

REDUCED LIGNIN ALFALFA TECHNOLOGY UPDATE

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Forage Genetics International, the Samuel Roberts Noble Foundation and the U.S. Dairy Forage Research Center began working together in 2000 to produce transgenic alfalfa plants with reduced lignin content and improved fiber digestibility. This team of ~ 12 scientists collaborated in using gene silencing technology to systematically “knock out” each of the twelve genes in the lignin biosynthetic pathway and to compare the effect of these individual gene knockouts on alfalfa forage composition, fiber digestibility (NDFD) and agronomic performance. We were able to develop a gene knockout that gave the desired improvement in forage quality, without any negative impact on forage yield and standability. Multiple transgenic events were created containing this commercial gene silencing construct, and in 2009 a single commercial event was selected after extensive field and laboratory testing.

This commercial transgenic event has been introgressed into a wide variety of FGI germplasm to produce Reduced Lignin (RL) alfalfa. RL alfalfa has now been tested in multiple genetic backgrounds for multiple years and in multiple locations. When compared both to the non-transgenic control and to appropriate commercial check cultivars, RL alfalfa has consistently shown a ~15% reduction in whole plant lignin content and a 10 to 15% increase in NDFD and RFQ. In current trials, forage yield potential of current RL alfalfa experimentals is similar to appropriate commercial check cultivars. There is no difference in incidence of lodging of RL alfalfa compared to the non-transgenic control or conventional commercial varieties.

In cutting management trials the decreased lignin content of RL alfalfa has resulted in increased flexibility in harvest timing. A 2011 trial (Fig. 1) compared performance of a RL alfalfa breeding population to two commercial check cultivars, under two harvest treatments: 3 cuts/yr (harvest interval ~38 days) and 4 cuts/yr (harvest interval ~31 days). In this trial, and in similar trials designed to look at changes in forage quality associated with increased physiological maturity, NDFD in RL alfalfa was equal to or higher than NDFD in conventional alfalfa harvested 7-10 days earlier.

It appears that RL alfalfa may benefit forage producers in two ways:

- 1) Increase the likelihood of harvesting alfalfa hay/haylage with high forage quality. The proven benefits of improved forage quality can be captured both by the dairy producer end-user and by the cash crop hay producer through forage quality premiums well established in U.S. hay markets.
- 2) Improve flexibility in alfalfa harvest management by extending the time period in which high quality hay/haylage can be harvested. Delaying harvest for several days (e.g. harvest at 10% bloom vs late bud stage), may result in reducing the number of harvests/yr without sacrificing forage quality of the hay harvested. Flexibility in harvest timing will also give growers more flexibility in timing harvest around weather or other farming operations.

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This project is on a commercial track. We have generated considerable amounts of data required for securing regulatory approvals and have made application for deregulation in the U.S., Canada and key export markets. Product development is also well underway. Reduced Lignin alfalfa will be sold in a trait stack with Genuity® Roundup Ready® alfalfa, and is expected to be available for U.S. commercial release ~ 2016.

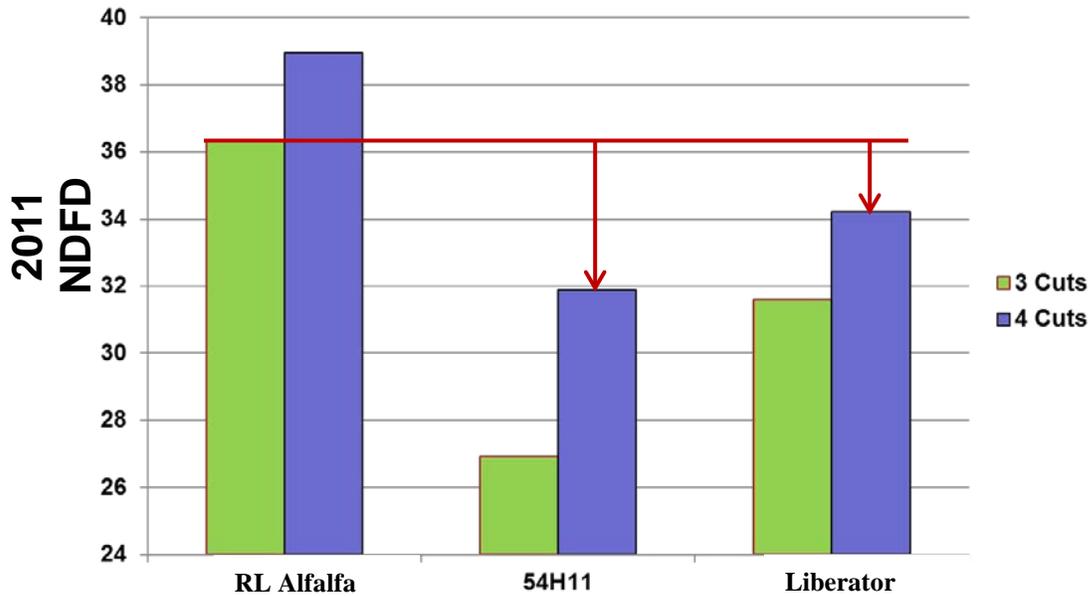


Figure 1. NDFD in RL Alfalfa vs. Commercial checks in three- vs. four-cut management West Salem, WI (established 2010, harvested 2011).