Extension Service
West Virginia University

Pasture Management for Pasture-finished Beef

Ed Rayburn, Extension Forage Agronomist March 2005

Forage quality is an important determinant in animal production. Cattle usually will grow faster and gain more weight when grazing on high- quality rather than low-quality pasture. Five fundamental principles determine forage quality:

Vegetative growth stage
Availability
Legume content of the forage
Utilization of the stand
Environment in which the forage is grown

Remember that pasture and hay forage quality is **VALUE**.

Vegetative growth stage

As forage matures, its quality decreases (Table 1). Pastures should be maintained in a vegetative growth stage to keep quality high. Even in vegetative pasture, forage quality will change over the season due to maturity and weather conditions and across paddocks due to plant composition (Table 2). For hay, yield is a major factor in reducing the cost per ton of hay harvested. To optimize yield and quality mow hay when the grass is in the late boot to early head growth stage.

Availability of pasture

If an adequate amount of pasture **dry matter (DM)** is not provided, cattle cannot consume maximum levels of forage, even if the quality is high. When the forage mass in a pasture falls below 1000 lb. DM/a (4-5 inches in orchardgrass and 2-3 inches in bluegrass pastures), availability will limit forage **dry matter intake (DMI)**.

When forage mass is greater than 1000 lb. DM/a, pasture intake will be near a maximum determined by the forage quality, selective grazing, animal size, and body condition. Under rotational grazing, when a herd of cattle is first put on a paddock, forage intake is high and then drops off. The rate of decline in intake depends on the botanical composition of the pasture and the stocking density (weight of animals per acre).

Forage mass can be estimated in a rotationally grazed pasture. An 8-inch tall mixed orchardgrass-ladino clover stand having a completely closed canopy (100% stand density), will yield approximately 2000 lb. DM/a when cut to ground level or 250 lb. DM/a/inch height. If the stand has a density of only 75%, the forage mass would be closer to 1500 lb. DM/a. Alfalfa and red clover stands near hay harvest stage yield about 125 lb. DM/a/inch height. Other forage species having a different canopy structure will differ in yield per inch of height. For more information, see the Web fact sheets by Rayburn and Lozier listed at the end of this paper.

Under rotational grazing, the availability of pasture can be defined in terms of **daily forage allowance (DFA)**. The DFA is the total forage offered to the herd compared to the **potential dry matter intake (PDMI)** of the herd. Total forage offered is the **initial forage mass per acre (IFM)** times the number of **acres (A)** in the paddock. The PDMI is the product of DMI per animal, the number of **head (HD)** in the herd, and the number of **days (DAYS)** the herd will be grazing the paddock. As an example, if we have 60 steers averaging of 600 lb. live weight, with a DMI of 2.5% of their body weight, on a 6.0 acre pasture having an **initial forage mass (IFM)** of 1800 lb. DM/a, and a grazing stay on the paddock of 6 days, the DFA would be:

Table 1. The effect of date of harvest on the quality of orchardgrass forage (Reid et al., 1966).

Date	Maturity	DMI	DDM	CP	ADF	NDF	Lig.
		% Body wt.	% Dry matter				
May 5-9	veg.	2.7	77	17	29	51	2.4
May 20-24	boot-e.h.	2.0	71	13	34	60	3.9
June 6-10	l.h.-e.b.	1.9	65	9	38	65	4.9
Jul 15-19	veg	2.6	67	14	31	57	4.1
Jul 27-31	veg	2.7	66	12	35	59	4.3
Aug 9-13	veg	2.9	61	10	38	65	4.3

Table 2. Pasture quality as measured by chemical analysis of 497 rotationally grazed pasture samples taken in the Northeast over a three-year period. [1.] The value listed for this class in this month is a regression-based mean.

