MANAGEMENT SYSTEMS FOR BEEF COWS AND CALVES IN DRYLOT

BY

KRIS G. KIMPLE

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INTRODUCTION

In recent years, the only certainty in livestock production seems to be higher costs. In most areas of the Great Plains land prices have more than doubled the past 10 years. Lease price of pasture and cost of hay have increased at the same time that higher return continuous grain cropping has increased and acreages of traditional meadowlands have decreased. These conditions have made partial or total confinement beef cow-calf herds and the utilization of crop residues important considerations both on their separate merits and as compliments of each other.

Feasibility of a confinement, drylot cow-calf operation is based on reducing the land investment per cow unit and providing low cost feed. Traditionally, in an area like the corn belt, many herds were limited in size to the summer carrying capacity of pasture land. By grazing and feeding stored crop residues, drylot may offer the chance for expanded cow-calf production in areas of limited pastures.

High land and grain production costs also demand that grain crops produce a maximal return. Utilization of crop residues by the beef cow adds to the value of the crops and is a logical means of reducing cow wintering costs. Kansas produces approximately six million tons of milo residue and has thousands of acres of corn aftermath each year. Recently, the development of numerous residue harvesting systems has provided alternatives for the producer to fit residues into his livestock program.

Limited data have been reported with corn and milo residues for drylot cows. The first objective of the research here was to determine the feeding value of various milo residues for wintering pregnant cows in drylot.

A combination of drylot confinement and grazing is another management alternative for using milo residues. Since these residues vary in protein content, additional protein may be needed. A second objective here was to evaluate various protein supplements for cows grazing milo stover.

Early weaning of calves could reduce drylot costs. Dry cows could be placed on a low energy ration while calves are fed separately. Little research has been reported on a practical management program to wean calves young enough to improve dam rebreeding and achieve desirable calf performance. A third objective of here was to evaluate the performance of calves weaned at 50 (±25) days of age and related dam performance.

Another means of reducing costs in drylot is to improve calf performance. A fourth objective here was to evaluate growth promoting implants for calves.

Successful drylot operations will have low feed costs but not at the expense of inadequate cow nutrition. NRC energy requirements do not consider differences in maintenance needs as environmental conditions change. A fifth objective here was to evaluate the need for additional energy for maintenance during cold stress.

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LITERATURE REVIEW

PRODUCTION OF COWS AND CALVES IN DRYLOT

Historical Overview of Drylot Research

One of the most important questions concerning drylot cow-calf production to answer is animal performance. Texas work (Marion et al., 1962, 1964, 1965, 1966, 1968, 1971) during the 1960's showed that cows and calves in drylot performed as well as those on pasture through seven calf crops. The 11-year study compared three different planes of nutrition providing low (1.25 lbs. CSOM), medium (.75 lbs. CSOM and 2 lbs. grain sorghum) or high (5 lbs. grain sorghum) during the wintering period for both the year-round pasture and drylot systems. Pasture cows received no additional feed whereas the drylot cows received sorghum silage or green chop. The drylot calves received a limited creep to compensate for grass eaten by pasture calves.

There were no significant differences in calf birth and weaning weights between the two groups. This agrees with most other drylot work (McGinty et al., 1969, 1972, 1973; Ewing et al., 1959, 1960; Brown et al. 1968). Cow-calf research by Perry et al. (1974) compared a year-long pasture group, a pasture group fed corn stover silage part of the year in drylot and a total drylot corn silage group. Overall calf weaning weights were similar but calves in total drylot gained compensatorily in the last phase to make up for slow gains initially. Poor early performance may have occurred because calves were not creep fed and could not yet compete at the feed bunk.

Work by Meiske and Goodrich (1968, 1969) over a five year period used Angus and Hereford cows in continuous drylot and continuous pasture where all calves were creep fed. They found that birth weights were similar but drylot calf weaning weights were usually lower. This contrasts with Illinois work (Albert and Lamb, 1967 and Albert, 1969) which showed that drylot calves weaned at significantly higher weights. Probably as stated by Kercher (1969) and indicated by most other researchers, there is no difference in calf weight between the two systems when creep feed is provided.

Another important consideration is the effect of various systems on cow condition and subsequent reproductive performance. Work by Marion _et al_. (1971) found no significant difference in the average percent calf crops of total drylot and total pasture cows. A Minnesota study (Meiske and Goodrich, 1968) found that conception rates, calf crop percentages and birth dates were the same for both total drylot and total pasture systems. Albert and Lamb (1967) and Albert (1969) found that drylot cows only required 1.42 services per conception compared to 1.75 for the pasture cows. Drylot cows fed haylage also gained 40 pounds more than the pasture cows during the summer period. Generalizations concerning cow weight changes and reproductive performance in drylot cannot accurately be made because of the dependancy on the rations fed and the animals studied.

Herd health is also an important area to evaluate. Texas workers (Marion _et al_., 1971) found the biggest differences between the total drylot and pasture systems to be cow longevity, which favored the drylot group. They also had a lower incidence of accidental losses, which agrees with similar findings at Minnesota (Meiske and Goodrich, 1968). Albert (1969) and Price and Ralston (1976) found no differences in the health of cows and calves between total drylot and pasture systems. In certain regions, health problems such as viral scours may be more of a problem in drylot than on pasture as Michigan (Richie et al., 1974) and Arizona (McGinty et al., 1972) work indicates. The Arizona work found death from scours to be less than 1 percent but usually severe weather conditions coupled with exposure to contaminated soil could cause problems. Kercher (1969) also states that herd health problems in drylot have been reported mainly in young calves.

One advantage of drylot systems listed by most researchers (McGinty et al., 1972; Kercher, 1969; Greathouse and Hawkins. 1970) that relates to herd health is close supervision that allows prompt treatment of illness and injury. Problems with predators, weather, lightning and nutritional problems such as bloat are generally fewer. Drylot also makes artificial insemination more manageable (Kercher, 1969; McGinty et al., 1972; Albert, 1969), which permits the use of superior bulls. Estrus synchronization could be more practical in drylot and culling and replacement decisions more accurate.

The possibility for greater management flexibility is offered by drylot systems. McGinty et al. (1969) concluded that calves raised in drylot wean more easily and require less time to start on a finishing ration than calves raised on pasture. Calving time is also more flexible in drylot allowing managers to take advantage of optimum labor supply and climatic conditions (Meiske et al., 1973). McGinty et al. (1972) and Kercher (1969) also conclude that drylot systems are less prone to hazards of drought and other adverse weather conditions because feeding is done from known quantities of stored feeds. This would allow more time to make adjustments in cow numbers in such emergencies.

An area of flexibility offered by drylot and essential to its profitability is to feed cows more accurately according to their age and production needs. At Michigan (Greathouse et al., 1969) and Oregon (Price and Ralston, 1976) cows were successfully fed at 80 percent of the NRC requirements for pregnant cows from weaning to calving. Goodrich et al. (1975), in a trial with Hereford and Angus cows separated by condition found that similar performance could be maintained at a savings of 5 cents per cow daily by restricting feed to fat cows. Arizona workers (Taylor et al., 1974), using Hereford cows and Brown Swiss-Hereford cows, found that if the higher milking cows were fed separately to meet their greater production needs, they would rebreed and maintain their weight similar to the lower milking cows. The effect on the calves was a 53 percent reduction in creep feed consumed by calves on high milking mothers compared to the others. Kercher (1969) stated that uniform feed intake could be achieved in limit feeding by feeding cows three times per week.

Drylot research projects have studied both total drylot (Marion et al., 1971; Meiske and Goodrich, 1968; Albert, 1969; Brown et al., 1969; Ritchie et al., 1975; McGinty et al., 1969; Slyter, 1970; Perry et al., 1974) and partial drylot systems (McGinty et al., 1969; Albert, 1969; Slyter, 1970; Ritchie and Nales, 1969; Ewing et al., 1959). As stated by Meiske and Goodrich (1968), a drylot system could be flexible enough to allow cows to use roughage left in fields after harvest and to graze small untilled areas for short periods. They felt that though a partial system might be more practical, a year-round study would be more intensive to bring out management problems more quickly. Arizona work on partial confinement (McGinty et al., 1969, 1972) used a system where irrigated pasture could be grazed when it was available. Albert (1969) and Kercher (1969) both found that a system of partial drylot and grazing offers more flexibility but the ideal system would depend on such things as size of operation and degree of mechanization.

With any drylot system, one intended result would be less land investment per cow unit. Minnesota research (Meiske and Goodrich, 1968) concluded that twice as many cows could be carried per acreage in drylot. A confinement system could also affect the acreage of forage needed to maintain a cow herd. Albert and Lamb (1967) found that carrying capacity could be increased by 47 percent by feeding the forage as haylage rather than through grazing. They also felt the mechanization necessary to harvest forages could be extended to an automated silage system which would save labor and insure greater nutrient yield per acre.

Mechanization for harvested forages, together with the opportunity cost of the forages themselves at the expense of feed grains point to economics as drylots' primary problem. Perry et al. (1974), in a 1967 to 1970 study, found a feed cost per cow-calf unit for year-round bluegrass pasture and hay to be $40.42. Yearly expense of a partial drylot system of perennial pasture, summer annual and corn stover silage system was $82.16 and the cost of a year-round drylot system with corn silage was $100.78. McGinty et al. (1972) reported a total drylot feed cost per cow-calf unit of $148.13 feeding a mixture of alfalfa hay, alfalfa cubes, cottonseed hulls and bermuda grass straw according to stage of production. This compares to a partial confinement cost of $115.41 for cows on irrigated pasture part of the time.

One reason for added drylot expense is the extra consumption of creep feed by drylot calves (McGinty et al., 1969, 1972, 1973; Ewing et al., 1959, 1960; Brown et al., 1968). An evaluation of the forages fed shows that most work, until recently, has been done with grain silages and hays from tillable land. Albert and Lamb (1967) listed the cost of the silages fed in their drylot system as follows: cornstalk silage, $7.00 per ton; corn silage, $9.00 per ton; haylage, $10.00 per ton. Cost of hay to drylot cows was $20 to $30 per ton. The problem facing drylot cow-calf production was clarified by Greathouse (1969) when he stated that the feasibility of drylot production is based upon obtaining maximum production of low cost feed supply per unit of land area.

