Extended Digestibility Windows Enable a Three-Cut Harvest System in Improved Alfalfa Germplasm

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Alfalfa digestibility declines rapidly with maturity due to increased lignification, leading producers to rely on frequent cutting schedules to maintain forage quality. These high frequency harvest systems increase operating costs, reduce stand longevity, and may not maximize digestible biomass yield. To evaluate whether improved genetics can extend the harvest window while sustaining forage quality, five genetically distinct alfalfa germplasms—two derived from divergent selection for stem fiber digestibility and three commercial cultivars—were tested across multi year field trials in Minnesota and Wisconsin in sward plots. Measurements of in vitro NDF digestibility (IVNDFD), lignin concentration, and maturity specific decline rates from leaves, stems, and total herbage were used to determine whether the high digestibility germplasm could maintain forage quality under an extended maturity window.

High digestibility germplasm consistently exhibited superior IVNDFD and a slower decline of fiber digestibility across four maturity stages compared to the high quality check cultivar. These advantages were strongly associated with reduced lignin content and moderate increases in cell wall deposition in the high stem digestibility germplasm. Environmental variation influenced overall forage digestibility values but did not alter relative rankings among germplasms. Critically, "days to target" analyses demonstrated that harvest could be delayed up to 18 days without sacrificing quality, supporting the feasibility of a three cut harvest system in the tested environments with the high digestibility germplasm. Deploying germplasm with improved stem fiber digestibility enables practical reductions in harvest frequency, lowers operational costs, maintains forage quality, and increases digestible biomass. These findings provide actionable, genetics based guidance for optimizing alfalfa harvest systems and improving profitability for U.S. forage and dairy producers.