Forage class	May	June	Jul	Aug	Sep	Oct	Avg.
	ADF %						
Grass	24	30	30	29	28	28	28
Mixed mostly grass	24	30	28	27	26	22	27
Mixed mostly legume	23	27	28	27	30	25	28
Legume	19	26[1]	25	27	20	23	23
Average	23	29	28	27	27	25	27
	TDN %						
Grass	73	69	68	69	70	71	70
Mixed mostly grass	71	67	68	69	70	73	69
Mixed mostly legume	72	69	68	69	67	71	69
Legume	73	70[1]	68	67	72	70	70
Average	72	68	68	69	69	71	69
	CP %						
Grass	22	18	20	20	21	21	20
Mixed mostly grass	24	20	22	22	22	26	22
Mixed mostly legume	22	21	22	22	21	24	22
Legume	26	24[1]	24	21	26	26	24
Average	23	20	22	22	22	24	22

PDMI = DMI x HD x DAYS

PDMI = (0.025 x 600) x 60 x 6 = 5400

DFA = (IFM x A) / PDMI = (1800 x 6) / 5400 = 2.0

The DFA and the IFM determine the effect of forage availability on pasture intake under rotational grazing. For high-yielding pastures (those with an IFM of more than 1500 lb. DM/a), a DFA of two will allow the animals to consume near maximum amounts of pasture DM determined by the pasture forage quality. This management allows maximum intake but is wasteful of feed and, if practiced continually, will result in the loss of white clovers and reduction in alfalfa and red clover (Blaser et al,1986). By allowing finishing cattle to graze at a DFA of 2 and then following up occasionally with cows to graze the pasture more closely, the manager can overcome this problem. For lower-yielding pastures (IFM less than 1500 lb./a), increasing the DFA will not allow the cattle to consume more since forage mass per grazing bite limits intake. It is important to have sufficient IFM for maximum intake when using rotational grazing.

For finishing cattle, it is best to allow animals to have near-maximum forage intake. In comparing the **total digestible nutrient (TDN)** needs of an 800-pound steer gaining 2.5 lbs. per day (Table 3, 68% TDN) with rotationally grazed pasture quality (Table 2, 68-73% TDN), it is apparent that this animal needs to have maximum forage intake from an excellent-quality pasture.

Legume content of the forage

Legume content in pasture or hay has a major effect on animal performance. Compared with grass-only pastures containing a mixture of grass and legumes allow cattle to consume more forage, grow more rapidly, and put on more body condition. This response to legumes is one of the most consistent variations seen in forage-livestock systems. For growing and finishing steers, legumes in a pasture will provide an additional 0.20 lb. to 0.49 lb. daily gain over the same grass fertilized with nitrogen (Blazer et al., 1969; Rayburn et al., 2004). At any given point in the season, legumes have less fiber than grasses (Table 2), and cattle will eat more of the legume forage. This results in a lower stocking rate being supported by legume pastures than grass pastures at the same forage yield (Table 4). However, legumes in pastures also replace the need for commercial nitrogen fertilizers. This cost savings can amount to $72/a at a 200 lb. N/a rate. Legumes can be added to rotationally grazed pastures by no-till, frost, or walk-in seedings after adjusting soil fertility and pH to proper levels.

Utilization of the stand

Grazing management consists of controlling the timing and intensity of livestock harvesting pastures within a grazing system. The grazing timing (when) and intensity (how much) determine in part the regrowth rates of the forage and the legume content of the pasture. Controlling the pasture IFM (timing) and the paddock stock density or DFA (intensity) determines the animals' DMI and the degree of pasture utilization. Forage species differ in their tolerance to harvest timing and intensity. The manager needs to know the forage species present in a paddock and the grazing management that will optimize animal production as determined by the animal's requirements and management goals (Table 5).

Table 3. Nutrient requirements of growing beef cattle (adapted from NRC, 1984).

Body Weight	Daily Gain	Dry Matter Intake	TDN	Crude Protein	Ca	P
lb.	lb.	lb.	%	%	%	%
Medium-frame Steers						
600	1.0	14	59	9	0.28	0.19
	1.5	15	63	10	0.35	0.21
	2.0	15	68	11	0.40	0.22
	2.5	15	74	11	0.46	0.24
	3.0	14	85	13	0.57	0.29
800	1.0	18	59	8	0.24	0.19
	1.5	18	63	9	0.28	0.19
	2.0	19	68	9	0.31	0.20
	2.5	19	74	10	0.35	0.21
	3.0	17	85	11	0.42	0.25
Medium-frame Heifers						
600	1.0	14	62	9	0.28	0.20
	1.5	14	69	10	0.32	0.21
	2.0	14	77	10	0.38	0.23
800	1.0	17	62	8	0.22	0.18
	1.5	17	68	9	0.24	0.19
	2.0	17	77	9	0.28	0.20

