GRAZING HOLSTEIN STEERS: AN ALTERNATIVE TO THE CALF-FED MODEL

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Introduction

In California, Pennsylvania, Wisconsin, and other states where the dairy industry is a large segment of the agricultural economy, dairy bull calves offer an alternative enterprise with a variety of options. These enterprises include and are not limited to rearing wet calves to light feeders weighing 275-350 lbs, taking wet calves to heavier feeder weights on either a high grain or roughage program to approximately 500 lb or even heavier to 750 lb, or young lightweight Holstein steers may be fed high concentrate rations from weaning to slaughter with this style of management being dominant in the Southwest and gaining popularity in the Midwest. Traditionally dairy producers have capitalized on feed refusals as a low cost diet ingredient for their dairy steers resulting in low costs of gain and often heavy unfinished steers. Holstein steers at harvest can be calf-fed or yearlings as market opportunities exist for both animals given they are finished appropriately to meet the buyers specification.

In 1953, McCormick and Kidwell reported their observations from 19 Holstein steers that were offered hay and pasture only from 400-1200 pounds. These steers were slaughtered at 2 years of age, gained on average 1.83 lb/d and consumed 11.3 lbs of hay per pound of liveweight gain. Carcasses "graded well" with heavier carcasses being more desirable and yielding better according to the authors. It was during this time frame that other institutions were investigating the use of dairy breeds for beef production with much of this information in station reports with early research work investigating Holstein steers reported as far back as the early 1920's (Bohstedt, 1922). In 1959, Ohio researchers released a summary of research projects investigating rearing systems and carcass traits of dairy steers (Hibbs et al., 1959). The investigators reported on the Ohio High Roughage System developed in 1957. This work illustrated that dairy steers could be grown from birth to six months of age (390-460 lb) using approximately 70% roughage as high quality hay and 30% grain mixture. The grain intake was limited to not more than four pounds which resulted in average daily gains of 1.5-1.75 lb/d from birth to six months. The utilization of the Holstein steer as a meat animal remains today with an estimated proportion of the current fed cattle kill near 6-8% (Schaefer, 2005).

Often overlooked, many dairy steers find their way to stocker or grazing operations. Utilizing previous data, Ainslie et al. (1992) reported the projected profitability of feeding Holstein steers depended upon interactions of animal performance, opportunity value of the forage, and non-feed costs. In all scenarios investigated in which no opportunity cost was assigned to pasture, grazing Holstein steers before finishing returned the greatest profit during the growing phase and over the entire production period. As product consistency concerns from retailers and packers arise, competition from urbanization increases value of pasture land, and availability of low cost, high energy feed ingredients increases, the economics of grazing Holstein steers may change. It is therefore important to have knowledge of the observed performance levels of grazing Holstein steers in order to better assess potential profitability of a system utilizing pasture as part of the growing phase.

The expected performance of grazing Holstein steers will vary depending upon a variety of factors. Some these factors may include the grazing system, forage type, level and form of supplementation as well as utilization of implants. These issues will be discussed briefly as they relate to the Holstein steer.

Grazing Systems

Various managed grazing systems have been proposed for over a century (Smith, 1895). A vast amount of research has been conducted comparing intensive management systems to continuous yearlong grazing. The majority of the research focused on intensively grazing the standing crop in order to maximize utilization. Determining the correct length of rest required by the forage to maintain persistency and yields while increasing returns per unit of land has been of great interest to the grazing community.

The conventional grazing system involves grazing the same area of land year round. The stocking rate or animals per unit of land generally does not exceed that required by the animals during the slowest growing phase of the forage or summer slump for cool season forages in the upper Midwest. This practice is commonly referred to as continuous grazing. In general, the disadvantage associated with such a system is the inefficient use of the forage during periods of rapid growth. In order to combat this, many producers will mechanically harvest a portion of the grazing land. The major advantage is the low inputs (both labor and material). This system is well suited for areas in which rainfall, soil fertility, and other environmental factors are unfavorable to support high forage productivity.

