Image recognition to predict alfalfa-grass stand composition

McRoberts, K., JH Cherney, BM Benson, & DJC Cherney
Cornell University, Ithaca, NY

There is a relatively small range in optimal fiber content (NDF) for lactating dairy cows, making quality-related harvest management decisions critical. The purpose of this project is to improve the timing and nutritive value of spring forage harvests for dairy operations by reducing uncertainty in stand composition. Accurate prediction equations exist for estimating NDF content of mixed alfalfa-grass stands in spring, and estimating the optimal harvest date, but the weak link is estimating the proportion of grass (or alfalfa) in a stand. In spring 2011 we acquired 580 digital images of alfalfa-grass stands in farmer's fields, harvested the area in the image, and separated and dried alfalfa and grass fractions to determine dry matter percentages. A program is being designed to allow farmers and consultants to accurately estimate alfalfa-grass proportion, stand NDF, and optimum harvest date. The program relies on digital image processing to filter 64 x 64 pixel chunks. These chunks are transformed to the frequency spectrum using the Fast Fourier algorithm. Selected frequencies are then aggregated for processing by artificial intelligence (AI) to estimate stand composition. Predicted stand composition by a naïve Bayes classifier AI was not correlated with actual values (p=0.12) when all grass species were pooled. Predictions improved when alfalfa maximum height and grass canopy height were added to the model (p<0.0001, r^2=0.2), and AI-predicted stand composition became significant (p=0.0445). Predictions improved further when disaggregated by grass species (orchardgrass r^2 = 0.43, quackgrass = 0.43, timothy=0.23, reed canarygrass=0.28). Advanced forms of AI are now being tested. When satisfactory predictive capacity is achieved, the only required inputs to an internet program accessible by computer or smart phone include a digital picture of the stand and several agronomic measures (e.g., maximum alfalfa height). Farmers and consultants could use this technology to prioritize the order of harvest of alfalfa-grass fields to maximize chances of obtaining optimal forage NDF for lactating dairy cow diets.