Ritchie et al. (1975), in summarizing 3 years of drylot work at Michigan provides insight into the potential and future direction of drylot research. He states "drylotting of beef cows year-round in the Midwest may be carried out quite successfully if one measures success or failure by parameters such as conception rate, calving percentage, calf mortality, weaning percentage and weaning weight. Nevertheless, until the price of land climbs to a significantly higher level, the feed, facility and labor costs are still too high to be competitive with less intensive systems." He further adds, "It would appear that maximum use of crop residues such as corn stover would make drylotting more feasible from a cost standpoint and should be examined in future research."

Early Weaning of Beef Calves From Drylot

Since economics is the major problem confronting drylot systems, reducing cow feed costs in drylot must be a major consideration. Early weaning and creep feeding may be more feasible in drylot since the intake of the cow may be closely controlled.

One limiting factor in drylot systems may be cow milk production (Meiske and Goodrich, 1968). Drylot work indicates that calves in drylot consume significantly more creep feed than do calves in a pasture system (McGinty et al., 1969; Meiske and Goodrich, 1968; Ewing et al., 1959; Brown et al., 1968), which may indicate both poorer milk production by the cow and the calf's desire for roughage. Peterson et al. (1975) in a 3-year trial with drylot cows and calves compared suckling calves with and without access to a creep for 53 to 71 days. They found that calves on creep gained from 37 to 87 percent faster, probably due to the cow's natural decline in milk production at this period while the calf is still not large enough to compete at the feed bunk.

Researchers have shown a high (.75 to .91) correlation between calf growth and milk production (Furr et al., 1964), meaning that a nutritional regime that depresses milk production also will lower weaning weights unless the calves have access to creep. Arizona workers (Taylor et al., 1974) found calves nursing Brown Swiss-Hereford cows consumed only 53 percent as much creep feed as did calves nursing lower milking cows. It is believed to be less efficient to feed the cow for milk production than to feed the calf directly (McGinty et al., 1969). Early weaning allows the cow to be placed on a lower quality, less expensive maintenance ration while the calf's needs are being met by a creep feed. Other reasons for early weaning could include emergency situations such as drought, induced twinning, fall calving where heavy winter feeding would be required and to accelerate rebreeding of first and second calf heifers.

Some of the first work on early weaning was done by British investigators (Aitken et al., 1963; Bowers et al., 1965; Whitelaw et al., 1961). Illinois workers (Bremer et al., 1967) weaned calves at 80 days that had been on creep for 3 weeks and fed rations of 12, 16, 20 and 24 percent crude protein. There were no significant differences in total gain or feed efficiency and performance was satisfactory.

Hinds and Cmarik (1971) compared calves weaned at 170 days to calves weaned at 200 plus days. All calves were placed on a shelled corn creep as soon as they would take feed. The early weaned calves gained faster to the time of normal weaning and the normal weaned calves gained more rapidly after 200 days, resulting in no overall differences in gain. Early weaned calves adjusted well to weaning and developed no shipping fever probably because colostrum provided resistance for up to 150 days post-partum. The workers stated such calves could contract the disease later from normal weaned calves after loss of immunity.

Work at Michigan with drylot calves (Ritchie et al., 1974) compared: (1) weaning at 1 week with 30 days of whole milk followed by dry creep; (2) weaning at 90 days with a dry creep and (3) weaning at 180 days after nursing their dams on pasture without creep. Calves weaned at 1 week could not compete in gain or cost of gain with the other two treatments. The 90 day weaned calves out gained the 180 day weaned calves by 21 lbs. (424 vs. 403) at 180 days, but total cow-calf feed costs favored the 180 day system ($96 vs. $123). The researchers concluded that extremely high calf prices, low grain prices, poor milking cows, limited feed and good management are factors that would favor early weaning.

Self (1975) compared 89 calves from fall-calving cows who were weaned at 45 days to spring calves nursing their mothers. After three seasons, there was no difference between performance of early weaned calves and spring calves, both averaging a gain of 2.2 lbs. per day. Early weaning allowed the fall calves to be weaned before the breeding period and resulted in a faster and higher percent return to estrus (99%) in the fall-calving than in the spring-calving cows.

South Dakota workers (McCone, 1970) weaned calves at 117 days of age, which was before severe winter weather had occurred and allowed the cows to receive only 20 lbs. of hay equivalent. These were compared to calves on the same creep that nursed their mothers, which were fed 30 lbs. of hay. The early weaned calves gained 2.55 lbs. per day compared to 2.43 for the nursing calves and also consumed twice as much creep feed.

Work in Kansas (McKee <u>et al</u>., 1974, 1975a) compared Simmental-cross calves weaned at both 90 and 110 days to calves nursing mothers on pasture and in drylot. All calves had access to a creep feed. Calves weaned at 110 days gained similarly to pasture calves (2.75 lbs. per day). Normal weaned calves in drylot gained 3.03 lbs. per day but also had the highest cow-calf feed costs. The following year calves were weaned at 90 days and when compared to normal weaned calves from drylot, showed similar gains of 3.09 and 3.23 lbs., respectively. The total cow-calf TDN requirement was 8.3 lbs. per lb. of calf gain for the early weaned treatment while the nursing treatment required 9.4 lbs. This data supports the theory of better

Meiske *et al.* (1973) weaned spring and fall calves at 109 and 205 days, with all calves having access to creep 6 to 8 weeks after birth. The 109 day weaners gained less rapidly than normal weaned calves, .84 kg and .93 kg per day, respectively. Early weaned calves consumed more creep but their dams consumed less TDN due to their shorter lactation. Although dry cows remained on the same quality of forage as the nursing cows, the total TDN needed to produce 100 kg of calf was similar for all treatment groups.

Three years of Louisiana work studied early weaning as early as 2 weeks (Posey *et al.*, 1976; O'Neal *et al.*, 1975; Posey and Smart, 1976). Work in 1972 compared 39 calves weaned at 30 days to calves nursing cows on pasture. Early weaned calves were placed on a creep ration including 28 percent milk replacer and were switched to a more standard creep at 90 days. Adjusted weaning weights were 418.9 lbs. for the early weaned and 415.5 lbs for the pasture calves. The period from parturition to conception for early weaned cows and pasture cows was 57 and 70 days, respectively.

The next year 40 cow-calf pairs were divided into a control pasture group and calves weaned at 2 and 4 weeks. The pasture calves were heavier at weaning (505 lbs.) than the calves weaned at 2 (418.2 lbs.) and 4 (422.8 lbs.) weeks. The control heifers averaged 61 days to first estrus while 2 and 4 week treatment cows cycled at 32 and 50 days, respectively. The following year the control calves weighed 398.8 lbs. at weaning compared to a more than 20 lb. advantage for the early weaned calves. Return to estrus for control cows was 92 days compared to 36 (2 weeks) and 48 (4 weeks) days.

Work has been done at the U.S. Meat Animal Research Center (Laster *et al.*, 1973; Research Report, 1976) with calves from seven breed groups weaned at 56, 112 and 168 days. The early weaned calves performed equal to and slightly better than nursing calves. Calves weaned at 50 to 75 days gained better than those weaned at 35 to 60 days. Time of weaning had no influence on gain from 200 days to slaughter. Improved percent return to estrus was observed from early weaning calves from 2 (29%), 3 (26%) and 4 (16.3%) year-old heifers but no advantage was shown for mature cows.

Research to date seems to indicate that early weaned calves will perform at least as well as normal weaners and that distinct advantage occurs in earlier cow and more complete heifer rebreeding. Cow-calf expense for producing early-weaned calves exceeds normal cost for pasture nursing but compares favorably with the costs of weaning calves at 205 days in drylot.

Factors Affecting Cow Nutritional Requirements

Two important factors determining profit and loss in a cow-calf operation are percent calf crop and pounds of calf produced at weaning. Since both reproduction and calf gain are profoundly affected by the health and well-being of the cow, an adequate level of nutrition in the cow herd is of major importance. Several factors affecting cow nutrient requirements are reviewed here, with much of the information coming from a paper by Corah (1975).

A major influence on cow nutrition is the cow's stage of production. The beef cow year can be broken up into four distinct nutritional periods.

Period one is the 82 days immediately following calving and the period of highest nutrient requirements. At this time lactation is at its highest, calf growth is rapid, uterine involution is occurring and the cow must cycle for rebreeding. Energy requirements for maintenance and gain in mature cows has been shown to be about 30 percent higher for lactating than for non-lactating cows (Neville and McCullough, 1969). Daily TDN requirements for an average milking 1000 lb. cow are 11 to 12 lbs. and increase to 14 lbs. at higher lactation levels (NRC, 1976). Adequate protein levels (2 lbs. per day) have also been shown to be important during this period (Clanton and Zimmerman, 1970). Improper nutrition at this time can result in poor milk production with resulting low calf gains and a lower percentage of cows cycling and conceiving.

Period two extends 123 days after period one and ends at calf weaning. The cow is declining in lactation and supporting only a small fetus so nutrient demands are lower (10 to 12 lbs. of TDN and 1.5 lbs. of protein for a 1000 lb. cow). The cow also needs to be gaining some weight to prepare for more severe winter months and spring calving weight loss. Low nutrition in this period will not adversely affect the developing fetus but will affect calf growth rate. This seems to be a logical place for early weaning in drylot systems so that calves can be directly fed higher energy feeds as their needs

Period three is the time following weaning when the cow's nutrient needs are the lowest of the year. The main concern is to maintain the growing fetus and levels of 7 to 8 lbs. of TDN and .5 to 1 lbs. of protein are adequate for a 1000 lb. cow. A cow in good condition can afford to lose 10 to 15 percent of her body weight at this time.

