Appendix A.

SARE Project LS94-63

PROCEEDINGS

OF

DAIRY FIELD DAY

NOVEMBER 1, 1995

LAKE WHEELER ROAD

DAIRY EDUCATIONAL UNIT

North Carolina
Agricultural Research Service

North Carolina
Cooperative Extension Service

College of Agriculture and Life Sciences
North Carolina State University

Program

George J. Kriz, Presiding
Associate Director
North Carolina Agricultural Research Service

9:00 - 9:40 a.m. **Registration; view displays, exhibits, and posters**

9:40 a.m. **Welcome**
W. R. Baker, *Director*
University Field Laboratories, NCARS

A. Broadwell, *Unit Manager*
Lake Wheeler Road Dairy Educational Unit

9:45 a.m. **Comments**
J. C. Wynne, *Director*
North Carolina Agricultural Research Service
J. F. Ort, *Director*
North Carolina Cooperative Extension Service

10:00 a.m. - 12:00 noon **Morning Session**
L. S. Bull, *Animal Science*, Chair
(Attendees will rotate among four stations)

1. **Nutrition Studies: Protein Sources, Aflatoxins, Poultry Litter for Heifers**
   B. A. Hopkins, L. W. Whitlow, M. H. Poore, *Animal Science*
2. **Reproduction Studies: Use of Ultrasound in Staging Pregnancies, Estrus Cycle Control**
   J. Cole, M. D. Whitacre, J. H. Britt, *Veterinary Medicine*
   S.P. Washburn, *Animal Science*
3. **Pasture Management I: Warm and Cool Season Forages, Grazing Management**
   J. T. Green, *Crop Science*, and S. L White, *Animal Science*
4. **Pasture Management II: Construction of Fencing, Water Lines, and Cow Lanes**
   J. M. Luginbuhl, *Animal/Crop Science*

12:00 p.m. **Lunch** (reservations required)

12:45 - 1:15 p.m. **Demonstration of Bale Wrapping and Unrolling Equipment**

1:15 - 3:15 p.m. **Afternoon Session**
L. S. Bull, *Animal Science*, Chair
(Attendees will rotate among four stations)

1. **Waste Management I: Flush Tanks, Solids Separation, Lagoons**
   J. C. Barker, *Biological and Agricultural Engineering*, and A. Broadwell, *University Field Laboratories*
2. **Waste Management II: Water Quality Monitoring, Settling Basins**
   G. D. Jennings, *Biological and Agricultural Engineering*
3. **Milk Quality: Use of Antibiotic Residue Tests, Milk Conductivity**
   K. L. Anderson, *Veterinary Medicine*, J. E. Rushing, *Food Science*, and B. T. McDaniel, *Animal Science*
4. **Production Economics: Preliminary Comparisons of Grazing vs. Confinement Feeding Systems**
   G. A. Benson, *Agricultural and Resource Economics*

3:15 p.m. **Reconvene for General Discussion and Evaluation**

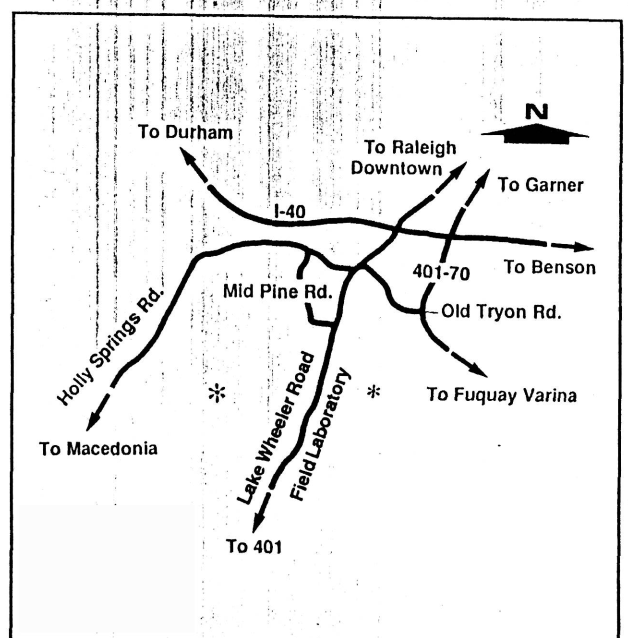
3:30 p.m. **Adjournment**

The Lake Wheeler Road Field Laboratory is located south of downtown Raleigh, with offices on Lake Wheeler Road.

This field laboratory consists of 1,453 acres with 623 acres of cropland, 330 acres in pastures and about 300 acres of woodland. Research and teaching programs at this unit involve dairy, swine, broilers, turkeys, horticultural and field crops, air pollution and quality, waste management, fish, wildlife, biological sciences, ecology, forage crops, grapes and tree fruits. The laboratory is the site of significant research and study of low-input sustainable agriculture.

The Lake Wheeler Road Field Laboratory is one of nine university research laboratories owned and operated by the North Carolina Agricultural Research Service, a division of the North Carolina State University College of Agriculture and Life Sciences. The administrative office for the Department of University Field Laboratories is at 3720 Lake Wheeler Road.

LAKE WHEELER ROAD FIELD LABORATORY - Lake Wheeler Road



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Proceedings of Dairy Field Day
November 1, 1995
Lake Wheeler Road
Dairy Educational Unit

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PRODUCTION ECONOMICS: PRELIMINARY COMPARISIONS OF GRAZING VS. CONFINEMENT FEEDING SYSTEMS

G.A. Benson, S.L. White, B.A. Hopkins and S.P. Washburn

The results discussed here must be treated with caution because they describe the experiences of the first few months of the project. This was a learning experience for all concerned and the results during the remainder of the project may look quite different. Nevertheless, this information is valuable because it highlights the need for good data.

The grazing project here at NCSU's Lake Wheeler Road Dairy was established in early 1995 with funding from USDA's Sustainable Agriculture Research and Extension program. This will be a three year project. Approximately 72 acres were converted to permanent pastures for use by milking cows under an intensively managed rotational grazing program. Grass species included tall fescue and orchardgrass, alone or in combination with clover or alfalfa; alfalfa, bermuda grass and caucasian bluestem. Lanes, fences and water lines were installed. The 72 cows in the project--24 Jerseys and 48 Holsteins--were originally housed and fed together in a traditional confinement system. Half of the cows--12 Jerseys and 24 Holsteins--were assigned to the grazing system and the other half remained in the confinement system to provide the basis for comparison. Both groups were comparable in terms of breed, age, stage of lactation, etc. Most of the cows calved in January, February and March. The grazing group went out to pasture in mid-March.

Rations were developed using the DART ration balancing program. Ingredient costs were calculated using current market prices. Silage was charged at $25/ton and pasture was charged at $10/ton, on an as fed basis. These charges should be adequate to cover the full cost of production and harvesting the crop, including operating expenses, labor, and annual charges on capital investments in machinery and equipment. No charges were included for feed preparation and feeding.

The confinement group was fed a total mixed ration that included corn silage, alfalfa haylage, whole cotton seed, ground corn and soybean meal. Grazing was the only source of forage for the grazing group. In addition, a low protein concentrate ration was fed that included whole cottonseed, ground corn and molasses. Concentrates were fed at levels that varied between 15 and 26 lb/head/day, depending on estimates of the availability and quality of pasture. All rations were supplemented with trace minerals and vitamins.

There were marked differences in the levels of milk production and in daily feed costs under the two feeding systems. For the period from March 30 through August 28, the confinement herd had higher feed costs but milk production levels also were higher. The Holsteins in the confinement herd produced an average of 68.5 lb/head/day compared to 57.2 lb. for the grazing Holsteins, an 11.2 lb. difference in favor of the confinement group. For the Jerseys, production for the two groups was 53.2 lb. and 46.3 lb. respectively, a 6.8 lb. advantage to the confinement herd. In percentage terms, the grazing Holsteins produced 16.5 percent less milk, and the Jerseys produced 12.8 percent less, than their counterparts in confinement.

Milk income was calculated using North Carolina average milk prices as reported by USDA, adjusted for butterfat test to breed averages. By this measure, the confinement herd generated $1.36/cow/day more income than the grazing herd. However, the estimated feed costs were $1.32/cow/day lower for the grazing group. Therefore, income over feed cost, a commonly used proxy for profitability, was virtually identical for the two groups. The grazing herd had a financial advantage in April and May, but the confinement herd had the advantage in the later months of the period.

These income over feed comparisons do not tell the whole story, however. The pasture group lost more body condition than the confinement group, which suggests that the feeding program may not have been optimal. The cost figures reported above do not fully reflect the cost of additional grain that has been fed to the grazing group recently to rebuild body condition for next lactation. Feeding strategies will be re-evaluated in an attempt to limit loss of body condition during the next lactation.

This was a first attempt at breeding cows in a short (2.5 month) breeding season, to get the cows on a tight seasonal production pattern. The breeding season for both groups of cows ran from the beginning of April through the middle of June. Both groups were at a comparable stage of lactation. Reproductive performance was relatively low for both groups of cows. Only 52 percent of the pasture group became pregnant compared to 72 percent of the cows kept in confinement. As noted above, the confinement group was in better body condition. Also, the confinement group were running as part of a larger group of cows and were kept on a dirt lot closer to the barn. All of these factors may have provided the confinement cows some advantage in heat detection. The heat detection program for the grazing group will be re-evaluated and adjusted. In future, the confinement group will be separated from other housed cows.

Three cows, 8 percent, were culled from the confinement group for mastitis (all Holsteins) but no cows were culled from the grazing group for this reason. Six cows (17 percent) in the grazing group had some lameness as a result of sharp stones in the cow lanes leading to the pastures, but none were culled. One cow in the grazing group died from bloat (a Jersey) and, based on that experience, the cows were fed an anti-bloating agent to prevent further occurrences. The anti-bloat product cost approximately 19 cents per cow per feeding, 38 cents per cow per day. It was added to the ration for 45 feedings when the risk of bloat was judged to be high, at a total cost per cow of $8.55. In future, the risk of bloat will be controlled by management rather than by medication.

New investments required to establish the grazing system included the lanes, fencing and water. The total length of the cow lanes to serve the 72 acre area is 5,400 feet at an estimated materials cost of $14,000, $2.59/linear foot, excluding labor and grading cost. Fencing cost included 11,540 feet of 6-wire perimeter fence ($.50/linear foot), 10,400 feet of 2-wire lane fencing ($.32/linear foot), and 12,800 feet of one-strand internal fencing for dividing paddocks ($.30/linear foot). The total materials cost was estimated at $14,000. Approximately one mile of 1.5 inch water line was needed to serve the paddocks, with connectors, at a materials cost of $6,200 ($1.25/linear foot). All materials costs were based on NC cost share prices.

Total materials cost for lanes, fencing and water were estimated at $33,400. If these materials costs were depreciated over 10 years, with no salvage value, the annual charge would be $3,340. Interest on investment at 8 percent would be $1,336 per year. At one cow to the acre, the combined depreciation and interest cost would be $65/cow/year. However, these costs are likely to vary widely from farm to farm, depending on layout and how the work is to be done.

Because the project is still in the early stages, no attempt was made to estimate the economic impact of the differences in reproduction and herd health. Labor differences and differences in manure handling were not evaluated either, for the same reason. After the project has been in operation longer, some light should be shed on these factors. However, it seems fair to conclude that no clear advantage to grazing was seen during this initial period and it remains to be seen whether the picture will change during the remainder of the project. With more experience in operating and managing the grazing system, economic advantages may become apparent. Also, even if the economic performance of the two systems is similar, environmental factors may give an advantage to grazing.

PRODUCTION ECONOMICS: PROFIT CONSIDERATIONS FOR GRAZING SYSTEMS

G.A. Benson

Farmers who are contemplating a switch to grazing should realize that the profitability of such a move depends on their particular circumstances. These circumstances affect the economic framework within which the decision must be made.

1. If you are a dairy farmer with a confinement facility that is in good working order then the existing facility is a sunk cost, but grazing requires a new investment. Grazing must generate a large enough margin to recoup the new investment and leave a profit compared to the confinement operation. This added margin could be obtained by increasing the margin per cow, adding cows, or a combination of both.
   (a) If grazing is treated as a supplement to a silage based forage program then the herd size remains constrained by the facility and the added margin must be generated by the same number of cows. This limit on cow numbers may be related to the parlor, housing, or manure storage capacity.
   (b). If the farm is converted to a fully fledged grazing herd then the size of the herd is determined either by the availability and quality of land for grazing by the milking herd or by the capacity of the parlor. The housing component of the facility ceases to be a constraint. Surplus equipment may be available that can be sold and the proceeds contributed to the new investment needed to establish a grazing program.

2. If the existing confinement facility needs major repairs or remodelling then the cost of the repairs or remodelling must be recouped if the herd remains in confinement. Differences in profitability between continued confinement and a grazing based herd will be affected by differences in the amount of new investment required, differences in herd size and differences in the operating margin for the two systems. For a confinement herd the limiting constraint may be the capacity the facility or the availability of land for feed production. For a grazing herd the binding constraint may be the availability of land for grazing or the capacity of the milking parlor.

