PROCEEDINGS OF THE SEVENTEENTH ANNUAL

FLORIDA DAIRY PRODUCTION CONFERENCE

"Effective Management"

UNIVERSITY OF FLORIDA, GAINESVILLE
MAY 6-7, 1980

Sponsored by
Department of Dairy Sciences
Cooperative Extension Service
Agricultural Experiment Station
of the
Institute of Food and Agricultural Sciences
with Cooperation of State Dairy Organizations
Jack Van Horn (right) was presented the 1980 Florida Purebred Dairy Cattle Association (PDCA) Extension Service Award by Mike Bond, President of the Florida PDCA at the 17th Annual Florida Dairy Production Conference, May 6.

Cover photo: Winners in the Dairy Herd Management Divisions are: (left to right) Wallace Eicher, Paul Glasscock (received for High View Dairy), and Bart Bongers. See Awards on page A.

This publication was promulgated at an annual cost of $642.80, or 80.4 cents per copy, to provide participants of the conference with a copy of each presentation.
TO: FLORIDA DAIRYMEN AND THOSE IN RELATED ENTERPRISES

SUBJECT: SEVENTEENTH ANNUAL FLORIDA DAIRY PRODUCTION CONFERENCE
MAY 6-7, 1980

Dear Dairy Cooperator:

The 17th Annual Florida Dairy Production Conference brought together authoritative speakers on topics of current major interest. The Dairy Advisory Committee, consisting of the DFI Board of Directors, is given special thanks for their help in planning the 1980 program.

Special thanks is given to the Dairy Division of the State Department of Agriculture and Consumer Services, the Federal Land Bank & Production Credit Associations of Florida, the Florida Farm Bureau Federation, PDCA, and State DHIA Board for their support and participation in the awards program on Tuesday evening, May 6.

A list of those attending the conference is included. Also, a list of the sponsors and those having display tables at the conference are recognized.

H.H. Van Horn
Chairman, Dairy Science
Department

Barney Harris, Jr.
Conference Chairman
Extension Dairyman

BHjr: jr
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DAIRY PRODUCTION CONFERENCE

AWARDEES - AWARD BANQUET

1. Dairy Family Award - Sponsored by the Florida Farm Bureau Federation.

   The Van Pelt Family, owners of Van Pelt Brothers Dairy in Escambia County, received the Distinguished Dairy Family Award. James and George Van Pelt are brothers and third generation dairymen. The dairy is located in the Davisville Community which is near Atmore, Alabama.

2. Dairy Herd Management Awards - Sponsored by Federal Landbank Association and the Production Credit Associations of Florida.

   a. Small Division Winner - Wallace Eicher of Escambia County with approximately 100 cows and a rolling herd average of 18,101 lbs milk.

   b. High View Dairy (W. Douglas Robison) of Hillsborough County with approximately 240 cows and a rolling herd average of 15,446 lbs milk.

   c. Oaklane Dairy (Bart Bongers) of Alachua County with approximately 550 cows and a rolling herd average of 14,376 lbs milk.

3. PDCA Awards - Dr's Jack VanHorn, Chairman Dairy Science Department and Ernest Buchanan, AI Technician in North East Florida.


   a. Small Division - Sorenson Dairy, Jefferson Co.
   b. Medium Division - Russell Dairy, Hillsborough Co.
   c. Large Division - Turnpike Dairy, Martin Co.

5. DHIA Awards

   a. TOP FIVE HERDS FOR MILK

   1. Eicher Dairy, Atmore, Ala. *57 cows, 17,250 M., 555 F.
   2. David Fietisma, Chipley *104 cows, 16,448 M., 590 F.
   3. Ray Fields, Dade City 154 cows, 16,375 M., M0
   4. C & D Dairy, Jacksonville 207 cows, 16,290 M., M0
   5. Bassett's Dairy, (Holstein) 950 cows, 15,623 M., 493 F.

   b. TOP FIVE HERDS FOR FAT

   1. David Fietisma, Chipley *104 cows, 16,448 M., 590 F.
   2. Robert Wier, Donaldsonville, 76 cows, 15,571 M., 573 F.
   3. Eicher Dairy, Atmore, Ala *57 cows, 17,250 M., 555 F.
   4. Arthur Aukema, Chipley *333 cows, 15,192 M., 554 F.
   5. Ray Fields, Dade City *154 cows, 16,375 M. 553 F.
# HONOR ROLL
## QUALITY MILK PRODUCERS

<table>
<thead>
<tr>
<th>Permit Number</th>
<th>Cows</th>
<th>Bacteria</th>
<th>Somatic Cells</th>
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</thead>
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<tr>
<td><strong>12 Months: 1979</strong></td>
<td></td>
<td></td>
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<tr>
<td>Hurst Dairy, Mayo</td>
<td>170</td>
<td>664</td>
<td>7,937</td>
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<td>925</td>
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<td>7,975</td>
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<td>Dutch Mill Dairy, Bonifay</td>
<td>961</td>
<td>60</td>
<td>5,476</td>
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<td>Bassett's Dairy Farm, Monticello</td>
<td>106</td>
<td>1200</td>
<td>7,300</td>
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<tr>
<td>Molar Dairy Ranch, Monticello</td>
<td>753</td>
<td>475</td>
<td>9,400</td>
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<tr>
<td>Davie Dairy, Okeechobee</td>
<td>468</td>
<td>900</td>
<td>9,000</td>
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<td>Larson's Dairy #1, Okeechobee</td>
<td>695</td>
<td>1200</td>
<td>8,211</td>
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<td>1200</td>
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<td>Bowie Dairy, Jacksonville</td>
<td>164</td>
<td>150</td>
<td>2,530</td>
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<td>C&amp;C Dairy, Jacksonville</td>
<td>721</td>
<td>145</td>
<td>5,600</td>
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<td>Williamsfield Dairy, Citra</td>
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<td>9,070</td>
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<td>Caralene Dairy, Citra</td>
<td>923</td>
<td>80</td>
<td>6,444</td>
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<td>Shreve-Summerfield Dairy, Bellevue</td>
<td>935</td>
<td>100</td>
<td>5,655</td>
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<td>Van Wagner Dairy, Citra</td>
<td>951</td>
<td>120</td>
<td>4,211</td>
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<td>J&amp;H Dairy, Zephyrhills</td>
<td>977</td>
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<td>5,120</td>
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<td>Hawks Progressive Dairy, Tampa</td>
<td>1015</td>
<td>170</td>
<td>8,918</td>
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<td>Delta J.K. Dairy, Myakka City</td>
<td>987</td>
<td>150</td>
<td>7,230</td>
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<td>D&amp;S Dairy, Gainesville</td>
<td>137</td>
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<td>4,825</td>
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<td>Watkins Farm, Hawthorne</td>
<td>620</td>
<td>60</td>
<td>2,300</td>
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<td>Carter Farm, Old Town</td>
<td>975</td>
<td>60</td>
<td>3,572</td>
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<td>Pine Ridge Dairy, Fruitland Park</td>
<td>241</td>
<td>410</td>
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<td>Beacon Farms, DeLand</td>
<td>279</td>
<td>260</td>
<td>3,661</td>
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<td>Fleser Dairy, DeLeon Springs</td>
<td>281</td>
<td>320</td>
<td>7,075</td>
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<tr>
<td>Hollingsworth Dairy, Atmore, AL</td>
<td>615</td>
<td>115</td>
<td>10,000</td>
</tr>
<tr>
<td>Sipple Dairy, Thomotosassa</td>
<td>799</td>
<td>90</td>
<td>7,762</td>
</tr>
<tr>
<td>Cray's Dairy #2, Century</td>
<td>915</td>
<td>150</td>
<td>8,527</td>
</tr>
<tr>
<td>Maple Lane Dairy, Tampa</td>
<td>362</td>
<td>275</td>
<td>6,000</td>
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<tr>
<td>Russell Dairy, Brandon</td>
<td>665</td>
<td>350</td>
<td>3,314</td>
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</table>

| **24 Months:** |
| Koon Dairy, Mayo | 126 | 300 | 10,000 | 560,000 |
| McMillan Dairy, Live Oak | 635 | 85 | 6,800 | 662,000 |
| Rodney Morgan Dairy, Mayo | 916 | 85 | 7,725 | 658,750 |

<p>| <strong>24 Months:</strong> |
| C.M. McArthur, Inc., Okeechobee | 558 | 1450 | 6,566 | 583,333 |
| Summer Fields Jersey Dairy, Summerfield | 233 | 180 | 6,255 | 593,333 |
| T.J. Smith &amp; Sons, Inc., Brooksville | 922 | 280 | 8,477 | 580,000 |
| Comstock's Dairy, Loxley, AL | 789 | 70 | 3,018 | 529,000 |
| Henson Dairy, Loxley, AL | 929 | 70 | 5,733 | 592,142 |
| Hoosier Dairy, Lakeland | 402 | 75 | 3,925 | 465,000 |
| Nickerson Dairy, Wauchula | 556 | 100 | 9,637 | 502,000 |</p>
<table>
<thead>
<tr>
<th>PERMIT NUMBER</th>
<th>COWS</th>
<th>BACTERIA</th>
<th>SOMATIC CELLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing View Dairy, Bonifay</td>
<td>818</td>
<td>177</td>
<td>5,000</td>
</tr>
<tr>
<td>McInarnay Dairy, Melrose</td>
<td>207</td>
<td>200</td>
<td>9,177</td>
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<tr>
<td>Wilbro Dairy, Malabar</td>
<td>289</td>
<td>125</td>
<td>4,130</td>
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<td>36 Months:</td>
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<tr>
<td>Busy Acres Dairy, Atmore, AL</td>
<td>20</td>
<td>45</td>
<td>6,225</td>
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<tr>
<td>Eicher Dairy, Atmore, AL</td>
<td>899</td>
<td>60</td>
<td>2,708</td>
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<td>60 Months:</td>
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<tr>
<td>Brantley's Dairy, Melbourne</td>
<td>288</td>
<td>125</td>
<td>3,722</td>
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<tr>
<td>River Dairy, DeLand</td>
<td>626</td>
<td>90</td>
<td>2,037</td>
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<tr>
<td>Walden Dairy, Plant City</td>
<td>389</td>
<td>75</td>
<td>7,000</td>
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<tr>
<td>96 Months:</td>
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<tr>
<td>Sorenson Dairy, Monticello</td>
<td>113</td>
<td>50</td>
<td>2,100</td>
</tr>
<tr>
<td>Turnpike Dairy, Palm City</td>
<td>990</td>
<td>540</td>
<td>3,200</td>
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<tr>
<td>102 Months:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Square D Dairy, Dade City</td>
<td>672</td>
<td>135</td>
<td>6,100</td>
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</table>
ORGANIZATIONS SPONSORING THE DAIRY PRODUCTION CONFERENCE

1. Upper Florida Milk Producers Association  -  $200
2. Tampa IDFA  -  $200
3. South Florida IDFA  -  $200

COMPANIES REPRESENTED AT DISPLAY BOOTH
AT PRODUCTION CONFERENCE

1. Veterinary Sales Consultants
   Tom Holloway and Jerry C. Kemp
   The Upjohn Company, Inc.
2. Butler Manufacturing Co.
   Oswalt Division
   Allin Butcher
3. Church and Dwight Co., Inc.
   Derek E. Hutchinson
4. J&S Herd Supplies
   James F. Ziegler and Jay Swiers
5. Top Quality Dairy Equipment Co.
   (Chore Boy) - Triple J. Dairy
   Joseph Milletto
6. Anchor Laboratories, Inc.
   Feed Additives
   Herbert J. Weimer
7. SURGE
   Bill Issacs
8. Select Sires
   Danny Yant & Scott Yant
9. NOBA
   Walter Oelfke, Don Hanson
10. ABS
    George Manter
11. Donovan Enterprises, Inc.
    Mike F. Ciferri
12. Miller Machinery - DeLaval
    Ellis Gulledge
13. Klenzade
    Gene Chestnut
    Michael Oberlander
15. Biozyme Enterprises
    Morris Hicks, Bert King
    and Mike Taylor
16. Southeast Genetics, Inc.
    Herb Wright
17. Silopress
    "Book" Cunningham
"PROBLEMS ASSOCIATED IN MAINTAINING QUALITY MILK ON THE FARM - ANTIBIOTIC RESIDUALS"

by

James J. Jezeski
Extension Dairy Technologist
University of Florida
Gainesville, Florida

In the course of the past years observations and experiences, one of the items of current interest and concern is the problem of antibiotic residuals in raw milk, both farm samples and commingled tanker samples. This arises because of changes in approved testing methods which result in increased sensitivity in detecting antibiotic residuals.

The present situation as summarized in Table 1 (1978 PMO, p. 45) shows that individual producer samples are tested by the Bacillus subtilis disc assay (about 0.05 units minimal detection) whereas commingled milk and pasteurized milk products are tested by the Sarcina lutea Cylinder Plate Method (about 0.01 units minimal detection). This indicates that individual producer milk is tested for antibiotics by a less sensitive test than is commingled milk or finished dairy products. Therefore it is possible to have no producers on a load show a positive test and yet have the load show the presence of a detectable residual and be rejected.

Furthermore, the B. subtilis test while readily adapted to routine laboratory screening testing for quality control purposes is relatively slow (about 4 hours incubation time). And the Sarcina lutea test is quite involved and somewhat complicated for routine laboratory usage and takes as long, if not more so.

With these limitations in mind, as the new Pasteurized Milk Ordinance (approved in 1978; to go into effect July 1, 1980) was being negotiated by the National Conference on Interstate Milk Shipments, the need was recognized for one or more tests of sensitivity equal to the Sarcina lutea test, but readily adaptable to routine laboratory procedures, and which would yield results in a substantially shorter time.

And, there are tests available and being developed which appear to be more sensitive and/or quicker and are readily adaptable to routine lab testing. These include the Charm test and the Swaisgood test which are not conventional bacteriological assays and several other more conventional procedures that use Bacillus stearothermophilus as the test organism.

The characteristics of the two tests using B. stearothermophilus for assay are compared with the standard B. subtilis test in Table 2. The
latter uses an incubation temperature of 37°C, requires 3 to 4 hours for reading and is sensitive at 0.05 units (down to 0.02 in certain situations). The modified AOAC test uses B. stearothermophilus as the assay organism with an incubation temperature of 55°C and a reading time of 3 hours-30 minutes to 3 hours-50 minutes. The sensitivity is considered to be 0.005 units (and down to 0.003 under some circumstances). The accelerated modified AOAC disc assay (Difco) uses B. stearothermophilus with an incubation temperature of 65°C. The reading time is reduced to from 2 hours-40 minutes to 2 hours-50 minutes. The higher incubation temperature results in a shorter reading time but with a slight decrease in sensitivity (about 0.008 units).

The consequence of FDA considering that the disc assay test using B. stearothermophilus is equivalent to the B. subtilis test and the Sarcina lutea test is that producer milk samples will be tested at the same level of sensitivity as commingled milk or finished products. Experience to date indicates that increased numbers and incidence of positive samples will be detected.

The increased incidence of positive samples can be due to 2 possible causes:

1. Even if every precaution is taken to "do things by the book" or exactly as the directions read on the label, the withdrawal times for the antibiotic preparations used may not be based on testing methods of equivalent sensitivity. To say it in another way, the withdrawal times as presently stated on the label may not be applicable with the more sensitive B. stearothermophilus test to be approved for farm sample testing.

2. The procedures and strategies of handling antibiotic-treated cows and milk on the farm (where there may be some even minor deviation from label instructions and other faulty practices) must be reevaluated. While the solution for pollution may be dilution, more sensitive detection tests mean more dilution is necessary to avoid detection (about 10 times more). Thus any possible ways that antibiotic contaminated milk can reach the bulk tank must be eliminated.

In any event, the producer must be constantly aware that his chances of being involved with a positive antibiotic test are greatly increased with the proposed and anticipated shift from the B. subtilis disc assay method to a method using B. stearothermophilus as the test organism. It will be necessary to go exactly by the label directions with recommended and approved antibiotic preparations in regard to withdrawal times; and to scrupulously avoid any inadvertent exposures of milking animals to sources of antibiotics which could contaminate the milk.
TABLE 1 Chemical, Bacteriological, and Temperature Standards

Grade A raw milk for pasteurization

<table>
<thead>
<tr>
<th>Temperature ..........</th>
<th>Cooled to 45°F (7°C) or less within two hours after milking, provided that the blend temperature after the first and subsequent milkings does not exceed 50°F (10°C).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial limits ......</td>
<td>Individual producer milk not to exceed 100,000 per ml. prior to commingling with other producer milk. Not to exceed 300,000 per ml. as commingled milk prior to pasteurization.</td>
</tr>
<tr>
<td>Antibiotics ..........</td>
<td>Individual producer milk: No detectable zone with the <em>Bacillus subtilis</em> method or equivalent. Commingled milk: No detectable zone by the <em>Sarcina lutea</em> Cylinder Plate Method or equivalent.</td>
</tr>
<tr>
<td>Somatic .............</td>
<td>Individual producer milk: Not to exceed 1,500,000 per ml.</td>
</tr>
</tbody>
</table>

Grade A pasteurized milk and milk products

<table>
<thead>
<tr>
<th>Temperature ..........</th>
<th>Cooled to 45°F (7°C) or less and maintained thereat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial limits* .....</td>
<td>20,000 per ml.</td>
</tr>
<tr>
<td>Coliform ..............</td>
<td>Not to exceed 10 per ml. Provided that, in the case of bulk milk transport tank shipments, shall not exceed 100 per ml.</td>
</tr>
<tr>
<td>Phosphatase ..........</td>
<td>Less than 1 microgram per ml. by the Scharer Rapid Method or equivalent.</td>
</tr>
<tr>
<td>Antibiotics ..........</td>
<td>No detectable zone by the <em>Sarcina lutea</em> Cylinder Plate Method or equivalent.</td>
</tr>
</tbody>
</table>

*Not applicable to cultured products.

Table 2.
Characteristics of Tests For Detecting Antibiotics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Disc Assay</td>
<td>B. Subtilis</td>
<td>37°C</td>
<td>3–4 hrs</td>
<td>0.05 (to 0.02)²</td>
</tr>
<tr>
<td>Modified AOAC</td>
<td>B. Stearchothermophilus</td>
<td>55°C</td>
<td>3.5–3.83 hrs</td>
<td>0.005 (to 0.003)²</td>
</tr>
<tr>
<td>Modified AOAC</td>
<td>B. Stearchothermophilus</td>
<td>65°C</td>
<td>2.67–2.83 hrs</td>
<td>0.008 (to 0.005)²</td>
</tr>
<tr>
<td>High Temp. (DIFCO)</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

* - Stipulated in PMO (1978) for producer milk.
** - Can be used on producer meilk (after July 1,
*** - Collaborative study not yet finished.
POTENTIAL OF HEAT RECOVERY UNITS ON MILK REFRIGERATION EQUIPMENT

D. E. Buffington and C. D. Baird
Agricultural Engineering Department
Institute of Food and Agricultural Sciences
University of Florida
Gainesville, Florida

Introduction

Heat recovery units can be effectively used to heat process hot water with the heat that is normally rejected from an air conditioning or refrigeration system to the ambient environment. Substantial reductions in the energy requirements for heating process water can be realized by using a heat recovery unit; while at the same time, there will be a corresponding increase in the efficiency of operation of the refrigeration system (increase in coefficient of performance). The efficiency increase will be evidenced by either a decrease in the electrical energy required to operate the refrigeration system or an increase in the cooling capacity of the refrigeration system for a given electrical input.

