

# **PUBLICATIONS**

## **1992**

**Forage Research  
in Texas,  
1992**

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# FORAGVAL for Economic Interpretation of Forage Quality Data from Small-Plot Studies

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## Summary

FORAGVAL, a computer software program that estimates cattle performance from crude protein and acid detergent fiber values of the forage diet, was used to demonstrate its utility in economic analysis and planning. Data from a study of the influence of nitrogen fertilization on the growth and forage quality of different ages of 'Gordo' bluestem were used as inputs for FORAGVAL. An

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**Keywords:** forage evaluation / Gordo bluestem.

elementary economic analysis using FORAGVAL estimates of daily forage intake and weight gain showed that 6-week-old Gordo bluestem forage would be superior to 10-week-old forage for both weanling and mature cattle.

## Introduction

Forage quality analyses of clippings from small-plot studies almost always include protein determinations and, typically, determinations of neutral and acid detergent fibers (NDF and ADF).



These values may be used for quality rankings, but they provide no estimate of animal performance for use in economic evaluation of different forages or management treatments. Some attempts at economic analysis have been based on the cottonseed meal (CSM) replacement value of total protein in the forage. Such evaluation considers neither the variable requirements of ruminant livestock nor the most common method of marketing forages, i.e., through the grower's animals.

FORAGVAL (Lippke and Herd, 1990) is a software program that integrates the quality measures of forages, specifically protein and ADF, and the needs of various classes of cattle to estimate forage value in terms of body weight gain, milk production, or days of maintenance at zero gain, which have economic value. In this paper, selected data from a small-plot study of Gordo bluestem were used to demonstrate the utility of FORAGVAL as a link between standard measures of forage quality and economic analysis of various forage management regimes.

## Procedure

Table 1 shows the dry matter yields and crude protein and ADF contents of forages that were cut on August 16 (6-weeks old) or September 14 (10-

**Table 1. Dry matter yield and protein and ADF contents of Gordo bluestem.**

Age	N fert.	Yield	Protein	ADF
wk	.....lb/A.....	.....	.....%	.....
6	0	2550	5.4	35.2
10	0	3890	5.7	38.9
6	50	3560	7.0	35.2
10	50	4400	7.1	39.3
6	100	3420	8.7	34.3
10	100	4820	7.9	39.2
6	150	3390	9.4	33.7
10	150	5230	8.9	39.6

**Table 2. Estimated body weight gain and intake by weaned 500-lb cattle fed Gordo bluestem hay free-choice.**

Age	N fert.	Gain <sup>†</sup>	Intake	CSM <sup>‡</sup>	Gain w/CSM	Gain/ton <sup>§</sup>	CSM/ton <sup>¶</sup>
wk	lb/A	.....	.....lb/day.....	.....	.....	.....lb.....	.....
6	0	—	9.8	1.9	.92	187	388
10	0	—	9.4	1.4	.67	143	298
6	50	.41	10.8	1.2	.88	163	224
10	50	.18	9.8	.8	.55	112	167
6	100	.66	11.2	.6	.89	159	105
10	100	.27	9.9	.5	.51	103	107
6	150	.78	11.4	.3	.91	160	59
10	150	.37	9.9	.1	.41	83	18

<sup>†</sup>All forages were deficient in protein relative to digestible energy.

<sup>‡</sup>Levels of cottonseed meal supplementation recommended by FORAGVAL.

<sup>§</sup>Gain/ton of hay with cottonseed meal supplementation.

<sup>¶</sup>Cottonseed meal supplement needed to achieve the indicated gain/ton.

weeks old) from Gordo bluestem swards that had been fertilized with nitrogen at the rate of 0, 50, 100, or 150 lb/A (Evers and Gabrysch, 1992; H. Lippke, unpublished data). FORAGVAL evaluated the quality of the harvested forages and their capability to meet the nutritional needs of cattle by estimating weight gains and dry matter intakes of 500-lb weanling calves and 1,000-lb dry cows when the forages are offered free-choice. Acid detergent fiber (ADF) and crude protein contents of the forages in Table 1 were used for program inputs. We exercised the program option to set reduced levels of gain to zero for dry cows and obtained revised intake estimates under those conditions. For protein-deficient forages, we used another option that calculates the amount of cottonseed meal supplement needed to provide protein adequate to balance available energy.

## Results and Discussion

Estimates from FORAGVAL are reported in Table 2 for young cattle and in Table 3 for mature dry cows. Calf gain and CSM required/ton of hay (Table 2) and maintenance days/ton of hay (Table 3) were hand-calculated from these estimates. When dietary protein falls below 7%, rumen function in cattle becomes erratic and unpredictable. Consequently, FORAGVAL issued a warning that its basic estimates for the hays from the unfertilized Gordo bluestem plots were invalid. These values were not included in Tables 2 and 3.

Comparisons of the forage quality data shown in Table 1 with the calculations shown in Tables 2 and 3 reveal the usefulness of FORAGVAL for obtaining inputs for economic analysis. Table 1 shows that the first 50-lb increment of nitrogen fertilizer increased forage dry matter yield about 1,000 lb/A at the 6-week cutting and half that much at the 10-week cutting. Additional increments of nitrogen gave no response in yield at the



**Table 3. Estimated weight gains, free-choice intakes, and maintenance intakes by a 1,000-lb dry cow fed Gordo bluestem hays.**

Age	N fert.	Gain	Intake	Mainten. intake	Days/ton <sup>†</sup>
wk	lb/A	..... lb/day .....			
6	0	.10 <sup>‡</sup>	25.9 <sup>‡</sup>	25.0 <sup>‡</sup>	80
10	0	.08 <sup>‡</sup>	24.7 <sup>‡</sup>	24.0 <sup>‡</sup>	83
6	50	.15	26.2	18.9	106
10	50	.13	24.6	19.1	105
6	100	.37	26.8	16.2	123
10	100	.22	24.8	17.5	114
6	150	.47	27.1	15.4	130
10	150	.36	24.9	15.9	126

<sup>†</sup>Cow days at maintenance intake.

<sup>‡</sup>Gain and intake values with 1.0 lb daily of CSM supplement.

6-week cutting but yielded a response of about 400 lb/A at 10 weeks. Estimates for daily gain of weanling cattle without CSM supplement (Table 2) continued to increase when the amounts of nitrogen fertilizer were increased. Calculations show the 6-week cutting yielding more cattle weight gain/ton (Table 2) at all fertilizer levels than the 10-week cutting. When dry matter yields and the increased number of harvests per season with a 6-week cutting schedule are considered, the economic advantage lies heavily with 6-week-old hay for young cattle.

The best choice among management regimes for maintenance of mature dry cows is uncertain.

Except for the 0 nitrogen level, the use of 6-week cutting periods is again suggested when yield, number of harvests, and extrapolations from FORAGVAL estimates are considered. However, fixed costs per cutting may negate the small advantage that simple economic analysis found for 6-week hays fed to dry cows.

To decide among nitrogen fertilizer levels for forages harvested for young cattle, the relative costs of nitrogen fertilizer and CSM must also be applied to the values in Table 2. For example, if the cost of nitrogen fertilizer is \$0.25/lb, the cost of CSM supplement is \$0.13/lb, and the value of gain by young cattle is \$0.50/lb, then somewhat higher returns occur at the two lower rates of nitrogen fertilization. Although changing price structures may alter the most profitable agronomic practices, valid estimates of performance, such as those provided by FORAGVAL, will remain essential for useful economic analysis.

### Literature Cited

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