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

2018 Cool-Season Grass Horse Grazing Tolerance Report

G.L. Olson, S.R. Smith, C.D.Teutsch, J.C. Henning, and T.D. Phillips, Plant and Soil Sciences, and L.M. Lawrence, Animal and Food Sciences

Introduction

Cool-season grasses such as Kentucky bluegrass, tall fescue, and orchardgrass are dominant pasture grasses for horses in Kentucky. Variety evaluations for yield have been carried out for many years, but little work has been done to establish the effect of variety on persistence when subjected to close, continuous grazing by horses.

The purpose of this report is to summarize current research on the grazing tolerance of varieties of tall fescue, orchardgrass, and other species when subjected to continuous heavy grazing pressure by horses within the grazing season. The main focus will be on stand survival.

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 from a large number of other forage publications.

Important Selection Considerations

Local adaptation and seasonal yield. The variety should be adapted to Kentucky as indicated by good winter survival and good performance across years and locations in replicated yield and grazing trials, such as those presented in this publication. Choose high-yielding persistent varieties and varieties that are productive during the desired season of use. Refer to the appropriate yield trial reports for yield data on specific varieties of interest.

Seed quality. Buy premium-quality seed that is high in germination, high in 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 previous nine months), the level of germination, and percentage of other crop and weed seed. Order seed well in advance of planting time to assure that it will be available when needed.

Important: When seeding perennial ryegrasses for horse pasture (of any kind), insist on an endophyte-free variety. The endophyte level will be stated on a green tag on every bag of seed. Most forage types of perennial ryegrass are endophyte free, and most new turf types are infected. This endophyte is similar to the endophyte of tall fescue and produces alkaloids that are toxic to horses and cattle. Similarly, when seeding tall fescue insist on endophyte-free or novel endophyte varieties (the endophyte level will be stated on a green tag on every bag of seed). Seed of novel endophyte varieties should be handled carefully to preserve the infection, which means keeping seed cool and planting as soon as possible. Novel endophyte tall fescue varieties are good options for horses because of their improved persistence and absence of the toxic alkaloid. The exception is the novel endophyte variety BarOptima PLUS E34. It contains low levels of the alkaloid ergovaline and therefore should never be seeded in pastures where pregnant mares are grazing, since they are very sensitive to ergovaline during their last trimester.

Description of the Tests

Tests were established in Lexington in the fall of 2014, 2015, 2016, and 2017. The soils at this location are well-drained silt loams and are well suited to tall fescue, orchardgrass, and other cool-season grasses. 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

Table 1. Temperature and rainfall at Lexington, Kentucky in 2015, 2016, 2017, and 2018.

	2015				2016				2017				2018[2]			
	Temp		Rainfall		Temp		Rainfall		Temp		Rainfall		Temp		Rainfall	
	°F	DEP[1]	IN	DEP	°F	DEP	IN	DEP	°F	DEP	IN	DEP	°F	DEP	IN	DEP
JAN	32	+1	2.17	-0.69	32	+1	0.80	-2.06	40	+9	6.81	+3.95	31	0	2.01	-0.85
FEB	26	-9	3.08	-0.13	38	+3	6.09	+2.88	47	+12	4.46	+1.25	45	+10	9.77	+6.56
MAR	45	+1	7.34	+2.94	52	+8	4.07	-0.33	48	+4	3.34	-1.06	42	-2.	5.16	+0.76
APR	57	+2	13.19	+9.31	57	+2	3.97	+0.09	62	+7	4.17	+0.29	50	-5	5.52	+1.64
MAY	69	+5	3.02	-1.45	64	0	9.17	+4.70	66	+2	7.74	+3.27	73	+9	8.39	+3.92
JUN	75	+3	8.20	+4.54	76	+4	5.09	+1.43	73	+1	7.68	+4.02	76	+4	6.42	+2.76
JUL	77	+1	10.22	+5.22	79	+3	7.43	+2.43	76	0	4.49	-0.51	77	+1	6.15	+1.15
AUG	74	-1	3.49	-0.44	79	+4	4.37	+0.44	74	-1	6.66	+2.73	77	+2	6.45	+2.52
SEP	72	+4	3.49	+0.29	74	+6	2.18	-1.02	69	+1	4.72	+1.52	74	+6	12.88	+9.68
OCT	59	+2	2.78	+0.21	64	+7	0.37	-2.20	60	+3	6.06	+3.49	59	+2	6.54	+3.97
NOV	51	+6	3.72	+0.33	51	+6	1.94	-1.45	47	+2	3.09	-0.30				
DEC	49	+13	8.42	+4.44	37	+1	9.4	+5.42	35	-1	2.66	-1.32				
Total			69.12	+24.57			54.88	+10.33			61.88	+17.33			69.29	+32.11