Heat recovery units for refrigeration systems are not new products; recovery units have been commercially available since 1935. Until recently, heat recovery units were generally viewed as being an uneconomical means of heating water for dairy farm applications. However, as the price of energy has rapidly escalated in the past decade, the use of heat recovery units offers an economical means of conserving energy.

Usage of hot water on dairy farms has been measured by Wiersma and Armstrong (1979) to range from 1.3 to 1.6 gallons (5 to 6 liters) per cow per day for herringbone parlors and from 2.4 to 2.9 gallons (9 to 11 liters) per cow per day for side opening parlors and prep stalls. Wiersma and Armstrong also found that the settings on water heaters ranged up to 113°F (45°C) for prep washing and general wash water and up to 167°F (75°C) for sanitation wash water. Under typical Florida conditions, the energy required to supply 2 gallons (7.5 liters) per cow per day of hot water at 165°F (74°C) is 1568 BTU (1.65 MJ), assuming a supply water temperature of 70°F (21°C). Assuming an electricity cost of $0.065/per KWH and a heater efficiency of 95%, the cost of providing the hot water is $0.033 per cow per day. For a 1000 cow dairy herd, the yearly cost for energy for heating water is $12,111. If natural gas or fuel oil is used as the energy source for heating the water, the energy cost for heating may then be significantly less than heating with electricity. In most applications, a heat recovery unit that is properly designed, installed, operated, and maintained will provide a major portion of the hot water needs on a dairy farm.

Principle of Operation

A heat recovery unit is installed in a refrigeration system between the compressor and condenser. (In some applications, the heat recovery unit actually takes the place of the condenser.) The hot refrigerant gas leaving
the compressor enters the heat recovery unit, that functions as a counter-flow heat exchanger. The other medium entering the heat recovery unit is the water that is to be heated. The heat transfer process of water being heated by the hot refrigerant and the refrigerant being cooled by the lower temperature water provides the dual benefits of producing hot water and increasing the efficiency of the refrigeration system.

A brief introduction to the operation of a refrigeration cycle will illustrate the potential of heat recovery units. Consider a rather typical dairy refrigeration system (air-cooled) having a condensing temperature of 165°F (73.9°C) and an evaporating temperature of 0°F (-17.8°C) for refrigerant R-12. The corresponding condensing and evaporating pressures are 296.1 psia (2042 kPa) and 23.8 psia (164 kPa), respectively. A pressure-enthalpy (P-h) diagram of the theoretical refrigeration cycle is shown in Figure 1; the temperature-entropy (T-s) diagram of the same cycle is shown in Figure 2. Enthalpy refers to the amount of energy in the refrigerant, while entropy refers to the amount of energy given up or absorbed by the refrigerant as its temperature changes.

The various steps of the refrigeration cycle are labelled in Figure 1, for the case of liquid refrigerant subcooling of 10°F(5.6°C) and refrigerant gas superheating of 20°F (11.1°C). The useful cooling effect of the refrigeration cycle is the heat absorbed by the evaporating liquid refrigerant as represented by line C-D. The energy required to compress the superheated gas refrigerant, denoted as E-F, is the electrical energy demanded by the compressor. The energy released by the hot gas refrigerant as it condenses back into the liquid refrigerant ready to start the cycle again is represented by line F-B. The energy utilized by heat recovery units for heating process water is a portion of the energy released from F to B. The actual portion of the energy released from F to B that is recovered for heating water depends on the design, installation, and operation of the refrigeration/heat recovery system.

The effect of increasing the refrigerant liquid subcooling can be seen in Figure 1. As the subcooling increases, both lines A-B and C-D lengthen; line E-F does not change. Consequently, an increase in refrigerant subcooling will increase the useful refrigerating effect of the system without an increase in the energy input to the compressor. For the case of a fixed refrigerating load, then the energy input to the compressor would decrease as the refrigerant subcooling increases. Inspection of the P-h diagram will also indicate the effects of increasing the refrigerant gas superheat (line D-E) and/or the condensing pressure. There is a corresponding increase in the heat energy that is available (F-B) for recovery by the heat recovery unit for heating water. Unfortunately, the benefit of the additional heat energy available is more than offset by the increase in the electrical energy required by the compressor (line E-F). The condensing pressure should never be higher than rated conditions, even though one is able to recover more heat by running the system at an elevated condensing pressure. The disadvantages of high condensing pressures are an increase in the cost to operate the compressor and a decrease in the longevity of the compressor. The amount of refrigerant gas superheat (line D-E) can be minimized by insulating the refrigerant gas line from the evaporator to the compressor in order to reduce the load on the compressor.
Even though the condensing temperature in this example is 165°F (73.9°C), the hot gas refrigerant reaches a high temperature of 210°F (99°C) as it exits the compressor, as shown in the temperature-entropy diagram in Figure 2. All steps of the refrigerant cycle are labeled to correspond with the labels in Figure 1. It may be difficult to appreciate the magnitude of heat transfer that occurs in a heat recovery unit of a refrigeration system until one realizes that the refrigerant reaches a temperature considerably higher than the condensing temperature as shown in Figure 2.

Application

The two basic types of heat recovery units on the market today are: 1) desuperheaters; and 2) complete condensers. A desuperheater recovers the superheat (represented by line F-G in Figure 1) and perhaps a small portion of the latent heat of condensation line (G-A). The heat recovered is roughly the heat equivalent of the energy input to the compressor. Heat recovered is approximately one third of the total amount of heat discharged. A conventional condensing unit must be used along with the desuperheater heat recovery unit.

The complete condenser heat recovery unit is capable of recovering nearly 100% of the heat discharged from the refrigeration system (denoted as line F-B); therefore, the condensing unit is no longer necessary. It is advisable, however, to retain the condenser to serve as a back-up and to reduce water wastage. As pointed out by Koelsch (1979), the quantity and timing of the hot water produced by the complete condenser type heat recovery unit necessitates that approximately 40% of the heat recovered must be dumped. This loss of heat, either through warm water being discharged or through conductive and radiant heat losses, is necessary because of design restraints of the heat exchanger that limits the maximum temperature of water. The limit on the maximum temperature of water is to prevent the condensing pressure from rising excessively. One dairy observed by Koelsch was forced to dump one gallon of hot water for each three gallons of hot water utilized. The hot water from the heat recovery unit that must be discharged could be beneficially used for other operations on the dairy.

The value and performance of heat recovery units were evaluated on 18 dairy farms in New York by Koelsch (1979). He concluded that the heat recovery unit can eliminate a major portion of the energy cost for heating water on a dairy. Complete condensing units can eliminate 65 to 85% of water heating costs; while desuperheaters can eliminate about 50% of the energy required for heating water. A properly installed and operated heat recovery unit for recovering the refrigeration system's discharge heat represents an excellent financial investment for most dairy farmers today.

A study of the effectiveness of desuperheaters in California was conducted by Thompson and Fairbanks (1979). They also concluded that properly installed heat recovery units will greatly reduce the energy costs for water heating in dairies and are an excellent financial investment.
One additional benefit of installing a heat recovery unit is that the financial investment is currently recognized by the Internal Revenue Service as an effective energy conservation measure. Therefore, tax benefits are available to effectively decrease the required financial investment.

The use of solar energy for heating water on dairies has been researched for several years and some dairies have installed elaborate solar energy systems. The economics of solar energy systems vs. heat recovery systems for heating water on dairies has been evaluated by Stipanuk et al. (1979) for ten major dairy states. They concluded that solar systems, with an assumed 20 year life, did save money for those dairies currently heating water with electricity. However, the savings were always less than the savings resulting from using heat recovery units.

One note of extreme caution. The favorable results in the studies cited were all for heat recovery units that were properly installed and operated. One dairy in Florida was observed that was using a heat recovery unit. The system was installed so that there would always be "free" hot water. To achieve the "free" hot water supply, a manual pressure regulator was installed on the high pressure side of the compressor. The herdsman was instructed to increase the setting on the pressure regulator whenever he wasn't getting sufficient supply or temperature of hot water. By increasing the pressure, the herdsman was increasing the condensing pressure and temperature. Consequently, he would get more "free" hot water, BUT..... the increased energy required to operate the compressor at the higher condensing pressure more than offset the energy savings in the additional amount of hot water. Furthermore, operating the compressor at higher than rated conditions not only requires more electricity, but also decreases the service life of the compressor. The extra amount of "free" hot water was very expensive. When more hot water is needed than the heat recovery unit can supply, use a conventional water heater to complete the heating.

The herdsman should be advised to consult the manufacturer of the refrigeration system before installing and operating a heat recovery unit. It is good practice to obtain a letter from the manufacturer stating the conditions of the warranty on the refrigeration system.

In his report, Koelsch (1979) concluded that "heat recovery units for heating water from the refrigeration system's heat ought to be promoted as standard equipment for most dairy operations. The benefits to the dairyman should make this investment very worthwhile.

References


Figure 1: Pressure-Enthalpy (p-h) diagram for R-12.

ENTHALPY (BTU/lb)

104
80
44

PRESSURE (PSIA)

24
296

By Condenser
F-G Heat Normally Rejected
Energy Input Required
Refrigerant Compression
Refrigerant Superheating
Useful Refrigerating Effect
Refrigerant Evaporation
Refrigerant Expansion
A-B Refrigerant Subcooling

REFRIGERATION CYCLE

STEPS OF
Figure 2. Temperature-Entropy (T-s) diagram for R-12.
UPDATE ON EFFECTIVE MASTITIS CONTROL METHODS

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Mastitis is still our most expensive herd management problem. In herds where there is not an effective mastitis control program, approximately 50 percent of the cows are infected in an average of two quarters. In 1978 the National Mastitis Council (NMC) estimated that mastitis cost about $161 per cow per year in the average herd. If this is adjusted with a 13 percent inflation rate, it becomes about $180 per cow.

How much does mastitis cost you? Obviously the only way you can answer this question is to know how much mastitis you have in your herd. Mastitis robs you in four ways:

1. **Treatment cost** - This is a direct loss for veterinary fees, drugs and medicine.

2. **Discarded milk** - When milk does not go into the tank, it is a direct loss. If abnormal milk finds its way into the tank, the quality of your milk goes down. In time, this will affect you and your fellow producers at the market place.

3. **Cost of replacements** - When you cull a cow because of mastitis, you have to bring in a replacement. The difference between beef price and the replacement cost is a loss.

4. The hardest financial blow from mastitis is **lost milk production**—milk your cows never produced. This loss is due to subclinical mastitis that most dairymen do not detect (the quarter is infected, but the milk appears to be normal). The NMC estimates this loss at $105 per cow after the feed cost for lost milk production is removed.

How effective is your mastitis control program? Most dairymen evaluate the effectiveness of their herd mastitis control program by the number of cows requiring antibiotic therapy. However, several facts indicate that knowing the amount of clinical mastitis (visibly abnormal quarters), although important, is not adequate for evaluating the effectiveness of a control program.

1. Most cases of mastitis in a herd are subclinical. These quarters are infected and are costing money but are not visibly abnormal. Research has demonstrated that for every case of clinical mastitis observed in the average herd, approximately 15 to 40 cases of subclinical mastitis are not detected.

2. The percentage of subclinical cases that eventually show up as clinical and require treatment is quite variable. A few factors are: how well we detect clinical cases, what type of bacteria are involved, how much the cows are stressed, etc.
I am convinced that in most herds, a routine procedure for obtaining an accurate evaluation of the herd mastitis control program will increase profits. This is particularly true for large herds. Some reasons include:

(1) The direct supervision of the milking operation is more difficult. Weaknesses in the milking operation will affect a far greater number of cows.

(2) The purchase of milking cows from different sources introduces more strains of microorganisms into the herd (some of which are highly invasive and difficult to cure).

(3) The problem associated with providing adequate housing increases with herd size as well as the likelihood of infections with environmental microorganisms.

On the other hand, if the mastitis control program is evaluated on a routine basis and problems detected before they become problems of major proportions, special precautions can be taken at a lower cost per cow.

How should you evaluate your herd mastitis control program? Because mastitis is frequently "hidden," a number of tests have been developed for detecting mastitis. The majority of these tests approximate the number of somatic cells present in a milk sample. The term "somatic" simply means to be derived from the body. Thus somatic cell counts include both tissue cells and leucocytes (white blood cells). It is normal for these cells to be in milk, however, it is abnormal for an excessive number of them to be there. Tissue cells enter milk as a result of stress or injury to secretory tissue. Whereas leucocytes (the body's chief defensive mechanism against foreign material) accumulate at the site of an injury or infection. Their primary function is to engulf and degrade invading bacteria. There are, however, other occasions when cell concentration in milk are higher than normal. Freshening, late lactation, old age, estrus, sickness, environmental stress, etc., may elevate cell counts. Such increased counts will generally be lower than those due to infection. Thus when leucocytes are found in excessive numbers, they indicate udder irritation.

Bulk tank cell counts. Cell counts on bulk tank milk, if accurate, provide a good indication of the average mastitis status in your herd. Unfortunately, regulatory agencies in some areas only follow the abnormal milk program to the letter and the information they provide is not as useful as it might be. However, even accurate counts on herd milk do nothing to identify problem cows or locate factors contributing to the high counts.

It should also be noted that herds with bulk tank counts over 500 thousand have serious subclinical mastitis problems even though they do not approach the 1.5 million regulatory level. Milk production has been estimated to decrease by 12 percent with bulk tank counts between 500 thousand and one million and by 20 percent or more when counts exceed one million.

Screening tests on individual quarter samples. The effectiveness of a control program can best be evaluated by conducting the California Mastitis Test (CMT) on milk from each quarter of each cow and determining the
frequency of the various reactions. However, to be of value as a management tool, the screening test must be conducted and summarized on a routine basis.

Since most dairymen find this difficult to do in their own herds, many states have provided a mastitis screening test option through DHIA.

Somatic cell counts on cow composite milk samples. In North Carolina somatic cell counts are determined on the same sample as is used for the fat test. These counts are determined at the centralized butterfat testing laboratory using a Fossomatic (an automated cell counting instrument). The results for individual cows for the current and previous month are reported on the standard monthly report (DH1-200). A scale of 1 to 99 is used with each count corresponding to 100,000 somatic cells/ml milk. The current test day results are also summarized on the herd summary page (DH1-202) as to percentage of first lactation cows and older cows in each of five cell count categories (0 - 200,000; 200 - 400,000; 400 - 800,000; and above 800,000).

Herd problems can be identified from initial tests by a high percentage of positive reactions (400 - 800,000 and above 800,000) and a low percentage of negative reactions (less than 200,000). Cell counts of greater than 400,000 are cause for concern since the vast majority of these cows have quarters with bacterial infections and thus decreased milk production. We would suggest that less than 5 percent of the cows above 800,000 cells/ml is a good goal level to be achieved without increasing cow turnover. Dairymen with 15 percent of their cows above 800,000 cells/ml should re-evaluate their herd mastitis control program.

Perhaps the best evaluation as to whether the current control program is effective in preventing new infections in your herd is the condition of the first calf heifers (provided on DH1-202). These cows are not affected as much as older cows by previous herd conditions.

### STATUS OF HERDS ON THE DHI SCREENING TEST PROGRAM

<table>
<thead>
<tr>
<th>Percent &gt;800,000 cells/ml</th>
<th>No. of Herds</th>
<th>Percentage of Herds</th>
<th>% Cows Left Herd</th>
<th>Holstein Herds Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 5</td>
<td>55</td>
<td>22</td>
<td>28</td>
<td>15,114</td>
</tr>
<tr>
<td>6 - 10</td>
<td>52</td>
<td>21</td>
<td>31</td>
<td>14,735</td>
</tr>
<tr>
<td>11 - 20</td>
<td>75</td>
<td>30</td>
<td>30</td>
<td>14,005</td>
</tr>
<tr>
<td>21 - 30</td>
<td>36</td>
<td>15</td>
<td>31</td>
<td>13,633</td>
</tr>
<tr>
<td>31 - 40</td>
<td>12</td>
<td>5</td>
<td>35</td>
<td>13,595</td>
</tr>
<tr>
<td>Over 40</td>
<td>17</td>
<td>7</td>
<td>33</td>
<td>11,427</td>
</tr>
</tbody>
</table>

Table 1 presents a summary of North Carolina herds on the DHI screening test program. It appears that the herd goal level (less than 5 percent of the cows above 800,000) is achievable. It is not possible to determine from these figures how much of the differences in production between high cell count herds and low cell count herds is due to mastitis. However, it seems safe to conclude that a reduced incidence of mastitis must be achieved before substantial production progress will be made in the high cell count herds.
North Carolina dairymen have found the somatic cell count program to be a valuable tool for monitoring their herd milking management and mastitis control program. Evidence for this is the fact that the number of herds using the optional program has continued to increase, and the percentage of problem cows in these herds has decreased.

**Prevention and Elimination of Infection**

Long-term programs for mastitis control must be based on the prevention of new infections. However, for a program to be successful in an average herd in a relatively short period of time (one year), it must be directed at eliminating existing infections as well as preventing new ones.

The following management areas must be evaluated:

1. Inspect and restore milking equipment to proper operating condition.

2. Re-evaluate and correct milking procedures, including milking sanitation (especially the practice of dipping teats immediately after milking on a routine basis with a proven product).

3. Review other management practices, such as culling source of herd replacements, condition of cow lots and free stalls, etc.

4. Re-evaluate mastitis detection and lactation treatment program. DHIA somatic cell count monitoring programs are of particular value in making this evaluation. The presence of individual cows in the milking string with counts above 5 million (reported as 50) indicates that clinical cases are either being ignored or not detected. In large herds this is unfortunately one of the first indications that "all is not going well in the milking parlor."

5. Re-evaluate dry cow treatment program.

**Prevention of Infections**

**Streak Canal** - Intramammary infections occur as the result of microorganisms passing through the streak canal (teat opening). Injury to, or sores on the teat apex greatly enhance the chances of an intramammary infection.

**What is a normal teat end?** The streak canal is 1/4 to 1/2 an inch in length and lined with cells that form a series of very small folds. These cells secrete a lipid-like secretion that inhibits bacterial growth. Normally this canal is kept closed, except when pressure opens it, by a sphincter muscle. The tightness of this closure determines the ease of milking as well as the ease by which bacteria enter the gland.

If we dip normal teats in a culture containing large numbers of bacteria capable of causing an infection, the incidence of infection is quite low (higher than we could tolerate in a herd, but still low). On the other hand, if we place very small numbers of bacteria halfway up the streak canal
(1/8 to 1/4 of an inch), infections (at least temporary infections) will occur almost 100 percent of the time. Thus, the importance of maintaining the integrity of the teat end is obvious.

**Sources of Pathogens.** Mastitis may be caused by many different types of microorganisms. An extensive review of the literature indicates that approximately 90 different microorganisms may cause mastitis. However, four types, *Staphylococcus aureus*; *Streptococcus agalactiae*; *Streptococcus dysgalactiae*; and *Streptococcus uberis* account for about 95 percent of all udder infections.

It is desirable to obtain bacteriological information for evaluating a herd control program. Although it is usually not practical to sample all cows, a reliable herd profile can be obtained by sampling a representative group of cows (subclinical infections as well as clinical ones). The characteristics of the predominant microorganisms should then be considered in evaluating the control program.

**Streptococcus agalactiae** (*Streptococcus Group B*) is the only mastitis pathogen which is an obligate parasite of the mammary gland. It can be isolated from other sites within the herd; however, once it is removed from the cows, it usually cannot be brought back to the herd unless infected cows are purchased. Thus, if a herd has a high incidence of infection with this organism, it has been passed from infected to noninfected cows during the milking process. *S. agalactiae* is not an active tissue invader. It multiplies in the milk and on the surface of cisterns and large ducts. Antibiotic therapy during lactation or the dry period is very effective against this organism.