3. If a new dairy farmer has an existing farm but no dairy facility, all options are open. A new grazing based dairy must be shown to be more profitable than a new confinement operation. The comparison must be based on the optimal system for each type of dairy. Cash flow considerations are important and must be considered in addition to the question of profitability.

4. If someone wants to get into dairy farming and has no farm at present, all options are open, including the location, size, type and layout of the farm. Renting or buying are both options. In this situation, a new grazing based dairy must be shown to be more profitable than a new confinement operation, including the farm investment. The comparison must be based on the optimal system for each type of dairy, given that the choice is not constrained in any way but is driven by costs and returns. Cash flow considerations are important and must be considered in addition to the question of profitability.

Clearly, there are no easy answers to questions of profitability. Decisions will be specific to individual farm situations and reliable information is a problem. Hopefully, over the next few years the project at NCSU's Lake Wheeler Road Dairy will provide information to allow more objective evaluation of alternative dairy herd management strategies. Stay in touch.

CONSTRUCTION OF FENCING, WATER LINES, COW LANES

J-M. Luginbuhl, J. T. Green, K. M. Snyder and C. G. Campbell

Introduction

The grazing area (77 acres) of the dairy unit was surveyed and divided into 38 paddocks (Figure 1). Paddocks averaged 2.0 acres in size and ranged from 1.4 to 3.2 acres. Paddock size and shape were dictated by contour lines, existing roads, existing forage crops and previous use. In addition to fences, new investments included the lanes and water lines.

Lanes

A cow lane system totaling 5,400 feet in length connects all paddocks to the milking parlor area. The lanes are 16 feet wide and were constructed using 1,990 tons of crush and run gravel ($5.25/ton) 3 to 6 inches deep. Three culverts had to be installed. Geo-textile cloth ($1.5/linear foot) was used under the gravel in parts of the lane system subject to heavy traffic. The estimated materials cost was $14,000 ($2.59/linear foot), excluding labor and grading cost. The crush and run gravel used to construct the lanes seems to be too angular for cows with soft hooves, which is the case of early lactating cows that suddenly have to walk the lane twice daily. Softer materials such as sand, limestone and pine bark would greatly decrease incidences of lameness.

Fences

The perimeter fence encompassing the grazing area measures 11,540 feet. Perimeter fence line posts (diameter: 3.5-4.5 inches; length: 6.5 feet) were spaced 50 feet apart, with 6 strands of high tensile (12.5 gauge) galvanized wire all carrying electrical current (distance from ground: 13, 18, 24, 31, 39, 48 inches). The number of strands used for the perimeter fence was dictated by NCSU farm safety regulations. On a commercial farm, 3 strands would be adequate.

The fences bordering the cow lanes total 10,800 feet in length. Lane fence line posts (diameter: 3-3.5 inches; length: 6.5 feet) with 2 strands of high tensile (12.5 gauge) galvanized wire carrying electrical current (distance from ground: 18 and 32 inches) were spaced at 50 feet intervals.

Paddocks are delimited with semipermanent fences using one strand of maxishock wire suspended at 32 inches above the ground and quick polyposts installed every 40 feet. Maxishock is a 7-strand galvanized all steel soft cable with 80 times the conductivity of polywire, a breaking strength of 200-250 lb, and an useful life of 10 years. In addition, maxishock is cut easily with common pliers and easily formed into square knots and joints with bare hands. A spring and wire tightener were installed at the end post on one side of the paddock to keep the tension up and a quick reel at the end post located on the other side. The quick reel allows for the easy installation and(or) removal of the fence to hay several adjacent paddocks at one time. The total length of fencing for dividing paddocks is 12,800 feet. During periods of lush growth, paddocks are subdivided using quick polyposts and one strand of polywire.

Paddocks are accessible from the cow lanes through a gate system set up as equidistant triangles 16 feet a side. One side of the triangle is parallel to the cow lane whereas the two remaining sides give access to two separate paddocks. Therefore, a single strand of polytape 16 feet in length, attached to two gate handles, is used to either bar entry to two paddocks (when hooked to lane posts) or to allow entry to one paddock while the other is closed. Another piece of polytape hooked up to two gate handles is used to block the lane and direct animals to the chosen paddock. The gates serving the paddocks are situated such that animals do not have to walk in the opposite direction of their destination to access the lanes.

Metallic gates are located at each farm access and public entry road to the lane system to prevent animals from escaping the grazing area and also extraneous traffic.

Fencing cost included the 6-wire perimeter fence ($.50/linear foot), the 2-wire lane fencing ($.32/linear foot) and the 1-strand maxishock cable for internal fencing between paddocks ($.30/linear foot). Alternatively, a single steel wire with 2-inch wooden posts 70 feet apart would lower the cost of internal fencing to $.05/linear foot. The total materials cost, including wire, posts, energizer, reels, cut-offs, gate handles, gates, etc. would be $14,000 using current cost-share prices.

Water lines

A 1.5-inch diameter water line system (flow rate: 14 gallons/min) having a total length of 5,200 feet gives animals access to fresh water in every paddock. The water line is buried under the lane system. Twenty-five quick couple connector lines tee off from the main line. The quick couple connectors, or snap-on valves ($16 ea), are located in underground shafts under the semipermanent fence separating the paddocks, approximately 30 feet from the lane. These connectors make water instantly available whenever a tank is hooked up to the line. In our grazing system, portable 24-gallon Mirafont ($250 ea) or 100-gallon open ($75 ea) tanks are used. Long water hoses offer the flexibility to move water tanks to different locations each grazing rotation, thus decreasing the amount of trampling and killed spots. The materials cost for the water delivery system would be $6,200 ($1.25/linear foot) using cost share prices.

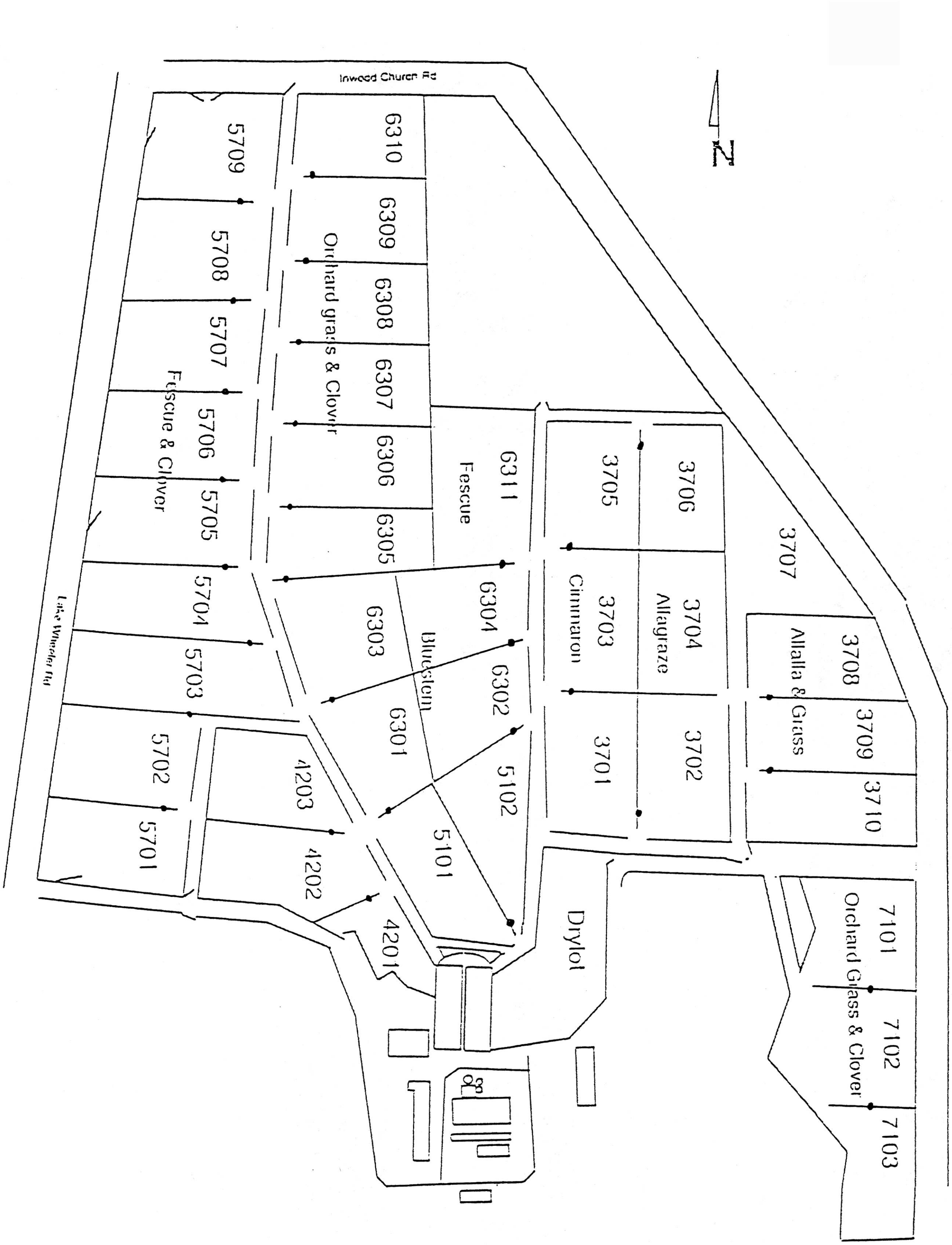

Figure 1. Layout of the grazing dairy unit
•represents quick couple connectors

EFFECT OF RATION CRUDE PROTEIN AND UNDEGRADABLE INTAKE PROTEIN ON MILK YIELD AND MILK PROTEIN CONTENT

B. A. Hopkins and A. H. Rakes

Introduction

Although many milk markets presently use a single component pricing system, there are indications that, in the future, milk pricing arrangements will be based on several milk components with increased emphasis on milk protein and less emphasis on milk fat. The increasing consumer demands for cheese, the awareness of the nutritional value of milk proteins, and the negative health related concerns regarding fat are factors that influence the change to a multiple component milk pricing system. As a result of these pricing changes, dairy farmers will benefit by implementing feeding strategies to increase the protein content of milk.

Researchers at North Carolina State University as well as those at other locations have found that feeding cows rations containing larger amounts of concentrate results in increased milk and milk protein yield and milk which contains a higher percentage of protein. It has been noted in several studies that milk protein yield and content increased when Holstein cows were changed from a normal fiber to a low fiber, high concentrate diet. There are also some indications that increasing the crude protein content of high concentrate rations fed to early lactation cows results in additional increases in total milk production, milk protein content and milk protein yield.

Undegradable intake protein, also known as bypass protein, refers to the portion of protein that escapes breakdown in the rumen and is available for absorption at the small intestine. In a recent study at North Carolina State University, first lactation Jersey cows fed soybean meal that was chemically treated to increase undegradable intake protein, significantly increased milk and fat-corrected milk production.

The objective of this study was to determine the effect of level of ration crude protein and undegradable intake protein on milk yield and milk protein content in early lactation Holstein cows.

Materials and Methods

Sixteen first lactation and twelve second and later lactation cows were randomly assigned at calving to one of the following dietary treatments:

- 15% crude protein in the total ration dry matter using conventional soybean meal as the primary protein source.

- 19% crude protein in the total ration dry matter using conventional soybean meal as the primary protein source.

- 19% crude protein in the total ration dry matter using conventional soybean meal at a level to provide 15% crude protein with the remaining 4% crude protein in the total diet provided by soybean meal that was chemically treated to increase the amount of undegradable intake protein. This treatment is shown as 19% CP PT in Table 1.

All rations contained 18% acid-detergent fiber (ADF) with chopped alfalfa-grass hay as the forage source. Cows received their assigned diets from d 30 through d 120 postpartum. Cows were fed twice daily with feed refusals recorded prior to each feeding and daily dry matter and crude protein intakes were determined.

Body weights were measured weekly and cows were body condition scored at 30, 60, 90, and 120 d postpartum.

Milk production was recorded at each milking with a.m. and p.m. milk samples collected once weekly. Composites of milk samples were analyzed for true protein, non-protein nitrogen, milk fat, casein, and total solids.

Blood samples were collected via jugular venipuncture at 30, 60, 90, and 120 d postpartum and analyzed for plasma urea nitrogen.

Rumen fluid was collected on these same days via stomach tube and analyzed for ammonia nitrogen.

Results and Discussion

First lactation cows: Milk, casein, milk fat, and fat-corrected milk production were not different among the three dietary treatments (Table 1). However, milk fat percentage increased (P<.03) with the 19% crude protein diets compared with the 15% crude protein ration (Table 1). This confirms earlier research in which we observed increases in milk fat percentage when early lactation cows being fed low fiber diets were fed a diet containing high levels of crude protein and soybean meal was the primary protein source. Milk protein percentage tended to increase (P<.18) when cows were fed the 19% crude protein diets, but there was no difference between the two 19% crude protein treatments (Table 1).

