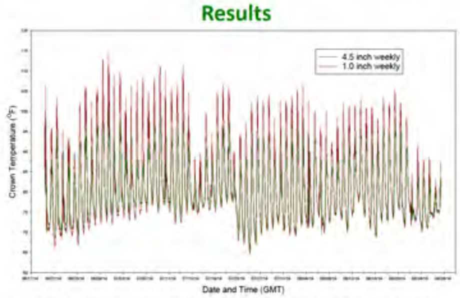

Figure 2. Crown temperature of the tall fescue plant measured at 15 minute intervals from June 19 to August 27, 2020.

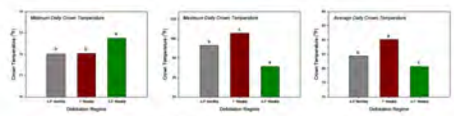

Figure 3. Impact of defoliation regime on the minimum, maximum, and average daily crown temperature.

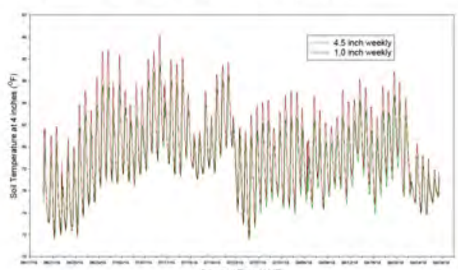

Figure 4. Soil temperature at 4 inches measured at 15 minute intervals from June 19 to August 27, 2020.

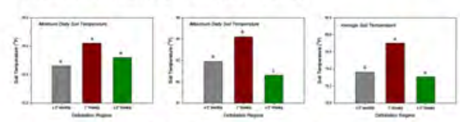

Figure 5. Impact of defoliation regime on the minimum, maximum, and average daily soil temperature at 4 inches.

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College of Agriculture and Life Sciences

Funding for this project was provided by USDA-NIFA ELI-REEU 2017-06637.

Figure 6. Plots were defoliated to 1.0 and 4.5 inches using a lawnmower with a bagging attachment.

Figure 7. HOBO MX2303 data loggers with two external temperature sensors (Onset, Bourne, MA) were installed to measure crown and soil temperature.

Summary

- 1.0 inch defoliation height increased daily maximum crown and soil temp (Figs. 2, 3, 4, 5)
- During periods of high temperature, the difference between a defoliation height of 1 and 4.5 inches often exceeded 10°F
- After approx. one month of close and frequent defoliation (1 inch weekly), crabgrass became the dominate grass species (Fig. 8)
- Close and frequent defoliation negatively impacts photosynthesis, transpiration and energy reserves in cool-season grass plants
- Modifying microclimate at and below the soil surface could impact soil moisture (not measured in this study)
- Rotational stocking could moderate crown and soil temperatures in pastures
- Maintaining a defoliation height above 4.5 inches may help cool-season grasses persist during hot summers

Figure 8. After approximately one month, crabgrass dominated plots that were defoliated to 1 inch on a weekly basis (right). On the left is a plot defoliated to 4.5 inches.

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ENHANCING THE PRECISION OF FROST SEEDING USING GPS GUIDANCE

Conner Raymond, Chris Teutsch, and Josh Jackson

UK Grain and Forage Center of Excellence and Biosystems & Agricultural Engineering

Introduction

- Guidance using the global positioning system (GPS) has long been used in row crop ag
- High price of these systems has limited use in low input forage-livestock systems
- Lower costs and the availability of used guidance systems could increase use

Objective

To evaluate the impact of using GPS Guidance on pasture coverage during overseeding.

Figure 1. Frost seeding red clover in February.

Materials & Methods

- Conducted at UKREC located near Princeton, KY
- Experimental design was a RCB with 4 reps
  - Pasture served as replication
- Pasture size ranged from 6.2 to 10.6 acres
- A simulated frost seeding was conducted using a Kawasaki Mule UTV and a Raven Cruiser II guidance system (Raven Industries, Sioux Fall, SD)
- Target ground speed was 10 mph
- Target spread width was 30 ft
- All pastures overseeded first with NO GUIDANCE
  - GPS guidance was initiated and covered
- Then all pastures overseeded with GUIDANCE
- Data was exported from the guidance system in the form of shapefiles
- ARC GIS (ESRI, Redlands, CA) was to analyze the files for misses and overlaps
  - Bounding geography was created for pastures
  - Centroids created for each path-polygon
  - Centroids spatially joined to path-polygons to determine amount of overlap
  - Missed area determined using erase feature
- UTV speed data was downloaded for each pasture
  - Min, max, mean, and median were calculated
- Data for each pasture was analyzed using the General Linear Model procedure (SAS, Cary, NC)

