Beets as feed for growing and finishing steers

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Sugar beets can be grown for feed, stored and fed to cattle with no negative effects. Feeding beets fresh or frozen requires processing to reduce particle size. Feedlot performance and carcass traits were equal or better, compared with corn silage. Beets are uniquely tolerant of saline soils.

Summary

Sugar beets produce excellent yields throughout the northern Plains and are uniquely tolerant of saline soil conditions. "Feed beets" are a variation of sugar beets selected specifically for feeding beef and dairy cattle. Beets contain more energy than corn silage (80 vs. 70 percent total digestible nutrients [TDN]) but are typically lower in dry matter (DM; 25 vs. 35 percent). A growing and finishing study was conducted to evaluate feed beets at the NDSU Carrington Research Extension Center in the fall and winter of 2013-14. One hundred forty-three weaned crossbred steer calves were blocked by weight into four weight groups and allotted to one of three treatments with four replicates per treatment. Pen was the experimental unit in the randomized complete block design. Feed beets (BEET), beet pulp (PULP) and corn silage (CSIL) were compared in 0.57 megacalorie of net energy gain per pound (Mcal NEg)/lb growing diets and 0.63 Mcal NEg/lb finishing diets. The corn-based rations included feed beets at 25.8 percent (DM) of the growing rations and 9.4 percent of the finishing diets with beet pulp and corn silage included at approximately the same proportions. Chopped straw was included at about 5 percent DM in all rations. Beets were stored whole in an outdoor pile and processed weekly by chipping with a flail head manure spreader. Pressed beet pulp was fed as wet shreds (American Crystal Sugar, Hillsboro, N.D.). Well-eared CSIL was harvested from irrigated fields at the Carrington center. The trial started on Nov. 12 and terminated on May 5, 2014. After approximately Dec. 1, ambient temperatures were below freezing, and sugar beets were chipped and fed frozen. During the 63-day growing phase, dry-matter intake (DMI) was greater ($P < 0.01$) for BEET (23.6 pounds/day) and PULP (20.87 pounds/day) diets than CSIL (19.96 pounds/day) with improved average daily gain (ADG) ($P < 0.03$) observed for BEET (4.38 pounds/day) and PULP (4.41 pounds/day), compared with CSIL (4.03 pounds/day). A reduced gain-to-feed (G:F) ratio ($P < 0.04$) was observed for BEET, compared with PULP and CSIL. During the 112-day finishing period, DMI was greatest ($P < 0.04$) for CSIL (23.83 pounds/day), compared with PULP (22.16 pounds/day) and BEET (22.88 pounds/day), with a tendency for improved ADG ($P < 0.12$) at 4.22 pounds/day for CSIL vs.3.95 pounds/day for PULP and 3.92 pounds/day for BEET. The finishing G:F was not affected ($P > 0.43$), nor were any of the carcass traits ($P > 0.33$). Practical methods of ensiling should be explored for long-term storage to avoid feeding frozen beets.

Introduction

Sugar beets have been fed to cattle throughout the world for the past 100-plus years, but only recently have we realized that this crop has the unique potential of producing excellent yields on saline soils where few other crops will grow.

"Feed beets" are a variation of sugar beets developed specifically for feeding ruminant animals. The sugar content and digestible fiber make beets particularly attractive for lactating dairy cows and all classes of beef cattle. Sugar beet production guidelines are available from industry and university publications for growers interested in planting feed beets.

Growing beets in saline soil may be a method of bioremediation. The long tap root takes up water from deeper in the soil profile, lowering the water table. Historically, beets were grown in Holland on land reclaimed from the sea bed that was relatively high in salts.

Soil salinity is measured in electro-conductivity (EC). Productive soils typically have a value of 0 to 1.5 millimhos per centimeter (mmho/cm). At values ranging from 1.5 to 4, crops such as soybeans, dry beans, wheat and corn lose yield quickly. Few annual crops typically do well beyond values of 4 mmho/cm. Such crops would include some brassicas, barley, sunflower and sugar beets.

