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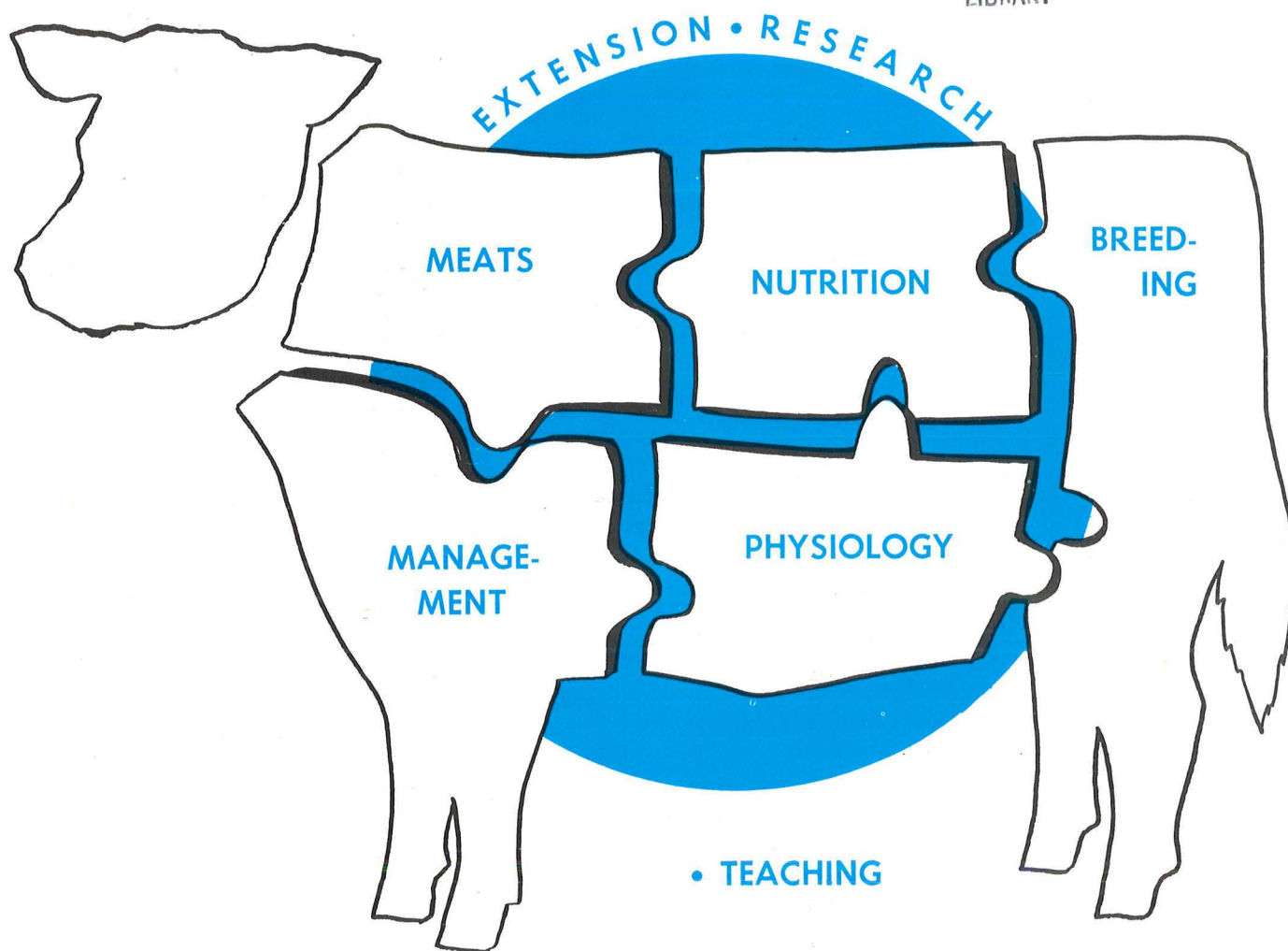
EC 72-218

1972 NEBRASKA BEEF CATTLE REPORT

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Prepared by the staff in Animal Science and cooperating
Departments for use in the Extension and Teaching programs

University of Nebraska—Lincoln College of Agriculture

Director of Extension
J. L. Adams

E. F. Frolik, Dean
R. W. Kleis
Acting Director, Agricultural Experiment Station

F. E. Eldridge
Director, Resident Instruction

EC 72-218

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The Nebraska Livestock Development Program

Frank H. Baker, Chairman,
Animal Science Department

James D. Heldt, Extension
Livestock Specialist
(Livestock Development)

Livestock development is Nebraska's No. 1 opportunity. The Nebraska Livestock Development Committee was formed to help use Nebraska's great feed and forage resources in economic development. Growth will occur through land and water resource development in a meat production and distribution system. This system will include all the steps of production and processing from grain to grill.

The beef enterprises, both cow-calf production and feedlot production, have potential for further development in the state. Beef demand is expected to continue to increase by 25 to 50 percent during the next decade. If one uses a 30 percent increase as a basis for projecting needs for fed cattle, 7.4 million additional cattle will be fed in the early 1980's.

Only 59 percent of Nebraska's feed grain was fed to livestock within Nebraska during the last 5 years of the 60's. There were 5.2 million tons of unused feed grain per year compared to the 4.0 million tons used each year for finishing cattle.

In 1970 approximately 4.4 million tons of the 1969 feed grain crop was used to finish 3.6 million cattle. Nebraska has the feed supply *today* to more than *double* its cattle feeding enterprise. Increases in irrigated acres will produce an even greater abundance of feed grain. *It appears that Nebraska's feed grain supply is, or will be in the future, the greatest unprogrammed feed grain supply in the U.S.*

Supply Attractive

Nebraska's unprogrammed feed supply is attractive to cattle interests and financial institutions planning expansion or development of cattle feeding operations. This feed supply can be the basis for attracting one-third of the new cattle feeding business of this decade to Nebraska. The cattle feeding industry of the state can expand by 2.4 million head or to a total cattle feeding business of more than 6 million head for the year of 1980.

Nebraska could produce all of its own feeder cattle. A question might be asked, "How large must Nebraska's cow herd be to produce 6 million feeder cattle for use in the feeding operations of 1980?" A cow herd of 6.7 million head would be required.

Producing and feeding 6 million feeder cattle and marketing three-fourths of a million cull cows in 1980 could gross an income of \$2 billion (assuming a finished animal is worth \$310 and a cull cow is worth \$180). This is twice the level of Nebraska's gross receipts from the beef enterprises in 1970.

New investments during the next decade of about \$100 million in new cattle feeding facilities and at least \$500 million in working capi-

tal for cattle feeders is necessary to assure the added income.

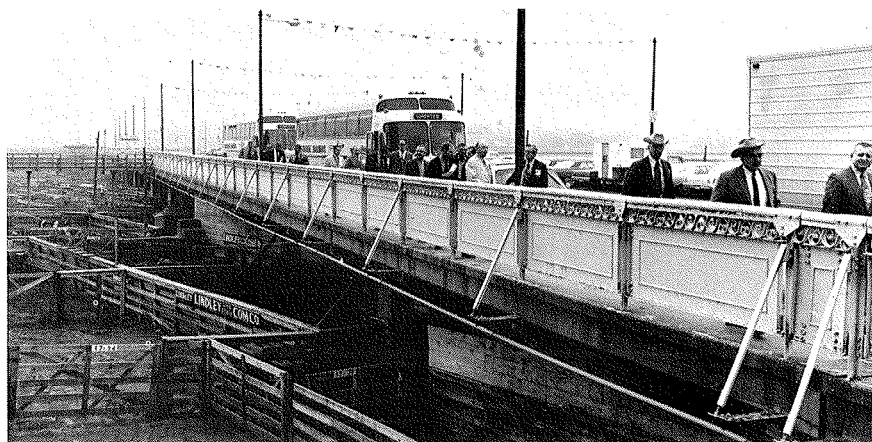
New investments of \$2 billion in cows and working capital are needed for increasing the Nebraska cow herds to 6.7 million head. Additional investment in land and irrigation development would be necessary to assure the feed and forage supply for 6.7 million cows.

It has been estimated that the feed supply for 6.7 million cows can originate in the following ways:

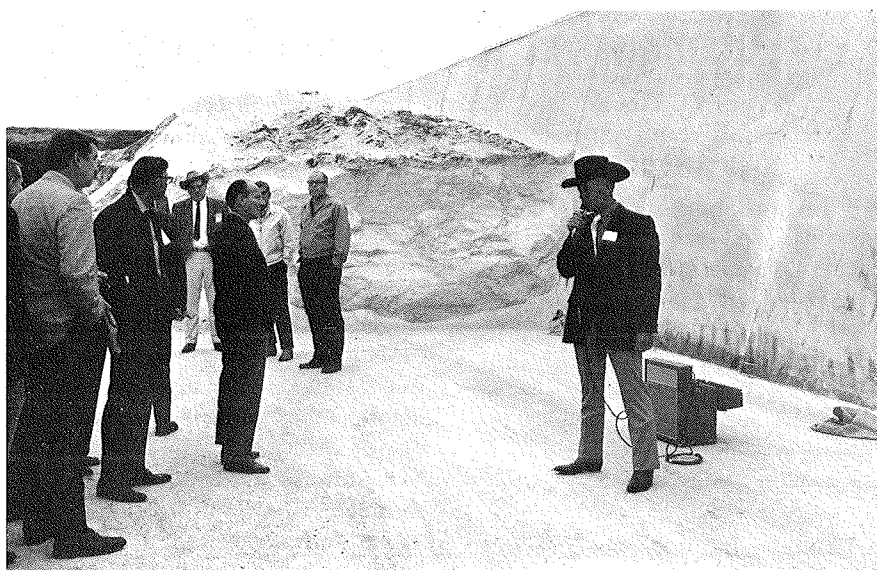
1. Development of irrigated pasture on 10% of the Sandhill acres (14 million acres in Sandhills). A twenty fold increase in feed produced on these acres is possible based on research at North Platte. This irrigated pasture would provide feed for 2.8 million cows.
2. The stalks and other residues from 6.5 million acres of corn and grain sorghum and other poorly used resources of farming areas can support 2 to 3 million cows.

Study Sparked

President Varner has sparked study of Nebraska's economic opportunities through the use of feed resources by livestock. The Livestock Development Committee, chaired by Stanley Matzke, Director of the Nebraska Department of Economic Development, is providing leadership for study and action. The committee has "action" subcommittees for several high priority



Participants in the Nebraskaland cattle tour visiting the Omaha stock yards.



Participants in the Nebraskaland cattle tour visit a feedlot using high moisture corn.

activities during the coming year. Everyone will be given an opportunity to be a part of one or all of these activities.

I. Nebraskaland Cattle Tour

**Subcommittee Chairman—
H. W. Harrington, Grand Island**

This subcommittee planned and conducted a tour of Nebraska's livestock production resources for representatives of financial interests from inside and outside Nebraska and representatives of the national press concerned with finance and livestock production, October 21 and 22. Participants indicated that the tour stimulated their interest in Nebraska resources for livestock development.

II. Area Seminars and Tours

**Subcommittee Chairman—
Andy Hove, Jr., Minden**

This subcommittee is developing plans to help with area seminar meetings and/or tours for Nebraska businessmen, bankers, livestock industry leaders and young farmers. These would be a means of increasing understanding of the potential of Nebraska's resources for livestock development and methods for achieving this potential.

III. Educational Activities for Youth

**Subcommittee Chairman—
Gerald Frankl, Dakota City**

This subcommittee is developing and implementing plans for improving educational programs for Nebraska youth to further the development of their capability as future agricultural producers, leaders and contributors to the full use of Nebraska's feed and forage in livestock production.

It is anticipated that special projects, demonstrations and other educational activities will be developed. The focal point of these activities will be to increase the understanding of young people of Nebraska animal agriculture, its profit opportunities, its potential for careers and its essentiality in the total economy. These goals may be accomplished through existing organizations or new groups as appropriate.

IV. Legislation

**Subcommittee Chairman—
John Olson, Alliance**

This subcommittee is developing a detailed evaluation of existing Nebraska laws for encouraging or discouraging livestock development com-

pared to the laws of Nebraska's neighboring and competitor states.

This report will be available to livestock industry organizations and firms, to public agencies, the Governor and the members of the Legislature for use in relation to future legislation.

Initially this subcommittee will concentrate its efforts on those laws concerning the financing of livestock enterprises and their profit potential. The subcommittee should not duplicate the efforts of other organizations working in this area.

V. Publications and Publicity

**Subcommittee Chairman—
Marvin Russell, Lincoln**

This subcommittee plans to develop publications needed to inform the public of the potential of Nebraska's resources for livestock development and methods for achieving this potential.

They will plan and implement through appropriate media channels a program for informing the public of important activities and materials concerning Nebraska's Livestock Development Program.

One major publication entitled *Opportunities for Beef Feeding in Nebraska, EC 71-228*, was released in October during the Nebraskaland Cattle Tour. "Fact-sheet type" leaflets will be developed as appropriate on specific subjects important in the livestock development program.

The committee will plan other subcommittees and activities as appropriate to help the development of the state's economy through livestock enterprises.

The livestock development committee members, their association with phases of the livestock industry, addresses and phone numbers are in the accompanying list. These

(continued on page 6)

(continued from page 5)

people can help you in establishing contacts regarding any phase of Nebraska livestock development.

Stanley Matzke, Chairman—Director, Department of Economic Development, Box 9466, State Capitol Building, Lincoln, Nebraska 68509. (402) 477-8984.

Frank H. Baker, Vice Chairman—Chairman, Animal Science Department, 203 Marvel Baker Hall, University of Nebraska, Lincoln, Nebraska 68503. (402) 472-3571.

Mervin Aegerter—Vice President, First National Bank, 16th & Dodge Streets, Omaha, Nebraska 68102. (402) 341-0500.

Norman Beller—State Federal Agricultural Statistician, Statistical Reporting Service, 129 North 10th Street, Lincoln, Nebraska 68508. (402) 475-3546.

Winton Buckley—Chairman, Board of Directors, Nebraska State Bank, South Sioux City, Nebraska 68776. (402) 494-4225.

John R. Cooper—Public Relations, O. A. Cooper Company, Humboldt, Nebraska 68376. (402) 862-2251.

George David—General Manager, American Stores Packing Company, Box 82008, Lincoln, Nebraska 68501. (402) 432-5531.

Gerald Frankl—Vice President, Cattle Feeding and Research, Iowa Beef Processors, Inc., Dakota City, Nebraska 68731. (402) 494-2061.

Wes Hansen—Vice President, Nebraska Stock Growers Association, Rural Route 3, North Platte, Nebraska 69101. (308) 532-6249.

H. W. Harrington—Harrington Feed Yards, Inc., Rural Route 1, Grand Island, Nebraska 68801. (308) 382-2431.

Wayne Hendrickson—Cattle Feeder and President, Kearney Chamber of Commerce, Kearney, Nebraska 68847. (308) 236-5251.

Andy Hove, Jr.—Vice President, Minden Exchange National Bank, Minden, Nebraska 68959. (308) 832-1600.

David Johnson—Vice President, Omaha National Bank, Omaha Nebraska 68102. (402) 348-6565.

Glenn Kreuscher—Director, State Department of Agriculture, State Capitol Building, Lincoln, Nebraska 68508. (402) 471-2341.

Glenn LeDioyt—LeDioyt Land Company, 345 Farm Credit Building, Omaha, Nebraska 68102. (402) 345-9800.

John Olson—Prairie States Feedlots, Alliance, Nebraska 69301. (308) 762-2961.

Marvin Russell—Editor, Nebraska Farmer, 5601 "O" Street, Lincoln, Nebraska 68510. (402) 489-9331.

Dale Tinstman—President, First Mid America, Inc., 1001 "O" Street, Lincoln, Nebraska 68501. (402) 477-9221.

Changes in Cattle Marketing

Paul Q. Guyer
Extension Livestock Specialist
(Beef Cattle)

A revolution in beef marketing has been in progress during the past 1½ decades. Structural changes have been many—new locations, new organizations, new slaughter techniques, new methods of shipping, etc. The 70's will be characterized by even more changes. We must gear these changes to a more competitive and prosperous beef industry.

An understanding of trends that have taken place and reasons for them can be helpful for decision making and pointing to needs in the marketing area in the decade ahead.

Marketing Patterns of the 60's

What has been happening is shown in Figures 1 through 6 and Table 1. Packers have been shifting rapidly to direct buying. The result has been a rapid decrease in percentage of total purchases at the terminal markets and a slight decline in the percentage purchased at auction markets (Figure 1). A number of terminal markets have either closed or reduced cattle marketing activities drastically. The influence of this change for Nebraskans is shown in Figure 2. Cattle sold on the terminal markets de-

clined nearly 50 percent while total cattle marketings almost doubled.

Direct marketings of fed cattle are apparently higher than for other classes of slaughter cattle (Figure 3). Seventy percent of the steers and heifers were purchased direct in 1969 compared to 62 percent of all cattle. The major feeding states show a high percentage of the steer and heifer kill purchased direct.

Results of a survey of Nebraska feeders (Table 1) indicate that type of marketing is related to the number of cattle fed. Feeders marketing more than 1,000 head reported 93 percent of their cattle sold direct compared to 65 percent for those selling 300 to 1,000 head and 47 percent for those selling under 300 head. Data in Figure 3 and also observation of marketing from larger feedlots indicate that larger feeders market most of their cattle direct to the packer. One exception is Iowa, where even though small feeders feed most of the cattle the percentage marketed direct is high.

Purchases in the "beef" have increased steadily since sales by this method were first summarized in 1963 (Figure 4). Considerable variation in the use of this method of marketing exists in the major beef feeding states.

