Evaluation of Late Calving during Early May to Late June, and Grazing Perennial Grass Spring and Summer Twice-over Rotation System Pastures from Early May to Mid October

Progress Report of Project Year One

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The concept of changing calving dates from the long established traditional March period was initiated during the years when regional stockman attempted to develop a feedlot-slaughter plant system in the Northern Plains. The value added to finished beef animals was lost to the northern regions by shipping weaned calves and stockers to southern facilities. In order to keep a northern feedlot-slaughter plant system economically viable, regional calves would have needed to be available to enter the feedlots each month. Local cow-calf producers would have needed to adjust their calving dates. Even though the northern beef finishing system was not developed, several beef producers have ventured into, or have contemplated, changing their calving date. Unfortunately there is insufficient scientific data available that documents the positive and negative components involved when calving dates are changed from the regional traditional calving date.

Study Area

This project was conducted at the NDSU Dickinson Research Extension Center ranch located in Dunn county in western North Dakota, USA, at 47° 14' north latitude, 102° 50' west longitude. Mean annual temperature is 42.2° F (5.7° C). January is the coldest month, with a mean temperature of 14.3° F (-9.8° C). July and August are the warmest months, with mean temperatures of 69.6° F (20.9° C) and 68.6° F (20.4° C), respectively. Long-term (1982-2011) mean annual precipitation is 16.96 inches (430.84 mm). The perennial plant growing-season precipitation (April through October) is 14.15 inches (359.41 mm) and is 83.43% of the annual precipitation. June has the greatest monthly precipitation, at 3.24 inches (82.20 mm). The precipitation received during the 3-month period of May, June, and July (8.28 inches, 210.11 mm) accounts for 48.82% of the annual precipitation (Manske 2012). Soils are primarily Typic Haploborolls developed on sedimentary deposits. The fine loamy soils have 5 to 6 tons of organic nitrogen per acre. Native vegetation is the Wheatgrass-Needlegrass Type (Barker and Whitman 1988) of the mixed grass prairie.

Growing Season Precipitation

Growing season precipitation of 2010 was 16.18 inches (114.35% of LTM). April through July precipitation was 109.08% of LTM and August through October precipitation was 125.50% of LTM. Growing season precipitation of 2011 was 17.91 inches (126.57% of LTM). April through July precipitation was 134.26% of LTM and August through October precipitation was 109.62% of LTM. Growing season precipitation of 2012 was 13.63 inches (96.33% of LTM). April through July precipitation was 105.78% of LTM and August through October precipitation was 75.62% of LTM. Mean growing season precipitation of 2010-2012 was 15.90 inches (112.37% of LTM). Mean April through July precipitation was 116.31% of LTM and mean August through October precipitation was 103.58% of LTM (tables 1 and 2).

Water stress develops in perennial plants during water deficiency periods when the amount of rainfall is less than evapotranspiration demand. Water deficiency months were identified from historical temperature and precipitation data by the ombrothermic diagram technique (Emberger et al. 1963). The frequency of water deficiency reoccurrence during April, May, June, and July is 16.7%, 10.0%, 10.0%, and 36.7%, respectively, and during August, September, and October water deficiency reoccurs 53.3%, 56.7%, and 36.7% of the growing seasons, respectively. Long-term occurrence of water deficiency conditions is 32.2% of the growing season months, for a mean of 2.0 water deficient months per growing season (Manske 2012). Water deficiency conditions occurred during August and October in 2010, during October in 2011, and during August and September in 2012.

Procedures

The purpose of this research project is to describe differences in calf weight gain performance and to identify differences in forage costs and returns from pasture weight gains after forage costs that result from differences in early calf birth dates, early March to mid April, and late calf birth dates, early May to late June, for cow-calf pairs grazing perennial grass spring and summer twice-over rotation system pastures from early May to mid October.

The range management grazing research projects conducted at the Dickinson Research Extension Center used black baldy cows with calf birth dates during early March to mid April to graze the spring and summer perennial grass pastures of the twice-over rotation system during the growing seasons of 1983-1998. Lowline X cows composed of 50% lowline and 50% angus and calves with birth dates during early March to mid April were used to graze the same spring and summer perennial grass pastures during the growing seasons of 2010 and 2011. The calf birth dates for the lowline X cows were changed to late season calving during early May to late June in 2012. These lowline X cows and calves with late birth dates were used to graze spring and summer perennial grass pastures of the twice-over rotation system during the growing season of 2012.