The primary source of *Staphylococcus aureus* in a herd is also infected glands. However, it can persist for long periods of time outside the udder. Thus, secondary sources of the organism: the skin of cows' teats, infected teat blemishes, etc., are important reservoirs of infection. *Staphylococcus aureus* differs from *Streptococci* in that it can penetrate into tissue producing deep seated areas of infection. Thus, severe clinical flareups are more frequent. Only a small percentage of established infections can be eliminated with antibiotic therapy during lactation. Dry period therapy is much more effective.

**Streptococcus uberis** and **Streptococcus dysgalactiae** (*Strep not Group B*) are widely distributed being isolated quite frequently from cow's lips, belly and udder skin. They are moderately susceptible to antibiotic therapy during lactation. A higher percentage are successfully eliminated by dry period therapy.

A second group of bacteria which have received a great deal of attention in the last few years is the coliforms. Only a small percentage of dairymen have problems with these microorganisms; however, when they do cause problems, the losses are severe. The term "coliform mastitis" has been used to identify mastitis caused by *Escherichia sp.*, *Enterobacter sp.*, and *Klebsiella sp.* Results from problem herds suggest that the primary source of all three of these microorganisms is the environment. Recommendations for preventing...
coliform mastitis are based on reducing the amount of contamination from
the environment as well as the ease with which they enter the mammary gland.

It can be seen from the previous discussion that methods that aid in
reducing the transfer of microorganisms from infected to noninfected quarters
must be incorporated in any successful mastitis preventative program.

**Milking Equipment**

When did you last have your milking system checked with testing equipment
and deficiencies in function corrected? It has been well established that
the milking machine can contribute to an increased incidence of mastitis.
The milking machine can influence the likelihood of infection in three ways:

1. The milking machine liners may transfer large numbers of organisms
   from one cow to others milked with that same unit.

2. The milking machine may cause injury to the teat end, teat canal
   and delicate interior lining of the teat sinus. The extent of the
   injury is increased if the milking equipment is improperly designed,
   installed or used. Injury to or sores on the teat apex greatly
   enhance the chances of an intramammary infection.

3. During operation organisms may be jetted on the teat end with
   sufficient force to place the organisms at least part way into the
   streak canal.

Considerable emphasis has been placed on milking time sanitation to reduce
the spread of organisms from cow to cow during milking. Post-milking teat
dips are effective because they eliminate organisms placed on the surface of
the teats during the milking process before they can gain entrance into the
mammary gland. British workers have also shown in extensive field trials that
the incidence of infection was reduced by an additional 10 percent when teat
cups were pasteurized between cows.

During the last few years automated back-flushing units have been
developed for the sanitation of units between cows. Currently the majority
of the experimental and commercial back-flushing units are being used in
large herds in California. This approach may become practical and economical
as these models are improved and as our milking parlors become more automated.

The mechanical aspects of milking machine function as it relates to the
new infection rate is not fully understood. Research has shown that vacuum
fluctuation at the teat end during milking contributes to an increased
incidence of mastitis. Two types of fluctuation may occur during milking.
The first type, cyclic fluctuation, is associated with liner movement, milk
flow and volume change within the inflation. This type occurs with each
pulsation cycle. Some of the factors that increase cyclic fluctuation
include: (1) claw of insufficient size, (2) decreased or lack of air admis-
sion at the claw or in the inflation stems, (3) flooding of the inflation,
(4) small diameter short milk tubes. The second type, irregular fluctuation,
is not associated with the pulsation cycle but occurs at random during
milking. Factors that increase irregular fluctuation include: (1) inadequate
pump capacity, (2) malfunctioning vacuum regulators, (3) poorly sized milk
or vacuum lines (restricted, under-sized or excessively long), (4) milk entering the bottom half of the pipeline, (5) lifting milk to a high line, (6) careless attachment or improper removal of teat cups.

Research has shown that the incidence of mastitis is increased when cyclic and irregular vacuum fluctuation occur at the same time. The combination apparently results in a higher vacuum at the teat end than the claw or pipeline. Thus, small milk droplets containing bacteria are jetted back on the teat opening (possibly implanted in the streak canal). These studies have also shown that the majority of the machine-induced infections occur near the end of milking. There are several possible explanations: (1) the bacteria that have been jetted on the teat end are not washed away again, (2) the velocity and frequency of impacts on the teat end are greatest when there is not much milk in the cluster, (3) the air entering the first teat cup to be detached will cause jetting on the other three teats.

Milking Procedures

When did you last analyze your milking procedures or review the correct way of milking with your hired men? It is well documented that the milking procedures have a pronounced effect on milk production and mastitis control. The primary emphasis must be placed on sanitation and avoiding udder injury. The following steps should be considered:

(1) **Udder washing** - The purpose of this step is to clean the udder and at the same time stimulate milk let-down. In too many herds this is done with a quick spray from a hose and a "promise" with a sponge. This will not accomplish either purpose. Washing with warm running water metered with a sanitizer and an individual paper towel followed by drying will minimize the spread of mastitis-causing bacteria.

(2) Remove a few streams of milk prior to attaching the milking unit. This step is often omitted by dairymen. However, it can play an important role in early detection of mastitis and keeping abnormal milk out of the bulk tank. Further, it will aid in the milk let-down process.

(3) **Attach the milking unit** about one minute following stimulation. Be careful to minimize the amount of air let into the system. Timing is important since the effect of oxytocin (milk let-down hormone) occurs within one minute after stimulation and persists for five to eight minutes. Failure to milk within this interval will result in a decrease in the milk obtained and an increase in milking time.

(4) Adjust the teat cups during milking as necessary to insure that the quarters milk out properly.

(5) When milk flow ceases, **remove the unit** by breaking the vacuum. Machine stripping should be eliminated or at least minimized (0-1/2 minute). Avoid overmilking; most cows will milk out in four to five minutes if machines are operating properly and if cows are prepared correctly.
(6) After removing the machine, dip teats in a post-milking teat dip of proven safety and efficacy. This is the most important single procedure that a dairymen can follow for preventing new infections during lactation. Research at several institutions has shown that teat dipping reduces the rate of new infections by approximately 50 percent in most herds.

(7) Rinse teat cups between cows - Although recommended for years, this procedure is difficult to effectively carry out. However, units that have been used on clinically infected cows should be sanitized before being used on another cow.

Are you using an effective teat dip? A post-milking teat dip to be effective must: remove the film of milk which provides nutrients for bacterial growth; kill microorganisms deposited on the teat skin during the milking process; leave a film of sanitizer on the teats between milkings; and be non-irritating to the teat. Currently, proof of effectiveness is not required on products prior to going on the market. A few products have appeared on the market which, when tested, have been shown to be ineffective. Most of these products are no longer being manufactured; however, there are still products being marketed that have not been tested for effectiveness. Since the benefits of teat dipping may become apparent only after a long period of use, dairymen must demand good research evidence concerning the value of a product prior to using it.

Are you really dipping the teats immediately after each milking? Obviously to be effective, this procedure must be carried out at each milking in a way that gets good coverage of the teat; particularly the teat end. The limited research that has been done comparing teat dipping with spraying shows a marked advantage for dipping. This is most likely due to better coverage of the teat end. If you are spraying, examine the teats on the opposite side immediately after spraying. Be sure you are getting good coverage of the bottom one-half inch of the teat.

Elimination of Infections

Infections are eliminated from a herd by three means: spontaneous recovery, culling and antibiotic therapy. Spontaneous recovery is relatively common in instances of milk infection, but the frequency is extremely low in cases of well-established infection. At the present time, we do not understand this mechanism nor have a method to increase the spontaneous recovery rate.

Culling is often the most practical means of eliminating chronic infections from a herd. In most herds the clinical mastitis flare-ups actually involve a relatively small number of cows. If a cow requires therapy more than three times during lactation (using a full series of recommended intramammary treatments) her value in the herd should be re-evaluated. These cows provide potent reservoirs of bacteria which are spread during the milking process.
Therapy is by necessity the most suitable procedure for eliminating mastitis infections from a herd. A few general suggestions will be offered regarding antibiotic therapy as it relates to lowering the level of infection in a herd. However, as with any procedure involving herd health, you will want to consult with your veterinarian. The general subject of mastitis treatment is also covered in the National Mastitis Publication entitled, "Mastitis Treatment Guidelines for Dairymen."

Lactation treatment

The efficacy of treating subclinical infections, especially old well-established infections during lactation, is extremely poor. The only exception is infections caused by *Streptococcus agalactiae*. Thus, treatment during lactation in most herds should be limited:

1. The first group of quarters that must be treated during lactation are clinical quarters. Since the milk must be discarded from all quarters on treated cows regardless of the number treated, other high CMT quarters should be treated at the same time. In instances of acute-clinical mastitis, normal appearing quarters should also be treated to prevent possible spread of infection. Although the treatment of clinical quarters is necessary, the effectiveness of treatment (complete elimination of bacteria) is not high.

2. Much research is needed before we can clearly determine conditions (age, stage of lactation, type or organism, etc.) where lactation therapy is economical. Young cows in early lactation with increasing cell counts (approaching 400,000 cells/ml) would be the most likely possibility. I would suggest that dairymen run the CMT on individual quarters of these cows as potential cows for lactation therapy. NOTE: Lactation treatment based on cell counts should be extremely limited.

3. Dairymen in danger of losing their Grade A market because of high somatic cell counts (leucocytes) may find it necessary to treat additional high cell count cows during lactation. Bacteriological results, production, stage of lactation and age should be considered in selecting cows for treatment.

It should also be emphasized that even after a successful treatment the screening test will probably remain higher than normal for the remainder of the lactation.

Dry treatment

Treatment at drying off has several advantages: a higher percentage of infections can be eliminated; the number of new dry period infections is reduced; damaged tissue may be regenerated prior to freshening; reduces clinical mastitis at freshening; and salable milk is not lost.

What type of preparation should be used? Use a product that is labeled specifically for treatment at drying off. By using a slow release base, a
higher concentration of antibiotic can be kept in the udder for a longer period of time. Unless you have bacteriological information to tell you differently, a formulation that is highly effective against both Staphylococci and Streptococci should be chosen.

**Which quarters should be dry treated?** There is not complete agreement on how much we should dry treat. Certainly in most herds all quarters of all cows should be treated. Research data is not available to determine if there is a level of infection which is low enough to justify selective dry therapy rather than complete therapy.

If the dairymen chooses to use a selective dry cow treatment program, a mastitis screening test is essential. For example, if only quarters which are visibly abnormal in late lactation are treated, most of the infected quarters will be missed—about 80 percent. Therefore, the selection procedure must identify more infections for treatment. Suggested quarters would include: those treated or clinical during lactation, those running high on the screening test at any time during lactation, and all quarters on cows with problems drying off. Selective treatment based on these criteria may still fail to reach 20 to 40 percent of the infected quarters. In addition quarters not treated at drying off are more likely than treated quarters to become infected before calving.

A comparison of the cell counts for a few months before drying off with a month after calving will give some indication as to how effective the dry treatment program (selection of cows, formulation, etc.) is in your herd.

Dry treatment should be a part of our herd mastitis control program. However, it is pointless to initiate a dry treatment program unless an effective preventative program is being used to keep susceptible quarters from becoming reinfected.

**Response To A Control Program**

Implementation of proven procedures will reduce the incidence of mastitis in most herds. Results from an extensive field trial conducted in New York State revealed that the simple routine of dipping teats after each milking in an effective teat dip, and the treatment of quarters at drying off with a specially formulated preparation, reduced the level of infection by about 50 percent within one year and 75 percent within two to three years. This reduction in the infection level was accompanied by an increase in herd milk production of more than 1,000 pounds per cow annually when compared to control herds not on the study. The production increase in your herd will depend on the level of infection, but there is money to be made by managing the mastitis control program.
MASTITIS - THE PROBLEM HERD

R.K. Braun, DVM
University of Florida

Introduction

A popular way for dairymen to approach herd health management is by basic, well designed programs that employ the part-time services of an outside specialist. Nutrition, reproduction, immunization, hoof care, etc. are all examples of such programs that have gained widespread acceptance. Likewise, mastitis control or milk quality control should be a significant part of an overall herd health management program.

A problem mastitis herd can mean different things to different people. Milk quality control personnel at milk plants send warning letters to dairymen who have reached 100,000 somatic cells per ml. of milk and expulsion from the milk plant or degrading occurs when somatic cell counts reach 1,500,000 cells. Well managed herds are striving for a somatic cell count of 300,000 cells per ml. or less. When this level is surpassed managers should quickly check on sanitation, milking procedures and equipment maintenance.

A herd mastitis control program to be reasonably complete and effective should give attention to all of the following:

1. Milking hygiene program
2. Routine maintenance of milking practices and performance
3. Lactating cow therapy practices
4. Dry cow therapy
5. Milking equipment design
6. Milking equipment maintenance
7. Herd segregation and culling practices
8. Udder contamination potential between milkings
9. Monthly bulk tank samples for quantitative bacteria identification and somatic cell evaluation

The National Mastitis Council (NMC) has estimated that 5% of all dairy herds are in danger of being degraded at any one time due to a mastitis related problem. A serious mastitis condition may be reflected in a high incidence of clinical mastitis, a high somatic cell count or a high bacteria count. Regardless of the nature of the problem the best place to start is by having a sample of bulk tank milk analyzed in a laboratory. This is a simple procedure that should never be overlooked. Mastitis is costly. Mastitis cost the average dairyman $150/cow/year. Even a well managed herd of 200 cows can lose $32,000 a year simply by doing nothing.
Problem Mastitis Herd - What Is It?

A herd can be defined as having a problem with milk quality if any one or all of the following parameters are out of line. This would include:

1. **High incidence of clinical mastitis.**

   Herds with greater than 2% of the lactating cows under treatment on any given day should be considered to have a mastitis problem. This situation usually results from a major deficiency in management such as unsanitary loafing or calving areas, improper treatment procedures, inadequate milking hygiene or faulty milking machines. A comprehensive herd survey should be conducted immediately to identify the predisposing factors responsible for the outbreak. Affected animals should be treated.

2. **High somatic cell counts.**

   A count of greater than 1.5 million somatic cells in bulk tank milk will result in loss of the dairyman's milk market. Somatic cell counts of greater than one million is cause for concern in a probational milk market. Somatic cell counts greater than 500,000 are costly to dairymen and result in a poor quality product.

   In problem herds the California Mastitis Test (CMT) should be conducted on every lactating cow in the herd. Cows with milk that is visibly abnormal or positive to the CMT should be treated and the milk discarded.

   A survey of herd management milking equipment and milking procedures should be performed.

   In many instances individual cows should have milk samples cultured in a laboratory to provide more information on the type of organisms responsible for mastitis. This information is often helpful in determining what steps should be taken to resolve the herd problem. The steps usually involve:

   a. Correcting deficiencies in management and environment,
   b. Upgrading milking equipment and milking procedures,
   c. Treating selected lactating cows,
   d. Drying off and dry treating or culling other cows.

3. **High bacteria counts.**

   a. Most often the problem is due to poor sanitation of the milking equipment or bulk tank, milking of wet udders, contaminated water supplies or inadequate refrigeration. Equipment should be checked thoroughly to determine that it is clean. Hot water temperature at beginning and end of washup should be monitored.

   b. Occasionally strep. agalactiae will cause an increased bacteria count in bulk tank milk. Problem cows should be identified following culture and treated. Animals not responding to rigid treatment should be culled.
Mastitis Management Goals

Goals should be set and a control program initiated that will enable the dairyman to achieve them. Some reasonable goals for which to strive for are:

1. Clinical mastitis. No more than 1-1.5 percent of the milking herd under treatment on any given day.
2. Monthly bulk milk screening scores for mastitis. Somatic cells less than 300,000 per ml.
3. Bacteriological procedures. Standard plate count less than 10,000.

Milking Procedure Goals

To milk clean dry teats with clean properly functioning machines effectively and completely.

1. Outside pre-wash and allow to drip-dry.
2. As cows enter and before touching cows, hose off filth from legs and floor.
3. Foremilk and wash teats (sanitized water).
4. Dry teats (using individual service towels).
5. Attach machine within 2 minutes of foremilking.
6. Adjust cluster as necessary during milking.
7. Detach cluster when cow is milked out (break vacuum first).
8. Dip teats.
9. Allow cows to exit and stay free of udder contamination for first hour.

Herd Mastitis Control Program Components

1. A sound hygiene program.
2. Routine monitoring of milker practices and performances.
3. A program providing prompt effective treatment for mastitis cows.
4. Routine sanitary dry cow therapy for every quarter at drying off.
5. Proper milking system design.
6. Routine milking equipment maintenance.
7. Segregation facilities and sound culling practices.
8. Minimization of between milking udder contamination.
9. Routine veterinary interpretation of bulk tank milk and pretreat mastitis milk samples.
Summary

The goal of a dairymen is to maximize profits through efficient production of milk. This includes all procedures which enable dairymen to produce wholesome, low bacteria count milk which in turn reflects well on the image of the industry and the sale of its products.

Fortunately most mastitis is controllable and the ravages of the disease need not be sustained because research has resulted in the development of simple yet effective control procedures. These are:

1. Strict sanitation.
2. Use functionally adequate milking machines in the correct manner.
3. Dip teats after milking with an effective product.
4. Administer promptly a full series of recommended treatments to all clinical cases.
5. Treat each quarter of every cow at drying off with a special formulated commercially available antibiotic preparation.
6. Cull animals with chronic infection that do not respond to treatment.
SETTING GOALS FOR EFFECTIVE MANAGEMENT

by

Dan W. Webb
Extension Dairyman
University of Florida
Gainesville, Florida

It has been said that 90% of the people don't set any goals, but of the 10% who do, 90% reach them! Management objectives (goals) need to be verbalized and committed to writing on a regular basis to insure that sufficient effort will be expended in all areas of management need.

Some characteristics of goals have been identified which should be helpful.

1. Goals should be appropriate. It serves no purpose to set or reach a goal that is not meaningful in terms of the whole dairy operation. Each goal should relate to some phase of the operation where performance is related to general success.

2. Goals should be specific. We need to enumerate our desired level of performance so that it will be evident quickly when a goal is achieved.

3. Goals should be expressed in terms that are measurable.

4. Goals should be understood by all employees and members of the management team.

5. Goals should be consistent with other goals and the general objectives of the business. It is possible to select individual goals which are desirable because they add pleasure to the business, but these should be scrutinized carefully for conflict with profit potential. Another example of conflict might include excessive culling of cows just to reach a specific production average without regard to economics.

6. Goals should be set at an optimistic level. Each goal, when reached, should improve the operation. If goals are set too low, they may not help as much as possible.

7. Goals should be realistic. To be effective, we need to select goals that are attainable in a reasonable length of time. Unreasonable expectation on the part of management or labor can be discouraging.