In research conducted near Carrington, N.D., energy beets (a type of sugar beet) performed as well as or better than our check crop, barley (Figure 1). In fact, in a 16-acre demonstration plot, we achieved an av-

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erage of 25 tons/acre of energy beets in soils ranging from 1 to 8 mmho/cm. This yield was more impressive, given that the energy beets were not planted until June 20, 1½ months beyond the typical planting date in North Dakota.

The application of energy beets as a bioremediation crop for saline soils is intriguing. The beets provide benefits that other salt-tolerant species do not. The benefits include the combination of high water use, deep tap root and high livestock palatability. Therefore, a successful seeding of energy beets can utilize excess moisture, which will prevent the accumulation of surface salts, penetrate hard pans that form as a result of excess moisture and lack of plant growth, and provide a usable end product. However, production barriers, including seed cost and specialized harvest equipment, do exist.

Feed beets are very palatable and contain more predicted energy than corn silage (Table 1). Moisture content is quite high, providing a ration-conditioning effect. More sampling is needed to provide a more accurate database of nutrients in feed beets. Soil type, moisture conditions, harvest time and storage can affect dirt clinging to beet roots, which will increase ash content.

Table 1. Nutrients in feed beets compared to other forages.

	Feed Beets*	Beet Pulp**	Corn Silage**
Dry matter, %	**20.1**	**14.2**	**34.6**
	------ Percent, Dry-matter basis ------		
Crude protein	6.8	9.8	8.7
TDN estimate	81	74	72
Crude fiber	16.6	20.0	19.5
ADF	18.3	27.5	26.6
NDF	24.4	44.6	46.0
Fat	0.6	0.6	3.1
NEm, Mcal/lb	0.91	0.77	0.74
NEg, Mcal/lb	0.59	0.49	0.53
Ash	5.5	5.3	3.6
Calcium	0.24	0.68	0.25
Phosphorous	0.24	0.10	0.22
Potassium	1.52	0.22	1.14

* Lardy and Anderson, 2009, "Alternative Feeds for Ruminants," NDSU Extension publication AS1182 (sugar beets); NAS, 1971, "Atlas of Nutritional Data on United States and Canadian Feeds" (sugar beet root) and Commercial lab analysis from NDSU research trial.

** NRC, Nutrient Requirements of Beef Cattle, 7th Revised Edition, 2001

Beets need to be processed to reduce particle size for better mixing and reducing the risk of choking from feeding whole beets. Tub grinders, wood chippers or bale processors may work, but substantial splattering occurs and rocks or stones can damage machinery. Washing beets that have substantial dirt contamination is recommended. Specialized washing and de-stoning equipment has been developed in Europe, where beets are grown for feed.

Whole beets can be piled for short periods of time, followed by feeding or processing and ensiling beets. A small amount of dry forage or other dry ingredients should be mixed with chipped beets prior to ensiling to lower the moisture to optimum ensiling conditions (32 to 35 percent dry matter). Beet "silage" may be packed in a bunker silo or stored in an "ag bag." Some baggers may function to process the beets to a desired particle size during filling.

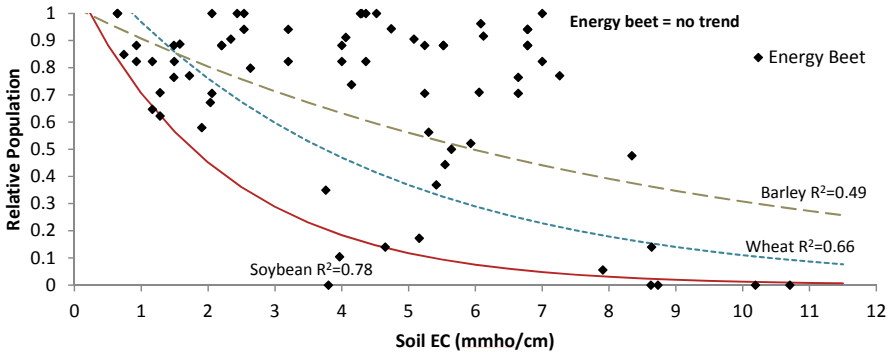

Figure 1. Relative performance of barley, energy beets, soybeans and wheat across a saline gradient.