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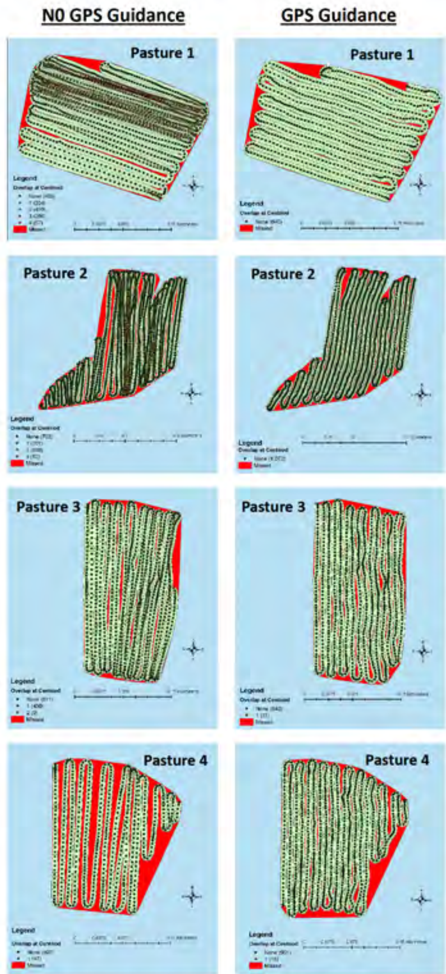

Figure 2. Coverage for pastures 1,2, 3, and 4 with or without GPS Guidance.

Acknowledgement

We would like to thank Greg Comer, ANR Agent, Ohio County, for encouraging us to conduct this study.

Results

- No guidance resulted in increased overlap
- Guidance had no impact on missed areas
- Mean and median speed were not impacted by guidance

Table 1. Impact of GPS guidance on misses, overlaps, and mean and median speed.

Guidance	Missed	Overlap	Mean Speed	Median Speed
	%	%	mph	mph
No Guidance	14.0	49.8	10.0	10.3
Guidance	10.0	3.0	9.2	9.3
P-Value	**0.49**	**0.09**	**0.38**	**0.41**

Summary & Implications

- In this study, overseeding without guidance resulted in an 50% overlap
- At an overseeding cost of $24/acre, the increased cost of seeding without guidance would be $12/acre
- The cost of the guidance system ($2,000) could be recouped in as little as 165 acres
- The guidance system could also be used for other operations such spreading fertilizer, lime or litter, no-till seeding, and herbicide application

Figure 3. Frost seeding a mixture of red clover, annual lespedeza, and crabgrass using GPS guidance.

