

The North Central Quarterly

Published by the North Central Experiment Station of the University of Minnesota

GRAND RAPIDS, MINNESOTA

FEBRUARY 1986

VOLUME 56 NUMBER 1

UNDERSTANDING FORAGE QUALITY TESTING

David L. Rabas

UNIVERSITY OF MINNESOTA

NOV 30 1987

ST. PAUL CAMPUS LIBRARIES

Feed costs represent more than 50 percent of the cash costs of dairy production and nearly 90 percent of the cash costs for the beef cow-calf herd. As the economic crunch in agriculture continues to affect the livestock industry, farmers need to pay additional attention to reducing the cost of feed for livestock production. Forage and perhaps more importantly, higher quality forages, form the base for lowest cost ration formulation. Farmers can provide protein and energy for livestock rations at one-half the usual purchased cost by growing their own protein and energy supply in the form of high quality forage crops. Forages must be tested for quality before they can be most effectively and efficiently utilized in the rations of high producing livestock. Forage testing is a necessary first step to improve livestock production efficiency and profitability on northern Minnesota farms.

How forages are tested and the quality factors for which they should be analyzed have changed substantially in the past few years. In the past a typical forage analysis included percent dry matter (DM), crude protein (CP), crude fiber (CF), and an estimate of total digestible nutrients called TDN. Now a typical forage test may include such quality measures and calculated values as acid detergent fiber (ADF), neutral detergent fiber (NDF), digestible dry matter (DDM), dry matter intake (DMI), digestible dry matter intake (DDMI), non-digestible or adjusted crude protein (ACP) or acid detergent fiber-crude protein (ADF-CP) and relative feed value (RVF) as well as crude protein.

The number and complexity of the quality measurements and calculated values listed above often confuse and discourage livestock producers considering increased forage testing. Hopefully, this article will serve to reduce some of the confusion surrounding forage test results and encourage increased use of testing as a way to improve forage utilization in livestock rations.

What kind of forage testing information do we need to develop rations around a forage base? What information is necessary to evaluate forage quality and to compare forages for purchase or sale? What information should a good forage test contain? From a practical standpoint to be useful to answer all of the questions posed; a good forage test should include acid detergent fiber, neutral detergent fiber, crude protein and percent dry matter. From these tests almost all other forage quality factors can be calculated. If the forage has undergone considerable heating, a test to determine available protein should be included. In recent years a new concept called relative feed value (RVF) has been used to compare forages. The forage quality factors listed above and their use in evaluating forages are discussed in the following paragraphs:

CRUDE PROTEIN (CP) is the most common forage quality measurement with which farmers are familiar. It is commonly determined from a measurement of the nitrogen content of a plant. It is a mixture of true protein and non-protein nitrogen. A test for crude protein is necessary to calculate the capacity of a feed to meet an

animal's protein needs. Farmers are aware the high crude protein is desirable. It is highest in less mature plants therefore early cutting is desirable for high protein forage. In grasses, both early cutting and nitrogen fertilization will improve crude protein content. Crude protein is of little value in predicting the energy content or intake potential of forages. It may be a misleading value in forages that have undergone considerable heating. As a general guideline, to be effectively utilized in a ration for high producing livestock, the crude protein content of the stored forage must be at least 16 percent.

DRY MATTER (DM) is the percentage of the forage that is not water. Forage test results are often given on an "as is (as fed)" and on a "dry matter" basis. The test results expressed on a dry matter basis are often easier to use in ration formulating. The feeds in the total ration may vary from 10 percent dry matter grain to 45 or 60 + percent dry matter haylage or silage. The ration must be balanced to fit the dry matter intake potential of the feed and the amount of dry matter an animal of a given size might be expected to consume. In order to maximize intake, the dry matter content of lactating dairy cow diets should be above 50 percent.

ACID DETERGENT FIBER (ADF) is a measure of the percentage of highly indigestible plant material in a feed or forage. It is roughly similar to the crude fiber plus the silica content of plant material. ADF is highly correlated with forage digestibility and energy value and is used to calculate digestible dry matter (DDM). Since ADF values represent the less desirable plant components, lower ADF values are desirable. An ADF value of less than 35 is desirable in a forage based ration for high producing cows.

