Feedstuffs, July 2, 2018 Feedstuffs Reprint

Recent research studies on corn silage for dairy cows summarized

By **FERNANDO DIAZ***

CORN silage has become one of the most used ingredients in the dairy industry. Its high energy content, coupled with its effective fiber, make corn silage an excellent forage for dairy cows.

Production and management of corn silage have evolved considerably since French farmer Auguste Goffart published his book about ensiling green corn in 1877.

The objective of this article is to summarize the latest publications of scientific research on corn silage on management practices and feed quality.

Feedout practices

Dairy producers in the San Joaquin Valley of California were surveyed about their corn silage feeding practices. The study, published recently in the *Journal of Dairy Science* (Heguy et al., 2016), included 153 dairies averaging 1,512 milking cows.

The silage structures were wedge piles (33.8%), drive-over piles (31.8%), bunkers (7.4%), bags (6.1%) or a combination (20.9%), with floor base material of concrete slabs (55.4%), earthen (9.5%) or a combination (35.1%). In summary:

- Silage was removed with a front-end loader (85.1% of the dairies), a rake (10.8%) or a defacer (4.1%).
- Daily removal rates were a depth of less than 15 cm on 25.5% of operations, 15-30 cm on 21.3%, 30-45 cm on 29.1% or more than 45 cm on 24.1% and spanned the entire width on 53.6% of operations, half the width on 14.9%, one-third the width on 27.7% or one-fourth the width on 3.5% of the silage face.
- Spoiled forage was discarded on 50.4% of dairies or fed only to heifers or dry cows on 33.1%, lactating cows on 3.0%, lactating and dry cows on 1.5% and lactating cows, dry cows and heifers on 12.0%.

The authors concluded, "The results indicate that silage structures are not sized according to feedout needs in California but are likely a function of available space and forage quantity."

*Dr. Fernando Diaz is a dairy nutrition and management consultant with Rosecrans Dairy Consulting LLC.

Shrink losses

Researchers from the University of California-Davis measured silage "shrink," defined as the loss of freshly chopped crop between ensiling and feedout, in well-managed corn silage piles from dairy farms in the San Joaquin Valley.

The piles — four wedge, two rollover/wedge and one bunker — from 950 to 12,204 metric tons (average of 6,257 mt) used a bacterial inoculant, were covered with a 45 µm oxygen barrier (OB) polyethylene inner film and 125 µm black/white outer plastic weighted with chains of half-tires and were fed out using large front-end loaders through an electronic feed tracking system.

The results, published in the *Science of the Total Environment* (Robinson et al., 2016), showed that shrink losses between chopping the fresh-chop corn crop and putting the corn silage in the total mixed ration mixer averaged 9.0% of the fresh and 6.8% of the dry matter weight.

Additionally, the authors reported that increased pile age at feedout was strongly associated with greater shrink losses: shrink (% fresh matter) = -3 + (10.9 x month)/10 (r-square = 0.78).

Lining bunker walls

Avoiding spoilage at the shoulders of corn silage in bunker silos is a priority on dairy farms. A study published in the *Journal of Dairy Science* (Lima et al., 2017) by researchers in Brazil evaluated the effects of lining bunker walls with a sheet of 45 µm thick OB film.

The researchers divided eight commercial bunkers into two parts lengthwise so that only one wall of the silo was covered with the OB film. The OB film was placed along the length of the sidewall before filling, with approximately 7 ft. of excess draped over the wall. After the silo was filled, the excess film was overlapped onto the forage, and a 180 µm-thick standard polyethylene film was placed on the entire top of the silo.

In summary, fermentation, spoilage and nutrient losses evaluated in the shoulder of the bunker walls (20 in. from the wall and 16 in. below the top surface) considerably improved:

- The pH — 3.94 in the OB film-covered shoulder versus 4.41 in the shoulder that was not covered;
- Lactate — 6.9% versus 4.6% of dry matter;
- Acetate — 0.85% versus 0.63% of dry matter;
- Yeast — 4.72 versus 6.42 colony-forming units per gram;
- Molds — less than 2.0 versus 2.6 colony-forming units per gram;
- Starch — 34.5% versus 30.4% of dry matter;
- Neutral detergent fiber digestibility — 49.3% versus 46.3% of fiber;
- Energy — 0.61 versus 58 Mcal net energy of lactation per kilogram, and
- Dry matter losses — 5.07% versus 9.86%.

Frozen corn silage

A new study from the University of Wisconsin evaluated the effect of thawing unfermented whole-plant corn silage on fermentation capacity after several months of frozen storage. The researchers froze an unfermented corn silage sample collected at harvest in September, which was stored at -68°F until January. Subsequently, the sample was thawed and stored in nylon-polyethylene barrier vacuum pouches at room temperature (approximately 68°F) for 0, 0.5, 1, 2, 3, 7, 14 and 28 days.

