January 2003

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The feeding value of corn residue is not different between transgenic hybrids (Bt Corn Rootworm Protected and Roundup Ready®) compared to non-transgenic corn.

Summary

Two studies were conducted to evaluate the efficacy of transgenic corn hybrids for residue grazing. In Experiment 1 two irrigated corn fields were used after grain harvest, one Roundup Ready® and it's non-transgenic control line to evaluate grazing performance. This experiment was terminated after 35 days due to excessive snow cover. There was no significant difference in performance in Experiment 1. Experiment 2 was conducted the following year using dryland corn. In Experiment 2 corn root worm protected variety (Bt), Roundup Ready®, and their non-transgenic control line were evaluated. No differences in animal performance were observed between either genetically enhanced hybrid and their non-transgenic control.

Introduction

Genetic enhancement has been performed for centuries in plants and animals beginning with the selection of seed from superior plants and livestock with desirable traits and reproducing these through selection and breeding. These methods have significantly increased productivity, with corn yields approximately doubling over the past 40 to 50 years. The most recent innovation is the ability to introduce DNA directly into crop plants. This genetic enhancement enables a selective plant improvement process that promises to continue to improve agricultural productivity. The use of direct DNA introduction allows for more specific selection of traits, rather than the imprecise process of conventional plant breeding. Corn root worm (Bt) protected and Roundup Ready® hybrids are two hybrids of interest. These corn hybrids have been designed to reduce pesticide and herbicide use in cropping systems. Recent concerns include the possibility that genetic enhancements may affect performance when residue is used as a feedstuff for cattle. The objectives of this research were to 1) compare corn residue from a corn root worm (Bt) protected and conventional non-transgenic (nonBt) hybrid on growth performance, and 2) compare corn residue from a Roundup Ready® hybrid (RR) and the parental non-transgenic (nonRR) hybrid on growth performance.

Procedure

Experiment 1

Sixty-four crossbred steer calves (530 lb) were used in a completely randomized design in the fall of 2000. Twenty-eight acres of irrigated Roundup Ready® and 28 acres of irrigated nonRR corn residue were divided into eight equally sized pastures (4 RR and 4 nonRR). Steers were stratified by weight and assigned randomly to one of eight pastures. Each pasture was stocked with 8 steers to achieve equal stocking rates (.875 acre/steer/60days). Before grazing, residual corn (bu/acre) was estimated by counting full and partial ears in each of the eight pastures. Steer weights were taken for two consecutive days at the start and finish of the trial after a five-day period of limit-feeding (2% of BW; DM basis) to equalize gut fill. All steers were supplied a protein supplement (1lb/head/day; Table 1) to ensure protein did not limit performance. When snow covered the residue, a storm ration (47% ground corn cobs, 47% soybean hulls, 4% molasses, and 2% pellet binder) was fed.

Experiment 2

One hundred twenty-eight crossbred steer calves (576 lb) were used in a completely randomized design in the fall of 2001. Four 34 acre fields (Bt corn root worm protected, nonBt, RR and nonRR corn residue; all corn seed provided by Monsanto Company, St. Louis, MO) were divided into 16 equal pastures (4 pastures per hybrid). Steers were stratified by weight and assigned randomly to one of sixteen pastures for 60 days. Steer weights were taken as in Experiment 1. Each pasture was stocked with 8 steers to achieve equal stocking density (1.06 acre/steer/60 days). All steers were supplemented with an equal amount of protein supplement (1 lb/head/day; Table 1) to ensure protein intake did not limit performance. Steer performance data were analyzed using the GLM procedure of SAS.

Corn residues were sampled in every pasture before and after grazing to measure residue remaining (lb/acre) and initial stalk strength. Residue was collected from ten feet of row within each pasture,

Table 1. Composition of protein supplement in Experiment 1 and 2.

Ingredients (DM%)	Experiment 1	Experiment 2
Soybean meal	78.1	78.1
Urea	8.8	8.8
Dicalcium Phosphate	5.0	5.0
Salt	4.0	4.0
Molasses	2.7	2.7
Trace mineral[a]	.7	.7
Vitamin A-D-E[b]	.4	.4
Rumensin-80[c]	.23	—
Bovatec[d]	—	.27
Selenium premix[e]	.2	.2

[a]Trace mineral composition;10% Mg, 6% Zn, 4.5% Fe, 2% Mn, .5% Cu, .3% I, and .05% Co.
[b]Vitamin A-D-E; 15,000 IU of vitamin A, 3,000 IU of vitamin D, and 3.75 IU of vitamin E/g of premix.
[c]Rumensin-80; 367 g of Rumensin per ton of supplement.
[d]Bovatec; 340 g of Bovatec per ton of supplement.
[e]1 g Se per ton of premix.

Table 2. Performance of growing steers grazing Roundup Ready and nonRoundup Ready corn residue in Exp. 1.

Item[a]	RR	nonRR	SEM	P-Value
Initial weight, lb	531	529	1.43	.41
End weight, lb	576	566	3.53	.09
ADG, lb/day	1.28	1.05	.07	.07

[a]Roundup Ready (RR), non-Roundup Ready (nonRR).

