



2017 Red and White Clover Grazing Tolerance Report

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

Introduction

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. Stands of improved varieties are generally productive for two and a half 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, high yield, and animal acceptance.

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. Three types of white clover grow in Kentucky: Dutch, intermediate, and ladino. Dutch white clover, sometimes called common, naturally occurs in many Kentucky pastures and even lawns. It is generally long lived and reseeds readily, but its small leaves and low growth habit result in low forage yield. The intermediate type is a cross between ladino and Dutch white clover and has been developed to give higher yields than

the Dutch type and to persist better than the ladino type under pasture or frequent grazing conditions. Ladino white clover has larger leaves and taller growth than the intermediate and Dutch types and is the highest yielding of the three white clover types.

This report summarizes research on the grazing tolerance of clover varieties when subjected to continuous grazing pressure. Table 10 shows a summary of all white clover varieties tested in Kentucky during the last 15 years. Due to minimal stands remaining after two years of grazing, a summary table for red clover is not included in this report. Go to the UK Forage Extension website, at www.uky.edu/Ag/Forage, to obtain electronic versions of all forage variety testing reports from Kentucky and surrounding states and a large number of other forage publications.

Table 1. Temperature and rainfall at Lexington, Kentucky, in 2014, 2015, 2016, and 2017.

	2014				2015				2016				2017 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	25	-6	2.28	-.58	32	+1	2.17	-0.69	32	+1	0.80	-2.06	40	+9	6.81	+3.95
FEB	30	-5	5.47	+2.26	26	-9	3.08	-0.13	38	+3	6.09	+2.88	47	+12	4.46	+1.25
MAR	39	-5	3.08	-1.32	45	+1	7.34	+2.94	52	+8	4.07	-0.33	48	+4	3.34	-1.06
APR	58	+3	5.27	-1.89	57	+2	13.19	+9.31	57	+2	3.97	+0.09	62	+7	4.17	+0.29
MAY	66	+2	5.72	+1.25	69	+5	3.02	-1.45	64	0	9.17	+4.70	66	+2	7.74	+3.27
JUN	75	+3	2.93	-0.73	75	+3	8.20	+4.54	76	+4	5.09	+1.43	73	+1	7.68	+4.02
JUL	74	-2	3.18	-1.82	77	+1	10.22	+5.22	79	+3	7.43	+2.43	76	0	4.49	-0.51
AUG	76	+1	6.53	+2.60	74	-1	3.49	-0.44	79	+4	4.37	+0.44	74	-1	6.66	+2.73
SEP	69	+1	3.63	+4.3	72	+4	3.49	+0.29	74	+6	2.18	-1.02	69	+1	4.72	+1.52
OCT	57	0	5.55	+2.98	59	+2	2.78	+0.21	64	+7	0.37	-2.20	60	+3	6.06	+3.49
NOV	41	-4	2.79	-0.60	51	+6	3.72	+0.33	51	+6	1.94	-1.45				
DEC	40	+4	2.47	-1.51	49	+13	8.42	+4.44	37	+1	9.4	+5.42				
Total			49.4	+4.85			69.12	+24.57			54.88	+10.33			56.13	+18.95

¹ DEP is departure from the long-term average.

² 2017 data is for the ten months through October.

Table 2. Seedling vigor and stand persistence of red clover varieties sown September 3, 2015, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Seedling Vigor ¹ Oct 19, 2015	Percent Stand			
		2016			
		Oct 19	Mar 24	Oct 5	Mar 22
Commercial Varieties-Available for Farm Use					
SS-0303RCG	4.0	95	94	42	23*
Kenland	3.9	97	96	29	18*
Freedom!	4.3	95	93	23	8
Experimental Varieties					
RC 001	3.4	92	92	37	23*
RC 1206G	4.7	99	96	38	19*
GA9908	4.2	98	85	32	13*
Mean	4.1	96	93	33	17
CV,%	21.4	4	7	37	62
LSD,0.05	1.0	5	8	14	13