The spring complementary crested wheatgrass pastures were grazed from early May to late May for 28 to 31 days. During the summer portion of the grazing season from early June to mid October, three native rangeland pastures were grazed for two periods. During the first period of 45 days, each of the three pastures were grazed for 15 days between 1 June and 15 July (when lead tillers of grasses were between the 3.5 new leaf stage and the flower stage). During the second period of 90 days, each of the three pastures were grazed a second time for 30 days after 15 July and prior to mid October. The spring and summer perennial grass pastures were grazed during early May to mid October for 163 to 168 days. The spring and summer pasture system of the twice-over rotation grazing strategy had two replications.

Forage costs were determined by the average pasture land rent per acre from western North Dakota at $8.76 per acre and the land area in acres needed to feed a cow and calf during the grazing period. Forage cost per day was determined by dividing the total forage cost by the number of days on pasture. Dollar value of calf pasture weight gain was determined from the accumulated calf weight gain which was the difference of the calf live weight at the beginning of the growth period from the calf live weight at the end of the growth period. The calf accumulated pasture weight gain was multiplied by an assumed market value of $1.25 per pound. Net return after forage costs per cow-calf pair was determined by subtracting the forage costs from the dollar value of calf pasture weight gain. Net return after forage costs per acre was determined by dividing the net return per cow-calf pair by the land area in acres needed per cow-calf pair. Net return per 640 acres was determined by multiplying the net return per acre by 640 acres. Cost per pound of calf pasture weight gain was determined by dividing the forage costs by the pounds of accumulated calf weight. Calf weaning weight as a percentage of cow weight was determined by dividing the average calf weaning weight by the average cow weight at weaning.

Calf pasture weight gains, pasture forage costs, and net returns from pasture weight gains after forage costs were determined for the lowline X calves born in 2012 with late birth dates during early May to late June, for the lowline X calves born in 2010 and 2011 with early birth dates during early March to mid April, and for the black baldy calves born during 1983 to 1998 with early birth dates during early March to mid April.

Results

Weight Gains Compared

Pasture weight gains of lowline X calves with late birth dates (2012) were compared to that of lowline X calves with early birth dates (2010) grazing the spring complementary crested wheatgrass pastures, and the 1st and 2nd rotation periods on the three native rangeland pastures (table 3).

The mean calf weight gain on the crested wheatgrass pastures for the lowline X calves with early birth dates was 1.79 lbs per day and 41.14 lbs per acre; accumulated pasture weight gain was 50.09 lbs. The mean calf weight gain on the crested wheatgrass pastures for the lowline X calves with late birth dates was 0.75 lbs per day and 23.32 lbs per acre; accumulated pasture weight gain was 28.39 lbs. The weight gain for the lowline X calves with late birth dates was 58.10% lower per day, 43.32% lower per acre, and with 43.32% lower accumulated weight gain than that of the lowline X calves with early birth dates grazing the crested wheatgrass pastures (table 3)

The mean calf weight gain on the native rangeland pastures during the 1st rotation period for the lowline X calves with early birth dates was 2.62 lbs per day and 11.30 lbs per acre; accumulated pasture weight gain was 115.50 lbs. The mean calf weight gain on the native rangeland pastures during the 1st rotation period for the lowline X calves with late birth dates was 2.28 lbs per day and 9.39 lbs per acre; accumulated pasture weight gain was 95.95 lbs. The weight gain for the lowline X calves with late birth dates was 12.98% lower per day, 16.90% lower per acre, and with 16.93% lower accumulated weight gain than that of the lowline X calves with early birth dates grazing the native rangeland pastures during the 1st rotation (table 3).

The mean calf weight gain on the native rangeland pastures during the 2nd rotation period for the lowline X calves with early birth dates was 2.39 lbs per day and 21.49 lbs per acre; accumulated pasture weight gain was 219.57 lbs. The mean calf weight gain on the native rangeland pastures during the 2nd rotation period for the lowline X calves with late birth dates was 2.04 lbs per day and 17.97 lbs per acre; accumulated pasture weight gain was 183.61 lbs. The weight gain for the lowline X calves with late birth dates was 14.64% lower per day, 16.38% lower per acre, and with 16.38% lower accumulated weight gain than that of the lowline X calves with early birth dates grazing the native rangeland pastures during the 2nd rotation (table 3).

The calf weight gain on the native rangeland pastures during both the 1st and 2nd rotation periods for the lowline X calves with late birth dates was 13.82% lower per day, 16.56% lower per acre, and with 16.56% lower accumulated weight gain than that of the lowline X calves with early birth dates (table 3).