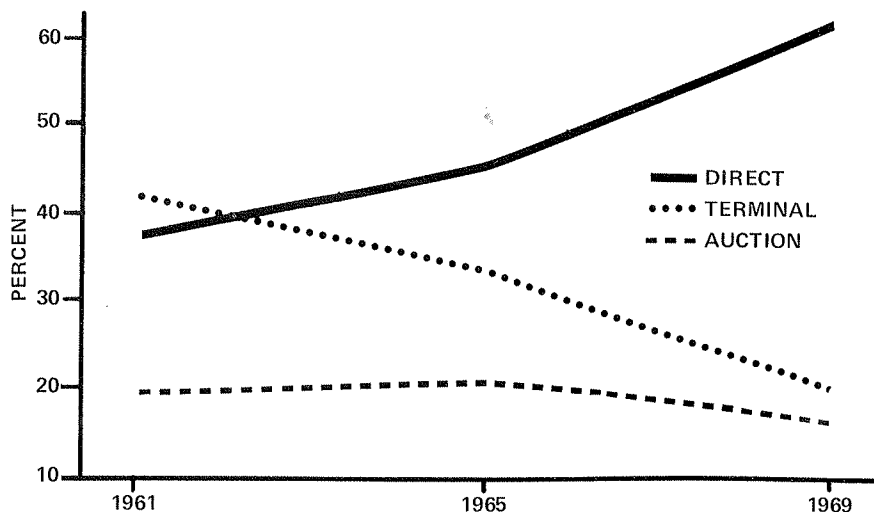


Figure 1. Packer purchases by type of market outlet.

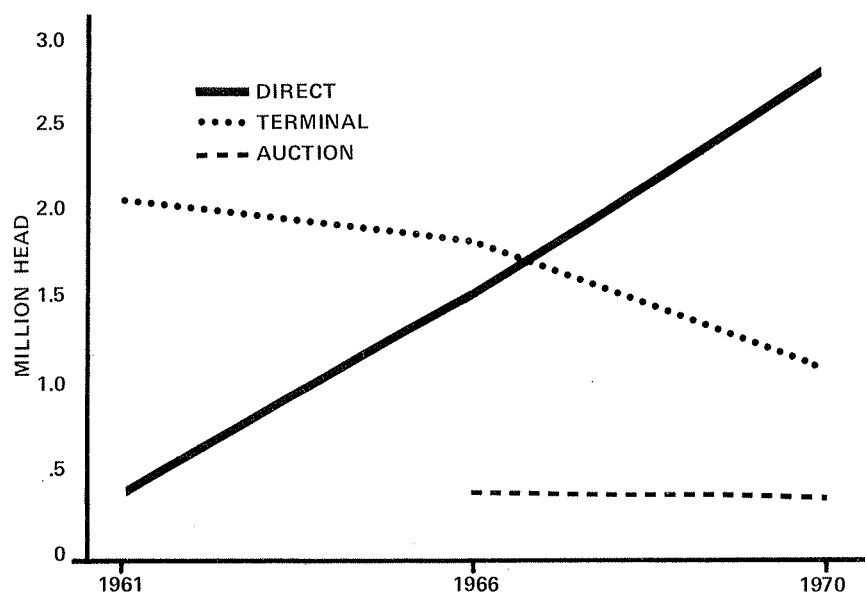


Figure 2. Cattle marketings by types of market outlet—Nebraska.

States with a large percentage of cattle fed in large feedlots market less cattle in the "beef" than Nebraska and Iowa, where feedlots have smaller average size (Figure 5). On the other hand, large feeders in the Nebraska survey marketed more cattle in the beef than those selling under 1,000 head annually (Table 1).

Perhaps mud on the cattle in late winter and spring contributes to a higher percent of marketing in the "beef" in both Iowa and Nebraska. Nebraska feeders preferred selling on carcass weight compared to a pricing system involving both carcass weight and grade.

Why Have These Changes Taken Place?

A new dimension in marketing has been provided for most Nebraska cattle feeders as a result of shifts in the location of slaughter plants (Figure 6). These shifts have been a basic contributing factor to the increase in direct marketing.

How does the feeder look at his different marketing opportunities? One of the reasons for making a survey was to get his views to this question.

Replies indicate the following reasons for selling direct:

Slaughter plant located close to lot:

- “Less transportation”
- “Less shrink”
- “Fewer bruises”
- “No unnecessary handling”

Higher returns:

- “Sale price negotiated before animals leave lot—avoids bad days”
- “Less tissue shrink—sell more beef—higher dress on home weights”
- “I feed plain cattle that grade better than they look”
- “Calfy heifers and heiferettes bring more on grade and weight”

- “More buyers see my cattle than on the terminal”
- “I know more about my cattle than a hired seller”
- “I sell in beef with additional credit for yield grade”
- “Little or no sorting”
- “I believe in central market but not economically feasible”

Other:

- “Feed back on carcass desirability, grub control, bruises, etc. makes a better manager of me.”
- “When cattle carry mud, buyers underestimate dressing percentage, therefore I sell in the beef”
- “Not practical to ship large numbers through market.”

Reasons for selling on terminal market included:

- “More competition”
- “I don’t believe in paper shrink”
- “I’m not well enough informed to price livestock”
- “Market near by”
- “Central market sets price”
- “Need a professional to sell to a professional”
- “Pay is quick—better guarantee of payment”
- “A number of buyers—demand

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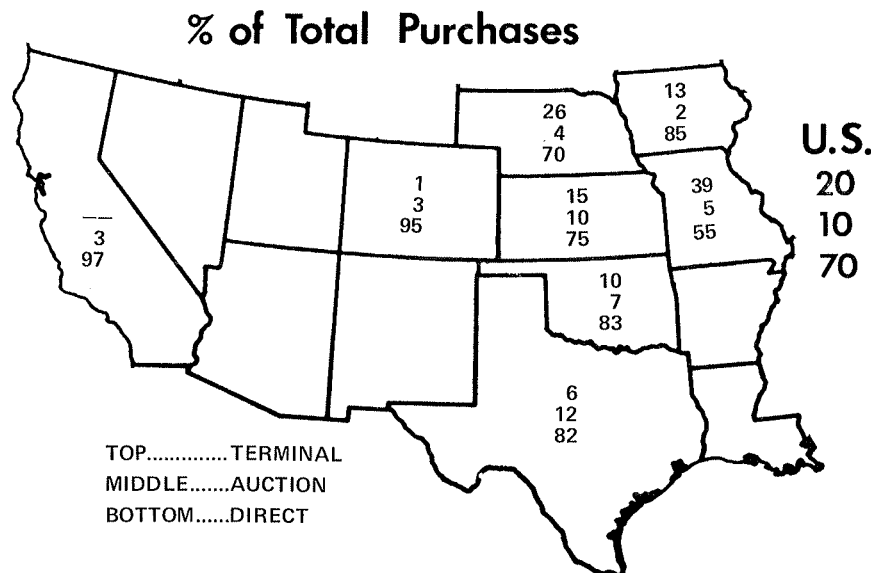


Figure 3. Packer purchases of steers and heifers—1969.

(continued from page 7)

for a wider variety of weights and grades"

Points favorable to auction market were:

- "Not enough ready to haul to central market or attract buyers at one time"
- "Near"—"ready cash"
- "Equal attention with larger producers"
- "Small number of other marketing alternatives in area"

Many feeders expressed dissatisfaction with their choice of marketing and pointed to need for modification:

Direct market:

- "I need more complete market information several times daily"
- "I would like to have a country commission man sell my livestock"
- "May need extension of Cattle-Fax to sell cattle for us"
- "To much yield difference between packers"
- "Need bonded weighmasters when we sell in the 'beef' "
- "Pay is too slow, especially when we sell in the 'beef' "
- "Need more information on financial condition of packers"
- "Feeder should not stand post-mortem condemnations"
- "When I sell on carcass weight, I'm concerned about the length of time between delivery and kill"

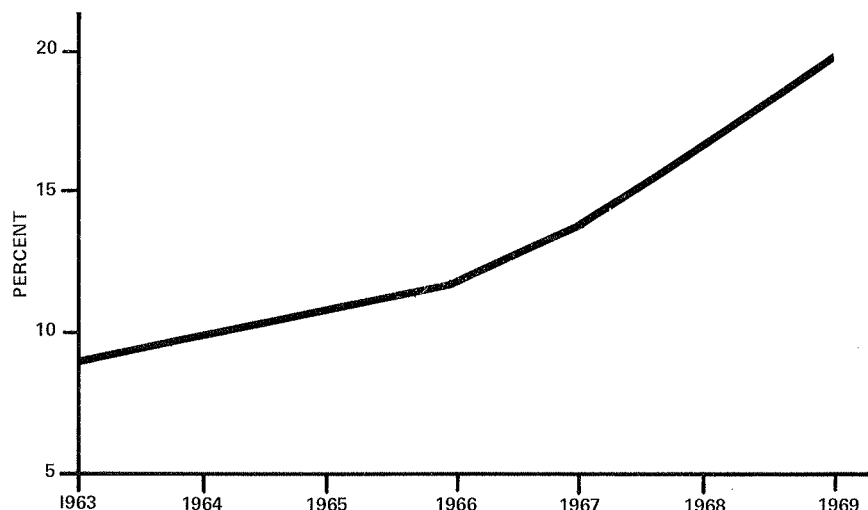


Figure 4. Cattle purchased in the beef—1963-69.

—"We need more recognition of yield grade in pricing"

Terminal:

- "Can't get carcass information—if we continue, this must change"
- "To much fluctuation day to day receipts and price"
- "Too many outs—not justified"
- "Big feeders get better pens"
- "Commission firms should be positive rather than degrade direct marketing"
- "Commission newsletters don't contain market information"

Needs of a Beef Marketing System

These comments of feeders emphasize some strengths and weaknesses of our marketing system and point to needs.

The beef industry must (1) pinpoint weaknesses and (2) be willing to take bold action to capitalize on strengths and minimize weaknesses. Some of the needs indicated by feeders include:

Accurate pricing:

New methods of pricing must be found. The central market has set the live animal price for other methods of marketing in the past. The "yellow sheet" has been looked to for carcass prices for beef. Now both represent a limited portion of the total sales. In addition, breaking of beef carcasses at the slaughter plant is increasing rapidly. These developments point to the need for different methods of price discovery than those traditionally used.

More accurate monetary recognition of a superior product is another need. Several feeders indicated that packer "feed back" made them better managers. Prices that give credit for cutability or meatiness, that discount grubs and excessive bruises, that refine payment to recognize superior management and superior animals in the price paid will encourage efficiency, contribute to economic health of the industry, and help us meet the challenges from substitute foods that may beset us.

An informed seller:

The need rings loud and clear

Table 1. Methods of Cattle Marketing—Nebr., 1970²

Size of Feeder	Under 300	301-1,000	1,001-2,000	2,001 Up	Total
No. Responding	68	48	26	36	176
Avg. No. Marketed	120	580	1300	5650	1560
Methods of Marketing					
1. Terminal (%)	44	25	7	5	8
2. Auction (%)	9	10	.....	2	3
3. Direct (%)	47	65	93	93	89
—Weighed at Plant (%)	24	23	39	21	23
—Weighed at Lot (%)	7	23	18	35	31
Carcass Weight (%)	7	9	26	25	23
—Packer Contracts (%)	.....	.....	.....	.....	.....
—Carcass Weight & Grade (%)	9	9	10	11	11

² From survey by author.

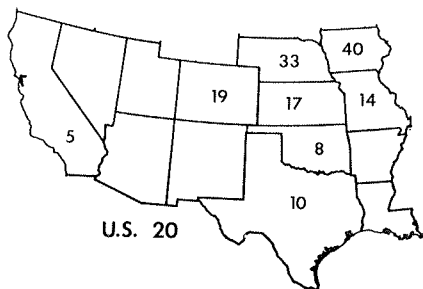


Figure 5. Percentage of slaughter steers and heifers purchased in the beef—1969.

whether feeders sell at auction, terminals or direct. The seller needs to be up-to-date on market information, and have judgment to interpret it. The seller needs to know differences between slaughterers—financial condition, kinds of livestock preferred, factors that affect yield, etc.

Many who market direct feel they are better qualified to market their own livestock than professional sellers they might hire. They feel that many sellers are not well informed in the area of production—feed costs; length of feeding; quality of cattle; grade; carcass desirability; shrink; etc.

Country commission men or “order sellers” would be preferred by many whether they now sell direct, at auction or through terminal markets. These feeders do not feel that they have adequate sources of market information, the time to spend in selling and establishing good relationships with a number of buyers or the desire to make a good salesman.

Cattle-Fax programs and tele-

phone tape market news services are two attempts by livestock feeders and producers to reduce or eliminate the market information gap. Although these are both rather new in Nebraska a number of feeders commented on how helpful they have been. One even suggested an extension of the Cattle-Fax program to include a selling service.

Avoid unnecessary delays from shipping to slaughter:

A number of feeders indicated their dressing percentage (based on home weights) was higher when livestock are slaughtered as quickly as possible. The reduction seems to be due to less tissue shrinkage. This can be particularly important to an individual feeder when his livestock are sold on carcass weight. We have feeders who request a kill schedule and then arrange for delivery as close as feasible to the kill schedule for their cattle when they sell in the beef.

Informed producer:

The producer needs to know what product he produces in order to modify management to make him most competitive. He needs to know almost as much about the selling of livestock as the professional seller—if he hires one—so he can intelligently manage the selling operation.

Summary

Slaughter cattle marketing has shifted rapidly from sale at a pub-

lic central market to direct marketing during the past decade. Dispersion of packing plants to country locations and increase in size of feeding operations have been two major contributing factors.

Many feeders who sell direct are not satisfied with their present marketing program. To be most competitive we need to market cattle fed in Nebraska at their full value. We need to combine the efforts of feeders, marketing agencies and research.

An analysis of beef cattle marketing and studying new approaches are needed to modernize marketing for greatest returns to a modern beef industry.

What Is Animal Science All About?

Animal science is the art and science of animal agriculture whereby meat and fiber are produced for America's millions. Today Animal Science requires knowledge of all biological sciences, botany, zoology, bacteriology, genetics and physiology. It also requires a knowledge of mathematics, chemistry and physics, as well as the agricultural sciences dealing with forages, feed grains, insects, animal health, nutrition, breeding and meats.

The person who likes science will find Animal Science challenging. Many Animal Science positions require considerable contact with people. For those who would rather work by themselves, there are positions in laboratories and offices. So, whether you prefer the outdoors or the indoors, the market place, the laboratory or the classroom, there is a place for you in Animal Science if you like livestock.

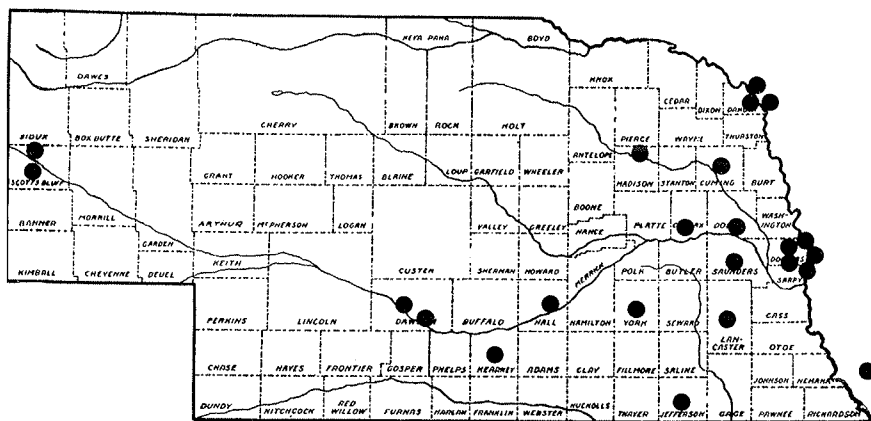


Figure 6. Location of beef packing plants.

Hormonal Implants

For Increasing Calf Weight Gains

E. F. Ellington
Associate Professor,
Animal Physiology

J. E. Kinder
Graduate Assistant,
Animal Science

Many hormonal preparations are now being used in feedlot operations to increase the rate and efficiency of gain in feeder cattle. The main component of most preparations used is an estrogen which causes stimulation of weight gains by increasing primarily the amount of muscle. However, the use of hormones in suckling calves has been practiced very little. A contributing reason for the lack of use of hormones in calves is the fact that there has been less research done with growth stimulants in this area.

We conducted the present study to provide information on the effect of various hormones on weight gains of suckling steer and heifer calves.

Study Design

Synovex S¹ and Synovex H¹ were the two implants used. Synovex S contains 200 mg of progesterone and 20 mg of estradiol benzoate. Synovex H also has 20 mg of estradiol benzoate but instead of progesterone it contains 200 mg of testosterone. Each implant consists of eight individual tablets in a plastic cartridge.

The cartridge was placed in an implanting device which had a needle and a plunger. The plunger forces the implants from the cartridge and through the needle. The implants were always placed below the skin on the top side of the ear. Each treated animal received the contents of one implant cartridge.

We used 22 Angus-Hereford

Table 1. Weight Gains on Heifer Calves Implanted with Synovex S

Treatment group	Weight gain in pounds/head				
	1st month	2nd month	3rd month	4th month	Total
I. Controls	46	65	35	37	183
II. Synovex S	58	70	37	35	200

crossbred heifers, 36 Angus-Hereford crossbred steers, 9 Hereford steers and 28 Holstein-Hereford crossbred steers in this study. The 22 Angus-Hereford crossbred heifers were allotted to two groups of 11 each on a weight basis so that the calves in each group would weigh approximately the same at the beginning of the study. Group I served as a control group and received no implant, while Group II received Synovex S implants.

The steers were placed in three groups (22 head per group) on the basis of weight and breeding. Group I of the steers served as a control group and received no implant. Group II was implanted with Synovex S and Group III was implanted with Synovex H.

We kept the calves with their dams, which were grazing native type warm season pasture during the treatment period. We did not creep feed at any time during the study. Weights were taken on the calves at monthly intervals after overnight stands without feed (including milk) and water. The heifer calves averaged 166 pounds and the steer calves averaged 189 pounds at the beginning of the study.