¹ 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 3. Seedling vigor and stand persistence of red clover varieties sown September 8, 2016, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Seedling Vigor ¹ Oct 4, 2016	Percent Stand		
		2017		
		Oct 4	Mar 15	Oct 11
Commercial Varieties-Available for Farm Use				
SS0303RCG	4.9	100	97	90*
Freedom!	4.8	100	93	75
Kenland	4.9	99	97	65
Experimental Varieties				
GA9908	4.8	100	89	81*
Mean	4.9	100	94	78
CV,%	5.8	1	4	13
LSD,0.05	0.3	1	5	13

¹ 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 4. Stand persistence of white clover varieties sown April 10, 2014, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Percent Stand						
	2014		2015		2016		2017
	Oct 6	Apr 6	Oct 22	Mar 24	Oct 7	Mar 22	
Commercial Varieties-Available for Farm Use							
Will	98	90	73	66	36	37*	
Patriot	95	81	46	43	30	31*	
Kopu II	96	53	53	45	28	25*	
Renovation	93	73	64	39	23	24*	
Seminole	94	67	51	37	21	21	
Durana	97	77	50	42	18	19	
RegalGraze	97	79	65	49	19	19	
Canterbury	92	50	46	40	15	12	
Experimental Varieties							
B-12.1216	96	67	38	27	26	33*	
GA 178	97	75	65	53	28	28*	
GA 21160	93	73	47	30	19	23*	
Mean	95	72	54	43	24	25	
CV,%	3	16	32	41	43	47	
LSD,0.05	3	13	20	21	12	14	

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

Important Selection Considerations

Local adaptation and persistence. The variety should be adapted to Kentucky as indicated by superior performance across years and locations in replicated yield trials, such as those reported in this publication. High-yielding varieties are generally also those varieties that are the most persistent. Improved red clover generally produces measurable yields for 2½ to 3 years, with the year of establishment considered as the first year. The highest yields occur in the year following establishment. White clover generally persists longer than red clover, particularly in wet seasons, and has the ability to reseed even under grazing. Refer to the 2017 Red and White Clover Report (PR-728) (or previous years if needed) for yield data on specific varieties of interest.

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, such as those reported in this publication. Other information on the label will include the test date (which must be within the previous nine months), the level of germination, and the percentage 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

Red clover (fall of 2015 and 2016) and white clover (fall of 2013, 2014, 2015, and 2016) tests for grazing were established in Lexington. Soils at the test site are well-drained silt loams and are well suited to clover production. Plots were 5 feet by 15 feet in a randomized complete block design with each variety replicated six times.

Red clover was seeded at the rate of 12 pounds per acre and white clover at 3 pounds per acre into a prepared seedbed using a disk drill. All seed lots were inoculated prior to planting. Plots were grazed continuously beginning the spring after fall

Table 5. Stand persistence of white clover varieties sown September 9, 2014, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Percent Stand						
	2014		2015		2016		2017
	Nov 3	Apr 6	Oct 30	Mar 24	Oct 17	Mar 22	Oct 19
Commercial Varieties-Available for Farm Use							
Durana	83	91	91	86	69	48	64*
Will	94	86	86	88	66	57	63*
Patriot	87	93	93	90	78	53	62*
RegalGraze	93	93	93	81	65	51	58*
Renovation	90	92	92	89	73	50	57*
Alice	91	92	92	85	53	35	53*
Canterbury	97	90	90	72	68	48	53*
Kopu II	96	93	93	87	58	43	53*
Seminole	93	87	87	78	53	43	48
Experimental Varieties							
GA 21160	92	88	88	88	68	50	68*
PPG-TR101	72	88	88	89	68	45	66*
SSS-SH1	84	91	91	88	65	50	65*
GA-178	94	90	90	88	70	47	60*
B-12.1216	90	93	93	91	71	45	52*
NFWC04-29	94	94	94	87	70	47	50
VS-41730	94	77	77	76	53	42	50
Mean	90	90	90	85	65	47	58
CV,%	9	8	8	10	21	31	24
LSD,0.05	9	8	8	10	16	17	16