The calf weight gain on the spring and summer pastures during the total season for the lowline X calves with late birth dates was 22.98% lower per day, 20.05% lower per acre, and with 20.04% lower accumulated weight gain than the lowline X calves with early birth dates (table 3).

The lowline X calves with late birth dates did not perform as well as the lowline X calves with early birth dates. The lowline X cows and calves with late birth dates did not receive the typical benefits from grazing crested wheatgrass pastures with month old or older calves during May. As a result, the cows were unable to achieve their genetic potential milk production throughout the entire grazing season. The lowline X cows with calves that had late birth dates had reduced conception rates; of the exposed cows, 2% were open at the end of the 2012 breeding season. The calves were unable to achieve their genetic potential rates of weight gain on the crested wheatgrass pastures and on the three twice-over rotation native rangeland pastures. The weaning weight of the lowline X calves with late birth dates was 29.75% lower than the weaning weight of the lowline X calves with early birth dates (table 3). The potential calf weight not accumulated when available perennial forage plants have adequate nutrient quality are lost opportunities to capture wealth from the land resources and can never be recovered.

Early and Late Birth Dates Compared

The spring and summer twice-over rotation system pastures were grazed for 164 days from early May to mid October by lowline X cow-calf pairs with early birth dates from early March to mid April during 2010 and 2011. A cow-calf pair was allotted 11.44 acres for the production period; at a pasture rent value of $8.76 per acre, the forage cost was $100.21 per period, or $0.61 per day. The mean calf weight gain was 2.35 lbs per day and 33.69 lbs per acre; accumulated pasture weight gain was 385.40 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $481.75 per calf, and the net returns after pasture costs were $381.54 per cow-calf pair and $33.35 per acre. The net return after pastures costs on 640 acres was $21,344.00. The cost of calf weight gain was $0.26 per pound. The mean calf weaning weight was 543.33 pounds and was 51.12% of the mean cow weight (table 4).

The spring and summer twice-over rotation system pastures were grazed for 168 days from early May to mid October by black baldy cow-calf pairs with early birth dates from early March to mid April during 1983 to 1998. A cow-calf pair was allotted 13.15 acres for the production period; at a pasture rent value of $8.76 per acre, the forage cost was $115.19 per period, or $0.69 per day. The mean calf weight gain was 2.20 lbs per day and 28.16 lbs per acre; accumulated pasture weight gain was 370.35 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $462.94 per calf, and the net returns after pasture costs were $347.75 per cow-calf pair and $26.44 per acre. The net return after pastures costs on 640 acres was $16,925.00. The cost of calf weight gain was $0.31 per pound. The mean calf weaning weight was 619.49 pounds and was 48.39% of the mean cow weight (table 4).

The spring and summer twice-over rotation system pastures were grazed for 170 days from early May to mid October by lowline X cow-calf pairs with late birth dates from early May to late June during 2012. A cow-calf pair was allotted 11.44 acres for the production period; at a pasture rent value of $8.76 per acre, the forage cost was $100.21 per period, or $0.59 per day. The mean calf weight gain was 1.81 lbs per day and 26.92 lbs per acre; accumulated pasture weight gain was 307.95 lbs. When calf accumulated weight was assumed to have a value of $1.25 per pound, the gross return was $384.94 per calf, and the net returns after pasture costs were $284.73 per cow-calf pair and $24.89 per acre. The net return after pastures costs on 640 acres was $15,929.00. The cost of calf weight gain was $0.33 per pound. The mean calf weaning weight was 380.07 pounds and was 35.45% of the mean cow weight (table 4).

The performance of the lowline X calves with early birth dates (2010-2011) was greater than the performance of the black baldy calves with early birth dates (1983-1998) and greater than the performance of the lowline X calves with late birth dates (2012) (table 4).

The mean pasture weight gain of the lowline X calves with early birth dates was 6.82% greater per day, 19.64% greater per acre, and with 4.06% greater accumulated weight gain than that of the black baldy calves with early birth dates. The net returns after pasture costs of the lowline X calves with early birth dates was 9.72% greater per cow-calf pair, 26.13% greater per acre, and 26.11% greater per 640 acres than that of the black baldy calves with early birth dates (table 4).

The mean pasture weight gain of the lowline X calves with early birth dates was 29.83% greater per day, 25.15% greater per acre, and with 25.15% greater accumulated weight gain than that of the lowline X calves with late birth dates. The net returns after pasture costs of the lowline X calves with early birth dates was 34.00% greater per cow-calf pair, 33.99% greater per acre, and 33.99% greater per 640 acres than that of the lowline X calves with late birth dates (table 4).