Period four is the 50 days pre-calving and is a time of increasing nutrient demands as 70 to 80 percent of fetal growth occurs and the cow is preparing for lactation. Cows that are in thin condition or that have lost considerable weight should be gaining weight during this time. Energy levels of 10 to 11 lbs. of TDN are necessary for 1000 lb. cows and protein needs increase to 1 lb. Underfeeding during this period can result in lower birth weight of 6 to 8 lbs. but ease of calving is not affected (Bellows <u>et al</u>., 1972). It has also been shown that nutritional stress on the cow can produce early abortion and problems with calf survival (Corah <u>et al</u>., 1974). Cow milk production may also be reduced, which will affect later calf growth. It has been shown by Wiltbank <u>et al</u>. (1962) that low nutrition will lengthen the interval to first estrus.

Age of the female affects her nutrient requirements. Bred heifers are still in a growing stage and should be fed separately from mature cows to produce the necessary weight gains (Wiltbank <u>et al</u>., 1965). Energy needs vary with heifer size and desired weight gain but range from 9 to 12 lbs. of TDN. First-calf heifers also have higher energy requirements than mature cows after calving in order to start them cycling for breeding.

A third factor affecting cow nutrient requirements is condition or fleshiness. Cows in poor condition must receive more feed than good condition cows of equal weight if they are to gain back to their optimum weight. This means that cow condition should determine the feeding levels even in the maintenance period. Fat cows may be fed less and lose more weight and still show comparable interval to first estrus and conception rate as thin cows that receive extra feed. Thus, it may be necessary to separate cows by condition so that fat cows are not overfed or thin cows underfed and nutritionally stressed.

Requirements are also affected by cow size. Cows with larger skeletal size or heavier weight in average condition have higher requirements than do smaller cows. The energy requirements for a dry pregnant cow of 800 lbs. and one of 1400 lbs. are 7 and 10.5 lbs. of TDN, respectively. Differences in size would thus influence stocking rates on winter feeds like crop residues and the need for supplemental energy.

Size differences in mature cows are due in part to breed differences. Breed of the cow also plays a role in nutrition by its effect on lactation levels. It has been shown that dairy breeds used for calf production require 25 to 30 percent more feed to achieve comparable reproduction compared to British breeds (Lusby et al., 1974). It is likely that some of the higher milking, larger beef breeds also require 15 to 20 percent more feed than smaller British breeds. Another difference represented by some larger breeds is a faster rate of growth and older chronological age for physiological maturity which raises the nutritional requirements for growing heifers.

A final influence on cow nutrition is weather conditions. Cow requirements are increased under severe weather conditions. When temperature drops below an animal's thermal zone, an animal's net energy for maintenance increases. During cold, increased intake does not fully compensate for increased maintenance needs so the possibilities of weight loss are increased. Severe weather, such as snow, increases feed waste in many systems so that more available nutrients are necessary to insure adequate intake.

MILO AND CORN CROP RESIDUES

Residue Yields

Crop residues are a necessary by-product of grain production and will be available for use by beef cattle as long as grain is grown for humans and other monogastrics. It has been shown that 40 to 50 percent of the total corn plant dry matter and up to 40 percent of milo plant dry matter is left in the field after harvesting (Minyard, 1975). Work in Iowa (Martin et al., 1974) indicates that 50 to 60 percent of the milo plant dry matter remains. Yields of dry matter per acre for corn stover range from 1.5 to 3 tons (Perry, 1973; Ward, 1972). This compares to 1.25 to 2.5 tons per acre for milo stover (Vanderlip et al., 1974; Martin et al., 1974). To translate this yield into grazing days, it has been estimated that residue from a 100 bushel corn crop yields 80 to 100 days of grazing at 2 acres per cow (Vetter and Ayres, 1973).

Vanderlip et al. (1974) investigated milo stover yields at both early (32% moisture grain) and late (15% moisture grain) harvesting dates and found no significant decreases in silage tonage. In some cases, late harvest gave higher yields due to late branch growth before a killing frost. The fact that leaf percentage in the stover has been found to change from only 35 percent of the stover to 28 percent makes its dry matter yields fairly constant (Vetter, 1973). Some losses occur in dry matter yields 30 days or more after a killing frost according to Iowa work (Martin et al., 1974). Although corn stover usually has higher yields at harvest than milo stover, it declines more with time (Perry et al., 1973). This is due, in part, to a greater percentage of corn stover dry matter content in the leaves. Vetter (1973) states that leaf loss can be up to 50 percent as kernel moisture decreases only 5 percent.

Although changes in leaf content affects the nutritive value to some degree, crude protein levels in both corn and milo stover remains fairly constant over time. Crude protein in corn stover has been found to range from 2.1 to 5.5 percent, with an average value of 4 percent (Vetter, 1973). Milo stover crude protein was shown by Vanderlip et al. (1974) to range from 4.5 to 10.6 percent. The composition of milo stover is

Milo stover has a moisture content of 50 to 70 percent (Vetter and Ayres, 1973), making it ideal for ensiling. Corn stover moisture is generally 30 to 50 percent which is too low for ensiling. However, Albert _et al_. (1967) found that early harvesting and fine chopping directly behind the combine provided a palatable corn stover silage. Harvesting high moisture corn provides a higher moisture corn stover. A common rule of thumb is that two times the corn grain moisture equals the corn stover moisture (Vetter, 1973).

Percent dry matter of crop residue increases with time after harvesting, while the digestible dry matter decreases due to leaching and decay, particularly of the cellular contents (Perry, 1973). This decreasing digestibility is also due to leaf losses. Normal lignin content of both corn and milo stover is about 10 percent which becomes a greater portion of the remaining stover with time (Vetter, 1973; Smith, 1976). _In vitro_ dry matter digestibility for milo stover has been reported at 53 to 54 percent by Vetter and Ayres (1973), 27 to 46 by Vanderlip _et al_. (1974) and 37 to 39 (late harvest) and 47 to 48 (early harvest) by Perry, (1973). Corn stover digestibilities are generally higher than milo stover at 36 to 44 percent (late harvest) and 49 to 54 (early harvest) from Perry (1973) and 51 to 67 percent from Iowa work (Vetter and Ayres, 1973).

Nutritive Value and Animal Performance

Crop residues are characteristically high in bulk, low in palatability and limited in content of available energy and protein. Bolsen et al. (1975) determined that forage sorghum silage as a feed for growing heifers had a significantly higher feeding value than milo stover silage or milo stover pellets. This agrees with work by Colenbrander et al. (1971) who found that corn stover silage could be used in rations for dairy heifers only if additional energy is supplied. Brethour and Duitsman (1975) in a trial with growing steers fed milo stover silage, concluded that it had only 42 percent the value of forage sorghum silage for growth.

The requirements of a 1000 lb. dry pregnant beef cow are 15 to 16.5 lbs. of dry matter consumption providing at least 8 to 9.5 lbs. of TDN (NRC, 1976). Corn and milo stover dry matter intake will range from 18 to 20 lbs. (Albert, 1971). In vitro digestibility values of 45 to 60 percent for corn stover and slightly lower values for milo stover (Ward and Gilster, 1975) at 18 to 20 lb. intake level indicate that these crop residues can supply adequate energy for cow maintenance rations.

Work by McKee et al. (1975b) demonstrated that cows from 5 months to 3 weeks precalving could be successfully maintained with milo stover silage when only supplemental mineral and vitamin A was added. After 2 years research, they concluded that milo stover had 85 to 90 percent of the maintenance value of forage sorghum silage. This agrees with Arizona work (Taylor et al., 1975) which found milo stover fed with 1.5 lbs. cotton seed meal per day to be adequate in maintaining dry pregnant

Purdue work (Smith, 1976) with corn stover silage fed over a 3 year period to non-lactating cows in drylot showed satisfactory performance. The 65 percent moisture corn stover silage was similar in palatability to corn silage and was fed daily _ad libitum_ at 50 to 60 lbs. (as fed). Iowa work (Ritter _et al._, 1976; Vetter and Burroughs, 1975) has also demonstrated that corn stover stacks and silage are more than adequate for cow maintenance. Corn stover silage from high moisture corn, with a TDN value of 53 to 54 percent, fed to cows for 2 months precalving produced 64 lbs. of gain. Other cows in mid-gestation during a mild winter received only a protein and mineral supplement and good quality stacked corn stover and registered satisfactory gains. Good corn stover silage may offer advantages over whole plant corn silage in that limit feeding is not necessary to keep cows from becoming over-conditioned (Vetter and Weber, 1971).

Milo and corn residues, though able to supply maintenance energy needs for mature cows, must be supplemented for lactating cows or younger heifers (Ward and Gilster, 1975). At the Meade, Nebraska station, cows were fed stacked milo and corn stover during early lactation with 4 lbs. of corn. The workers concluded that the Hereford-Angus cows needed an additional 6 lbs. of corn daily to maintain their weight during this period. Smith (1976), feeding lactating cows corn stover silage from high moisture corn found that no additional energy was necessary but increased the protein level from .5 lb. to 1.5 lbs. during lactation. Ward (1972) compared pregnant heifers receiving corn stover silage, 1 lb. of corn and 1.25 lbs. of 40 percent protein to heifers fed hay and wintered on grazed stover. They found the silage-fed heifers gained .68 lbs. daily while the other heifers stayed at constant weight. Iowa work has also shown that bred heifers of 15 to 17 months, grazing unsupplemented residues, have more difficulty meeting their requirements than older cows with only maintenance needs.

The amount of supplemental energy needed is affected not only by the animal's requirements but also will vary by the severity of the weather and the nature of the residues. The greatest feeding value for grazing, is in the first two months (Ward, 1973), the period with the most grain and the least stover trampling. This factor, along with winter severity and greater cow gestation requirements increases the possible need for supplemental energy and other nutrients, such as protein.

It is believed that milo stover, with a protein value of 6 to 7 percent, will generally meet the requirements of pregnant cows. Grazed corn stover, with a 3 to 5 percent protein content, is also usually adequate for cow protein needs during the first 30 days when grain is still present (Minyard, 1975; Ward and Gilster, 1975; Vetter and Weber, 1971). In general, when feeding corn residues to the gestating cow, at least .5 lbs. of crude protein should be supplemented (Ward, 1972; 1973; Albert, 1971). This level might need to be increased depending on snow cover, quality of the forage and the cow's stage of production. Lactating cows on corn residues have been successfully maintained with 1.5 to 2 lbs. of protein supplement and 2 to 3 lbs. of corn grain (Smith, 1976; Smith et al., 1975).