While the same goals may not be appropriate for all operations, several are presented in the following tables which would be appropriate for many Florida herds.
Table 1. Production Goals

<table>
<thead>
<tr>
<th>Category</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolling herd average</td>
<td>14,000 lbs</td>
</tr>
<tr>
<td>Daily production - milking cows</td>
<td>50</td>
</tr>
<tr>
<td>Daily production - all cows</td>
<td>42.5</td>
</tr>
</tbody>
</table>

Table 2. Reproduction Goals

<table>
<thead>
<tr>
<th>Category</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average days open</td>
<td>100</td>
</tr>
<tr>
<td>Calving interval (months)</td>
<td>12.8</td>
</tr>
<tr>
<td>% Services Successful</td>
<td>50</td>
</tr>
<tr>
<td>% Cows Conceived on 1st Service</td>
<td>45</td>
</tr>
<tr>
<td>Average number of days from calving to 1st service</td>
<td>70</td>
</tr>
<tr>
<td>Numbers cows sold for reproductive failure (% of cows sold):</td>
<td>&lt;25%</td>
</tr>
</tbody>
</table>

Table 3. Replacement Goals

<table>
<thead>
<tr>
<th>Category</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival rate (1st 30 days)</td>
<td>95%</td>
</tr>
<tr>
<td>% Freshening with four normal quarters</td>
<td>95%</td>
</tr>
<tr>
<td>Age at first calving</td>
<td>27 months</td>
</tr>
<tr>
<td>Average M.E. Production</td>
<td>14,000 lbs</td>
</tr>
<tr>
<td>% with known sire identity</td>
<td>95%</td>
</tr>
<tr>
<td>Number first-calf heifers culled</td>
<td>25%</td>
</tr>
</tbody>
</table>

Table 4. General Management Goals

<table>
<thead>
<tr>
<th>Category</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>% cows left herd</td>
<td>25%</td>
</tr>
<tr>
<td>Average number of days dry</td>
<td>60</td>
</tr>
<tr>
<td>% cows over 800-thousand somatic cells</td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>% 1st calf heifers over 800-thousand SCC</td>
<td>0%</td>
</tr>
<tr>
<td>Average bulk tank SCC</td>
<td>&lt;300 thousand</td>
</tr>
<tr>
<td>% cows with known sire identity</td>
<td>75%</td>
</tr>
<tr>
<td>Average Predicted Difference - Milk of Service sires used</td>
<td>+1200</td>
</tr>
</tbody>
</table>

Other areas of goal-setting are certainly feasible. An obvious one includes finances. This set of financial goals forms the annual budget for the operation. It is probably useful for management to select a limited number of goals that can be followed rather than too many that be forgotten.

In summary, we need to -

1. set goals that are:
   1. meaningful,
   2. specific,
   3. measureable,
   4. understood,
   5. consistent,
   6. optimistic, and
   7. realistic.

Remember, everyone needs a map. If you don't know where you are going, you might not get there!
BUDGETING FOR SUCCESSFUL MANAGEMENT*

by

John Holt and Bryan E. Melton
IFAS, University of Florida
Gainesville, Florida 32611

Successful management is made up of much more than just budgeting, but sky-high interest rates and other cost increases are forcing managers to take a hard look at investments before they decide to commit funds. This paper reports a computer-assisted procedure for estimating the financial consequences of different courses of action.

The recent "Cost of Production Survey", to which many of you responded, provided the base for the two dairies budgeted in this paper. As you will see, there are still some holes in the data that make up our example, but when the survey analysis is completed, we will plug those holes. Then we will have a set of information that will make it possible to analyze most of the alternatives that Florida dairymen will want to consider.

Dairymen interested in cutting feed costs are currently asking about silage so to analyze the effect of adding a silage operation, we first developed a budget for a 450 cow dairy which was buying all its feed. Then we examined the effect of buying more land and developing a silage feeding program for the same size dairy. This example emphasizes the budgeting process, not the answer we got. Different individuals, with different data, would get different results. Once the bugs are worked out of this system, we will make this planning process available to Florida dairymen. Then dairymen will be able to use their own

*This paper was developed from information provided by Florida dairymen who responded to the "Cost of Production Survey." Dr. Bill Ocumpaugh provided technical assistance with silage budgets, and David Zimet compiled the survey data. Paper was presented at the Dairy Production Conference, May 6, 1980, Gainesville.
...supplemented with information stored in the computer, to tailor-make a
plan for their own operation.

**450 Cow Dairy Budget**

Table 1 contains a budget for a medium-sized dairy in Central Florida. The dairy has 450 cows, raises one-half of the heifer calves as replacements, and buys all its feed. Feed costs are 62% of variable costs, and one-fourth of the total costs are fixed costs, which include interest on investment in buildings and equipment.

A brief explanation of the major budgeting items follows:

- Milk production is 12,770 pounds per cow per year, sold at an average price of $15.30 per hundredweight.

- Complete feed purchased at an average price of $160 per ton ($8 per hundredweight).

- Replacement heifers entering the milking herd were priced at $1,000 per head. (Raising replacements in drylot appears to cost about $1,000, and purchased heifers recently ranged from $900 to about $1,200 each [Fieser, 1980]). Cows stayed in the herd about three lactations.

- No management time is charged, only hired labor.

- Interest was charged at 10 percent on capital investment, including cows.

- Net returns of $12.49 per cow. This amounts to about $5,620 on a 450 cow dairy, which is probably lower than most dairies of that size are realizing.

In considering the effect of adding a silage operation and feeding silage.

**Growing Silage**

This silage production plan rests on buying:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td></td>
</tr>
<tr>
<td>450 acres @ $750 per acre</td>
<td>$337,500</td>
</tr>
<tr>
<td>Down payment</td>
<td>$97,500</td>
</tr>
<tr>
<td>Debt</td>
<td>$240,000</td>
</tr>
</tbody>
</table>

Annual payment @ 10% for 20 years: $28,190.40
TABLE 1.

DAIRY PRODUCTION COSTS AND RETURNS PER COW  
450 COW DAIRY  
CENTRAL FLORIDA

<table>
<thead>
<tr>
<th>ITEM</th>
<th>WEIGHT EACH</th>
<th>UNIT</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILK</td>
<td>1.00</td>
<td>CWT.</td>
<td>15.30</td>
<td>127.70</td>
<td>1953.81</td>
</tr>
<tr>
<td>DAIRY BULL CALV</td>
<td>1.30</td>
<td>HD.</td>
<td>50.00</td>
<td>0.46</td>
<td>22.80</td>
</tr>
<tr>
<td>DAIRY COWS</td>
<td>12.50</td>
<td>CWT.</td>
<td>25.00</td>
<td>0.24</td>
<td>75.00</td>
</tr>
<tr>
<td>DAIRY AGED BULL</td>
<td>16.00</td>
<td>CWT.</td>
<td>25.00</td>
<td>0.01</td>
<td>4.00</td>
</tr>
<tr>
<td>DAIRY HEIFER CALVES</td>
<td>1.00</td>
<td>HD.</td>
<td>75.00</td>
<td>0.24</td>
<td>18.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2073.81</td>
</tr>
</tbody>
</table>

2. VARIABLE COSTS

| 15-16% PRO., FEED           |            | CWT. | 8.00                | 120.60   | 964.80        |
| VET. & MED.                 |            | HD.  | 2.00                | 12.00    | 24.00         |
| HAULING & MKTG.             |            | HD.  | 5.62                | 12.00    | 67.44         |
| TRUCKING                    |            | HD.  | 0.03                | 12.00    | 0.36          |
| HAY                         |            | LBS. | 0.03                | 50.00    | 18.00         |
| BREEDING FEES               |            | HD.  | 1.15                | 12.00    | 13.80         |
| DAIRY AGED BULL             |            | HD.  | 1500.00             | 0.01     | 15.00         |
| SALES COMM.                 |            | HD.  | 0.25                | 12.00    | 3.00          |
| CHEMICALS                   |            | HD.  | 0.08                | 12.00    | 0.96          |
| MISC. OTHER                 |            | HD.  | 0.30                | 12.00    | 3.60          |
| DAIRY HEIFERS               |            | HD.  | 1000.00             | 0.30     | 300.00        |
| MACHINERY(FUEL, LUBE, REP)  |            | DOL. |                    | 7.24     |               |
| EQUIPMENT(FUEL, LUBE, REP)  |            | DOL. |                    | 6.67     |               |
| LABOR, TRACTOR & MACHINERY  |            | HRS. | 3.25                | 2.88     | 9.36          |
| LABOR, EQUIPMENT            |            | HRS. | 3.00                | 0.14     | 0.42          |
| LABOR, LIVESTOCK            |            | HRS. | 3.00                | 36.50    | 109.50        |
| TOTAL VARIABLE COSTS        |            |      |                     |          | 1545.50       |

3. INCOME ABOVE VARIABLE COSTS

528.55

4. FIXED COSTS

| INT. ON LIVESTOCK CAPITAL   | DOL.       | 0.10 | 945.00 | 94.50 |
| INT. ON OTHER EQUIPMENT     | DOL.       | 0.10 | 74.31  | 7.43  |
| DEPR. ON DAIRY COW          | DOL.       |      |        | 302.00 |
| DEPR. ON DAIRY HEIFER       | DOL.       |      |        | 52.50  |
| DEPR. ON OTHER EQUIP.       | DOL.       |      |        | 52.50  |
| OTHER FC, MACH & EQUIP.     | DOL.       |      |        | 9.25   |
| TOTAL FIXED COSTS           |            |      |        | 516.58 |

5. TOTAL COSTS

2061.11

6. NET RETURNS

12.49

328 TOTAL ACRES  
BAHIA PASTURE  
PREPARED BY: WELTON  
DATE: 5/1/80
Silos:
- 6 upright, 400 T capacity @ $20,000 = $120,000
- Down payment = $20,000
- Debt = $100,000
- Annual payment @ 10% for 7 years = $20,540.50

Machinery:
- 55 hp tractor @ $9,200
- 83 hp tractor @ $13,000
- 100 hp tractor @ $16,750
- Truck = $10,800
- M.B. Plow = $2,550
- Tandem disk = $1,300
- Rolling cultivator = $1,380
- Planter = $2,200
- Sprayer = $300
- Silage cutter = $8,200
- Silage wagon = $7,200
- Grain drill = $2,300
- Total = $74,180
- Down payment = $10,000
- Debt = $64,180
- Annual payment @ 10% for 5 years = $16,930.52

Thus, even going with mostly used equipment, a dairyman would have to come up with downpayments of $127,500. This silage production plan involves producing:

Table 2 -- 300 acres of corn and sorghum silage, double-cropped, 14 tons corn silage per acre, 5 tons sorghum silage.

Table 3 -- 100 acres of small grain silage at 4 tons per acre.

Table 4 -- 50 acres of corn and small grains double-cropped, at 14 and 4 tons per acre, respectively.

This amounts to about 7,000 tons of silage annually, and figuring a 25 percent loss would get to 5,250 tons produced. Feeding about 30 percent of their dry matter requirements as silage, the milking herd would require about 2,300 tons, and raising the replacements would take another 820 tons, so the dairy would use about 3,120 tons of silage.

At this writing, we had no decent estimate of the extra cost of feeding the silage to the cows, as compared to feeding all "dry" feed. You will notice there is something over 2,000 tons of silage left over. We employed what one
TABLE 2.

CORN - SORGHUM SILAGE
FOR DAIRY COW USE
CENTRAL FLORIDA, 1979 PRICES

<table>
<thead>
<tr>
<th>UNIT</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>TONS</td>
<td>0.00</td>
<td>14.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>TONS</td>
<td>0.00</td>
<td>5.00</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

1. GROSS RECEIPTS FROM PRODUCTION
   CORN SILAGE
   SORGHUM SILAGE
   TOTAL

2. VARIABLE COSTS
   PREHARVEST
   NP & PK
   NPK
   NITROGEN
   LIME
   CORN SEED
   FTE 503
   LASSO
   AATREX
   FURADAN
   MESUROL
   PARAQUAT
   SORGHUM SEED
   IRRIgeCHEM APPL.
   MACHINERY
   TRACTORS
   LABOR (TRACTOR & MACHINERY)
   INTEREST ON OP. CAP.
   SUBTOTAL, PRE-HARVEST
   HARVEST COSTS
   SUBTOTAL, HARVEST
   TOTAL VARIABLE COST
   $253.45

3. INCOME ABOVE VARIABLE COSTS

4. FIXED COSTS
   MACHINERY
   TRACTORS
   TOTAL FIXED COSTS
   $46.67

5. TOTAL COSTS
   $300.12

6. NET RETURNS
   FERTILIZER: 4-12-18, 15-6-15, 33-0-0
   SOMEWHAT POORLY DRAINED ACID SANDS
   PREPARED BY: MELTON 4/25/80
   BUDGET IDENTIFICATION NUMBER—— 131864069 101 1
   ANNUAL CAPITAL MOUNT 6
   PROCESSED BY FARM SYSTEMS LAB - FOOD & RESOURCE ECON. DEPT. OF FLORIDA
   PROGRAM DEVELOPED BY DEPT. OF AG. ECON. , OKLAHOMA STATE UNIVERSITY
   DATE PRINTED: 01 MAY 1980

BREAK EVEN PRICES

IF 14.00 TONS CORN SILAGE ARE PRODUCED:

TO COVER VARIABLE INPUFS TO COVER VARIABLE INPUTS AND INTEREST TO COVER VARIABLE INPUTS AND LABOR TO COVER VARIABLE INPUTS INTEREST AND LABOR TO COVER ALL COSTS EXCEPT LAND OVERHEAD RISK AND MANAGEMENT

16,204 18,113 17,372 15,281 21,437
### TABLE 3

**SMALL GRAIN SILAGE FOR DAIRY COW USE**
**CENTRAL FLORIDA, 1979 PRICES**

<table>
<thead>
<tr>
<th>UNIT</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. GROSS RECEIPTS FROM PRODUCTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SM. GRAIN SILAGE</td>
<td>TONS</td>
<td>0.0</td>
<td>4.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. VARIABLE COSTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PREHARVEST</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSPKE</td>
<td>LBS.</td>
<td>0.05</td>
<td>450.00</td>
</tr>
<tr>
<td>LIME</td>
<td>TONS</td>
<td>20.60</td>
<td>1.00</td>
</tr>
<tr>
<td>FTS 503</td>
<td>LBS.</td>
<td>0.17</td>
<td>30.00</td>
</tr>
<tr>
<td>GRAIN SEED</td>
<td>LBS.</td>
<td>0.10</td>
<td>120.00</td>
</tr>
<tr>
<td>IRRI&amp;CEM APPL.</td>
<td>ACRE</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>MACHINERY</td>
<td>ACRE</td>
<td>2.23</td>
<td>1.00</td>
</tr>
<tr>
<td>TRACTORS</td>
<td>ACRE</td>
<td>8.77</td>
<td>1.00</td>
</tr>
<tr>
<td>LABOR (TRACTOR &amp; MACHINERY)</td>
<td>HOUR</td>
<td>3.25</td>
<td>2.20</td>
</tr>
<tr>
<td>INTEREST ON OP. CAP.</td>
<td>DOL.</td>
<td>0.10</td>
<td>32.23</td>
</tr>
<tr>
<td><strong>SUBTOTAL, PRE-HARVEST</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HARVEST COSTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SUBTOTAL, HARVEST</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL VARIABLE COST</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>3. INCOME ABOVE VARIABLE COSTS</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>4. FIXED COSTS</strong></td>
<td></td>
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<tr>
<td>MACHINERY</td>
<td>ACRE</td>
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<td>1.00</td>
</tr>
<tr>
<td>TRACTORS</td>
<td>ACRE</td>
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<td>1.00</td>
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<tr>
<td><strong>TOTAL FIXED COSTS</strong></td>
<td></td>
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<tr>
<td><strong>5. TOTAL COSTS</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>6. NET RETURNS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SOMETHING POORLY DRAINED & ACID SANDS**
**FERTILIZER: 15-6-15**
**PREPARED BY: MELTON**
**DATE: 4/25/80**

**BUDGET IDENTIFICATION NUMBER--- 131864060 101 1**
**ANNUAL CAPITAL MONTH 6**

**PROCESSED BY FARM SYSTEMS LAB - FOOD & RESOURCE ECON. DEPT. OF FLORIDA**
**PROGRAM DEVELOPED BY DEPT. OF AG. ECON. • OKLAHOMA STATE UNIVERSITY**
**DATE PRINTED: 01 MAY 1983**

**BREAK EVEN PRICES**

**IF** 4.00 TONS SM. GRAIN SILAGE ARE PRODUCED:

- TO COVER VARIABLE INPUTS 18,298
- TO COVER VARIABLE INPUTS AND INTEREST 21,532
- TO COVER VARIABLE INPUTS AND LABOR 20,085
- TO COVER ALL COSTS EXCEPT LAND OVERHEAD RISK AND MANAGEMENT 26,874
TABLE 4.

CORN SILAGE - GRAIN SILAGE
FOR DAIRY COW USE
CENTRAL FLORIDA, 1979 PRICES

<table>
<thead>
<tr>
<th>UNIT</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
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<tr>
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<td>8.00</td>
<td>0.00</td>
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<tr>
<td>TONS</td>
<td>4.00</td>
<td>0.00</td>
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2. VARIABLE COSTS
PREHARVEST
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<td>45.00</td>
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<td>850.00</td>
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<tr>
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<td>12.00</td>
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<tr>
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<td>6.00</td>
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<tr>
<td>ACRE</td>
<td>20.44</td>
<td>1.00</td>
<td>20.44</td>
</tr>
<tr>
<td>HOUR</td>
<td>3.25</td>
<td>4.77</td>
<td>15.50</td>
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<tr>
<td>DOL.</td>
<td>0.10</td>
<td>86.38</td>
<td>8.68</td>
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HARVEST COSTS
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<thead>
<tr>
<th>ITEM</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
</table>

SUBTOTAL, PRE-HARVEST

TOTAL VARIABLE COST
<table>
<thead>
<tr>
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<th>QUANTITY</th>
<th>VALUE OR COST</th>
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</thead>
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3. INCOME ABOVE VARIABLE COSTS

4. FIXED COSTS
MACHINERY
<table>
<thead>
<tr>
<th>ITEM</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
</table>

TRACTORS
<table>
<thead>
<tr>
<th>ITEM</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
</table>

TOTAL FIXED COSTS

5. TOTAL COSTS

6. NET RETURNS

SOMewhat POORLY DRAINED ACID SANDS
FERTILIZER: 4-12-13, 15-6-15, 33-0-0
PREPARED BY: MELTON
DATE: 4/25/80

BUDGET IDENTIFICATION NUMBER—- 131864060 101 1
ANNUAL CAPITAL MONTH

PROCESSED BY FARM SYSTEMS LAB - FOOD & RESOURCE ECON. DEPT., U. OF FLORIDA
PROGRAM DEVELOPED BY DEPT. OF AG. ECON., OKLAHOMA STATE UNIVERSITY
DATE PRINTED: 01 MAY 1980

BREAKEVEN PRICES

IF 14.00 TONS CORN SILAGE ARE PRODUCED:

TO COVER VARIABLE INPUTS
TO COVER VARIABLE INPUTS AND INTEREST
TO COVER VARIABLE INPUTS AND LABOR
TO COVER ALL COSTS EXCEPT LAND OVERHEAD RISK AND MANAGEMENT

14.246
16.011
15.353
17.118
19.200
world-class economist called a "heroic assumption", and assumed this extra silage could be sold to a neighboring dairyman for enough money to cover the extra cost of feeding the silage. In Tables 2, 3, and 4, the per acre costs are for silage in the wagon, ready to go into the silo.

Given time, we could estimate the missing costs, and/or recalculate the silage systems, different amounts of land, and different crops. The computerized budgeting procedure makes it possible to do this rather easily, once we get all the necessary data.

While we don't yet have all the data assembled that we need, a lot of very useful information is already stored in the computer. Table 5 shows the operations involved in double-cropping corn and sorghum silage. This information becomes an input in the cash flow, and it is vital for more rigorous farm planning approaches such as linear programming.