NEUTRAL DETERGENT FIBER (NDF) is the most complete measure of the total fiber content of a feed. It is highly correlated with voluntary intake of forages and is used to calculate dry matter intake (DMI). Combined with ADF values it can be used to estimate digestible dry matter intake (DDMI) or how much dry matter an animal will consume. High NDF forages limit intake by taking up too much space in the rumen thus creating a "fill effect." NDF is related to total chewing time and rate of digestion or rate of passage through the animal. Lower NDF values are needed to allow increased substitution of forage for concentrate in the ration. NDF values for forages fed to high producing cows should be less than 50. Values nearer to 45 may be needed to maximize forage utilization in a ration.

Continued on page three



Technician Rebecca Hayes prepares a sample for analysis in the NIR mobile forage testing van.

This archival publication may not reflect current scientific knowledge or recommendations.
Current information available from University of Minnesota Extension: <http://www.extension.umn.edu>.

ARE DAY NEUTRAL STRAWBERRIES FOR YOU?

David K. Wildung

Day neutral strawberries are similar to the old-fashioned everbearing types that fruit in the early summer and then again from late summer until frost. Generally the traditional everbearing types are considered too small, too soft and not productive enough to be grown on a commercial basis. In northern Minnesota it is also thought that the fruiting season is too short before fall frost terminates production.

In the early 1980s, the U.S.D.A. Breeding Program released the first day neutral cultivars: Tribute and Tristar. About the same time the California Program released Aptos, Brighton, Hecker, Fern and Selva. These new cultivars seem to overcome the problems of size, firmness and productivity. The major question remaining was if they would produce enough fruit before fall frosts terminated their fruiting season. If fall production was adequate, a commercial grower could obtain annual production on a crop that normally does not fruit until the year after planting (as with Junebearing types). Annual cropping would reduce the need for winter mulching for winter protection as is normally done with Junebearing types. If the new cultivars were able to survive northern Minnesota winters, they could continue to produce fruit two or more years after planting. Certainly the concept of growing day neutral cultivars for annual production was appealing.

In 1984, NCES planted the first experimental trials of day neutral strawberries. The first planting was a cultivar planting that was used to determine productivity potential, fruiting characteristics and basic cultural management techniques. The planting included Tribute, Tristar, Aptos, Fern, Hecker and Selva as well as the old standard everbearing cultivars Ogallala and Ft. Laramie. It was decided that the planting would be overwintered as is done with Junebearing cultivars to determine how well they would survive and their fruiting patterns during their second growing season. Table 1 presents the results of this trial.

Table 1. Productivity and fruit size of day neutral strawberry cultivars at North Central.

Cultivar	Production (lbs/12½ ft. row)				Fruit size (gm/fruit)			
	Fall 1984	Spring 1985	Fall 1985	Total	Lbs/A Total	Fall 1984	Spring 1985	Fall 1985
Aptos	16.6	0.5	9.2	26.3	22,881	8.2	9.2	9.2
Fern	15.8	0.6	9.2	25.6	22,272	9.2	10.4	11.1
Ft. Laramie	12.4	4.9	0.1	17.4	15,138	10.9	9.1	20.3
Hecker	16.3	1.2	7.4	24.9	21,663	9.4	8.2	8.7
Ogallala	10.1	1.4	0.0	11.5	10,005	6.6	5.2	0.0
Selva	9.6	1.5	1.1	12.2	10,614	14.8	10.5	19.6
Tribute	13.1	1.3	4.8	19.2	16,704	8.7	7.1	8.5
Tristar	14.0	1.3	6.0	21.3	18,531	8.5	6.8	9.4

As Table 1 indicates, the productivity was greatest during the fall of the first season followed by the fall of the second season. During both years, fruiting began about August 8 and was terminated by a killing frost between September 21 and 25. The winter of 1984-85 was relatively free of snow and all cultivars suffered winter

damage which greatly reduced the spring crop. The plants seemed to recover during the growing season and Aptos, Fern and Hecker produced a satisfactory crop in the fall of 1985. Fruit size with all cultivars was better than Ogallala and very good with Selva, Ft. Laramie and Fern. Total productivity over the two-year period for Fern, Hecker and Aptos was over 20,000 lbs per acre which is as good as any Junebearing cultivar produces in a comparable time.

It appears that these cultivars are productive enough but what about their fruit characteristics? Table 2 presents the fresh fruit evaluations for the 1984 season.

Table 2. Fresh quality evaluation of day neutral strawberry cultivars at North Central.