[1] DEP is departure from the long-term average.
[2] 2018 data is for the ten months through October.

Table 2. Seedling vigor, grazing preference, and stand persistence of forage grasses sown September 9, 2014, in a horse grazing tolerance study at Lexington, Kentucky.

				Grazing Preference[3]				Percent Stand								
				2015	2016	2017	2018	2014	2015		2016		2017		2018	
Variety	Species	Endophyte Status[1]	Seedling Vigor[2] Oct 9, 2014	May 1	Apr 26	May 31	May 18	Oct 9	Apr 6	Oct 21	Mar 29	Oct 14	Mar 24	Oct 11	Mar 15	Oct 31
Commercial Varieties-Available for Farm Use																
BarOptima PLUS E34[4]	tall fescue	novel	3.3	2.5	1.0	1.0	2.3	99	99	100	100	99	99	99	99	99*
KY31+	tall fescue	toxic	5.0	2.0	1.0	1.0	2.7	100	100	100	100	99	99	99	99	99*
Jesup MaxQ	tall fescue	novel	3.8	1.8	1.0	1.0	2.2	99	100	100	100	99	98	98	98	98*
SS-0705TFSL	tall fescue	free	4.2	2.0	1.0	1.0	1.3	99	100	99	99	99	98	98	98	98*
Select	tall fescue	free	3.6	1.2	1.0	1.0	2.0	97	99	98	99	98	97	97	97	97*
Profit	orchardgrass		4.5	2.8	3.3	5.8	7.7	100	100	80	96	45	32	38	40	32
Benchmark Plus	orchardgrass		3.7	3.0	3.8	5.5	6.5	99	99	98	97	48	45	49	48	31
Persist	orchardgrass		3.3	2.7	3.2	4.0	6.0	99	99	98	96	60	52	57	53	28
SS0708OGDT	orchardgrass		4.4	3.3	3.8	5.7	5.7	100	100	99	98	56	47	51	51	27
Power	perennial ryegrass		4.8	5.7	5.8	8.4	6.3	100	96	95	96	40	10	18	22	12
Grand Daddy	perennial ryegrass		4.4	3.5	3.0	4.5		98	98	95	94	38	10	10	8	8
Experimental Varieties																
NFTF1370	tall fescue	free	4.5	1.3	1.0	1.0	1.5	100	100	100	100	100	100	100	100	100*
KY31-	tall fescue	free	4.3	2.2	1.0	1.0	1.8	98	99	99	99	100	99	100	100	100*
NFTF1044	tall fescue	free	3.8	1.8	1.0	1.2	1.3	100	100	100	100	100	99	99	99	99*
NFTF1051	tall fescue	free	3.8	1.2	1.0	1.0	2.3	100	100	100	100	98	98	98	98	97*
2014.90.19	orchardgrass		4.3	2.7	3.2	4.8	5.8	100	100	99	99	70	68	68	63	37
OG1101G	orchardgrass		3.6	3.4	4.2	6.4	6.2	100	100	95	94	36	24	22	24	34
OG1102G	orchardgrass		3.8	3.2	3.6	6.0	6.0	100	100	98	98	50	34	36	32	28
B-14.0516	orchardgrass		2.3	4.2	5.3	5.5	6.7	95	95	94	94	51	38	39	34	20
OG0901G	orchardgrass		3.8	3.3	5.5	6.2	6.7	98	99	98	97	56	33	35	28	20
Mean			4.0	2.7	3.7	3.5	4.3	99	99	97	98	71	64	67	67	60
CV,%			16.1	28.1	30.9	43.0	34.1	2	2	8	3	17	20	22	20	22
LSD,0.05			0.7	0.9	1.0	1.8	1.7	2	3	9	3	14	15	17	16	16