Results and Discussion

The data for the heifer calves (Table 1) show that the Group II or Synovex S calves outgained the Group I or control calves by 12 pounds for the first month and by 5 pounds for the second month. After that the hormonal effect apparently subsided and very little difference in gain between groups resulted during the final two

months of the study. It is interesting, however, that the increased gain was maintained throughout the study. In other words, the implanted calves were 17 pounds larger at weaning (final weight) than were the controls which had not been implanted.

Data from Table 2 indicates that steers implanted with Synovex S or Synovex H outgained the controls. Synovex H appears to have a slight advantage over Synovex S when used in the steer calves. The implants seemed to lose most of their weight stimulating activity during the first two months after implantation. However, the extra gains made during the first two months were maintained and still apparent at weaning (final weight).

Synovex S appears to have similar weight stimulating effects on both steers and heifers. In this study it is possible to compare the responses of Synovex S in steers and heifers of the same breeding, namely, the Angus-Hereford crossbreds. The weight gains of such implanted steers and heifers were identical (200 pounds) over the 4 month test period, whereas the respective controls were essentially identical (180 pounds for the steers vs. 183 pounds for the heifers). Apparently the endogenous hormones of the two sexes of calves are not causing any striking differential effect on body weight gain during this period of life.

Attention should be drawn to the fact that the materials implanted in this study are actually hormones that are produced by the ovaries and testicles. Not only are

¹ Supplied by Syntex Laboratories, Inc., Palo Alto, California.

they capable of causing various effects associated with general body growth and development, but they have the ability to produce other effects as well.

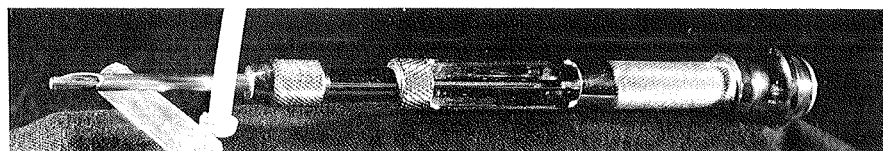
For example, the two female hormones (estrogen and progesterone) have roles in natural development of the mammary gland and could thus cause such development in animals to which they are administered. Although such response was not encountered in this study, it has been reported in earlier studies with feedlot cattle, especially with excessive doses of estrogen.

Among other possible precautions, it may well be inadvisable to implant heifers even at this early age that are to be kept as replacements. The heifers treated in this study are being held for subsequent study of their reproductive activity.

Summary

Synovex S implants appeared to cause increased gains in heifer calves for 2 months after implantation. Both Synovex S and Synovex H appeared to have similar stimulating effects in steer calves. In both heifers and steers most of the induced gain appeared to take place in the first month and it was still apparent at weaning.

Further studies are needed to see if reimplantation would cause even greater increase in gains. It would also be interesting to determine if creep fed calves could utilize the hormonal activity of the implant for even greater gains. Continued attention needs to be given to possible undesirable side effects.



Synovex implant (cartridge containing the actual implant), implant instrument and needle protector (plastic tubing).

Table 2. Weight Gains of Steer Calves Implanted with Synovex S and Synovex H

Treatment group	Gain in pounds/head				
	1st month	2nd month	3rd month	4th month	Total
I. Control	52	67	31	33	183
II. Synovex S	55	72	28	37	192
III. Synovex H	63	70	32	32	197

Reproductive Activity. I

Cycle Control

With Hormonal Injections

E. F. Ellington
Associate Professor,
Animal Physiology

R. B. Osland
Graduate Assistant,
Animal Science

J. E. Kinder
Graduate Assistant,
Animal Science

Successfully controlling the occurrence of estrus in the beef cow offers many potential advantages. One large advantage would be increased capability of using artificial insemination (AI) in the beef industry. This would allow greater use of genetically superior sires, elimination of bull herds, better management control and more uniform calf crops.

Some additional advantages might be more indirect. For instance, a better understanding of the physiological events associated with estrus should occur as estrus is more successfully controlled. This understanding could lead to improved treatments for at least some reproductive problems in cows.

One method of controlling the estrous cycle is by using hormones, since a complex of hormones naturally regulates reproductive activity. The particular hormone(s) used, the amount and the timing of treat-

ments are all important. Among hormones that have been investigated in estrous synchronization research with cattle, a group of hormones called progestogens appears to offer the most promise. But even so, continued attention needs to be given to the refinement of procedures for greater convenience in administration, greater precision of cycle regulation and for increased conception.

Previous reports from this station (1970 and 1971 Nebraska Beef Cattle Reports) have been concerned with injections of the natural progestogen, progesterone, alone and in combination with other hormones. The status of estrous synchronization research was also reviewed. The present study involves experiments with combinations of progesterone and equine gonadotropin (also called pregnant mare serum gonadotropin or PMSG) where emphasis is given to the time that equine gonadotropin is administered.

Study Design

We assigned 88 Hereford cows, which had calved in the spring at 2 years of age, randomly to four equal sized treatment groups. Group I (control) received no hormonal treatment. All of the cows in the other three groups received a subcutaneous injection of 750 mg of progesterone. The time of this injection, May 13, 1970, will be considered as Day 1 of treatment for convenience.

Previous studies have indicated that the majority of cows so injected will show standing estrus between Day 10 to Day 16 following this Day 1 injection. Since conception at this first estrus is usually low, we did not allow breeding in this study until the

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next estrus. In order to maintain synchronization, we gave a second progesterone injection in the same quantity on Day 22 to all cows in the three treated groups.

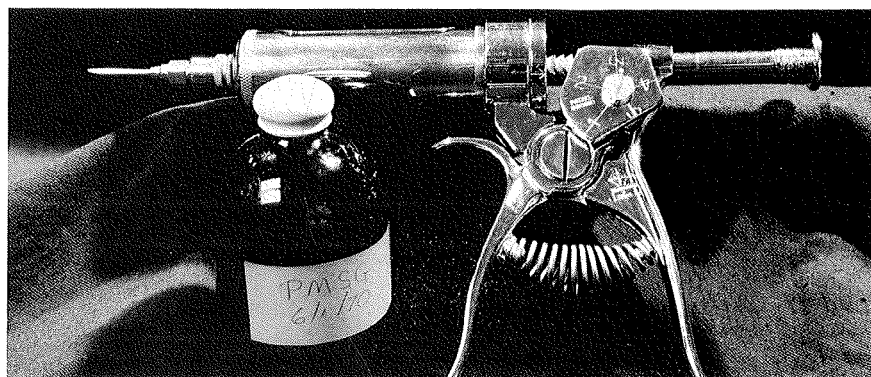
In addition to the two injections of progesterone, we also administered a second hormone, PMSG, to all three progestogen-treated groups. PMSG was given subcutaneously at a dosage of 750 IU on Day 29 to Group II cows, on Day 30 to Group III cows and on both Days 27 and 30 to Group IV cows. As PMSG has been demonstrated to act directly on the ovary to stimulate activity, it may provide a means for increasing the effectiveness of the total treatment.

Following the last PMSG injection on Day 30, we started a 16-day AI period, using extended semen from a Holstein bull. The cows were inseminated in the mornings or evenings approximately 12 hours following the time estrus was first detected. We considered a cow to be in estrus when she stood for mounting by another cow or an androgen-treated steer. We also used rump mounted, pressure sensitive heat detectors to facilitate estrous detection. We used Angus bulls for natural service following the 16-day AI period. The total breeding period (AI plus natural) was 60 days.

Results and Discussion

The summarized breeding and calving data are shown in Table 1. Most of the cows did exhibit standing estrus during the 16-day AI period. For example, in Group II, 18 of the 22 cows expressed estrus during this period. The percentages of cows showing estrus during the AI period varied from 68 percent for Groups I and IV to 82 percent for Groups I and IV to 82 percent for Group II.

The treatments employed did cause a grouping of synchronization effect. For instance, the percentage of cows that had shown estrus by the 7th day of AI was 41 percent for the uninjected controls, 59 percent for Group IV, 64 per-



Syringes of this type were used for progesterone and pregnant mare serum gonadotropin (PMSG) injections.

cent for Group III and 77 percent for Group II. Cows receiving an early PMSG injection (Day 29) showed estrus earlier than those receiving the later PMSG injection (Day 30). Cattle receiving both an early and late PMSG injection (Day 27 and 30) responded similar to Group III in this regard. The difference in responses among treated groups is due, no doubt, to the timing and amount of PMSG injected prior to the AI period.

The effectiveness of the hormone treatment in terms of fertility is indicated by the calving performance data. The four groups were quite comparable in terms of total number of cows that calved when considering the conceptions for the overall breeding period (artificial plus natural). In each group, a total of 18 to 20 cows calved out of 22 cows per group. In terms of calving as a result of conception during the AI period, Groups II and III, which received a single injection of PMSG, had a smaller percentage of cows calving. The superior percentage of Group IV

apparently is due to the injection timing of PMSG or to the larger total dosage of PMSG because of the two injections. If any of the treatments had an influence on rate of ovulation, it was not reflected in the calving results, as no multiple births were apparent.

Early research reports have indicated calving percentages as low as 10 to 20 percent with synchronization accomplished by 15 to 20 daily administrations of progestogens. Frequent handling of the cattle and much labor were obviously required.

In light of this, our research procedures seem encouraging with regard to degree of synchronization, fertility and ease of treatment. From the data presented here, it would appear that the time(s) at which PMSG is administered in a progestogen-cycle control program is important in influencing the resulting number of conceptions. Further experimentation in this area could perhaps yield fruitful results.

Table 1. Summarized Breeding and Calving Data for the PMSG-Time Study

Group	No. cows showing estrus by					No. cows calving to		
	No. cows	3rd day AI	5th day AI	7th day AI	Entire AI period	AI	Cover bulls	Total
I (Control)	22	4	6	9	15 (68%) ^a	11 (73%) ^b	9	20
II (Day 29 PMSG)	22	8	14	17	18 (82%)	9 (50%)	9	18
III (Day 30 PMSG)	22	4	9	14	16 (73%)	7 (44%)	13	20
IV (Day 27 & 30 PMSG)	22	6	9	13	15 (68%)	10 (67%)	8	18

^a Percent animals in a group that expressed estrus during the AI period.

^b Percent of animals artificially inseminated that calved as a result.

Reproductive Activity. II

Cycle Control and Twinning With Hormonal Injections

E. F. Ellington
Associate Professor,
Animal Physiology

R. B. Osland
Graduate Assistant,
Animal Science

J. E. Kinder
Graduate Assistant,
Animal Science

The potential value of estrous cycle control in cattle operations was discussed in the preceding paper. Another potential for increasing the efficiency of a cow-calf operation would be increasing the frequency of multiple births. Of the different types of multiple births, it appears that twinning offers the most promise both in terms of successful pregnancies and resulting performance of the calves.

The beef cow, because of her relatively long generation interval and characteristic single birth at each parturition, is considered among the least efficient of all farm animals. She is typically maintained for one year with the expectations of producing one marketable product, the calf.

Unfortunately, there are usually some cows in all herds that fail to calve, which not only makes their contribution nil but causes their maintenance costs to be borne by the productive members of the herd. Currently, the average calf crop in the United States is less than 80 percent with 85 percent suggested as an average for some of the better managed herds.

In addition to reductions in the calf crop because of failure of some cows to calve, an additional toll of calves must be deducted for replacements if the producer is to maintain his rate of production. This may involve saving replace-

Table 1. Breeding and Calving Performance for the Cycle Control-Twinning Study

Group	No. cows	No. cows showing estrus during AI period			No. cows that calved			
		Entire 16-day period	3-day period ^a	Twice (Split estrus)	Total	To AI	To clean-up bull	With multiple birth
I (Control)	20	13	4	0	19	6	13	1
II (2 progesterone + low PMSG)	20	15	9	0	15	5	10	0
III (2 progesterone + 2 PMSG)	20	12	7	4	16	6 (1) ^b	10	1
IV (2 progesterone + high PMSG)	20	18	14	6	16	9 (2)	7	3

^a Represents maximum number of cows in estrus during any 3 days of the 16-day AI period.

^b Number in parenthesis indicates number of the AI settled cattle that produced Charolais calves.

ments for 20 percent of the cow herd. Simple mathematics will reveal that this leaves the producer with approximately a 60 to 65 percent "marketable" calf crop.

If the cow-calf operation is to be competitive and profitable, especially in the future, emphasis must be given to increasing the calf crop that can be marketed. Moreover, if the human population continues to increase and standards of living continue to rise throughout the world, producers will be faced with a problem of producing increased quantities of meat. It is apparent from past trends that as these standards rise, so does the demand for meat, particularly beef.

Successful twinning procedures would, of course, offer a means of increasing the percent calf crop. In this way calf crops exceeding 100 percent and possibly even 150 percent may result.

Twinning does occur naturally in beef cattle, but the frequency of twinning is rare in that it occurs only once or twice in every hundred births. It also appears that twinning is not highly heritable, which indicates that the progress that can be made through selection will be very slow.

Owing to the fact that ova or egg production is under control of hormones, it appears that use of hormones for inducing twinning would presently offer the most promise. Supposedly, each cow has the potential of producing some 75,000 ova over her lifetime, but at best under present management conditions only about 10 to 12 of these ova will actually develop into calves.

The present report deals with the study of experimental procedures for estrous cycle control where emphasis is given not only to the control of the time of ovulation but also to the control of the rate of ovulation. In other words, emphasis was given to combination of procedures for cycle control and twinning.

Since past research has indicated the development of problems such as increased chances of pregnancy termination when attempts are made to produce multiple births exceeding twins, the present investigation involves hormonal treatments which should cause a mild superovulatory stimulus. Hopefully, such treatments would serve to increase the frequency of twin-

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ning without resulting in excessive number of embryos.

Study Design

We allotted 80 mature Hereford cows to 4 equal sized groups for treatment prior to the breeding period. All of the cows had calved in the spring and were nursing calves. Group I served as the control and received no hormonal treatment. The other three groups (II, III and IV), received a subcutaneous injection of 750 mg of progesterone on May 13, 1970, which will be considered Day 1 of the treatment period. The same progesterone treatment was again given to the cattle of Groups II, III and IV on Day 22. On Day 29, Groups II and III received a subcutaneous injection of 1500 IU of PMSG (pregnant mare serum gonadotropin) while Group IV received 2000 IU. Group III received an additional subcutaneous injection consisting of 750 IU of PMSG at the time of insemination.

Detection of estrus, artificial insemination and use of clean-up bulls were carried out as described in the previous paper. In this study, all inseminations during the 16-day AI period were made with Hereford semen with the exception of any cattle that might have returned to heat during the 16-day period. In this case, such cows were reinseminated using Charolais semen.

Results and Discussion

The breeding and calving performance of the cattle involved in this study is briefly summarized in *Table 1*. As to breeding performance, attention is given in this table only to the cattle that showed estrus during the 16-day AI period. Obviously, there would be additional breeding activity during the period with the clean-up bulls, but the activity occurring immediately after the hormonal treatment was of major interest.

All treatments had an estrous synchronizing effect, as evidenced

by the maximum number of cows showing estrus over any 3-day period of the 16-day AI period. In this regard, the treatment involving the higher levels of gonadotropin (Group IV) appeared especially effective.

Calving performance data based on conceptions for the total breeding period (*Table 1*) reveal that all but one cow in the control group calved, whereas lesser numbers calved in the three treatment groups. Somewhat comparable numbers calved in all four groups as a result of AI, with the possible exception of Group IV where a higher number is indicated. Conception rates to AI, based on cows inseminated during the AI period, for Groups III and IV (50 percent and 50 percent, respectively) compared favorably with that of the control (46 percent) but was less for Group II (33 percent).

A total of five multiple births occurred and all of these were twin births resulting from impregnations originating during the AI period. Three sets of the twins were in Group IV, one in Group III and one was in the control group. Multiple births in cattle have been associated with problems such as weak or dead calves and retained placentae, especially when the number of calves exceeds twins. Although only five sets of twins is a small number, it is interesting to note that such problems were not encountered in this study.

A finding of interest pertains to the incidence of split estrus. This condition involves a return to estrus after the cow has been out

of estrus for a brief period. Such activity was observed in four cows in Group II and six cows in Group IV. It may well be that the higher total doses of gonadotropin in these two groups is related to this response.

The cattle showing split estrus were reinseminated during the second estrus with semen from a Charolais bull instead of the Hereford. Of the 10 cows showing split estrus, four calved to artificial insemination, five to the clean-up bulls and one failed to calve. Of the four that settled to AI, two settled to the Charolais insemination, one to the Hereford insemination and one to both inseminations in that it produced twins of which one was Hereford and the other Charolais sired.

From these results it would appear possible to accomplish conception in some cases to the first estrus portion and in others to the second portion of a split estrus and perhaps in some individual cases in both portions.

In summary, hormonal treatments involving the use of progesterone and equine gonadotropin were found promising as a means of controlling both the time and rate of ovulation. Such a development would allow for more convenient use of AI and for increased calf crop percentages. Additional study is needed to increase the precision of cycle control and frequency of twinning over that realized in this study. Attention needs to be given to resulting fertility and the split estrous problem as well as possibly others that might arise.

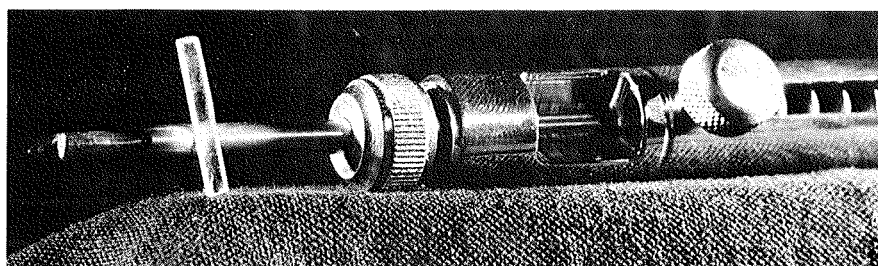
Reproductive Activity. III

Cycle Control With Hormonal Implants

J. E. Kinder
Graduate Assistant,
Animal Science

E. F. Ellington
Associate Professor,
Animal Physiology

In the preceding parts, attention was drawn to the significance of estrous cycle control and to problems remaining to be solved before successful application of such procedures will be possible. Prerequisites for successful procedures were



Hydron implant and instrument used for subcutaneous placement of the implants.

indicated to include that the administration of hormonal material must (1) be convenient and (2) effective in terms of precision of cycle control. It would appear that the use of a removable hormonal implant might have potential in regard to these particular points.