Table 3. Corn residue measurements in Experiment 2[a].

	Residue type (lb/acre)								
	Husk			Leaf			Stem		
Hybrid[b]	Before	After	P-value[c]	Before	After	P-value[c]	Before	After	P-value[c]
RR	562.4	0	.0001	1427.8	982.9	.581	2583.3	2261.7	.36
nonRR	383.0	0	.0001	1289.4	738.7	.009	2320.8	1907.0	.27
Bt CRW	322.5	0	.0001	1650.9	1138.3	.343	2481.4	2036.1	.19
nonBt	454.3	0	.0001	1903.1	1649.5	.179	1799.3	1705.7	.48

[a]Time designates when the stalk samples were taken before or after grazing.
[b]Roundup Ready (RR), non-Roundup Ready (nonRR), Corn Root Worm protected (Bt CRW), and non-Corn Root Worm protected (nonBt).
[c]P-value comparison for residue before and after grazing within hybrid.

Table 4. Corn stalk characteristics in Experiment 2[a].

Item[b]	RR	nonRR	SEM	P-Value	Bt CRW	nonBt	SEM	P-Value
Diameter, mm	22.5	22.8	1.34	.89	23.1	27.5	1.34	.04
Total force, mJ	4132.9	3428.7	304.4	.128	2482.1	3300.1	304.4	.082
Force/Diameter, mJ/mm	183.1	149.7	10.7	.047	107.7	119.6	10.6	.44

[a]Measurements taken on corn stalks following harvest or prior to grazing.
[b]Roundup Ready (RR), non-Roundup Ready (nonRR), Corn Root Worm protected (Bt CRW), and non-Corn Root Worm protected (nonBt).

Table 5.Steer performance in Experiment 2.

Item[a]	RR	nonRR	SEM	P-Value	Bt CRW	nonBt	SEM	P-Value
Initial wt, lb	577	577	1.01	.60	574	576	1.83	.33
End wt, lb	631	627	2.00	.22	618	628	5.65	.25
ADG lb/day	.86	.79	.04	.23	.75	.87	.08	.31
Residual corn bu/acre	0	.13	—	—	.29	.58	—	—

[a]Roundup Ready (RR), non-Roundup Ready (nonRR), Corn Root Worm protected (Bt CRW), and non-Corn Root Worm protected (nonBt).

dried (48 hour @ 60°C), and separated into husk, leaf and stem fractions. Stalk diameter was measured with calipers. Stalks then were tested for breaking strength using a Instron 5500R compression tester (Canton, MA). Residue weights, stalk diameter and strength were analyzed using the GLM procedure of SAS.

Results

Experiment 1

Grain yield for RR was 137 bu/ac and 147 bu/ac for nonRR. Trial 1 grazing was terminated at 35 days due to inclement weather and snow cover. In the last eight days of this experiment 10 inches of snow accumulated, completely covering corn stalk residue. This made it necessary to provide additional feed in the form of storm ration (7 lb/head/day). There was no significant difference ($P > 0.01$) in steer performance (Table 2). Previous Nebraska research has demonstrated a high correlation ($r=.79$) between residual corn and daily gain of steers grazing corn residue (*1997 Nebraska Beef Report, pp 27-29*). In Experiment 1 steer gain was numerically different with RR and nonRR ADG of 1.28 lb/day and 1.05 lb/day respectfully. The differences in residual corn (2.3 and 1.6 bu/acre, RR and nonRR respectively) are our explanation for differences in ADG. Due to the termination of Experiment 1 at 35 days, Experiment 2 was conducted to further the understanding of genetic enhancements on residue value.

Experiment 2

Grazing residue weights were reduced with larger reductions in husks and leaves than in stalks as would be expected under normal grazing selection (Table 3). Significant reductions were accounted for in husks in all hybrids. Numerical reductions were noticed in all leaf and stem residue with a significant reduction in only nonRR leaves. Corn stalk analysis shows significant differences in stalk diameter and total breaking strength (Table 4). Differences in breaking strength may be a function of stalk diameter. When total breaking strength is adjusted for diameter, RR stalks are significantly stronger than nonRR stalks ($P < 0.05$). Corn root worm protected (Bt) show a significant difference in diameter and total force ($P < 0.10$) when compared to nonBt stalks. When total force is adjusted for diameter however, no differences in stalk strength were observed.

Steer performance was not different between Bt corn root worm protected or RR hybrids and their parental control (Table 5) following the 60 day grazing period. Steer ADG for the Bt and nonBt were .87 and .75 lb/day, respectfully. Roundup Ready® and nonRR were similar with ADG of .86 and .79 lb/day, respectfully. The animal performance data demonstrates feeding value of corn residue does not differ between genetically enhanced corn hybrids and their non-genetically enhanced parent hybrid.

The data from these experiments suggest genetic enhancement has no effect on corn residue utilization by grazing beef steers. Producers can take advantage of increased yields and reduced herbicide/pesticide use with Bt corn root worm protected or RR hybrids without adverse effects on corn residue grazing performance.

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