[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. Orchardgrass does not contain an endophyte and forage type perennial ryegrass varieties do not contain a toxic endophyte.
[2] Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
[3] Preference score based on a scale of 1 to 9 with 9 indicating all forage was grazed. Grazing time before rating; 2015-4 days, 2016-5 days, 2017-35 days, 2018-25 days.
[4] BarOptima PLUS E34 is not recommended for pregnant mares because it produces low levels of the alkaloid ergovaline.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

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 1 to 3 inches for the remainder of the grazing season. Individual trials were occasionally clipped to remove seedheads or weed growth not controlled by herbicides. Supplemental hay was fed during periods of slowest growth. Visual ratings of percent stand were made in the fall several weeks after the horses 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. Since trials were seeded in rows, persistence ratings were based on density within a row and not total ground cover. Grass plots were fertilized with 30 pounds of actual N per acre in March, 30 pounds of actual N in May, and 40 pounds of actual N in early November after 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.

Results and Discussion

Weather data for Lexington for 2015, 2016, 2017, and 2018 are presented in Table 1. Data on percent stand are presented in Tables 2, 3, 4, and 5.

Statistical analyses were performed on all entries (including experimentals) to determine if numerical differences are truly due to variety. Varieties not significantly different from the highest numerical value in a column are marked with one asterisk (*). To determine if two varieties are truly different, compare the difference between the two varieties to the least significant difference (LSD) 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 a given location. The coefficient of variation (CV), which is a measure of the variability of the data, is included for each column of means. Low variability is desirable, and increased variability within a study results in higher CVs and larger LSDs.

In general, commercial varieties of tall fescue and orchardgrass tolerated overgrazing well (Tables 2, 3, and 4), but the varieties of timothy in these trials did not. The sensitivity of timothy to heavy grazing was not surprising, as it is an erect species and sensitive to heavy defoliation. Perennial ryegrasses, Kentucky bluegrasses, and festuloliums vary in tolerance to grazing by horses.

The lack of a defined "grazing-tolerant variety" for these species makes absolute interpretation difficult. For example, endophyte-infected Kentucky 31 (KY31+) is known to be grazing tolerant. (Note: KY31+ is not recommended for late term mares because of toxicity issues

Table 3. Seedling vigor, grazing preference, and stand persistence of forage grasses sown September 3, 2015, in a horse grazing tolerance study at Lexington, Kentucky.

Variety	Species	Endophyte Status[1]	Seedling Vigor[2] Oct 19, 2015	Grazing Preference[3] 2016 Apr 26	2017 May 31	2018 May 18	Percent Stand 2015 Oct 19	2016 Mar 29	2016 Oct 14	2017 Mar 24	2017 Oct 9	2018 Mar 15	2018 Oct 31
Commercial Varieties-Available for Farm Use													
Jesup MaxQ	tall fescue	novel	3.5	1.4	1.0	3.0	100	100	100	100	100	100	100*
KY31+	tall fescue	toxic	3.6	1.8	1.0	2.5	100	100	100	100	100	100	100*
Lacefield MaxQII	tall fescue	novel	3.7	1.8	1.0	2.8	100	100	100	100	100	100	100*
SS-0705TFSL	tall fescue	free	3.3	1.5	1.0	2.7	100	100	100	100	100	100	100*
BarOptima PLUS E34[4]	tall fescue	novel	3.0	1.9	1.0	3.2	100	100	99	99	99	99	99*
Select	tall fescue	free	3.3	1.5	1.0	2.7	100	100	100	100	100	100	99*
Power	perennial ryegrass		4.7	4.5	8.2	8.8	100	100	93	87	57	52	55
Persist	orchardgrass		3.3	2.7	1.7	7.8	100	100	97	97	97	97	25
Tekapo	orchardgrass		3.3	4.2	2.7	8.0	100	100	97	95	95	95	25
SS-0708OGDT	orchardgrass		3.7	2.5	3.5	7.5	100	100	94	93	92	92	21
Prairie	orchardgrass		3.3	2.7	3.0	7.7	100	100	94	92	93	93	20
Spring Green	festulolium		4.8	3.7	7.8	8.8	100	100	88	85	52	43	18
Duo	festulolium		5.0	6.3	8.8	9.0	100	98	72	70	37	27	12
Experimental Varieties													
KY31-	tall fescue	free	3.3	1.6	1.0	3.2	100	100	100	100	100	100	100*
KYFA1113	tall fescue	free	3.4	1.7	1.0	2.7	100	100	100	100	100	100	100*
KYFA1114	tall fescue	free	3.6	1.8	1.2	3.3	100	100	100	100	100	100	100*
KYFA9821/AR584	tall fescue	novel	3.8	1.5	1.0	2.7	100	100	100	100	100	100	100*
KYFA1311	tall fescue	free	3.2	1.5	1.0	2.8	100	100	98	99	99	99	99*
KYDG1001	orchardgrass		3.3	3.0	4.0	7.7	100	100	93	92	82	88	30
KYDG1002	orchardgrass		3.2	3.2	2.7	6.3	100	100	96	93	88	88	27
KYFL1013	festulolium		4.9	3.5	8.5	8.8	100	100	86	78	33	20	10
Mean			3.7	2.6	3.0	5.3	100	100	96	94	87	85	64
CV,%			9.2	27.0	24.5	16.7	0	1	7	7	9	8	35
LSD,0.05			0.4	0.8	1.3	1.0	0	1	7	8	9	8	25

