LD
5655
A762
no.153
c.2

Dairy guidelines

EXTENSION DIVISION VIRGINIA POLYTECHNIC INSTITUTE BLACKSBURG, VIRGINIA

Series 153 - May 1969

VIRGINIA POLYTECHNIC INSTITUTE
AND STATE UNIVERSITY LIBRARIES

Forage Testing--A Tool for Improved Feeding of Dairy Cows

S. B. Carr, Extension Specialist, Forage Evaluation
W. R. Murley, Extension Specialist, Dairy Science

The VPI Forage Testing Program is available to all dairymen in Virginia and provides another management "tool" for improving feeding programs for dairy cattle. One of the many problems involved in practical feeding programs is the variation in energy and protein content of forages. Forage testing can reduce some of the "judgement" errors in feeding that result from variation in forage quality. The tables contained in this guideline are designed for use with forage test results and permit a rapid check on concentrate feeding to satisfy energy and protein requirements. Although the tables will not be as accurate as if more exact requirements are calculated using the methods described in the Dairy Guideline, Series 105, titled "A Guide For Feeding Dairy Cows," they are sufficiently accurate to be used as a general feeding guide. In extreme cases of either high or low production, fat test, or body size, it would be desirable to use the more exact methods of calculation.

Feed costs account for a large portion of the costs of milk production, and high quality forages are one means of reducing these costs. Maximum, and usually the most economical, milk production occurs when liberal grain feeding is combined with maximum intake of high quality forages. Slighting one or both of these areas of feeding, either in amounts or quality, will tend to lower production. The dairy cow will produce approximately 70% as much milk when fed a forage diet alone as when fed a diet of grain and forage balanced to meet her nutritional requirements.

However, forage can play a major role in supplying both the cow's protein and energy needs at lower costs and without sacrificing production if managed properly in the feeding program. The importance of forage quality is reflected in 2 ways. First, the better quality forages are consumed in greater amounts. Secondly, the better quality forages furnish more usable nutrients to the cow for each unit of forage consumed. Of these 2, the intake level is the most important. This guideline has taken this into consideration and grain and protein requirements are expressed relative to forage intake rates.

Information contained in the tables:

To simplify the feeding tables, the levels of milk production (Table 3) are expressed as 4% fat-corrected milk (4% FCM). Grain levels required for maintenance and milk production of a 1300 lb. cow are expressed relative to forage quality, forage intake rate, and milk production (Table 1). Table 2 indicates the percent protein needed in the grain mix to satisfy requirements when forage protein content, forage and grain intake rate, and milk production are known. Conversely, the table can be used

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture. W. E. Skelton, Dean, Extension Division, Cooperative Extension Service, Virginia Polytechnic Institute, Blacksburg, Virginia 24061.

to indicate the number of pounds of grain needed when a specified protein mix is available. Generally, it is impractical to feed more than one grain mixture and corrections for protein supplementation should be made by varying the amount of grain fed. By using Tables 1 and 2, concentrates needed to meet both energy and protein requirements can be determined.

To use the tables, the following information is needed in the listed form of measurement:

1. The level of milk production expressed in pounds per day.
2. The milk-fat or butter-fat content expressed as a percent.
3. An estimate of cows' weight in hundreds of pounds.
4. An estimate of the forage intake rate expressed as pounds of dry matter consumed per 100 lbs. of body weight daily.
5. A forage test or an estimate of the percent TDN and crude protein contained in the completely dry forage(s) consumed by the herd.

Conversion of forage intakes to pounds of dry matter per 100 lbs. body weight:

To use Tables 1 and 2 for grain and protein feeding, convert the amounts of forage consumed daily into dry matter per hundred pounds of body weight (lb.DM/cwt). Assume you have determined that the cow(s) in question are consuming an average of 45 lbs. of corn silage and 12 lbs. of mixed hay daily. From the forage test, you have available the following information.

	Mixed hay	Corn silage
Dry matter	87.4	37.3
TDN (% dry basis)	58.4	66.8
Crude protein (% dry basis)	12.2	8.1

To determine the average forage dry matter intakes, where more than one forage is fed, follow the example below. Assume 1300 lbs. body weight for the example.

87.4% DM x 12 lbs. hay = 10.5 lbs. dry matter
37.3% DM x 45 lbs. silage = 16.8 lbs. dry matter
Sum 27.3 lbs. dry matter

$$\frac{27.3 \text{ lbs. DM}}{13 \text{ cwt}} = 2.1 \text{ lbs. DM/cwt}$$

The TDN content of the combined forages may be calculated in a similar manner.