<u>Second and later lactation cows</u>: Milk production, when covariately adjusted using previous lactation milk yield, increased (P<.04) with the 19% crude protein diets (Table 1) but no advantage was observed with the diet containing protected soybean meal. Fat-corrected milk, milk fat, milk casein percentage, and milk protein percentage were not different among the three treatments.

The Bottom Line

No advantage to feeding protected soybean meal was observed in this study. We did, however, observe responses to the 19% crude protein diets.

In first lactation cows, milk fat percentage increased significantly with the 19% crude protein diets (Table 1). This confirms earlier research in which we observed increases in milk fat percentage when early lactation cows being fed low fiber diets were fed high protein levels when soybean meal was the primary protein source. Milk protein percentage also tended to increase with the 19% crude protein diets in first lactation cows (Table 1).

Milk production, when adjusted using previous lactation milk yield, significantly increased in second and later lactation cows when they were fed the 19% crude protein diets (Table 1).

TABLE 1. EFFECT OF RATION CP AND UNDEGRADABLE INTAKE CP ON MILK YIELD AND COMPOSITION

Measure	1st Lacation 15% CP	1st Lacation 19% CP	1st Lacation 19% CP PT	2nd+Lacation 15% CP	2nd+Lacation 19% CP	2nd+Lacation 19% CP PT
Milk kg/hd/da	29.7	27.0	23.0	28.4	36.5	35.1
Milk protein %	3.26	3.59	3.51	3.24	3.14	3.44
Milk casein %	2.52	2.79	2.65	2.46	2.43	2.64
Milk fat %	2.94	3.70	3.60	3.57	3.24	3.46
FCM kg/hd/da	24.98	25.79	21.62	26.57	32.34	32.26
Plasma urea N mg/dl	10.74	21.58	22.78	13.12	19.85	20.9

THE EFFECT OF RATION CRUDE PROTEIN AND UNDEGRADABLE INTAKE PROTEIN ON MILK, MILK PROTEIN, AND MILK FAT PRODUCTION BY PRIMIPAROUS COWS

M.A. Smith, A.H. Rakes, and B.A. Hopkins

In previous studies we have been able to increase the milk fat production and, to some extent, the milk protein production of cows by feeding soybean meal treated to resist rumen protein degradation. The effect has been much more striking with primiparous cows than with multiparous cows. The objective of this study was to measure the effect of feeding soybean meal [1]treated to resist rumen degradation at dietary protein levels of either 15 or 19 percent on the performance of primiparous cows.

Materials and Methods

Twenty-four primiparous Holstein cows were randomly assigned at calving to one of the following treatments: 1) 15% crude protein using conventional soybean meal; 2) 15% crude protein using treated soybean meal; 3) 19% crude protein using conventional soybean meal and 4) 19% crude protein using treated soybean meal.

All rations were formulated so that the dry matter contained 18% acid detergent fiber (ADF) with chopped alfalfa-grass hay as the forage source. Ground corn was used as the main ration energy source. Minerals were added to meet or exceed current National Research Council recommendations (1989). Cows received their assigned rations from d 30 through d 120 postpartum. They were fed twice daily with feed refusals recorded prior to each feeding. Daily dry matter and crude protein intakes were determined.

Body weights were measured weekly and body condition scores were assigned at 30, 60, 90, and 120 postpartum.

Milk production was recorded at each milking with am and pm milk samples collected once weekly. Composites of these samples were analyzed for fat, protein, casein and total solids.

Blood samples were collected via jugular venipuncture at 30, 60, 90, and 120 d postpartum and analyzed for plasma urea nitrogen.

Rumen fluid collected on these same days via stomach tube and analyzed for ammonia nitrogen.

Results and Discussion

Production data are shown in Tables 1 through 4. Increasing the ration crude protein level of primiparous cows significantly ($P<0.01$) increased milk, milk protein and milk fat production. Milk casein production was also increased ($P<0.10$). Milk protein percent was increased, but the difference was not statistically significant. These responses were as expected. Although the rumen ammonia levels shown in Table 5 are lower than would be expected, the levels in the rations containing 19% crude protein were higher than those in the ones with 15% crude protein and the values for the animals fed protected soybean meal are lower than those for the cows fed conventional soybean meal. Using protected soybean meal to increase the crude protein level from 15 to 19 percent in the rations of primiparous cows was effective in increasing milk, milk protein, and milk fat production.

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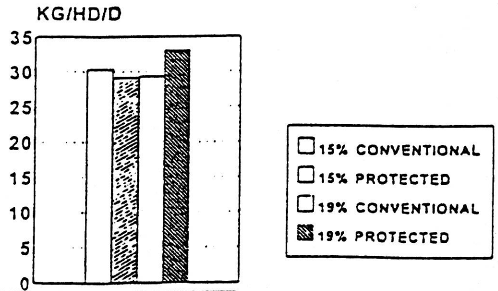
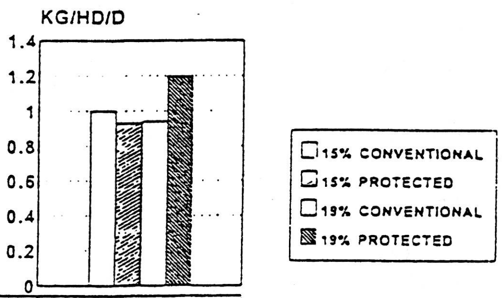
[1]Premiere Agri Technologies, Inc., Ft. Wayne, Indiana

TABLE 1. EFFECT OF FEEDING SOYBEAN MEAL TREATED TO RESIST RUMEN PROTEIN DEGRADATION AT DIETARY CRUDE PROTEIN LEVELS OF OF 15 OR 19 PERCENT ON MILK PROD. BY PRIMIPAROUS COWS



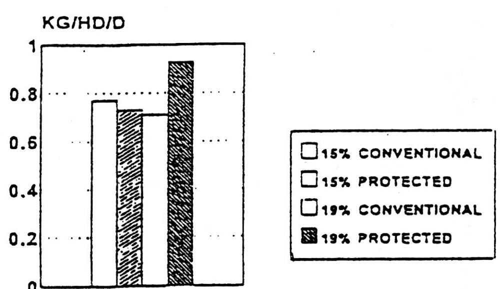
15% CONVENTIONAL	30.32
15% PROTECTED	29.14
19% CONVENTIONAL	29.32
19% PROTECTED	33.1

TABLE 2. EFFECT OF FEEDING SOYBEAN MEAL TREATED TO RESIST RUMEN PROTEIN DEGRADATION AT DIETARY CRUDE PROTEIN LEVELS OF OF 15 OR 19 PERCENT ON MILK PROTEIN PROD. BY PRIMIPAROUS COWS



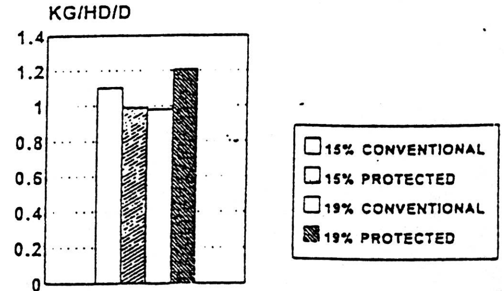
15% CONVENTIONAL	1
15% PROTECTED	0.93
19% CONVENTIONAL	0.94
19% PROTECTED	1.2

TABLE 3. EFFECT OF FEEDING SOYBEAN MEAL TREATED TO RESIST RUMEN PROTEIN DEGRADATION AT DIETARY CRUDE PROTEIN LEVELS OF OF 15 OR 19 PERCENT ON MILK CASEIN PROD.BY PRIMIPAROUS COWS



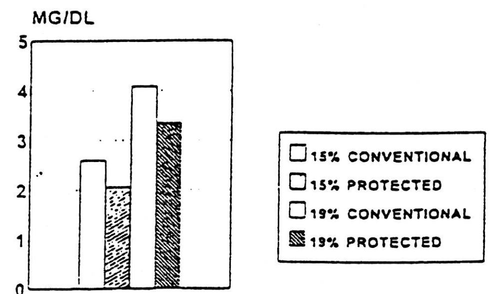
15% CONVENTIONAL	0.77
15% PROTECTED	0.73
19% CONVENTIONAL	0.71
19% PROTECTED	0.93

TABLE 4. EFFECT OF FEEDING SOYBEAN MEAL TREATED TO RESIST RUMEN PROTEIN DEGRADATION AT DIETARY CRUDE PROTEIN LEVELS OF OF 15 OR 19 PERCENT ON MILK FAT PROD. BY PRIMIPAROUS COWS



15% CONVENTIONAL	1.1
15% PROTECTED	0.99
19% CONVENTIONAL	0.98
19% PROTECTED	1.21

TABLE 5. EFFECT OF FEEDING SOYBEAN MEAL TREATED TO RESIST RUMEN PROTEIN DEGRADATION AT DIETARY CRUDE PROTEIN LEVELS OF OF 15 OR 19 PERCENT ON RUMEN AMMONIA LEVEL OF PRIMIPAROUS COWS



15% CONVENTIONAL	2.6
15% PROTECTED	2.05
19% CONVENTIONAL	4.08
19% PROTECTED	3.35

THE EFFECT OF PROTEIN SOURCE AND FIBER LEVEL ON MILK YIELD AND MILK PROTEIN CONTENT

M. K. Beal*, B. A. Hopkins, and A. H. Rakes

The amino acids methionine and lysine have been suggested as limiting or co-limiting for milk production and milk protein synthesis when dairy cows are fed corn based diets. Increasing the postruminal supply of these amino acids, by feeding supplements containing high percentages of methionine and lysine and that are also high in rumen undegradable protein, may increase milk yield and milk protein content.

Corn gluten meal and blood meal have complementary amino acid profiles, especially for the amino acids methionine, lysine, isoleucine, and valine. Corn gluten meal contains approximately 67% crude protein which is about 55% undegradable in the rumen. Blood meal contains approximately 87% crude protein of which about 82% is rumen undegradable.

The objective of this study was to evaluate the effects of feeding a 3:1 mixture of corn gluten meal:blood meal on milk yield and milk protein content when compared to a conventional soybean meal protein supplement in rations containing 16% or 21% acid-detergent fiber.

Materials and Methods

Eighteen primiparous and eleven multiparous Holstein cows were assigned at calving to one of four treatment groups, balanced for parity, using a completely randomized block design. All cows were fed a blended ration containing 16% crude protein (CP) with corn silage as the forage source. The 16% CP level was fed in order to quantify any response due to supplemental protein source. Ration treatment factors included 16% or 21% acid-detergent fiber (ADF) and either conventional 48% CP soybean meal (SBM) or a 3:1 corn gluten meal/blood meal (CGM/BM) mixture (actual weight basis) as the sources of supplemental protein. A 3:1 ratio of corn gluten meal:blood meal was chosen to supply levels of methionine and lysine postruminally that have been shown to improve milk yield and milk protein content in studies where rumen-protected methionine and lysine were fed.

Cows received their assigned rations from d 30 through d 120 postpartum. They were fed twice daily for ad libitum intake from mangers equipped with individual Calan feeding gates. Feed refusals were recorded prior to each feeding and daily dry matter and CP intakes were determined.

Corn silage, soybean meal, corn gluten meal, and blood meal were sampled monthly, dried, and ground through a Wiley mill using a 2 mm screen. Samples were analyzed for dry matter, CP, and ADF.

Cows were milked twice daily with milk weights recorded at each milking and a.m. and p.m. samples collected once weekly. Composite milk samples were analyzed for CP, milk fat, solids-not-fat, non-casein nitrogen, non-protein nitrogen, and total solids.

Blood samples were collected by jugular venipuncture at 30, 60, 90, and 120 d postpartum. Plasma was analyzed for urea nitrogen and the amino acids methionine, lysine, leucine, isoleucine, valine, and arginine.

Rumen fluid was collected via stomach tube approximately five hours postfeeding at 30, 60, 90, and 120 d postpartum and analyzed for ammonia nitrogen and volatile fatty acids.

Body weights were measured weekly at the same time of day from d 30 through d 120 postpartum and a body condition score was assigned at calving and at 30, 60, 90, and 120 d postpartum.

Data were analyzed as a randomized complete block design using the general linear models procedure of SAS with significance declared at $P < .10$ unless otherwise noted.

Results and Discussion

Cows fed the 21% ADF rations consumed less dry matter and CP with the exception of the primiparous cows receiving the CGM/BM ration.

Milk and 4% fat-corrected milk yield, milk protein percentage, milk fat yield, solids-not-fat

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production, milk non-casein nitrogen, and milk non-protein nitrogen were not different among treatments. Milk protein yield was greater ($P < .09$) for multiparous cows fed the 16% ADF diets. Milk fat percentage was greater ($P < .01$) for cows receiving the CGM/BM rations.

