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Corn silage from corn treated with foliar fungicide and performance of Holstein cows

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ABSTRACT

Foliar fungicide application to corn plants is used in corn aimed for corn silage in the dairy industry, but questions regarding frequency of application and its effect on corn silage quality and feed conversion when fed to dairy cows remain prevalent. The objective of this study was to evaluate the effects of various foliar fungicide applications to corn on dry matter intake (DMI), milk production, and milk composition when fed to dairy cows. Sixty-four Holstein cows with parity 2.5 ± 1.5, 653 ± 80 kg of body weight, and 161 ± 51 d in milk were blocked and randomly assigned to 1 of 4 corn silage treatments (total mixed ration with 35% of the dry matter as corn silage). Treatments were as follows: control (CON), corn silage with no applications of foliar fungicide; treatment 1 (1X), corn silage from corn that received 1 application of pyraclostrobin (PYR) foliar fungicide (Headline; BASF Corp.) at corn vegetative stage 5; treatment 2 (2X), corn silage from corn that received the same application as 1X plus another application of a mixture of PYR and metconazole (Headline AMP; BASF Corp.) at corn reproductive stage 1 (“silking”); and treatment 3 (3X), corn silage from corn that received the same applications as 2X as well as a third application of PYR and metconazole at reproductive stage 3 (“milky kernel”). Corn was harvested at about 32% dry matter and 3/4 milk line stage of kernel development and ensiled for 200 d. Treatments were fed to cows for 5 wk, with the last week being used for statistical inferences. Week −1 was used as a covariate in the statistical analysis. Dry matter intake tended to be lower for cows fed corn silage treated with fungicide than CON (23.8, 23.0, 19.5, and 21.3 kg for CON, 1X, 2X, and 3X, respectively). A linear treatment effect for DMI was observed, with DMI decreasing as foliar fungicide applications increased. Treatments CON, 1X, 2X, and 3X did not differ for milk yield (34.5, 34.5, 34.2, and 34.4 kg/d, respectively); however, a trend for increased feed conversion represented by fat-corrected milk/DMI (1.65 vs. 1.47) and energy-corrected milk/DMI (1.60 vs. 1.43) was noted for cows fed corn silage with fungicide compared with CON. In conclusion, cows receiving corn silage treated with foliar fungicide had better conversion of feed dry matter to milk than those receiving CON silage.
Key words: milk yield, corn silage, foliar fungicide, feed conversion

INTRODUCTION

Corn silage is a major component of dairy rations, sometimes constituting more than 50% of total dietary DM. As prices of corn increase, producers are assessing more ways of improving corn. The use of foliar fungicides to efficiently increase corn yield for grain production has been studied in recent years (Wise and Mueller, 2011). A meta-analysis concluded that corn treated with a pyraclostrobin-based fungicide had a mean yield increase of 256 kg/ha when compared with a control crop (Paul et al., 2011). Fungicides may cause changes in plant physiology that may be beneficial to plant nutritive quality (Venancio et al., 2009).

One of the primary factors affecting corn silage quality is NDF digestibility, as NDF makes up a major portion of corn silage (Allen et al., 2003). A one-unit increase in in vitro or in situ digestibility of corn silage NDF was associated with 0.25 kg/d increase in 4% FCM yield (Oba and Allen, 1999). Fungal contamination may cause an increase in lignification of the fiber in plants and, therefore, decrease NDF digestibility (Yates et al., 1997). Another aspect of concern in corn silage quality is the availability and total content of starch (Teller et al., 2012). Bal et al. (2000) reported that processing whole-plant corn silage with a kernel processing method increased apparent total-tract starch digestibility by 4% compared with no kernel processing. However, using a meta-analysis approach, Ferraretto

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and Shaver (2012) reported that DMI was unaffected by kernel processing. Their study also reported an increase in milk production of 1 kg/d when corn silage subjected to kernel processing using rollers was fed to Holstein cows. Damage to ears while in the field can cause a decrease in total starch content and an increase in fumonisin content in corn used for silage, which can decrease feed quality (Teller et al., 2012). In addition, damaged crop due to a fungal infection can increase defoliation and decrease the photosynthetic area on the plant. This has the potential to decrease both grain yield and starch content (Ward et al., 1997; Adee et al., 2005). Infestation by fungal colonies can also decrease corn silage quality and can pose a risk for the animals and people exposed to the feed (dos Santos et al., 2003; Richard et al., 2007). Some common mycotoxins in corn silage are aflatoxin, deoxynivalenol, zearalenone, T-2 toxins, fumonisin, and ochratoxin (Allen et al., 2003).