While first and second calf heifers have been shown to require both higher winter protein and energy levels than mature cows for acceptable rebreeding (Pinney et al. 1972; Wiltbank et al. 1965), low levels of protein (60% of NRC) for mature cows actually improved percent calf crop and lifetime calf weight per cow. Iowa work (Weber and Vetter, 1974) with cows grazing corn stover, however, indicates that adequate protein levels must be maintained. Cows on low protein (3.1% before calving and 7.9% after calving) had greater weight loss and poorer reproduction than cows on average or high protein. Both average and high levels of natural protein outperformed average and high levels of protein furnished by urea. The average levels were 6.4 percent (pre-calving) and 10.9 percent (post-calving) while the high levels were 11.8 and 13.1 percent. The possible superiority of natural protein to non-protein nitrogen may be due to borderline energy availability from crop residues and is indicated by other work (Lamm et al. 1975; Vetter and Ritter, 1975; Ward and Gilster, 1975).

Other nutrients that should be included in crop residue supplements include vitamin A, calcium, phosphorus and trace minerals. Vitamin A is usually considered to be the only limiting vitamin in crop residue and can be fed in the supplement at 20,000 I.U. and 40,000 I.U. during gestation and lactation, respectively (Vetter and Ayres, 1973; Ward, 1973) or in good quality alfalfa hay. Vitamin E is also low in crop residues but is not generally included in supplement recommendations (Minyard, 1975). Phosphorus has been shown to be the most deficient mineral in both corn and milo residues and should be supplemented nearly to requirement (Martin et al., 1974; Vetter and Ayres, 1973). These workers have also shown corn residues to be slightly limiting in calcium and sulfur levels for the dry beef cow. Most trace minerals are shown to be adequate in laboratory analyses but their availability and that of calcium is questionable. A typical recommendation for both corn and milo residues is a free choice mineral that includes trace minerals and sulfur. Calcium and phosphorus should be fed in a ratio of 1:2 and 1:1 for gestating and lactating cows, respectively.

Methods of Harvesting Crop Residues

There are four common methods of utilizing crop residues: (1) grazing; (2) baled or stacked dry stover; (3) ensiled stover and (4) corn husklage or milo tailing dumps.

The most common and perhaps most flexible method of utilizing crop residues is grazing during the fall and early winter months. In Iowa (Vetter and Weber, 1971) it has been estimated that stover from 100 bushel corn will provide 80 to 100 grazing days at a stocking rate of 2 acres per cow. Milo stover has been estimated to provide 65 cow days per acre (Martin et al., 1974). During the early days of grazing, cow requirements are easily met because of the presence of grain and other more digestible residues which are the first to be selected. This leaves poor quality stover as cold weather approaches and requirements go up. Grazing, however, has been found to be the least cost, highest profit system for most producers (Powell et al., 1975). Other limitations include hindrances of severe winter weather, the elimination of fall tillage and the inefficiency of grazing, which gleans only 10 to 20 percent of available corn stover dry matter (Vetter and Weber, 1971). Milo stover grazing is more efficient because of the leaf distribution and standing ability of the stalk, so that 50 to 60 percent is utilized. Martin et al. (1974) found that cows and bred heifers grazing milo stover with field stored dumps were maintained more successfully than cows grazing corn stover with field stored dumps and stacks fed during excessive snow cover.

Grazing of crop residues with field stored husklage or dry stacks can eliminate some of the problems of winter grazing by providing nutritionally adequate and accessible feed in any weather according to Vetter and Weber (1971). Access to the stacks should be controlled to prevent excessive waste and to encourage grazing in normal weather. A disadvantage of field stored stacks and husklage dumps is waste. Estimates of from 20 to 45 percent waste have been made for large packages fed on the ground without feeding panels (Goodrich et al., 1975; Smith, 1974) and over 50 percent waste from husklage dumps (Ward, 1972).

Corn and milo stover either in large dry packages or chopped and ensiled may also be used to maintain cows in drylot.

Smith *et al*. (1975) found that large bales or stacks should be made when stalk moisture content is less than 35 percent to minimize mold. High moisture content also may cause the packages to freeze in sub-zero weather. Martin *et al*. (1974) found that milo stover moisture was never low enough during the winter to make large bales and concluded that this system would not work under normal Iowa conditions. This same high moisture content of 60 to 75 percent allowed these workers to make good milo stover silage. Smith *et al*. (1975) found ideal moisture levels for corn stover silage to be 50 to 70 percent, which meant that chopping should be done shortly after grain removal for adequate moisture. They concluded that a feeding system using corn stover silage is more dependable than a dry harvested stover system because the silage is made in the fall under more dependable and favorable weather conditions. They found no difference between the chemical composition of corn stover silage and dry stacks when harvested at similar dates. Mineral leaching and lower digestibility occurred in stover harvested later in the winter.

Feeding trials with corn stover silages and dry harvested stacks generally have shown corn stover silage to be superior over dry stacks for cow maintenance. Utilization of stover stacks has been found to range from 65 to 85 percent of the harvested material (Minyard, 1975) while corn stover silage feeding losses are lower. When corn stover is finely chopped at optimum moisture content, dry matter intake and digestibility are higher than for dry stacks and the spoilage problem is not as great. Vetter and Ritter (1975) compared: (1) cows fed dry harvested corn stover under zero grazing conditions on stover; (2) cows in drylot fed ground harvested stacks and (3) cows grazing corn stover with field stacks. Cows on all treatments lost weight in the severe winter. The stover grazing treatment performed the best but the drylot cows showed the least periodic weight change. They concluded that the harvested stover for zero grazing and drylot did not support adequate performance. Iowa work with corn stover silage though under less severe weather conditions, has shown satisfactory results (Vetter and Burroughs, 1975).

Purdue research (Smith et al. 1975; Smith, 1976) has found corn stover silage to provide superior cow performance compared to dry harvested stover stacks. The stover silage was made 1 to 3 days after high-moisture corn harvest while the stacks were not put up until December. The average stack dry matter value for each year of the trial was 66 and 44 percent. Cow average daily gain was .29 lbs. and .11 lbs. for corn stover silage and dry stacks, respectively. Calf gain was 1.33 lbs. for silage compared to 1.00 lbs. for dry stacks. The first year the stacks were fed with a hot wire which limited intake but the worker reported improved consumption using feeding panels the second year. Cows fed dry stacks and 1 to 2 lbs. of 35 percent natural protein did not perform adequately until 9 lbs. of mixed hay was added. Fifty lbs. of corn stover silage plus .5 to 1 lbs. of protein supplement supported acceptable dry cow performance and 60 lbs. of corn stover silage, 2 lbs. of corn and 2 lbs. of supplement supported acceptable lactating cow performance.

Economics and flexibility must also be considered in comparing residue harvesting systems. Crop residues removed from the field have soil fertility value that must be replaced and even grazing crop residues may not be profitable for every operation (Henderson, 1973). According to Powell et al. (1975), after grazing the least cost--highest returning method of utilization is to feed stover stacks in combination with hay. Feeding hay alone, or feeding dry corn stover plus supplemental protein and energy or feeding corn silage are similar in cost. Petritz et al. (1975) stated that a Foster dump system for husklage or tailings is not profitable to add to a grazing system for 75 cows or less. They believe that large package stacks and bales are not practical at present for less than 100 cows. Costs of the mechanization necessary for stover silage would limit most operators unless the equipment could also be applied to other uses.

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SUMMARY

Four maintenance trials for beef cows were conducted to determine the feeding value of dry harvested milo stover (MSB), milo stover silage (MSS), forage sorghum (FSS), and an alfalfa hay-wheat straw mixture (AS) and to measure performance of cows grazing milo stover and supplemented with different sources of protein. Trials I and II were conducted during the winter of 1975-76; trials III and IV, during the winter of 1976-77. A fifth trial during the summer of 1976 studied the effects of various management practices on the performance of calves and dams confined to drylot.

In trial I, one hundred two drylot cows were fed MSB, MSS or FSS in an 83-day trial. Cows were fed to meet NRC maintenance requirements and received .57 kg protein supplement daily. Cows fed FSS gained more weight and condition than cows fed MSB or MSS. Cows fed MSS lost weight the first 53 days but gained weight the final 30 days when silage intake was increased. Cows fed MSB gained weight the first 53 days but lost weight and condition the final 30 days due to a sharp decline in dry matter intake. Cows fed MSB had lighter calves than cows fed MSS or FSS.

In trial II, 63 cows grazed milo stover for 53 days to compare four protein treatments: no protein supplement; .91 kg daily of a 16% natural protein cube supplement; 16% non-protein nitrogen liquid supplement or 18% non-protein nitrogen liquid supplement. Both liquid supplements were fed free-choice. Cows re-

ceiving no protein or the natural protein cube gained weight and lost less condition than cows receiving either liquid supplement.

Ninety drylot cows were fed MSB, MSS or AS for 61 days in trial III. Cows were fed to meet NRC energy requirements but no supplemental protein was fed. One-half of the cows in each forage treatment received additional energy during cold stress conditions. Cows fed MSS or AS gained more weight and condition than cows fed MSB. Feeding additional energy during cold stress increased cow weight gains.

In trial IV, 40 cows grazed milo stover for 61 days and received no protein supplement or .91 kg daily of 16% natural protein cube supplement. Cows fed the natural protein cube gained more weight than non-supplemented cows.

In trial V, 125 calves were confined in drylot during a 107-day trial to compare: calves weaned at 50 (±25) days of age (EW); nursing calves receiving a creep (C) and nursing calves with no creep (NC). Within each group, calves were further divided into three subtreatments: implanted with Ralgro once; implanted with Ralgro and re-implanted 60 days later and non-implanted. Total gain was highest for EW calves and lowest for NC calves. EW calves consumed twice as much creep as C calves. Implanted calves gained more weight than non-implanted calves but the number of times implanted did not affect gain. Dams of EW and C calves gained more weight and condition than dams of NC calves and more dams of EW calves cycled early in the breeding season than dams of C or NC calves.