Cultivar	Size	Attractiveness	Firmness	Quality	Overall
Aptos	5.8	6.0	7.7	4.8	5.0
Fern	6.0	7.0	7.8	6.0	6.7
Ft. Laramie	7.0	6.3	4.2	5.3	5.7
Hecker	6.3	7.3	7.2	5.7	6.0
Ogallala	4.7	4.2	3.7	3.5	3.7
Selva	8.2	6.5	8.2	4.2	5.2
Tribute	6.2	6.5	7.2	6.0	6.2
Tristar	5.5	5.8	7.0	6.2	5.7

Ratings are on a 1 - 9 scale with 1 being lowest and 9 being highest. A rating of 4 or less is unacceptable.

Table 3. Effect of planting date on growth and productivity of Fern day neutral strawberry.

Date	Vegetative growth			Fruit production		
	Lvs/plant 7/11/85	Runners/plant 10/4/85	Vigor rank 10/25/85	Lbs/15 ft row	Lbs/acre	Average gr/fruit
5/10	8.8	2.4	1.2	13.2	12,799	11.1
5/17	6.6	2.5	2.0	11.0	10,647	11.2
5/24	5.5	2.4	3.0	8.6	8,307	11.6
5/31	5.2	2.3	3.8	5.2	5,002	13.5
6/7	4.1	2.4	5.0	2.6	2,538	14.7

All cultivars were rated superior to the standard everbearer Ogallala. Ogallala itself was rated unacceptable in most categories. Individually, cultivars varied, being good in some factors, not in others. For example, Aptos which had excellent productivity was judged to be too small and lacking in quality. Selva which has very

rigation, fall frost injury can be reduced, but it cannot be stopped forever. Would earlier planting result in earlier fruiting and increased production? In order to answer this question, in 1985 the cultivar Fern was planted at weekly intervals beginning on May 10 and continuing until June 7. Table 3 presents the results of this study.

It is evident that planting date does affect productivity and plant development. The difference in early development was seen by July 11 when the May 10 planting averaged 8.8 leaves per plant compared to 4.1 leaves per plant for the June 7 planting.

The initial early start was true even in late October when early plantings continued to be more vigorous than later plantings. The superior growth and vigor carried over to productivity too. The May 10 planting averaged 12,799 lbs per acre compared to 2,538 lbs for the June 7 planting. It appeared that during 1985 a grower would gain about 2,500 lbs per acre for each week of earlier planting. The June 7 treatment was just beginning to fruit heavily when frost terminated production.

The results of these studies show the potential for day neutral strawberries in north central Minnesota. Cultural management is more critical for day neutral cultivars than for Junebearing cultivars. Early planting is more important. Management of fertilizer and irrigation is much more critical. Higher density plantings, use of raised beds, use of plastic, etc., probably will benefit production. However with maximum cultural management the potential looks promising for annual production of strawberries in Minnesota. Potential pick-your-own growers will have to educate their consumers to pick fruit in the fall rather than in early summer which should not be too difficult. Because of the attractiveness, size and firmness of some of the cultivars like Fern, Hecker and Selva, the potential for development of fresh market sales dur-

large firm fruit had fair-poor quality. Overall, Fern and Hecker appeared to have the best fruit characteristics and productivity followed by Tribute and Tristar.

During the 1984 season a hard frost during the week of September 21 abruptly ended the fruiting season even though many green fruit had not matured. With ir-

BLUEBERRY PROJECT REFUNDED

David K. Wildung

In 1985 the Governor's Council on Rural Development (GCRD) funded a blueberry project for Developing Blueberry Potential in Northeastern Minnesota. This project was successful in identifying over fifty potential blueberry growers and reaching many more through educational meetings. In late December, 1985, I learned that the GCRD had funded this project for a second year. The additional funding will enable the current project to continue one more year at an expanded level which should reach many more potential blueberry growers.

During February and March extension agents in northeastern and central Minnesota and around the Twin Cities will be presenting county meetings for people interested in blueberry production. There will be a combined spring meeting and a summer tour of established blueberry plantings. An extension aide will be hired for the summer and fall. This individual will answer questions on site selection and establishment problems for new and potential growers. This aide will also work with our research program to help set our demonstration plantings at grower sites. These plantings will deal with winter protection practices and fall versus spring planting comparisons. In addition, we hope to survey nursery sources periodically to determine their blueberry plant inventories. This information will be made available to the county extension offices who in turn can let prospective growers know of plant availability. Extension personnel will also begin to develop direct marketing educational programs that can be used not only by blueberry growers but by other horticultural crop producers as well.

