



## Comparison between HarvXtra™ Alfalfa and Alfalfa Varieties Selected for Improved Forage Quality via Conventional Breeding

### Background

For over three decades alfalfa breeders have used conventional alfalfa breeding techniques to select for improved forage quality. Varieties developed from such selection generally show an incremental improvement in forage quality when compared to non-selected varieties. Examples of cultivars selected for improved forage quality include the W-L HQ series, CROPLAN® brand LegenDairy and its more recent derivatives, the Q series varieties from Pioneer and NexGrow® brand, and Hi-Gest® alfalfa from Alforex. It should also be noted that independent of such breeding efforts, fall dormancy has a significant impact on forage quality: FD3>FD4; FD6>FD7, etc. More dormant cultivars are higher in forage quality. To avoid confounding genetic improvements per se with fall dormancy differences when comparing forage quality between varieties, most breeders/agronomists often take care to compare forage quality between varieties that fall within a narrow range of fall dormancy classes.

HarvXtra™ alfalfa is a biotech derived trait that uses Genetically Enhanced (GE) technology for gene suppression to “re-wire” the process that alfalfa plants use to make lignin – changing both lignin content and lignin composition. This approach was adopted as part of a long-term research effort by the Consortium for Alfalfa Improvement<sup>1</sup> to use modern biotechnology to make improvements in alfalfa forage quality not possible through conventional breeding.

HarvXtra™ alfalfa was deregulated by USDA/APHIS in late 2014, and in 2015 several trials were planted to compare HarvXtra™ alfalfa and one or more alfalfa varieties selected for improved quality using conventional breeding techniques. The results summarized below are from a 2015 experiment at two FGI locations West Salem, WI and Nampa, ID, with four replications/treatment and five cutting treatments, where the varieties were harvested, and forage quality analyzed every 3-4 days over a 17 day period.

This experiment was designed to compare HarvXtra™ alfalfa versus other alfalfa varieties that have used conventional alfalfa breeding techniques by observing changes in forage quality over advancing maturity for various variety types. The four types used in the experiment were: 1) HvX118 is a FD4 HarvXtra™ experimental alfalfa variety to be named and released in 2017, 2) LegenDairy XHD (LD XHD) is a FD3 alfalfa variety selected for improved forage quality via conventional breeding, released in 2012 by the CROPLAN® brand, 3) Hi-Gest 360 is a FD3 alfalfa variety selected for improved forage quality via conventional breeding, released in 2015 by Alforex, and 4) Pioneer 54R02 is a FD4 Roundup Ready® alfalfa variety with forage quality typical of varieties that have not been selected for improved forage quality during the breeding process, was released in 2011 and is sold by Pioneer HiBred Intl.

Near infrared reflectance spectroscopy (NIRS) was used to predict forage quality parameters in this study. Tables 1 and 2 summarize ADL (acid detergent lignin) and NDFD (neutral detergent fiber digestibility), respectively.

---

<sup>1</sup> The Consortium for Alfalfa Improvement was started in 2001, with the following current members: U.S. Dairy Forage Research Center, The Samuel Roberts Noble Foundation, Pioneer HiBred Intl, and Forage Genetics Intl.