[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. Orchardgrass and festulolium do not contain an endophyte and forage type perennial ryegrass varieties do not contain a toxic endophyte.
[2] Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
[3] Preference score based on a scale of 1 to 9 with 9 indicating all forage was grazed. Grazing time before rating; 2016-5 days, 2017-35 days, 2018-25 days.
[4] BarOptima PLUS E34 is not recommended for pregnant mares because it produces low levels of the alkaloid ergovaline.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

associated with ergovaline production.) However, there are no proven grazing-tolerant varieties for the other species. Still, certain varieties were clearly more tolerant than others.

Differences in tolerance among varieties could be due to true grazing tolerance but also to preference, especially where highly palatable species such as Kentucky bluegrass and perennial ryegrass were in the same test as tall fescue. Horses may graze the preferred varieties more intensely than the less preferred varieties. Because of potential preference between species, comparison between varieties is most accurate within a species. These data should be taken as an indication of tolerance to periods of overgrazing. For best pasture stands, forage grasses should not be abused as in this study.

Tables 2, 3, 4, and 5 include preference ratings made two to three weeks after horses started grazing. These ratings do not provide information on initial preference but do provide a good indication of the varieties that the horses repeatedly grazed during the first few weeks on pasture.

Table 6 summarizes information about distributors and persistence across years for all varieties in these tests. Varieties are listed in alphabetical order, with experimental varieties listed at the bottom. An open block indicates that the variety was not in that particular test (labeled at the top of the column); an "x" in the block indicates the variety was in the test but was significantly different from the most persistent variety. A single asterisk (*) means that the variety was not significantly different from the most persistent variety in that study based on the 0.05 LSD. It is best to choose a variety that has performed well over several years.

Tables 7 and 8 are summaries of stand persistence data from 1999 to 2018 of commercial tall fescue and orchardgrass varieties that have been entered in the Kentucky trials. In Table 7 the data is listed as a percentage of endophyte free KY31 (KY31-). In other words, in the tall fescue trials KY31- is 100 percent. Varieties with percentages over 100 persisted better than KY31-, and varieties with percentages less than 100 persisted less than KY31-. In Table 8 the data is listed as a percentage of the mean of the commercial orchardgrass varieties entered in each specific trial. In other words, the mean for each trial is 100 percent. Varieties with percentages over 100 persisted better than average, and varieties with percentages less than 100 persisted less than average. Direct, statistical comparisons of varieties cannot be made using the summary Tables 7 and 8, but these comparisons do help identify varieties for further consideration. Varieties that have performed better than average over many

years have very stable performance; others may have performed 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 footnotes in Tables 7 and 8 to determine which yearly report should be referenced. Table 9 is a summary of perennial ryegrass and festulolium varieties in the cattle tolerance grazing trials (included to represent grazing tolerance of grass species not shown in horse tolerance summary tables).