Because fuel is becoming so scarce and high priced, dairymen might want to know what the fuel use requirements are for producing corn and sorghum silage. That information is in Table 6. I was surprised that it took more than 17 gallons of fuel to double-crop corn and sorghum silage.

The Comparison

Keeping the cow herd the same size and feeding silage reduces purchased feed costs from $964.80 per cow to $678.40 (Table 7). Also, we reduced the per cow production to 11,570 pounds per cow. The net effect of these changes is to increase the profitability to $166.64 per cow or $74,988 for the 450 cow herd.

But we have not yet accounted for the costs of producing the silage, or making the extra land payments. The silage production costs were:
<table>
<thead>
<tr>
<th>Temperature</th>
<th>13°C</th>
<th>16°C</th>
<th>18°C</th>
<th>20°C</th>
<th>22°C</th>
<th>24°C</th>
<th>26°C</th>
<th>28°C</th>
<th>30°C</th>
<th>32°C</th>
<th>34°C</th>
<th>36°C</th>
<th>38°C</th>
<th>40°C</th>
<th>42°C</th>
<th>44°C</th>
<th>46°C</th>
<th>48°C</th>
<th>50°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>15°C</td>
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<td>30°C</td>
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<td>35°C</td>
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<td>49°C</td>
<td>49°C</td>
<td>49°C</td>
<td>49°C</td>
<td>49°C</td>
</tr>
</tbody>
</table>

**TABLE**
**TABLE 6.**

FUEL USE SUMMARY FOR BUDGET NUMBER 133884360 1011

**CORN - SORGHUM SILAGE**

FOR DAIRY COW USE

CENTRAL FLORIDA, 1979 PRICES

**FUEL USED IN GALLONS PER HOUR**

<table>
<thead>
<tr>
<th>POWER UNIT</th>
<th>TRACTOR(1)</th>
<th>TRACTOR(2)</th>
<th>TRACTOR(3)</th>
<th>TRACTOR(4)</th>
<th>TRUCK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.640</td>
<td>3.984</td>
<td>4.800</td>
<td>4.050</td>
<td></td>
</tr>
</tbody>
</table>

**FUEL ALLOCATED TO OPERATIONS IN GALLONS PER ACRE COVERED**

<table>
<thead>
<tr>
<th>MACHINE</th>
<th>Gallons</th>
<th>POWER UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.B. PLOW 5</td>
<td>1.633</td>
<td>TRACTOR(2)</td>
</tr>
<tr>
<td>TANDEM DISK</td>
<td>0.781</td>
<td>TRACTOR(2)</td>
</tr>
<tr>
<td>PLANTER</td>
<td>0.567</td>
<td>TRACTOR(3)</td>
</tr>
<tr>
<td>SPRAYER</td>
<td>0.876</td>
<td>TRACTOR(1)</td>
</tr>
<tr>
<td>ROLL CULTIVATOR</td>
<td>0.594</td>
<td>TRACTOR(2)</td>
</tr>
<tr>
<td>SILAGE CUTTER</td>
<td>3.025</td>
<td>TRACTOR(1)</td>
</tr>
<tr>
<td>SILAGE WAGON</td>
<td>3.753</td>
<td>TRACTOR(2)</td>
</tr>
</tbody>
</table>

**FUEL ALLOCATED TO OPERATIONS FOR THE BUDGET UNIT**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>TOTAL</th>
<th>FUEL TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.B. PLOW 5</td>
<td>0.917</td>
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<tr>
<td>SILAGE CUTTER</td>
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<td>0.0</td>
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<tr>
<td>SILAGE WAGON</td>
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<td>0.0</td>
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</tr>
<tr>
<td>TRUCK</td>
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<td>0.0</td>
<td>1.000</td>
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<td>3.0</td>
<td>3.0</td>
<td>1.000</td>
<td>0.0</td>
<td>0.0</td>
<td>2.000</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>0.917</td>
<td>3.034</td>
<td>0.584</td>
<td>0.0</td>
<td>0.0</td>
<td>5.009</td>
<td>3.025</td>
<td>0.0</td>
<td>0.0</td>
<td>4.590</td>
<td>0.0</td>
<td>0.0</td>
<td>17.270</td>
<td></td>
</tr>
</tbody>
</table>

**GALLONS FUEL BY TYPE**

<table>
<thead>
<tr>
<th></th>
<th>2.00 GAS</th>
<th>0.0 LP</th>
<th>15.27 DIESEL</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FUEL TYPES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1=GAS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2=L.P.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3=DIESEL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 7.

DAIRY PRODUCTION COSTS AND RETURNS PER COW
450 COW DAIRY
CENTRAL FLORIDA

<table>
<thead>
<tr>
<th>ITEM</th>
<th>WEIGHT EACH</th>
<th>UNIT</th>
<th>PRICE OR COST/UNIT</th>
<th>QUANTITY</th>
<th>VALUE OR COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GROSS RECEIPTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MILK</td>
<td>1.00</td>
<td>CWT.</td>
<td>15.30</td>
<td>1.15</td>
<td>1770.21</td>
</tr>
<tr>
<td>DAIRY BULL CALV</td>
<td>1.00</td>
<td>HD.</td>
<td>50.00</td>
<td>0.46</td>
<td>22.60</td>
</tr>
<tr>
<td>DAIRY COWS</td>
<td>12.50</td>
<td>CWT.</td>
<td>25.00</td>
<td>0.24</td>
<td>75.00</td>
</tr>
<tr>
<td>DAIRY AGED BULL</td>
<td>16.00</td>
<td>CWT.</td>
<td>25.00</td>
<td>0.01</td>
<td>4.00</td>
</tr>
<tr>
<td>DAIRY HFR CALVES</td>
<td>1.00</td>
<td>HD.</td>
<td>75.00</td>
<td>0.24</td>
<td>18.00</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1890.01</strong></td>
</tr>
<tr>
<td>2. VARIABLE COSTS</td>
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<tr>
<td>15-16% PRO. FEED</td>
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<tr>
<td>VEI &amp; MED.</td>
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<tr>
<td>HAULING &amp; MKTG.</td>
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<td></td>
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<tr>
<td>TRUCKING</td>
<td></td>
<td></td>
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<tr>
<td>BREEDING FEES</td>
<td></td>
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<tr>
<td>DAIRY AGED BULL</td>
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<tr>
<td>SALES COMM.</td>
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<td>CHEMICALS</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>NISC OTHER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAIRY HEIFERS</td>
<td></td>
<td></td>
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<tr>
<td>MACHINERY(FUEL,LUBE,REP)</td>
<td></td>
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<td></td>
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<tr>
<td>EQUIPMENT(FUEL,LUBE,REP)</td>
<td></td>
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</tr>
<tr>
<td>LABOR, TRACTOR &amp; MACHINERY</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>LABOR, EQUIPMENT</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>LABOR, LIVESTOCK</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL VARIABLE COSTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1181.07</strong></td>
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<tr>
<td>3. INCOME ABOVE VARIABLE COSTS</td>
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<td></td>
<td></td>
<td><strong>708.33</strong></td>
</tr>
<tr>
<td>4. FIXED COSTS</td>
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<tr>
<td>INT. ON LIVESTOCK CAPITAL</td>
<td></td>
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<td></td>
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<tr>
<td>INT. ON OTHER EQUIPMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DEPR. ON DAIRY COW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPR. ON DAIRY HEIFER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPR. ON OTHER EQUIP.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTHER PLC, MACH &amp; EQUIP.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL FIXED COSTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>541.70</strong></td>
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<tr>
<td>5. TOTAL COSTS</td>
<td></td>
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<td></td>
<td><strong>1723.37</strong></td>
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<tr>
<td>6. NET RETURNS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>166.64</strong></td>
</tr>
</tbody>
</table>

328 TOTAL ACRES
BAMIA PASTURE
PREPARED BY: MELTON
DATE: 5/1/80
Table 2.--Corn-sorghum @ $300 per acre, 300 acres = $ 90,000
Table 3.--Small grain silage @ $107 per acre, 100 acres = 10,750
Table 4.--Corn-small grain silage @ $267 per acre, 50 acres = 13,350
$114,100

So the feed cost savings will not cover the extra cost of the silage program, even without the land payment.

Conclusion

Given the holes in our data, and the silage feeding program budgeted here, a silage feeding program won't work. But it quite possibly might with cheaper silos or different silage production techniques, or if more silage was substituted into the ration.

The usefulness of the computer-assisted budgeting approach underlying this example is that it can do the mountainous amount of arithmetic necessary to evaluate alternatives. When we get a little practice with this new system, Florida dairymen can describe what they are considering doing, and get a detailed budgeting analysis of the financial consequences. An investment can be tried out on paper before any money is invested, and we will be one step closer to "Budgeting For Successful Management".
A NUTRITIONAL PROGRAM FOR HIGH HERDS

by

Barney Harris, Jr., PhD
Extension Dairy Nutritionist
University of Florida
Gainesville, Florida

Introduction

In recent years, dry cow and early lactation feeding have received added attention due to their importance on peak production and maximum milk yields.

Proper feeding is essential to successful dairying since feed costs account for about half the total costs of milk production and can be much greater. Therefore, for a profitable dairy enterprise, it is essential to have cows with a high genetic potential for milk production. At the same time, the cows must be fed in a way that the greatest output can be attained at the most economical cost. A shortage of energy, protein, fiber, minerals, vitamins, and water leads to stress and decreased milk production.

Superb management is extremely important if dairies are to attain rolling herd averages varying from 14,000 to 20,000 lbs of milk or even a six or more gallon average with the lactating cows. The feeding program may be quite simple so long as the overall ration contains excellent balance. Careful attention must be given to details such as how to feed, when to feed, availability of water, shade, stress related problems, traffic patterns and disease preventive programs. A program must be developed that is easy to handle and one that can be monitored on a day to day basis.

Late Dry Period

Research and accumulated results have demonstrated that a dry period of 45-60 days is needed to attain the greatest milk yield. This allows the mammary gland time to involute and prepare for the subsequent lactation. Maximum dry matter intake and milk production can be obtained if cows are fed during the dry period so that they are in good body condition without becoming fat.

Non-lactating or dry cows should be properly managed during the dry period to assure top production in the subsequent lactations. The greater her production the more likely that her body has been depleted of the nutrients used in milk secretion and the longer the dry period required to replenish the losses and to store adequate reserves for the next lactation. Cows having had any mastitis during the lactating period should be treated and carefully examined at frequent intervals during the dry period.
The condition of the cow must be taken into consideration as the lactating cow enters the non-lactating group. It has been demonstrated in recent years that lactating cows utilize energy (61.6%) more efficiently for body gain than do dry cows (48.3%). This being true means that it would be more profitable to allow the lactating cow to gain back most or all body weight losses during the latter stages of lactation rather than wait until the dry period.

During the dry period the dairy cow should be maintained in good condition. Thinner cows will need to gain some in extra flesh. Every attempt, however, should be made to maintain the dry cow in good flesh rather than fatten her. Dairy cows allowed to fatten in excess during the dry period have more problems than dairy cows freshening in good condition. Metabolic conditions and problems associated with nutritional inadequacies during the dry period are milk fever, udder edema, ketosis, and displaced abomasum. All may be controlled by proper feeding management.

The nutrient needs of dry cows are shown in Table 1.

<table>
<thead>
<tr>
<th>Body Wt.</th>
<th>Crude Protein (lb)</th>
<th>TDN (lb)</th>
<th>Ca (lb)</th>
<th>Phos (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>1.45</td>
<td>8.40</td>
<td>.053</td>
<td>.038</td>
</tr>
<tr>
<td>1000</td>
<td>1.69</td>
<td>9.93</td>
<td>.064</td>
<td>.045</td>
</tr>
<tr>
<td>1200</td>
<td>1.92</td>
<td>11.38</td>
<td>.075</td>
<td>.053</td>
</tr>
<tr>
<td>1400</td>
<td>2.13</td>
<td>12.78</td>
<td>.085</td>
<td>.060</td>
</tr>
<tr>
<td>1600</td>
<td>2.34</td>
<td>14.12</td>
<td>.095</td>
<td>.067</td>
</tr>
</tbody>
</table>

Most discussions of dry cow management tend to ignore fiber (roughage) since most operations have adequate silage and/or hay. In Florida, the need may become great since silage is rare in most operations and hay may be limiting or expensive. Even so, every attempt should be made to provide some long hay to heavy springing dry cows. Avoid feeding a lot of legume hay since legumes are high in calcium and an imbalance of calcium and phosphorus may occur leading to more milk fever. Also, limit silage to 30-40 lbs per day with an increase in long fiber. Large amounts of silage, especially corn silage, tends to overcondition cows because of the high energy content. Heavy springing dry cows should receive rations that are very similar to the lactating cow in order to reduce stress brought about by changes in the feeding program at calving.

**Early Lactation**

The demands for nutrients by the mammary gland in early lactation are extremely great for high producing cows. Generally peak production occurs within 4-8 weeks after calving with nutrient needs increasing several fold. Peak feed intake however does not usually occur until a few weeks after peak production. During the time that feed intake lags behind milk production, nutrient intake may not be adequate to meet the needs of the mammary
gland for milk production even though the cow is being fed according to recommended guidelines or in many cases free choice. The cow is simply unable to consume enough feed or dry matter to supply the energy needed for maximum milk production even though the protein may be adequate. When the requirements become greater than the intake, some loss in body weight occurs.

![Graph showing milk production, feed intake, and body weight over time](image)

**FIGURE 1. CHANGES IN MILK PRODUCTION, FEED INTAKE AND BODY WEIGHT DURING A LACTATION.**

It is normal for high producing cows to lose from 100-150 lbs body weight in early lactation. The greater the cow's appetite the less body weight she will lose. If the cow has to rely too heavily upon body stores of energy and protein, either milk production will be held to the level of nutrient availability or she may develop a metabolic disorder such as ketosis. It has been demonstrated that for each pound lost from body reserves, eight pounds of milk may result.

Most weight lost in early lactation is in the form of fat with a small proportion in the form of stored protein. Fortunately, the ability of the cow to store and mobilize large quantities of energy for milk synthesis is highly developed in the high producing cow. The storage of protein, however, is less developed but some may be mobilized from tissue protein. Even so, the first limiting nutrient of high producing cows is energy, for the intake of all other nutrients can be increased in proportion to the available energy. Table 3 shows the need for nutrients of dairy cows for several different levels of milk production at two different sizes.

<table>
<thead>
<tr>
<th>Milk</th>
<th>Body Wt.</th>
<th>CP (lb)</th>
<th>TDN (lb)</th>
<th>NE (Mcal)</th>
<th>Ca (lb)</th>
<th>Phos (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(lb)</td>
<td>(lb)</td>
<td>(lb)</td>
<td>(lb)</td>
<td>(lb)</td>
<td>(lb)</td>
<td>(lb)</td>
</tr>
<tr>
<td>30</td>
<td>1000</td>
<td>3.38</td>
<td>16.90</td>
<td>17.46</td>
<td>.116</td>
<td>.084</td>
</tr>
<tr>
<td></td>
<td>1400</td>
<td>3.61</td>
<td>19.09</td>
<td>19.72</td>
<td>.126</td>
<td>.093</td>
</tr>
<tr>
<td>50</td>
<td>1000</td>
<td>5.04</td>
<td>23.08</td>
<td>23.86</td>
<td>.168</td>
<td>.120</td>
</tr>
<tr>
<td></td>
<td>1400</td>
<td>5.27</td>
<td>25.27</td>
<td>26.12</td>
<td>.178</td>
<td>.129</td>
</tr>
<tr>
<td>70</td>
<td>1000</td>
<td>6.70</td>
<td>29.26</td>
<td>30.26</td>
<td>.220</td>
<td>.157</td>
</tr>
<tr>
<td></td>
<td>1400</td>
<td>6.93</td>
<td>31.45</td>
<td>32.52</td>
<td>.230</td>
<td>.165</td>
</tr>
<tr>
<td>80</td>
<td>1000</td>
<td>7.53</td>
<td>32.35</td>
<td>33.46</td>
<td>.246</td>
<td>.174</td>
</tr>
<tr>
<td></td>
<td>1400</td>
<td>7.76</td>
<td>34.54</td>
<td>35.72</td>
<td>.256</td>
<td>.183</td>
</tr>
</tbody>
</table>
Peak milk yield has been shown to be as important as average persistence in determining total milk yield for the lactation. It has been demonstrated that for each pound increase in peak milk production there is a 200 pound increase in total milk yield for the lactation.

Peak milk yield and maximum milk yield depend upon the formulation of a balanced ration and the manner in which it is presented to the cows. It must be high in energy, adequate in protein and fiber and with good balance in minerals and vitamins, especially vitamin A. The droppings from the cows should be observed daily for the right texture and stool. Acidosis and a depressed fat test may be controlled with careful observations of the droppings. Generally, complete feeds with cottonseed hulls (without other roughage) should contain about 18-19% effective fiber. Consistency in ration texture and palatability is important in keeping cows on full feed during the critical period of early lactation.

Dry matter intake for high producing cows varies and in some cows with an exceptional good appetite may peak as high as 7-8 lbs dry matter per 100 lb body weight. In general though, high producing cows will consume from 4.0-5.0 lbs of dry matter per 100 lbs body weight when receiving complete feeds containing cottonseed hulls or similar type roughages. Less dry matter intake will be obtained by cows receiving silage base rations. A number of studies have shown that high producing cows will consume an average of 3-4 lbs of dry matter when on corn silage base rations and 3.8-4.2 lbs dry matter per 100 lbs body weight when on CSH complete feeds during the first 100 days of lactation.

Ration Energy Density

The proportion of concentrates used in Florida dairy ration usually varies from 60-70%. Some dairymen use a lesser amount of roughage in the complete feed but will add some hay or silage on the outside. Care must be taken in defining the roughage portion of a ration since some researches report corn silage as all roughage when in reality it contains 50% corn dry matter and 50% stalk and leaves.

Dairy cows consume feed to meet their energy requirements. Our studies have shown that cows tend to consume the same amount of energy each day regardless of the energy density of the ration. During the hot summer, using rations that varied from 63 to 70% TDN did not influence energy intake or milk production. Some of the rations contained roughages with high effective fiber values and others contained added fat. In all cases, the added fat did not affect dry matter intake. Similar results have been obtained by Palmquist at Ohio State.

Using The Protein Solubility Concept

In recent years attention has been focused on the use of protein solubility values in formulating rations for high producing cows. Estimates of protein degradation in the rumen of high producing cows are at best only crude estimates because most ruminal protein degradation determinations have been made in sheep. Extrapolation of such estimates
from sheep to high producing cows may be erroneous since differences do exist in retention time in the rumen, feed consumption, and length of chewing time. Even so, several studies have shown an advantage in milk production when low protein solubility rations were compared to high solubility rations.

Apparently, cows producing less than 40 lbs of milk may not greatly benefit from low solubility protein rations. The reason appears to be due to the fact that microbial protein provides sufficient quantities of amino acids in the lower gut.