Experimental Procedures

A cattle feeding study was conducted at the NDSU Carrington Research Extension Center in the fall and winter of 2013-2014 with 143 head of weaned mixed breed steer calves to explore adding feed beets to growing and finishing diets. Beets were stored in a pile outside and chipped weekly. A flail-type manure

spreader (Knight Slinger) was used to chip beets.

Chipped beets were included at about 25 percent of the diet (DM basis) during the 63-day growing period (approximately November and December). The beet pile froze in mid-December, with frozen chipped beets fed after that. Steers were transitioned to finishing diets with beets included at about 10 percent of the diet DM.

Other treatments included corn silage (CSIL) and beet pulp (PULP), which were fed at approximately the same proportions as BEETS (Table 2). Diets met or exceeded National Research Council (2000) nutrient recommendations. Steers were weighed individually, blocked by weight and randomly allotted to one of the three treatments into equal-sized pens.

Steers were fed once daily in fence-line bunks, with water available in automatic heated fountains. Feed bunks were read daily, with adjustments in rations made for intake to appetite. Equal amounts of straw were proved as needed for bedding to all pens during the winter.

Steers were weighed approximately every 28 days. Wind fences and shelterbelts provided wind protection for all pens during the winter. Steers were harvested when we estimated that 60-plus percent would grade U.S. Department of Agriculture Choice or better and fat thickness over the rib was .5 inch or less.

Carcasses were evaluated by a trained grader after a 24-hour chill at Tyson Fresh Meats, Dakota City, Neb. Pen was the experimental unit in this randomized complete block design with statistical analysis conducted using SAS Mixed procedures.

Results and Discussion

Initial and end weights for steers in respective treatments during growing and finishing periods were similar ($P = 0.23$) (Table 3). During growing, DM intake was greatest ($P < 0.05$) for BEET, suggesting excellent palatability when fed at 25.82 percent of DMI, followed by PULP and CSIL. Gains also favored BEET and PULP vs. CSIL, with no difference in gain efficiency.

Chipped beets were not frozen when fed during most of the growing period but were frozen during most of the finishing period. During finishing, DMI was greatest for CSIL vs. BEET and PULP ($P < 0.05$), but ADG and gain efficiency were not affected. ($P > 0.12$). No differences in carcass traits were observed (Table 4.)

Few trials have been conducted with feeding chipped whole beets

Table 2. Diets comparing corn silage, beet pulp or sugar beets during growing and finishing.

	Growing			Finishing		
Item	Corn Silage	Beet Pulp	Chipped Beets	Corn Silage	Beet Pulp	Chipped Beets
	---------- Percent, DM basis ----------					
Corn, dry rolled	35.36	37.77	36.95	56.97	58.29	57.78
Mod dist grains	28.15	30.21	29.63	25.22	25.88	25.69
Straw, chopped	4.99	5.36	5.22	4.93	4.87	4.94
Corn silage	29.45	0.74	0.67	10.76	0.00	0.00
Beet pulp, shreds	0	23.97	0.00	0.00	8.68	0.00
Chipped beets	0	0.00	25.82	0.00	0.00	9.39
Supplement*	2.05	1.95	1.73	2.12	2.28	2.22
DM, %	51.59	44.80	43.74	63.20	59.48	58.73
CP, %	14.52	15.48	14.44	14.40	14.73	14.34
NEg, Mcal/lb	0.55	0.54	0.55	0.63	0.62	0.63
ADF, %	15.46	14.92	12.08	10.53	10.13	9.17

* Ionophore, mineral and vitamins

Table 3. Performance of steers fed corn silage, beet pulp or sugar beets during growing and finishing.