EXPERIMENTAL PROCEDURE

Cow Maintenance Trial I: Winter, 1975-76

The objective of this trial was to compare the feeding values of dry harvested milo stover, milo stover silage and forage sorghum silage.

Milo stover and forage sorghum silage were harvested after a killing frost in October, 1975 with a self-propelled forage harvester equipped with a 3.7 m cutterbar and a 5.06 cm recutter screen. Milo stover silage was ensiled in a trench silo; forage sorghum silage, in a 3.1x15.2 m concrete silo. Dry milo stover was harvested in late October with a Hesston Stakhand 10 (stack weight, 908 kg) and a Hesston 5600 baler (bale weight, 545 kg).

One hundred two mature cows in mid to late gestation and confined in drylot were used in the 83-day trial (November 20, 1975 to February 12, 1976). Cows were allotted within breed by weight and condition score to a 2x3 factorial design. Breed treatments were Simmental x Hereford and Hereford, and the forage treatments were: (1) dry harvested milo stover (MSB), (2) milo stover silage (MSS) and (3) forage sorghum silage (FSS). The six pens ranged in area from 1700 to 2500 m^2 and bunk space varied from 18 to 27 m per pen. MSB was fed ad libitum with collapsable feeding panels. FSS and MSS were estimated to be 67 and 57% total digestible nutrients (TDN), respectively, and were fed to meet NRC (1976) maintenance energy requirements. All cows received protein supplement (table 1) daily: .57 kg

Table 1. Composition of Cow Supplements Fed in Trials I, II, IV and V

	% as-fed basis	
Ingredient	Trials I and V	Trials II and IV
Soybean meal	53.5	15.0
Milo, rolled	24.6	54.9
Molasses	2.0	7.5
Vitamin A premix[1]	.3	.1
Dehydrated alfalfa	-	20.0
Dicalcium phosphate	-	2.5
Pellet binder	-	.05
Salt	10.0	-
Bone meal	6.7	-
Trace mineral	1.0	-
Urea	3.2	-

[1]Premix provided 9,080 (I and V) and 13,620 (II and IV) I.U. of vitamin A/cow/day.

the first 53 days and .68 kg the final 30 days. All received .91 kg of corn daily the first 20 days.

All weights were taken after cows had gone 15 hours without feed. Condition scores were average visual appraisals by three persons using a range from 1 (extremely thin) to 10 (extremely fleshy). Samples of the forages were taken weekly for dry matter determination and adjustments were made in amounts fed when more than two percentage unit change occurred. Proximate analyses for each forage were determined using A.O.A.C. (1970) methods.

Statistical analyses of the data were by least squares analysis of variance with unequal subclass procedures (Kemp, 1972). Duncan's Multiple Range Test as described by Steele and Torrie (1960) was used to determine differences between treatment means. Analysis of variance tables for data reported appear in the Appendix.

Cow Maintenance Trial II: Winter, 1975-76

The objective of this trial was to compare the performance of cows grazing milo stover and supplemented with three different sources of supplemental protein.

Sixty-three mature Hereford cows in mid to late gestation were allotted by weight and condition score to compare: (1) no protein supplement, (2) .91 kg daily of a 16% natural protein supplement (table 1), (3) 16% protein liquid supplement[a]

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[a]Supplement contained Starea and was an experimental mixture provided by the Department of Grain Science and Industry, Kansas State University.

and (4) 18% protein liquid supplement[b]. The natural supplement was fed as a 1.9 cm cube and both liquid supplements were fed free-choice in commercial lick tanks.

The treatment groups grazed 94 acres of milo stover which had been divided into four equivalent areas. No mineral was supplemented. The 53-day trial began November 20, 1975 and ended January 12, 1976. Initial weights were taken after cows had gone 15 hours without feed; final weights were taken immediately after cows were removed from milo stover. Condition score and statistical analyses were determined by procedures described in trial I.

Cow Maintenance Trial III: Winter, 1976-77

The objectives of this trial were: (1) to compare the feeding values of milo stover silage, dry harvested milo stover and an alfalfa hay and wheat straw mixture and (2) to determine the need for additional energy for maintenance during cold stress.

Milo stover silage was harvested and ensiled in October, 1976 as described in trial I. Dry milo stover was harvested in early November with a Hawk built 580 baler (bale weight, 658 kg) and a Vermeer baler (bale weight, 545 kg).

Ninety mature cows (Simmental x Hereford and Hereford) in mid to late gestation were allotted by weight, condition score, breed and calving date to six treatments: (1) dry harvested milo stover (MSB), (2) dry harvested milo stover plus additional energy during cold stress (MSB + E), (3) milo stover silage (MSS), (4) milo stover silage plus additional energy during

[b]Supplement contained urea and was provided by a commercial company.

cold stress (MSS + E), (5) 33% alfalfa hay and 67% wheat straw hay (AS) and (6) 33% alfalfa hay and 67% wheat straw hay plus additional energy during cold stress (AS + E).

The 61-day trial began December 2, 1976 and ended February 1, 1977. All forages were assumed to be 50% TDN. Cows receiving MSS, MSS + E, AS, and AS + E were fed at NRC (1976) maintenance energy requirements. MSB and MSB + E were fed *ad libitum* in collapsable feeding panels.

Additional energy for maintenance during cold stress was supplied by corn grain fed when effective temperature dropped below the cow's critical temperature (the value below which additional heat must be produced to maintain internal temperature). Effective temperature was determined daily using a 7 a.m. dry bulb temperature reading and the average wind speed over the previous 24 hours. Critical temperature was estimated to be -1.11 C. An additional 1.8% of recommended NRC (1976) energy intake was added for each degree drop below critical temperature (table 2).

Protein was not supplemented but all cows had access to a 50% dicalcium phosphate, 50% salt mixture. Cow weights and condition scores, forage analyses and statistical analyses were determined by procedures described in trial I. Van Soest analyses (Goering and Van Soest, 1970) were also determined for samples of each forage.

Cow Maintenance Trial IV: Winter, 1976-77

The objective of this trial was to evaluate the need for supplemental protein for cows grazing milo stover.

Table 2. Energy Additions in Trial III

	Increased NE_m During Cold	
Insulation C/Kcal/m^2/day	Weight kg	Fed[1] % Inc/C
.010		3.72
.015		2.48
.020	400	1.86
.025		1.49
.010		3.60
.015		2.40
.020	500	1.80
.025		1.44

Additional Energy Supplied by Corn

Effective Temperature	Corn/15 Cows (kg)
-1.11 or above	0
-3.89	3.2
-6.69	6.4
-9.44	9.5
-12.22	12.7
-15.00	15.4
-17.78	18.6
-20.56	21.8
-23.33	25.0
-26.11	28.1
-28.89	31.3
-31.67	34.5

Forty mature Hereford and Simmental x Hereford cows in mid to late gestation were allotted by weight, condition score, breed and calving date to compare: (1) no protein supplement and (2) .91 kg daily of a 16% natural protein supplement fed as a 1.9 cm cube (table 1). The two groups receiving protein supplement were each allotted to 15 acres of milo stover; the two non-supplemented groups each grazed 20 acres of milo stover. Estimated stover yields were lowest in the fields grazed by the non-supplemented cows.

The 61-day trial began December 2, 1976 and ended February 1, 1977. All cows had access to a 50% dicalcium phosphate, 50% salt mineral mix. Initial and final weights were taken as described in trial II. Condition score and statistical analyses were determined by procedures described in trial I. Van Soest and proximate analyses were determined for samples from each field.

Early Weaning Trial V: Summer, 1976

The objectives of this trial were: (1) to compare the performance of calves weaned at 50 days of age to nursing calves, with or without access to creep in drylot, (2) to compare performances of calves receiving one or two implants of Ralgro to non-implanted calves and (3) to evaluate calf treatment effects on dam performance.

Ninety calves (avg wt, 57 kg) from Hereford dams sired by Charolais, Angus and Hereford bulls and 35 calves (avg wt, 71 kg) from Simmental x Hereford dams, sired by Simmental bulls were used in the 107-day trial (May 10, 1976 to August 25, 1976).

All calves were born in drylot and were allotted by age, sex and breed among three treatments: (1) calves weaned at 50 (±25) days of age (EW), (2) nursing calves receiving a creep (C) and (3) nursing calves with no creep (NC). Within each group, the 90 calves from Hereford dams were further divided by weight and age into three sub-treatments: (a) calves implanted on June 11 with 36 mg Ralgro, (b) calves implanted May 10 with 36 mg Ralgro and re-implanted 60 days later and (c) non-implanted calves.

Calf dams were maintained in drylot and allotted to six lots according to calf treatment with Simmental x Hereford and Hereford cows grouped separately. When cows were allotted, weight and condition score were determined as described in trial I and were similar within breed groups. Calves were weighed monthly (5 times) without removal from feed or water.

Early weaned calves were housed indoors in pens of nine calves with access to a starter creep (table 3) which contained 3.6 Mcal digestible energy (DE) per kg. At 18 days post-weaning, calves were moved outside and at 50 days post-weaning were shifted gradually to a standard creep containing 3.35 Mcal DE per kg (table 3). Nursing calves fed creep had access the entire 107 days to the standard creep. Early weaned calves were fed 2.7 kg of native grass hay per calf daily during the final 30 days.

Calf dams were fed three different silages (table 4), rolled milo and a protein supplement (table 1) to meet NRC energy and protein requirements. Cows whose calves were not fed creep received approximately 1.5 kg additional TDN from silage the

Table 3. Composition of Creep Rations for Nursing and Early Weaned Calves in Trial V

	% as-fed basis	
Ingredient	Starter creep	Standard creep
Rolled oats	21.1	65.7
Rolled corn	35.9	18.5
Dehydrated alfalfa	-	4.7
Calf Manna[1]	14.8	-
Wet molasses	3.1	3.1
Dicalcium phosphate	.5	-
Limestone	.5	-
Soybean meal	21.1	4.2
Dry molasses	-	2.6
Premix[2]	1.1	-
Salt	1.1	.5
Aureo-10	.7	.7

[1]Calf manna milk replacer manufactured by Albers Milling Co.