The mean pasture weight gain of the black baldy calves with early birth dates was 21.55% greater per day, 4.61% greater per acre, and with 20.26% greater accumulated weight gain than that of the lowline X calves with late birth dates. The net returns after pasture costs of the black baldy calves with early birth dates was 22.13% greater per cow-calf pair, 6.23% greater per acre, and 6.25% greater per 640 acres than that of the lowline X calves with late birth dates (table 4).

The lowline X calves with early birth dates performance was greater than that of the black baldy calves with early birth dates primarily because the lowline X cows were smaller in size and required fewer acres of pasture forage during the production period than the black baldy cows. The smaller lowline X cows and their calves with early birth dates produced closer to their genetic potential levels than the larger black baldy cows and their calves with early birth dates as shown by the greater weight gain per day and the greater percent of cow weight produced as calf weaning weight by the lowline X cows and calves with early birth dates (table 4).

The lowline X calves with late birth dates performed poorly because the lowline X cows were unable to achieve their genetic potential milk production and the lowline X calves were unable to achieve their genetic potential rates of weight gain during the entire grazing season. The poor animal performance of the lowline X cows and calves resulting from late birth dates cost this beef producer $8.46 per acre and $96.81 per cow-calf pair during one (170 day) grazing season (table 4).

Three Birth Date Periods Compared

The calving periods for the lowline X cattle were separated into three birth date categories: 1st period, 2nd period, and 3rd period calves. The performance of the lowline X calves with early birth dates born during the 2nd period was greater than that of calves born during the 1st and 3rd periods in 2010 and 2011. The performance of the lowline X calves with late birth dates born during the 1st period was greater than that of calves born during the 2nd and 3rd periods in 2012, and the performance of the calves born during the 2nd period was greater than that of the calves born during the 3rd period in 2012.

The mean pasture weight gain of the lowline X calves with early birth dates in 2010 born during the 2nd period was 11.01% greater per day, 11.03% greater per acre, and with 11.02% greater accumulated weight gain than that of the lowline X calves born during the 1st period in 2010. The net returns after pasture costs of the lowline X calves born during the 2nd period in 2010 was 14.04% greater per cow-calf pair, 14.02% greater per acre, and 14.02% greater per 640 acres than that of the lowline X calves born during the 1st period in 2010 (table 5).

The mean pasture weight gain of the lowline X calves with early birth dates in 2010 born during the 2nd period was 13.00% greater per day, 13.00% greater per acre, and with 13.00% greater accumulated weight gain than that of the lowline X calves born during the 3rd period in 2010. The net returns after pasture costs of the lowline X calves born during the 2nd period in 2010 was 16.64% greater per cow-calf pair, 16.65% greater per acre, and 16.65% greater per 640 acres than that of the lowline X calves born during the 3rd period in 2010 (table 5).

The mean pasture weight gain of the lowline X calves with early birth dates in 2011 born during the 2nd period was 2.24% greater per day, 2.11% greater per acre, and with 2.22% greater accumulated weight gain than that of the lowline X calves born during the 1st period in 2011. The net returns after pasture costs of the lowline X calves born during the 2nd period in 2011 was 2.82% greater per cow-calf pair, 2.81% greater per acre, and 2.82% greater per 640 acres than that of the lowline X calves born during the 1st period in 2011 (table 6).

The mean pasture weight gain of the lowline X calves with early birth dates in 2011 born during the 2nd period was 4.03% greater per day, 3.86% greater per acre, and with 4.01% greater accumulated weight gain than that of the lowline X calves born during the 3rd period in 2011. The net returns after pasture costs of the lowline X calves born during the 2nd period in 2011 was 5.11% greater per cow-calf pair, 5.11% greater per acre, and 5.11% greater per 640 acres than that of the lowline X calves born during the 3rd period in 2011 (table 6).

The performance of the lowline X calves with early birth dates in 2010 and 2011 was greater for the calves born during the 2nd period. The lowline X calves born during the 3rd period in 2010 and 2011 performed at levels behind that of the lowline X calves born during the 2nd and 1st periods in 2010 and 2011. The lowline X calves born during the 3rd period usually were younger than one month old when grazing on crested wheatgrass pastures was started in early May. The younger calves born during the 3rd period never caught up to the greater rates of weight gain of the calves born during the 2nd and 1st periods that were older than one month of age at the start of grazing crested wheatgrass pastures in early May (tables 5 and 6).

