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Determination of differences in nutritive value of corn forage and silage from conventional corn hybrid and Bt hybrid

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ABSTRACT

The objective of the study was to determine the differences in nutrient content of corn forage and silage from the Bt-hybrid (Bt) and its near-isogenic control conventional corn hybrid (C) grown, harvested and ensilaged under identical conditions. The experimental field of corn forage was divided into two areas of 10 m^2 – control (C) with the conventional corn hybrid and experimental containing the Bt hybrid (Bt). Entire corn plants of both hybrids were harvested at the same time at the soft dough stage of maturity, cut and immediately packed into the microsilage tubes (approximately 6.5 kg per tube, 5 tubes per treatment) and fermented at 25 °C (±1°C). A forage from the control plants (C) had significantly lower content ($P<0.05$) of dry matter (362.1 vs. 375.8 g/kg) and organic matter (315.2 vs. 329.7 g/kg) than the Bt hybrid forage (Bt). The dry matter, organic matter and NDF content of conventional hybrid silage (C) was significantly lower ($P<0.05$) than that of Bt hybrid silage (Bt) (346.7 vs. 360.8 g/kg and 297.6 vs. 315.5 g/kg, 389.8 vs. 426.0 g/kg respectively).

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INTRODUCTION:

Corn hybrids genetically enhanced to express proteins that are native to the *Bacillus thuringiensis* (Bt) bacterium, commonly referred to as Bt-corn hybrids, are resistant to damage caused by European corn borer (*Ostrinia nubilalis*) infestation (Koziel et al., 1993). *Bacillus thuringiensis* is a soilborne bacterium that produces crystalline proteins in the form of protoxins. When consumed by the larval stage of the European corn borer and other insects, the crystalline proteins are activated and bind to the lining of the gut causing cellular swelling and lysis due to osmotic balance disruption (Feitelson et al., 1992). Expression of the crystalline protein gene in corn hybrids provides protection against European corn borer infestation (Koziel et al., 1993; Peferoen, 1997; Rice and Pilcher, 1998).

The objective of the study was to determine the differences between the nutritional value of fresh corn forage as well as silage made from the Bt-corn hybrid and its near-isogenic conventional corn hybrid.

MATERIAL AND METHODS

In 2005 a field trial was conducted in the Research Institute of Plant Production Praha-Ruzyně. The experimental field of corn forage was divided into two areas of 10 m^2 – Bt-hybrid MONSANTO 810 (Bt) and control (C) with near-isogenic conventional corn hybrid. Entire corn plants were harvested at the soft dough stage of maturity and than prepared for ensilagement (done in the Research Institute for Cattle Breeding, Ltd. Rapotín, dept. Pohořelice). Stalks with cops were cut in a branch grinder and leaves were cut separately in a chopper in such a way that the 70% of the forage was 5-10 mm and 30% within 12 mm. Forage was than mixed by hand and packed into the microsilage tubes (approximately 6,5 kg per tube, 5 tubes in each experimental group). Samples of raw forage were taken. Immediately after the filling the tubes were closed and stored at 25 °C (±1°C). After the fermentation tubes were opened, the contents were mixed thoroughly and samples of silage were taken for analyses. Obtained results were analysed using the Statgraphics 7.0 package.

RESULTS

Table 1 shows the nutrient content of fresh corn forage. Control (C) plants had significantly lower content ($P<0.05$) of dry matter, organic matter and crude fiber than the Bt-corn (Bt). The values of crude protein, fat, ash, ADF and NDF were similar and were not affected by the type of corn. Similar results were observed in the nutrient content of corn silage as presented in Table 2. The dry matter, organic matter and NDF content of control silage (C) was significantly lower ($P<0.05$) than that of Bt hybrid (Bt) while the content of ash found in control plants (C) was significantly higher ($P<0.05$) than found in Bt corn (Bt).

Table 1. Nutrient content of fresh corn forage

Nutrient		C (n=5)		Bt (n=5)	
		Mean	SEM	Mean	SEM
Dry matter	g/kg	362.1 [a]	1.63	375.8 [b]	2.29
Organic matter	g/kg	315.2 [a]	1.54	329.7 [b]	2.60
Crude protein	g/kg	65.9	1.51	62.2	1.37
Crude fiber	g/kg	179.6 [a]	2.09	195.3 [b]	4.45
ADF	g/kg	216.3	2.77	223.7	5.94
NDF	g/kg	416.1	9.00	424.2	10.5
Ash	g/kg	46.9	0.75	46.1	0.83
Fat	g/kg	21.7	0.83	23.4	0.28

[a, b] means followed by the superscripts are significantly different ($P<0.05$)

Table 2. Nutrient content of corn silage

Nutrient		C (n=5)		Bt (n=5)	
		Mean	SEM	Mean	SEM
Dry matter	g/kg	346.8 [a]	2.86	360.8 [b]	3.60
Organic matter	g/kg	297.6 [a]	3.10	315.5 [b]	4.01
Crude protein	g/kg	67.3	1.60	62.8	1.23
Crude fiber	g/kg	173.5	0.85	176.1	2.57
ADF	g/kg	201.4	2.39	208.5	4.64
NDF	g/kg	389.8 [a]	4.90	426.0 [b]	14.05

Ash	g/kg	49.2 [a]	0.35	45.3 [b]	0.58
Fat	g/kg	26.8	0.77	27.8	0.61

[a, b] means followed by the superscripts are significantly different ($P<0.05$)

DISCUSSION AND CONCLUSION

Our findings are in disagreement with Donkin et al. (2003) who found out that the nutrient content of silage originating from the Bt hybrid as well as the non-transgenic corn was similar and was not affected by the type of corn hybrid. According to Aulrich et al. (2001) who studied the nutritional differences between the transgenic Bt corn and its corresponding non-transgenic hybrid, the results of the analysed corn samples as well as of the silage samples illustrated substantial equivalence in investigated crude nutrients contents. Similarly Rossi et al. (2005) found out that chemical composition was not different between Bt and its isogenic non-transgenic form.

Considering the fact that up to now, no significant differences in nutritional value between feeds from isogenic and transgenic plants of the first generation were observed, Flachowsky and Aulrich (2003) suggested that in the future, long term feeding experiments for nutritional assessment of novel feeds should be combined with risk assessment studies.

We can conclude that fresh forage and silage from control (C) plants had lower content of dry matter, organic matter and crude fiber than from the Bt-corn (Bt).

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