The Merrill system employs the use of four pastures and three herds allowing for 12 months of grazing and four months of rest for each pasture (Merrill, 1954). This system has been modified in which a single herd is used in a four pasture system. Cattle are moved to a new pasture after a set amount of time allowing rest periods for forage regrowth in the previously grazed areas. This system has evolved to which a given land area is divided into several equal units or paddocks. Animals graze a paddock until the standing crop is below that necessary to maintain the animals and yet leaving ample leaf area for photosynthesis to occur promoting plant regrowth. Animals are then moved into a different paddock and the previous paddock is allowed to rest for a given period of time. The length of the rest period is dependent upon the number of paddocks present, forage productivity and stocking rate.

Savory and Parson (1980) introduced the concept of short duration grazing in which several paddocks are established by subdividing a pasture and animals are moved every few days allowing for 30 or more days of rest. Voison's concept of "rational" grazing utilizes similar practices as Savory and Parson, however, it is made clear that the rest period required for forage regrowth is dependent upon several factors. He further implies that the rest period is much greater during the summer when compared with the spring and that there is not a static number of days for pasture rest that can be used all year long. This type of grazing system is typically referred to as rotational grazing. In the recent years it has gone by the acronym MiG for Managed intensive Grazing. The major advantages of an intense grazing system are enhanced forage utilization via less loss to trampling and senescence (Stuth et al., 1981), more even or uniform grazing, and increased carrying capacity of 25 – 100% (Merrill, 1954; Savory and Parsons, 1980).

Animal Performance with Respect to Grazing System

The most commonly observed response with rotational grazing is increased animal production per land unit. This increased production may be derived from an increase in animal performance and/or increased stocking rate. Heitschmidt and co-workers (1990) investigated the response of cattle production when animals were continuously, rotationally or deferred rotationally grazed. No differences were observed between treatments for gain over the season-long study while production per hectare was greater in rotational pastures. In another study conducted by these researchers (Heitschmidt 1982a), no improvement in average daily gain for heifers grazing under short duration or continuous management systems was noted. Their data revealed similar weaned calf crop and production per cow between the rotational and continuous systems while the production per land unit was significantly greater for the rotational system. This difference in land productivity was largely due to stocking rate as the short duration treatments were twice that of the continuous. This is supported by Chestnut et al. (1992) in which average daily gain of cows and calves were similar for animals grazing endophyte-free tall fescue-clover mix pastures under rotational or continuous management. Cow average daily gains were 0.62 and 0.64 lb for continuous and rotational systems, respectively. Calf gains were not different for either system averaging 1.86 lb/d. Similar trials have shown increased production per land unit with little to no impact on individual animal performance (Heitschmidt et al., 1982b; Hoveland et al., 1997; Bertelsen et al., 1993; Warner and Sharrow, 1984).

Stocking rate did not alter animal gains of animals grazing in a continuous or rotationally grazed system over a six year trial reported by Hart et al. (1988). This lack of response to stocking rate does not always exist, however, as Rogler (1951) illustrated higher production with moderately stocked continuous grazing in a 25 years grazing trial. This would suggest that the grazing system that yields the best return per unit of land is dependent upon a variety of factors which may include climate, soil type, forage species, along with several other variables.

Few researchers have seen improvements in average daily gains under rotationally grazed animals when compared to continuously grazed animals. This is primarily due to a much higher stocking rate in the rotational systems. In most instances when gains have been observed to be greater in rotational pastures, the stocking density was similar between the systems. Conway (1963) illustrated this response with yearling and two year-old steers. His research consistently revealed greater production with rotational grazing when grazing pressure was high (6.18 animals/ha). However, little advantage was observed with intensive grazing with low stocking densities (2.47 animals/ha). Liveweight gain for years 1960, 1961 and 1962 under rotational and continuous management were 782 vs. 588 lb, 630 vs. 329 lb, and 720 vs. 594 lb. With moderate stocking density (4.32 animals/ha), rotational pastures produced only 14.1 – 53 lb more than did continuous pastures. Walton and co-workers (1981) have shown similar results. In three of four years, average daily gains were greater in rotational systems than continuous supporting Conway's findings. Rotational grazing tended to improve animal performance of Holstein steers the last 28 days of a 56 grazing trial in comparison to continuous grazing when stocking rates were similar (Lehmkuhler et al., 1998). This work illustrates the need for comparison of animal performance of the two systems at similar stocking rates. In summary, the research suggests that intensive grazing may improve animal performance (i.e. ADG) or carrying capacity can be increased while maintaining similar performance. Further, no conclusion as to which system is best has been identified for all grazing environments. As grazing conditions change, so too must the management.