The results, published in the *The Professional Animal Scientist* (Ferraretto et al., 2017), suggest that fermentation occurred normally and that, upon thawing, the corn silage maintained fermentation capacity. In summary, the effects storage length had on the fermentation profile upon thawing were:

- The dry matter content did not differ (36.1% on average);
- The pH decreased linearly from 5.49 at day 0 to 3.84 on day 28;
- Lactic acid concentration increased linearly from 0.24% to 5.48% of dry matter;
- Acetic acid concentration increased linearly from 0.00% to 1.58% of dry matter;
- Propionate concentration did not differ (range of 0.00-0.05% of dry matter), and
- Ammonia-nitrogen increased linearly from 0.02% to 0.06% of dry matter.

Re-ensiling quality

A new study from the Universidade Federal de Minas Gerais of Brazil evaluated the effects of re-ensiling on the chemical composition, digestibility, quality and aerobic stability of corn silage after different periods of exposure to air.

At 150 days of fermentation in experimental silos, the researchers re-ensiled

the corn silage after 12, 24 and 48 hours of exposure to air. Subsequently, after 150 days of fermentation of the re-ensiled material, the silos were opened, and samples were taken to determine silage quality parameters.

The article, published in the *Canadian Journal of Animal Science* (Lima et al., 2016), showed that the chemical composition, quality and aerobic stability of silage were not influenced by re-ensiling. Although pH increased linearly by different times of re-ensiling (3.61, 3.63, 3.65 and 3.64 at 0, 12, 24 and 48 hours of exposure to air, respectively), the total count of microorganisms (yeasts, mold and bacteria), concentration of acids and variation of silage temperatures were not affected by exposure to air during re-ensiling. These results suggest that good-quality corn silage can be transferred within 48 hours without affecting silage quality.

Fiber quality

A study published by Danish researchers in *Animal Feed Science & Technology* (Kramer-Schmid et al., 2016) investigated the importance of corn silage fiber digestibility on intake, milk production and bodyweight change in dairy cows.

The data set compiled for the study comprised 29 experiments with 96 diets that were published in the literature from 1999. The average forage proportion of the diets was 53.9% on a dry matter basis (range of 40.0-98.0%), and the average corn silage proportion of forage was 77.6% (range of 58.6-100%), resulting in an average proportion of corn silage as a percent of total ration dry matter of 42.0% (range of 26.8-98.0%).

Across studies, an increase of one percentage unit in the fiber digestibility of corn silage increased daily milk yield by 0.185 lb. per day and bodyweight gain by 12 g per day. Surprisingly, fiber digestibility did not significantly alter dry matter intake. Since corn silage was not the only ingredient in the diets, these effects would have been 1.29 lb. greater if forage had consisted of only corn silage and 2.38 lb. greater if whole rations had been only corn silage.

IN conclusion, digestible fiber is an important nutrient in corn silage for feeding dairy cows.

References

Ferraretto, L.F., J.P. Goeser and R.D. Shaver. 2017. Case study: Fermentation of frozen whole-plant corn silage and high-moisture corn after thawing. The Professional Animal Scientist 33:504-508.

Heguy, J.M., D. Meyer and N. Silva-del-Rio. 2016. A survey of silage management practices on California dairies. J. Dairy Sci. 99:1649-1654.

Kramer-Schmid, M., P. Lund and M.R. Weisbjerg. 2016. Importance of NDF digestibility of whole crop maize silage for dry matter intake and milk production in dairy cows. Anim. Feed Sci. Tech. 219:68-76.

Lima, E.M, L.C. Goncalves, K.M. Keller, J.A.S. Rodrigues, F.P.C. Santos, P.H.F. Michel, V.S. Raposo and D.G. Jayme. 2017. Re-ensiling and its effects on chemical composition, *in vitro* digestibility and quality of corn silage after different lengths of exposure to air. Can. J. Anim. Sci. 97:250-257.

Lima, L.M., J.P. Dos Santos, D.R. Casagrande, C.L.S. Avila, M.S. Lara and T.F. Bernardes. 2017. Lining bunker walls with oxygen barrier film reduces nutrient losses in corn silages. J. Dairy Sci. 100:4565-4573.

Robinson, P.H., N. Swanepoel, J.M. Heguy, T. Price and D.M. Meyer. 2016. 'Shrink' losses in commercially sized corn silage piles: Quantifying total losses and where they occur. Science of the Total Environment. 542:530-539. ■