The calving season of the lowline X cows with calves that had late birth dates in 2012 was 8% longer than the calving seasons of the lowline X cows with calves that had early birth dates in 2010 and 2011. The mean pasture weight gain of the lowline X calves with late birth dates in 2012 born during the 1st period was 2.61% greater per day, 2.72% greater per acre, and with 2.59% greater accumulated weight gain than that of the lowline X calves born during the 2nd period in 2012. The net returns after pasture costs of the lowline X calves born during the 1st period in 2012 was 3.51% greater per cow-calf pair, 3.49% greater per acre, and 3.49% greater per 640 acres than that of the lowline X calves born during the 2nd period in 2012 (table 7).

The mean pasture weight gain of the lowline X calves with late birth dates in 2012 born during the 1st period was 15.48% greater per day, 15.24% greater per acre, and with 15.49% greater accumulated weight gain than that of the lowline X calves born during the 3rd period in 2012. The net returns after pasture costs of the lowline X calves born during the 1st period was 21.73% greater per cow-calf pair, 21.74% greater per acre, and 21.73% greater per 640 acres than that of the lowline X calves born during the 3rd period in 2012 (table 7).

The mean pasture weight gain of the lowline X calves with late birth dates in 2012 born during the 2nd period was 12.20% greater per day, 12.57% greater per acre, and with 12.54% greater accumulated weight gain than that of the lowline X calves born during the 3rd period in 2012. The net returns after pasture costs of the lowline X calves born during the 2nd period was 17.60% greater per cow-calf pair, 17.63% greater per acre, and 17.63% greater per 640 acres than that of the lowline X calves born during the 3rd period in 2012 (table 7).

The performance of the lowline X calves with late birth dates in 2012 was greater for the calves born during the 1st period. The performance of the calves born during the 2nd period was slightly behind that of the calves born during the 1st period. The performance of the calves born during the 3rd period in 2012 was considerably below that of the calves born during the 1st and 2nd periods in 2012. The poor animal performance of the lowline X cows and calves resulting from the late birth dates of the 3rd period cost this beef producer $11.68 per acre and $133.62 per cow-calf pair during one (170 day) grazing season. With a one hundred cow herd with early birth dates, the net return after forage costs would be $38,154.00, and with a one hundred cow herd with late birth dates during the 3rd period, the net return after forage costs would be

$24,722.00 resulting in a loss of $13,362.00 for the herd with late birth dates.

The lowline X cows and calves with early birth dates during the 2nd and 1st periods (end of February to late March) in 2010 and 2011 performed well. The cows produced milk at or near their genetic potential levels and these calves accumulated weight at or near their genetic potential rates. The calves with early birth dates during the 2nd and 1st periods were older than one month of age at the start of grazing the crested wheatgrass pastures in early May.

The lowline X cows and calves with early birth dates during the 3rd period (end of March to the last third of April) in 2010 and 2011 performed at reduced levels below their genetic potentials. The calves with early birth dates during the 3rd period were younger than one month of age at the start of grazing the crested wheatgrass pastures in early May.

The lowline X cows and calves with late birth dates during the 1st and 2nd periods (early May to late May) in 2012 performed at greatly reduced levels much below their genetic potentials. The calves with late birth dates during the 1st and 2nd periods were born after the start of grazing crested wheatgrass pastures in early May.

The lowline X cows and calves with late birth dates during the 3rd period (early June to the last third of June) in 2012 performed poorly at severely reduced levels way below their genetic potentials. The calves with late birth dates during the 3rd period were born after the start of grazing the twice-over rotation system native rangeland pastures.

Discussion

Beef livestock agriculture has high production costs and low profit margins because modern high-performance cattle are still being fed with old-style traditional type forage management practices as a direct result from the common assumption that beef weight is the source of income and forage feed is an expense. Beef producers have transformed old-style, low performance cattle into high-performance, fast-growing meat animals with improved genetic potential and increased nutrient demands. Modern, high-performance cattle are larger and heavier, gain weight more rapidly, produce more milk, and deposit less fat on their bodies than old-style cattle. However, the beef production industry has not similarly improved the efficiency and production of forage feed management systems for brood cows. The asymmetrical mismatch between the quantity of forage nutrients required by modern, high-performance cows and the quantity of forage nutrients provided from traditional forage management practices perpetuates the problems with both modern cattle performance and grassland ecosystem productivity to remain at less than potential levels (Manske and Schneider 2008b).

