CORN SILAGE IN SUSTAINABLE AND CONVENTIONAL SYSTEMS FOR FINISHING BEEF CATTLE

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ABSTRACT
The objective of the research was to compare finishing beef steers on high corn (*Zea mays* L.) silage diets in which the corn was produced under conventional and sustainable systems. The conventional corn forage was produced on a given area for 5 yr, using conventional practices, alternating with 5 yr of alfalfa (*Medicago sativa* L.) The sustainable system corn forage was produced in a 4-yr rotation with small grain cover crops and legumes, in which corn was grown in a given area once every 4 yr. Input of pesticides was less for the sustainable system. Steers were fed sustainable and conventional corn silage supplemented with broiler litter and soybean (*Glycine max* L., Merr.) meal, respectively. Performance was lower (P<.05) for steers fed the sustainable silage supplemented with broiler litter. However, final bodyweights and carcass weights were higher (P<.05) for these cattle. Average carcass quality grades were similar for cattle fed the two diets. It appears that chemical inputs can be reduced without affecting profit in forage-livestock systems.

KEYWORDS
Corn, silage, cattle, digestibility, sustainable.

INTRODUCTION
High quality corn silage is higher in energy than most other harvested forages (NRC, 1984). Beef cattle have been finished on a diet of high quality corn silage plus protein and mineral supplements, without supplemental grain (Hammes et al., 1964). In the United States (USA) practices for corn production involve use of large quantities of nitrogen (N) and pesticides. Approximately 50% of the pesticides and 44% of the chemical fertilizers used in the USA are used for corn production (NRC, 1989). Soil erosion continues to be a major source of surface water contamination for corn production, especially when conventional tillage is used. A promising approach for reducing soil erosion and N fertilizer inputs is utilization of fall-planted small grain cover crops and legumes. Sustainable production systems should minimize chemical inputs and soil loss, and maintain profit. Alternative cropping systems have been evaluated but few comparative studies of sustainable farming systems have included livestock. The objective of the research was to compare finishing of beef steers on high corn silage diets, in which the corn forage was produced under conventional and sustainable systems.

MATERIALS AND METHODS
The corn was produced as part of a long-term comprehensive crop/livestock comparison of two systems, conventional and sustainable. For the sustainable system the corn was produced in a 4-yr rotation including wheat (*Triticum aestivum* L.), millet (*Setaria italica* L. Beauv.), alfalfa and rye (*Secale cereale* L.). Corn was produced only once every 4 yr in the same area. In the conventional system a rotation was used in which corn was produced on a given area for 5 yr, alternating with 5 yr of alfalfa. Four field replications of 0.6 ha corn were used in each system. The conventional corn was seeded after a cover crop of rye had been killed with herbicides. For the sustainable system the winter cover crop (alfalfa-rye) was grazed lightly in early spring. For the first 5 yr the cover crop was "rolled" down with a cultipacker and the corn was planted with a specially designed corn planter. For the last 2 yr the cover crop was sprayed with glyphosphate, rolled down with a cultipacker, then seeded immediately with a conventional corn planter.

Each year 48 Angus steers were fed in an open shed with a concrete floor divided into eight pens with concrete dividers (30 cm) to keep the excreta separate. The cattle had been allotted to four replicates of six steers within each system, and were started on the grazing phase of the study at about 225 kg bodyweight (Allen *et al*., 1997). The four groups of steers in each system were allotted to the eight pens in the feedlot. The steers were full fed corn silage from their respective systems. Corn forage was chopped with a forage harvester and ensiled in plastic bags, separately by system. Supplements consisted of soybean meal for the conventional and deep stacked broiler litter for the sustainable system, plus trace mineralized salt, free choice. Vitamin A (20,000 IU/d) and monensin (250 mg/d) were mixed in the protein supplements, and steers were implanted with zerenol. The steers were slaughtered at the end of the trial.

The excreta from each pen were scraped once or twice per week and stored by system in covered concrete storage bays. In the spring the manure was spread by system on the areas to be planted to corn in order to recycle nutrients to both systems..

During one of the years (1992-93) a metabolism trial was conducted with lambs fed silage made from corn forage grown by conventional and sustainable methods. For the trial 24 wether lambs were allotted to four diets: 1) conventional corn silage supplemented with urea, 2) conventional corn silage supplemented with soybean meal, 3) sustainable corn silage supplemented with urea, and 4) sustainable corn silage supplemented with deep stacked broiler litter. The lambs were kept in metabolism stalls which allowed separate collection of feces and urine during a 7-d period preceded by a 7-d preliminary period.

Energy expenditures were estimated for all inputs to each system using a sequestered energy approach. Net income to variable cost was calculated for each system. The data were analyzed as a complete randomized block design by the least squares method of SAS (1985).

RESULTS AND DISCUSSION
For the first 2 yr corn forage yields were approximately twice as high for the conventional system, compared to the sustainable system, after which yields generally were similar for the two systems. Quantity and kinds of pesticides were less for corn grown using sustainable methods. The silages from both systems ensiled satisfactorily. The pH was below 4 and the silages contained substantial concentrations of lactic acid. The DM of the silages averaged 39% for both systems. Average CP content was 6.8% for the conventional and 7.3%, DM basis, for the sustainable silage.

Average bodyweight of the steers when they were placed in the feedlot was higher (P<.05) for the sustainable system (Table 1), reflecting better performance by the cattle on the sustainable system during the grazing phase (Allen *et al*., 1997). In the feedlot daily gains were 0.1 kg higher (P<.05) for the steers on the conventional system, probably reflecting some compensatory gains. However, final bodyweights remained higher (P<.05) for the steers in the sustainable

system. Silage dry matter intakes were similar for the silages produced under both systems. Dry matter per gain was higher (P<.05) for the sustainable than the conventional system, perhaps reflecting a difference in available energy concentration of the supplements, and higher initial bodyweight, for the sustainable cattle. Carcass weights were higher (P<.05) for the steers on the sustainable system. Quality grades of the carcasses were similar for both systems.

Dry matter digestibility of the diets and N retention by lambs were not significantly different for the conventional silage supplemented with soybean meal and the sustainable silage supplemented with broiler litter.

The energetics efficiency tended to be lower for production of conventional corn silage, compared to sustainable corn silage. The net income to variable cost, including the grazing and finishing phases, was similar for both system. These results indicate that inputs of pesticides can be reduced in forage-livestock production systems without sacrificing profit and quality of product.

Table 1
Performance and carcass characteristics of steers fed diets containing corn silage from sustainable and conventional systems (5 yr avg).

Item	System	
	Conventional	Sustainable
Performance, kg.		
Initial[abc]	427	454
Final wt.[abc]	568	580
Daily gain[abc]	0.99	0.90
Dry matter/d		
Silage	9.13	9.14
Soybean meal	0.63	
Broiler litter		1.18
Dry matter/gain[ab]	9.62	11.35
Carcass characteristics		
Carcass wt, kg[abc]	325	334
Dressing percent	57.2	57.4
Quality grade[d]	11.6	11.8
Yield grade[bc]	2.2	2.2

[a]Systems differed (P<.05).
[b]Year effect (P<.05).
[c]System x year interaction (P<.05).
[d]Code: 11=high select; 12=low choice; 13=avg choice.

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