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

Table 6. Seedling vigor and stand persistence of white clover varieties sown September 3, 2015, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Seedling Vigor ¹ Oct 21, 2015	Percent Stand				
		2015	2016		2017	
		Dec 11	Mar 24	Oct 5	Mar 22	Oct 12
Commercial Varieties-Available for Farm Use						
Patriot	2.0	88	90	94	94	93*
Durana	3.2	91	91	95	95	90*
Neches	4.0	95	95	96	94	88*
Will	4.2	96	98	93	92	87*
Alice	3.7	77	94	94	91	85
Kopu II	4.5	96	95	88	87	84
RegalGraze	4.3	97	97	87	83	74
Renovation	1.2	71	68	78	77	72
Experimental Varieties						
BARTRALRG	3.9	93	95	92	88	83
GA-178	2.3	90	90	87	88	79
Mean	3.3	89	91	90	89	83
CV,%	26.7	14	8	6	7	6
LSD,0.05	1.0	15	8	7	7	6

¹ 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.

seeding. In general, plots were grazed from mid-May to mid-September to a height of 1 inch to 3 inches. 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. Ratings were made 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

Table 7. Seedling vigor and stand persistence of white clover varieties sown September 8, 2016, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Seedling Vigor ¹ Oct 4	Percent Stand		
		2016		2017
		Oct 4	Mar 15	Oct 11
Commercial Varieties-Available for Farm Use				
Patriot	4	97	97	98*
Durana	4	97	95	97*
Alice	4	96	94	95*
Kopu II	5	100	89	94*
Will	5	100	98	94*
RegalGraze	5	100	95	90
Mean	4	98	95	95
CV,%	11	2	2	4
LSD,0.05	1	2	3	4

¹ Vigor score based on a scale of 1 to 5 with 5 being the most vigorous seedling growth.
² Date of rating of percent stand.
³ "x" in the block indicates the variety was in the test but the stand survival was significantly less than the most persistent red clover 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.

density within a row and not on total ground cover. Fertilizers (lime, P, K, and boron) were applied according to University of Kentucky recommendations.

Results and Discussion

Weather data for Lexington for 2014, 2015, 2016, and 2017 are presented in Table 1.

Data on percent stand are presented in tables 2 through 7. Statistical analyses were performed on these data to determine if the apparent differences are truly due to variety or just due to chance. 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

Table 8. Summary of persistence of red clover varieties under heavy grazing pressure across years at Lexington, Kentucky.

Variety	Proprietor/KY Distributor	2015 ¹			2016	
		Mar	Oct	Mar	Mar	Oct
		2016 ²		2017	2017	
Commercial Varieties-Available for Farm Use						
Freedom!	Barenbrug USA	*	*	x ³	*	x
Kenland (certified)	Public	*	*	*	*	x
SS-0303RCG	Southern States	*	*	*	*	*
Experimental Varieties						
GA9908	Univ. of Georgia	x	*	*	x	*
RC 1001	FFR/Southern States	*	*	*		
RC 1206G	FFR/Southern States	*	*	*		

¹ Establishment year.
² Date of rating of percent stand.
³ "x" in the block indicates the variety was in the test but the stand survival was significantly less than the most persistent red clover variety. An open block indicates the variety was not in the test.
 *Not significantly different from the most persistent red clover variety.

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.

Tables 8 and 9 summarize information about distributors and persistence across years.

Table 10 is a summary of stand persistence data from 2002 to 2017 of commercial white clover varieties that have been entered in the 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

Table 9. Summary of persistence of white clover varieties under heavy grazing pressure across years at Lexington, Kentucky.