[2]Premix kg per 454 kg: SBM, 202; ground oats, 201, vitamin A, 15; Auremycin-10, 13.5; trace mineral, 22.7.

Table 4. Analysis of Forages Fed Dams in Trial V.

Silage	Dry matter (%)	Crude protein	Crude fiber	Ether extract	Ash	Estimated DE (Mcal/kg)
			% dry matter basis			
Forage sorghum silage	35.0	7.6	25.0	1.9	8.1	2.95
Straw-alfalfa silage	52.0	14.2	32.8	2.9	13.3	2.34
Straw-excreta silage	32.0	13.2	26.7	3.1	15.3	2.42

RESULTS

Cow Maintenance Trial I: Winter, 1975-76

Results of the forage analyses are shown in table 5. Cow performance data for trial I are presented in table 6. Cows fed MSB and FSS gained more weight ($P<.05$) and condition ($P<.05$) than cows fed MSS the first 53 days. The amount of MSS fed during the last 30 days was increased to compensate for weight lost during the first 53 days. Dry matter ad libitum intake of MSB tended to decrease as time increased. Cows fed FSS gained more weight ($P<.05$) and condition ($P<.05$) than cows fed MSB or MSS at 83 days. Breed did not affect weight gain or condition score. Calf birth weights were less ($P<.10$) for cows fed MSB than for cows fed FSS or MSS. Of cows remaining in the herd the following summer, fewer cows fed MSB cycled in the first 30 days of the breeding season than cows fed FSS or MSS but the difference was not significant.

Cow Maintenance Trial II: Winter, 1975-76

Cow performance data are shown in table 7. Mild weather prevailed during the trial but snow cover one day necessitated feeding 182 kg of wheat straw hay to cows in each treatment. Cows grazing milo stover and receiving natural protein supplement gained more weight ($P<.05$) than cows receiving the two liquid supplements. Cows fed the 16% protein liquid supplement lost more weight ($P<.05$) than cows fed natural protein supplement or no protein supplement. Cows fed natural protein supplement or no protein supplement lost less condition ($P<.05$) than cows fed

Table 5. Analysis of Forages Fed in Trials I, III and IV

	Dry matter %	Crude protein	Crude fiber	Ether extract	Ash	Acid detergent fiber	True crude protein	Ca	P
		% dry matter basis							
Trial I									
Milo stover bales	64.0	5.0	29.2	2.2	13.0				
Milo stover stacks	65.0	5.1	33.0	2.0	10.9				
Milo stover silage	30.0	5.2	29.6	1.4	14.2				
Forage sorghum silage	29.0	7.6	25.0	1.9	8.1				
Trial III									
Milo stover bales	75.0	5.1	33.1	1.4	15.4	56.5	3.1	.37	.14
Milo stover silage	38.0	8.0	25.1	2.2	9.4	38.2	5.0	.39	.25
33% alfalfa + 67% wheat straw[1]	90.0	8.3	37.4	1.8	9.3	49.5	4.8	.60	.17
Trial IV									
Milo stover (15 acre fields)									
leaves	-	4.4	32.9	2.0	17.1	66.9	2.6	.56	.14
stalks	-	3.4	34.3	1.4	12.3	56.0	1.6	.30	.10
Milo stover (20 acre fields)									
leaves	-	6.4	33.4	2.0	12.6	57.2	3.6	.55	.18
stalks	-	5.1	36.5	1.6	10.5	50.9	2.1	.41	.11

[1]Calculated from separate analysis of alfalfa and wheat straw.

Table 6. Performance of Cows Fed MSB, MSS, and FSS in Trial I[1]

<table>
<tr><th></th><th colspan="6">Forage treatment and breed[2]</th></tr>
<tr><th></th><th colspan="2">Milo stover bales[3]</th><th colspan="2">Milo stover silage</th><th colspan="2">Forage sorghum silage</th></tr>
<tr><th></th><th>H</th><th>SXH</th><th>H</th><th>SXH</th><th>H</th><th>SXH</th></tr>
<tr><td>No cows</td><td>16</td><td>18</td><td>17</td><td>17</td><td>17</td><td>17</td></tr>
<tr><td>Initial wt, kg</td><td>458</td><td>532</td><td>456</td><td>532</td><td>460</td><td>532</td></tr>
<tr><td>Initial condition</td><td>5.51</td><td>5.72</td><td>5.46</td><td>5.70</td><td>5.45</td><td>5.70</td></tr>
<tr><td><u>First 53 days</u></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dry matter intake, kg</td><td>10.7</td><td>11.0</td><td>6.9</td><td>7.1</td><td>6.1</td><td>6.3</td></tr>
<tr><td>Wt change, kg</td><td>10.9</td><td>10.7</td><td>-35.1</td><td>-39.4</td><td>3.8</td><td>.4</td></tr>
<tr><td>Breeds pooled</td><td colspan="2">10.8^a</td><td colspan="2">-37.4^b</td><td colspan="2">2.1^a</td></tr>
<tr><td>Condition change</td><td>.08</td><td>.05</td><td>-.67</td><td>-.61</td><td>.20</td><td>-.04</td></tr>
<tr><td>Breeds pooled</td><td colspan="2">$.06^a$</td><td colspan="2">$-.64^b$</td><td colspan="2">$.08^a$</td></tr>
<tr><td><u>Final 30 days</u></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dry matter intake, kg</td><td>8.4</td><td>8.4</td><td>9.4</td><td>9.7</td><td>5.3</td><td>5.5</td></tr>
<tr><td>Wt change, kg</td><td>-14.6</td><td>-16.5</td><td>35.2</td><td>16.7</td><td>18.4</td><td>16.6</td></tr>
<tr><td>Condition change</td><td>-.48</td><td>-.60</td><td>.03</td><td>.21</td><td>-.13</td><td>.06</td></tr>
<tr><td><u>Total 83 days</u></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Wt change, kg</td><td>-3.7</td><td>-5.8</td><td>.1</td><td>-22.7</td><td>22.2</td><td>17.0</td></tr>
<tr><td>Breeds pooled</td><td colspan="2">-4.7^b</td><td colspan="2">-11.3^b</td><td colspan="2">19.6^a</td></tr>
<tr><td>Condition change</td><td>-.40</td><td>-.55</td><td>-.64</td><td>-.40</td><td>.07</td><td>.02</td></tr>
<tr><td>Breeds pooled</td><td colspan="2">$-.47^b$</td><td colspan="2">$-.52^b$</td><td colspan="2">$-.04^a$</td></tr>
<tr><td>Calf birth wt, kg</td><td>28.9</td><td>37.4</td><td>34.8</td><td>38.3</td><td>34.7</td><td>39.0</td></tr>
<tr><td>Breeds pooled</td><td colspan="2">33.1^c</td><td colspan="2">36.6^d</td><td colspan="2">36.9^d</td></tr>
<tr><td>% cows cycling[4]</td><td colspan="2">82.8^a</td><td colspan="2">90.9^a</td><td colspan="2">93.3^a</td></tr>
</table>

[a,b] Least square means with different superscripts differ significantly ($p<.05$).

[c,d] Least square means with different superscripts differ significantly ($P<.10$).

[1] Values are least square means [2] H=Hereford; SXH=Simmental X Hereford

[3] For dry stacks, disappearance is assumed as intake (waste estimated at 10-15%).

[4] Represents % of cows remaining in herd that cycled from May 20 to June 20, 1976.

Table 7. Performance of Cows Grazing Milo Stover and Supplemented with Different Protein Sources in Trial II[1]

Item	No protein supplement	16% natural protein cube	16% NPN liquid	18% NPN liquid
No cows	16	16	16	15
Supplement dry matter intake, kg	-	.82	1.1	1.1[2]
Initial weight, kg	448	452	451	470
Weight change, kg	-2.0[ab]	6.7[a]	-22.5[c]	-10.6[bc]
Initial condition	5.56	5.63	5.44	5.87
Condition change	-.61[a]	-.36[a]	-1.06[b]	-1.07[b]

[a,b,c]Means on the same line with different superscripts differ significantly ($p<.05$)

[1]Values are least square means

[2]Estimated from tank measurements

the two liquid supplements. There were no significant effects on calf birth weights or cow rebreeding the following spring.

Cow Maintenance Trial III: Winter, 1976-77

Results of the forage analyses and cow performance data are shown in tables 5 and 8, respectively.

With energy treatments pooled in each forage group, cows fed MSS and MSS+E and cows fed AS and AS+E gained more weight (P<.05) than cows fed MSB and MSB+E. Cows fed MSS and MSS+E gained more condition (P<.05) than cows fed AS and AS+E and both cow groups gained more condition (P<.05) than cows fed MSB and MSB+E. Simmental X Hereford cows gained more weight (P<.05) and lost more condition (P<.05) than Hereford cows.

Corn was fed to energy adjusted cows for 43 days during the 61-day trial. Total corn intake was 14.0 kg per cow. Cows fed additional energy during cold stress gained more weight (P<.05) than cows fed to NRC energy requirements.

Cow Maintenance Trial IV: Winter, 1976-77

Results of the forage analyses and cow performance data are shown in tables 5 and 9, respectively.

Cows supplemented with 16% natural protein while grazing milo stover gained more weight (P<.05) than cows receiving no protein supplement. Protein treatment did not affect condition score. Simmental X Hereford cows gained more weight (P<.05) than Hereford cows but gained less condition (P<.05).

During seventeen days of snow cover in January, 552 kg of wheat straw hay was fed to each of the four cow groups.