10.5 lbs. dry hay x 58.4% TDN = 6.13 lbs. dry TDN
16.8 lbs. dry silage x 66.8% TDN = 11.22 lbs. dry TDN
Sum 27.3 lbs. 17.35 lbs. dry TDN

$$\frac{17.35 \text{ lbs. (dry) TDN}}{27.3 \text{ lbs. dry forage}} \times 100 = 63.6\% \text{ on dry basis}$$

The percent protein in the forage can be calculated in the same manner:

10.5 lbs. dry hay x 12.2% = 1.28 lbs. dry protein
16.8 lbs. dry silage x 8.1% = 1.36 lbs. dry protein
Sum 27.3 lbs. dry forage Sum 2.64 lbs. dry protein

$$\frac{2.64 \text{ lbs. protein}}{27.3 \text{ lbs. dry forage}} \times 100 = 9.7\% \text{ or } 10\% \text{ forage crude protein on dry basis}$$

Table 1. Concentrate feeding guide for 1300 lb cow producing 4% fat-corrected milk.

Forage intake rate	TDN in dry forage	Daily milk production expressed as pounds of 4% fat-corrected milk												
		20	25	30	35	40	45	50	55	60	65	70	75	80
(lb/cwt)	(%)	Concentrate to feed daily (lb)												
3.0	47			1	3	5	9	13	15	18	22	25	28	32
	50				1	3	8	11	14	17	20	23	27	30
	53					2	6	9	12	16	19	22	25	29
	56						5	8	11	14	17	20	24	27
	59						3	6	9	12	15	19	22	26
	62						2	5	8	11	14	17	21	24
	65							3	6	9	12	16	19	23
	68							2	4	8	11	14	17	21
2.5	47		3	5	7	9	14	17	20	23	26	29	33	36
	50		1	3	6	8	12	16	18	21	25	28	31	35
	53			2	4	7	11	14	17	20	23	27	30	34
	56			1	3	5	10	13	16	19	22	25	29	32
	59				2	4	9	12	14	18	21	24	27	31
	62					3	7	10	13	16	19	23	26	30
	65					1	6	9	12	15	18	21	25	28
	68						5	8	11	14	17	20	24	27
2.0	47	4	7	9	11	13	18	21	24	27	30	33	37	40
	50	3	6	8	10	12	17	20	23	26	29	32	36	39
	53	2	5	7	9	11	16	19	22	25	28	31	35	38
	56	1	3	6	8	10	15	18	21	24	27	30	34	37
	59		2	5	7	9	14	17	20	23	26	29	33	36
	62		1	4	6	8	13	16	19	22	25	28	32	35
	65			3	5	7	12	15	17	21	24	27	30	34
	68			2	4	6	11	14	16	20	23	26	29	33
1.5	47	8	11	13	15	17	22	25	28	31	34	37	41	44
	50	7	10	12	14	16	21	24	27	30	33	37	40	44
	53	7	9	11	13	16	20	23	26	29	33	36	39	43
	56	6	8	11	13	15	19	23	25	29	32	35	38	42
	59	5	8	10	12	14	19	22	25	28	31	34	38	41
	62	5	7	9	11	13	18	21	24	27	30	33	37	40
	65	4	6	8	10	13	17	20	23	26	29	33	36	40
	68	3	5	7	10	12	16	20	22	25	29	32	35	39
1.0	47	13	15	17	19	21	26	29	32	35	38	41	45	48
	50	12	14	16	19	21	25	28	31	34	38	41	44	48
	53	11	14	16	18	20	25	28	31	34	37	40	44	47
	56	11	13	15	18	20	24	27	30	33	37	40	43	47
	59	10	13	15	17	19	24	27	30	33	36	39	43	46
	62	10	12	14	17	19	23	26	29	32	36	39	42	46
	65	9	12	14	16	18	23	26	29	32	35	38	42	45
	68	9	11	13	15	18	22	25	28	31	35	38	41	45

Note: To correct for differences in animal weights, add 1.0 lb of grain for each 100 lb body weight above 1300 lb. Substract 0.5 lb of grain for each 100 lb body weight less than 1300 lb.

The suggested grain rates do not include feed required for growing out 2 and 3 year old cows nor additional feed required during last 3 months of pregnancy. These animals may need from 2 to 4 lbs additional grain per day.

Table 2. Per cent crude protein required in grain mix.