Table 1. Changes in ADL with Advancing Maturity of the Alfalfa Crop

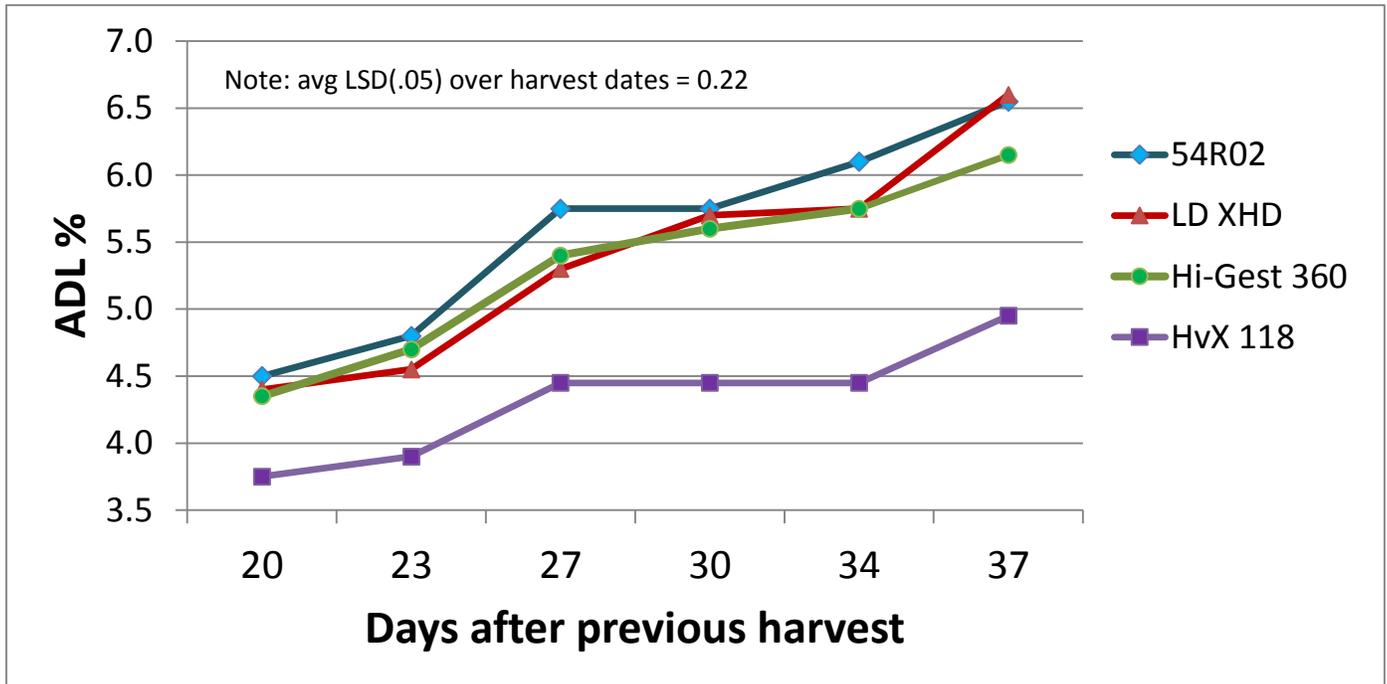
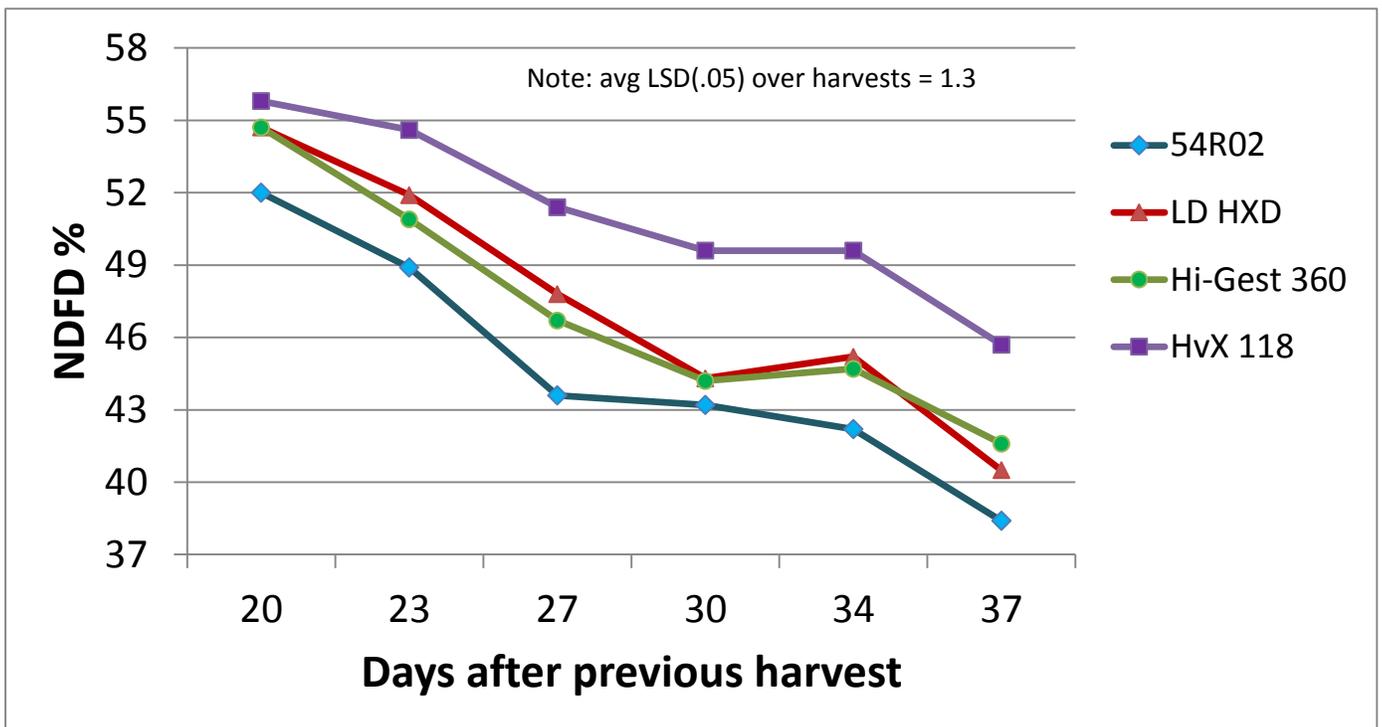


Table 2. Changes in NDFD with Advancing Maturity of the Alfalfa Crop



## Discussion of Results

Lignin content generally increases as the alfalfa crop matures. Lignin is indigestible and binds with other cell wall components to limit their digestibility. As lignin increases, cell wall/fiber digestibility decreases. This experiment allows a comparison between the alfalfa variety types in how forage quality changes with advancing maturity. These results clearly show that the alfalfa variety types differ significantly in these quality changes. Although there may be an incremental improvement in these quality parameters related to a conventional breeding history for improved quality (e.g. LD XHD, Hi-Gest® 360) when compared to an unselected variety (e.g. 54R02), the new HarvXtra™ trait provided a marked, and statistically significant improvement over all commercial check varieties for both ADL and NDFD at every sampling date in this experiment ( $p < 0.05$ ). Lignin (ADL) content in HarvXtra™ alfalfa was over two LSD units lower than the commercial checks at every sampling date, and more than 20% lower than any of the commercial check varieties at the last sampling date.

On-farm, agronomic performance (forage yield, persistence, pest resistance) of alfalfa varieties is of critical importance to growers, and we have found that the soon to be introduced HarvXtra™ alfalfa varieties deliver competitive levels of forage yield, persistence, and pest resistance, and show no increase in lodging risk when compared to current commercial cultivars.

New technology is creating revolutionary advances in plant breeding. Traditional conventional breeding techniques are now routinely enhanced with the use of molecular markers and the introduction of GE traits in corn, soybeans ....and alfalfa. HarvXtra™ alfalfa represents the first, of what we hope to be several game-changing traits that deliver significant improvements in alfalfa forage quality.