The goals of the 1985 GCRD project were surpassed. If the 1986 project goals can be met our long range goal of developing a viable commercial blueberry industry in Minnesota will become a reality. If you are interested in additional information on commercial blueberry growing, contact your County Extension Office or North Central Experiment Station.



FERN

ing late August and September looks quite good.

Currently Tribute and Tristar are the only day neutral cultivars available to home gardeners. The California cultivars like Fern and Hecker are available only to commercial growers mainly through west coast

nursery sources. As we learn more about their potential, plant availability will also improve. If you have questions concerning the potential of day neutral strawberries for commercial plantings, contact North Central Experiment Station.

Understanding Forage Quality Testing continued from page one

ACID DETERGENT FIBER-CRUDE PROTEIN (ADF-CP) is a measure of the unavailable protein in a feed. ADF-CP or other measures of unavailable protein need only be determined on forages that have undergone considerable heating. Caramelized haylage for example should be tested for ADF-CP. Rations formulated from crude protein values obtained from feeds that have undergone periods of heating may be very low in protein.

RELATIVE FEED VALUE (RFV) is an index used for ranking forage quality or comparing one forage with another. It is calculated from the DDM and DMI or the DDMI values obtained from the ADF and

NDF forage values. A very small part of the RFV value is related to the crude protein content of the forage. For high producing cows a RFV of 118 or greater is required.

Forage tests can tell you a lot about the quality and use of your stored forages. A program of testing must include identification of different lots of stored forages and accurate sampling to insure a representative sample is obtained. (Information for this article was adapted from publications developed by Dr. Neal Martin, Extension Forage Specialist, and Dr. Jim Linn, Extension Dairy Specialist, University of Minnesota, St. Paul.)

Typical range in composition of forages grown in the northern regions of the U.S.*

Quality Measure	Legumes ¹		Legume/grass		Grass		Acceptable ³ Values
	Early	Late ²	Early	Late	Early	Late	
CP%	26	- 13	25	- 9.0	25	- 6.5	▶16
ADF%	28	- 45	31	- 46	33	- 47	◀35
NDF%	40	- 55	48	- 60	50	- 65	◀50

*Determined from Wisconsin trials, AFGC data bank, summary of Wisconsin forage and feed samples, and NSF tables. Source: Rohweder, et al. 1985.

¹Alfalfa, red clover, birdsfoot trefoil.

²Early maturity and late maturity.

³Values required to most effectively utilize forage as a base for rations for high producing dairy cows.

HIGHLIGHTS FROM BEEF COW-CALF AND DAIRYMAN'S DAYS

A number of feed additives are available for use in dairy cow and heifer rations. In some cases certain of these additives are justified to improve milk production, health or growth rate. If used indiscriminately, however, additives may not be justified economically. Some examples of feed additives were discussed. Vitamin A and D in the proper amounts are usually recommended unless the forage supply is of excellent quality with good green color. Adequate calcium, phosphorus and salt are always necessary in any ration. Additives such as magnesium oxide, methionine hydroxy analog, niacin, sodium bicarbonate, propylene glycol and isoacids may be recommended in certain circumstances.

Monensin fed at the rate of 150 to 200 milligrams per head per day has been shown to improve feed efficiency in beef cattle and dairy heifers, but must never be fed to lactating cows.

Good reproductive performance in the dairy herd is achieved when a goal of a 12 to 13-month calving interval can be achieved. Close attention to heat detection, herd health, and insemination technique is necessary. The use of high PD sires and selected high performance indexed young sires will improve the production level of the herd.

Many beef and dairy producers are short on forage supply this year especially good quality forages. When selecting an alter-

native feed to supplement the available forages, we need to keep costs as low as possible while being consistent with adequate nutrition. Grains or by-product feeds can be a good alternative as a substitute for part of the hay in the ration. Feed sources should usually be evaluated on the basis of their cost per unit of energy. Consideration of the protein content is also important especially if one or more of the feed sources are very low in protein content. Late gestation and the lactation period are the times when it is most critical to provide adequate nutrition for beef cows. Young growing animals need a higher quality feed in regard to energy content and protein content compared to adult cows.