Cows fed the 3:1 CGM/BM protein supplement had higher milk fat percentage and greater plasma valine and leucine than those fed the SBM diets.

The Bottom Line

Protein source did not affect milk yield (milk protein content in this study. The calculate levels of rumen undegradable protein in tl CGM/BM diets were much higher than normall recommended and may have reduced rume degradable protein, thus limiting microbial protei synthesis.

Effects of Protein Source and Fiber Level on Milk Yield and Milk Protein Content

	SBM 16% ADF	SBM 21% ADF	CGM/BM 16% ADF	CGM/BM 21% ADF
1st Lactation				
Milk, lb/day	65.4	55.3	60.9	64.6
4% FCM, lb/day	55.8	48.8	52.7	59.9
Milk CP, %	3.42	3.32	3.32	3.28
Milk CP, lb/day	2.24	1.83	2.02	2.11
Milk fat, %	3.06	3.20	3.13	3.54
Milk fat, lb/day	2.00	1.78	1.89	2.27
2nd+ Lactation				
Milk, lb/day	88.0	77.8	75.4	76.3
4% FCM, lb/day	71.8	66.9	70.2	70.2
Milk CP, %	3.27	3.21	3.52	3.21
Milk CP, lb/day	2.84	2.49	2.64	2.44
Milk fat, %	2.79	3.05	3.59	3.46
Milk fat, lb/day	2.44	2.38	2.66	2.64

EFFECT OF RUMEN UNDEGRADABLE PROTEIN AND FIBER LEVEL ON MILK YIELD AND MILK PROTEIN CONTENT FROM EARLY LACTATION COWS FED CORN SILAGE DIETS

K. L. Adams* and B. A. Hopkins

Introduction

Milk protein, due to its nutritional value and in response to consumer demand, is becoming the most important component of milk. As milk pricing strategies adjust to this shift in consumer demand, dairy farmers will benefit from implementing feeding strategies that will increase milk protein content as well as milk yield.

Increasing the level of rumen undegradable protein that escapes degradation in the rumen has been shown to increase milk protein. However, degradable protein is also required to ensure optimum microbial protein synthesis. Previous studies have also shown that feeding low fiber diets has increased milk yield and milk protein content.

While high producing early lactation cows require rumen undegradable protein to optimize milk and milk protein yield, it is also important to provide degradable protein to ensure that rumen microbial protein synthesis is not compromised.

Objectives

The following experiment was designed to determine the effect of feeding a combination of undegradable and degradable intake protein using either conventional soybean meal or soybean meal that has been treated to increase the content of undegradable intake protein when cows are fed corn silage based diets. Two levels of acid-detergent fiber (21% or 16%) were fed in order to confirm the previously observed positive effect of low ration fiber on milk and milk protein yield and to note any interactions of fiber level and protein source.

Materials and Methods

Thirty-six Holstein dairy cows,(20 first lactation and 16 second and later lactation cows) were assigned to one of the following treatments in a completely randomized block design:

1). 21% acid-detergent fiber (ADF) level in the total ration dry matter (TRDM). Supplementary protein from conventional soybean meal;

2). 21% ADF level in TRDM. Supplementary protein from a 60:40 combination of soybean meal treated to protect it from rumen degradation and conventional soybean meal;

3). 16% ADF level in TRDM. Supplementary protein from conventional soybean meal;

4). 16% ADF level in TRDM. Supplementary protein from a 60:40 combination of soybean meal treated to protect it from rumen degradation and conventional soybean meal.

Cows were fed their assigned diets from d 30 through d 120 postpartum twice

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daily using Calan® feeding stations. Rations were formulated to contain 17% crude protein.

Measurements and Analyses

Milk yield was recorded at each milking with am and pm milk samples collected once weekly. Composites of these milk samples were analyzed for crude protein, milk fat, and total solids.

Blood samples were collected via jugular venipuncture at 30, 60, 90, and 120 days in milk and analyzed for plasma urea nitrogen and plasma amino acids.

Rumen fluid was collected on these same days and analyzed for volatile fatty acids and rumen ammonia nitrogen.

Body weight was measured weekly and body condition scores were assigned at 30, 60, 90, and 120 days in milk.

Data were analyzed using the General Linear Models Procedure of SAS® and significance was declared at $P < .10$.

Results and Discussion

Second and later lactation cows consumed more dry matter and crude protein ($P < .01$) and produced more milk ($P < .01$), milk protein ($P < .01$), and milk fat ($P < .01$) than first lactation cows.

Cows fed the 21% ADF diets had a higher milk fat percentage ($P < .01$) and greater milk fat yield ($P < .01$) than those fed the lower fiber diets.

Cows fed conventional soybean meal produced a greater milk protein yield than those fed the 60:40 combination of rumen protected soybean meal and conventional soybean meal.

The Bottom Line

Protein source and fiber level had no significant effect on milk yield, milk protein percentage, or total solids. No advantage to feeding the 60:40 combination of rumen protected soybean meal and conventional soybean meal was observed in this study using corn silage as the forage source.

Effects of Protein Source and Fiber Level on Milk Yield and Milk Composition

	Lactation		Protein Source		ADF Level	
	1st	2nd +	RP-SBM and SBM	SBM	16%	21%
Milk, lb/day	71.7	93.9	81.6	84.0	83.6	81.8
Milk CP, %	3.56	3.46	3.45	3.57	3.55	3.48
Milk CP, lb/day	2.55	3.26	2.82	2.99	2.97	2.84
Milk fat, %	3.30	3.21	3.13	3.37	2.79	3.71
Milk fat, lb/day	2.31	3.01	2.51	2.82	2.33	3.01

COMPARISON OF COTTONSEED MEAL TO SOYBEAN MEAL AS A PROTEIN SOURCE FOR EARLY LACTATION DAIRY COWS

J. T. Blackwelder*, B. A. Hopkins, and L. W. Whitlow

(Experiment in Progress)

Introduction

Cottonseed meal is an available supplemental protein source that is slightly lower in crude protein than soybean meal, but is higher in rumen undegradable protein. However, it is higher in acid-detergent fiber and lignin compared to soybean meal. There is a lack of information available concerning the feeding value and use of cottonseed meal as a supplemental protein source compared to soybean meal.

Objectives

This study is designed to compare cottonseed meal to soybean meal as a supplemental protein source for early lactation dairy cows and to determine the effect of an additional source of rumen undegradable protein when cows are fed a combination of corn silage and alfalfa haylage as the forage source.

Materials and Methods

Thirty-two Holstein dairy cows, balanced for parity, are being assigned to one of the following treatments with all rations formulated to contain 17% crude protein and 20% acid-detergent fiber on a dry matter basis:

1). Supplementary protein from cottonseed meal with total ration formulated to contain 33% of the crude protein as rumen undegradable protein.

2). Supplementary protein from soybean meal with total ration formulated to contain 33% of the crude protein as rumen undegradable protein.

3). Supplementary protein from cottonseed with the total ration formulated to contain 40% of the crude protein as rumen undegradable protein.

4). Supplementary protein from soybean meal with the total ration formulated to contain 40% of the crude protein as rumen undegradable protein.

Cows receive their assigned diets from 30 through 120 days postpartum. Corn silage and alfalfa silage are the forage sources.

Measurements and Analyses

Cows are fed twice daily using Calan® feeding stations with feed refusals recorded after each feeding. Daily dry matter and crude protein intakes will be calculated.

Milk yield is recorded at each milking with a.m. and p.m. samples collected weekly. Composites of milk samples are analyzed for milk crude protein content, milk fat content, milk urea nitrogen, and solids-not-fat content.

Blood samples are collected via jugular venipuncture at 44, 58, 93, and 107 days postpartum and analyzed for plasma urea nitrogen and plasma amino acids.

Rumen fluid is collected on these same days using a stomach tube and analyzed for volatile fatty acids and rumen ammonia nitrogen.

Body weights are taken once weekly and cows are scored routinely to monitor changes in body condition.

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DEEP-STACKED BROILER LITTER AS A PROTEIN SUPPLEMENT FOR DAIRY REPLACEMENT HEIFERS

B. A. Hopkins and M. H. Poore

(Experiment in Progress)

Introduction

Broiler litter is a byproduct of the broiler industry that is causing concern due to environmental impact in areas of industry concentration. Deep-stacked broiler litter can be utilized as a feed for ruminant animals. Ruminants can utilize the nitrogen (primarily from uric acid), energy, and minerals in the broiler litter.

Objectives

This study is designed to evaluate the feeding value of deep-stacked broiler litter as a supplemental protein source compared to soybean meal for growing dairy heifers and to determine the effect of an additional source of rumen undegradable protein when heifers are fed broiler litter.

Materials and Methods

Fifty Holstein dairy heifers (approximately 500 pounds body weight) are being assigned to one of the following treatments with all rations formulated to contain 14% crude protein and 68% TDN on a dry matter basis:

1). 100% of supplementary crude protein from soybean meal.

2). 67% of supplementary crude protein from soybean meal and 33% of supplemental crude protein from deep-stacked broiler litter.

3). 33% of supplementary crude protein from soybean meal and 67% of supplemental crude protein from deep-stacked broiler litter.

4). 100% of supplementary crude protein from broiler litter.

5). 67% of supplementary crude protein from broiler litter and 33% of supplemental crude protein from a source of rumen undegradable protein.

Heifers receive their assigned diets for 112 days. Corn silage and cottonseed hulls are the forage and fiber sources.

Measurements and Analyses

Heifers are fed a total mixed ration once daily using Calan® feeding stations with feed refusals recorded after each feeding. Daily dry matter and crude protein intakes will be calculated.

Ration and ingredient samples are obtained every 14 days throughout the trial and analyzed for nutrient analysis.

Body weights are taken before feeding on three consecutive days at the beginning and the end of the trial. Interim weights are taken every 28 days throughout the trial. Wither heights and body condition scores are determined at the beginning and end of the trial.

Blood samples are collected via jugular venipuncture at two hours post-feeding on day 56 of the trial and will be analyzed for plasma urea nitrogen and minerals.

Rumen fluid is also collected at this time using a stomach tube and analyzed for volatile fatty acids and rumen ammonia nitrogen.

MYCOTOXIN CONCERNS IN DAIRY CATTLE

L. W. Whitlow and W. M. Hagler, Jr.*

Introduction

Mycotoxins are poisons produced by molds commonly occurring in feedstuffs. Mycotoxin production is often related to extremes in weather conditions, plant fungal diseases and poor storage conditions. Cattle consuming mycotoxins may have an increased incidence of disease and poor production.

Mycotoxins exert their effects through three primary mechanisms: (1) changes in nutrient supply due to alteration in feed nutrient content, or absorption and metabolism by the animal, (2) changes in the endocrine and neuroendocrine function, and (3) suppression of the immune system (CAST, 1989). Schilfer (1990) listed problems of diagnosis including 1) lack of research on some mycotoxins, 2) nonspecific effects, 3) interaction with other mycotoxins or other agents, 4) difficulty of accurate sampling, and 5) complex analysis.

Our experience suggests that while a definitive diagnosis cannot be made directly from symptoms or specific tissue damage, it is helpful to: 1) Realize that mycotoxins can be an important primary factor causing disease and production losses. 2) Relate symptoms to documented effects. 3) Look for systemic effects as well as specific damage to target tissues. 4) Post mortem examinations often indicate severe gut irritation and usually liver damage. 5) Rule out other possible causes. 6) Analyze feeds for common mycotoxins. 7) Observe for responses to treatments.

Animal symptoms which may suggest a mycotoxin problem include: reduced feed intake or feed refusal; subnormal production; unthriftiness; rough hair coat; undernourished or parasitic appearance; higher incidence of disease, particularly metabolic disorders in fresh cows; poor response to veterinary therapy; intermittent diarrhea, sometimes with bloody or dark feces; increased abortions or embryonic mortalities; and poor reproductive performance. Only a few or many symptoms may be obvious.

The most common mycotoxins thought to be of concern to dairy producers are aflatoxin, deoxynivalenol (DON), zearalenone (F-2), and T-2 toxin (T-2). Due to lack of observation and analysis, other mycotoxins may not be identified.

Aflatoxin

Aflatoxin, produced primarily by *Aspergillus flavus*, is a carcinogen and thus regulated by FDA to no more than 20 ppb in lactating dairy feeds and 0.5 ppb in milk. Aflatoxin is excreted into milk in the form of aflatoxin M1 with residues equal to about 1.7% of the dietary level (Van Egmond, 1989). Regulatory pressures and awareness have helped minimize aflatoxin problems.

