



2016 Red and White Clover Grazing Tolerance Report

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Introduction

Red clover (*Trifolium pratense* L.) is a high-quality, short-lived perennial legume 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 10-plus years. 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.

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 may persist longer than red clover, particularly in wet seasons, and has the ability to reseed even under grazing. Refer to the 2016 Red and White Clover Report (PR-710) (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 2014 and 2015) and white clover (fall of 2012, 2013, 2014, and 2015) 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

Table 1. Temperature and rainfall at Lexington, Kentucky, in 2013, 2014, 2015, and 2016.

	2013				2014				2015				2016 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	38	+7	4.50	+1.64	25	-6	2.28	-5.58	32	+1	2.17	-0.69	32	+1	0.80	-2.06
FEB	36	+1	1.78	-1.43	30	-5	5.47	+2.26	26	14	3.08	-0.13	38	+3	6.09	+2.88
MAR	39	-5	5.47	+1.07	39	-5	3.08	-1.32	45	+1	7.34	+2.94	52	+8	4.07	-0.33
APR	55	0	4.46	+0.58	58	+3	5.27	-1.89	57	+2	13.19	+9.31	57	+2	3.97	+0.09
MAY	65	+1	5.23	+0.76	66	+2	5.72	+1.25	69	+5	3.02	-1.45	64	0	9.17	+4.70
JUN	72	0	7.32	+3.66	75	+3	2.93	-0.73	75	+3	8.20	+4.54	76	+4	5.09	+1.43
JUL	72	-4	9.33	+4.33	74	-2	3.18	-1.82	77	+1	10.22	+5.22	79	+3	7.43	+2.43
AUG	72	-3	3.68	-0.25	76	+1	6.53	+2.60	74	-1	3.49	-0.44	79	+4	4.37	+0.44
SEP	67	-1	2.21	-0.99	69	+1	3.63	+4.3	72	+4	3.49	+0.29	74	+6	2.18	-1.02
OCT	55	-2	7.02	+4.45	57	0	5.55	+2.98	59	+2	2.78	+0.21	64	+7	0.37	-2.20
NOV	41	-4	3.06	-0.33	41	-4	2.79	-0.60	51	+6	3.72	+0.33				
DEC	36	0	4.19	+0.21	40	+4	2.47	-1.51	49	+13	8.42	+4.44				
Total			58.25	+13.70			49.4	+4.85			69.12	+24.57			43.54	+6.36

¹ DEP is departure from the long-term average.

² 2016 data is for the ten months through October.

Table 2. Seedling vigor and stand persistence of red clover varieties sown September 9, 2014, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Seedling Vigor ¹ Oct 9, 2014	Percent Stand				
		2014		2015		2016
		Oct 9	Apr 6	Oct 21	Mar 24	Oct 17 ²
Commercial Varieties-Available for Farm Use						
Kenland	3.7	94	82	29	20*	–
Gallant	4.0	96	78	40	18*	–
Freedom!	4.4	96	78	34	17*	–
SS-0303RCG	3.8	93	80	28	13*	–
LS 9703	3.6	92	73	25	12*	–
Common O	4.7	96	82	27	8	–
Mean	4.0	95	79	30	15	
CV,%	19.4	3	12	68	69	
LSD,0.05	0.9	4	11	25	12	

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

² No survival by end of season for any variety.

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

were inoculated prior to planting. Plots were grazed continuously beginning the spring after fall seeding. In general, plots were grazed from mid-April 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 density within a row and not total ground cover. Fertilizers (lime, P, K, and boron) were ap-

plied according to University of Kentucky recommendations.