Utilizing protein solubility values on a routine basis for formulating dairy rations requires some knowledge and understanding of the degradation values for feed ingredients. These values will no doubt vary since ingredients are processed under varying temperatures and conditions each day. The values given in Table 4 could be used as a guide where this sort of information is desirable.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Crude Protein (%)</th>
<th>Protein Solubility (%)</th>
<th>Calculated Degradation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>281.0</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Corn Silage (30% DM)</td>
<td>2.5</td>
<td>54</td>
<td>77</td>
</tr>
<tr>
<td>Peanut meal</td>
<td>50.0</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>Wheat midds</td>
<td>16.0</td>
<td>39</td>
<td>70</td>
</tr>
<tr>
<td>Citrus pulp</td>
<td>6.2</td>
<td>26</td>
<td>63</td>
</tr>
<tr>
<td>Hay, grass</td>
<td>8.0</td>
<td>18</td>
<td>62</td>
</tr>
<tr>
<td>Hominy feed</td>
<td>10.5</td>
<td>23</td>
<td>62</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>44.0</td>
<td>13</td>
<td>56</td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>41.0</td>
<td>7</td>
<td>53</td>
</tr>
<tr>
<td>Cottonseed hulls</td>
<td>4.0</td>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>Corn</td>
<td>8.6</td>
<td>12</td>
<td>56</td>
</tr>
<tr>
<td>Soy millfeed</td>
<td>11.0</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>Brewers grains</td>
<td>26.0</td>
<td>3</td>
<td>51</td>
</tr>
</tbody>
</table>

Attempts should be made to formulate rations for high producing cows varying from 15-25% soluble protein so long as the economics can be justified. Avoid using several ingredients with high solubility values in combination such as urea, peanut meal, wheat midds, and corn silage. Such combinations would benefit from having limited amounts of brewers or cottonseed meal included in the ration.

**Adding Buffers and Enzymes**

Reported successes with feed additives in recent years have prompted a number of researchers to further investigate their usefulness under different herd management conditions. Also, as production level increases, dairymen tend to feed higher concentrate rations and less roughage. Several additives have been shown to be helpful under stress conditions such as rapid changes in ration composition, hot weather and high humidity, disease, and stress of freshening. Buffers as feed additives are reported to be useful in counteracting acidity in the rumen produced when animals are on high grain diets or under stress conditions.
Sodium bicarbonate and magnesium oxide are the two buffers more frequently used to aid in maintaining normal milk composition and are sometimes used in combination. Sodium bicarbonate helps in the maintenance of rumen pH as well as preventing acidosis and magnesium oxide increases the uptake of plasma acetate in the mammary.

In recent months, sodium bicarbonate has been used successfully in increasing milk production in early lactation. Studies at Kentucky and Penn State both showed responses in milk production in early lactation. Results of the Penn State studies are shown in Table 5.

### Table 5. Average Feed Intake and Milk Yield and First 8 Week Postpartum

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Control-Buffer</th>
<th>Buffer-Buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Cows</td>
<td>15.00</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>Dry Matter Intake, lb</td>
<td>40.04</td>
<td>44.88</td>
<td>42.02</td>
</tr>
<tr>
<td>% of B.W.</td>
<td>2.93</td>
<td>3.25</td>
<td>3.05</td>
</tr>
<tr>
<td>Milk Yield, lb</td>
<td>63.80</td>
<td>70.18</td>
<td>70.62</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.91</td>
<td>3.96</td>
<td>3.92</td>
</tr>
</tbody>
</table>

Muller et al. Penn State University, NC 119

The authors state that cows receiving rations with buffers appeared to adapt to the rations more rapidly postpartum than controls.

A survey of several top dairies and nutritionist by Marshall McCullough of Georgia in the fall of 1980 indicated that several dairies throughout the country are using enzyme preparations derived from Aspergillus oryzae as additives to dairy cattle rations. In a feedlot trial by McCullough, treated animals had daily gains of 2.77 lb/day compared to 2.31 lb/day for the control group.

Two experiments were conducted at the University of Florida Dairy Research Unit to compare the value Aspergillus Oryzae (GX) for sugarcane forage and as a complement in dairy rations. The results are shown in Tables 6 and 7.

### Table 6. The Value of an Aspergillus Oryzae Product (GX) With Sugarcane Silage and Compared to Other Roughage Sources

<table>
<thead>
<tr>
<th>Roughage Sources</th>
<th>Feed Intake (Dry Matter)</th>
<th>Milk Yield</th>
<th>3.5% FCM</th>
<th>Fat Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarcane Silage (C)</td>
<td>46.7</td>
<td>54.5</td>
<td>54.9</td>
<td>3.59</td>
</tr>
<tr>
<td>Sugarcane Silage (T)</td>
<td>47.1</td>
<td>55.3</td>
<td>57.0</td>
<td>3.71</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>46.1</td>
<td>55.9</td>
<td>56.0</td>
<td>3.53</td>
</tr>
<tr>
<td>PCSH</td>
<td>56.7</td>
<td>59.5</td>
<td>56.4</td>
<td>3.21</td>
</tr>
</tbody>
</table>

The results in Table 6 show an advantage with the use of GX treated sugarcane forage over the control sugarcane silage of 2.1 lbs more 3.5% FCM per day during the 56 days study. Also, feed intake and fat percent were slightly greater for the cows receiving the GX treated sugarcane silage. Surprisingly, the cows receiving the GX treated sugarcane silage out performed cows receiving corn silage rations and complete feed containing PCSH; whereas cows receiving control sugarcane silage had the poorest production performance.
In a second experiment, 32 Holstein cows were used. The design of the experiment allowed for two levels of Vita Ferm (none and two ounces) to be superimposed as a continuous treatment over all other treatments. Vita Charge was fed for the first two weeks and Vita Ferm to the same cows thereafter. Vita Ferm cows were hand-fed one ounce in AM and one ounce mixed in the PM ration. Three consecutive 28-day periods were conducted. The results are shown in Table 7.

Table 7. The Value of an Aspergillus Oryzae Product (Vita Ferm) as a Complement in Complete Feeds for Dairy Cattle

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Feed Intake (DM)</th>
<th>Milk Yield (lb)</th>
<th>3.5% FCM</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>50.9</td>
<td>54.1</td>
<td>53.8</td>
<td>3.50</td>
</tr>
<tr>
<td>Added Vita Ferm</td>
<td>52.7</td>
<td>58.0</td>
<td>56.1</td>
<td>3.30</td>
</tr>
</tbody>
</table>

The results in Table 7 show an increase of 2.3 lbs more milk with the feeding of Vita Ferm which was significant (P < .05). Feed intake was greater on the Vita Ferm fed cows and fat percent lower.

Management Intensity

Superb management is essential if cows are to peak high and maintain consistency in lactation. A dry cow feeding program must be developed that will allow cows to freshen in good condition with keen appetites. Consistency in the feeding program must be maintained. A high energy program with adequate roughage and protein is important for high producing cows.

Group feeding must be considered where the facilities will allow for top management. The highest producing cows should be fresh from 1-3 months and will have the most aggressive appetites. The cows should have an empty trough for 1-2 hours each day. This increases the appetites of the cows, makes them more aggressive, and keeps the trough from accumulating stale feed. Provide fresh water as near the feed bunk as practical.

Ideally, the dairy should have a fresh cow group (3-4 wks), high group, medium group, and low group. Cows may be grouped according to stage of lactation or according to production. Avoid moving cows as much as possible during the lactation.

Monitor the cows daily for heat, feed consumption, stress, disease, droppings, alertness, and others as observed.
A Feeding Program for High Producing Cows

<table>
<thead>
<tr>
<th>Milk (lb)</th>
<th>Complete Feed (CSH)*</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>50</td>
<td>12.5-14% CP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>62-64% TDN</td>
</tr>
<tr>
<td>80</td>
<td>55</td>
<td>SAME</td>
</tr>
</tbody>
</table>

*3-5 lb hay/cow or equivalent

<table>
<thead>
<tr>
<th>Milk (lb)</th>
<th>Feeding Program</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>40# Corn Silage</td>
<td>2.5% 20%</td>
</tr>
<tr>
<td></td>
<td>3-5# Hay</td>
<td>6.0% 40%</td>
</tr>
<tr>
<td></td>
<td>31# Grain</td>
<td>18-20% 72%</td>
</tr>
<tr>
<td>80</td>
<td>40# Corn Silage</td>
<td>SAME</td>
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<tr>
<td></td>
<td>3-5# Hay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>36# Grain</td>
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</table>

<table>
<thead>
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<th>Milk (lb)</th>
<th>Feeding Program (lb)</th>
<th>Composition (CP) (TDN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>70 Pasture 8 Hay 30 Grain</td>
<td>2.1% 11.0 6.0% 40.0 16.17% 68.0</td>
</tr>
<tr>
<td>80</td>
<td>70 Pasture 8 Hay 35 Grain</td>
<td>SAME</td>
</tr>
</tbody>
</table>
THE USE OF BUFFERS IN RATIONS FOR DAIRY CATTLE

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Animal and Dairy Science
University of Georgia, Athens, Ga.

The dairy cow evolved as a forage eating animal; therefore it is not surprising that her digestive system developed to digest fiber. The rumen is the cow's forage processing factory. The feed is the raw material, the microbes are the workers and the microbial protein and volatile fatty acids are the products produced by the factory for use by the cow. The rumen factory normally accounts for 60 to 90% of the digestion that occurs in the cow. The volatile fatty acids are the major source of energy for the dairy cow and are also important raw materials for use in manufacturing milk and fat in the mammary gland. Thus, optimum operation of the rumen factory and its workers, the microbes, is important for the best performance of the cow. However, the relationship is not one-sided because the microbes benefit from the cow's management of the factory. The cow provides the feed and water, maintains the temperature, and controls the acidity by secreting salivary buffers and absorbing acid end-products. Because we have demanded ever greater milk production from the cow, we have changed her diet to provide the high energy materials needed to produce more milk. As we add grain to the diet, the environment in the rumen factory is altered and some of these changes are harmful to the microbial workers and the cow.

Although many factors change when grain is added to dairy cow diets, we are beginning to realize that the change in rumen pH, or acidity, may be the factor responsible for most of the harmful effects. Since buffers play a central role in the control of pH in the rumen, this discussion will focus on the use of buffers to aid rumen pH regulation. Although some buffers, such as limestone and magnesium oxide, can affect the pH of the contents of the small intestine, these effects are small compared to changes that can occur when rumen pH is buffered. Several compounds have been used to buffer the rumen, including sodium bicarbonate, magnesium oxide and bentonite. There is some research to suggest that magnesium oxide may cause its effects by means other than buffering. Bentonite also appears to affect more than the pH of the rumen. Thus, the primary compound considered to be a ruminal buffer in this discussion is sodium bicarbonate. To help predict when supplemental buffer feeding is feasible and recommended, it is pertinent to discuss changes that occur in lactating cows when grain is added to the ration.
As the amount of roughage in the diet decreases, both fiber content and ruminal pH decrease (table 1). Typical fiber contents of rations are given in table 1 to emphasize that it is the fiber and not the roughage per se that results in ruminal changes. In general, less roughage of a higher fiber content will result in the same rumen conditions as a larger amount of a roughage with less fiber content. Crude fiber values are given because they are most commonly available; however, recent research suggests that neutral detergent fiber is a more accurate measure of the total fibrousness of a feed and is more closely related to ruminal changes. As the fiber content of the ration decreases, the average pH in the rumen decreases. This is due primarily to two factors: (1) decreased chewing time and salivation by the cow and (2) increased volatile fatty acid production by the microbes.

Although reduced chewing time with decreased ration fiber content would imply that less energy is wasted by the cow in moving her jaw, the loss of saliva during chewing is much more detrimental than the benefits of saving energy. Ruminants, such as the cow, are unique in that they secrete saliva continuously to supply buffers to the rumen and keep pH near 6.5 to 6.8. However, the cow secretes saliva 2.5 to 3.5 times faster when eating or ruminating than when resting. Thus, the cow secretes less saliva when she chews less because the ration contains less fiber. Most dairy rations contain between 20 to 60% roughage, and decreased chewing by cows receiving these rations can result in .3 to .5 pounds less salivary sodium bicarbonate secreted each day. Since bicarbonate is the major buffer in saliva, this loss of salivary bicarbonate could explain partially the drop in rumen pH.

The relationship of chewing and salivary buffer secretion also indicates how physical form and particle size of the roughage affects pH. We have recently determined that chopping hay to pass a 3/4 inch screen reduces eating time by 10% but does not affect ruminating time. However, grinding feeds to pass a 1/4 inch screen reduces eating time by 20% and ruminating time by 50%. Thus, at the same fiber content, a ground roughage, or one consisting of small particles, will result in 30 to 40% less total chewing time. This in turn results in less saliva secretion, less buffer in the rumen, and higher rumen pH. This effect can be dramatic; for example, a ration containing 50% fiber of small particle size will result in the same chewing as a ration containing 20% long roughage. Silages may result in less salivary buffer secretion because they are not only chopped, but also they are moist. Generally, cows chew wet feeds less than dry ones when they eat. Since the relationship between ration fiber content and saliva production can be changed by altering the moisture content and physical form of the fiber, several researchers have suggested that chewing time be used directly to measure the roughage or effective fiber value of various feeds.

While decreased roughage content of rations results in less saliva bicarbonate production, increased grain content results in greater acid production. The easily digested nutrients of grains are rapidly fermented by ruminal microorganisms, causing an increase in volatile fatty acids in the rumen. The combination of less chewing of grains and greater acid production results in lower ruminal pH. Even some readily fermentable fibrous feeds, such as soybean hulls and citrus pulp, result in rapid acid accumulation in the rumen. Thus, these feeds have effective fiber values lower than their fiber contents would suggest.
As the pH of rumen contents decreases, the pattern of volatile fatty acids changes. Acetate concentration decreases and propionate concentration increases. These changes in volatile fatty acid pattern affect the metabolic function of mammary gland and body fat tissues. Acetate is used by the mammary gland to synthesize some of the fat in milk. However, a deficiency of acetate cannot explain completely the depression in milk fat that occurs when the acetate propionate ratio falls below 2.0. Infusing acetate into the bloodstream of cows secreting low fat milk will not correct the problem completely. Therefore, it appears that increased ruminal propionate may be involved. High ruminal propionate is associated with fattening in feedlot steers and it appears that it may cause metabolic changes in lactating cows that switch the conversion of absorbed energy from milk production to body fat synthesis. This results in depressed fat percentages in milk and fattening of the cow.

The relationship between ruminal pH, changes in volatile fatty acid patterns and milk fat depression suggests that this mechanism may be related to the low milk fat percentages observed during hot weather stress. Cows have limited ability to sweat and typically pant to cool themselves by evaporation in the lungs. However, panting, or hyperventilation, may affect blood bicarbonate concentration. Humans that hyperventilate have lower blood bicarbonate levels because it is broken down to carbon dioxide and exhaled. If this also occurred in cattle, then saliva bicarbonate, which comes from the blood, may be decreased. Decreased salivary buffer could result in lower rumen pH and milk fat depression. This theory is supported by some Japanese research that indicates the rumen pH of cows exposed to hot temperatures is lower than when they are exposed to temperatures that do not cause panting. Furthermore, it has been observed that giving bicarbonate to humans can elevate blood bicarbonate levels when they hyperventilate. Similarly, supplemental buffer feeding often alleviates the milk fat depression during hot weather, indicating that the animals may be suffering from a bicarbonate deficiency.

While the effects of pH on milk fat depression is dramatic, it may also affect fiber digestion, adaptation to high energy diets and fluctuations in rumen environment associated with meal feeding patterns. It has been known for many years that adding readily fermentable, high energy feeds to forage diets results in reduced fiber digestion. Recent evidence suggests that this may be due to decreases in pH because of acid accumulation during rapid fermentation. The optimum pH for many fiber-digesting enzymes is near 6.8 and their activity is greatly reduced as pH falls from 6.8 to 6.0. Thus, maintaining pH near 6.8 may be important in maximizing fiber digestion.

In addition to improving fiber digestion, maintaining rumen pH may reduce the stress associated with the adaptation of cows to high energy diets after freshening. When changed from a high roughage feed to a high energy one, the types and proportions of ruminal microbes change to accommodate the diet and the cow's physiological status. Unfortunately, the microbes rapidly ferment the new diet, causing widely fluctuating pH cycles in the rumen, which not only adversely affect themselves but also affect the cow detrimentally. Adaptation to diets may be accelerated by buffer feeding because buffers moderate the pH fluctuations that occur. Although there is little direct evidence to support this theory, it is interesting that the maximum response of animals to supplemental bicarbonate feeding is often observed during the first 4 to 8 weeks after diet changes.
Supplemental buffer feeding also may reduce fluctuations in pH throughout the day that are associated with meal feeding patterns. In general, rumen pH falls after a meal because microbial workers produce acid. The extent of pH drop is related to the amount of feed eaten at the meal. More feed eaten results in larger pH decreases. Approximately 2 to 6 hours after the meal the pH begins to rise as the cow ruminates and secretes saliva. The fluctuation in rumen pH is much greater and the minimum pH reached is much lower when only one meal is eaten per day as compared to the normal 10 to 14 meals a cow will consume under the best conditions. Generally cows consume fewer meals and eat a majority of their daily feed intake during the nighttime hours during hot weather. Thus, feeding buffers may moderate the fluctuations in pH that occur with irregular feeding patterns during hot weather.

In addition to the fermentation characteristics of a feed, its natural buffering capacity and acidity may influence rumen pH and alter the efficacy of supplemental buffer feeding. Although little research is available, there are indications that legume forages have greater natural buffering capacities than grasses. While the buffering capacities of feeds are low, the large amounts of feeds eaten could have a significant effect on rumen pH. Differences in feed buffering capacities may explain some of the variable results obtained with supplemental buffers. Conversely, the acid content of feeds such as silages may result in lower rumen pH. Although the acid consumed in silages is low compared to the amount of acid produced by ruminal microbes, it may result in some changes in rumen environment. Differences in feed buffering capacities and acid contents may explain why buffers are less effective in alfalfa hay rations than other rations and why added buffers typically increase the intake of silage rations.

While supplemental buffer feeding may help correct abnormal pH conditions in the rumen, it may also affect the microbes and cow in other ways. Sodium bicarbonate may increase water turnover in the rumen by increasing water outflow from the rumen. Increasing water outflow may change the rumen microbial population because slow-growers will be washed out. In addition, increasing water outflow has been associated with decreased propionate concentration in the rumen. Since decreased propionate concentration is related to increased milk fat synthesis, this effect may explain partially the positive effect of sodium bicarbonate in correcting milk fat depression.

Supplemental buffers often result in increased intake of the total ration. Although some research suggests that sodium bicarbonate and magnesium oxide are unpalatable when included in the concentrate mixture, most research indicates that these buffers increase intake when mixed in the total ration. Increased intake is usually greater for problem diets that are low in fiber or rations containing corn silage, but also occurs in normal and hay rations. In general, sodium bicarbonate is more palatable and increases intake more than magnesium oxide.

In conclusion, supplemental buffers may be recommended in certain situations to help the dairy cow maintain optimum pH and buffering capacity in the rumen. Rations that are low in effective fiber, whether due to fiber deficiency or to small particle size, usually are benefited by additions of buffers. Problems with milk fat depression and borderline rumen dysfunction usually occur when (1) roughage is less than 40% of the total ration dry matter, (2) cows consume less than 1.5% of hay equivalent per day, (3) fibrous feeds that are highly digestible or of small particle size (soybean hulls, citrus pulp, etc.) furnish more than 30% of the roughage dry matter, or (4) cows are consuming
more than 2.0% of their body weight of concentrates per day. Buffers also may improve rations containing low buffering or acid containing feeds such as when chopped and fermented silages supply more than 80% of roughage dry matter in the ration.

In addition, buffers may benefit cows suffering off-feed disorders or irregular feeding patterns that result in widely fluctuating conditions of rumen pH. They also appear to help dairy cows adapt to high energy lactating cow rations after freshening. Research indicates that buffered rations result in increased intake, more rapid attainment of peak feed intake and improved milk production during these high stress, adaptation periods. Milk fat depression during heat stress may also be reduced by buffer addition to the ration. This disorder may be due to bicarbonate deficiency caused by hyperventilation during hot weather and to unstable rumen pH associated with irregular feeding patterns during high temperature periods.