The present series of studies involved the use of a removable ear implant which contains a synthetic progestogen. It was possible in these studies to gain information on the implants in programs involving different intervals from treatment withdrawal to breeding, when used alone or in combination with other hormonal preparations and when used in cattle of different ages.

Study Design

We conducted three trials to evaluate the effectiveness of a progestogen-impregnated, removable implant.¹ The implants, consisting of a synthetic material called "Hydron," are cylindrical in shape with dimensions of 3 mm x 18 mm. Each implant contains 6 mg of a synthetic progestogen. We placed all implants under the skin in the ear. We removed the implant by making a small skin incision immediately over the implant.

Trial I. We conducted Trial I as a pilot trial to provide preliminary information on the effectiveness of the implant in precision of cycle control and resulting fertility. We allotted 21 18-month-old, cycling heifers to three groups. Group I (single treatment, breeding delayed group) received the implant on Day 1 of the treatment period.

Implants in this group were removed 16 days later on Day 17. Group II (double treatment group) received the same treatment as Group I and in addition a reimplantation on Day 22 with implant removal on Day 38. Group III (single treatment group) was implanted on Day 22 and the implants were removed on Day 38.

All 21 heifers were exposed to three Angus bulls for only 7 days starting the day of final implant removal (Day 38). We used pressure-sensitive, rump heat detectors together with twice daily observations to detect heat. During the treatment period, we used testosterone treated steers rather than intact bulls. Pregnancy palpations were performed 7 weeks after the bulls were removed.

Trial II. We conducted Trial II to verify estrous synchronization results of the previous trial and to determine the value of incorporating an exogenous gonadotropin (PSMG, or pregnant mare serum gonadotropin) in the treatment program. In this trial, we allotted 34 yearling Angus-Hereford crossbred heifers to three groups. Group I (controls) received no hormonal treatment. Group II (implanted) was implanted on Day 1 and the

implants were removed on Day 17. Group III (implanted + PMSG) was implanted on Day 1 and the implants were removed on Day 17, at which time 500 IU PMSG were injected under the skin. The same heat detecting procedures that were used during the treatment period in Trial I were used both during and after the treatment period. Trial II heifers were not bred.

Trial III. We performed Trial III to further verify the findings of Trials I and II and to determine if the response to the implant treatment might differ in cycling heifers and mature lactating cows. We used 40 yearling Hereford heifers and 40 lactating 3-year-old Hereford cows. We allotted the yearling heifers to two groups, with Group I remaining untreated and serving as a control. Group II was implanted on Day 1 and the implants were removed on Day 17. The lactating 3-year-old animals were similarly assigned with Group III serving as the untreated group and Group IV as the implanted group.

We again used heat detection procedures previously described. All animals in heat after the treatment period were artificially inseminated with Hereford semen 12 hours after heat was first detected. All animals were placed with Angus bulls for an additional 46 days after the AI period.

Results and Discussion

Trial I. The results of the first trial indicated that the implants definitely had an estrous synchroni-

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Table 1. Breeding and Conception Results for Trial I.

Group	No. heifers	No. of heifers showing estrus during:			No. of heifers palpated pregnant
		Time implants in place	7-day (entire) breeding period	1-day period ^a	
I (Single treatment, breeding delayed)	6	1	5	2	2
II (Double treatment)	7	2	7	5	3
III (Single treatment)	8	0	8	6	6

^a Most heifers in heat on any 1 day during the 7-day breeding period.

¹ Prepared and provided by G. D. Searle and Company, Chicago, Illinois.

Table 2. Estrous Activity Results for Trial II.

Group	No. animals	No. of animals showing estrus	
		21-day period ^a	2-day period ^b
I (Controls)	11	4	2
II (Implanted)	11	9	9
III (Implanted + PMSG)	12	10	9

^a 21-day period immediately after the treatment period.^b Most heifers in estrus on any 1 day of the 21-day period.

Table 3. Breeding and Conception Results for Trial III.

Group	No. animals	No. animals showing estrus		No. animals palpated pregnant ^b
		14-day AI period	2-day period ^a	
I (Yearling controls)	20	11	5	18
II (Yearling implants)	20	13	11	20
III (3-year-old controls)	20	17	5	19
IV (3-year-old implanted)	20	16	13	18

^a Most animals in heat on any 2-day period during the 14-day AI period.^b Includes both animals that have conceived to AI and animals that have conceived to the cover bulls.

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zation effect (Table 1). All heifers in the three groups exhibited estrus within the seven day breeding period with the exception of one heifer in Group I. These observations alone indicate an estrous synchronization effect in response to implant treatment. Especially noteworthy was the degree of precision of this effect in Group II and III where all animals except two in each group exhibited estrus during a 1-day period. The greatest number of heifers in estrus at one time resulted 1½ days after final implant removal.

The precision of cycle control is less in Group I, no doubt, because the heat period of concern here is the second post-treatment estrus and apparently some synchronization has been lost. It is interesting, however, that synchronization could be maintained at the second period if a second treatment with implants were used as evidenced by the findings of Group II.

One problem became apparent when one heifer in Group I and two heifers in Group II showed estrus during the time that the implants were in place. All three heifers, however, exhibited estrus

again after treatment in the seven day breeding period.

Results from pregnancy palpations show that six out of eight heifers conceived in Group III whereas only three out of seven and two out of six conceived in Groups I and II, respectively. The high percent impregnations in Group III in such a brief period is indeed encouraging on the basis of previous studies which, of course, have involved other progestogens and other administration methods. It may well be that this implant preparation does not cause some of the detrimental effects observed for earlier treatments.

Trial II. A relatively high degree of estrous synchronization also occurred in Trial II (Table 2). Group III, which received PMSG when the implants were removed, showed no particular advantage in terms of cycle control over Group II, in which implants were used alone. The largest number of heifers in heat at one time resulted about 1½ days after implant removal. This agrees with the results from Trial I.

Trial III. More than 50 percent of the implanted animals responded by showing estrus in a 2-

Biuret In Range Supplements

D. C. Clanton, Professor,
Animal Science

L. E. Jones, Research Technician

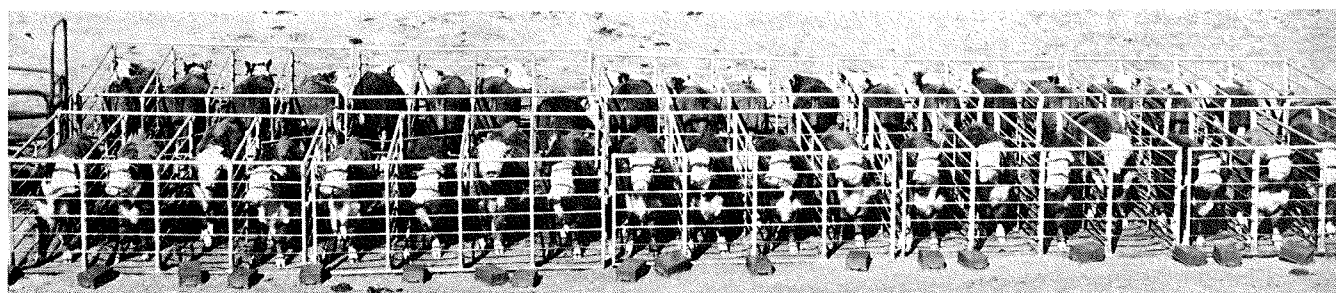
Data from the North Platte Station has shown that urea in range supplements is not well utilized (1969 *Nebraska Beef Cattle Report*, E.C. 69-218). Further data has been

day period in Trial III (Table 3). This was true for both the lactating 3-year-old cows and the yearling heifers. The peak number of heifers in heat at one time resulted 1½ days after implant removal, which is in agreement with Trials I and II. But in the 3-year-old lactating cows, the peak number resulted at 2 to 2½ days after implant removal. The cattle involved are scheduled to calve during the spring of 1972. At that time, it will be possible to determine with certainty in the case of each animal whether the conception originated to AI or to natural service.

Summary

Although the implants used in these studies appear to offer promise in terms of both precision of cycle control and resulting fertility, there is still need for additional work. Optimum times for artificial insemination needs to be studied. Further work needs to be done to maximize the number of conceptions after the implant treatment.

No doubt, additional studies involving experimentation with dose and time of gonadotropin administration, as well as some other hormones in combination with implants, would offer promise. Studies directed toward developing an understanding of the mechanism(s) by which the implants are acting to result in cycle control would be appropriate.



Calves being individually fed supplements on winter range.

accumulated which substantiates this fact.

In more recent experiments a non-protein nitrogen (NPN) source called biuret has been compared with other sources of NPN using different plant carriers. Biuret is similar to urea in that it is essentially two urea molecules attached together. Urea is 45 percent nitrogen and very soluble, whereas biuret is 37 percent nitrogen and quite insoluble.

Objectives of three experiments reported here were to compare the performance of calves fed supplements containing biuret with calves fed supplements containing other sources of NPN while grazing native winter range. In the third experiment different plant carriers for biuret in a supplement were compared.

We corralled the calves every day and fed each his respective supplement individually. Six calves received each supplement.

Experiment 1

We conducted the first experiment during the winter of 1968-69 to compare the performance of calves fed supplements containing different levels and sources of NPN while grazing native winter range. We used 12 supplements (*Table 1*).

Treatment 1 was a negative control. Treatment 2 was a positive control using all plant protein. Treatments 3 through 10 were a comparison of levels and sources of NPN. Treatments 11 and 12 provided the same natural protein as Treatments 3, 5, 7, 9, and Treatments 4, 6, 8, 10, respectively, and gave an evaluation of the benefit

of adding the NPN to the supplement. All supplements contained phosphorus and vitamin A so that all calves received the same daily intake.

There was a significant advantage in weight gains from feeding any one of the supplements. This was shown when comparing Treatment 1 with the rest. When comparing the positive control (Treatment 2) with all those containing NPN (Treatments 3 through 10) there was a significant advantage in weight gains for the positive control.

As we increased the level of urea in the supplements, Treatments 2, 3, and 4, there was a significant decrease in weight gains. The change in weight gains when comparing levels of biuret, extruded starch-urea or clay-urea was not significant. Calves fed the supplements with the low levels of NPN (Treatments 3, 5, 7, and 9) gained significantly more than the calves fed the higher levels of NPN (Treatments 4, 6, 8, and 10). This was

due primarily to the difference in urea and clay-urea levels, as there was a source by level interaction.

The calves fed the 40 percent protein supplement (Treatment 2) gained significantly more than those fed the 24 percent protein supplement (Treatment 12) but not significantly more than those fed the 32 percent natural protein supplement. When comparing the gains of calves fed the supplement with either level of NPN with gains of those fed the supplement in Treatment 11 and 12, there was no benefit from adding the NPN.

Experiment 2

We conducted the second experiment during the winter of 1969-70 to compare the performance of calves fed supplements containing different levels and sources of NPN with different sources of plant protein while grazing native winter range. We used 11 supplements (*Table 2*).

Treatment 1 was a negative con-

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Table 1. Amounts and kinds of supplements fed and average daily gains of the calves in Experiment 1.

Treatment No.	Daily feed lb.	Protein %	NPN		Protein eq. from NPN %	Average daily gain 126 days lb.
			Source	%		
1	0.25	6	None	0.00	0.00	-0.45
2	1.50	40	None	0.00	0.00	0.44
3	1.50	40	Urea	3.00	8.43	0.35
4	1.50	40	Urea	6.00	16.86	0.12
5	1.50	40	Biuret	3.56	8.43	0.29
6	1.50	40	Biuret	7.10	16.86	0.31
7	1.50	40	Extruded starch-urea	21.80	8.43	0.32
8	1.50	40	Extruded starch-urea	43.60	16.86	0.33
9	1.68	36	Clay-urea	13.34	7.80	0.27
10	1.86	33	Clay-urea	24.11	14.10	0.21
11	1.50	32	None	0.00	0.00	0.36
12	1.50	24	None	0.00	0.00	0.25

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trol and provided no supplemental protein, only minerals and vitamin A.

Treatments 2 and 7 were positive controls and provided all plant protein.

Treatments 3 and 4 contained two levels of urea with corn and soybean meal making up the balance of the supplements.

Treatments 5 and 6 contained two levels of biuret, with corn and soybean meal making up the balance of the supplements.

Treatments 7, 8, and 9, were the same as Treatments 2, 3, and 4, except dehydrated alfalfa was used instead of corn and some of the soybean meal for the balance of the protein.

The supplements were 18, 39, and 57 percent dehydrated alfalfa, respectively. The dehydrated alfalfa contained 17 percent protein.

Treatments 10 and 11 were the same as Treatments 5 and 6 except dehydrated alfalfa was used instead of the corn and some of the soybean meal.

The supplements were 38 and 56 percent dehydrated alfalfa, respectively.

There was a significant advantage in weight gains from feeding any of the supplements compared to the negative control.

As the level of urea was increased in the supplements (Treatments 2, 3, 4, and 7, 8, 9) there was a significant decrease in weight gains. However, there was no significant difference in gains when the level of biuret was increased in the supplements (Treatments 2, 5, 6, and 7, 10, 11). This indicated that higher levels of NPN from biuret as compared to urea can be used effectively in this type of supplementation program.

There was no difference in gains when comparing supplements containing dehydrated alfalfa with those not containing dehydrated alfalfa. There were no interacting effects between sources of NPN and source of plant protein.

Table 2. Amounts and kinds of supplements fed and average daily gains of the calves in Experiment 2.

Treatment No.	Description	Supplement fed per day lb.	Protein %	Urea or biuret %	Protein eq. from NPN %	Average daily gain 126 days lb.
1	Negative control	0.25	6.0	0.0	0.00	-0.13
2	Soybean meal N.	1.50	40.0	0.0	0.00	0.52
3	Soybean meal + urea	1.50	40.0	3.0	8.43	0.52
4	Soybean meal + urea	1.50	40.0	6.0	16.86	0.32
5	Soybean meal + biuret	1.50	40.0	3.7	8.43	0.46
6	Soybean meal + biuret	1.50	40.0	7.3	16.86	0.45
7	Dehy. alf. + soybean	1.50	40.0	0.0	0.00	0.54
8	Dehy. alf. + urea	1.55	40.0	3.0	8.43	0.50
9	Dehy. alf. + urea	1.62	40.0	6.0	16.86	0.41
10	Dehy. alf. + biuret	1.55	40.0	3.7	8.43	0.47
11	Dehy. alf. + biuret	1.62	40.0	7.3	16.86	0.52

Experiment 3

We conducted the third experiment during the winter of 1970-71, to evaluate higher levels of biuret with and without dehydrated alfalfa in the supplements (Table 3). All supplements contained phosphorus and vitamin A, so that all calves received the same daily intake.

Treatment 1 was a negative control and provided no supplemental protein, only minerals and vitamin A. Treatment 2 was a positive control and provided all plant protein. Treatments 3 through 6 contained four levels of biuret with corn and soybean meal making up the balance of the supplements. Treatments 7 through 10 contained four levels of biuret with 17 percent protein dehydrated alfalfa replacing some of the corn and soybean meal to make up the balance of the supplements.

There was a significant advantage

in weight gains from feeding any one of the supplements. This was shown when comparing Treatment 1 with the rest. When comparing the positive control (Treatment 2) with the average of all supplements containing biuret (Treatments 3 through 10) there was no significant difference in weight gains.

There was an advantage in weight gains when dehydrated alfalfa was in the supplement (Treatments 7 through 10 vs. Treatments 3 through 6). As the amount of biuret in the supplement was increased, the amount of dehydrated alfalfa was also increased. It would appear that it is desirable to have dehydrated alfalfa in supplements with high levels of biuret.

Summary

In conclusion it appears that biuret is used more effectively than urea when incorporated in supplements fed to calves wintered on

Table 3. Amounts and kinds of supplements fed and average daily gains of the calves in Experiment 3.

Treatment No.	Description	Supplement fed per day lb.	Protein %	Biuret %	Protein eq. from NPN %	Average daily gain lb.
1	Negative control	0.25	6.0	0.0	0.0	0.14
2	Soybean meal N.	1.50	40.0	0.0	0.0	0.79
3	Soybean meal + biuret	1.50	40.0	3.0	6.9	0.79
4	Soybean meal + biuret	1.50	40.0	6.0	13.8	0.73
5	Soybean meal + biuret	1.50	40.0	9.0	20.7	0.58
6	Soybean meal + biuret	1.50	40.0	12.0	27.6	0.51
7	Dehy. alf. + biuret	1.50	40.0	3.0	6.9	0.79
8	Dehy. alf. + biuret	1.50	40.0	6.0	12.8	0.71
9	Dehy. alf. + biuret ¹	1.59	37.7	8.5	19.6	0.72
10	Dehy. alf. + biuret ¹	1.67	36.0	10.8	24.8	0.70

¹ In an attempt to equalize energy intake, it was necessary to feed more of each supplement which contained less protein so that the total supplemental protein intake was the same for all treatments.

Quality Control in Feedlot Management

Paul Q. Guyer
Extension Livestock Specialist
(Beef Cattle)

Two cattle feeders can split a group of cattle, feed the same ration, and yet have as much as \$1.50 to \$2.00 per cwt difference in cost of gains. The difference is in "Quality Control" in feedlot management.