Modern high-performance beef cattle produce at their genetic potentials when their nutrient requirements are met each day (Manske and Schneider 2007). Perennial grassland ecosystems produce at potential levels when the biological requirements of the plants and soil organisms are met (Manske 2011b). The renewable forage plant nutrients produced on the land natural resources are the original source of new wealth generated by beef livestock agriculture (Manske and Schneider 2008b).

The nutrient requirements for beef cows above maintenance levels varies with the changes in nutrient demand from milk production for the nursing calf as it grows and with the changes in nutrient demand of the physiological preparation for breeding and the development of the fetus that will be the next calf (BCRC 1999).

The annual nutritional quality curves of available perennial forage plants change with the development of the phenological growth stages. Plant growth is triggered by changes in day length (photoperiod). Domesticated grasses are physiologically ready for grazing in early May and they have the highest levels of crude protein during May. Native cool-season grasses are physiologically ready for grazing in early June and they have adequate levels of crude protein from early June to the middle of July. Native warm-season grasses are physiologically ready for grazing in mid June and they have adequate levels of crude protein from June to late July (Whitman et al. 1951, Manske 2008a, 2011a). Adequate crude protein levels from native cool-season and warm-season grasses can be extended to late September or mid October by stimulation of vegetative tillers during the period of early June to mid July (Manske 2011b).

The nutritional quality curves of available perennial grasses cannot be changed. The time of year during which the cow production periods with different nutritional requirements occur can be changed and synchronized with the nutritional quality curves of the perennial grasses by rationally setting the calving date which is determined by the breeding date. The nutritional quality curves of the common domesticated grasses and the native rangeland grasses in the Northern Plains match the nutritional requirement curves of the spring and summer lactation production periods of cows with calving dates during January through March (Manske 2002, 2008a).

The nutrients are the valuable products produced by forage plants on the land. The cow processes the forage nutrients and produces milk resulting in calf weight accumulation. The calf weight is the commodity sold at the market, nevertheless, the original source of the income from the sale of beef weight is the forage nutrients. The renewable forage nutrients are the primary unit of production in a beef operation, and they are the source of new wealth from agricultural use of grazingland and hayland resources (Manske and Schneider 2007).

The quantity of new wealth generated from agricultural use of land resources is limited by the biological capacity of the forage plants to produce herbage and nutrients from soil, sunlight, water, and carbon dioxide and by the effectiveness of management treatments in capturing value from plant production. Increasing value captured from the land requires using biologically effective forage management strategies that place priority on plant health and stimulate ecological biogeochemical processes, enhance vegetative plant growth, capture a high proportion of the produced nutrients, and efficiently convert these nutrients into saleable commodities such as calf weight (Manske and Schneider 2007).

The quantity of crude protein captured per acre as livestock feed is the factor that has the greatest influence on the costs of pasture forage and harvested forage and on the amount of new wealth generated from the land resources. The weight of crude protein captured per acre is related to the percent crude protein content and the weight of the forage dry matter at the time of grazing or haying. The cost per pound of crude protein is determined by the weight of the crude protein captured per acre prorated against the forage production costs which include the land costs, equipments costs, and labor costs per acre. Reductions in livestock feed costs result from capturing greater quantities of crude protein per acre. Capturing greater quantities of the produced crude protein from a land base causes reduction in the amount of land area required to feed a cow-calf pair and results in lowering the forage feed costs because the forage production costs per acre are spread over a greater number of pounds of crude protein (Manske and Schneider 2007).

The nutritional quality curves of the domesticated perennial grasses and the native rangeland perennial grasses in the Northern Plains are not synchronized with the nutritional requirement curves of the production periods of cows with calving dates during the perennial grass growing season, April through October (Manske 2002). When the nutrient quality curves of the available perennial forage grasses and nutrient requirement curves of beef cows are not synchronized, modern high-performance beef cattle do not produce at genetic potentials, perennial grassland ecosystems do not produce at biogeochemical potentials, and new wealth captured from forage plant nutrients through beef weight gain is not generated at potential levels. Forage nutrients from sources other than perennial grasses is required to provide low-cost feed for beef cows with calving dates during April through October (Manske 2002).

Lower forage feed costs and greater net returns after forage costs are largely determined by the biological effectiveness of meeting the plant and soil organism requirements, the efficiency of crude protein capture per acre, and the efficiency at conversion of forage crude protein into a saleable product like calf weight resulting from biologically effective forage management strategies that have the nutrient requirement curves of cow production periods synchronized with the nutrient quality curves of the available perennial forage grasses (Manske and Schneider 2007).