Usually sodium bicarbonate and magnesium oxide are fed in combination when buffer supplementation is indicated. It appears that their modes of action are different and their effects are additive. In general, sodium bicarbonate is more effective in improving rumen conditions by raising and stabilizing pH than is magnesium oxide, while magnesium oxide may affect volatile fatty acid patterns in the rumen and alter the metabolism of the mammary gland directly. The optimum amount of each buffer to feed has not been clearly established by research. Some work suggests that both sodium bicarbonate and magnesium oxide are unpalatable when added to the concentrate mixture. Although magnesium oxide generally is less palatable than sodium bicarbonate, intakes of complete feeds containing more than 5.0% sodium bicarbonate have increased. Thus, it appears that supplementing buffers at normally recommended levels should not cause problems. Normal recommendations for buffer supplementation of rations are .75% sodium bicarbonate and .3% magnesium oxide in the ration dry matter. However, a recent review suggests that no additional benefits to fat depressing rations are observed with intakes greater than 280g sodium bicarbonate and 140g magnesium oxide per day. This would correspond to approximately 1.4% of sodium bicarbonate and .7% of magnesium oxide in the ration dry matter and would suggest that these levels are the maximum recommended levels for severe milk fat depression. Although no research is available, field experience suggests that the level of buffers that can be fed without detrimentally affecting palatability is related to the type of ration. In general, higher levels of buffers have been fed successfully in silage-based, completely blended rations than in low acid containing complete rations or rations where concentrates are fed separately.

In addition to buffer supplementation, it is recommended that all other deficiencies in fiber content and form be corrected to the extent that is possible. Although buffers can help, they cannot be expected to correct all the problems inherent in the diet or due to stress in the environment. Furthermore, it should be recognized that changes due to buffer feeding will be gradual. Generally some response will be observed within one week, but often 3 to 4 weeks must pass before the maximum effect of buffer feeding is achieved.
TABLE 1: Typical changes in the ration and the dairy cow associated with roughage content of the total ration.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>LONG ROUGHAGE CONTENT OF THE RATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Neutral detergent fiber content(%)</td>
<td>70</td>
</tr>
<tr>
<td>Crude fiber content(%)</td>
<td>34</td>
</tr>
<tr>
<td>Rumen pH</td>
<td>6.8</td>
</tr>
<tr>
<td>Daily chewing time (minutes)</td>
<td>960</td>
</tr>
<tr>
<td>Daily saliva secretion (liters)</td>
<td>189</td>
</tr>
<tr>
<td>Daily salivary bicarbonate (lbs)</td>
<td>5.2</td>
</tr>
<tr>
<td>Rumen volatile fatty acid conc.(mM)</td>
<td>85</td>
</tr>
<tr>
<td>Rumen acetate (molar %)</td>
<td>70</td>
</tr>
<tr>
<td>Rumen propionate (molar %)</td>
<td>15</td>
</tr>
<tr>
<td>Acetate: Propionate ratio</td>
<td>4.7</td>
</tr>
<tr>
<td>Milk fat content (%)</td>
<td>3.5</td>
</tr>
</tbody>
</table>
UPDATE ON BRUCELLOSIS

by

Dr. Paul Nicoletti
College of Veterinary Medicine
University of Florida
Gainesville, Florida

The past year has been one of changes in the brucellosis eradication program. There have been several research efforts of interest to dairymen.

Program Status - Nationwide

<table>
<thead>
<tr>
<th>Year (Fiscal)</th>
<th>All Cattle Tested</th>
<th>Reactor Rates</th>
<th>New Infected Herds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>1.11</td>
<td>0.5</td>
<td>14108</td>
</tr>
<tr>
<td>1978</td>
<td>1.16</td>
<td>0.54</td>
<td>14657</td>
</tr>
<tr>
<td>1977</td>
<td>1.14</td>
<td>0.53</td>
<td>14331</td>
</tr>
<tr>
<td>1976</td>
<td>1.29</td>
<td>0.66</td>
<td>16910</td>
</tr>
</tbody>
</table>

The milk ring test (BRT) was positive in 0.26% of the dairy herds and 348 infected herds were located by this surveillance method. There were approximately 6600 herds under quarantine at the end of 1979. There was an increase in calves vaccinated by 1.1 million to a total of 5.2 million. The number of human cases of brucellosis reported to the Communicable Disease Center was approximately 175, the lowest since records were kept. However, in 1980 the number so far is over twice that of last year.

The national budget for brucellosis eradication was approximately $78 million.

Program Status - Florida

At the end of March 1980, there were 717 quarantined herds (3.7%). There has been a decrease in reactors in dairy herds:

<table>
<thead>
<tr>
<th>Year</th>
<th>No. Tests</th>
<th>Reactors</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>428,815</td>
<td>4079</td>
<td>0.95</td>
</tr>
<tr>
<td>1978</td>
<td>385,581</td>
<td>5743</td>
<td>1.49</td>
</tr>
<tr>
<td>1977</td>
<td>584,383</td>
<td>8090</td>
<td>1.38</td>
</tr>
<tr>
<td>1976</td>
<td>667,039</td>
<td>8353</td>
<td>1.25</td>
</tr>
</tbody>
</table>

There were 44,157 dairy cows and 35,394 beef cows adult vaccinated in 1979. To date, there are 122 dairy and 124 beef herds adult vaccinated. Of these, 22 dairy (18%) and 17 (14%) beef herds have been released from quarantine.
In a recently published report on dairy herds vaccinated in Florida and Puerto Rico, there was an 87% reduction in reactors removed on the third post-vaccination test when compared with pre-vaccination losses. Among culture positive cows following vaccination, 13.7% were shedding strain 19. This represented approximately 0.45% of the vaccinated cattle (reduced dose). If permitted to remain in the herds, approximately 80% of 98 Strain 19 positive cows appeared to recover from the infection.

Changes in Uniform Methods and Rules - February 1980

1. Permits 'V' brand or AV tattoo and eartag
2. Licensing of dealers and required records
3. Retest of previous quarantined herds 6 months after release
4. Requires herds adjacent to infected herds to be tested
5. Provides for release of quarantine and movement of adult vaccinated cows under certain criteria
6. Allows non-infected herds to be adult vaccinated but requires them to be quarantined. Two negative tests are necessary.
7. Terminates present county and state classifications and moves to A, B, and C status on January 1, 1982. Movements of cattle are affected.
8. Permits 2 classifications within a state.

Some Proposed Changes in Florida

1. Requires all herds (except dairy) to test annually
2. Removes the card test as final test in field or laboratory except where requested by herd owner; adds complement fixation to official tests
3. Requires 'S' brand for all untested cattle in markets

Research Activities

1. Diagnostic Tests
   a. Indirect Hemolytic Test
   b. Radial Immunodiffusion Test
   c. Enzyme Labelled Antibody Test
   d. Automation of complement fixation test
2. Vaccine
   a. Reduced dose - recent studies showed that there was no difference in protection between 5 groups of cattle when the vaccine was used at the standard dose and diluted beyond 5000 times.
   b. New vaccine - an extract of strain 43/20
3. Dermal antigens
4. Wildlife - prevalence and pathogenesis
EFFECT OF HEAT STRESS ON
DAIRY CATTLE PERFORMANCE A. PHYSIOLOGICAL ASPECTS

by

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Environmental factors play a major role in the seasonal decline in milk yield during summer months. Some of this decline is due to events occurring prepartum and some postpartum. Let's examine both aspects.

Prepartum Factors

Last year we demonstrated that the milk production of the cow is related to the birth weight of the calf. Cows giving birth to large calves gave more milk in a 305 day lactation than cows giving birth to small calves. Furthermore, heat stress during pregnancy reduced calf birth weight and postpartum milk yield of the dam. Cows housed under a shade structure the last trimester of pregnancy gave birth to larger calves than cows with no access to shade and went on to produce more milk during a 305 day lactation (Table 1).

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Heat Stressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth Weight (kg)</td>
<td>39.68</td>
<td>36.64</td>
</tr>
<tr>
<td>100 day Milk Yield (kg)</td>
<td>2672.4</td>
<td>2556.0</td>
</tr>
<tr>
<td>Pd 305-Day Yield</td>
<td>6752.8</td>
<td>5948</td>
</tr>
</tbody>
</table>

*Heat stressed different than controls P<.05
*Predicted yield adjusted for age, and month of calving.

Presumably this effect of heat stress on milk yield is caused by a reduction in mammary growth because in heat stressed cows the placenta is putting out less hormones which cause development of the gland. If this is related to the seasonal trend in milk yield, there should be a seasonal trend in calf birth weight. We have examined 1000 calvings over a 23 year period in Holstein cows. The month trend in birth weight and dams milk yield is shown on Figure 1.

There is indeed a month trend in birth weight of Holstein calves with the lowest birth weight occurring at the end of summer. Apparently, the longer a cow is heat stressed during pregnancy the smaller the size of the calf. As can be seen, the month trend in birth weight is not
FIGURE 1. EFFECT OF MONTH OF CALVING ON BIRTH WEIGHT AND MILK YIELD IN HOLSTEIN COWS
identical to the month trend in milk yield. This is due to the postpartum effects of heat stress on lactation itself. Prepartum events are influencing the cows’ ability to produce milk. However, postpartum stress also plays a role. Thus, cows calving in June and July have the combined problem of low calf birth weight and heat stress during lactation which causes them to produce the least milk in a 305 day lactation. How does heat stress effect the cow postpartum.

Postpartum Factors

As stated earlier, heat stress adversely affects lactation. This occurs by a number of mechanisms. The first effect is to raise body temperature which results in reduced feed intake, and basal metabolism. Rumen function is also altered. Figure 2 illustrates rectal temperatures around a 25 hour period in Holstein cows having access to shade or denied shade. Zero in this graph corresponds to twelve o’clock and 25 to noon the following day. Not only is rectal temperature elevated, rumen temperature is also increased, Figure 3. We examined rumen pH and found it to be lower in no shade cows, Figure 4. Although rumen pH was lower in heat stressed cows, it was not due to an increase in volatile fatty acid content of the rumen. This is depicted in Figure 5. Note that volatile fatty acid content rises in both groups following feeding, marked “F” on the graph, however shade animals maintain a higher concentration after the initial rise which may reflect differences in feed intake. Associated with the lower concentration of volatile fatty acids there is an alteration in pattern of rumen fermentation as shown in Figure 6. The acetate to propionate ratio is lower in heat stressed cows. Thus, shade management during warm weather has dramatic effects on rumen function and feed intake. This is reflected in higher milk production of cows having access to shade.

How much shade should be provided to cows? The answer is, as much as possible. We have examined Black Globe temperatures under 70% or 90% shade cloth and compared them to temperatures in the no shade area and under our insulated shade structure. The shade cloth was kindly provided by Donovan Enterprises, Palm City, Florida. As shown in Table 2, Black Globe temperatures are reduced by shade cloth. However, 90% shade would provide the greater protection for cows. Although more expensive the insulated shade reduced temperature the most.

Table 2. Effect of Shade Type on Black Globe Temperature

<table>
<thead>
<tr>
<th>Sun Shade Structure</th>
<th>Shade Cloth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90%</td>
</tr>
<tr>
<td>Black Globe Temp °C</td>
<td>38.78</td>
</tr>
<tr>
<td></td>
<td>33.69</td>
</tr>
</tbody>
</table>

How important are these differences in Environmental temperature. Evidence to date suggests that cows faced with afternoon Black Globe temperatures of 45°C produce 1.5 kg less milk per day per cow than cows at 30°C. Cows exposed to temperatures averaging 30°C produce 3 kg less milk per day. Thus, a dairy farmer with 100 cows which are exposed to afternoon temperatures averaging about 38°C is losing close to $100 a day in milk. It is fairly easy to see that investing a little extra money to get maximum shade will pay for itself.
FIGURE 2. EFFECT OF SHADE ON RECTAL TEMPERATURE IN HOLSTEIN COWS

--- + SHADE

--- ♦ NO SHADE

RECTAL TEMPERATURE [°C]

0 5 10 15 20 25

HOUR
Figure 3. Effect of shade on rumen temperature in Holstein cows.
Figure 5. Effect of shade on total volatile fatty acid concentration in rumen fluid of Holstein cows.
EFFECTS OF HEAT STRESS ON DAIRY CATTLE PERFORMANCE. B. GENETIC ASPECTS

by

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Surprising little is known on the degree to which the ability of individual animals to tolerate climatic stress is genetically influenced. There are differences among cows in nearly everything we can measure. We study these differences in order to reduce their detrimental effects, to devise management techniques to improve performance, and to develop genetic selection programs directed towards greater production. Final goal is greater profitability, either on an individual cow basis or on a total farm unit basis.

To study heat stress it is convenient to see how cows react to changes in their climatic environment. Since this environment represents several things other than temperature, it perhaps is more proper to refer to climatic, rather than simply heat, stress. Discussion here, however, refers only to those climatic factors associated with hot climates. Florida is listed in most classification systems as being subtropical.

The cow adjusts to hot stressful conditions by changing her habits such as eating, drinking, walking, and seeking shade. These, and similar actions, are conscious changes because she is uncomfortable. Many other changes are not conscious, such as sweating, increased respiration, decreased rumen contraction, etc.

Her ability to change is called adaptation. She adapts as much as she can; if the stress imposed on her pushes her beyond her limit to adapt, in the ultimate, she dies. It is convenient also to divide the adaptation process into parts, realizing that our division is far from perfect.

Physiological adaptation involves those processes of the cow, conscious or not, which she performs to maintain her personal health and well-being and stay alive. They include many changes not mentioned, and indeed many which are either not known or little understood. Production adaptation involves those responses more related to the well-being of the herd owner, ie, milk yield and composition, growth, etc. These are, of course, under physiological control. To put this in proper perspective, the herd owner takes actions to reduce climatic stress as much as possible. He wants his animals to be comfortable, to maintain their general health, and to stay alive. The cows must, however, maintain their production performance during this time or he cannot afford to keep them. Unfortunately, physiological adaptation to climatic stress seems to be associated with lowered performance; hence it seems that the
desired animal is one which has great ability to adapt physiologically while simultaneously maintaining productivity.

A clear example of this can be seen comparing the performance of Criollo and Brown Swiss herdmates in Venezuela. Data are from McDowell (1972). There is little interest in Criollo in Florida because of their low milk producing ability, but there is much interest in local cattle in tropical areas of the world because they are able to maintain rectal temperature, breathing rate and general well being under stress; they do this partly by eating less and giving less milk. They are physiologically adaptable but not production adaptable. The Brown Swiss, however, exhibits many signs of discomfort but maintains milk yield when stressed, but not nearly to the degree done by the native Criollo. In Table 1 is shown the decrease in milk yield with increasing temperature.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Brown Swiss</th>
<th>Criollo</th>
</tr>
</thead>
<tbody>
<tr>
<td>73.4 F</td>
<td>29.5 lb</td>
<td>18.1</td>
</tr>
<tr>
<td>75.2</td>
<td>29.1</td>
<td>16.8</td>
</tr>
<tr>
<td>77</td>
<td>28.9</td>
<td>16.1</td>
</tr>
<tr>
<td>78.8</td>
<td>28.7</td>
<td>15.9</td>
</tr>
</tbody>
</table>


Within this temperature range, the Brown Swiss declined less (.8 vs 2.2 lb., or 2.7 vs 12.2%). At even higher temperatures Brown Swiss declined more than Criollo in pounds, but less on a percentage basis.

Of direct interest to Florida is research completed on genetic aspects of climatic stress in Gainesville, with animals of five dairy breeds (76% Holsteins or Jerseys), by graduate students from two tropical areas, L. A. Rodriguez (Venezuela) and A. K. Sharma (India and Brazil). Climate during this research is shown in Table 2.

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>MEAN</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum temp.</td>
<td>80.9</td>
<td>49 - 97</td>
</tr>
<tr>
<td>Minimum temp.</td>
<td>57.2</td>
<td>21 - 75</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>44.7</td>
<td>12 - 99</td>
</tr>
<tr>
<td>Solar radiation</td>
<td>447.1</td>
<td>164 - 756</td>
</tr>
</tbody>
</table>

We examined 17 measures of milk production performance, counting milk yield, percentages and yields of constituents, titratable acidity, chloride content, and percent DNA reflectance, a measure of somatic cell count. Every measure of performance was affected by every measure (four) of climate studied.
Measures were on a within-cow basis and represented performance for 1 day; studied simultaneously were the stages of lactation and pregnancy. Effects of climate were quantified in two ways, the percent of the variability in performance associated with variability in climate, and the actual change in performance associated with changes in climate. The former gives an indication of sensitivity to climate (lack of ability to adapt); the latter gives an indication of economic loss to dairymen due to unfavorable climate and the amount which one could hope to recover by improving the environment.

In Table 3 are estimates of variances due to climate for Holsteins and Jerseys.

Table 3. Variation in performance due to climate.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Jerseys</th>
<th>Holsteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield</td>
<td>2.1%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Fat %</td>
<td>10.2%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Protein %</td>
<td>10.1%</td>
<td>8.9%</td>
</tr>
<tr>
<td>Chloride %</td>
<td>3.4%</td>
<td>3.9%</td>
</tr>
<tr>
<td>DNA reflect.</td>
<td>1.9%</td>
<td>1.4%</td>
</tr>
</tbody>
</table>


These results, and others not in the table, suggest that Holstein milk yield is more sensitive to climatic stress than is Jersey, but Jersey composition is more sensitive. Both breeds' composition was more sensitive than yield.

Temperature effects on milk yield are slight when maximum temperatures fluctuate between 46 and 74 F. Slight declines appear at 75 F and above, but these are quite small until 85 F, at which time drops become appreciable. These results are based on about 18,000 samples and agree closely with climatic chamber studies based on just a few cows. Chloride content increased at temperatures above 70 F. This suggests a decline in lactose percent. Other percentages changed appreciable at 85%.

Decreases in Holstein milk yield approached 10% when maximum temperatures increased from 85 to 95 F, but Jersey losses were less than 2%. Jersey fat percentage decreased by about three times as much as did Holsteins, however.

Effects of maximum and minimum temperatures were about the same, with the latter becoming apparent about 24 F lower. The two measures are highly correlated, of course. Solar radiation ranged from 164 to 756 Langleys in our study. No effects on milk yield were apparent until radiation exceeded 200; at that point a steady decline occurred. In Jerseys, a 43% decline in yield was found if radiation reached 600. At mean radiation (447), loss in Jersey milk yield was 14% lower than at 200. Solar radiation was shown earlier to be slightly more important than temperature at the University of Florida in causing lower conception rates. It is obvious that it is a stress-full agent on yields as well; we are continuing our research in this area.
Losses due to humidity were surprisingly small. Very low and very high (rainy days) values were beneficial. Losses due to intermediate humidity were as much as 1.75 lbs. in Holsteins, but most of this was due to high temperatures rather than humidity alone.