Feeders who develop management programs which give due attention to the little things as well as the big have been improving rate of gain and decreasing cost of gain in recent years—a period devoid of major breakthroughs in beef cattle nutrition and management. These successful feeders have made careful plans and developed appropriate checks to see that the plans are carried out. They have encouraged pride in a job done with skill and dedication among their personnel.

Every major phase of feedlot management needs to be involved in a quality control program. Among the more important areas are ration formulation and management, feedlot design and starting new cattle.

RATION FORMULATION AND MANAGEMENT

Rations should include feeds produced on the farm, in the local area, or, when they will reduce cost of production, grains and by-product feeds which may be transported

native range. Higher levels of biuret can be used than urea. The advantage of having dehydrated alfalfa in the supplements containing high levels of biuret is not well understood. In contrast, the supplement containing a high level of biuret with 66 percent corn and 15 percent soybean meal as the main carrier (Treatment 6, Table 3) was not as effective as when no soybean meal, 30 percent corn and 45 percent dehydrated alfalfa was used (Treatment 10, Table 3).

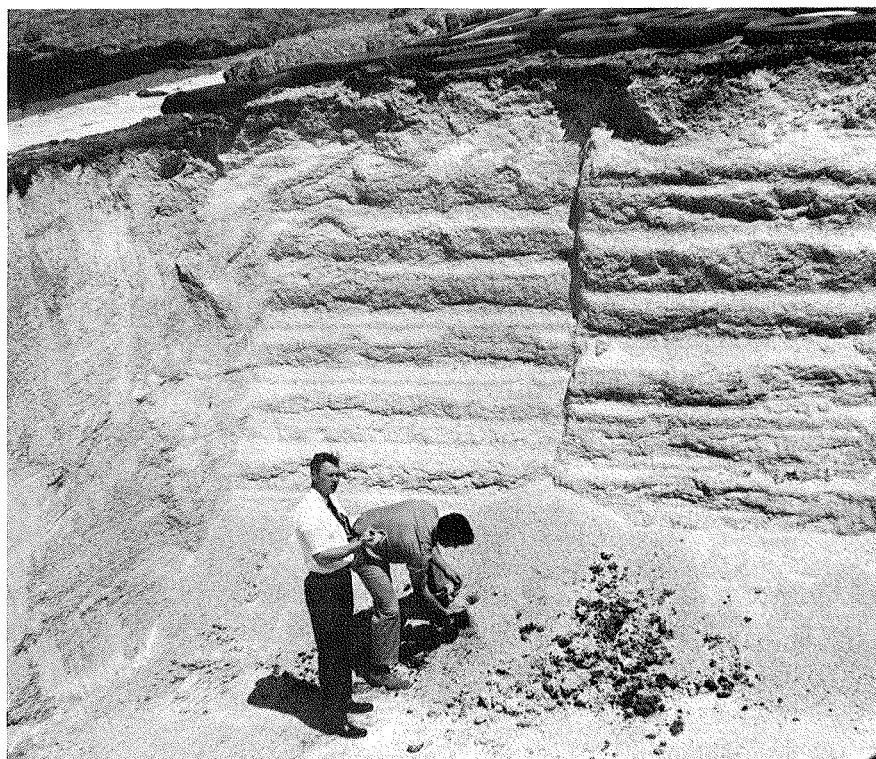


Figure 1. High moisture corn stored in trenches will often vary 8 to 10 percent in moisture content from early to late fill.

rather long distances. Rations should be designed to produce efficient gains for the type of program that is to be followed.

Normally, calves should be grown at a rate up to 1.25 pounds daily if they are to be grazed afterward or 1.75 to 2.0 pounds daily if they are to be finished after the growing period. When cattle reach a stage of growth that they can be finished at acceptable weights in 100 to 140 days (500-650 pounds for heifers and 600-750 for steers) they should be moved rapidly to a high concentrate finishing ration. Recommendations for two finishing rations are listed in Table 1.

Formulation on a Dry Basis— an Aid in Quality Control

The wide variation in moisture content of feedstuffs currently used requires ration formulation and feed purchasing programs that take moisture into account. Grains may vary in moisture content from 12

to 30 percent and silages from 50-75 percent or even more.

In buying feed grain and silage your purchase price should involve adjustment for any deviation from the normal moisture content. Using 15.5 percent moisture as the base, grain changes approximately 1.2 percent in nutrient content with each 1 percent moisture change. Using 70 percent moisture as a base, silage changes 3.3 percent in nutrient content with each 1 percent moisture change. The cost of handling higher moisture feedstuffs may place them at a further disadvantage.

In formulating rations, the simplest method of handling moisture differences is to formulate on a dry basis. The ration can be easily adjusted to an "as fed" basis each time a major ingredient changes significantly in moisture content. Adjusting for moisture variation requires periodic checking of all in-

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gredients expected to vary more than 2-4 percent in moisture during the feeding period.

Moisture adjustments need to be made in both grain and roughage in high concentrate-low roughage finishing rations. Rather small changes in moisture content of roughage can effect an important change in the relative amounts of roughage dry matter fed. In many low roughage rations cattle are borderline acidosis cases. A sudden drop of roughage dry matter (even as low as 1 to 2 percent of the total ration) may precipitate death loss from enterotoxemia.

The farmer-feeder who weighs feed only periodically many times feeds cattle more accurately than feeders who do not adjust for moisture variations but do weigh their feed daily. Without scales, the feed wagon is filled to about the same level from day to day and about the same amount of dry matter is fed even though the moisture content may vary substantially. Weighing feed daily can improve management, but, in addition you need to make adjustments for variation in moisture.

Chemical Checks on the Ration

Feeds vary considerably in composition. One opportunity avail-



Figure 2. Uniform feed mixing contributes to increased efficiency of gain, use of high concentrate rations and high protein content supplements.

able to feeders, particularly farmer-feeders, is to take advantage of protein analyses of feedstuffs in formulating rations. A meaningful protein analysis is difficult in larger feedlots that have a rapid turnover of feedstuffs.

Occasional checks for toxic substances such as nitrates may be desirable in addition to protein and moisture. Checks on minerals and vitamins and other chemical constituents are seldom justified.

Chemical checks are justified as a rule on only the major feedstuffs in the ration. In finishing rations the major grain is the only ingredient that needs to be evaluated for

protein. In growing rations the roughage may be checked.

When protein analysis of the major feed ingredient is used in formulating rations, care will need to be used in selecting a supplement that will not only balance the ration for protein but also provide the needed calcium, phosphorus, trace minerals, vitamin A and feed additives.

Periodic checks should be made of feed samples taken from the bunk. This gives a good check on the effectiveness of your formulation and mixing program. Bunk samples serve to check (1) accuracy of formulation, (2) mixing adequacy and (3) separation in the bunk.

Management of Feed Additives

Stilbestrol should be included in the ration at the rate of 10 mg per head daily when antibiotics are fed. Twenty mg per head daily can be fed to cattle weighing over 750 pounds if antibiotics are not included in the ration. Ear implants can be used when it is not convenient to add stilbestrol to the feed.

Antibiotics fed continuously at low levels increase rate and efficiency of gain in finishing rations (Table 2). In addition, broad spectrum antibiotics appear to be effective in reducing liver abscesses on low roughage-high concentrate finishing rations.

Table 1. Specifications for Two Finishing Rations^a

	High roughage		High concentrate	
	Min.	Max.	Min.	Max.
Roughage (%)	15	20	5	10
Net energy for gain megcal/100 lbs.	58	....	61	....
Crude protein (%)	11.5	....	12.0	....
Urea (%)	....	1.0	....	1.0
Calcium (%)	.35	.5	.35	.5
Phosphorus (%)	.35	.5	.35	.5
Salt (%)	.3	.3	.3	.3
Potassium (%)	.55	....	.55	....
Iodine ^b mg./lb.	.1	....	.1	....
Cobalt ^b mg./lb.	.05	....	.05	....
Copper ^b mg./lb.	4.0	....	4.0	....
Zinc ^b mg./lb.	25.2	....	25.2	....
Vitamin A IU/lb.	1400	....	1400	....
Stilbestrol ^c mg./lb.	.55	.55	.55	.55
Antibiotic mg./lb.	3.9	3.9	3.9	3.9

^a On a dry matter basis (moisture free).

^b 1 mg iodine, 1 mg cobalt, 15 mg copper and 100 mg zinc per head daily added in the supplement.

^c May feed heifers MGA in lieu of stilbestrol.

Withdrawal periods for stilbestrol must be rigidly followed. To be absolutely safe, remove the supplement from the ration at least 7 days before delivering the cattle for slaughter if palatability or dustiness of the ration is not a problem. If palatability or dustiness is a problem substitute molasses for liquid supplements and soybean meal or visually different commercial dry supplements for the stilbestrol-containing supplement.

Where MGA is fed, observe the 48 hour withdrawal period required before slaughter. In this case, too, all the supplement can usually be dropped from the ration without harm.

Avoid violation of drug withdrawal regulations on sick cattle and "bullers." This may mean that stilbestrol cannot be fed in "buller" lots if these are to be marketed with their original mates. In the case of sick cattle, an accurate record of treatment (date and product used) will be necessary in order to avoid withdrawal violations.

Uniformity of Mix Affects Ration Formulation

With modern rations containing feed additives and highly potent feedstuffs like urea, delivering a uniform mix to the feed bunk and preventing separation in the feed bunk is increasingly important. Many factors influence the uniformity of the mix in the feed bunk, including processing, feeding equipment, the physical properties of the ration, etc. The degree of uniformity of mixing needs to be considered in choosing sup-



Figure 3. Feed should be nearly cleaned once a day.

plements and roughage levels in ration formulation.

Uniform mixing requires either stationary mixers or mobile mixers, operated properly. Where these are not available or where separation of ingredients may occur, rations should be modified to reduce digestive disturbances. Some points to consider are:

1. High protein, high urea supplements can provide all the supplemental nitrogen needs (for finishing rations) in uniform mixtures fed free choice. Where feed wagons will not mix uniformly, low protein equivalent supplements (35 percent or less) should be fed if urea is to provide most of the supplemental nitrogen.

2. Where rations are uniformly mixed and formulated on a percentage basis, 5 to 10 percent roughage gives maximum rate and efficiency of gain. In these rations antibiotics should be fed at the recommended continuous level to minimize loss from liver abscesses. Where feed is not well mixed, 15 to 20 percent roughage may be necessary to minimize death loss, or founder and other digestive upsets.

3. Separation of finely ground ingredients or excessive wind loss can be prevented by adding molasses, liquid supplement, fat or water in the quantity needed.

4. Coarsely chopped forages, large pellets, etc. may be sorted out by cattle. To prevent this, forage should be chopped fine enough to prevent sorting and pellets may need to be crushed.

Select Feeds Carefully

Differences in feed value need to be recognized in selecting and purchasing feedstuffs.

Silage Selection—For growing and finishing rations, corn varieties producing the highest grain yields per acre have usually produced the highest daily gains and the most beef per acre in tests at North Platte. If you buy silage, you may find that recommending specific varieties of corn or sorghum to potential suppliers will improve the quality and uniformity of the silage.

The choice between sorghum and corn silage should be influenced more by the availability of moisture and other production factors than by their comparative feed value per ton of dry matter.

Silage should be rather mature (corn in the late dent stage—sorghum in the hard dough to ripe stage) for the highest productivity per acre and most rapid gain in growing rations. Silages containing less than 70 percent moisture appear to produce faster gains in growing rations than wetter silages. Silage should be chopped fine

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Table 2. Performance of Cattle Fed Low Levels of Antibiotics Continuously (Data Collected in 1960's)

Comparison	No. trials	Improvement over controls	
		Daily gain %	Feed efficiency %
Zinc Bacitracin ^a	20	5.0	5.4
Aureomycin ^b	20	4.8	4.5
Terramycin ^b	10	5.9	3.4
Bacitracin-methylene disalicylate	5	4.1	4.9

^a Level fed ranged from 35 to 80 mg/head/day.

^b Level fed ranged from 70 to 100 mg/head/day.

^c Level fed ranged from 70 to 80 mg/head/day.

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enough that the coarser particles cannot be separated and refused.

Selection of grain or by-product feeds—Where energy feeds must be purchased, grains not commonly used and by-product feeds are often available at prices that will increase profits.

Comparative values of different energy sources and restrictions that appear appropriate for satisfactory results are shown in *Table 3*. Preliminary research with wheat and milo indicate that varietal differences may influence both the feed value and the restrictions needed. However, further research is needed before varietal recommendations can be made.

Use of sub-standard energy sources—On occasion, below standard feedstuffs are available at "bargain" prices. Most of these can be fed to advantage with proper processing and management. Old, heat or insect damaged grains often produce as good results per unit of dry matter as does high quality grain of the current year's crop. Moldy grains tend to reduce appetite and on occasion may be toxic enough to cause problems. These usually can be successfully fed as a portion of the ration. The use of substandard protein, minerals and vitamins cannot be recommended.

BUNK MANAGEMENT

Cattle tend to develop a rather uniform feed intake from day to day in well designed and well managed lots. Changes in weather will influence intake, but once fair weather returns cattle will soon adjust appetites to their average level.

Symptoms of poor bunk management show up in the daily feed records, in observing the bunk and in observing the cattle.

The good feeder strives for maximum feed intake. Factors involved in accomplishing this include (1) keep feed before the cattle at all times, (2) avoid stale feed



Figure 4. Mounds help defeat MUD—enemy No. 1 in the feeding business.

Table 3. Energy Sources for Finishing Rations

Feedstuff	Value compared to corn (%)	Ration restrictions (maximum %)
Animal fat	160-180	5
Barley	88-90	100
Beet pulp	88-95	50
Corn	100	100
Hominy feed	95-98	20
Millet	90-100	50
Milo	85-95	100
Molasses	70	5
Oats	88-94	25
Rye	80-85	20
Wheat	100-105	40
Wheat bran	65-80	10
Wheat midls	70-85	20

in the bunks, (3) keep bunks clean, (4) use a series of rations to get cattle on full feed.

With high concentrate rations containing non-protein-nitrogen, many micro-ingredients, and, in many feedlots, whole corn, the feeding program should be designed for the critter to satisfy his appetite at his leisure rather than on schedule fitted to the feeder's needs or wishes. This means that feed should be available throughout the 24 hour day. To avoid having stale feed, cattle should nearly clean up the bunks once a day. They should clean the bunk well enough to avoid any accumulation of fines.

Stale feed will reduce feed intake and rate of gain. Stale feed should be discarded. On the other hand, relatively fresh feed covered with snow or wet by rain will usually be consumed without problem if mixed with the next batch of feed. Clean bottomed bunks are one indication of a careful feeder. Spoiled feed caked over the bottom of the bunk indicates a lack of judgment and industry on the part of the feeder, improper bunk design, or ingredient separation in the bunk. Regardless of the cause, cattle should benefit by its correction. In the years ahead we may be recycling waste into cattle rations. But until this practice has been proven, manure left in the bunk indicates poor management.

STARTING CATTLE ON FEED

Cattle should be filled quickly once they reach the feedlot and have a full belly until they reach the kill floor. An exception would be a short period just ahead of worm treatment, if the wormer is to be fed.

Cattle should be allowed to fill with roughage on arrival. Then grain should be added according to a planned schedule either by a series of ration mixtures or by a planned increase in grain with a

Table 4. Suggested Specifications for 4 Feedlot Rations from Start to Finish^a

Ration No.	1	2	3 ^b	4
Days to be fed	5-10	5-10	5-10	Till finished
Roughage (%)	60-70	30-35	15-20	5-10
Crude Protein (%)	11.5	11.5	11.5	12.0
Urea (%)	0	0	0-1	0-1
Calcium (%)	.35-.9	.35-.8	.35-.5	.35-.5
Salt	.3	.3	.3	.3

^a Ration content on a dry matter basis.

^b Can be used as the final finishing ration where good mixing equipment is not available.

corresponding decrease in roughage.

Recommendations for a series of mixes are shown in *Table 4*.

Changes to more concentrated rations can be made at 5 to 10 day intervals, depending on how the cattle start. When the change is made, the more concentrated feed should be fed at a rate to provide grain at about the same level as on the previous day.

When following a program of a gradual increase in grain, older cattle may be started on concentrates at approximately 1 percent of body weight with all the roughage they'll clean up. Increase the grain and decrease roughage at the rate of about $\frac{1}{2}$ to $\frac{3}{4}$ pound air dry equivalent daily until the cattle are eating slightly less than 2 pounds of concentrates per hundredweight live weight. Then slow the rate of adjustment until the desired roughage level is reached.

Cattle in Nebraska tests have gained more rapidly when started on all plant supplements than when the supplement contained urea. In tests at Lincoln and Mead, whey fed at the rate of .5 pound dry matter per head daily seems to contribute to lot adaptation when urea is used.

FEEDLOT DESIGN

The feedlot should be designed so that cattle can eat and drink following a minimal stimulus and should provide a comfortable place to rest close at hand in between visits to the feed bunk or water trough.

Some points to check in regard to proper feedlot design are:

1. Is water located close to the feed?
2. Is adequate concrete used to eliminate mud interfering with travel from the resting area to feed and water?
3. Is drainage designed to provide a dry resting area a relatively high percentage of the time? (Most lots need mounds that are perpendicular to the

Comparison of Bull And Steer Carcass Characteristics

Vincent H. Arthaud
Assoc. Prof., Animal Science

Consumers increasingly prefer beef cuts with a high proportion of lean in relation to fat. Though bulls gain more rapidly with less feed than steers or heifers, bulls have generally been considered undesirable for block beef. This premise has been challenged in recent years due to increased emphasis on lean beef and the changes in feeding and management practices that stress maximum rate of gain and marketing at young ages.

We designed studies to provide data on carcass characteristics of bulls versus steers whose genetic background and environment were similar.

Bulls and steers slaughtered at the same age and fed the same ration

We collected data in this study during 1963, 1964 and 1965 on 77 bulls and 80 steers from the Uni-

versity Angus herd. We allotted bull calves at random to two groups; one we left intact and the other we castrated after weaning.