Table 8. Performance of Cows in Trial III

Forage and energy treatments	No cows	Initial wt, kg	Initial condition	Dry matter intake, kg	Wt change kg	Condition change
MSB						
NRC	15	500	5.61	10.6	-31.4	-1.12
Adjusted energy	15	492	5.47	9.5	-23.3	-1.05
MSS						
NRC	15	512	5.47	7.9	6.2	.27
Adjusted energy	15	524	6.10	7.9	16.6	.02
AS						
NRC	15	525	5.63	7.9	7.1	-.24
Adjusted energy	15	511	5.53	7.9	21.7	-.16
Treatments pooled						
MSB	30				-27.4[b]	-1.09[c]
MSS	30				10.8[a]	.14[a]
AS	30				15.3[a]	-.21[b]
NRC	45				-6.1[b]	-.41
Adjusted energy	45				4.8[a]	-.40
Hereford	48				-4.6[b]	-.14[a]
Simmental X Hereford	42				3.8[a]	-.64[b]

[a,b,c]Least square means with different superscripts differ significantly ($P<.05$) within a factor group

[1]For MSB, disappearance is assumed as intake (waste estimated at 15%)

Table 9. Performance of Cows Grazing Milo Stover in Trial IV

Grazing treatment	No cows	Initial wt kg	Initial condition	Wt gain kg	Condition change
16% natural protein	19	458	5.17	51.4[a]	.45[a]
No supplement	21	490	5.60	34.5[b]	.34[a]
Breed effects					
Hereford	21	-	-	28.7[b]	.62[a]
Simmental X Hereford	19	-	-	57.2[a]	.17[b]

[a,b]Least square means with different superscripts differ significantly ($P<.05$) within a factor group

Early Weaning Trial V: Summer, 1976

Calf performance data, calf and dam feed consumptions and treatment effects on dams are presented in tables 10, 11 and 12, respectively.

Total gain was highest ($P<.05$) for EW calves and lowest ($P<.05$) for NC calves (table 10). Implanted calves gained more weight ($P<.05$) than non-implanted calves but no advantage was shown for re-implanted calves over single implanted calves.

Dams of EW and C calves gained more weight ($P<.05$) and condition ($P<.05$) than dams of NC calves (table 12). Dams of EW calves gained less weight ($P<.05$) than C calf dams. Hereford cows gained more weight ($P<.05$) and condition ($P<.05$) than Simmental X Hereford cows. Simmental X Hereford cows with NC calves lost more condition ($P<.05$) than all other cow groups. More cows with EW calves cycled during the first 30 days of the breeding season than either dams of C or NC calves ($P<.05$). Breed did not affect cycling.

Table 10. Performance of Early Weaned, Creep Fed, and Non-Creep Fed Calves in Trial V[1]

		Calf treatments and dam breeds[2]					
		Early weaned		Creep fed		Non-creep fed	
Item		H	SXH	H	SXH	H	SXH
No calves		30	15	30	10	30	10
Age on test, days		50	50	47	50	49	47
Initial weight, kg[3]		56.8	73.5	56.8	70.8	58.1	69.0
Final weight, kg[3]		175.2	209.3	170.7	196.6	106.7	125.8
Total gain, kg		121.5[a]		114.7[b]		49.7[c]	
Daily gain, kg		1.14		1.07		.46	
Implanting results	(total gain, kg)[4]						
Single implant	(94.7)[a]	121.9		115.8		46.6	
Double implant	(95.2)[a]	123.3		111.3		51.1	
Non-implanted	(88.0)[b]	105.1		113.4		46.7	

[1]Values are least square means

[2]H=Hereford; SXH=Simmental X Hereford

[3]Weights are actual values

[4]Parenthesis values are pooled weaning treatments

Table 11. Feed Consumption of Calves and Dams in Trial V.

	Daily feed (kg, as fed) for calf treatments					
	Early Weaned		Creep fed		Non-creep fed	
	H	SXH	H	SXH	H	SXH
Dams[1]						
Sorghum silage	15.9	18.2	18.2	22.7	18.2	22.7
Straw-alfalfa silage	7.1	8.3	8.4	12.4	8.4	12.4
Straw-excreta silage	15.6	17.6	22.7	21.0	27.3	24.7
Milo[2]	1.8		2.7		2.7	
Supplement	.45		.68		.68	
Avg DE (Mcal)	22.0		29.1		30.0	
Calves						
Starter creep	2.5		-		-	
Standard creep	4.5[3]		1.9		-	
Avg creep consumption	3.5		1.9		-	
Avg creep DE (Mcal)	12.3		6.2		-	
Dam + calf De (Mcal)	34.3		35.3		30.0	
Total dam + calf DE (Mcal/kg calf gain)	30.2		32.8		64.6	

[1]H=Hereford; SXH= Simmental X Hereford

[2]Actual levels changed during the trial; dry cows (.91-1.8); creep cows (1.8-2.7); non-cree cows (1.8-3.6).

[3]Creep not fed until starter creep ended.

Table 12. Performance of Dams for Calf Treatments in Trial V.

Calf treatments and cow breeds	Initial wt kg	Initial Condition	Wt change kg	Condition change	% cycling[1]	% conceived[2]
Early weaned						
Hereford	428	5.01	26.8	.48	100	86.0
Simmental X Hereford	509	6.22	19.5	-.12	100	81.0
Creep fed						
Hereford	397	4.73	41.3	.55	86.3	76.0
Simmental X Hereford	499	6.30	24.5	.12	81.9	80.0
Non-creep fed						
Hereford	429	5.21	18.7	.30	92.4	80.0
Simmental X Hereford	479	5.80	-11.0	-.99	78.6	80.0
Treatments pooled						
Early weaned			23.2[b]	.18[a]	100.0[a]	-
Creep fed			33.0[a]	.34[a]	84.1[b]	-
Non-creep fed			3.9[c]	-.34[b]	85.5[b]	-
Hereford			28.7[a]	.45[a]	93.7[a]	-
Simmental X Hereford			11.1[b]	-.33[b]	86.2[a]	-

[a,b,c]Least square means with different superscripts differ significantly ($P<.05$) within factor groups.

[1]% cycling represents those cows observed in estrus May 20-June 20, 1976.

[2]% conceived is calculated from rectal palpation October 8, 1976.

DISCUSSION

Results of trials I and III indicated that cows were successfully maintained with MSS. This agrees with research by McKee _et al_. (1975b) and Taylor _et al_. (1975).

In trial I, weight and condition loss the first 53 days for cows fed MSS appeared due to as overestimation of its TDN value; thus not enough MSS was fed to meet maintenance energy requirements. Increasing the amount of MSS fed the final 30 days produced weight gain.

Cows fed MSB in trial I gained weight and condition the first 53 days but lost weight during the final 30 days. In trial III, cows fed MSB lost weight and condition at both 31 days and 61 days. Cows fed MSB in trial I also produced lighter calves and fewer of these cows cycled early in the breeding season. Research by Bellows _et al_. (1972) showed a low plane of nutrition during late gestation caused low calf birth weights and Wiltbank _et al_. (1965) showed inadequate nutrition in late gestation lengthened the interval to first estrus.

In trial I, poorer performance for cows fed MSB during the final 30 days paralleled decreased dry matter intake. The apparent decreased palatability could have been due to a loss of moisture and increased mold in the MSB as the winter progressed. Crude fiber increased slightly and ether extract decreased with time. Perry (1973) showed that digestible dry matter decreased in crop residues due to decaying and leaching of cellular contents.

Weight and condition loss for cows fed MSB in trial III may suggest a slight protein deficiency. These cows had a daily crude protein intake of .38 kg compared to a daily requirement of .49 kg (NRC, 1976). In trial III, milo stover was obtained from two sources and ensiled had more grain than baled stover. MSS had higher crude protein and lower crude fiber content than MSB (table 5).

Results from trials I and III show superior performance for cows fed MSS over those fed MSB. Minyard (1975) found a higher dry matter intake and digestibility for corn stover silage compared to dry corn stover stacks. Vetter and Ritter (1975), Smith et al. (1975) and Smith (1976) showed corn stover silage was superior to dry corn stover stacks for maintaining dry cows. Smith (1976) reported that cows fed dry corn stover stacks with supplemental protein did not perform adequately until 4 kg of mixed hay was added.

Cows fed FSS gained more weight than cows fed MSS. This was not expected because all cows were theoretically fed to meet their maintenance energy requirements (NRC, 1976). McKee et al. (1975b) concluded after two years of research that MSS had 85 to 90% the maintenance energy value of FSS. Proximate analyses of forages fed in trial I show higher crude protein and lower ash and crude fiber for FSS than for MSS.

In trials II and IV cows fed a natural protein supplement and non-supplemented cows had similar weight and condition changes. These results suggest that protein requirements for pregnant cows are met by grazed milo stover forage.

Cows receiving natural protein cubes gained more weight than cows receiving non-protein nitrogen liquid supplements in trial II. Weber and Vetter (1974) found that average and high levels of natural protein supplements for cows grazing cornstalks gave superior performances over similar levels of urea supplements. Other research (Vetter and Ritter, 1975; Ward and Gilster, 1975) has indicated more efficient use of natural protein than non-protein nitrogen by cows grazing crop residues. Cows in trial IV gained considerably more weight than cows in trial II. If less energy was available to cows in trial II than trial IV, this may be one explanation for the poor utilization of the urea supplements in trial II.

In trial V, total gain was highest for early weaned calves and lowest for calves without creep. This is similar to findings by Peterson et al. (1975) who compared drylot calves with and without access to creep. They found that calves fed creep gained up to 87% faster and theorized that it was due to declining cow milk production while the calf without creep was still not large enough to compete at the feed bunk. This is supported by work by Perry et al. (1974) who compared non-creep fed calves from cows on year-round pasture and cows in drylot. They observed poor performance for drylot calves until they were old enough to compete at the feedbunk. Gains of calves without creep in trial V tended to be lower in late summer, possibly corresponding to a decline in cow milk production. This agrees with research showing a high correlation between calf growth and dam milk production (Furr et al., 1964).

Higher gains for early weaned calves compared to nursing creep fed calves is in agreement with results reported for calves weaned at 170 days (Hinds and Cmarik, 1971), 90 days (Ritchie et al., 1974), 117 days (McCone, 1970) but differs with work by Meiske et al. (1973) with 109 day-old calves. Other research has shown little difference in gain between early weaned and creep fed nursing calves. (McKee et al., 1975a; Self, 1975; Laster et al., 1973).