Increasing production per unit of land has also involved improving existing pastures or renovating pastures to more productive, persistent, and high quality forages. With increased understanding of genetics, improved varieties have been developed for pasture systems that increase yield over the common pasture species found in many permanent pastures. Holstein steers are commonly utilized as an animal model for these pasture trials due to their docile nature and ease of training to navigate through a labyrinth of electrified high-tensile and poly-wire.

A majority of the grazing research involving Holstein steers in recent years has been conducted in the upper Midwest. Researchers at the University of Wisconsin-Madison have been investigating supplementation and implant strategies for Holstein steers for the past decade. Investigations of new pasture forages have also utilized Holstein steers at the research station in Wisconsin and much of these findings will be presented below. Research conducted by other institutions utilizing Holstein steers in grazing trials during past decade will also be presented.

Response to Forage Type

Increasing oil and natural gas prices are leading to higher expenditures for nitrogen fertilizer. This increased expense will reduce returns to grazing systems dependent upon nitrogen inputs to maximize forage production. Grass responses to nitrogen fertilizer have been well established and recent research conducted in Wisconsin would suggest that incorporation of a legume in the pasture results in fertilizer nitrogen replacement values ranging from 225-240 pounds per acre (Zemenchik et at el., 2001). Several legumes have the disadvantage of having reduced or limited stand persistency, difficulty of establishment in existing pasture, and concerns of causing bloat in grazing animals. While other legumes have been found to be easily established in existing pastures such as the commonly utilized red clover and offer a viable alternative to nitrogen fertilizer as a means to increase nitrogen into the system. A review of the grazing research conducted in the US revealed that legume-grass systems typically produced greater production per unit of land and greater individual animal performance (Burns and Standaert, 1985).

Kura clover, a rhizomatous perennial legume, has been the center of investigation by University of Wisconsin-Madison researchers the past several years. A three year trial compared grass-kura clover to grass-red clover pastures (Mourino et al. 2003). Holstein steers weighing approximately 450 lb at turnout were administered a growth promoting implant and a variable stocking rate rotational grazing design was utilized with grazing seasons lasting 140-184 days. The mean legume content in the mixed pastures was 68% for the kura clover-grass pastures and 21% in the red clover-grass stands. The high level of legume in the kura clover stands resulted in death loss each year due to bloat until Poloxalene™ was incorporated into the mineral mixture. Bloat occurred during the time of the year which favored legume growth more than the cool-season forages and in paddocks containing the highest proportion of legume. Carrying capacity, average daily gain, and gain per acre were greater for the kura clover-grass stands than for the red clover-grass pastures. Kura clover containing pastures were more productive supporting a 14% increase in carrying capacity, 24% greater average daily gain, and 28% more gain per acre than red clover stands. Holstein steers in these two systems had average daily gains that ranged between 2.0-2.7 lb/d over the three year study. These are impressive gains, yet not as impressive as the mean beef gain of 914 lb/acre for the kura clover-grass system.