Summary

These studies indicate there are varieties of cool-season grasses that can tolerate overgrazing by horses for three to four seasons and maintain reasonable stands. This information should be used along with yield and other information (for example, relative maturity in spring) in selecting the best grass variety for each individual use. See yield variety trials on website (forages.ca.uky.edu) or the summary publication *2018 Long-Term Summary of Kentucky Forage Variety Trials* (PR-754) that shows variety comparisons over all species. It is not generally recommended that tall fescue, orchardgrass, or other cool-season grasses be continually overgrazed as was done in this trial. Although several varieties expressed tolerance to the level of grazing pressure used in these trials, overgrazing greatly reduces forage production. This information should be an indication of those varieties that will better withstand overgrazing when it occurs.

Good management for maximum life from any grass would be to allow complete establishment before grazing and to avoid overgrazing during times of extreme stress, such as drought.

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. L.M. Lawrence is a professor of horse nutrition, and T.D. Phillips is an associate professor of tall fescue and grass breeding.

Table 4. Seedling vigor, grazing preference, and stand persistence of forage grasses sown September 8, 2016, in a horse grazing tolerance study at Lexington, Kentucky.

Variety	Species	Endophyte Status[1]	Seedling Vigor[2] Oct 6, 2016	Grazing Preference[3] 2017 May 26	Grazing Preference[3] 2018 May 18	Percent Stand 2016 Oct 6	Percent Stand 2017 Mar 15	Percent Stand 2017 Oct 9	Percent Stand 2018 Mar 15	Percent Stand 2018 Nov 2
Commercial Varieties-Available for Farm Use										
KY31+	tall fescue	toxic	2.5	1.2	1.7	100	100	100	100	100*
BarOptima PLUS E34[4]	tall fescue	novel	2.3	1.5	2.0	100	100	100	100	100*
Cajun II	tall fescue	free	2.8	1.3	1.3	100	100	99	100	100*
Lacefield MaxQII	tall fescue	novel	3.7	1.3	1.3	100	100	99	99	99*
SS0705TFSL	tall fescue	free	3.0	2.5	1.3	100	100	99	99	99*
Jesup MaxQ	tall fescue	novel	3.6	1.5	1.3	100	100	98	98	98*
Vision	colonial bentgrass		1.0	9.0	8.2	75	78	86	88	92*
Remington	perennial ryegrass		4.3	8.3	9.0	100	100	98	98	58
Persist	orchardgrass		2.8	3.2	7.8	100	100	98	98	30
Spring Green	festulolium		3.8	6.7	8.5	100	100	98	98	28
Giant	redtop bentgrass		1.0	8.7	8.2	73	68	57	80	25
Linn	perennial ryegrass		4.7	6.2	7.8	100	100	95	95	23
PayDay	perennial ryegrass		3.9	8.3	8.8	100	100	98	93	23
SS0708DGDT	orchardgrass		3.8	4.7	7.0	100	100	96	97	23
Prairie	orchardgrass		3.3	5.2	7.7	100	100	97	97	21
Duo	festulolium		4.8	6.7	9.0	100	98	68	56	18
Experimental Varieties										
KYFA1303	tall fescue	free	4.0	2.0	1.5	100	100	100	100	100*
KYFA9732/AR584	tall fescue	novel	3.8	1.8	1.7	100	100	100	100	100*
KYFA1201	tall fescue	free	3.2	1.5	1.5	100	100	100	100	100*
KY31-	tall fescue	free	2.8	1.3	1.5	100	100	99	99	99*
KYFA9304	tall fescue	free	3.5	1.7	1.8	100	100	99	99	99*
KYDG1001	orchardgrass		3.5	5.7	8.2	100	100	99	99	19
KYDG1002	orchardgrass		4.2	5.0	8.0	100	100	97	97	15
KYFL1301	festulolium		4.2	6.5	8.8	100	100	94	93	15
Mean			3.3	4.2	5.7	98	98	95	95	62
CV,%			15.7	26.1	13.5	4	4	8	7	16
LSD,0.05			0.6	1.3	0.8	4	4	8	7	11

[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. Orchardgrass does not contain an endophyte and forage type perennial ryegrass varieties do not contain a toxic endophyte.
[2] Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
[3] Preference score based on a scale of 1 to 9 with 9 indicating all forage was grazed. Grazing time before rating; 2017-35 days, 2018-25 days.
[4] BarOptima PLUS E34 is not recommended for pregnant mares because it produces low levels of the alkaloid ergovaline.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 5. Seedling vigor, grazing preference, and stand persistence of forage grasses sown September 9, 2017 in a horse grazing tolerance study at Lexington, Kentucky.

