nonstructural carbohydrates (glucose, sucrose, fructose, fructans, and starch), NSC, are a significant component of forage crops. They play an important role as a source of energy for microorganisms during silage fermentation and in the rumen, and they affect the overall efficiency of nitrogen (N) use by dairy cattle. The conversion of dietary N into milk N is low in dairy cattle, ranging between 13 and 45%. Dietary N that is not converted into milk N has negative impacts on the animal and the environment. Energy is generally the main limiting nutrient for productivity, while the N supply usually exceeds animal requirements. Between 40 and 90% of crude proteins in alfalfa silage is degraded into non-protein N in the silo, which leads to excessive ammonia formation in the rumen. An increase in alfalfa NSC to balance the supplies of readily fermentable energy and non-protein nitrogen in the rumen may enhance ammonia capture by ruminal microbes and N utilization in dairy cows.

Increasing NSC concentration in forages can be done through genetic selection or cutting management. Although genetic improvements for NSC concentration have been achieved in perennial ryegrass through the innovative efforts of British scientists, most of the efforts in North America have focused on cutting management. Daytime cutting management (afternoon vs. morning cut) has been shown to increase NSC of most forage species, including alfalfa. This advantage was shown to be maintained during wilting to a forage dry matter (DM) concentration of 350 g DM kg\(^{-1}\) fresh matter (FM). Wilting in wide swaths was also shown to help maintain this improved alfalfa NSC concentration with afternoon cutting. During the fermentation process for the making of alfalfa silage, however, NSC are used, and the increased NSC concentration with afternoon cutting might be lost.

In a study reported in the January--February 2014 issue Crop Science, differences in alfalfa NSC concentration at the time of ensiling due to afternoon cutting combined or not with wide swaths were reduced and often not maintained during the fermentation of wilted alfalfa silage (≈ 350 g DM kg\(^{-1}\) FM). In fact, NSC concentration in alfalfa after 128 days of silage fermentation was increased with afternoon cutting and wide swathing only in two of the six growth cycles (+15 and +8 g kg\(^{-1}\) DM), and those increases were likely not large enough to directly impact milk production and N use efficiency of dairy cows. Increasing alfalfa silage NSC concentration with afternoon cutting and wide swathing is therefore unlikely in itself to improve milk production and N use efficiency if alfalfa is conserved as wilted silage with 350 g DM kg\(^{-1}\) FM. However, when the increased NSC concentration associated with afternoon cutting and wide swathing was still substantial at ensiling (>10 g NSC concentration kg\(^{-1}\) DM) due to favorable wilting conditions, most silage conservation attributes were improved with lower pH (−0.2 to −0.4), greater concentrations of lactate (+8 to +20 g kg\(^{-1}\) DM), and lower concentrations of volatile fatty acids (−8 to −11 g kg\(^{-1}\) DM) and ammonia N (−6 to −11 g kg\(^{-1}\) total N).

Increased NSC concentrations in alfalfa silage combined with improvements in silage conservation attributes because of greater NSC concentration at ensiling could potentially improve milk production and nitrogen use efficiency in dairy cows. Average differences of 23 g of NSC per kg of DM in alfalfa baleage (≈531 g DM kg\(^{-1}\) FM) were shown to be sufficient to improve milk production and nitrogen use efficiency of late-lactation dairy cows.

This study was part of an overall research program aimed at producing forages with a greater NSC concentration. Factors such as N fertilization, species selection, stages of development at harvest, and alfalfa genetic selection potential were also investigated.