Ryegrass, a productive and high quality species, is commonly utilized in the Southeast. A study conducted to investigate the impact of stocking rates for ryegrass pastures utilized three month old Holstein steers weighing on average 180 pounds at turnout over five years (Murphey et al., 1997). Stocking rates consisted of 3.0, 3.5, or 4.5 steers per acre. Steers received whole shelled corn at a rate of 1% of body weight from the beginning of the grazing period until March for the two lower stocking rates and the entire grazing season for the high stocking rate. Supplementation with corn was found to aid in reducing the incidence of bloat. Grazing seasons ranged from 144 to 187 days during the five grazing seasons. Grazing ryegrass with young, light Holstein steers resulted in an average gain of 1,246, 1,474, and 1,861 lb/acre with average daily gains near 2.7 lb/d. Returns above costs less labor, debt, income tax, and overhead expenses ranged from -$86.12/hd to $133.52 and averaged $46/hd from 1991-1996 for this grazing system utilizing lightweight Holstein steers. Level of profitability was highly dependent upon current market conditions.

Michigan researchers investigated the response to stocking rate and grazing method (4 or 13 paddock system) of Holstein steers grazing alfalfa over four grazing seasons which spanned years 1989-1992 (Schlegel et al., 2000). Holstein steers averaged 510-585 lb at the beginning of the grazing season and varied slightly between years. Steers grazed alfalfa pastures for 103-118 days and stocking rates ranged from 2.2-2.4 steers/acre for the low and 3.2-4.7 steers/acre for high stocking rates. Steer daily gains were not impacted by the number of paddocks in the grazing system while increasing stocking rate reduced average daily gains in three of the four seasons. High stocking rates in the were excessive in the first year of the trial and animals grazed extra pasture area allowing for an additional 14 days of rest. If one does not include performance from this first year, daily gains observed for Holstein steers grazing alfalfa ranged from a low of 1.21 lb/d to a high of 2.25 lb/d across the remaining years. The average reported gain per acre during the last three years of the trial were 491, 562, 511, and 616 lb/acre for 4 paddock/low stocking, 4 paddock/high stocking, 13 paddock/low stocking, and 13 paddock/high stocking treatments, respectively. An additional trial by Michigan researchers observed average daily gains of 2.3 lb/d and 2.5 lb/d for Holstein steers (513 lb initial weight) grazing perennial ryegrass-alfalfa or perennial ryegrass-birdsfoot trefoil mixtures (Tomecek and Leep, 1998). These trials indicate that utilization of alfalfa in pastures can support average daily gains for Holstein steers near or above two pounds per day.

Orchardgrass is a common forage species for improving pastures throughout the Midwest. Fescue on the other hand is regarded as an undesirable forage species in the upper due to concerns over endophyte infection levels and palatability. Improved varieties include non-infected varieties as well as those with a “safe” fungus. No differences in average daily gain were observed for Holstein steers grazing orchardgrass or non-infected tall fescue with gains being 2.1 and 2.2 lb/d for Holstein steers weighing 525 lb at the beginning of the 2004 season (Lehmkuhler unpublished data). Average daily gains during the early portion of the grazing season ranged from 2.6-2.9 lb/d while gains during the latter portion of the season decreased to 1.2-1.8 lb/d. Calculated gain per acre was between 380-440 lb/acre with hay harvest yielding approximately 1,500 lb DM/acre from half of the grazed area. These data are for a single year and should be interpreted as preliminary data and on-going research over the next few years will increase our knowledge of how Holstein steers respond to these forage species.

Response to Supplementation

The simplest method to maintain performance during the grazing season could arguably be supplementation. Supplementation can increase protein and energy intake, reduce pasture consumption, and improve animal performance. Current prices for grains and grain co-products in relationship to feeder cattle prices make supplementation more favorable.

During 1995, 1996, and 1997, Holstein steers were utilized to investigate the response to supplementation, ionophore, and implant by University of Wisconsin-Madison researchers (Undersander et al., 2001). Treatments varied slightly from year to year, but the effect of implanting and supplementing with corn was constant across all years.