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Table 1. Precipitation in inches for growing season months of 2010-2012, DREC Ranch, North Dakota.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Growing Season
Long-term mean	1.41	2.60	3.24	2.44	1.73	1.46	1.28	14.15
2010	1.43	3.70	3.50	1.94	1.39	4.09	0.13	16.18
% of LTM	101.42	142.31	108.02	79.51	80.35	280.14	10.16	114.35
2011	1.66	6.87	2.15	2.33	2.70	1.76	0.44	17.91
% of LTM	117.73	264.23	66.36	95.49	156.07	120.55	34.38	126.57
2012	2.38	1.58	4.31	1.98	0.82	0.21	2.35	13.63
% of LTM	168.79	60.77	133.02	81.15	47.40	14.38	183.59	96.33
Mean	1.82	4.05	3.32	2.08	1.64	2.02	0.97	15.90
% of LTM	129.31	155.77	102.47	85.38	94.61	138.36	76.04	112.37

Table 2. Running total precipitation in inches for growing season months of 2010-2012, DREC Ranch, North Dakota.

	Apr	May	Jun	Jul	Aug	Sep	Oct
Long-term mean 1982-2011	1.41	4.01	7.25	9.69	11.42	12.88	14.15
2010	1.43	5.13	8.63	10.57	11.96	16.05	16.18
% of LTM	101.42	127.93	119.03	109.08	104.73	124.61	114.35
2011	1.66	8.53	10.68	13.01	15.71	17.47	17.91
% of LTM	117.73	212.72	147.31	134.26	137.57	135.64	126.57
2012	2.38	3.96	8.27	10.25	11.07	11.28	13.63
% of LTM	168.79	98.75	114.07	105.78	96.94	87.58	96.33
Mean	1.82	5.87	9.19	11.28	12.91	14.93	15.90
% of LTM	129.31	146.47	126.80	116.37	113.08	115.94	112.37

Table 3. Weight gain in pounds for lowline X calves, with calf birth during early March to mid April, 2010; and early May to late June, 2012; grazing spring and summer twice-over rotation system pastures, from early May to mid October, 2010 and 2012.

		Crested Wheatgrass	Native Rangeland 1st Rotation	Native Rangeland 2nd Rotation	Total Native	Total Season	Weaning Weight
Period Grazed		E. to L. May	E. Jun to M. Jul	M. Jul to M. Oct	E. Jun to M. Oct	E. May to M. Oct	
2010							
Weight Gain	lbs	50.09	115.50	219.57	335.07	385.15	541.04
Gain/Day	lbs	1.79	2.62	2.39	2.46	2.35	
Gain/Acre	lbs	41.14	11.30	21.49	32.79	33.67	
2012							
Weight Gain	lbs	28.39	95.95	183.61	279.57	307.95	380.07
Gain/Day	lbs	0.75	2.28	2.04	2.12	1.81	
Gain/Acre	lbs	23.32	9.39	17.97	27.36	26.92	
Difference							
Weight Gain	lbs	-21.70	-19.55	-35.96	-55.50	-77.20	-160.97
	%	-43.32	-16.93	-16.38	-16.56	-20.04	-29.75
Gain/Day	lbs	-1.04	-0.34	-0.35	-0.34	-0.54	
	%	-58.10	-12.98	-14.64	-13.82	-22.98	
Gain/Acre	lbs	-17.82	-1.91	-3.52	-5.43	-6.75	
	%	-43.32	-16.90	-16.38	-16.56	-20.05	

Table 4. Weight gain, costs, and net returns for baldy and lowline X calves with early or late birth date categories grazing spring and summer twice-over rotation system pastures, from early May to mid October.

Years		Black Baldy 1983 to 1998	Lowline X 2010 to 2011	Lowline X 2012
Calf Birth Dates		Early Mar to Mid Apr	Early Mar to Mid Apr	Early May to Late Jun
Land Rent	$	8.76	8.76	8.76
Land Area	ac	13.15	11.44	11.44
Forage Costs	$	115.19	100.21	100.21
Days on Pasture		168.00	164.00	170.00
Cost/Day	$	0.69	0.61	0.59
Calf Wt				
Pasture Gain	lbs	370.35	385.40	307.95
Gain/Day	lbs	2.20	2.35	1.81
Gain/Acre	lbs	28.16	33.69	26.92
Wt Value@$1.25/lb		462.94	481.75	384.94
Net Return/Cow	$	347.75	381.54	284.73
Net Return/Acre	$	26.44	33.35	24.89
Cost/lb Gain	$	0.31	0.26	0.33
Weaning Wt	lbs	619.49	543.33	380.07
% Cow Wt		48.39	51.12	35.45
C-Cprs/640 ac		49	56	56
Net Return/640 ac	$	16,925.00	21,344.00	15,929.00

Table 5. Weight gain, costs, and net returns for lowline X calves with three early birth date categories grazing spring and summer twice-over rotation system pastures, from early May to mid October, 2010.