Results and Discussion

Weather data for Lexington for 2013, 2014, 2015, and 2016 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 whether the apparent differences are due to variety or 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

Table 3. 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		
		2015		2016
		Oct 19	Mar 24	Oct 5
Commercial Varieties-Available for Farm Use				
SS-0303RCG	4.0	95	94	42*
Kenland	3.9	97	96	29*
Freedom!	4.3	95	93	23
Experimental Varieties				
RC 1206G	4.7	99	96	38*
RC 1001	3.4	92	92	37*
GA9908	4.2	98	85	32*
Mean	4.1	96	93	33
CV,%	21.4	4	7	37
LSD,0.05	1.0	5	8	14

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.

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.

Several white clover entries persisted into the second season under the abusive grazing of these trials. Tables 8 and 9 summarize information about distributors and persistence across years.

Table 4. Seedling vigor and stand persistence of white clover varieties sown August 30, 2012, in a cattle grazing tolerance study at Lexington, Kentucky.

Variety	Seedling Vigor ¹ Oct 8, 2012	Percent Stand								
		2012		2013		2014		2015		2016
		Oct 8	Mar 28	Sep 19	Apr 3	Oct 9	Apr 6	Oct 22	Apr 6	
Commercial Varieties-Available for Farm Use										
Will	3.8	98	80	60	69	64	62	45	17*	
Patriot	2.2	91	37	14	33	47	43	31	13*	
RegalGraze	4.5	98	63	28	28	38	37	33	12*	
Durana	1.7	84	17	14	23	38	30	20	11*	
Kopu II	3.8	96	38	22	28	35	32	28	11*	
Experimental Varieties										
B-12.1218	2.3	89	35	22	37	43	35	28	10*	
Mean	3.0	93	45	27	36	44	40	31	12	
CV,%	26.1	8	26	46	30	27	27	28	62	
LSD,0.05	0.9	9	14	15	13	14	13	10	9	

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 5. 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
	Oct 6	Apr 6	Oct 22	Mar 24	Oct 6
Commercial Varieties-Available for Farm Use					
Will	98	90	73	66	36*
Patriot	95	81	46	43	30*
Kopu II	96	53	53	45	28*
Renovation	93	73	64	39	23
Seminole	94	67	51	37	21
RegalGraze	97	79	65	49	19
Durana	97	77	50	42	18
Canterbury	92	50	46	40	15
Experimental Varieties					
GA 178	97	75	65	53	28*
B-12.1216	96	67	38	27	26*
GA 21160	93	73	47	30	19
Mean	95	72	54	43	24
CV,%	3	16	32	41	43
LSD,0.05	3	13	20	21	12

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

Table 10 is a summary of stand persistence data from 2002 to 2016 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 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 to which yearly report to refer.

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

Table 6. 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	
	Nov 3	Apr 6	Oct 30	Mar 24	Oct 17
Commercial Varieties-Available for Farm Use					
Patriot	87	93	93	90	78*
Renovation	90	92	92	89	73*
Durana	83	91	91	86	69*
Canterbury	97	90	90	72	68*
Will	94	86	86	88	66*
Regal Graze	93	93	93	81	65*
Kopu II	96	93	93	87	58
Alice	91	92	92	85	53
Seminole	93	87	87	78	53
Experimental Varieties					
B-12.1216	90	93	93	91	71*
GA-178	94	90	90	88	70*
NFWC04-29	94	94	94	87	70*
GA 21160	92	88	88	88	68*
PPG-TR101	72	88	88	89	68*
SSS-SH1	84	91	91	88	65*
VS-41730	94	77	77	76	53
Mean	90	90	90	85	65
CV,%	9	8	8	10	21
LSD,0.05	9	8	8	10	16

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

About the Authors

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Table 7. 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
		Dec 11	Mar 24	Oct 5
Commercial Varieties-Available for Farm Use				
Neches	4.0	95	95	96*
Durana	3.2	91	91	95*
Patriot	2.0	88	90	94*
Alice	3.7	77	94	94*
Will	4.2	96	98	93*
Kopu II	4.5	96	95	88
RegalGraze	4.3	97	97	87
Renovation	1.2	71	68	78
Experimental Varieties				
BARTRALRG	3.9	93	95	92*
GA-178	2.3	90	90	87
Mean	3.3	89	91	90
CV,%	26.7	14	8	6
LSD,0.05	1.0	15	8	7