Item	Corn Silage	Beet Pulp	Chipped Beets	SEM	*P*-value
Growing phase					
Initial wt, lb.	661	653	654	2.53	0.23
End wt, lb.	911	926	925	4.71	0.23
DMI, lb./hd/d	19.96[c]	20.87[b]	23.60[a]	0.23	<0.001
ADG, lb.	4.03[b]	4.41[a]	4.38[a]	0.07	0.03
Gain:feed	0.20[a]	0.21[a]	0.19[b]	0.00	0.004
Finishing phase					
End wt, lb.	1383	1367	1363	7.87	0.36
DMI, lb./hd/d	23.83[a]	22.16[b]	22.88[b]	0.22	0.01
ADG, lb.	4.22	3.95	3.92	0.08	0.12
Gain:feed	0.18	0.18	0.17	0.00	0.43

[abc] means with differing superscripts are different, P < 0.05

to beef cattle. Arrizon et al. (2012) concluded that substituting beets for corn grain did not alter DM intake, with ADG reported at 3.26 pounds/day for the control diet, compared with 3.08 pounds/day for 20 and 40 percent beets in finishing rations for Holstein steers. The control diet in this study did not contain a succulent feed. Carcass traits were not affected during this 97-day California trial.

Ensiling chopped whole sugar beets with dry feeds stuffs has been addressed in a laboratory trial. Gilbery et al. (2010) ensiled beets alone (25 percent DM) or mixed them with four different dry feeds at targeted DM levels of 27.5, 35, 42.5 and 50 percent. The mixtures were created by adding varying amounts of chopped wheat straw, chopped alfalfa hay, wheat midds and rolled corn.

Satisfactory fermentation was observed for chipped beets alone (pH 3.69) and in all combinations with dry feeds (pH averaged 3.99), with the highest pH (4.61) observed in the 50 percent DM treatment with alfalfa hay. Protein and digestibility (IVDMD) in the mixes was altered based on the proportion and relative nutrient level in the respective dry feed product added.

Feed beets are a viable crop to grow in saline or healthy soils in the northern Plains. Chipped beets can be fed in feedlot rations to replace corn silage. More work is needed to determine the effects of different inclusion rates in growing and finishing diets, as well as potential use in gestating and lactating dry lot beef cow rations. Washing or cleaning by conveyor may be required if substantial dirt adheres to beets during harvest.

If beet fields have rocks and stones, washing or some method of removing rocks and stones picked up by the beet lifter is highly recommended to avoid equipment damage rocks and stones in the feed when chipping. Research in practical and economical methods of mixing dry feeds and ensiling beets for longer-term storage and to prevent freezing is needed.

Table 4. Carcass traits of steers fed corn silage, beet pulp or sugar beets during growing and finishing.

Values	Corn Silage	Beet Pulp	Chipped Beets	SEM	*P*-value
Hot carcass wt, lb.	839	837	830	4.27	0.49
Dressing percent	63.14	63.74	63.43	0.20	0.36
Back fat, in.	0.49	0.49	0.48	0.02	0.93
Rib eye area, sq. in.	14.09	13.83	14.06	0.09	0.33
KPH, %	2.49	2.49	2.46	0.03	0.87
Marbling Score	445	462	438	10.91	0.46
Percent USDA Ch or better	66	66	62		
Yield Grade	2.91	2.98	2.85	0.08	0.65

*USDA quality grade select is 300-399, low choice is 400-499 and avg choice is 500-599.

Acknowledgements

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Literature Cited

Gilbery, T.C., G.P. Lardy and M.L. Bauer. 2010. Characterizing the ensiling properties of sugarbeets with dry feedstuffs. Anim. Feed Sci Tech. 155:140-146.