Calf Birth Dates 2010		01 Mar to 15 Mar (15 days)	16 Mar to 30 Mar (15 days)	31 Mar to 19 Apr (20 days)	01 Mar to 19 Apr (50 days)
Birth Weight	lbs				
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	11.44	11.44
Forage Costs	$	100.21	100.21	100.21	100.21
Days on Pasture		164.00	164.00	164.00	164.00
Cost/Day	$	0.61	0.61	0.61	0.61
Calf Wt					
Pasture Gain	lbs	372.53	413.57	366.00	385. 15
Gain/Day	lbs	2.27	2.52	2.23	2.35
Gain/Acre	lbs	32.56	36.15	31.99	33.67
Wt Value@$1.25/lb		465.66	516.96	457.50	481.44
Net Return/Cow	$	365.45	416.75	357.29	381.23
Net Return/Acre	$	31.95	36.43	31.23	33.32
Cost/lb Gain	$	0.27	0.24	0.27	0.26
Weaning Wt	lbs	540.42	589.57	489.69	541.04
% Cow Wt		53.14	57.97	48.15	53.20
C-Cprs/640 ac		56	56	56	56
Net Return/640 ac	$	20,448.00	23,315.00	19,987.00	21,325.00

Table 6. Weight gain, costs, and net returns for lowline X calves with three early birth date categories grazing spring and summer twice-over rotation system pastures, from early May to mid October, 2011.

Calf Birth Dates 2011		26 Feb to 11 Mar (15 days)	12 Mar to 25 Mar (14 days)	26 Mar to 15 Apr (21 days)	26 Feb to 15 Apr (50 days)
Birth Weight	lbs	69.11	69.47	71.40	69.76
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	11.44	11.44
Forage Costs	$	100.21	100.21	100.21	100.21
Days on Pasture		163.00	163.00	163.00	163.00
Cost/Day	$	0.61	0.61	0.61	0.61
Calf Wt					
Pasture Gain	lbs	385.84	394.47	379.20	387.62
Gain/Day	lbs	2.37	2.42	2.33	2.38
Gain/Acre	lbs	33.73	34.48	33.15	33.88
Wt Value@$1.25/lb		482.30	493.09	474.00	484.53
Net Return/Cow	$	382.09	392.88	373.79	384.32
Net Return/Acre	$	33.40	34.34	32.67	33.59
Cost/lb Gain	$	0.26	0.25	0.26	0.26
Weaning Wt	lbs	558.17	557.76	502.40	545.62
% Cow Wt		50.35	50.31	45.32	49.62
C-Cprs/640 ac		56	56	56	56
Net Return/640 ac	$	21,376.00	21,978.00	20,909.00	21,498.00

Table 7. Weight gain, costs, and net returns for lowline X calves with three late birth date categories grazing spring and summer twice-over rotation system pastures, from early May to mid October, 2012.

Calf Birth Dates 2012		01 May to 16 May (16 days)	17 May to 31 May (15 days)	1 Jun to 23 Jun (23 days)	01 May to 23 Jun (54 days)
Birth Weight	lbs	64.60	76.85	76.00	75.22
Land Rent	$	8.76	8.76	8.76	8.76
Land Area	ac	11.44	11.44	11.44	11.44
Forage Costs	$	100.21	100.21	100.21	100.21
Days on Pasture		170.00	170.00	170.00	170.00
Cost/Day	$	0.59	0.59	0.59	0.59
Calf Wt					
Pasture Gain	lbs	321.60	313.41	278.50	307.95
Gain/Day	lbs	1.89	1.84	1.64	1.81
Gain/Acre	lbs	28.11	27.40	24.34	26.92
Wt Value@$1.25/lb		402.00	391.76	348.13	384.94
Net Return/Cow	$	301.79	291.55	247.92	284.73
Net Return/Acre	$	26.38	25.49	21.67	24.89
Cost/lb Gain	$	0.31	0.32	0.36	0.33
Weaning Wt	lbs	388.20	390.26	354.50	380.07
% Cow Wt		36.21	36.40	33.06	35.45
C-Cprs/640 ac		56	56	56	56
Net Return/640 ac	$	16,883.00	16,314.00	13,869.00	15,929.00

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