Early weaned calves consumed more creep (see table 11) than nursing calves. This agrees with results of McCone, (1970) and Meiske et al., (1973). Total dam and calf energy intakes (Mcal DE) per kg calf gain are shown in table 11 and were similar for early weaned and creep fed calves. This is in agreement with results reported by Meiske et al. (1973) and McKee et al. (1975a).

Single implanted and re-implanted calves, when grouped together, gained more weight than non-implanted calves. There were no interactions and no advantage for re-implanting calves over single implanting, though actual mean gains were somewhat higher for re-implanted calves.

Dams of early weaned and creep fed calves gained more weight and condition than dams of non-creep fed calves. Poorer performance of cows whose calves were not creep fed is probably due to higher demands on these cows to meet their calves' nutritional needs. Calves not yet old enough to compete at the bunk had no other feed source. Research has shown that nursing calves raised in drylot consume more creep than calves raised on pasture (McGinty et al., 1973; Brown et al., 1968), which indicates that pasture calves also benefit from forages. Calves with no creep in drylot possibly nurse more often because no other nutrient source is available.

Hereford cows gained more weight and condition than Simmental X Hereford cows. Breed groups were fed according to NRC requirements for weight and lactation ability. As shown by Lusby et al. (1974), dairy breeds require 30% more nutrients than British breeds for calf production and possibly the Simmental X Hereford cows needed higher levels of energy than were fed. The only group losing weight during the test was the Simmental X Hereford cows with non-creep fed calves; the group with possibly the highest energy demands.

Nutritional stress during lactation has been shown to slow return to estrus. More cows with early weaned calves cycled during the first 30 days of the breeding season than dams of creep fed or non-creep fed calves. This agrees with other early weaning results that show a higher and faster percent return to estrus for dams of early weaned calves (Self, 1975; Posey and Smart, 1976; Laster et al., 1973).

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APPENDIX

APPENDIX TABLE 1. ANALYSIS OF VARIANCE FOR COW PERFORMANCE IN TRIAL I.

		Mean square				
Source of Variation	d.f.	53-day Wt gain	83-day Wt gain	53-day Condition change	83-day Condition change	Calf birth wt
Total	101					
Treatment	2	107720.31[b]	43724.76[b]	5.6597[b]	3.2835[b]	488.50
Breed	1	542.37	7774.47	.0955	.0026	1563.54
Breed X treat.	2	118.21	3184.49	.1215	.2157	119.45
Beginning weight	1	9738.14[a]	5543.73[a]	13.2578[b]	4.2855[b]	221.67
Beg. wt. X breed	1	388.46	251.17	.0273	.2945	411.65
Beg. wt. X treat.	2	372.78	94.48	.4307	.5504	294.34
Beginning condition	1	2027.43[a]	2355.71	25.9584[b]	25.5772[b]	24.56
Beg. cond. X breed	1	1043.68	1993.70	.0019	.0204	265.77
Beg. cond. X treat.	2	1986.27	1798.79	.2134	.1961	209.29
Error	88	2027.43	2355.71	.3497	.4664	165.39

[a] $P<.05$

[b] $P<.01$

[c] $P<.06$

APPENDIX TABLE 2. ANALYSIS OF VARIANCE FOR COW PERFORMANCE IN TRIAL II.

Source of Variation	d.f.	Mean square: Wt change	Mean square: Condition change	Mean square: Calf birth wt
Total	62			
Treatment	3	11340.98[b]	1.8540[b]	220.27
Beginning weight	1	3141.34	3.0421[b]	893.56[a]
Beginning condition	1	1387.64	20.4725[b]	58.22
Beg. wt. X treat.	3	1862.61	.1285	29.33
Beg. cond. X treat.	3	1838.47	.1270	744.85[b]
Error	51	2136.14	.3179	138.96

[a]$P<.05$

[b]$P<.01$

APPENDIX TABEL 3. ANALYSIS OF VARIANCE FOR COW PERFORMANCE IN TRIAL III.

Source of Variation	d.f.	Mean Square: Wt change	Mean Square: Condition change
Analysis by Forage Treatments:			
Total	89		
Forage treatment	2	75169.81[b]	11.3781[b]
Breed	1	6024.14[b]	4.2549[b]
Breed X treat.	2	1768.24	.1182
Beginning weight	1	176.46	12.1234[b]
Beg. wt X treat.	2	98.57	.0664
Beginning condition	1	1443.76	23.5228[b]
Beg. cond. X treat.	2	983.89	.2265
Error	78	825.35	.2857
Analysis by Energy Adjustment Treatments:			
Total	89		
Energy treatment	1	12769.20[a]	.0037
Breed	1	2822.17	5.5353[b]
Breed X treat.	1	505.04	.0788
Beginning weight	1	5523.48	22.1047[b]
Beg. wt X treat.	1	2940.17	.3272
Beginning condition	1	8531.46	32.8710[b]
Beg. cond. X treat.	1	5550.83	.8028
Error	82	2574.09	.5650

[a] $P<.05$

[b] $P<.01$

APPENDIX TABLE 4. ANALYSIS OF VARIANCE FOR COW PERFORMANCE IN TRIAL IV.

		Mean Square	
Source of Variation	d.f.	Wt change	Condition change
Total	39		
Treatment	1	13003.93[a]	.1150
Breed	1	38178.59[b]	1.9741[b]
Breed X treat.	1	1885.27	.9898[a]
Beginning weight	1	5077.34	.9196[a]
Beg. wt. X treat.	1	5301.74	.3264
Beginning condition	1	2489.42	1.8792[b]
Beg. cond. X treat.	1	5365.32	.4834
Error	32	1900.54	.2143

[a] $P<.05$

[b] $P<.01$

APPENDIX TABLE 5. ANALYSIS OF VARIANCE FOR CALF PERFORMANCE IN TRIAL V.

Source of Variation	d.f.	Mean Square: Wt gain
Total	124	
Treatment	2	172252.50[b]
Breed	1	6.84
Breed X treat.	2	1010.44
Prev. dam treat.	6	1681.39
Prev. dam X treat.	12	2184.70[a]
Implanting	3	1242.19
Implant X treat.	6	1817.81
Calf age	1	3170.33
Calf age X treat.	2	484.22
Calf age X implant	3	1325.04
Beginning weight	1	26900.65[b]
Beg. wt X treat.	2	2540.94
Error	86	939.90

[a] $P<.05$

[b] $P<.01$

APPENDIX TABLE 6. ANALYSIS OF VARIANCE FOR DAM PERFORMANCE IN TRIAL V.

Source of Variation	d.f.	Mean Square: Wt change	Mean Square: Condition change	Mean Square: % cycling
Total	133			
Treatment	2	28048.15[b]	3.4037[b]	.2809[a]
Breed	1	28027.50[b]	10.8035[b]	.0999
Breed X treat.	2	4440.63	1.2410[a]	.0194
Calf age	1	1014.15	.0370	.6951[b]
Calf age X treat.	2	11577.56[b]	.6832	.2544[a]
Beginning weight	1	146.66	4.1981[b]	.0162
Beg. wt. X treat.	2	7186.04[a]	.4601	.1352
Beginning condition	1	5793.21	11.5842[b]	.6073[b]
Error	121	1805.09	.3200	.0777

[a]P<.05

[b]P<.01

MANAGEMENT SYSTEMS FOR BEEF COWS AND CALVES IN DRYLOT

by

KRIS G. KIMPLE

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Objectives of four maintenance trials for beef cows were: to determine the feeding value of dry harvested milo stover (MSB), milo stover silage (MSS), forage sorghum silage (FSS), and an alfalfa hay-wheat straw mixture (AS) and to measure performance of cows grazing milo stover and supplemented with different sources of protein. Trials I and II were conducted during the winter of 1975-76; trials III and IV, during the winter of 1976-77. A fifth trial during the summer of 1976 studied the effects of various management practices on the performance of calves and dams confined to drylot.

In trial I, one hundred two drylot cows were fed MSB, MSS or FSS in an 83-day trial. Cows were fed to meet NRC maintenance requirements and received .57 kg protein supplement daily. Cows fed FSS gained more weight and condition than cows fed MSB or MSS ($P<.05$). Cows fed MSS lost weight the first 53 days but gained weight the final 30 days when silage intake was increased. Cows fed MSB gained weight the first 53 days but lost weight and condition the final 30 days due to a sharp decline in dry matter intake. Cows fed MSB had lighter calves ($P<.10$) than cows fed MSS or FSS.

In trial II, 63 cows grazed milo stover for 53 days to compare four protein treatments: no protein supplement; .91 kg daily of a 16% natural protein cube supplement; 16% non-protein nitrogen liquid supplement or 18% non-protein nitrogen liquid supplement. Both liquid supplements were fed free-choice. Cows receiving the natural protein cube gained more weight ($P<.05$) than cows receiving either liquid supplement. Cows fed the natural protein cube or no protein lost less condition ($P<.05$) than cows fed liquid supplements.

Ninety drylot cows were fed MSB, MSS or AS for 61 days in trial III. Cows were fed to meet NRC energy requirements but no supplemental protein was fed. One-half of the cows in each forage treatment received additional energy during cold stress conditions. Cows fed MSS or AS gained more weight and condition than cows fed MSB (P<.05). Feeding additional energy during cold stress increased cow weight gains.

In trial IV, 40 cows grazed milo stover for 61 days and received no protein supplement or .91 kg daily of 16% natural protein cube supplement. Cows fed the natural protein cube gained more weight (P<.05) than non-supplemented cows.

In trial V, 125 calves were confined in drylot during a 107-day trial to compare: calves weaned at 50 ($\pm$ 25) days of age (EW); nursing calves receiving a creep (C) and nursing calves with no creep (NC). Within each group, calves were further divided into three subtreatments: implanted with Ralgro once; implanted with Ralgro and re-implanted 60 days later and non-implanted. Total gain was highest for EW calves and lowest for NC calves (P<.05). EW calves consumed twice as much creep as C calves. Implanted calves gained more weight (P<.05) than non-implanted calves but the number of times implanted did not affect gain. Dams of EW and C calves gained more weight and condition than dams of NC calves (P<.05). More dams of EW calves cycled early in the breeding season than dams of C or NC calves (P<.05).