Foliar fungicide application on corn plants could affect milk production and farm overall profitability by increasing corn silage quality. Therefore, the objective of our study was to determine the effects of various fungicide applications to corn on DMI, milk production, and milk composition when it was fed to lactating dairy cows.

MATERIALS AND METHODS

Corn

The corn hybrid used for this study was LG2636 VT3P RIB (LG Seeds, Elmhurst, IL), which is a dual-purpose hybrid used for either grain or silage. It is advertised as 114-d maturity, with high yield potential, strong stalks, and high vigor. This hybrid is advertised as having a high level of resistance against northern corn leaf blight (caused by the fungus *Exserohilum turcicum*), southern corn leaf blight (caused by the fungus *Bipolaris maydis*), and gray leaf spot (caused by the fungus *Cercospora zeae-maydis*). This hybrid also contains transgenic traits that provide protection against corn earworm (*Helicoverpa zea*). Treatments were randomly assigned to four 0.8-ha plots and all corn was planted on June 5, 2013. Treatments were as follows: control (**CON**), corn received no foliar fungicide application; treatment 1 (**1X**), in which corn received 1 application of pyraclostrobin (**PYR**) foliar fungicide (Headline; BASF Corp.) at a rate of 0.11 kg of active ingredient (**a.i.**)/ha at corn vegetative stage 5 (**V5**; when 5 visible leaf collars can be seen; Mueller and Pope, 2009); treatment 2 (**2X**), in which corn received 2 applications of foliar fungicides, PYR at 0.11 kg of a.i./ha at corn stage V5, and a mixture of PYR + metconazole (**MET**; Headline AMP; BASF Corp.) at 0.11 + 0.04 kg of a.i./ha at corn reproductive stage 1 (when silks are visible outside the husks; Mueller and Pope, 2009); and treatment 3 (**3X**), in which corn received 3 applications of foliar fungicide, PYR at 0.11 kg of a.i./ha at corn stage V5, PYR + MET at 0.11 + 0.04 kg of a.i./ha at corn reproductive stage 1, and PYR + MET at 0.11 + 0.04 kg of a.i./ha at corn reproductive stage 3 (when kernel is yellow outside, whereas the inner fluid is now milky white due to accumulating starch; Mueller and Pope, 2009). The dates for fungicide application for first, second, and third applications were July 7, July 26, and August 13, 2013, respectively.

Corn foliar disease severity was evaluated throughout the growing season. Plots were evaluated at corn silk-emergence (August 2) and kernel-milk stage (August 16). Ten plants were arbitrarily selected within each plot for each evaluation date. For each selected plant, disease severity (percentage of leaf area) was estimated for the ear leaf, the leaf above the ear leaf, and the leaf below the ear leaf. Fungicide applications were made with a 4430 Case IH ground sprayer (CNH Industrial, London, UK) and applied at 27.27 kg of pressure using 73–60–110 10 VS nozzle tips at a volume of 348.5 L/ha. The sprayer was driven through all plots at each application timing, including those plots that did not receive a fungicide application, to account for any physical damage. For each plot, at least 3 samples of chopped corn were used in a composite sample to measure DM. Corn silage was harvested at 3/4 milk line stage of kernel development and DM of 33, 30, 30, and 32.5% for CON, 1X, 2X, and 3X treatments, respectively. The corn silage was harvested and processed over a period of 2 d using a New Holland FP240 forage chopper (CNH Industrial). The processer was set for a 1.9-cm theoretical length of chop, and a kernel processor was used to ensure mechanical processing of corn kernels. Chopped plant material was then transported to the storage site using an H&P forage wagon (H & S Manufacturing Company Inc., Marshfield, WI) and ensiled in 2.74-m diameter bags with an AG Bagger (Ag Bag Systems, St. Nazianz, WI), using the DM of the silage to adjust the setting on the bagger to ensure adequate and uniform preservation of the corn silage. Corn silage was allowed to ferment for at least 200 d before opening. The trial finished 300 d postensiling.

Animals

All experimental procedures were approved by the University of Illinois (Urbana-Champaign) Institutional Animal Care and Use Committee. Sixty-four Holstein cows with parity 2.53 ± 1.5, 653 + 80 kg of BW, and 161 ± 51 DIM were randomly selected and assigned to 1 of 4 treatments in a randomized complete