Calves were adjusted to the feeding regime for 30 days after weaning. For the remainder of the experiment, we fed the calves a pelleted ration while tied overnight to individual feeders. The ration was calculated to contain 68.4 percent total digestible nutrients (TDN).

We also fed approximately 2 pounds of grass hay per head during the day.

The cattle were slaughtered in a commercial packing plant and complete carcass information was obtained. The right side of each carcass was returned to the University Meat Laboratory.

Rib samples were obtained for tenderness test by shear and for chemical analysis.

The wholesale rib, chuck, loin and round were boned and sur-

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bunk apron to best accomplish this.)

4. Is enough area allowed to permit reasonably fast drying, but not so large that movement requires undue energy? (Usually 200-250 square feet per animal in eastern Nebraska—see article on page 26).
5. Are slopes moderate so that they do not interfere with frequent feeding by the cattle?
6. Are night lights provided to stimulate night feed consumption and to reduce the danger of night fright?
7. Are waterers and bunks designed for ease of cleaning and are they cleaned at least once a week?

SUMMARY

The successful cattle feeder will attain a high degree of efficiency in all aspects of his business. Real progress can come from the personnel involved in a feeding operation doing their jobs with greater knowledge, skill and dedication.

Too often feeders have looked for the "miracle additive" to solve problems and have wasted time and money on worthless or over priced products that may reduce profits.

Let's put our effort in upgrading feedlot performance with management and quality control programs which will let the cattle and the rations fed fully express their merit. In many cases you will be able to increase rate and efficiency of gain by several percentage points and profits by much more with tighter management controls.

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face and intermuscular fat trimmed to about $\frac{1}{4}$ inch. Weights of these boneless cuts were determined.

The remaining wholesale cuts were boned, closely trimmed of fat and ground. The ground beef was added to the total retail yield of the primal cuts to obtain total retail product.

Bulls gained 15 percent more with 11 percent less feed than steers. The average carcass weight of bulls was 548 pounds and of similar aged steers 494 pounds. The average amount of total retail product from these bull carcasses was 59 pounds greater than from the steers. This is a reflection of the more rapid lean growth in bulls.

Carcass measures of bulls and steers adjusted to a common carcass weight of 518 pounds are presented in *Table 1*. Bull carcasses yielded 29 pounds more total retail product from carcasses of the same weight. This increased yield was produced with 311 pounds less TDN.

The greatest difference between bulls and steers in weight of individual boneless retail cuts was that of the chuck and ground beef. There was essentially no difference in weight of boneless rib or loin.

Steers were more tender than bulls because 2.9 pounds less force was needed to shear a 1-inch core of the rib eye muscle. Bulls were more variable in their tenderness than steers.

Table 2. Averages of Measures for Bulls and Steers Implanted and Not Implanted with Stilbestrol

	Steers		Bulls		
	No implant	Two 24 mg. implants	No implant	Two 48 mg. implants	Two 96 mg. implants
Number	12	12	14	12	12
Av. daily gain, lbs.	1.60	1.74	1.83	2.05	1.99
Lbs. TDN/lb. gain	7.2	6.9	6.3	5.8	6.2
Carcass grade ¹	9.6	8.9	8.6	9.2	9.2
Shear tenderness, lbs. ²	14.0	12.4	17.0	18.0	18.3
Fat thickness, in.	0.34	0.36	0.26	0.28	0.32
Kidney & pelvic fat, lbs.	3.0	2.8	2.6	2.4	2.7
Yield of trimmed boneless cuts from loin, round, rib & chuck, % ³	52.8	53.4	55.6	56.4	54.7

¹ 8 = av. good 9 = good 10 = choice -

² Pounds of force required to shear a 1-inch core of cooked rib eye muscle with a Warner-Bratzler shear.

³ Percent of closely trimmed boneless cuts determined by trimming and boning the cuts from one side of the carcass.



Bulls 15 months of age prior to slaughter.

Steer carcasses graded higher, averaging low choice, while their bull mates averaged between middle and high good. Steers had more marbling and a finer texture and brighter red color of lean. Chemical analyses of a $\frac{1}{2}$ -inch thick, untrimmed, boneless 12th rib sample indicated that bulls had 11 percent less fat and 11 percent more protein than comparable cuts from steers.

Stilbestrol implant study with bulls and steers

Bulls and steers from the same source as those in the previous experiments were also allotted and fed in the same way except that we implanted some with stilbestrol. One of the two lots of steers was implanted with 24 mg. of stilbestrol at the start of the feeding period and again with 24 mg. at the midpoint of the period. The bulls were divided into three treatment groups; one with no implants, one with a 48 mg. implant at the start and another 48 mg. implant midway, and the third with a 96 mg. implant at the start and another

Table 1. Averages of Carcass Measures for Bulls and Steers Adjusted to a Common Carcass Weight of 518 Pounds.

Measure	Bulls	Steers
Total retail products, lbs.	344	315
Boneless retail cuts		
Round, lbs.	91.9	88.2
Loin, lbs.	48.5	48.5
Rib, lbs.	25.8	26.2
Chuck, lbs.	113.8	101.0
Ground beef, lbs.	64.2	51.1
Rib eye area, sq. in.	11.0	10.2
Fat thickness, in.	.35	.55
Kidney & pelvic fat, lbs.	5.5	7.9
Shear tenderness, lbs. ¹	13.9	11.0
Carcass grade ²	10.3	11.9
Marbling score ³	8.1	9.6
Lean texture score ⁴	10.0	12.5
Color score ⁵	10.1	12.6
Fat, 12th rib sample, %	46	57
Protein, 12th rib sample, %	47	36

¹ Pounds of force required to shear a 1-inch core of rib eye muscle with a Warner-Bratzler shear.

² 10 = av. good 11 = good + 12 = choice - 13 = av. choice

³ 8 = small amount 9 = modest amount 10 = moderate

⁴ 10 = slightly coarse 11 = slightly fine 12 = moderately fine

⁵ 10 = moderately dark red 11 = slightly dark red 12 = cherry red

96 mg. implant midway in the feeding period.

Carcasses were evaluated in the same manner as in the previous test. Some of the measures are shown in *Table 2* for each treatment and sex.

Implanted steers gained more rapidly and efficiently, but produced lower grading carcasses than controls. Implanted steers were slightly more tender with larger rib eyes, a little less fat, less kidney fat and had higher cutability.

A comparison of implanted and

Table 3. Averages of Quality Measures for Matched¹ Bull and Steer Ribs

	Age group (months)	Bulls	Steers
Grade ²	9	8.6	8.6
	12	11.2	11.1
	15	12.5	12.7
	18	11.5	11.9
	24	13.0	13.4
Shear force, lbs. ³	9	13.6	15.2
	12	16.2	11.4
	15	15.5	14.2
	18	16.3	12.7
	24	14.5	14.1
Panel tenderness ⁴	9	7.0	7.7
	12	7.0	7.9
	15	6.9	7.7
	18	6.9	8.1
	24	6.9	7.2
Panel juiciness ⁵	9	7.2	7.4
	12	7.1	7.5
	15	7.0	7.2
	18	7.2	7.3
	24	7.1	7.1

¹ Bull and steer ribs matched from carcasses within 1/3 of a quality grade and of the same age.

² 8 = standard + 11 = good + 12 = choice - 13 = av. choice

³ Pounds of force required to shear 1-inch core of cooked rib eye muscle.

⁴ 10 = very tender 1 = very tough

⁵ 10 = very juicy 1 = very dry

not implanted bulls shows little difference in the three treatments. However, bulls with implants did gain slightly more rapidly and efficiently and produced higher grading carcasses than bulls without implants.

Control bulls gained a little faster and more efficiently than steers with implants. There was very little difference in their carcass grade, but the bulls without implants had less fat and higher cutability than the implanted steers.

Comparison of bulls and steers slaughtered within different age groups

We have completed a two year study comparing Angus bulls and steers slaughtered at 9, 12, 15, 18 and 24 months of age. This work was in cooperation with and supported in part by the Market Quality Division, ARS, USDA. This study was started to provide more information on carcass characteristics of bulls and steers of the same age and grade and to provide more information for the revision of grade standards of bulls. A final

report has been made, but the results have not been published.

The study involved complete detailed measures and comparisons of the live animals and their carcasses. A few of the tenderness and palatability comparisons are included in this report.

Eight wholesale ribs were selected from the highest grading bull carcasses within each age group. These ribs were then matched with ribs from steers fed in the same age groups within 1/3 of a quality grade. Eight ribs were also selected from steer carcasses of unknown origin in the cooler that matched within 1/3 of a quality grade and had the same maturity as visually expressed in the carcass by the color, hardness and porosity of bone and size of cartilage as the eight selected bull ribs. The first group is referred to as matched bull and steer ribs in Table 3. The second group is referred to as matched bull and selected ribs in Table 4.

Tables 3 and 4 show the grade of the matched ribs, tenderness as measured by the shear force required to shear a 1-inch core of the cooked rib eye sample with the

Warner-Bratzler shear, and tenderness and juiciness measured by a taste panel which scored a cooked sample of each rib.

The matched bull and steer ribs, Table 3, all matched with 1/3 of a grade. In all the age groups except 9 months, a greater force was required to shear the bull rib sample. The difference was the greatest in the 12 month pair and this difference was significant, but not significant in the other age groups.

The taste panel also found the steers to be more tender than bulls as shown by the higher scores, but these differences were small and significant only in the 12 and 18 month age groups. The samples from steers were found to be more juicy by the panel, but differences were small and not significant.

Table 4 shows that the bull and selected steer ribs matched very closely in grade. Less force was required to shear the samples from the 9 and 12 month bulls, but greater force was required to shear the bulls in the 15, 18 and 24 month age groups. These differences were small and not significant.

The taste panel found the 9, 12 and 18 month bull ribs more tender and juicy than the selected steer ribs of the same grade and maturity. In the 15 and 24 month groups, they found the selected steer ribs more tender and juicy. These differences were also small and not significant.

Bulls of the same age show more maturity of bone and cartilage than steers. The selected ribs were from steers of the same maturity as that of the matching bull ribs, but steers may have been older as measured by age.

Summary

Bulls gain faster and more efficiently than steers. Steer carcasses grade higher than bulls when both are fed the same ration and slaughtered at the same age. Bulls will require different feeding management than steers to reach the desired grade.

(continued on next page)

Table 4. Averages of Quality Measures for Matched¹ Bull and Selected Ribs

	Age group (months)	Bulls	Selected
Quality grade ²	9	8.8	8.9
	12	11.0	11.0
	15	12.4	12.3
	18	11.4	11.5
	24	12.9	13.0
Shear force, lbs. ³	9	13.7	12.3
	12	16.0	15.1
	15	15.5	16.5
	18	15.9	18.7
	24	14.2	14.4
Panel tenderness ⁴	9	7.2	5.9
	12	6.8	6.2
	15	7.0	7.3
	18	6.9	6.9
	24	6.9	7.4
Panel juiciness ⁵	9	7.3	6.4
	12	6.9	6.6
	15	7.0	7.4
	18	7.2	6.9
	24	7.0	7.3

¹ Bull ribs were matched with selected ribs from carcasses within 1/3 of a quality grade and showing the same maturity as shown by hardness, color and porosity of bone and size of cartilage.

² 8 = standard + 11 = good + 12 = choice - 13 = av. choice

³ Pounds of force required to shear a 1-inch core of cooked rib eye muscle.

⁴ 10 = very tender 1 = very tough

⁵ 10 = very juicy 1 = very dry

Waste Management and Animal Performance in Beef Feedlots

Walter Woods
Former Prof., Beef Nutrition

T. M. McCalla
Prof. of Agronomy
Microbiologist, SWCRD,
ARS, USDA

C. B. Gilbertson
Asst. Prof. Ag. Engr.
AERD, ARS, USDA

J. R. Ellis
Instructor in Agronomy
Microbiologist, ARS, USDA

The concern for the quality of our environment has called atten-

(continued from page 25)

Bulls produce carcasses with higher cutability than steers because of less outside fat, kidney and heart fat and larger rib eyes.

Bulls fed without stilbestrol implants gained more efficiently and faster than steers implanted with 24 mg. of stilbestrol twice during the feeding period.

Shear tests indicated that bulls fed the same ration and slaughtered at the same age were less tender than their steer mates. Steers had more marbling and a finer texture and brighter color of lean. Bulls were more variable in their shear values.

A chemical analysis of a 12th rib sample showed that bulls had 11 percent less fat and 11 percent more protein.

Bulls were less tender than their steer mates at 9, 12, 15, 18 and 24 months. The differences were not significant in most comparisons and when significant, the difference was not great. Variation in tenderness was greater in bulls.

When bull ribs were matched with selected ribs of the same quality grade and maturity in the carcass, no real differences were found in tenderness.

Bulls show more maturity of bone and cartilage in the carcass than steers of the same age in days.



Figure 1. Feedlots during 1969 with poor surface conditions.

tion to agriculture as a potential source of pollution. Particular attention has been given to the beef cattle feedlot industry.

A waste management research program at the University of Nebraska was developed with an interdisciplinary approach to the problem. This involves inputs from several individuals representing the Departments of Animal Science, Agronomy and Agricultural Engineering cooperating with the Agricultural Engineering and Soil and Water Research Divisions of A.R.S., U.S. Department of Agriculture.

The program on waste management in animal agriculture must

maintain certain objectives: (1) to maintain or improve the quality of our environment; (2) to permit continued growth and development of our livestock industry, which is the primary user of grains and the only user of pastures and harvested forages; (3) to recognize that changes taking place in animal agriculture must be economically sound.

The waste management research program at the University of Nebraska has measured characteristics of runoff from feedlots, percolation into the soil, and animal responses to different lot surface conditions. The animal response will be re-

Table 1. Summary of Effect of Density upon Animal Performance

	Square feet/head	
	200	100
<i>Growing</i>		
No. trials	2	2
No. head	60	120
Initial weight, lb.	434	429
Average daily gain, lb.	1.26	1.10
Average daily feed, lb. ¹	14.19	13.93
Feed required/lb. gain, lb. ¹	11.25	12.63
<i>Finishing</i>		
No. trials	3	3
No. head	90	180
Initial weight, lb.	609	589
Average daily gain, lb.	2.48	2.40
Average daily feed, lb. ¹	20.00	19.27
Feed required/lb. gain, lb. ¹	8.05	8.03
<i>Overall Average</i>		
Average daily gain	1.99	1.88

¹ Dry matter basis.



Figure 2. Feedlots during 1970 with good surface conditions.

viewed in more detail as related to animal density and lot slope, but briefly, the results in waste management research thus far indicate:

1. Nitrates have not moved into the ground water under active feedlots.
2. Manure can be managed on the feedlot surface with considerable decomposition occurring; however, accumulations to the point of adversely affecting animal performance must be discouraged.
3. Mounds in the feedlots may be beneficial to cattle as well as helping manure management in permitting decomposition to occur.

Effective developments in waste management for beef feedlots are necessary to permit continued and efficient growth in the beef feedlot industry. Of high priority is the need to maximize animal per-

formance in feedlot programs. Waste management systems which cause reduced performance may not be acceptable.

Lot conditions are influenced by weather, animal density, lot management, slope, ration fed, size of cattle and time of year. The lot conditions in winter of 1969 were extremely poor because of high precipitation in the form of snow and rain (Figure 1). In the winter of 1970 lot conditions were relatively good (Figure 2). Although direct comparisons could not be made on animal performance between years, gains were less in 1969. Thus, in waste management programs it is necessary to develop management systems that do not adversely affect cattle performance.

Animal Density

The waste management research program at the Mead Field Labora-

tory has permitted the comparison of 100 and 200 square feet per animal. Though these animal densities are greater than commonly recommended for dirt lots, we felt it advisable to increase animal concentration in order to increase the pressure on the measurements associated with runoff and percolation.

Since 1968 six lots of cattle have been fed with either 10 or 20 head per lot. The lots were the same size, thus, space allotted was 100 and 200 square feet per animal. One lot at each density was on 3, 6 and 9 percent slope. The cattle were started on a high roughage growing program and finished on a high concentrate ration. All were fed the same ration to permit direct comparison of animal density and effect of slope of lot upon performance. Five comparisons have been made (Table 1); three finishing periods (starting in June or July and finishing in November or December) and two growing periods (starting in December or January and finishing in May or June).

The cattle fed with 100 square feet per animal gained 12.7 percent less during the growing period and 3.2 percent less during the finishing period than those fed with 200 square feet per head density. The overall average reduction in gain for growing and finishing with 100 square feet per head as compared to 200 was 5.5 percent.

A greater reduction occurred during the growing period than in the finishing period. This could be expected since weather conditions were more severe during the winter growing periods. Surface and lot conditions were poor during winter and spring and comparatively good during summer and fall.

Feed Consumption

The cattle fed with 100 square feet per head consumed slightly less feed per day than those fed with the 200 square feet per head. We do not know if this is a function of the adverse lot conditions or the limited bunk space—half as much as in lots with 10 head.

The feed required per hundred-
(continued on next page)

Table 2. Effect of Slope on Animal Performance

	Slope in feedlot, %		
	3	6	9
<i>Growing</i>			
No. trials	2	2	2
No. head	60	60	60
Initial weight, lb.	433	428	433
Average daily gain, lb.	1.17	1.15	1.22
Average daily feed, lb. ¹	14.1	14.05	14.03
Feed required/lb. gain, lb. ¹	12.01	12.21	11.59
<i>Finishing</i>			
No. trials	3	3	3
No. head	90	90	90
Initial weight, lb.	598	593	604
Average daily gain, lb.	2.46	2.46	2.40
Average daily feed, lb.	19.6	19.6	19.6
Feed required/lb. gain, lb. ¹	7.98	7.98	8.17
<i>Overall Average</i>			
Average daily gain, lb.	1.94	1.93	1.93

¹ Dry matter basis.