Variety	Species	Endophyte Status[1]	Seedling Vigor[2] Oct 12, 2017	Grazing Preference[3] May 18, 2018	Percent Stand 2017 Oct 12	Percent Stand 2018 Mar 15	Percent Stand 2018 Nov 2
Commercial Varieties-Available for Farm Use							
Jesup MaxQ	tall fescue	novel	3.3	1.5	100	100	100*
SS0705TFSL	tall fescue	free	3.3	1.3	100	100	100*
Lacefield MaxQII	tall fescue	novel	3.6	1.5	99	99	100*
BarOptima PLUS E34[4]	tall fescue	novel	3.3	2.8	100	100	99*
KY31+	tall fescue	toxic	3.3	2.2	99	98	99*
Potomac	orchardgrass		4.2	4.2	100	100	94
Persist	orchardgrass		3.4	5.5	100	99	91
SS0708OGDT	orchardgrass		4.3	5.8	100	100	90
Climax	timothy		2.5	6.3	85	93	89
Prairie	orchardgrass		3.3	5.3	99	99	87
KY Early	timothy		1.3	6.2	58	85	85
Clair	timothy		1.9	7.5	75	86	78
Experimental Varieties							
KYFA9304	tall fescue	free	3.4	2.0	100	100	100*
KYFA1306	tall fescue	free	3.5	1.7	100	100	100*
KYFA1404	tall fescue	free	3.0	1.8	99	99	99*
KYFA1305	tall fescue	free	3.8	1.5	98	98	99*
KY31-	tall fescue	free	3.3	2.3	98	98	99*
KYFA1304	tall fescue	free	3.1	1.2	99	99	99*
KYFA1405	tall fescue	free	2.3	1.8	97	97	97*
NC-JimGraze	timothy		2.4	5.2	94	98	94
Mean			3.1	3.4	95	97	95
CV,%			20.7	32.5	8	4	5
LSD,0.05			0.7	1.3	9	4	5

[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. Orchardgrass does not contain an endophyte and forage type perennial ryegrass varieties do not contain a toxic endophyte.
[2] Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
[3] Preference score based on a scale of 1 to 9 with 9 indicating all forage was grazed. Grazing time before rating; 2018-25 days.
[4] BarOptima PLUS E34 is not recommended for pregnant mares because it produces low levels of the alkaloid ergovaline.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 6. Summary of persistence of forage grasses under heavy grazing pressure by horses across years at Lexington, Kentucky.