Variety	Type	Proprietor/KY Distributor	2013 ¹					2014					2015				2016		
			Oct	Apr	Oct	Mar	Oct	Mar	Apr	Oct	Mar	Oct	Mar	Oct	Mar	Oct	Mar	Oct	
			2014 ²	2015	2016	2017	2015	2016	2017	2016	2017	2016	2017	2017	2017	2017	2017		
Commercial Varieties-Available for Farm Use																			
Alice	Intermediate	Barenbrug						*	*	*	x ³	*	*	*	*	*	x	x	*
Canterbury	Dutch	Allied Seed	x	x	x	x	x	x	*	*	x	*	*	*	*	*			
Durana	Intermediate	Pennington Seed	*	*	x	x	x	*	x	*	*	*	*	*	*	*	*	*	*
Kopu II	Intermediate	Ampac Seed	*	x	*	*	*	*	*	*	*	x	*	*	*	x	*	x	x
Patriot	Intermediate	Pennington Seed	*	*	x	x	*	*	*	*	*	*	*	*	*	*	*	*	*
Neches	Intermediate	Barenbrug												*	*	*	*		
Regal Graze	Ladino	Cal/West Seeds	*	*	*	*	x	*	*	*	*	*	*	*	*	x	x	x	*
Renovation	Intermediate	Smith Seed	x	x	*	x	x	*	*	*	*	*	*	*	x	x	x	x	
Seminole	Ladino	Saddle Butte/Caudill Seed	x	x	x	x	x	*	*	*	x	x	*	x					
Will	Ladino	Allied Seed	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Experimental Varieties																			
B-12.1216	—	Blue Moon Farms	*	x	x	x	x	*	*	*	*	*	*	*	*				
BARTRALRG	—	Barenbrug													*	*	*	x	
GA 178	—	Smith Seed	*	x	*	*	*	*	*	*	*	*	*	*	*	x	*	x	
GA 21160	—	Univ of Georgia	x	x	x	x	x	*	*	*	*	*	*	*					
NFWC04-29	—	Noble Foundation						*	*	*	*	*	x						
PPG-TR101	—	Mountain View Seeds						x	*	*	*	*	*	*					
SSS-SH1	Ladino	Smith Seed						x	*	*	*	*	*	*					
VS-41730	Ladino	Turner Seed						x	x	x	x	*	x						

¹ Establishment year.
² Date of rating of percent stand.
³ "x" in the block indicates the variety was in the test but the stand survival was significantly less than the most persistent white clover variety. An open block indicates the variety was not in the test.
 *Not significantly different from the most persistent white clover variety.

Table 10. Summary of 2002-2017 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}	2004	2006 ³	2006	2008 ⁴	2008	2009	2010	2011	2012	2013	2014	2015	Mean ⁵ (#trials)
			2yr ⁶	4yr	2yr	2yr	3yr	4yr	4yr	4yr	4yr	4yr	4yr	4yr	3yr	
Alice	Intermediate	Barenbrug USA		59	98									93	101	88(4)
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	107	103(11)
GWC-AS10	–	Ampac Seed								77						–
Insight	Ladino	Allied Seed				77										–
Ivory	Intermediate	DLF International	132	142												137(2)
Ivory II	Intermediate	DLF International					102									–
Kopu II	Intermediate	Ampac Seed			77	122	96		93	113	112	86	106	93	100	100(10)
KY Select	Intermediate	KY Agr Ex. Sta.						105		83						94(2)
Neches	–	Barenbrug USA													105	–
Patriot	Intermediate	Pennington		110	137	122		100	111	110	123	102	132	109	111	115(11)
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	88	89(11)
Renovation	Intermediate	Smith Seed											102	100	86	96(3)
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	103	117(11)

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 KY Forage website at www.uky.edu/Ag/Forage.

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.

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 Table 10 summary, but these comparisons do help to identify varieties for further consideration. Varieties that have performed better than average over many years 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 footnote in Table 10 to determine the yearly report that should be referenced. Due to minimal stands remaining after two years of grazing, a summary table for red clover is not included in this report.

Summary

Although these varieties were abused during the growing season, they were allowed to rest and regrow after September 15 to prepare for winter. Research has shown that abusive grazing tests are a good way to sort out differences in grazing tolerance between varieties in a relatively short period of time.

This information should be used along with yield and pest resistance information in selecting the best clover variety for

each individual use. It is not recommended that clover be continuously grazed as was done in this trial. While several varieties expressed tolerance to the level of grazing pressure used in these trials, overgrazing greatly reduces yield and therefore profitability of these clovers.

Good management for maximum life from grazing clover would include:

- Allowing clover to become completely established before grazing
- Using rotational grazing where animals harvest available forage in seven days or less followed by resting for 28 days before regrazing; less time is required for white clover
- Adding any needed fertilizer and lime
- Removing grazing livestock from clover fields from mid-September to November 1 to replenish root reserves for winter survival, especially important with red clover

About the Authors

G.L. Olson is a research specialist, S.R. Smith is an Extension professor, and C.D. Teutsch is an Extension associate professor of Forages. J.D. Clark is research facility manager of the UK Dairy.