Asphalt Surface in a Feedlot

D. C. Clanton

Professor, Animal Science

Currently, there is much interest in feedlot design, ranging from just meeting pollution control standards to the ultimate in total confinement.

In 1967, a set of six pens were surfaced with a 3-inch layer of asphalt at the North Platte Station. We were able to compare the lots to another set of six pens with a regular earth surface.

We have replicated several experiments involving management and nutrition variables over the two sets of pens during the past four years. Comparing the two replications across all variables has provided a comparison of the two types of surfaces.

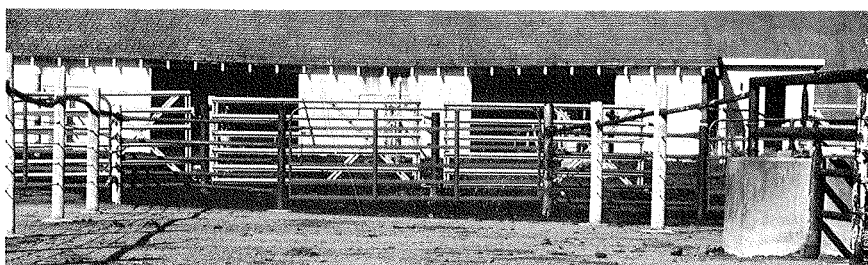
There was 1,700 square feet in each asphalt surfaced pen, and 4,600 square feet in each dirt surfaced pen (*Figure 1*). Both sets of pens had a slope of about $\frac{1}{4}$ inch per foot. They both had a six foot concrete slab next to a concrete fence line feeder. There was

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weight of gain was 12.3 percent more for the cattle fed at the higher concentration during the growing period. During the finishing period the cattle fed at the lower concentration were just as efficient as those fed at the higher concentration.

Differences between 3, 6 and 9 percent slope in lots did not influence performance of the cattle as fed in these studies.

In an attempt to place maximum pressure upon waste management control, placing the cattle at 100 square feet per head in the feedlot reduced animal performance as compared to feeding at 200 square feet per head. Even at 200 square feet per head, visual observation would suggest that lot surfaces were less than adequate and that gains might be reduced. Lot surfaces need to be maintained in a condition to avoid reducing animal performance as much of the time as possible.



Asphalt lots used in the North Platte study.

enough feed bunk space per pen for all animals to eat at one time. The fence line automatic temperature controlled waterer was about half way back in the asphalt surfaced pens and near the back of the earth surfaced pens. Both sets of pens had a windbreak, but neither had a shed.

There was no difference in performance of calves fed a growing ration of silage and supplement in the different lots during three different winter periods (December through April) (*Table 1*). The winter of 1968-69 was a severe winter, whereas the other two winters were mild, thus accounting for the 0.3 pound difference in average daily gain.

Two trials conducted during the summer (May through August) compared the lots with yearling cattle on finishing rations composed of approximately 80 percent dry rolled corn, 10 percent supplement and 10 percent silage. There was no difference in performance of the steers in the two sets of pens (*Table 1*). A third finishing trial using a similar ration conducted in the winter (October to February) showed no difference in performance as a result of the type of surface (*Table 1*).

In those trials where feed intake

was compared there was no difference when comparing the two sets of pens. For all practical purposes, it can be concluded there was no advantage in the asphalt surface over the earth surface.

General observations were that the cattle preferred the earth lots in the cold of winter and also the heat of summer. The asphalt no doubt was colder in winter and hotter in summer for lying down.

During one spring when the earth lots were muddy as a result of the ground thawing after heavy fall and winter moisture, the asphalt lots were desirable. However, in the North Platte area where this type of weather is not common and the soils are quite sandy, the need for the surfacing seems small.

The cattle in the asphalt surfaced lots always had more dirt on them than the cattle in earth surfaced lots. The asphalt lots needed cleaning more often.

There was no advantage in the asphalt surface at the North Platte Station. What would appear to be a desirable arrangement would be surfacing in part of the lot with earth in the remainder. This would allow the cattle to choose which they preferred. This would be influenced by the type of weather at the time.

Table 1. Average daily weight gains of cattle fed on asphalt or earth surfaced lots.

	Type of trial	Time when conducted	Earth surface		Asphalt surface	
			No.	A.D.G.	No.	A.D.G.
Calves	Growth	Dec.-Apr.	50	1.75	50	1.77
Calves	Growth	Dec.-Apr.	50	1.44	50	1.43
Calves	Growth	Dec.-Apr.	50	1.69	50	1.70
Yearlings	Finish	Oct.-Feb.	39	3.53	40	3.56
Yearlings	Finish	May-Aug.	44	3.27	44	3.30
Yearlings	Finish	May-Aug.	38	3.10	38	3.03

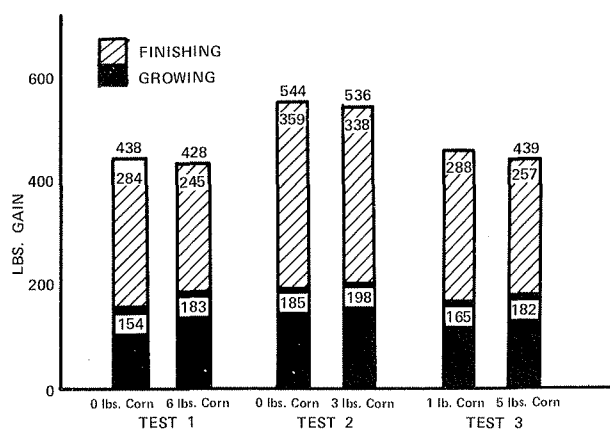


Figure 1. Gains during growing and finishing with relatively short growing periods.

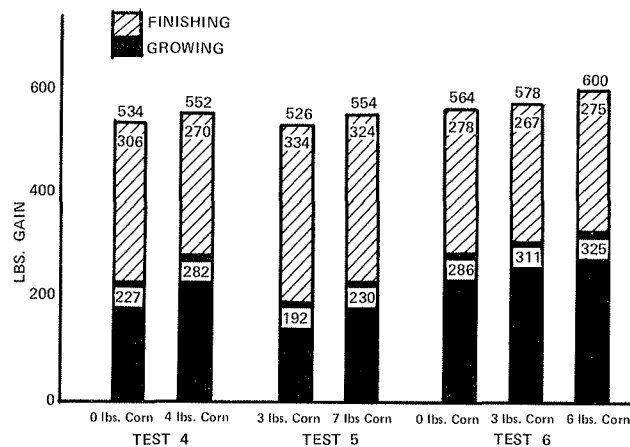


Figure 2. Gains during growing and finishing with relatively long growing periods.

Grain Levels for Cattle Growing Rations

Walter Tolman
Assistant Professor, Animal Science

Walter Woods
Professor, Beef Nutrition

Paul Q. Guyer
Extension Livestock Specialist
(Beef Cattle)

Adding grain to a high roughage growing ration for young cattle increases the rate of gain, but also results in slower, more expensive gains during the finishing period which follows. The total gain for both periods combined will probably be a little greater for the cattle getting the grain early.

An extra pound of dry matter from grain replaces more than a pound of dry matter from the lower energy roughage during the grow-

Table 1. Experiments Comparing the Effect of Added Grain During the Growing Phase

	Length of feeding period		Age of steers	Roughage	Growing ration ^a	
	Growing (days)	Finishing (days)			Control (lbs.)	Treated (lbs.)
Test 1	91	126	Yearlings	Corn Silage	0	6
Test 2	105	111	Calves	Corn Silage	0	3
Test 3	84	126	Yearlings	Alf. Haylage	1	5
Test 4	147	141	Calves	Corn Silage	0	4
Test 5	147	127	Calves	Alfalfa	3	7
Test 6	168	92	Calves	Corn Silage	0	3 and 6

^a High concentrate finishing rations were fed to all cattle after the growing phase.

ing period. But, because the cattle fed more heavily at first are less efficient during the finishing period, the overall efficiency, on an energy basis, favors the cattle grown more slowly. Or, put another way, roughage is used more efficiently in a high roughage growing system than when grain is fed more generously during this early period.

The cattle fed more grain appear fatter at the close of the growing period, but there is little or no advantage in carcass quality grade after equal finishing periods on a ration high in grain and low in roughage. When growing periods are short compared to finishing periods, additional grain in the growing phase appears to be used less efficiently than when growing periods are long and the finishing period relatively short.

In six experiments (Table 1) cattle fed less grain in the growing period gained less rapidly, but these same cattle gained more rapidly in the finishing period which followed (Figure 1). Total gains for the combined feeding periods were fully as great for the cattle started with less grain, when the growing periods were short compared to the finishing periods. Gains slightly favored the feeding system with higher grain growing rations when grow-

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Table 2. Effect of Added Grain During the Growing Period on Total Efficiency

	Growing	Finishing	Combined	Grain to roughage ratio ^a
— Lbs. Feed Per Lb. Gain (Dry Matter) —				
Test 1 0# Corn	10.7	7.8	8.8	
6# Corn	9.5	8.6	9.0	
Test 3 1# Corn	10.9	8.2	9.2	
5# Corn	9.6	9.2	9.4	
Test 4 0# Corn	9.0	7.8	8.3	40:60
4# Corn	8.0	8.5	8.2	48:52
Test 5 3# Corn	13.1	6.9	9.2	51:49
7# Corn	10.9	6.9	8.6	60:40
Test 6 0# Corn			7.1	35:65
3# Corn			7.0	44:56
6# Corn			7.0	56:44

^a For the combined periods.

Feeding Value of Crop Residues

John Ward
Associate Professor
Beef Cattle Management

Each of the some 5 million acres of corn produced in Nebraska this year in addition to yielding an estimated 85 bushels of corn also left approximately 2½-3½ tons of crop residue on the land. The potential per acre of harvested corn might be thought of as energy for finishing 2 yearling steers and furnishing a cow maintenance ration for approximately 4 months.

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ing periods were longer compared to finishing periods (Figure 2).

Total roughage consumption is higher and feed use is more efficient on an energy basis, with lower levels of grain in the growing periods (Table 2). Each pound of grain added to the growing ration saved from one to two pounds of roughage during the combined feeding periods (dry matter basis). Usually one pound of grain costs as much or more than two pounds of roughage.

Adding corn grain to a corn silage and supplement growing ration which has between 40 and 50 percent grain in the silage contributed little or no improvement in carcass grade in 4 experiments (tests 1, 2, 4 and 6, Table 3). Adding grain to a haylage growing ration did improve carcass grade in 2 experiments (tests 3 and 5, Table 3).

Table 3. Effect of Added Grain During the Growing Period on Carcass Quality Grade

	Control	Added grain
	Grade Score ^a	
Test 1	17.7	17.8
Test 2	17.8	17.5
Test 3	17.6	17.8
Test 4	17.4	18.0
Test 5	17.5	18.1
Test 6	19.5	19.6 ^b

^a 17—Low Choice, 18—Average Choice, 19—High Choice.

^b Cattle fed both 3 and 6# added corn averaged 19.6.

The residue from corn combining or picking is probably best used through a winter grazing program. Interest in providing either supplemental or a total roughage program for cows in partial or complete dry-lot programs at certain times of the year have caused the crop producer to reevaluate the potential of crop residues.

Corn crop residues such as stalks and shucklage may either be grazed or processed as dry feed or made into silage. The feeding value and cost involved in harvesting, storing and feeding determine the economics of their use.

Stalkage

In the fall of 1970-71 we cut stalklage with a flail chopper, recut it at the silo and added water to make a product that was about 50 percent dry matter. Yield in early December was 1.09 tons of dry matter per acre from irrigated 100 bushel corn. The material was stored in an upright silo and fed free choice to 38 gestating heifers due to calve in the spring (Table 1).

We fed the stalklage silage with 1 pound of shelled corn and 1¼ pounds of a 40 percent natural protein supplement containing 20,000 IU of vitamin A per pound and 2 percent phosphorus.

Heifers averaging 861 pounds going on test averaged 902 pounds after 60 days on the stalklage ensilage. There was no significant difference in gain when compared to two other lots wintered on hay and grazed on corn stalks respectively.

Average calf weights were respectively 67.0, 67.0 and 65.4 with no difference in calving difficulty among the three lots. Feed costs per head per day respectively were calculated to be 20.7¢, 17¢ and 13.3¢.

Although performance by 861 pound gestating heifers was satisfactory on stalklage ensilage the cost of harvesting was prohibitive. Until a way of harvesting the stalk and grain in a once-over operation is devised it is doubtful whether stalklage ensilage can be made eco-

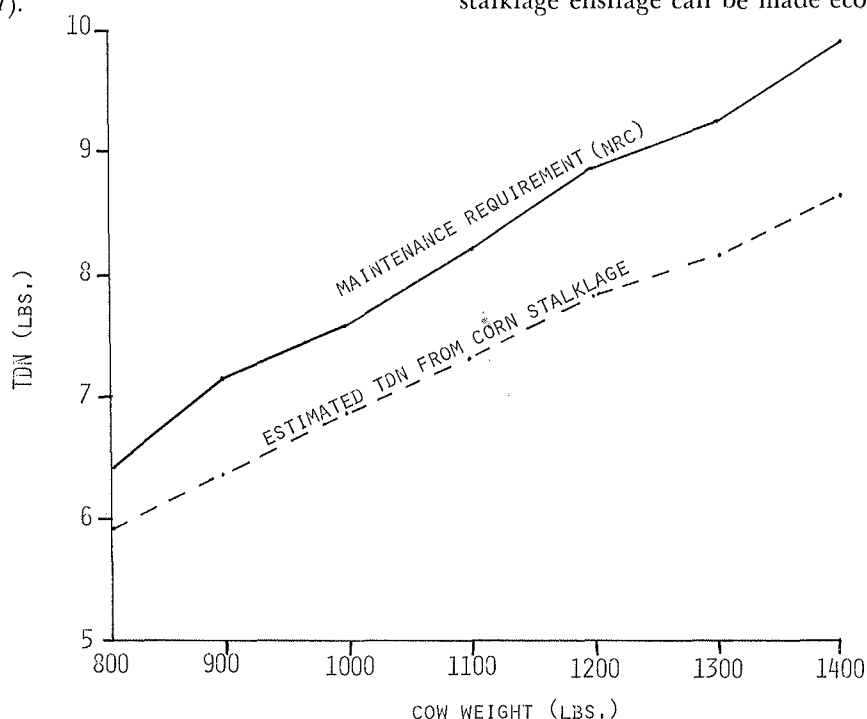


Figure 1. Daily energy maintenance requirement of gestating cows.



Stalk field in early December that yielded 1.09 tons of dry matter per acre, using a flail chopper for harvesting.

nomically competitive with other available roughages.

Shucklage

Shucklage as a supplemental feed is being used by a number of Nebraska cow-calf operators. A dump wagon pulled behind the corn combine catches all residues from the picking process and the dumps are deposited at the ends of the field. This product can then be fed where it has been dumped as a supplement to stalk grazing, stacked or chopped and ensiled.

The greatest difficulty encountered in feeding shucklage dumps in the field is waste. Depending on weather and feeding conditions, the material may be used at considerably less than a 50 percent level.

Stacking of shucklage dumps to be fed either as winter or summer feed has been satisfactory for some producers. The stacked shucklage is a reasonably adequate energy source for gestating cows, but not for lactating animals.

Shucklage recut with water added for ensiling makes a product which can be used as energy for dry cows or supplemented and fed to lactating cows. An advantage of recut ensiled shucklage is increased dry matter consumption and less rejection of cobs.

Feeding Value Maintenance requirements

(NRC) for gestating cows are shown in Figure 1. Heifers due to calve at two years of age gained 0.68 pounds daily on a ration of stalklage ensilage, 1 pound of corn and 1¼ pounds of a natural protein supplement. The total digestible nutrients (TDN) content of stalklage was estimated at 45 percent. The calculated TDN intake from stalklage was slightly below 90 percent of the maintenance requirement; however, energy from grain and supplement provided TDN in excess of maintenance requirements.

Supplementation of Crop Residues

A 1,000 pound spring calving, mature cow has winter requirements for protein, TDN, Vitamin

A and phosphorus of 7.6 pounds, 0.87 pounds, 20,000 IU and 0.26 pounds, respectively. Cows in good condition being wintered on corn stalks should not need additional energy unless stalks are snow covered.

Stalks may contain up to 5 percent protein on a dry matter basis, indicating a need for approximately 1 pound daily of a 40 percent protein supplement. Vitamin A should be supplied in the supplement at the requirement level.

Gestating cows will need at least half of the phosphorus requirement supplied in either the protein supplement or a mineral supplement. A protein supplement containing 1.5 percent phosphorus will generally be adequate if fed at the rate of 1 pound per head daily.

Salt should be available free choice and a mineral mixture should be provided if either roughage quality or intake is low.

Summary

Crop residues such as corn stalks can be used effectively as the energy source for mature gestating cows but must be supplemented if used with lactating animals. More effective use of crop residues properly supplemented can lower feed costs on the cow herd or provide a means for increasing cow-calf numbers in Nebraska.

Table 1. Performance and Production of 2-year Old Heifers Wintered on Grass and Crop Residue

	Brome-Alfalfa hay ground grazing	Corn stalks	Stalklage Ensilage
No.	39	39	38
Ration	8 acres/hd ^a	2 acres/hd ^a	Ad Libitum ^b
Wt. 1-15 (lbs.)	880.7	874.6	860.9
Wt. 3-15 (lbs.)	878.6	902.3	902.0
Daily feed cost (¢) ^c	17.0	13.3	20.7
Calf birth wt. (lbs.)	67.0	65.4	67.0
Cow wt. 6-1 (lbs.)	876.7	921.2	768.8
Cow wt. 10-13 (lbs.)	896.0	907.2	826.6
Percent pregnant 9-28	100.0	78.4	94.7
Calf weaning wt. (lbs.)	370.2	383.4	351.8

^a Fed 1¼ lbs/hd/day of 40% natural protein supplement with 20,000 IU of vitamin A/lb, 1% phosphorus, as needed pre-calving brome-alfalfa hay with ad libitum hay post-calving and brome-alfalfa pasture 4-15 through summer.