Variety	Species	Endophyte Status[1]	Proprietor/ KY Distributor	2014[2]								2015						2016				2017	
				Apr[3]	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Nov	Mar	Nov
				2015		2016		2017		2018		2016		2017		2018		2017		2018		2018	
Commercial Varieties-Available for Farm Use																							
BarOptima PLUS E34[4]	tall fescue	novel	Barenbrug USA	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Benchmark Plus	orchardgrass		Southern States	*	*	*	x[5]	x	x	x	x												
Cajun II	tall fescue	free	Smith Seed Services															*	*	*	*		
Clair	timothy		Turner Seed																			x	x
Climax	timothy		Canada Agr. Res. Station																			x	x
Duo	festulolium		Ampac Seed Company									x	x	x	x	x	x	*	x	x	x		
Giant	redtop bentgrass		Pure Seed Testing															x	x	x	x		
Grand Daddy	perennial ryegrass		Smith Seed Services	*	x	x	x	x	x	x	x												
Jesup Max Q	tall fescue	novel	Pennington Seed	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
KY Early	timothy		Smith Seed Services																			x	x
KY 31+	tall fescue	toxic	Public	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lacefield MaxQ II	tall fescue	novel	Pennington Seed									*	*	*	*	*	*	*	*	*	*	*	*
Linn	perennial ryegrass		Public															*	*	*	x		
PayDay	perennial ryegrass		Mountain View Seeds															*	*	*	x		
Persist	orchardgrass		Smith Seed Services	*	*	x	x	x	x	x	x	*	*	*	*	*	x	*	*	*	x	*	x
Potomac	orchardgrass		Public																			*	x
Power	perennial ryegrass		Ampac Seed Company	x	x	x	x	x	x	x	x	*	*	x	x	x	x						
Prairie	orchardgrass		Turner Seed									*	*	*	*	*	x	*	*	*	x	*	x
Profit	orchardgrass		Ampac Seed Company	*	x	x	x	x	x	x	x												
Remington	perennial ryegrass		Barenbrug USA															*	*	*	x		
Select	tall fescue	free	Southern States	*	*	*	*	*	*	*	*	*	*	*	*	*	*						
Spring Green	festulolium		Rose-Agri Seed									*	x	x	x	x	x	*	*	*	x		
SS-0705TFSL	tall fescue	free	Southern States	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
SS-0708OGDT	orchardgrass		Southern States	*	*	*	x	x	x	x	x	*	*	*	*	*	x	*	*	*	x	*	x
Tekapo	orchardgrass		Ampac Seed Company									*	*	*	*	*	x						
Vision	colonial bentgrass		Blue Moon Farms															x	x	x	*		
Experimental Varieties																							
B-14.0516	orchardgrass		Blue Moom Farms	x	x	x	x	x	x	x	x												
KY 31-[3]	tall fescue	free	KY Agric. Exp. Station	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
KYDG1001	orchardgrass		KY Agric. Exp. Station									*	*	*	*	x	x	*	*	*	x		
KYDG1002	orchardgrass		KY Agric. Exp. Station									*	*	*	*	x	x	*	*	*	x		
KYFA1113	tall fescue	free	KY Agric. Exp. Station									*	*	*	*	*	*						
KYFA1114	tall fescue	free	KY Agric. Exp. Station									*	*	*	*	*	*						
KYFA1201	tall fescue	free	KY Agric. Exp. Station															*	*	*	*		
KYFA1303	tall fescue	free	KY Agric. Exp. Station															*	*	*	*		
KYFA1304	tall fescue	free	KY Agric. Exp. Station																			*	*
KYFA1305	tall fescue	free	KY Agric. Exp. Station																			*	*
KYFA1306	tall fescue	free	KY Agric. Exp. Station																			*	*
KYFA1311	tall fescue	free	KY Agric. Exp. Station									*	*	*	*	*	*						
KYFA1404	tall fescue	free	KY Agric. Exp. Station																			*	*
KYFA1405	tall fescue	free	KY Agric. Exp. Station																			*	*
KYFA9304	tall fescue	free	KY Agric. Exp. Station															*	*	*	*	*	*
KYFA9732/AR584	tall fescue	novel	KY Agric. Exp. Station															*	*	*	*		
KYFA9821/AR584	tall fescue	novel	KY Agric. Exp. Station									*	*	*	*	*	*						

continued

Table 6. *continued*

Variety	Species	Endophyte Status[1]	Proprietor/ KY Distributor	2014[2]								2015						2016				2017	
				Apr[3]	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Nov	Mar	Nov
				2015		2016		2017		2018		2016		2017		2018		2017		2018		2018	
KYFL1013	festulolium		KY Agric. Exp. Station									*	x	x	x	x	x						
KYFL1301	festulolium		KY Agric. Exp. Station															*	*	*	x		
NC-JimGraze	timothy		Green Consulting Serv.																			*	x
NFTF 1044	tall fescue	free	Noble Foundation	*	*	*	*	*	*	*	*												
NFTF 1051	tall fescue	free	Noble Foundation	*	*	*	*	*	*	*	*												
NFTF 1370	tall fescue	free	Noble Foundation	*	*	*	*	*	*	*	*												
OG 0901G	orchardgrass		FFR/Southern States	*	*	*	x	x	x	x	x												
OG 1101G	orchardgrass		FFR/Southern States	*	x	x	x	x	x	x	x												
OG 1102G	orchardgrass		FFR/Southern States	*	*	*	x	x	x	x	x												
2014.90.19	orchardgrass		KY Agric. Exp. Station	*	*	*	x	x	x	x	x												