Fusarium Produced Mycotoxins

Common *Fusarium* produced mycotoxins are DON, zearalenone and T-2. All three can affect dairy cattle by reducing feed intake and causing intestinal irritation. Zearalenone is estrogenic and can result in reproductive disorders. T-2 is more potent and may cause hemorrhage and diarrhea. DON as well as the other *Fusarium* mycotoxins may serve as markers for moldy, mycotoxin contaminated feed and thus the possible presence of other mycotoxins or factors more toxic than these mycotoxins. Research is insufficient to establish exact tolerable levels but the following levels in the total diet may suggest a problem and warrant attention: 300 to 500 ppb DON, 100 ppb T-2 and 200 to 300 ppb zearalenone.

Mycotoxin Testing

Analytical techniques for detecting mycotoxins have limited research and field

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diagnosis, but improvements are being made rapidly. In 1993 the North Carolina Department of Agriculture began providing mycotoxin analyses as a part of the "N. C. Farm Feed Testing Program." Mycotoxins are now analyzed as a special request item at no charge.

Because molds grow in spots, mycotoxin levels are highly variable within a feed and thus sampling is difficult. In silages, the face provides the best estimate of daily feeding levels. Collected samples should be preserved and delivered to the lab quickly to avoid growth in the sample. Samples can be dried, frozen or treated with a mold inhibitor before shipping.

Prevention and Treatment

Acceptable levels of mycotoxins should be conservatively low due to nonuniform levels in feed, uncertainties in sampling and analysis, the potential for more than one source in the diet and lack of research on tolerable levels.

Prevention of mycotoxin formation is essential since there are few ways to completely overcome problems once mycotoxins are present. Following proper silage making practices can help prevent mycotoxins. Some forage additives such as ammonia, propionic acid and microbial or enzymatic silage additives can reduce mold growth. Silo size should be matched to herd size to insure daily removal of silage at a rate faster than deterioration. Feed bunks should be cleaned regularly. High moisture grains should be stored at proper moisture contents and in a well maintained structure. Grains or other dry feed such as hay should be stored at a low moisture content (<14%). Aeration of grain bins is important to reduce moisture and moisture migration.

If high levels of mycotoxins occur, dilution or removal of the contaminated feed is preferable. It is often impossible to completely replace some feeds in the ration, especially the forage ingredients. Increasing nutrients such as protein, energy and antioxidants may be advisable. Research shows a potential reduction of mycotoxin effects when adsorbent materials such as clays (bentonites) are added to diets of some species (Galey et al., 1987; Lindemann et al., 1991; Scheideler, 1990; Hays, 1990 and Smith, 1980). Adsorbent materials are not approved by the FDA for the purpose of prevention or treatment of mycotoxicoses. Unbalanced diets, acidic diets or other stresses may exacerbate effects of mycotoxins.

Areas of Needed Information

CAST has recently published a list of major needs for research (CAST, 1979). Some of our efforts which were included in their list are: surveillance of feeds for mycotoxin presence and quantity, assessment of control methods, improvement of sampling and analysis, and improved understanding of effects on animals.

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EVALUATION OF SIMPLE, QUICK AND INEXPENSIVE COWSIDE TESTS TO IDENTIFY SUBCLINICAL MASTITIS INFECTIONS.

B. T. McDaniel, K. L. Anderson*, and J. C. Wilk

The objective was to evaluate cowside measures of electrical conductivity to identify subclinically infected quarters in dairy cows, particularly those with high Somatic Cell Counts (SCC), and the type of organisms causing infections. Such information, if accurate, would allow producers to make the most profitable decision on each high SCC cow - to treat, dry off an offending quarter, or cull the cow - without the delay and expenses of obtaining bacteriological cultures on each quarter.

Our previous experience has shown that widely available small, easily-used hand-held meters that measure electrical conductivity are both accurate and inexpensive (about $50), but do require a few ounces of milk. Our preliminary research did identify a commercially available device, the MAS-D-TEC®, that only required a small amount of milk that could be squirted directly into the device's opening. Initial screening for all work reported was with the MAS-D-TEC®.

All nonclinical quarters of 237 Holstein cows in four herds and 110 Jerseys were screened at one or more milkings. Because the objective was to determine subclinical infections, quarters with abnormally appearing milk were not used. Samples were further evaluated in the laboratory for electrical conductivity and pH. Percentages of lactose, fat and protein as well as SCC were measured at the Blue Ridge DHI lab.

Single MAS-D-TEC® devices were purchased at three different times by normal university purchase orders. At least one month elapsed between all purchases. Thus, the instruments should represent varying times of manufacture and be representative of the ones that producers would obtain. Readings by the three devices on the same sample of milk were similar with a correlation of .995.

Unadjusted averages by MAS-D-TEC® reading for lactose, SCC and bacterial culture results are in Table 1. As MAS-D-TEC® reading increased, so did SCC, SCC Score and % infected with major pathogens. Lactose showed the opposite trend, decreasing as MAS-D-TEC® increased. Percent of quarters infected and those infected with major pathogens also increased.

Electrical conductivity of milk from different quarters of the same cow the same day was a particularly sensitive predictor of SCC and glands infected with major pathogens. These differences are shown in Table 2.

Summary

At least one simple, quick cowside tester based on electrical conductivity can be useful in identifying udder quarters that have abnormally high Somatic Cell Counts. It can also aid in identifying quarters that have an above average probability of being infected with major pathogens.

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* College of Veterinary Medicine

® MAS-D-TEC is a registered trademark of Westcor, Inc., Logan, Utah

Table 1. Averages for samples from individual non-clinical quarters of Holsteins by MAS-D-TEC® reading.

MAS-D-TEC® reading	N	SCC	Pathogens Cultured Major	Lactose
		('000)	---%---	---%---
0,1	74	261	5.1	5.12
2	78	331	12.2	5.05
3	92	229	10.3	5.03
4	75	269	7.6	5.00
5	51	524	10.7	4.76*
6	30	866**	19.6**	4.71**
7	29	877**	3.3	4.51**
8	88	1323**	31.0**	4.58**
9	78	2627**	33.0**	4.23**

*Indicates differences at $P<.05$ from MAS-D-TEC® reading of 1 or 0.
**Indicates differences at $P<.01$ from MAS-D-TEC® reading of 1 or 0.

Table 2. Association of differences in MAS-D-TEC® readings of different non-clinical quarters of cows with bacterial culture results from the higher quarter.

Differences in MAS-D-TEC®	With bacteria growth	With culture of major pathogens
	----------------%--------------	
0	27	8
1	30	9
2	31	23
3	38	19
4	50	31
5	56	50
6	71	54

MILK ANTIMICROBIAL RESIDUE RESEARCH

K.L. Anderson,* J.E. Rushing,** D. P. Wesen,*** W. A. Moats,**** and J. O'Carroll*

Introduction

Antimicrobial residue detection and avoidance are major concerns for the dairy industry. In the late 1980's, residues were reported in samples of market milk. The development of new testing methods, such as the Charm II test, which detect very low levels of antimicrobials may be a major factor in the increased detection of these residues. This report summarizes major findings of research by this group.

Potential for Oxytetracycline (OTC) Administration by 4 Routes to Produce Milk Residues

The purpose was to determine the potential of 4 routes of OTC administration in lactating cows to produce milk OTC levels above the FDA - established "safe" level of 30 ppb. The routes studied, doses administered and results of the testing are given in Table 1. Administration of OTC to lactating cows by other than the oral route at approved doses is extra-label drug use and appropriate milk/meat withholding times and residue monitoring are necessary. Use of OTC by the IV and IM routes has considerable potential to cause milk residues. The first milkings of cows treated IV, IM at the doses studied had high drug levels and could contaminate bulk milk in herds with a large number of cows. Oral administration of OTC as studied here did not produce milk OTC concentrations above the safe level, and appeared to have considerably less potential than IM and IV to produce residues.

Test Performance

The performance of the Charm II test for tetracyclines was compared to a chemical method, high performance liquid chromatography (HPLC). It is important to emphasize that the Charm II test is intended primarily for testing of raw, commingled tank milk and was used here on milk from individual cows. In total, 292 individual milk samples were tested by both methods. Results are in Table 2. Of the 172 samples negative by HPLC, 27% were presumptive positive by the Charm II test. These results demonstrate that samples containing OTC at safe levels as evaluated by HPLC may be presumptive positive by the Charm II test.

Beta-lactam Residue Research

Testing for beta-lactam antibiotics (primarily penicillin and cephalosporins) is a priority for the dairy industry. It is a requirement that every tanker load of milk is tested for beta lactams prior to processing. Based upon the importance of testing for beta lactams, we compared the ability of the Charm II test and HPLC to detect residues of 2 beta lactams following extra-label use.

Two injectable beta lactam antibiotics (ampicillin trihydrate, Polyflex; and amoxicillin trihydrate, Amoxi - inject) were administered at extra-label doses of 22 mg per kg IM to 6 lactating cows per drug. Milk concentrations of drugs after treatment were measured by HPLC and Charm II tests. Even at extra-label doses, milk residues were not detected beyond the labeled milk withdrawal times of 48 hours for ampicillin and 96 hours for amoxicillin. These

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results, however, should not be considered a recommendation to use such drugs at extra-label doses without concern for extended milk and meat withholding times.

When the residue status of 84 milk samples per drug was evaluated by the Charm II and HPLC tests, results were as in Table 3. These results, based on testing milk from individual cows, indicate that the Charm II test may test positive for milk samples containing residues below the FDA tolerance level of 10 ppb as evaluated by HPLC. The results demonstrate the considerable sensitivity of the test.

Use of 6 Screening Tests for Detection of Beta Lactam Milk Residues Following Intramammary Treatment

Lactating Holstein cows with clinical mastitis were treated by the intramammary (IMM) route with commercial infusion products (cephapirin sodium, 5 cows; amoxicillin, 4 cows; penicillin G, 4 cows). Composite milk samples were tested from treated cows after the label withdrawal time for the respective products. Each sample was tested by 6 commercial screening tests for beta-lactams. All tests gave at least one positive test result per drug after the completion of the labeled withholding time, except for one test, which gave no positives for cephapirin. These are presumed to be false positives, since they are beyond the withholding time. Testing underway using HPLC will be used to determine final status. Presumptive false positives were most common when milk was abnormal. The occurrence of false positives when testing individual cow milk samples is well known. Testing of individual cow milk samples may give erroneous positive results and testing of abnormal appearing milk samples is not recommended.

Conclusions:

Use of screening tests for antibiotics in milk has contributed to assuring the safety of the milk supply. These tests are primarily approved for raw commingled milk. Although the research here demonstrates concern relative to presumptive false positive tests results when testing milk from individual cows, these results may not reflect performance of the tests on commingled milk.

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TABLE 1 -- INVESTIGATION OF POTENTIAL OF OTC ADMINISTRATION BY 4 ROUTES TO PRODUCE MILK OTC ABOVE THE FDA SAFE LEVEL OF 30 PPB (N=6 LACTATING COWS/ROUTE)

Route	Dose	Extra-label	Time for mean OTC to reach safe level	Residue potential
IV = intravenous	16.5 mg/kg	Yes	$\leq$ 96 hours	Considerable
IM = intramuscular	11 mg/kg	Yes	$\leq$ 132 hours	Considerable
IU = Intrauterine	2g/cow	Yes	$\leq$ 84 hours	Much less than IV, IM
Oral	375mg/cow/day	Yes	All tests below safe level	Much less than IV, IM

TABLE 2 -- COMPARISON OF CHARM II TO HPLC TEST RESULTS ON 292 INDIVIDUAL COW MILK SAMPLES

	Charm II test results		
HPLC concentration, OTC ppb	Positive	Negative	Total
>30 ppb OTC (positive)	119	1	120
20-30 ppb OTC (negative)	17	4	21
<20 ppb OTC (negative)	30	121	151
TOTALS	166	126	292

TABLE 3 -- COMPARISON OF CHARM II AND HPLC TEST RESULTS FOR AMPICILLIN AND AMOXICILLIN MILK RESIDUES

	Ampicillin	Amoxicillin
Agree	74 (88%)	65 (77%)
Disagree*	10 (12%)	19 (23%)
TOTALS	84	84

* Charm II test positive and HPLC negative for ampicillin or amoxicillin at 10 ppb tolerance level.

INFLUENCE OF GENETIC DIVERSITY ON VIABILITY IN RANDLEIGH JERSEYS

J. C. Wilk and B. T. McDaniel

Genetic diversity has become a topic of interest due to recent attention on increased inbreeding resulting from intense selection in Jerseys. Proven sires most noted for increasing yield have been used extensively. Their sons are chosen for sampling in AI and most replacement females are their daughters. This trend has been evident for several years so most Jersey AI sires are closely related to the female population.

One strategy to overcome closely related matings is to use semen from bulls proven in other Jersey populations in the world that are unrelated to US Jerseys. Denmark is a potential source since it has a large Jersey population and effective sire proving program. US semen has been used in Denmark but most of their AI proven bulls are unrelated to US Jerseys.