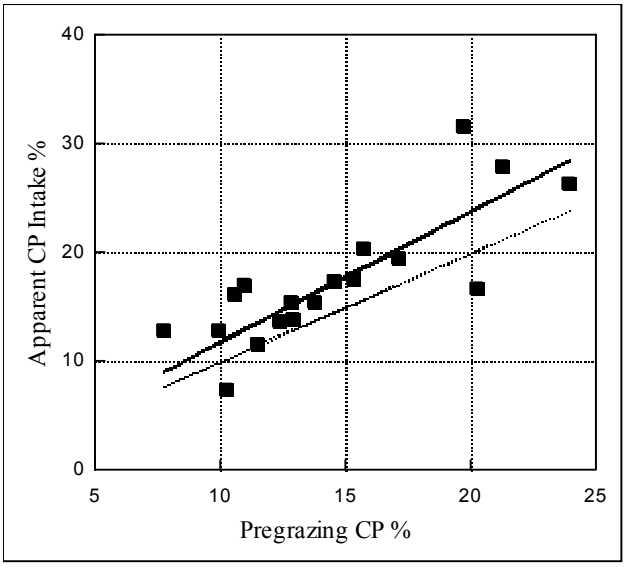
The timing and intensity of grazing also affect the selectivity of the cattle and the quality of the forage consumed. Selective grazing is the ability of livestock to harvest forage of a higher quality than the average forage in the pasture. When adequate pasturage is provided, cattle will eat the best and leave the rest. Selective grazing can be divided into selection across the surface of the pasture (horizontal selectivity) and selection within the depth of the forage canopy (vertical selectivity). Horizontal selectivity occurs in pastures that have patches of forage differing in palatability or quality. Examples of horizontal selectivity are the selection of orchardgrass and refusal of endophyte-infected tall fescue in a pasture, the spotty grazing of clover patches in continuously grazed pastures, and the refusal of forage around manure piles.

One advantage of rotational grazing is that horizontal selectivity of cattle can be reduced so that the animals utilize more of the forage. This increased utilization results in higher forage yield expressed as animal grazing days per acre. When first applied to a pasture system (especially one containing high levels of endophyte-infected tall fescue), it can result in reduced animal production. However, when applied properly, rotational grazing can result in more uniform pastures that contain adequate levels of desirable vegetative grasses and legumes, which support high levels of production per animal and per acre.

Using rotational grazing reduces horizontal selection but not vertical selection. An example of vertical selection is the eating of legume and grass leaves from the canopy surface, sometimes referred to as top-grazing. Another example, in pastures that mature before the manager gets livestock to them, is cattle reaching down into the canopy to graze the vegetative grass tillers and clovers from around the seed stems.

Under rotational grazing, cattle remove forage averaging 3 percentage points higher in **crude protein (CP)** and 5 percentage points lower in **acid detergent fiber**

Figure 1. The effect of initial forage crude protein (CP) on the CP quality of forage removed from the pasture by the selective grazing.



(ADF) than was measured in the pasture before grazing (Rayburn, 1991). However, as the quality of forage increased across pastures, the quality of the forage removed also increased (Fig. 1, example for CP). How closely the cattle were required to graze affects the degree of selective grazing. However, the initial quality of the pasture determines to a much greater extent the quality of forage removed by the animal than does selective grazing. It is tempting to think that if you have low-quality pasture, selective grazing can solve the problem if enough pasture is provided. However, this has limited application in uniform pastures. Providing high-quality or use the pasture is the practical way of providing high-quality forage to the cattle. If a paddock has "gone-by" and is going to head, it would be best to mow it for hay or silage lower-quality forage for cows instead of finishing animals.