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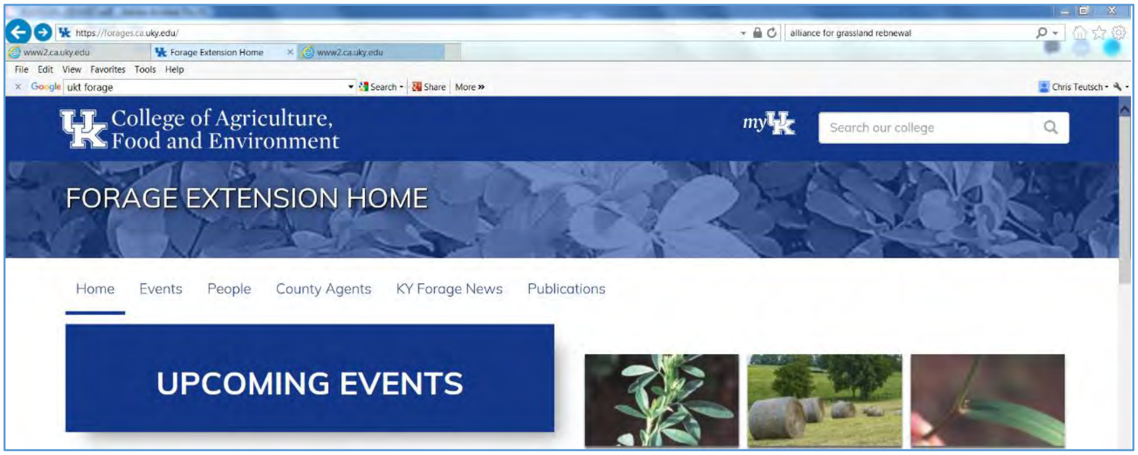
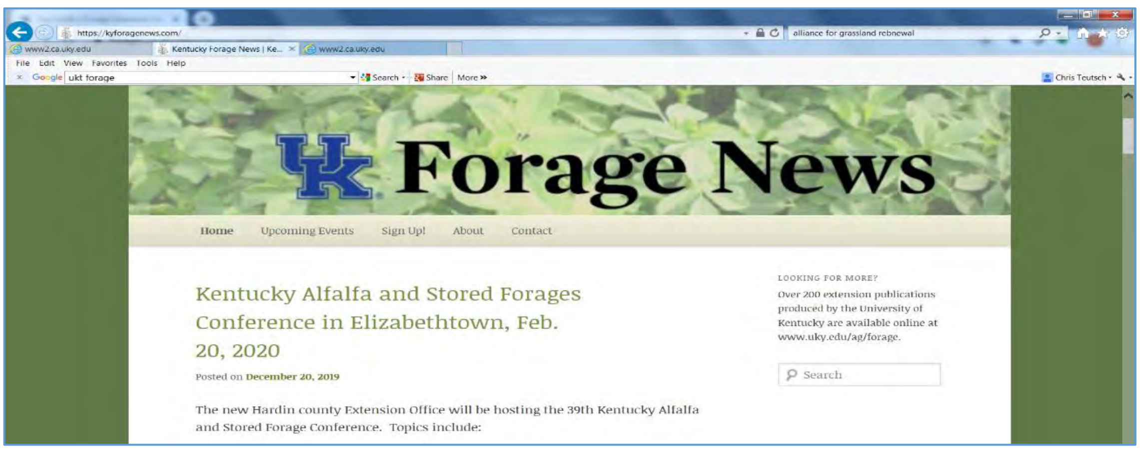
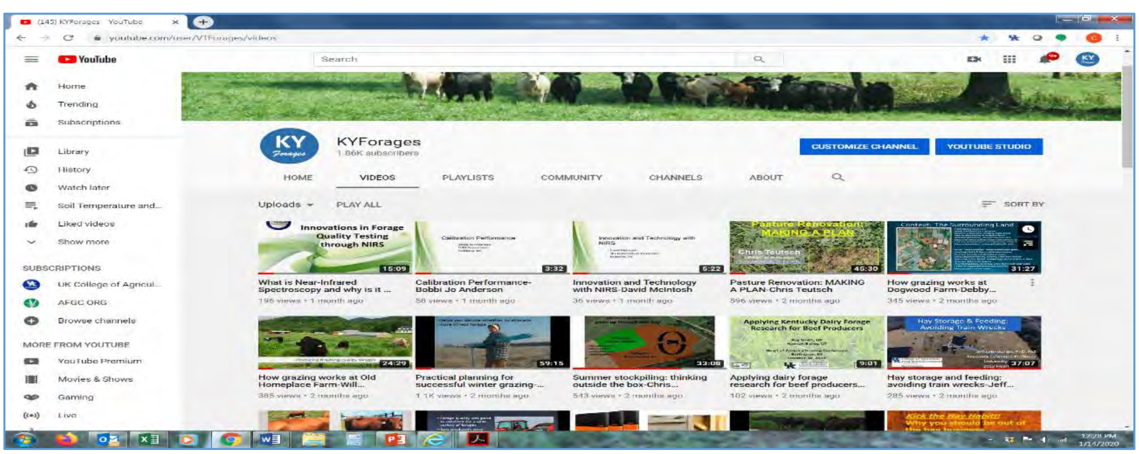
FORAGE RESOURCES IN KENTUCKY



UK Forages Website at https://forages.ca.uky.edu/



UK Forage News at https://kyforagenews.com/



KYForages YouTube Channel at http://www.youtube.com/c/KYForages