During 1985 and 1986, a cooperative national project sponsored by The American Jersey Cattle Association (AJCA) and the Danish Jersey Society (DJ) resulted in an exchange of semen from unproven bulls. Ten units of semen from each of 11 Danish bulls brought to the US were used in the Randleigh herd. Semen was also obtained from selected proven Danish bulls for use in the Randleigh herd. The objective of using Danish semen was to establish a Danish line for comparison with existing lines on various economically important traits.

A research project on selection for milk yield has been in progress in the Randleigh herd since 1967. A proven sire line has been developed by the continuous use of the highest available proven sires ranked on PTA Milk. A pedigree sire line was developed from the continuous use of young sires selected on the PTA Milk rating of their sire and dam. Semen from the young Danish bulls was used on randomly selected pedigree line females and proven Danish bulls were used on a randomly selected group of proven line heifers. Daughters of Danish sires were first mated to proven US bulls and later to unrelated proven Danish bulls. Heifers with 1/2, 1/4, and 3/4 Danish genes were included in the Danish line for analyses.

Data from heifers born from matings made November 1, 1984 through October 31, 1991 were used so all daughters of Danish bulls and their contemporaries from other lines would be included. A summary in Table 1 shows the number of calvings and heifers born from the different lines. A total of 24 sets of twins (1.89% of calvings) were born from these 1273 calvings. Only 1 heifer (born twin with a bull) of the 13 from sets survived to calve. Only single birth calvings were used in mortality and survival analyses.

Heifer mortality was summarized by four periods; 1) heifers dead at birth (DOA), 2) losses from birth to 3 months of age, 3) losses from 3 to 12 months of age, and 4) losses from 12 months to first calving. Line, birth month, and birth year were included as variables in analyses.

The Danish line had higher survival rates at each period than US lines but differences were not significant. Month of birth had an important influence ($P<.01$) on heifers DOA. July and September were more favorable months for heifers to be born for survival. Heifer losses were high in January and February, but March was least favorable for survival. The influence of birth month on survival diminished at each subsequent evaluation period.

A slightly higher percentage of calvings in the Danish line resulted in a heifer calf. More importantly, a higher percentage of them survived. Danish line heifers had a distinct advantage over US lines in survival to first calving (94% vs 84.1% for Proven and 81.6% for Pedigree lines). Year differences were significant ($P<.05$) for all survival periods.

Summary and Conclusions

Heifers with 25% or 50% Danish genes had lower mortality and higher viability. Most likely the differences were due to the heterotic effects of the crossing of relatively unrelated Jersey lines. The most important advantage is the higher number of heifers born that survive to calve which is a clear economic advantage.

Table 1. Numbers of calvings and mortality of single-birth heifers.

	Proven line	Pedigree line	Danish line
No. Calvings	884	238	151
No. Heifers born	429	109	77
Losses			
Born dead (DOA)	32	10	3
Birth to 3 mo	24	6	2
3 mo to 12 mo	8	2	1
12 mo to calving	4	3	0

Table 2. Heifers born from all calvings and survival to specific periods.

	Proven line (%)	Pedigree line (%)	Danish line (%)
Heifers born	47.6	43.8	52.1
Alive at birth	92.7	90.4	97.1
Alive at 3 mo	87.6	85.9	95.0
Alive at 12 mo	85.9	84.6	94.6
Survived to calve	84.7	81.6	94.0

WASTE MANAGEMENT SYSTEM
Dairy Educational Unit
Lake Wheeler Road Field Laboratory

James C. Barker*, Allen Y. Broadwell, and Charlie Campbell*****

Dairy components for handling, storing, treating and using the manure, washwater, and lot runoff have undergone substantial changes due to expansion, renovation, demonstration and research activities. Much of the farm has been converted to a predominant pasture-based system for one-half of the herd, while the other half continues to be managed conventionally. This article describes the existing waste handling facilities originally planned for the entire herd.

Milking Center

Water used in the heat exchangers to precool the milk is collected in a 475-gal tank at the head of each milk alley and reused to flush the parlor and holding area floor after each milking. These steel tanks have a 23-in diameter automotive-type tire valve opened and closed by an electric gearmotor. Flushed manure and wastewater are collected in a gutter covered by a metal grate across the lower end of the holding area, then routed to another gutter across the lower end of the adjacent free-stall barns. All parlor manure and wastewater including milkroom washwater and floor drainage are routed to a manure separation area.

Free-Stall Barns

The free-stall feeding and lounging areas consist of two roofed metal frame barns completely open on the end and side walls for maximum ventilation. The north wall has a curtain which can be raised during the winter to minimize the draft on the animals. Roof eave heights are at least 12 ft above ground. Each barn has a 20-ft wide drive-through feed alley with a single row of free-stalls on each side. Each row has 48 free-stalls for a total of 192 in both barns. Free-stall dimensions are 4 ft by 7 ft divided with cantilever metal pipe loops. Free-stall bases include clay soil, soil on geotextile fabric, buried tires, wood shavings and shredded paper. Cow lanes between the feed alley and free-stalls are 16 ft wide, 192 ft long, slope 2%, and are grooved lengthwise. There is an 11-ft wide cow lane across the upper and lower ends of the barns also under roof. Each row of free-stalls has waterers at each end and the middle.

Flush System

The free-stall cow lanes were originally equipped with mechanical alley folding-wing manure scrapers. Recent renovations have converted from scrapers to flushing. At the uppermost end of each lane, there is a 3,000-gal steel flush tank sitting on a concrete pad at ground level. These tanks are filled with liquid recycled from a second-stage lagoon. They are constructed of 1/4-in steel plate and painted with acryllic urethane enamel to resist corrosion. Each tank has an automotive-type tire valve with a manual lever for opening or closing. A 3-hp electric centrifugal pump with a suction intake floating near the lagoon surface returns liquid to the flush tanks through underground 4-in PVC main line and 2-in lateral lines. The lanes are flushed from 1 to 3 times daily depending on the weather and how much time the cows spend in the barns. It is extremely important that the lane concrete surface be level from side to side for proper cleaning.

Solids Separation

All flushed manure and wastewater are collected in a gutter 20 in wide by 22 in deep across the lower end of the free-stall lanes and transported to a collection tank. This reinforced concrete tank is 20 ft by 20 ft and varies from 10 to 12 ft deep. A manure solids handling trash pump mixes and lifts the contents of this tank to a stainless steel vibrating screen separator where the coarse, fibrous solids are removed from the liquids and finer organics. The separator has a 20-mesh screen 4 ft in diameter. Solids larger than 0.033 inch are moved to the outside of the screen and drop from the separator into either a manure spreader or a mixer wagon. They can be field spread directly or stacked and composted. The liquids flow from the separator to a first-stage anaerobic treatment lagoon.

When the animals have access to the adjacent dirt exercise lots and pasture paddocks, they track stones and gravel stuck to their hooves back onto the concrete cow lanes. These stones are flushed into the manure tank and cause problems with the pump and mechanical

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separator. A shallow reinforced concrete settling basin was constructed to intercept the flushed gutter wastes and allow the stones and any other large debris to settle by gravity before entering the tank. This basin is 15 ft wide, 40 ft long and 32 in deep with a sloping access ramp in one end. A tractor front-end loader is used to remove the settled materials from the basin.

Dirt Exercise Lots

Approximately 3 ac of open bare dirt exercise lots are adjacent to one of the free-stall barns. Cattle from this barn (92 head) have access to these lots which are divided into paddocks with electric fencing tape. Organic matter has recently been scraped and removed from these lots and they have been regraded and shaped. Since rainfall runoff from these lots contain sediment, organic solids and nutrients, it must be controlled or filtered. A reinforced concrete settling basin was constructed at the low point of the lot to intercept all rainfall runoff. This basin is 20 ft wide by 40 ft long and 3 ft deep with a sloping access ramp. Sediment, manure solids and other debris settle in the basin and are removed with a front-end loader after each heavy rain. The liquids which drain from this basin flow through 600 ft of grassed waterway where much of the nutrients are filtered and removed from the runoff.

Manure Treatment Lagoons

There are two manure treatment lagoons. The first-stage or primary lagoon provides anaerobic biological treatment of the manure and reduces the organic matter, odor level and nutrients. It has 408,750 cubic ft of treatment and sludge storage volume or 2,125 cubic ft per cow based on 100% confinement of the entire herd. Liquid overflows from this lagoon surface into the second stage which serves as storage for additional polishing until it can be irrigated onto the surrounding fields. This lagoon has 348,210 cubic ft of liquid volume (1,815 cubic ft per cow) or 1 year's storage. Both of these lagoons have enough space above the maximum liquid level to store a 25-yr, 24-hr rainfall (6 in) and still have at least 1 ft of freeboard to the top of the dam.

Field Irrigation

A stationary irrigation pump at the second lagoon with a floating suction intake can send liquid to one of two irrigation systems. The 500-gpm centrifugal irrigation pump is driven by a 120-hp diesel power unit. The system consists of underground 6-in PVC mainlines to dry hydrants at strategic points on the farm. A 3.1-in hard-hose reel travelling irrigator with a gun sprinkler can be connected to the hydrants and used to irrigate cropland. Before the farm converted to predominately pasture, a second irrigation system was installed on 21 ac of existing fescue and bermudagrass pasture to allow irrigation when the crops could not be irrigated or could not use the nutrients. This irrigation system is permanent with below-ground PVC main lines and laterals. Quick-disconnect couplers with spring-loaded valves were installed on an 80 ft by 80 ft spacing. Single-nozzle sprinklers are 9/32-in diameter applying approximately 16 gpm per nozzle. Approximately one-half of the sprinklers can be used together covering about 7 ac. The risers and nozzles can quickly be moved to different areas of the field. The couplers are at ground surface such that when the riser and sprinkler is removed, cattle can graze and mowing equipment can be operated over them.

Performance and Summary

Since one-half of the herd now spends most of their time on pasture, less manure has to be collected, stored and handled. Converting from cow lane mechanical scrape to flush has reduced maintenance on both the scrapers and, particularly, the solids separator pump, and is keeping the alleys cleaner. Water conservation (washwater usage, roof rainwater, and surface drainage from areas other than feedlots) should always be practiced to minimize the amount of wastewater to be collected and land applied. Management of the cow exercise dirt lots continues to be an important challenge. Future activities include composting and stabilizing the separated manure solids so they can either be marketed off-farm or stored for better nutrient and labor management. Also, sludge from the primary lagoon will need to be agitated, analyzed, removed and land applied.

Water Quality and Dairy Farming

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Maintaining excellent water quality is essential for continued economic growth and the high quality of life enjoyed in North Carolina. Dairy farming is one of many potential sources of water pollution that is being studied. This paper describes potential problems associated with dairy farming in the state and how these can be minimized.

North Carolina Water Quality

North Carolina has a Water Quality Standards Program consistent with the 1972 Federal Clean Water Act. All surface waters in the state are classified according to their "best uses." The Division of Environmental Management (DEM) is responsible for ensuring that waters meet quality standards supporting these uses. DEM rates surface waters as either *supporting*, *partially supporting*, or *nonsupporting* of their classified uses. Water quality monitoring results from over 500 sites across the state provide data for the ratings.

DEM publishes a report summarizing water quality every two years. The most recent edition is the 1992-1993 305(b) Report, "Water Quality Progress in North Carolina," which summarizes available information on water quality and describes programs designed to reduce water pollution.

DEM uses monitoring and professional judgment in attempting to determine sources and causes of pollution for waters not supporting their uses. Both *point sources*, such as wastewater discharges, and *nonpoint sources*, such as agricultural runoff, are evaluated. Estimates of the contributions of pollution sources to water degradation are intended for use in directing agency efforts and not for providing absolute representations of water quality problems.

The most recent 305(b) Report estimated that 67% of the state's 37,536 miles of freshwater rivers and streams supported their intended uses, 21% partially supported uses, 4% did not support uses, and 8% were not evaluated. River basins located in the mountains had the highest percentages of use-supporting streams, while more heavily developed piedmont and coastal plain basins had more impaired streams. Nonpoint sources are estimated to account for 78% of the total impaired stream mileage (partial and nonsupporting streams), meaning that *about 20% of the total stream mileage in the state was impaired by nonpoint sources*.

Major suspected sources in impaired stream miles were agricultural runoff (56%), urban runoff (12%), point sources (11%), and construction (10%). Major suspected causes of degradation were sediment (39%), fecal coliform bacteria (6%), and low dissolved oxygen (4%). Sources and causes for many of the impaired streams were unknown.

Potential Water Quality Problems

While the state's 305(b) Report does not report specific water quality problems associated with dairy farming, many studies are underway to determine potential pollutants and how to reduce these. The NCSU Dairy Educational Unit is one of four dairy farming sites where water quality is currently being monitored. The major pollutants of concern are:

Sediment. Erosion from pastures, cattle holding areas, cropland, and streambanks leads to sediment entering streams and rivers during rainfall. Sediment is the most common water quality problem associated with agriculture. Excess sediment in streams and rivers causes problems by clogging downstream water intakes and destroying habitat for fish and aquatic insects.