[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. Orchardgrass does not contain an endophyte and forage type perennial ryegrass varieties do not contain a toxic endophyte.
[2] Establishment year.
[3] Date of rating of percent stand.
[4] BarOptima PLUS E34 is not recommended for pregnant mares because it produces low levels of the alkaloid ergovaline.
[5] x in the block indicates the variety was in the test but the stand survival was significantly less than the most persistent variety. An open block indicates the variety was not in the test.
*Not significantly different from the highest numerical value in the column, based on the 0.05 LSD.

Table 7. Summary of 1999-2018 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]	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Mean[4] (#trials)
			3-yr[5]	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	4-yr	3-yr	
BarOptima PLUS E34[6]	novel	Barenbrug USA								107			101	101	95	104	99	99	101(6)
Bronson	free	Ampac Seed	80																–
Cajun II	free	Smith Seed Services														96			–
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	98(9)
Johnstone	free	ProSeeds Marketing		88															–
KY31+	toxic	KY Agri. Exp.Sta.		105				102	109	120	107	101	101	101	99	105	99	100	104(11)
KY31-	free	KY Agri. Exp.Sta.	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100(15)
Lacefield MaxQ II	novel	Pennington Seed							105	110		98				104		100	104(4)
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	99	96(14)
SS0705TFSL	free	Southern States															98	100	
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 4 years so the final report would be "2014 Cool-Season Grass Horse Grazing Tolerance Report" archived in the KY 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 8. Summary of 1999-2018 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 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	110	108(7)
Potomac	Public				117										–
Prairie	Turner Seed			100										88	–
Prodigy	Caudill Seed											54			–
Profit	Ampac Seed							93	86		92		108		95(4)
SS-0708OGDT	Southern States									104			92	92	96(3)
Tekapo	Ampac Seed	101	115		93	30		92	100	83	87	63		110	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 in 2010 was grazed four years so the final report would be "2014 Cool-Season Grass Horse Grazing Tolerance Report" archived in the KY 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.

Table 9. Summary of 2000-2018 Kentucky perennial ryegrass and festulolium (FL) cattle grazing tolerance trials with three or more years of data in Lexington (stand persistence shown as a percent of the mean of the commercial varieties in the trial). ***Included to represent grazing tolerance of grass species not shown in Horse Tolerance Summary Tables.***

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 3yr	Mean[3] (#trials)
AGRLP103	–	AgResearch USA	128		86									107(2)
Albion	tetraploid	Grassland Oregon											113	–
Aries	diploid	Ampac Seed		139										–
Barfest (FL)	MF x PR[6]	Barenbrug USA						116	112					114(2)
Barvitra	diploid	Barenbrug USA											34	–
Boost	tetraploid	Allied Seed					101	83	95	104				96(4)
Calibra	tetraploid	DLF International								120		88	101	103(3)
Citadel	tetraploid	Donley Seed	107											–
Duo (FL)	MF x PR[6]	Ampac Seed	116				95	72	90	115			82	95(6)
Grand Daddy	tetraploid	Smith Seed Services		121		82		100	81	103		85	115	98(7)
Lasso	diploid	DLF-Jenks		130										–
Linn (certified)	diploid	Public	112	129	63		95	108	95	103	96	80	73	95(10)
Maverick	tetraploid	Ampac Seed		36										–
Meadow Green (FL)	MF xIR[6]	Pure Seed								15				–
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	103	108(7)
Quartet	tetraploid	Ampac Seed		77		59								68(2)
Remington	tetraploid	Barenbrug USA			151							138	142	140(2)
Remington PLUS NEA2[5]	tetraploid	Barenbrug USA										145	137	141(2)
Spring Green (FL)	MF x PR6	Rose Agri-Seed	101				109	115	115	120			100	110(6)
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 in 2010 was grazed four years so the final report would be "2014 Cool-Season Grass Horse Grazing Tolerance Report" archived in the KY 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.

University of Kentucky
College of Agriculture, Food and Environment

11-2018