In summary, climatic effects were shown to account for appreciable portions of the variation in milk composition and yield, as was well known. Maximum temperatures caused declines in yields at 80 or 85 F, and were drastic above 90 F. Jersey yields were less sensitive than Holstein yields to climate stress, but their milk composition was more sensitive. In both breeds, composition was more sensitive than yields. Solar radiation effects were real and measurable but small. Estimates now are available to assist dairymen in making management decisions as to the benefit available to them, with cows of different breeds, from altering the environment in which their cow live.
SYNCHRONIZATION OF DAIRY HEIFERS WITH PROSTAGLANDIN F₂\textsuperscript{α}:
CURRENT UPDATE

by

William W. Thatcher and Robert M. Eley
Dairy Science Department
University of Florida
Gainesville, Florida

As reported in previous production conferences, detection of estrus and proper timing of insemination are major reproduction problems facing dairymen. Utilization of systems to synchronize estrus and control the time of insemination will benefit markedly the dairy producer of Florida. Large herds, seasonal periods of infertility associated with heat stress, and large use of artificial insemination place a major emphasis on reproductive management. We reported previously on our research findings, done within Florida, that prostaglandin F₂\textsuperscript{α} is a drug which will provide dairymen with a practical method to control time of ovulation, and that insemination at this synchronized ovulation yields a normal level of fertility.

Due to a major research effort by the Upjohn Co. in cooperation with research establishments throughout the United States and internationally, a PGF₂\textsuperscript{α} product is now available commercially to dairy producers. This product may be used to control the time heifers are inseminated.

Marketed under the name of Lutalyse this drug contains prostaglandin F₂\textsuperscript{α}, which when injected into normal cycling dairy animals, results in a predictable onset of heat and allows for controlled or timed breeding. As such Lutalyse can be thought of as a new breeding management tool for dairymen. However, it is not a substitute for good management. Successful use of Lutalyse requires even greater attention to management practices.

Lutalyse combined with good total management has many benefits: reduces or eliminates heat detection, utilizes AI more conveniently, times entry of animals in the milking herd, produces (via the use of AI) a genetically superior calf, and certainly increases productivity potential.

Lutalyse is currently available to the dairy producer as a prescription drug to be purchased from a veterinarian. At the present time it is approved by the Food and Drug Administration (FDA) to be used in non-lactating animals or dairy heifers. It is not at this time approved for use in lactating cows. However, approval of its use for lactating animals probably will be obtained in the near future.

How the drug is best utilized to control heat is a decision that is made between you and your veterinarian. The Upjohn Co. has proposed a management scheme for the drug's use that we will now review. There are
several factors required for an effective "Management Program". Animals must be cycling normally since the drug is only effective in cycling animals. It will not work in prepubertal heifers, and it will cause abortion if administered accidentally to a pregnant animal. Animals need to be under a proper plane of nutrition, adequate handling facilities must be available, and a good overall herd health program is essential. A two injection program is recommended by Upjohn. Simply stated, one Lutalyse injection is given followed by a second injection 11 days later, and then animals are inseminated. Producers can either observe for heat and follow normal breeding procedures, or do a timed AI at 80 hours after the second injection.

Study after study, including those in our own herd, indicate that you can expect conception rates characteristic of your herd. If your particular herd has a conception rate of 70% normally, then 70% will be expected following Lutalyse treatment. Likewise, if normal conception rate for your herd was only 40%, than you can expect 40% after treatment. Lutalyse is not a fertility drug, and it will not increase or decrease conception rates.

It is important to understand how Lutalyse works because this is the key to your management program and decisions will be based around it. On day zero of the biological clock, heifers shows heat for 8 to 18 hours at which time she will stand for other animals. On day one she ovulates releasing an egg from the ovarian follicle into the oviduct. In the next 5 days following ovulation, the empty follicle undergoes a change and develops into the corpus luteum (CL or yellow body) which produces progesterone. Progesterone is responsible for maintaining pregnancy should fertilization occur. About 16 days after ovulation, if fertilization does not occur, the CL begins to disappear or regress and progesterone secretion decreases markedly. As regression occurs, another follicle begins to develop and heat occurs again on approximately day 21 when the cycle is repeated. If fertilization occurs there is no regression of the CL and progesterone concentration is maintained throughout pregnancy.

If Lutalyse is injected during the first 5 days after ovulation, before the corpus luteum is functional, the cycle length is not altered. The developing CL is not affected by the drug. Consequently, injection at this time results in no alteration of cycle length. From about days 6 to 16 a functional CL exists. Injection of Lutalyse at this time will cause the CL to regress and the heifer to return to heat in 2 to 5 days. After day 16 the CL starts to regress naturally. If Lutalyse is injected at this time there is no effect and the animal returns to estrus naturally in 2 to 5 days.

Upjohn recommends a two injection sequence for the following reasons. On the day of the first injection, about 75 to 80% of normal cycling heifers will be between day 6 and 21 of the cycle. All these will be in heat within 2 to 5 days following injection. Those between days 6 and 16 of the cycle will respond to the drug and those between days 16 and 21 will return to heat naturally. This heat period 2 to 5 days after the 1st injection becomes another management check point. If the majority (example 75%) of animals are not in heat after the first injection; STOP! Do not give the second injection or inseminate.
In all probability the animals are not cycling normally (too young, pre-puberal, underfed, etc.). With the help of your veterinarian, you should re-evaluate your management program. The remaining 20 to 25% of the animals will be between days zero and 6 of the cycle, without a functional CL, and will not respond to the first injection of the drug.

Assuming that the majority of animals showed heat after the first injection, continue with the plan. That is reinject 11 days after the first injection. At this time all animals will have developed a fully functional and responsive CL which will be regressed by the drug. The second injection thus allows you to breed either by observing for estrus and following normal breeding procedure or by AI 80 hours after the second injection.

It is rather clear at this point that Lutalyse is a management tool which requires the implementation of a total breeding management program. Such a program includes cycling animals, proper nutrition, adequate handling facilities (adequate handling facilities must be available to restrain animals at least three times in 15 days; facilities should include holding pen, crowding alley and breeding chute), good herd health program, and quality semen and insemination technique. A quality inseminator is critical for in large herds fatigue is a major factor in lowering subsequent conception rate. These are all important to implement a controlled breeding program.

Let's review two examples of responses to Lutalyse treatment. In one trial dairy heifers were cycling and successfully synchronized by Lutalyse as evidenced by the fact that 90% of the injected heifers were in heat after the second injection. The control animals were also cycling with about 5% in heat per day. However, final pregnancy rates for the entire study were only 30% for both groups. These low pregnancy rates were attributed to poor semen handling and insemination problems.

In a trial with beef cows, results indicated that the animals did not respond to the first injection with no greater number in heat after the drug than in the control group. Normally you would have expected some 70-75% of animals responding to the Lutalyse treatment. Researchers believed animals were not cycling. The poor response was not a fault of the drug but poor timing relative to beginning the program. Animals must be cycling prior to the beginning of the program for it to be successful.

Let us now consider some specifics relative to implementing the program. If, for example, a September 1 calving date is desired, then breeding must occur about November 22. Working from a 4:00 p.m. breeding time on this date and using a two injection scheme, the second injection must be given 80 hours earlier at 8:00 a.m. on November 19. Consequently, the first injection should be given 11 days earlier to this on November 8.

Extensive field trials on over 25,000 test animals indicated that Lutalyse treated animals had conception rates and calving rates comparable to contemporary controls. No adverse effect on calving rate was found.
One question asked by dairy management is: will all cows calve on the same day? Normal gestation length varies by as much as 10 days; so not all heifers will calve on the same day.

Overall, dairy producers will show benefit from a "Lutalyse Total Reproductive Management Program". The program requires cooperation and coordination, between producers, veterinarians and the AI industry. Upjohn has made a conservative, well-planned attempt to introduce the drug onto the market with careful consideration for the producers by supplying complementary management suggestions, educational programs and by coordinating the sales program with the veterinary profession and the AI industry. Correct usage of the total package will increase productivity potential.

Other management options may also be considered. For example, the producer and veterinarian may want to inseminate all animals over a 5 day period and treat the remaining animals with a single Lutalyse injection on day 6. Those treated animals could then be inseminated at observed estrus following normal breeding procedures. If frequency of observed heat is low during the 5 day initial period, then animals may not be cycling and a decision to treat the remaining animals may be re-evaluated.

At the present time we would recommend that cows be bred at estrus or 80 hours following second injection depending on which comes first. Thus, insemination would not go beyond 80 hours following injection of Lutalyse. This system would probably be efficient following either a single or double injection regime.

In the future, treatment programs will undoubtedly be tailored to specific aims and objectives of the producer. However, at the present time Lutalyse is an effective drug that will complement a good reproductive management program. It certainly works in Florida dairy cows based upon studies completed over the last 6 years at the Dairy Research Unit and other locations within the State. However, it is not a substitute or cure all for poor management.


2) Upjohn Company Veterinary Products Information, Kalamazoo, Michigan
FORMATION AND ACTION OF DAIRY SCIENCE DEPARTMENT ADVISORY COMMITTEE

by H. H. (Jack) Van Horn, Chairman
Dairy Science Department
University of Florida, Gainesville 32611

Both the University of Florida and the dairy industry have at one time or another in past years asked the other to meet to discuss program direction in the Dairy Science Department. IFAS (Institute of Food and Agricultural Sciences) has had at least two long-range planning committees involving a large amount of industry input, the first in the 1960's being DARE (Developing Agricultural Research Effectively) and the second in the 1970's being AGUA (Agricultural Growth in an Urban Age). These committees were short-term committees specifically formed to plan for future needs. Another committee was formed in the 1970's at the request of Dairy Farmers, Inc. to review dairy science research programs and discuss needs for future research.

These committees served their initial function well. I think all participating felt good communication was achieved. The greatest inefficiency, however, was that communication through an organized committee was not available during a few times when it might of been most helpful to both the department and to various facets of the dairy industry.

Why form an advisory committee? First the Dairy Science Department feels it would be beneficial to discuss with industry some of the priorities it sets for research, teaching, and extension. Deficiencies in our programs definitely exist simply because we cannot afford extensive programs in all problem areas. If industry understood what was considered in setting these priorities, they have a chance to influence these priorities or at least understand why they were as they were if we were not able to cover some needs. We need better coordination within IFAS for our work on programs relating to dairy production and dairy foods processing. Although the Dairy Science Department has the biggest concentration of faculty working on programs relating to dairy, faculty within the Veterinary College, Food and Resources Economics, Agricultural Engineering, Food Science, Agronomy, Entomology and Nematology, and others also work on dairy related problems.

Faculty in the Dairy Science Department decided we would be more effective in the long run if we consulted with an Advisory Committee. Our objective is to counsel with dairy producers, dairy processors, and agribusinesses that employ our graduates and adopt the new technology that leads to more efficient production of dairy foods. In order to get good representation industry has helped in the selection of the committee. The committee appointed to date met for the first time December 11 (afternoon and evening) and December 12 (morning), 1979 and again immediately following the Dairy Production Conference
on May 7, 1980. Current committee members (in addition to Dairy Science Department Faculty) are:

Aubrey L. Burnham - IDFA Dairyman, Okeechobee  
Louis E. Larson, Jr. - IDFA Dairyman, Okeechobee  
Truman Smith - TIDFA Dairyman, Brooksville  
John A. Peachey - TIDFA Dairyman, Sarasota  
George Richardson - Dairyman, Upper Florida MPA, Sanderson  
Arthur Aukema, Dairyman, Sunshine State Dairyman’s Coop., Chipley  
J.T. (Tom) Christian, Jr. - Dairyman, Suncoast MPA, Bradenton  
C.L. (Bud) Ward - Dairyman, Florida DHIA Board Representative, Astatula  
Gene Smith - Food Processor, Superbrand Dairy Products, Jacksonville  
A. Lamar Garrett - Food Processor, Borden, Inc., Orlando  
Thomas B. Hart - Food Processor, Hart’s Dairy, Fort Myers  
Jay Boosinger - Director, Dairy Division of Florida Department of Agriculture and Consumer Services  
Paul Glasscock - Hillsborough County Extension Agent, Seffner  
Mike Kelly - Duval County Extension Agent, Jacksonville  
Kent Price - Okeechobee County Extension Director, Okeechobee  
Travis Seawright - Manatee County Extension Agent, Palmetto

At the first meeting in December, this committee (including 13 Dairy Science Department Faculty) spent considerable time reviewing important problems the dairy industry faces to improve efficiency of milk production, processing and product delivery. After listing a large number of problems, fairly extensive reports of various faculty were presented to show what is currently being done at the university in research, teaching and extension. This was done in order to review priorities previously set in program direction and we discussed whether or not future priorities should be changed. Plans for a few specific programs in the future were developed.

Table 1 attached summarizes problem areas discussed with some indication of the amount of current work directed to these problems and of needed program additions in the future. This table is not meant to be a complete listing of all problems. Problems were listed as they came up in the discussion and reflect a quick judgement made of current work and future need.

At the December meeting, need was expressed for a Pregnancy Diagnosis Short Course for Dairy Managers. In the May 7 meeting Dr. Dan Webb presented a proposal for a short course we expect to offer during November, 1980 on Reproductive Management. It will be a 3 or 4 day course held in Gainesville with rectal palpation laboratories at the Dairy Research Unit. Enrollment will be limited to twenty people to allow considerable pregnancy diagnosis training in addition to coursework in overall reproductive management. It is for people already breeding cows and actively managing reproduction programs in dairy herds. An enrollment fee will be charged to cover materials used in the course. Probable faculty which will do the teaching are Dr. Thatcher from Dairy Science and Dr. Drost from the Veterinary College with
### TABLE I

**DAIRY PROBLEM AREAS (NEEDS), CURRENT DAIRY SCIENCE DEPARTMENTAL PROGRAM ACTIVITY AND NEEDS**

<table>
<thead>
<tr>
<th>Problem (Needs)</th>
<th>Current Programs*</th>
<th>Needed Program Additions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reproduction</td>
<td>RRR E</td>
<td>R</td>
</tr>
<tr>
<td>2. Energy</td>
<td>EE R</td>
<td>RRR EEE</td>
</tr>
<tr>
<td>3. Water</td>
<td>EE</td>
<td>R E</td>
</tr>
<tr>
<td>4. Waste Disposal</td>
<td>EE</td>
<td></td>
</tr>
<tr>
<td>5. Labor Management</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>6. Toxins-Animal Feeds</td>
<td>EE</td>
<td>E R</td>
</tr>
<tr>
<td>7. Animal Health</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>8. Mastitis</td>
<td>EE</td>
<td>EEE R</td>
</tr>
<tr>
<td>9. Dairy Business Management</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>10. Residuals – Antibiotics Tests</td>
<td>EE</td>
<td></td>
</tr>
<tr>
<td>11. Market Research</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>12. Regulatory Requirements</td>
<td>R E</td>
<td></td>
</tr>
<tr>
<td>13. Land Use Planning</td>
<td>RRR EEE</td>
<td></td>
</tr>
<tr>
<td>14. Extended Shelf Life</td>
<td>RRR EEE</td>
<td></td>
</tr>
<tr>
<td>15. Improving Production Efficiency</td>
<td>EEEE RR</td>
<td></td>
</tr>
<tr>
<td>16. Feed Supply</td>
<td>EEEE RR</td>
<td></td>
</tr>
<tr>
<td>17. Breeding-Genetics</td>
<td>E RRR</td>
<td></td>
</tr>
<tr>
<td>18. New Product Development-Imitation Products</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>19. Milking Equipment</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>20. Housing</td>
<td>E R</td>
<td>E</td>
</tr>
<tr>
<td>21. Vertical Integration-Processing, Retail</td>
<td>EE RR</td>
<td></td>
</tr>
<tr>
<td>22. Milk Flavor</td>
<td>EE</td>
<td></td>
</tr>
<tr>
<td>23. Milking Management</td>
<td>E R</td>
<td></td>
</tr>
<tr>
<td>24. Toxins-Human Foods</td>
<td>EE RRR</td>
<td></td>
</tr>
<tr>
<td>25. Environmental Stress</td>
<td>EEE R</td>
<td></td>
</tr>
<tr>
<td>26. Dairy Product Processing</td>
<td>EEE R</td>
<td></td>
</tr>
</tbody>
</table>

* The number of times R or E appears is an indication of the amount of current program or of needed addition in research (R) or extension (E):
develop an educational program for mastitis control and improved milking management but did not include extensive research in this priority. The Advisory Committee does not feel these priorities were incorrect as far as research is concerned but that everything possible should be done to develop educational programs to help dairy farmers reduce mastitis. This would increase efficiency of milk production more than any other single problem correction available to us at this time, probably yielding 10-15% more milk production without increased costs in many herds making recommended improvements. At the May 7 meeting, I reported to the committee that we had submitted a request to IFAS Administration for an additional extension specialist to give leadership to mastitis and milking management education. If IFAS does not have a position that can be assigned to Dairy Science, faculty will attempt to increase educational assistance to the fullest extent possible, for example, the Dairy Production Conference Program this year concentrated heavily on mastitis and milking management. The Veterinary College through faculty like Dr. Braun have made considerable advancement in their capability in mastitis and Dr. George Meyerholz, an Extension Veterinarian, is now concentrating mainly on dairy programs where in the past he could only serve dairy programs a small percent of his time. All these advancements help but if Dairy Science faculty are to give leadership to this "team effort" additional faculty support is needed because we don't feel we can afford to give up programs currently directed by Dr. Harris and Dr. Webb.

Related to mastitis is the general need to improve raw milk quality at the farm level. Part of the need involves leucocytes but much involves antibiotic residues and other residuals in milk. More sensitive antibiotic tests are going to be used for producer milk than have been used in the past. Once regulatory agencies decide specifically on which test to use and how they are going to interpret and enforce the test, Dr. Jim Jezeski will work closely with the coops and processors to help people understand the test and how it will affect withholding times after treating lactating cows with antibiotics.

At the May 7 meeting, Aubrey Burnham indicated he has seen inconsistency in recommendations various people give concerning vaccine usage in herd health programs. He recommended that faculty try to provide new publications updating best recommendations for these areas. In the herd health area, others expressed a desire to obtain diagnostic reports on animals taken to state diagnostic laboratories and to circulate information from these reports when they might be helpful to alerting farmers to forthcoming problems they might be facing. Faculty (probably Dr. Harris, Dairy Science and Dr. Meyerholz, Extension Veterinarian) will try to include such information in newsletters from both Dairy Science and Veterinary Science. Also if producers in certain areas will benefit from a educational meeting on a topic like this, please ask local extension agents to set up a meeting with state specialists.

At the May 7 meeting, Dr. D.W. Webb reported on his plans for a nine-month faculty development leave from the University of Florida to work at North Carolina State University investigating on-farm computer terminals for use in
dairy management. One major area he plans to study is the use of on-farm terminals to communicate with the computer storing data collected in the DHIA program to obtain day-to-day management information such as lists of cows for pregnancy diagnosis, drying off, those cows needing special handling, etc. This communication improvement will allow input of data from the farm frequently and access to the information as needed. Other options such as payroll, employee benefits calculations, other financial records, ration formulations, etc. will also be studied. Dr. Harris also reported on IFAS's commitment to develop computer based management assistance as a part of future extension programs.

The May 7 meeting concluded at 3:30 p.m. with a decision that the next meeting of this committee should explore dairy related programs being conducted in other IFAS departments such as the Preventive Medicine Department in the Veterinary College, Food and Resource Economics Department, and Food Science and Human Nutrition Department. This will require another noon-to-noon meeting and might best be scheduled in November, 1980. However, if the new Dairy Science Department Chairman is not yet appointed at that time, consideration will be given to delaying the meeting a couple of months to gain the benefit of his or her participation in these discussions.
NAMES AND ADDRESSES OF THOSE ATTENDING THE
FLORIDA DAIRY PRODUCTION CONFERENCE, MAY 6-7, 1980

Adamson, Jim R.
Amiel, Donald Keith
Aprile Mr. & Mrs. Jimmie
Arnt, Mel
Aukema, Arthur
Baird, C. Direlle
Baker, Joe B.
Barrett, Arthur E.
Bassett, Jr., Ray Simpson
Batz, Kenneth John
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