Corn was offered at 1% of body weight with lasalocid (Bovatec) supplied at a rate of 200 mg/d for those receiving this treatment. Grazing season lasted 91 d, 125 d, and 162 d for 1995, 1996, and 1997 respectively. It should be noted in 1995 calves were sourced from a feed yard offering a high energy ration while calves utilized in the following years were sourced from forage-based backgrounding operations. Performance responses were variable with corn supplementation increasing daily gains in each year (Table 1). Daily gains for non-implanted Holstein steers weighing approximately 400-500 lbs at the beginning of the grazing season ranged from 1.55-2.38 lbs/d consuming pasture alone. Implanting Holstein steers along with corn supplementation increased gain over control steers by 0.39-0.59 lb/d. Implanting steers, offering corn at 1% of live weight and offering Bovatec increased daily gains by 0.60-0.70 lb/d. The amount of supplement consumed per unit of additional live weight varied dramatically from year to year and ranged from 8:1 to as high as 24:1 for implanted steers receiving corn supplementation. Due to the low supplement to live weight conversion in this trial, it is recommended that the cost of supplements be examined closely in relation to anticipated feeder cattle prices for Holstein steers at the end of the grazing season. Further, lower supplementation levels may increase the efficiency of supplement utilization while reducing performance slightly.

In 1994 and 1995, Holstein steers were rotationally grazed for 133-139 d or placed directly into the feedlot to examine the response of ad libitum intake of a liquid molasses-based protein supplement and growth promoting implants (Comerford et al., 2001). The supplement contained a combination of bloodmeal and fishmeal as a source of ruminally undegradable protein (69% RUP). Steers weighed approximately 400 lbs at the initiation of the grazing season or entry into the feed yard. Holstein steers consuming pasture alone gained approximately 1.2 lb/d while those consuming liquid supplement had 26-37% greater daily gains. Reported liquid supplement intake ranged from 1.3 lb/hd/d to 2.4 lb/hd/d. The authors further illustrate that as ambient temperature increased so did supplement intake. Implanting Holstein steers with a trenbalone acetate:estradiol combination product increased daily gains by 13% during the first 136 d. The conversion of supplement to live weight again was more efficient than the previously discussed trials at approximately 5:1 on a dry matter basis or 9.6:1 on an as-fed basis. These authors state that ad libitum consumption of a liquid molasses-based supplement may not be economically viable even though increased performance was observed.

Ruminally undegradable protein supplementation of grazing Holstein steers was conducted in Wisconsin in 1998 and 2004. In 1998, Holstein steers received no supplement, soybean meal (assumed 35% RUP), or Soy-Plus (55% assumed RUP) and were rotated every 2 or 4 days to examine the response to rotation frequency (Undersander et al, 2001). Non-supplemented steers gained 2.2 lb/d and 2.4 lb/d when rotated every 2 or 4 d, respectively. Supplementation slightly increased animal performance (0.2-0.3 lb/d) and response to RUP was variable. In 2004, Holstein steers (approximately 550 lb at turn out) were assigned to either no supplement, 4.4 lb of dried distillers grains, 4.4 lb dried distillers grains+monensin (175 mg/d), or 4.4 lb of a corn, soybean meal, monensin mixture formulated to supply the same level of crude protein as the other supplements (Lehmkuher et al., 2004). Supplements were offered following the spring flush (53 d after turnout). Targeted supplementation post-flush increased average daily gains 25-38% and response to supplementation was in agreement with previously reported data (Potter et al., 1986). Average daily gains ranged from 1.8 lb/d for control steers to 2.1 lb/d for supplemented cattle. Inclusion of monensin was additive in response to daily gain and increased animal performance by approximately 10% in agreement with previous monensin trials (Potter et al, 1986). Holstein steers consuming dried distillers grains performed similarly to those consuming the corn/soybean meal-based supplement. Supplement conversion ranged from 5.8:1 kg supplement DM/kg live weight gain to 9:1.