COMING EVENTS

Visitors Day
Thursday, July 17, 1986

Horticulture Night
Wednesday, August 27, 1986

NORTH CENTRAL FOUNDATION FUND

The North Central Experiment Station is currently in the process of setting up a Foundation. Interest from the principal in the Foundation would be used to fund projects conducted here at North Central. Projects could conceivably be anything from a research project to a building. It may sound strange to many people that a research station such as ours is appealing for private donations. In actuality only 37 percent of all University funds are from state appropriations. Here at North Central, most of our purchases of equipment, many of our buildings, machinery, some salaries and yes, our land purchase are through funds generated from income produced here on the station. Our income is very small compared to other experiment stations and has gotten smaller during the last few years. Like farmers we need to replace equipment and building in order to do research that will benefit northeastern Minnesota.

Contributions made to the Foundation fund are tax deductible. Donations of any amount may be made in the form of cash or property.

Money from the Foundation will not be used for day to day operations such as salaries, but for special items such as buildings, tractors or research projects that cannot be financed in any other way. Contributors will have the satisfaction of knowing their contributions will help to benefit northeastern Minnesota.

Contributions can be mailed to Director of Development, 201 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, MN 55108. Be sure to designate your contribution for the North Central Experiment Station. Further information can be received by writing to Dianne Hennes at the above address or calling at 612-373-0734 or call Dr. Joe Rust or Dr. Robert Nyvall at 218-327-1790.

Robert F. Nyvall, Supt.

Although it seems like a short period of time since the last **North Central Quarterly**, much has happened and continues to happen. The Station has purchased an additional 202 acres of land. This new land is located 6 miles south of the present station and is just south of the Grand Rapids city limits. We think with this land purchase, the station will be freed up from the uncertainty of using leased land. However, we will continue our present lease arrangements until it is no longer feasible. Research objectives will change but at first the new land will be used to study relationships between beef and forages, work that has been sorely needed in northeastern Minnesota for several years.

Speaking of research, about 27 additional acres of cleared land on the station will be devoted to forestry research. Some people may remember this as the "North" and "Woods" fields. The response from the Forestry faculty on the St. Paul Campus has been very favorable and I expect research on topics related to Christmas trees, interplanting of spruce, alder and aspen and testing shelterbelt plant materials to begin in a year.

Another retirement, Bill Horstman, who has been a faithful employee as an animal attendant for our beef herd retired in December. Bill has moved to Arizona to thaw out. He will be missed. Taking Bill's place is Ray Steffen. Todd Hammerlund and Terry Hanson have moved to the dairy barn. We have hired Dan Brown, a Grand Rapids native, who has been working at

North Dakota State University, as our new animal attendant in the swine barn. Speaking of the swine barn, our remodeling of the sow gestation unit should be soon completed. This will provide excellent research facilities.

Congratulations to some of our people in becoming reclassified to a higher level. Jim Anderson is now a Principal Accountant, Faye Mostoller to Administrative Secretary, Cliff Underwood to Maintenance Carpenter and Gordon Bickford to Maintenance Electrician. Russ Mathison has also been reclassified to Associate Scientist.

This is the season that many of our people are busy going to meetings as attendees or as participants. Other activities involve a slow but sure remodeling of our main office with new chairs, etc. We also have some new art work hanging around the building. These consist of several watercolors by Tyne Mike. We extend our appreciation and thanks to Tyne for the loan of her art. If anyone has a piece of art, such as a picture, etc., that they would like displayed in our building, we can probably find a place and it would be much appreciated by us.

As mentioned in the last **Quarterly**, the Superintendent's house will be sold and moved off the station. A tentative schedule is advertising of the house beginning March 1, opening of sealed bids around April 1 and house to be moved by June 1.

The faculty and staff would like to wish everyone a belated but happy New Year.



Passing of check and title to new land by Mr. and Mrs. Leo Hauser and Robert Nyvall.

The North Central Quarterly

Issued by
THE UNIVERSITY OF MINNESOTA
North Central Experiment Station
1861 Hwy. 169 East
Grand Rapids, Minnesota 55744

DR. ROBERT F. NYVALL
Superintendent

Published February, April, July, November
ISSN 0199-6347

by the North Central
Experiment Station,
Grand Rapids, Minnesota

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, religion, color, sex, national origin, handicap, age or veteran status.

Second-class postage paid at Grand Rapids, Minnesota