^b Fed 1¼ lbs/hd/day of 40% natural protein supplement with 20,000 IU of vitamin A/lb, 2% phosphorus, 1 lb. of shelled corn, 1-15 to 6-1 with brome-alfalfa pasture through summer.

^c Eight acres @ 50¢, corn stalks 7¢/head daily and stalklage ensilage 20.3 lbs. daily @ 0.62¢/lb., respectively. Ensilage cost based on yield and custom rates for ensiling.

How About Contract Feeding?

Stanley D. Farlin
Extension Livestock Specialist

By whatever name you may wish to call it (contract feeding, back-grounding, preconditioning), the business of feeding and managing calves for a period of time after weaning is taking on increasing importance in the beef-feeding industry.

Feeding calves on contract will no doubt play an even greater role in Nebraska's expanding beef-feed-

ing industry. Many feeders may choose to specialize in growing calves for larger feedlots which specialize in finishing for slaughter. Contract feeding provides an opportunity to use feed supplies, facilities, and labor supplies without large investments in cattle. It can be profitable to both feeder and owner and serve a critical need for the feeding industry.

Success will depend upon a thorough understanding by feeders and owners of those factors affecting

performance of calves during the contract period and their influence on profits. Inclusion of those points in a contract will assure an equitable distribution of costs and profits.

Success in feeding on contract will contribute to a broader base of financing of the beef-feeding industry by involving many more feeders who might not otherwise feed cattle, more ranchers who will retain ownership beyond weaning, and large operators, as well as their clients who want to own cattle from weaning to slaughter.

Traditionally, contract feeding has implied wintering of calves on contract, however, the term can be used equally well for any period of the year during which a feeder contracts to feed light calves for a second party prior to their being placed in a feedlot for finishing.

Owners interested in having their calves fed on contract usually can be classified as feedlot operators who buy replacement animals when calves are most available and ranchers who retain ownership beyond weaning time.

Feedlot operators may be interested in (1) insuring a future supply of feeders for the finishing lot, (2) guarding against higher prices for feeders when he needs them, or (3) exercising some control over the management of calves prior to the time they enter his finishing lot.

Objectives of controlling management by the feedlot operator during the growing phase include (1) accustoming the calves to bunk feeding and grain for easier transition to the finishing phase, (2) preconditioning for finishing by applying immunization and other treatments during the growing period instead of at the time they enter the finishing lot and, (3) obtaining a specified weight gain, which will permit the most efficient gains during both growing and finishing periods.

Ranchers may choose to contract feed to (1) defer sale of animals for tax considerations, (2) hold for a

High Moisture Corn For Finishing Cattle

Walter Tolman
Assistant Professor, Animal Science

Walter Woods
Professor, Beef Nutrition

Paul Q. Guyer
Extension Livestock Specialist
(Beef Cattle)

More rapid gains were produced with less feed by corn harvested and stored whole (shelled) at 24 to 25 percent moisture than by similar corn air dried during storage in both of two tests.

The average daily gains were 2.53 pounds with high moisture corn against 2.42 with dried corn and the requirement of dry feed per pound of gain was 7.2 against 7.5 pounds. Carcass quality grade, however, favored the cattle fed dried corn. They averaged choice against midway between average choice and low choice.

In another experiment where the high moisture corn stored whole was only 19 percent moisture its performance was slightly below that for dried corn in all three respects. Daily gains were 2.53 pounds against 2.64, feed per pound of gain 6.8 versus 6.7, and quality grade was $\frac{1}{5}$ grade lower. In this test results were practically the same for either corn whether silage was fed at the rate of $1\frac{1}{2}$ or 3 pounds dry matter per day.

High moisture corn ground before storage was not equal to dried corn in any of four comparisons with low roughage rations containing $1\frac{1}{2}$ to 2 pounds dry matter from silage or alfalfa. The average daily gains with high moisture corn "stored ground" were 2.2, dry corn 2.4 pounds, and dry feed per pound gain was 8.2 and 7.4 pounds respectively. Carcass quality grades were about equal.

Increasing the dry matter furnished by roughage (silage) from $1\frac{1}{2}$ pounds to 3 pounds daily in one test improved performance more with the high moisture corn stored ground than with dried corn. Gains were still $\frac{1}{10}$ pound less daily and feed requirement almost 1 pound more per pound gain with the high moisture corn.

There was some heating and surface spoilage with high moisture corn stored ground in upright structures and fed slowly to a few experimental cattle. This corn kept much better in plastic covered concrete bunkers.

Research is being continued with high moisture corn preserved by excluding air during storage. New research is also underway with corn preserved by adding organic acid to prevent mold and spoilage.

higher market at the end of the growing period, (3) grow replacement heifers when their feed supply is inadequate, or (4) maintain ownership until slaughtered, but must contract for both growing and finishing.

Feeders may wish to contract feed calves because:

1. they possess a feed supply which is well suited to feeding calves but which may not have a good cash market,
2. they do not want to assume any risk accompanying ownership of cattle,
3. they do not have adequate capital to purchase calves and

4. they prefer to custom feed calves to some other livestock enterprise.

It may be impossible to write a perfect contract, but satisfied parties (owners and feeders) to a contract arrangement can exist only if both parties are fully informed and all important points are covered by the contract. One of the most important points to be considered in drawing up a contract for feeding calves is the method of calculating payment from owner to feeder.

Contribution Method

Animals are inventoried into the enterprise at current prices. All

costs are allocated to owner or feeder, depending on who will pay them. Total income at the end of the period is then divided between owner and feeder in the same proportion as contributions from each are put into the enterprise.

This method is not often used, but does offer the feeder the opportunity to share in any profits in accordance with his contribution. To succeed, this method requires complete confidence between owner and feeder and demands an accurate set of records.

Feed Plus Overhead

This approach is used most often
(continued on next page)

Stilbestrol Levels in Finishing Rations

Walter Woods
Professor, Beef Nutrition

The feeding of 20 mg. stilbestrol daily was recently approved for steers over 750 pounds.

In previous work, the practice of feeding 10 mg. stilbestrol to cattle has given consistent benefits in rate and efficiency of gain. In this study the feeding of 10 mg. stilbestrol increased gains and efficiency of feed conversion by 6.7 and 7.2 percent.

Feeding 20 mg. stilbestrol daily further increased gains and efficiency of feed conversion to 13.3 and 12.4 percent over controls. For cattle above 750 lbs. there appears to be improved performance as a result of this practice compared to the feeding of 10 mg. stilbestrol.

We conducted two trials in which steers were fed stilbestrol at levels of 0, 10 and 20 mg. daily.

The cattle in both trials were fed high grain-low roughage finishing rations equal in nutrients except for stilbestrol levels.

In trial 1, in addition to levels of stilbestrol with steers, other comparisons were made with heifers fed different levels of stilbestrol and stilbestrol isomers. Only data collected with steers will be reported as related to stilbestrol levels.

In trial 2 there were two lots of six head on each treatment. Carcass measurements were taken and animal performance was expressed on an adjusted gain basis.

The results of the two trials are shown in Table 1. The response to feeding 10 mg. stilbestrol was not as great as previously reported for many trials. However, there was a 6.7 percent increase in gains and a 7.2 percent decrease in feed re-

quired per pound of gain. Feeding 20 mg. stilbestrol increased gain and efficiency of feed conversion above feeding 10 mg. stilbestrol by 6.2 and 5.7 percent, respectively. In both trials the responses were similar. Carcass grade and dressing percent were similar among treatments, suggesting that the higher level of stilbestrol did not adversely affect these traits.

The feeding of stilbestrol to steers at 10 and 20 mg. proved beneficial for increasing animal performance. Stilbestrol must be withdrawn from the ration seven days prior to slaughter as a result of a new regulation. It is suggested that this could be accomplished by either removing the supplement entirely from ration the last week or by feeding a stilbestrol-free supplement.

Table 1. Stilbestrol Levels in Finishing Rations for Steers

	Trial 1 ^a	Level of stilbestrol/steer/day						
		Control		10 mg.			20 mg.	
		Trial 2 ^a	Av.	Trial 1	Trial 2	Av.	Trial 1	Trial 2
No. head	35	12		35	12		35	12
Initial weight, lb.	652	747		640	748		636	750
Av. daily gain, lb. ^b	2.81	2.30	2.55	2.86	2.59	2.72	3.11	2.67
Daily feed, lb.	22.8	22.4	22.6	22.9	22.4	22.6	22.8	22.4
Feed/lb. gain, lb.	8.11	9.83	8.97	7.99	8.67	8.33	7.32	8.41
Carcass grade score	17.7	16.9	17.3	17.4	16.7	17.0	17.4	16.9
Dressing %	61.9	59.7	60.8	62.0	59.7	60.8	62.2	60.2
Cond. livers, %	2.9	25	13.9	5.7	33	19.3	8.6	8.3

^a Length of trial was 126 days for trial 1 and 118 days for trial 2.

^b Adjusted daily gain determined by adjusting final weight to equal dressing percentage (62) and gain calculated on this basis.

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by large feeders who have the capability to weigh all feed accurately. A charge for overhead incurred from feeding and caring for calves is added to the cost of feed and constitutes the method of payment.

Flat Price Per Head Per Day

A disadvantage to the owner is that this method supplies no incentive for the feeder to do a good job. Depending on the integrity of the feeder, it may be an incentive to feed as little as possible at the expense of animal performance and costly gains for the owner.

To avert this approach, an owner may require that a specified minimum gain be obtained before any payment is made to the feeder.

Conversely, if an owner desires a low rate of gain such as one pound or less, usually with the intention of putting calves on pasture, the feeder should insist on a flat price per head per day. This method will enable the feeder to calculate a price to offset the high cost of gains which he will be forced to produce.

Payment for Pounds Gained

An agreed upon price per pound of gain is paid to the feeder for gains made during the contract period. This is a widely-used practice. It provides an incentive for the feeder to utilize his best management techniques to obtain high rates of gain at the least cost.

The owner may want to specify a maximum gain if he is planning to finish the cattle. Too rapid a gain during the growing period may result in some cattle finishing too light and in higher costs of gain during the finishing phase.

The feeder assumes some risks with this method of payment, since weather conditions, health of cattle, prior treatment of cattle, as well as other factors, will affect rate and cost of gains.

A contract based on pounds of gain should specify in detail:

1. *Weighing Conditions*—Obtain fair weights by setting the allowance for pencil shrink, when and where calves are to be weighed, and

what fill procedures are to be used prior to weighing.

2. *Responsibilities for death loss*—An acceptable agreement usually specifies that the owner assumes all death losses for a certain specified time after arrival. Three to four weeks is a reasonable time for owner to assume all death losses. Following this, the feeder should share in death loss at an agreed-upon level, since his management will either contribute to or prevent death loss.

3. *Veterinary Costs* (medicine and services)—Feeders should insist that certain vaccinations and treatments such as dehorning and castration be done at owner's expense before calves arrive at the feedlot. If they are done during the contract period, the feeder should receive compensation for lost gain due to stress of treatment.

4. *Length of Feeding Period*—Specify minimum and maximum length of time. A minimum time will be needed for calves to recover enough of weight possibly lost from stress of shipment and prior management to be profitable for the feeder. Longer periods (150 days or greater) are generally more profitable for feeders, but a maximum period of time should be included to safeguard the feeder from high cost of gains of cattle of heavier weights or any hardship due to cattle not being removed on time.

5. *Payment in Advance*—Payments made in advance of the end of the contract period will reduce feeder's cost and this savings should be shared with the owners by a corresponding reduction in price charged per pound of gain.

6. *Mortgages and Liens*—Feeders should familiarize themselves with existing laws governing liens and mortgages on cattle in order to assure payment for feed and services rendered. They should also be aware of the rights of the secured party in case of mortgaged cattle in order to take possession after due notice and insure payment of the lien which the feeder has against the cattle for feed and services. The feeder must notify the holder of the

Experiments In Progress

Wheat for beef cattle. Investigations are continuing into the problems involved in feeding high levels of wheat to finishing cattle. The effectiveness of certain feed additives such as fat and buffers is being determined. In addition, variety and location of production differences are being measured.

Methods of processing and storing high moisture corn. Optimum storage moisture level and type of silo are being investigated. In addition the value of organic acids in preservation of high moisture shelled corn is being determined.

Dehy in finishing rations. Level and fineness of grind of dehydrated alfalfa in finishing rations as it provides roughage characteristics and supplemental nutrients is being investigated.

Mixtures of grains. Feeding values of grains commonly grown in the Nebraska Panhandle, wheat, rye and millet are being determined in addition to the value of these grains fed in various combinations. *Whey in cattle rations.* Dried whey and cottage cheese whey are being evaluated as additions to both finishing rations and corn silage growing rations.

Starting programs. Type of roughage and energy levels in starting rations are being investigated.

Biuret and Dehydrated Alfalfa in Range Supplements. Steer calves are being individually fed supplements containing 12% biuret and varying levels of dehydrated alfalfa while grazing native winter winter range. Past tests have shown that biuret (a non-protein nitrogen source) can be utilized by calves receiving low quality forage. The calf performance has been best when dehydrated alfalfa is in the

mortgage of his intent to assert his lien within ten days of receipt of the cattle if he wants his lien to be first in line.

supplement if high levels of biuret are used. The current study is designed to determine what level of dehydrated alfalfa is necessary to get the best performance.

Biuret in Supplements for Wintering Calves on Silage. Past experiments have shown that calves wintered on silage receiving supplements containing urea do not perform as well as those receiving a natural plant protein. Biuret (a non-protein-nitrogen source similar to urea) is less soluble than urea and may be a better source of non-protein nitrogen for calves fed silage. Different levels of biuret in supplements are being compared to different levels of urea and natural protein in supplements for growing calves on a basal corn silage ration.

Cows and Calves on Irrigated Pasture. A group of cows and calves managed on irrigated pasture is being compared with a comparable group of cows and calves managed in a conventional native summer range situation.

Intake and Digestibility of Irrigated Pasture Forage. Measurements of intake and digestibility of irrigated pasture forage are in progress using yearling cattle. The effect of energy supplementation on the intake and digestibility is also being evaluated.

Rate of Developing Replacement Heifer Calves. Three groups of heifer calves are being developed at different rates of growth from weaning (200 days before breeding) until breeding at approximately 15 months of age. The rates of development are: (1) no gain for 100 days and then 2 pounds per head per day gain for 100 days; (2) one pound per head per day gain for the entire 200 days; (3) two pounds per head per day gain the first 100 days followed by no gain the last 100 days. Thus the heifers will all end up at 625 to 650 pounds at breeding time. Reproductive performance and calf production for three or four lactations will be measured.

Beef Carcass Evaluation. A study on the effect of sex alteration on

production traits in beef is in progress. The objectives of the study are to evaluate the steer, bull, and the short scrotum bull. Production data including rate of gain, feed consumption as well as carcass evaluation including quality grade, cutability and overall acceptability are being studied. Chemical analysis to support the evaluation of the carcass data is being conducted in addition to taste panel evaluation for tenderness, juiciness and overall acceptability. The second year of taste panel data is now being collected on the three year study which is in progress.

Fabricated Beef Cuts. A study is in progress to determine the feasibility of producing fabricated beef cuts which have been flaked, formed, and sectioned. This technique involves high speed flaking of beef trimmings and by-products, reformulation, compression to a fixed form in a die and sectioning to portion controlled consumer cuts. The study is designed to determine the feasibility of upgrading the value of many beef trimming cuts to higher value consumer type of products. Parameters of manufacturing, quality control, and consumer acceptance are being studied.

Effects of Selection for Weaning Weight, Yearling Weight and Muscling In Beef Cattle. Three 150-cow-6-sire lines of Hereford cattle are selected on basis of (1) weaning weight, (2) yearling weight, and (3) an index of yearling weight and muscling. A fourth line of similar size is being formed from the foundation animals to serve as a control herd that will be maintained without deliberate selection. Unselected female offspring from each line have been individually fed to obtain information on correlated response in feed efficiency and carcass merit. Project was carried on at the Fort Robinson Beef Cattle Research Station from 1960-71 but is now transferred to the U.S. Meat Animal Research Center, Clay Center, Nebraska and is cooperative between the U.S. Department of Agriculture and the University of Nebraska.

Germ Plasm Evaluation Program. This program conducted at the U.S. Meat Animal Research Center, Clay Center, Nebraska, is designed to characterize breeds in the full spectrum of economic traits relating to growth, feed efficiency, reproduction, maternal ability, carcass, and meat traits. The basic objective of this program is to develop an understanding related to optimizing such biological factors as growth rate, cow size, and milk level in different feed environments and production situations. The first cycle of this program is designed to characterize the Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais breeds. The project is cooperative between the U.S. Department of Agriculture and the University of Nebraska.

Evaluation of Heterosis on Productive Efficiency and Carcass Merit in Beef Cattle. The Angus, Hereford, and Shorthorn breeds are included in this experiment to evaluate the effects of heterosis on economic traits on a full life cycle basis and procedures for using heterosis through continuous breed crossing programs. Approximately 250-300 breeding age females are used in the different phases of this experiment. Three kinds of two-breed crosses and the three-breed rotation are being compared with the straightbreds. The earlier phases of the experiment were carried out at the Fort Robinson Beef Cattle Research Station, but it has been transferred to the U.S. Meat Animal Research Center, Clay Center, Nebraska. The project is cooperative between the U.S. Department of Agriculture and the University of Nebraska.

Nitrogen Sources for Cows Grazing Corn Stalks. Soybean meal, urea and biuret are being compared as a source of nitrogen for cows being wintered on corn stalks.

Calving Difficulty. External body measurements and internal pelvic dimensions at various stages of cow development are being correlated to calving difficulty.

Internal Parasites. A study on internal parasite levels found in beef cows is being conducted.