Environment in which the forage is grown

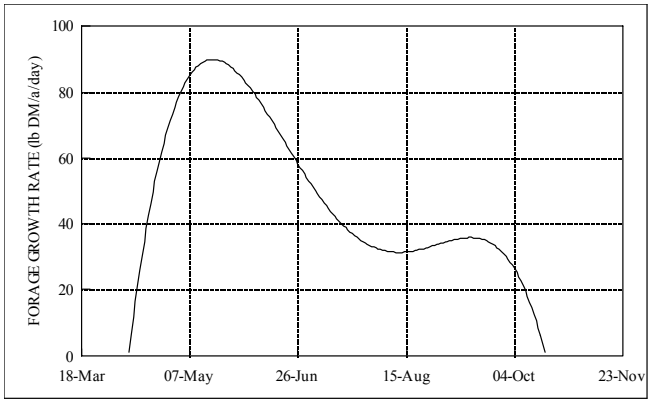
Environmental conditions during growth affect the quality of the forage harvested. During cool weather (spring and fall), the TDN and CP in pastures are high while the ADF content is low (Table 2). As the weather warms up, forage quality decreases. This can be managed by ensuring that pastures have a good legume content during the summer. This is done by proper early-season grazing and haying management, optimum liming and fertilization, over-seeding, and using deep-rooted legumes (alfalfa and red clover) on deep soils.

During hot weather, it is necessary to manage the cattle to reduce the effects of heat stress. This is done by making sure that adequate salt and minerals are available and that the animals have adequate high-quality water. Also, providing fly control will reduce this added stress during the heat of the summer.

Seasonal growth rate of pasture forage

When developing a rotational grazing system, it is important to remember that the growth rate of forages changes over the growing season (Fig. 2). In the Northeast, the average spring growth rate peaks at 90 lb. DM/a/day, and then decreases to 30 and 40 lb. DM/a/day during the summer (Rayburn, 1991). To provide adequate pasture availability over the whole growing season, more acres of pasture are required in the summer than in the spring. For example, a 1000-lb. steer consuming pasture at 2.5% of body weight will eat 25 lb. DM/day. When the pasture growth rate is 50 lb. DM/a/day, this animal needs 0.5 acre of pasture. Later in the summer if the growth rate is near 30 lb. DM/a/day, it would need almost 1 acre of pasture. Where half of the grazing acreage is hayed in late May or June, the regrowth will be available for use in July and August when the forage growth rate is lower. In ideal growing seasons, this leaves some second-cut hay to be taken in midsummer. In less favorable years, all the acreage may be needed for summer grazing.

Figure 2. Average pasture growth rate of rotationally grazed pastures in the Northeast.



If dry weather prevents normal forage growth, cattle should be fed in the barn or on an abuse pasture until the other paddocks have recovered to the proper height or growth stage. The grass in the ungrazed paddocks will accumulate sugars if they have leaf area for photosynthesis, and then bounce back with compensatory growth once rains return. If all the paddocks are opened for grazing, leaf area is removed, photosynthesis is reduced, and the ground is not shaded, soil heats up, which can increase plant mortality and allow weeds to invade the pasture.

The difference in animal requirement and forage production over the grazing season can be balanced by using buffers. Buffers can be provided, based upon planned management, or they will occur as the result of mismanagement. System buffers include:

Table 4. Grazing days, live weight gain per steer, and gain per acre over a 10-year period as affected by the use of a legume or 200 lb. N/acre/yr., provided by ammonium nitrate fertilizer, to stimulate grass growth. (adapted from Blaser, et al., 1969).

Grass species	Management	Grazing days / acre	Gain/head /day (lb.)	Gain /acre (lb.)
Orchardgrass	ladino clover	257	1.28	329
Orchardgrass	no clover	311	1.07	333
Ky. 31 tall fescue	ladino clover	303	1.02	309
Ky. 31 tall fescue	no clover	403	0.91	367
Bluegrass	white clover	258	1.21	312

Table 5. Plant height at which to harvest forage species and mixes and the stubble height to leave to optimize forage production and maintain legume content. For hay harvests, take the first cut when the grass is at the early head stage to optimize production and quality.