Nutrients. Nitrogen and phosphorus are the most common nutrients causing water quality problems. These are dissolved in stormwater runoff or attached to eroding soil particles. Nutrients in streams and lakes cause excessive growth of algae and other vegetation, sometimes causing fish kills and nuisance conditions. Monitoring at dairy farms has shown very high nutrient levels, especially where runoff from holding areas is severe and where cattle have unlimited access to streams.

Organic Waste. When organic materials break down in water, oxygen is used up. In the summer when water flow is low and temperature is high, low dissolved oxygen levels can lead to fish kills. Monitoring has shown that manure runoff from holding areas can result in very low stream oxygen levels.

Pathogens. Animal waste contains bacteria and other microorganisms that are potentially harmful to humans using water for drinking or swimming. The most common measure of pathogens in water is fecal coliform bacteria. These bacteria are excreted by warm-blooded animals and are indicators of other potential pathogens. Monitoring at dairy farms has shown fecal coliform bacteria levels as high as 2 million counts per 100 milliliters, or 10,000 times the state standard for surface waters. Levels are especially high where cattle have unlimited access to streams. Recent concerns have arisen about possible contamination by other pathogens including the protozoa cryptospordium and giardia. Outbreaks of disease in Milwaukee and other cities have been attributed to animal waste entering water supplies.

Water Quality Regulation

North Carolina's Water Quality Nondischarge Rule for Livestock Farms provides a mechanism to prevent water quality problems and help farmers better understand what is required to control pollution from their farms. The agricultural community is responsible for developing and maintaining animal waste management plans and records. The rule provides farmers flexibility to develop and adapt technology and best management practices (BMPs) to site-specific conditions.

Under the Nondischarge Rule, dairy farms with waste management systems designed to serve a capacity of 100 or more animals must follow the required registration and certification procedures for existing, new, or expanded waste management systems. Personnel at local Soil and Water Conservation District offices and Cooperative Extension Centers can provide further information and assistance to help farmers comply with state regulations.

BMPs for Water Quality Protection

The best way to reduce nonpoint source pollution is to keep potential pollutants out of stormwater runoff and away from streams.

Some common BMPs for protecting water quality are:

Wastewater Reduction. Divert clean water away from cattle holding areas using diversions, roof gutters, and subsurface drains. Reduce spillage from cow waterers in holding areas. Scrape lots frequently. Control erosion with vegetation and settling basins at the lot edge. Minimize the amount of water used in milking center cleaning. Handle lot runoff water and milking center water separately from manure storage facilities. If free-stall barns are flushed, use recycled liquid from treatment lagoons.

Heavy Use Areas. Keep dirt lots as far away from streams as possible. Use terraces and settling basins to trap solids and prevent sediment runoff. Rotate lots where possible. Scrape manure from unused dirt lots and seed with grass. Use geotextile filter fabric and gravel to improve drainage and prevent muddy conditions.

Pastures. Keep pasture feeding and watering areas away from streams. Move portable feed bunks frequently. Stabilize lanes and areas around permanent waterers with geotextile fabric, gravel, or concrete. Use rotational grazing to improve pasture productivity. Provide easy access to water and shade to maximize grazing time.

Stream Fencing. Stabilize eroding streambanks by fencing cattle out of streams degraded by cattle lounging. Fence out streams and wet areas next to heavy use areas. These may be grazed periodically during dry periods to reduce excessive vegetation if desired.

Stock Trails and Stream Crossings. Plan lanes for efficient cow movement. Keep lanes on the contour and away from streams as much as possible. Stabilize lanes with geotextile fabric and gravel. Provide stream crossings consisting of geotextile fabric and gravel, concrete slabs, or culverts where necessary.

Wastewater Handling. Size the holding pond to provide enough storage so that winter application is not necessary. Lower pond levels in the spring and summer by applying water to growing crops. Use settling basins to keep manure solids out of the holding pond. Irrigate water to meet crop and soil requirements without resulting in runoff of excess water or nutrients. Keep irrigation water as far away from streambanks as possible.

Vegetative Filters. Use grassed waterways, pastures, or crop fields as vegetative filters to settle solids from wastewater, infiltrate liquid into the soil, and provide nutrients for vegetation. Maintain a solids settling basin before the vegetative filter to prevent clogging of the filter. Divert outside surface water away from vegetative filters.

Manure Handling Systems. Seek expert assistance in designing the appropriate manure handling system for your operation. Consider water quality protection in determining the location, size, and management of manure storage and handling facilities.

Summary

As our water resources face increasing pressures from population growth, agriculture must work cooperatively to find the most effective and economical ways to protect water quality and maintain productivity. Information collected at the NCSU Dairy Educational Unit and other facilities will be used to provide dairy producers with the best management practices needed to accomplish this.

DETERMINATION OF UTERINE ARTERY DIAMETER FOR THE PREDICTION OF GESTATION LENGTH IN PREGNANT HOLSTEIN DAIRY CATTLE

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Introduction:

Dairy practitioners are often asked to diagnose pregnancy and predict fetal age in bull bred cows with unknown breeding dates Within these management systems veterinarians are staging the gestation of cows bred at 3 to 6 month intervals. Proper prediction of gestational age is important for accurately assessing the time of drying-off and for milk withholding times after dry-off treatments. Many practitioners use the uterine artery as a predictor of fetal age. Unfortunately, there is no report of an accurate, objective study to confirm these measurements. With the development of ultrasonography we are better able to address these questions and begin to define reliable measurements for the bovine practitioner. Many studies have been done in cattle using trans-rectal B-mode ultrasonic imaging, however none have identified a consistent fetal measurement which can be monitored through the later stages of gestation. More recently the ultrasound has been used by practitioners to confirm early pregnancy (day 25) and to predict fetal sex (days 55 to 75).

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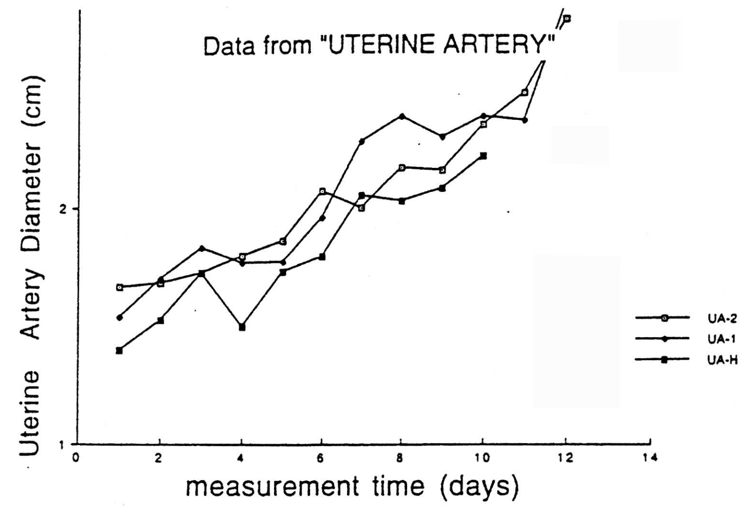
Materials and Methods:

Thirty-six Holstein dairy cows housed at The North Carolina Department of Agriculture Butner Dairy and 24 Holstein dairy cows housed at North Carolina State University Lake Wheeler Road Dairy were used in this study. Of the thirty-six animals at Butner, 12 were pregnant heifers, 12 were first lactation, and12 were second lactation or greater. Of the 24 animals at Lake Wheeler, 10 were pregnant heifers, 7 were first lactation, and 7 were second lactation or greater. All of the cows were bred artificially between 5/21/94 and 10/20/94 and confirmed pregnant at 35, 60 and 120 days. All cows were carrying single horn pregnancies, and delivered calves between 275 and 290 days of gestation. The 12 heifers at Butner were synchronized with 2 doses of prostaglandin timed 11 days apart bred, and all calved within a 3 day period. The heifers at both Butner and Lake Wheeler were maintained as a group on pasture. The cows were maintained in freestalls at both facilities. Uterine artery measurements were taken with a 5.0 mHz linear array probe. The probe was positioned perpendicularly on the uterine artery within the broad ligament of the pregnant horn along its long axis, equi-distance from the shaft of the ilium and the sacrum (pelvis). The cross-sectional diameter was measured with electronic calipers within the instrument. Uterine artery measurements for each animal were taken at two week intervals starting at 120 to 134 days of gestation and ending at 260 to 280 days of gestation. Measurements at the Lake Wheeler Road Dairy were recorded from 11/1/94 to 5/30/95, and measurements at the NCDA Butner Dairy were recorded from 1/31/95 to 7/5/95.

Results:

Preliminary results reveal a direct correlation between uterine artery diameter and fetal age. However, the amount of variation present between animals of the same gestation prevents this measurement from being used as a reliable indicator of fetal age in late term cows. Heifers seemed to have less variability than cows. The standard deviation or variability is the greatest during the 5th and 6th months of gestation. At those time points the variation can be as great as 30 days. The following is a graph of the uterine artery measurements for heifers, first lactation cows and second or greater lactation cows. The artery size is plotted by the measurement time (14 day intervals). The average uterine artery size and standard deviations for each measurement time have also been included.

graph 1:
UTERINE ARTERY DIAMETER



Discussion:

Since both the induction of parturition in cattle and dry cow treatments need to be more accurate than plus or minus fourteen days we do not feel that uterine artery diameter is a reliable tool for the dairy farmer. In conclusion, our preliminary results confirm that the variability in the uterine artery measurements precludes its use as a tool for the prediction of gestational age in cows and heifers.

Table 1:
UTERINE ARTERY DIAMETER AND STANDARD DEVIATION:

	measurement	UA-2nd lact	UA-1st lact	UA-Heifers	std-2	std-1	std-0
1	1.000	1.670	1.540	1.400	0.312	0.408	0.332
2	2.000	1.690	1.710	1.530	0.389	0.402	0.380
3	3.000	1.730	1.840	1.730	0.304	0.456	0.399
4	4.000	1.800	1.770	1.500	0.372	0.374	0.273
5	5.000	1.870	1.780	1.740	0.338	0.274	0.345
6	6.000	2.080	1.970	1.800	0.303	0.443	0.394
7	7.000	2.010	2.290	2.060	0.254	0.325	0.380
8	8.000	2.180	2.400	2.040	0.416	0.437	0.492
9	9.000	2.170	2.310	2.090	0.516	0.548	0.354
10	10.000	2.360	2.400	2.230	0.408	0.422	0.136
11	11.000	2.500	2.380		0.247	0.203	
12	12.000	2.810	2.890		0.000	0.000	

NATURAL DIFFERENCES IN PROGESTERONE INFLUENCE EMBRYO RECOVERY IN HIGH PRODUCING DAIRY COWS*

Jack H. Britt**, **Steven P. Washburn, Douglas W. Shaw and Vickie S. Hedgpeth****

Introduction

Low fertility in high producing cows is a costly problem. Previous studies at North Carolina State University and at other research centers indicated that natural differences in progesterone before first service influenced conception rate. For example, we found that a 1 ng/ml (ppb) change in average concentration of progesterone during 2 weeks before first breeding was associated with a 12% change in conception rate in Holstein cows (Fonseca et al., 1983).

Exactly how a change in concentration of progesterone influences fertility is unclear. It could influence oocyte development, fertilization and early embryonic development, or it could influence later embryonic development and recognition of the presence of an embryo by the cow. If one wished to improve fertility in cows with low concentrations of progesterone, it would be necessary to know which of these effects was important in order to develop appropriate treatment strategies.

The current study was undertaken to assess whether differences in progesterone influenced early embryonic survival in high producing Holstein cows.

Experimental Procedures

Holstein cows at the NCSU Dairy Field Laboratory in Raleigh and at the NCDA Umstead unit in Butner were assigned to clusters based upon calving dates—cows within a cluster calved within a 3-week period in the same herd. Commencing 3 weeks before the designated day of injection of the first of two injections of prostaglandin F2-alpha (Lutalyse, Upjohn Co.) milk samples were collected each Monday, Wednesday and Friday for determination of concentrations of progesterone. The first injection of PGF was given on a Monday when cows within a cluster were 44 to 64 days postpartum. The second injection of PGF was given 14 days later, and after the second injection of PGF, cows were inseminated at estrus with frozen-thawed semen from a single ejaculate of a Holstein bull with known fertility.

Seven days after estrus, the uterus of each cows was flushed by standard embryo transfer procedures (Shaw et al., 1995). Briefly, the cows was subjected to an epidural block by use of Lidocaine, a French foley catheter was inserted through the cervix to the distal uterine horn, the balloon on the catheter was inflated, and the flushing medium introduced by gravity-flow into the uterus. When the horn was distended, the inflow of medium was stopped and fluid was allowed to flow by gravity through the catheter into an embryo filter device. Embryos were examined through the use of a stereomicroscope and classified (Farin et al., 1995) according to stage (morulae, compact morulae, early blastocyst, blastocyst, expanded blastocyst, or hatched blastocyst) and grade (excellent, some defects, major defects or degenerate). Subsequently, each embryo was mounted on a microscope slide and stained for direct microscopic count of the number of cells.