Crude protein in dry forage	Milk produced daily	Forage intake rate — expressed as pounds dry matter consumed daily per 100 lb. body weight.																								
		3.0 lb/cwt					2.5 lb/cwt					2.0 lb/cwt					1.5 lb/cwt					1.0 lb/cwt				
		Grain fed daily (lb)					Grain fed daily (lb)					Grain fed daily (lb)					Grain fed daily (lb)					Grain fed daily (lb)				
		5	10	15	20	25	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25	5	10	15	20	25
(%)	(lb)																									
8	20	8	8	8	8	8	8	8	8	8	8	12	8	8	8	8	22	11	8	8	8	34	17	12	9	8
	30	8	8	8	8	8	12	8	8	8	8	22	11	8	8	8	32	16	11	8	8	44	22	15	11	9
	40	12	8	8	8	8	22	11	8	8	8	32	16	11	8	8	42	21	14	11	9		27	18	14	11
	50	34	17	12	9	8	44	22	15	11	9		27	18	14	11		32	22	16	13		38	26	19	16
	60		28	19	14	12		33	22	17	14		38	26	19	16		43	29	22	18		49	33	25	20
	70		36	24	18	15		41	28	21	17		46	31	23	19			34	26	21			38	29	23
	80		48	32	24	20			36	27	22			39	29	24			42	32	25			46	35	28
10	20	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	28	14	10	8	8
	30	8	8	8	8	8	8	8	8	8	8	12	8	8	8	8	25	13	9	8	8	38	19	13	10	8
	40	8	8	8	8	8	9	8	8	8	8	22	11	8	8	8	35	18	12	9	8	48	24	16	12	10
	50	18	9	8	8	8	31	16	11	8	8	44	22	15	11	9		29	19	15	12		35	24	18	14
	60	40	20	14	10	8		27	18	14	11		33	22	17	13		40	27	20	16		46	31	23	19
	70		28	19	14	14		35	23	17	14		41	28	21	17		48	32	24	19			36	27	22
	80		32	22	16	13		47	31	24	19			36	27	22			40	30	24			44	33	27
12	20	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	24	12	8	8	8
	30	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	18	9	8	8	8	34	17	12	9	8
	40	8	8	8	8	8	8	8	8	8	8	12	8	8	8	8	28	14	10	8	8	44	22	15	11	9
	50	8	8	8	8	8	18	9	8	8	8	34	17	12	9	8		25	17	13	10		33	22	17	14
	60	25	13	9	8	8	40	20	14	10	8		28	19	14	12		36	26	18	15		44	30	22	19
	70	41	21	14	11	9		28	19	14	12		36	26	18	15		36	26	18	15			35	26	21
	80		23	22	17	13		40	27	20	16		48	32	24	20			38	28	23			43	32	26
14	20	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	18	9	8	8	8
	30	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	10	8	8	8	8	27	14	10	8	8
	40	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	20	10	8	8	8	38	19	13	10	8
	50	8	8	8	8	8	8	8	8	8	8	24	21	14	11	9	42	21	14	11	9		30	20	15	12
	60	9	8	8	8	8	27	14	9	8	8	46	23	16	12	9		32	22	16	13		41	28	21	17
	70	25	13	9	8	8	43	22	15	11	9		31	21	16	13		40	27	20	16		49	33	25	20
	80		25	17	13	10		34	23	17	14		43	29	22	17			35	26	21			41	31	25
16	20	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	12	8	8	8	8
	30	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	22	11	8	8	8
	40	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	12	8	8	8	8	32	16	11	8	8
	50	8	8	8	8	8	8	8	8	8	8	12	8	8	8	8	34	17	12	9	8		27	18	14	11
	60	8	8	8	8	8	14	8	8	8	8	34	17	12	9	8		28	19	14	12		38	26	19	16
	70	10	8	8	8	8	30	15	10	8	8		25	17	13	10		36	24	18	17		46	31	23	19
	80	33	17	12	9	8		27	18	14	11		37	25	19	15		48	32	24	20			39	29	24

Note: Above tables are calculated to supply crude protein for maintenance and milk production. An additional 3/4 lb of protein should be provided for each additional 100 lbs of body weight greater than 1300 lbs. One pound of additional crude protein should be provided for cows in last 2 to 3 months of gestation.

Table 3. Conversion of milk to 4% fat-corrected milk (4% FCM)

Milk fat	Daily milk production (lb.)												
(%)	20	25	30	35	40	45	50	55	60	65	70	75	80
2.6	16	20	24	28	32	36	40	43	47	51	55	59	63
.8	16	20	25	29	33	37	41	45	49	53	57	62	66
3.0	17	21	26	30	34	38	42	47	51	55	60	64	68
.2	18	22	26	31	35	40	44	48	53	57	62	66	70
.4	18	23	27	32	36	41	46	50	55	59	64	68	73
.6	19	24	28	33	38	42	47	52	56	61	66	70	75
.8	19	24	29	34	39	44	48	53	58	63	68	73	78
4.0	20	25	30	35	40	45	50	55	60	65	70	75	80
.2	21	26	31	36	41	46	52	57	62	67	72	77	82
.4	21	26	32	37	42	48	53	58	64	69	74	80	85
.6	22	27	33	38	44	49	54	60	65	71	76	82	87
.8	22	28	34	39	45	50	56	62	67	73	78	84	90
5.0	23	29	34	40	46	52	58	63	69	75	80	86	92
.2	24	30	35	41	47	53	59	65	71	77	83	88	94
.4	24	30	36	42	48	54	60	67	73	79	85	91	97
.6	25	31	37	43	50	56	62	68	74	81	87	93	99
.8	25	32	38	44	51	57	64	70	76	83	89	95	102
6.0	26	33	39	46	52	59	65	72	78	85	91	98	104
.2	27	33	40	47	53	60	66	73	80	86	93	100	106
.4	27	34	41	48	54	61	68	75	82	88	95	102	109