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

Variety	Proprietor/KY Distributor	2014 ¹			2015	
		Apr	Oct	Mar	Mar	Oct
		2015 ²		2016	2016	
Commercial Varieties-Available for Farm Use						
Common O	Public	*	*	*		
Freedom!	Barenbrug USA	*	*	*	*	*
Gallant	Turner Seed	*	*	*		
Kenland (certified)	Public	*	*	*	*	*
LS 9703	Lewis Seed	*	*	*		
SS-0303RCG	Southern States	*	*	*	*	*
Experimental Varieties						
GA9908	Univ. of Georgia				x ³	*
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.

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

Variety	Type	Proprietor/KY Distributor	2012 ¹				2013				2014				2015					
			Mar	Sep	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Apr	Oct	Mar	Oct	Mar	Oct		
			2013 ²		2014		2015		2016		2014		2015		2016		2015		2016	
Commercial Varieties-Available for Farm Use																				
Alice	Intermediate	Barenbrug													*	*	*	X ³	*	*
Canterbury	Dutch	Allied Seed								X	X	X	X	X	*	*	X	*		
Durana	Intermediate	Pennington Seed	X	X	X	X	X	X	*	*	*	X	X	X	X	*	*	*	*	*
Kopu II	Intermediate	Ampac Seed	X	X	X	X	X	X	*	*	X	*	*	*	*	*	*	X	*	X
Patriot	Intermediate	Pennington Seed	X	X	X	X	X	X	*	*	*	X	X	*	*	*	*	*	*	*
Neches	–	Barenbrug																	*	*
Regal Graze	Ladino	Cal/West Seeds	X	X	X	X	X	X	*	*	*	*	*	X	*	*	*	*	*	X
Renovation	Intermediate	Smith Seed								X	X	*	X	X	*	*	*	*	X	X
Seminole	Ladino	Saddle Butte/Caudill Seed								X	X	X	X	X	*	*	X	X		
Will	Ladino	Allied Seed	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Experimental Varieties																				
B-12.1216	–	Blue Moon Farms	X	X	X	X	X	X	*	*	X	X	X	X	*	*	*	*		
BARTRALRG	–	Barenbrug																	*	*
GA 178	–	Smith Seed								*	X	*	*	*	*	*	*	*	*	X
GA 21160	–	Univ of Georgia								X	X	X	X	X	*	*	*	*	*	
NFWC04-29	–	Noble Foundation													*	*	*	*		
PPG-TR101	–	Mountain View Seeds													X	*	*	*		
SSS-SH1	Ladino	Smith Seed													X	*	*	*		
VS-41730	Ladino	Turner Seed													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 2002-2016 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	Mean ⁵ (#trials)
			2yr ⁶	4yr	2yr	2yr	3yr	4yr	4yr	4yr	4yr	4yr	4yr	3yr	
Alice	Intermediate	Barenbrug USA		59	98									82	80(3)
Barblanca	Intermediate	Barenbrug USA		118	91	151									120(3)
Canterbury	Dutch	Allied Seed											63	105	84(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	76	107	101(10)
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	118	90	101(9)
KY Select	Intermediate	KY Agr Ex. Sta.						105		83					94(2)
Patriot	Intermediate	Pennington		110	137	122		100	111	110	123	102	126	120	116(10)
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	80	100	89(10)
Renovation	Intermediate	Smith Seed										97	113	105(2)	
Resolute	Intermediate	Southern States			101	106				65				91(3)	
Seminole	Ladino	Saddle Butte Ag. Inc.		75		97	91					88	82	87(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	152	102	117(10)

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 replanted in the spring of 2006 due to poor establishment in the fall of 2005.

⁴ This trial was replanted in the spring of 2008 due to poor establishment in the fall of 2007.

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

⁶ Number of years of data.

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