Environmental concerns in the upper Midwest regarding animal agriculture's impact on water quality is increasing. Phosphorus-based limitations for land spreading manure are common for larger operations. Reducing phosphorus inputs in all agricultural enterprises is anticipated to be in the near future and some cities have banned the use of phosphorus containing fertilizer for lawns to reduce potential risk of nutrient runoff. During the 2002 and 2003 grazing seasons, the response to the removal of phosphorus from free-choice mineral supplements for rotationally grazed Holstein steers was investigated (Brokman, 2005). Reducing the phosphorus content of mineral supplement from 6% to nearly 0% did not negatively impact animal performance over the 126-139 d grazing seasons. Average daily gain ranged from 1.7-2.5 lb/d for Holstein steers weighing approximately 620 lb at the beginning of the grazing season. This response was anticipated as the forage provided phosphorus in excess of the calculated requirement and mineral derived phosphorus accounted for an estimated 3-9% of the total daily phosphorus consumed. Current price differentials for phosphorus containing mineral supplements favors offering free-choice trace mineralized salt supplements without additional phosphorus when cattle are grazing forages containing phosphorus at levels that meet or exceed the animals' requirement.

Summary

Implementation of a managed grazing system has been shown to increase pasture productivity and carrying capacity, improve forage quality, and enhance animal performance. The level of management required varies on several factors which include desired animal performance, forage or plant response, and the labor and water resources to name a few. Managed grazing programs should be flexible to adjust to varying environmental conditions. Emergency plans should be considered in drought prone areas as well as northern climates where winter kill is common reducing forage productivity and availability.

The response of grazing Holstein steers to technology such as implants and/or ionophores varies, but follows similar trends to those observed in other cattle. It would appear from the limited Holstein research that response to implants is greater when energy intake is elevated via supplementation. Additionally, the utilization of an ionophore is expected to result in an additive response when low to moderate supplementation levels are utilized.

Holstein steers can be managed on pasture to achieve gains equal to that of common backgrounding diets. Using pasture during the growing phase for Holstein steers is a viable production system. However, it is important that animals are managed to maintain sufficient performance. Managed Holstein steers have repeatedly gained 1.7-2.7 lb/d during the grazing season. Animal performance responses are highly dependent upon availability and quality of forage. Gains per unit of land are dependent upon forage species and management. Gain per acre is an important value when looking at alternative systems and assessing their economic viability.

General Observations/Experiences w/ Grazing Holstein Steers

- Utilizing fleshy, high-energy fed calves has been observed to result in low gains immediately following turn out to pasture
- Holstein steers appear to be more susceptible to pink-eye than are crossbred beef animals
- Holstein steers are docile, easily trainable, and work well in intensively managed rotational grazing systems
- Preliminary data and communications with those that have grazed Holstein steers would suggest that utilizing a slightly lighter Holstein steer (i.e. 400 lbs vs. 500 lb) in comparison to a beef steer results in similar average daily gains over the grazing season as energy intake limits the genetic capacity for growth
- Monitoring feces for internal parasites is important for maintaining animal performance
- Holstein steers removed from pasture weighing approximately 700-900 lbs will grade after approximately 150 days in the feedlot using a single implant strategy. Monitoring live weight to avoid heavy discounts is important in this system.

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Table 1. Summary of Holstein steer response to supplement, implant and ionophore.

	Average Daily Gain (lb/d)		
Treatment	**1995**	**1996**	**1997**
Control	1.55[a]	2.05[a]	2.38[a]
Implant (Synovex S)	1.66[a]	2.21[a]	2.68[b]
Corn @ 1% BW	1.92[b]	----	----
Implant + Corn	2.14[c]	2.44[b]	2.92[c]
Implant + Bovatec	----	2.48[b]	2.57[a,b]
Implant + Corn + Bovatec	2.19[c]	2.74[c]	2.99[c]

[a,b,c] Means within the same year with dissimilar superscripts are different ($P<0.05$). Adapted from Undersander et al. 2001.

Table 2. Summary of performance for rotationally grazed Holstein steers during the grazing seasons of 1995 through 2004 at the Lancaster Agricultural Research Station, Lancaster, WI.

Year	Implanted	ADG, lb/d
1995	Yes	1.7
1996	Yes	2.2
1997	Yes	2.7
1998	NA	2.6
1999	NA	2.3
2000	NA	2.5
2002	No	1.7
2003	Yes	2.1
2004	Yes	2.0
mean		2.2

NA – Information was not available on implant status for these years.