Forage species or mix	Plant height		Approximate rest interval
	Pre-harvest	Post-harvest	
	---------- inches ----------		weeks
Grass legume mixes			
Bluegrass-clover	4 - 6	½ - 1	3 - 6
Orchardgrass-clover	8 -10	2 - 3	3 - 6
Tall fescue-clover (E+)	5 - 6	1 - 2	3 - 4
Tall fescue-clover (E-)	8 -10	2 - 3	3 - 6
Alfalfa-grass	early bloom	2 - 3	5 - 6
Nitrogen-fertilized grasses			
Bluegrass	4 - 6	1 - 2	3 - 6
Orchardgrass	8 -10	4 - 5	3 - 6
Tall fescue (E+)	5 - 6	1 - 2	3 - 4
Tall fescue (E-)	8 -10	4 - 5	3 - 6
Bromegrass	early joint	2 - 3	5 - 6
Timothy	early joint	2 - 3	5 - 6
Reed canarygrass	early joint	2 - 3	5 - 6
E+ - endophyte infected E- - endophyte free			

- aftermath grazing of hay fields
- wasting spring forage (understocking)
- allowing the loss of BCS on the cattle during the summer (overstocking)
- growing warm-season grasses as supplemental feeds (annuals or perennials)
- feeding stored or purchased supplemental feeds
- stockpiling forage for fall grazing.

The profitability of a livestock operation will depend largely on how buffers are managed to reduce the cost of feed over the year and meet the animals' requirements.

Management application

To obtain good cattle performance from pasture, the manager needs to be mindful that the **VALUE** of pasture is found in pastures that are:

- vegetative
- available
- high in legume content (20% to 50% of forage)
- grazed to ensure proper utilization
- managed appropriately for the environmental conditions

For finishing beef cattle on pasture, the goal should be to use high-quality, rotationally grazed pastures having an IFM of 2000 lb. DM/a or more, provided fresh at least weekly, at a DFA of 2.0. Allowing selective grazing on poor-quality pasture will not enable cattle to obtain as high quality forage and DMI as will providing better quality pasture. Forage quality is maintained by proper timing and intensity of grazing and by proper liming and fertilization to benefit the legumes in the pasture.

References:

Blaser, R.E. and Colleagues. 1986. Forage Animal Management Systems. Va. Agr. Exp. Sta. Bull, 86-7. VPI and SU. Blacksburg VA 24061 90pp.
http://www.caf.wvu.edu/~forage/books/fams/index.htm

Blaser, R.E., H.T.Bryant, R.C. Hammes, R.L. Boman, J.P. Fontenot, C.E.Polan, C.Y.Kramer. 1969. Managing Forages for Animal Production. Va. Agr. Exp. Sta. Bull, 45. VPI and SU. Blacksburg VA 24061 88pp.
http://www.caf.wvu.edu/~forage/books/mffap/index.htm

NRC. 1984. Nutrient Requirements of Beef Cattle. National Academy Press, Washington DC 90pp.

Rayburn, E. and J. Lozier. 2003. A Falling Plate Meter for Estimating Pasture Forage Mass. WVU, Morgantown, WV. Extension Fact Sheet. Nov. 2003.
http://www.wvu.edu/~agexten/forglvst/passmass.pdf

Rayburn, E. and J. Lozier. 2003. A Falling Plate Meter for Estimating Pasture Forage Mass. WVU, Morgantown, WV. Extension Fact Sheet. Nov. 2003.
http://www.wvu.edu/~agexten/forglvst/fallplate.pdf

Rayburn, E.B., M.A. Whetsell, and P.I. Osborne. 2004. Calf Performance Related To Pasture Quality and Supplements. WVU, Morgantown, WV. Extension Fact Sheet. May 2004.
http://www.wvu.edu/~agexten/forglvst/calfperform.pdf

Rayburn, E.B. 1991. Forage quality of intensive rotationally grazed pastures in the Northeast, 1988 to 1990. 92p. Seneca Trail RC&D, 2 Park Square, Franklinville, NY. Northeastern Dairy Farm Forage Demonstration Project.

Reid, R.L., G.A. Jung, and C.M. Kinsey 1967. Nutritive value of nitrogen fertilized orchardgrass pasture at different times of the year. Agron. J. 59:519.