Example: Assume a 1300 lb. cow is producing 43 lbs. of 3.6% milk daily. To convert to 4% FCM read down the column "% milk-fat until you find 3.6; read across the page to figure 38 and 42 in columns headed 40 and 45 lbs. respectively since 43 is not listed specifically. Reading that 40 lbs. of 3.6% milk is equivalent to 38 lbs. of 4% FCM and 45 lbs. of 3.6% milk is equivalent to 42 lbs. of 4% FCM, interpolating gives 40 lbs. of 4% FCM for use in the grain feeding tables.

Determining amounts of concentrates to be fed:

After converting actual production to 4% FCM, read down the column labeled "Forage intake rate" (Table 1) to 2.0 lb/cwt. The intake rate that was calculated was 2.1 lbs. dry matter per 100 lbs. body weight. Rounding to "2.0 lbs./cwt" will correct for the variation among animals with different appetites and will also avoid underfeeding. Enter the row "62" under "TDN in dry forage" and read across page to "8" in the columns for 40 lbs. of 4% FCM produced daily. Note: It is not necessary to interpolate between 62 and 65% TDN (63.6 was calculated in forage test results, in the dry forage) because the difference in TDN content only reflects a small change in the recommended grain allowances. Again, using the lower TDN value will help avoid underfeeding. The 8 lbs. of concentrate indicates that TDN or energy requirements are met for the conditions established for intake rate, forage quality, body size, and milk production.

Meeting protein requirements:

In Table 2, with forage containing 10% CP on dry basis, we can determine the crude protein (CP) content required in the grain mix. Enter the table in the columns for 10% CP in forage and 40 lbs. FCM produced daily. Read across the page to the cell labeled 2.0 lb./cwt. If feeding 5 lb. of grain daily with this forage, the grain mix should contain at least 22% CP; if feeding 10 lbs. of grain daily, the grain mix should contain at least 11% CP. In the example above where 8 lbs. of grain was needed to meet energy requirements, a grain mix containing about 16% CP would meet requirements for protein.

For another example, assume that no hay was fed with the corn silage described in the previous example (8.1% crude protein). If a 16% grain mixture was available, it would take approximately 18 lbs. to meet protein requirements if the 1.0 lb./cwt intake rate is accepted (interpolating 15 lbs. of an 18% or 20 lbs. of a 14% CP mix). If removal of the hay increased corn silage intake to 2.0 lbs. DM/cwt, it would require 10 lbs. of a 16% CP concentrate to meet protein requirements. These values are calculated to meet requirements and it is advisable to feed above this level to ensure that all animals in the herd are adequately fed.

For another example, assume a cow milking 60 lbs. daily and consuming 10% CP forage at 1.5 lbs. DM/cwt. If we wanted to feed 30 lbs. of grain daily, it would require a 13.5% CP concentrate mix to meet CP requirements. Note: Read across the page for 10% CP in forage and 60 lbs. milk production to the cell for 1.5 lb. DM/cwt to the column 15 lbs. for grain fed daily. Since 15 lbs. is 1/2 the amount of grain fed, 1/2 of 27 equals 13.5%. For a safety factor, feed a 14 to 16% grain mix to assure that all animals would receive sufficient protein.

"Rules of Thumb":

Total dry matter consumption (both grain and forage) for lactating cows seldom exceeds 3.5% of body weight, and 3% is a workable average. Therefore, anticipate a decline in forage consumption when cows consume more than 15 lbs. of grain daily. For instance, if measured intake of forages is 2.0 lbs. DM/cwt., and you increase grain feeding above 15 lbs. of grain daily, you should use grain requirements for 1.5 lbs. DM/cwt. (Table 1). A "rough" estimate of forage intake decline is 0.5 lb. forage dry matter reduction per pound of grain fed over 15 lbs. This rule does not apply if the calculated total dry matter intake exceeds the 3.5% of body weight which is the maximum stomach capacity of the cow.

The total milk produced in a lactation is associated with high peak production after calving. For the cow to reach her peak production, it is desirable to feed liberal grain immediately before and after calving. For known high producers, try to have these cows consuming 20 lbs. of grain per day at calving.