Cumulative milk yield data were obtained from DHI records for each cow based on the test that occurred subsequent to the embryo collection phase. Embryo data were analyzed by chi square analyses (SAS, 1988) and data regarding intervals and milk yield were subjected to least squares analysis of variance to account for differences between herds and among cows of different parities.

Results

Of 119 cows that were assigned to the study and sampled, 89 were in the NCSU herd and 30 in the Umstead herd. Cows were distributed among three parity groups (1, 2, ≥3), with 40% being first parity. Based on profiles of milk progesterone, three-fourths of the cows were experiencing regular estrous cycles before the first PGF injection. Of the 119 cows assigned and treated, 63 (53%) were detected in estrus after the second injection of PGF. Cows that were cyclic before the first injection of PGF were detected in estrus after the second injection of PGF at a greater rate than anestrous cows

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(58% vs 39%). Among the 63 cows detected in estrus, an embryo was recovered from 41 (65%).

Days from calving to embryo recovery did not differ between cows from which an embryo was recovered (76 ± 1) or not recovered (78 ± 2). Milk yield during the first 90 days postpartum did not differ between herds (NCSU, 77 ± 2 lbs/day; Umstead, 74 ± 5 lbs/day), but multiparous cows produced more milk (90 ± 5 lbs/day) than primiparous cows (62 ± 3 lbs/day). There was no difference in milk yield between cows from which an embryo was recovered (76 ± 3 lbs/day) and those from which none was recovered (76 ± 4 lbs/day).

When all cows were considered, success of embryo recovery did not differ between herds, but among cows detected in estrus, recovery success was greater in the Umstead herd than in the NCSU herd (93% vs 57%). Parity had a major influence on success of embryo recovery—among cows in estrus, the recovery rate was 86% for first-calf heifers, 33% for second parity cows and 62% for older cows

Prior to estrus, **progesterone was greater in cows from which an embryo was recovered** than from those in which embryo recovery was unsuccessful (Figure 1). After estrus and before flushing on day 7, there was no difference between cows that had an embryo and those that did not. None of the factors examined influenced stage of development or quality of embryos recovered.

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Take Home Message

Cows from which an embryo was recovered between 70 and 80 days postpartum had naturally higher concentrations of progesterone before being bred. This suggests that embryo loss before day 7 after breeding may be related to progesterone during the previous cycle and that early (before day 7) embryo loss is more important than later loss (day 8 to 17) in high producing cows. Factors such as nutrition during the dry period and during the first 5 weeks after calving are known to influence progesterone during the breeding period, so early postpartum management should be focused on practices that lead to higher levels of progesterone.

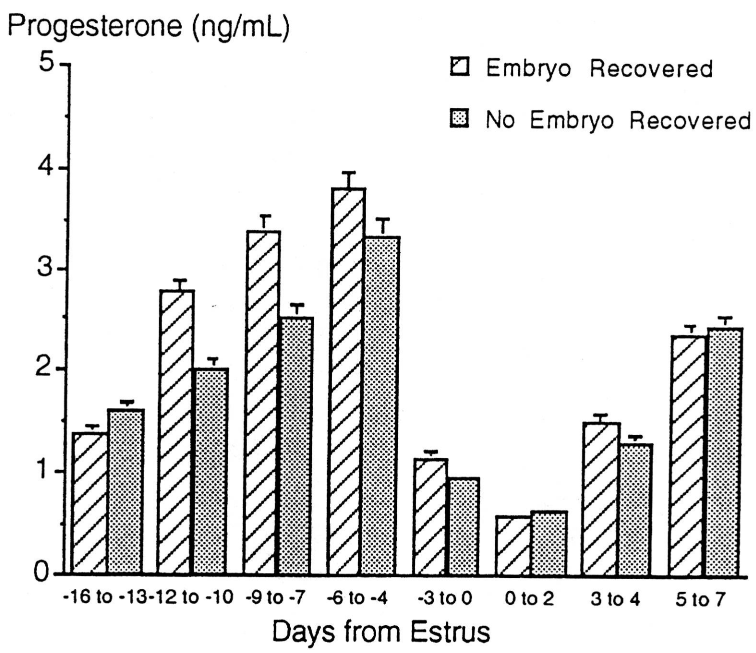


Figure 1. Progesterone concentrations in milk samples collected before and after estrus for cows from which an embryo was recovered for those from those from which no embryo was recovered.

PASTURE MANAGEMENT; WARM AND COOL SEASON FORAGES, GRAZING MANAGEMENT

James T. Green, Jr., Sharon L. White and Jean-Marie Luginbuhl

One of the major goals of this project is to see if pasture based feeding system can provide an economical alternative to stored forage and confinement feeding. This paper outlines the pasture system on the farm and some of the opportunities and problems encountered thus far.

Some Goals of Pasture Feeding:

1. To provide high quality forage for as many days of the year as possible, using a combination of cool and warm season species.

2. To graze as much of the forage as possible with the milking herd and harvest the excess growth as hay or haylage to be fed back during periods of limited pasture growth.

3. To monitor the fertility status of the pastures over a long period of time to determine if good grazing management and a long grazing season can have a positive effect on the nutrient management plan (manure distribution, runoff and water quality).

4. To provide the cows with fresh pasture after each milking to base the sequence of grazing on plant growth and quality.,

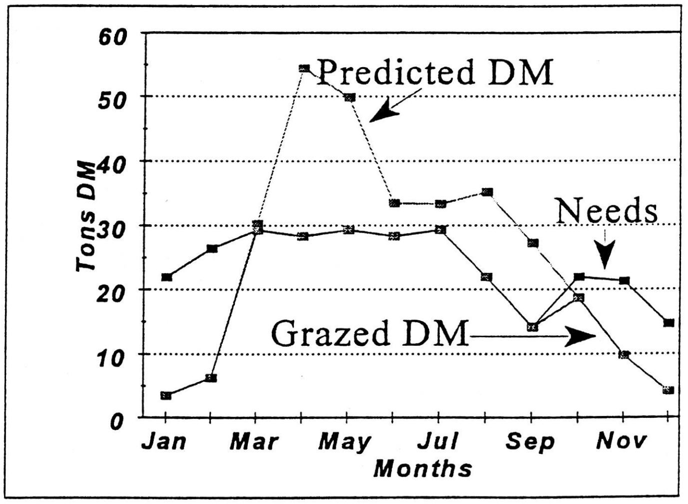
Pasture Combinations

The aim was to provide as many days of grazing per year as possible with about one acre per cow. Table 1 provides a summary of the acres of each species and the varieties being grown. Most of the pastures were planted within the past year, however, some of the fescue and orchardgrass stands are older. The warm season grasses will be overseeded with rye each fall to help supply winter grazing for the fall calving herd. Excess forage which accumulates during the growing season will be harvested as hay or hay-crop silage.

Pasture Growth and Animal Requirements

Figure 1 provides an estimate of the potential growth of pasture, animal needs and the amount that could be grazed, considering the daily intake assumption. The growth is based on long-term averages for the various crops, and the requirements were based on cows getting about 28 lbs of DM/hd/day from pasture. The pasture estimates average about 4 tons/acre; the animal requirements average about 2.89 tons/acre grazed, leaving about 1.07 tons/acre to be harvested for use during periods of slow pasture growth.

Figure 1 Estimated Yields, Needs and Amount Grazed.

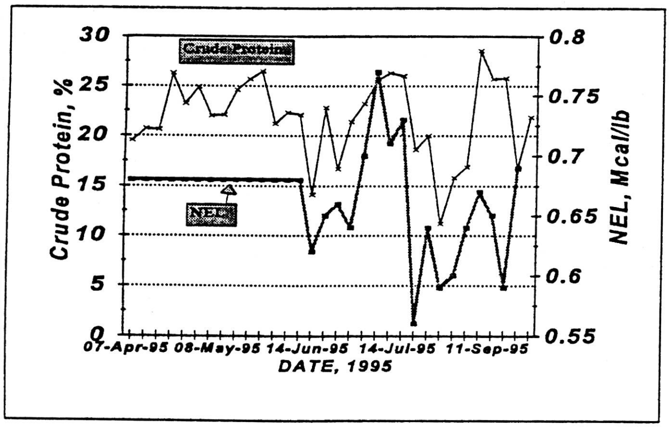


In 1995 there was plenty of forage, but we did not have the entire herd on the system, nor did we have the bermudagrass established. It is too early to determine if we can meet the complete forage needs of the animals with this stocking rate.

Pasture Quality Estimates

From April through October pasture samples were taken to estimate the quality of forage being offered to the cows. Figure 2 provides an estimate of the crude protein and net energy composition of the pasture throughout the season (includes values from all species). An attempt was made to sample the same material being grazed by the cow; this was done by taking plucked samples of the pasture to be grazed within the following 12 hour period. We were sampling the pastures as they were being grazed and the rotation sequence was based on plant growth rate. Animals were grazing several different species during any two week period. For example, the lowest quality values were from the bluestem-crabgrass mixture (June-Aug) and the high values during that period were from orchardgrass-clover. The quality of silage being fed to the drylot herd averaged 21% CP and 0.62 NEL for alfalfa and 9.5 CP and .73 NEL for corn, respectively.

Figure 2. Crude Protein and NEL for Grazed Pastures.



Summary Remarks about Our Experiences in 1995

1. This year has been a learning experience for everyone, and we feel that the fall freshening herd will do better than the spring herd because of increased grazing experience.

2. All of the fescue paddocks along Lake Wheeler Road were originally planted in 1991, but a wide strip of bermuda had encroached on the edges and this was killed in the autumn of 1994. The killed bermuda strips were reseeded to fungus free fescue-ladino clover. Cattle always preferred to graze the young fescue-clover strips and wasted or did not want to graze the "older stand", even though the growth was immature and of high quality. This "grazing preference" cause major handling problems because of having to back fence to "protect" the young seedlings when animals were in each of those paddocks. RECOMMENDATION...... do not replant partial paddocks and expect to get uniform grazing of the resulting growth.

3. All of the orchardgrass paddocks across the lanes from the fescue were laid out across land which had been strip cropped for the last several years. Within each paddock, there were two strips of orchardgrass planted in fall 1992, and two strips which were in corn in 1994 planted to the same variety of orchardgrass-clover as in the old strips. Cows prefer new seedlings over old established plants, even when both are in very early vegetative stage of growth. **Recommendation.....**do not try to graze old strips at same time as newly planted ones unless paddocks can be easily divided to keep animals on the respective sections. Animals appeared to have grazed the "old" orchardgrass better than the "old" fescue stands (even though all were green, leafy and of high quality).

4. Pasture systems should be less complex than what we have used here. Moving animals from species to species approximately every 3-5 days can have an adverse effect on intake. Even though pastures were vegetative and leafy most of the time, cows seemed to select against the fungus free fescue regardless of what they had grazed the previous day. If the whole farm or most of it had been in fungus-free fescue/clover, this response may not have been evident, except during the hot months. **Recommendation....**simplify the number of species in a system, especially during the start-up phase of a grazing program.

5. Grazing during hot weather presents plenty of challenges. During the hottest days of the summer cows were in the barn from 11am to 4 pm and were usually milked about noon and again at 4 am. Animals tend to stand in groups around the water tanks in the paddock causing problems with manure and trampling. Some people address this by moving fence and water tank 2-3 times during the day. During the hot weather, milk production from the pastured animals declined in a manner similar to that of of the drylot group.

Every paddock has drinking water available, therefore animals remain on the pasture for the maximum number of hours except for milking or breeding. This aspect is helpful in stimulating pasture intake.

7. Surplus pasture growth which could not be grazed in a reasonable time was harvested as hay or hay-crop silage. In 1995, hay making was very difficult to do properly.

Table 1. Acreage and Species Available for the Grazing Herd.

Species	Variety	Planting Date	Acres	% of Acreage
Alfalfa	Cimarron VR	Sept 1994	6.32	16
Alfalfa	Alfagraze	Sept 1994	6.32	
Alfalfa/Grass	Cimarron/Cajun Fescue	Sept 1994	2.1	11
Alfalfa/Grass	Alfagraze/Shiloh Orchardgrass	Sept 1994	4.4	
Alfalfa/Grass	Alfagraze/Cajun Fescue	Sept 1994	1.93	
Caucasian Bluestem	Caucasian & rye overseeded	May 1994 & Oct 1995	7.1	24
Bermuda	Tifton 44/ rye overseeded	April 1995 & Sept	11.1	
Fescue/Clover	Cajun/Regal	Sept 1991 & 1994	20.1	49
Orchardgrass/Clover	Shiloh/Regal	Sept 1992 & 1994	17.7	
Total Acres			77	100