

Low-Lignin Alfalfa Evaluated in the Black Soil Zone of Saskatchewan: Yield, Nutrient Profile, Rumen Degradation Kinetics, and Stand Establishment Costs

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Introduction

Lignin increases with advanced maturity in alfalfa. However, lignin is indigestible and reduces fiber digestibility in ruminants. Thus, reducing lignin content of alfalfa should increase fiber digestibility at any maturity stage.

Objective

To compare low-lignin Hi-Gest® 360 alfalfa to a conventional legume in both monoculture and binary mixtures.

Materials and Methods

Varieties

- Alfalfa: *Medicago sativa* L. cvs. AC Grazeland (**Grazeland**) and Hi-Gest 360 (**Hi-Gest**)
- Hybrid bromegrass (**HB**): cv. AC Success

Establishment Conditions

- In monoculture: **Grazeland** and **Hi-Gest**
- In mixture (binary): **Graze+HB** and **HiGest+HB**
- Soil zone: Black soil site in Lanigan (51°51'N; 105°02'W)

Experimental Setup

- Plot: 1.2 m × 6.2 m (7.44 m²) with 4 rows and 48 plots
- Design: plots in a randomized complete block design, four replicates with forages as treatments

Agronomic Information

- Seeding date: August 1, 2017
- Seeding rate: 20.5 kg/ha and 9.5 kg/ha for Hi-Gest and Grazeland alfalfa monocultures. 10.5 kg/ha and 4.76 kg/ha for Hi-Gest and Grazeland alfalfa binary mixtures, respectively; 15.95 kg/ha for HB
- The alfalfa was re-seeded by hand on June 13, 2018
- Irrigation: July 13 2018, 76 mm

Harvest

- At 3 maturity stages (**stage**) of alfalfa: 1 = 10% bloom; 2 = 40% bloom; and 3 = 100% bloom
- Harvest dates: 27 June, 8 and 29 July, 2019

Analysis

- Nutrient profiles and *in situ* rumen degradation kinetics
- The cost for stand establishment and revenue generation estimates

Results and Discussion

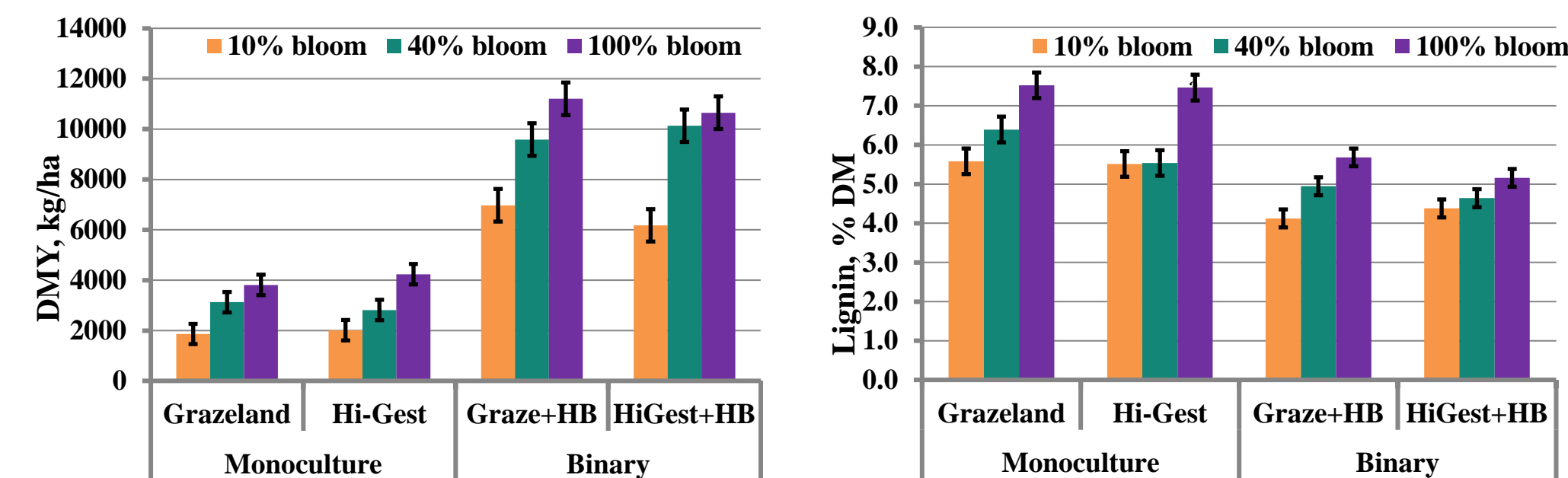


Fig. 1. Dry matter yield (DMY) of the experimental site (Means ± SE; kg/ha).

Fig. 2. Lignin content of forages (Means ± SE; %, DM basis).

- Forage × maturity stage interaction was not observed ($P > 0.05$) for all measured parameters.
- Grazeland and Hi-Gest or Graze+HB and Hi-Gest+HB exhibited similar ($P > 0.05$) DMY. As alfalfa maturity advanced, DMY increased ($P < 0.05$; 1940, 2970, 4023 kg/ha for stages 1, 2, and 3, respectively) (**Fig. 1**).
- In binary system, forages at stage 1 had lower ($P < 0.05$) DMY (6575 kg/ha) than those at stage 2 (9858 kg/ha) and stage 3 (10650 kg/ha).
- The lignin concentrations of Hi-Gest were 98.8%, 86.7%, and 99.2% of those of Grazeland alfalfa, for stage 1, stage 2, and stage 3, respectively (**Fig. 2**).
- The lignin concentration was strongly and positively correlated with DMY in both Grazeland ($r = 0.71$) and Hi-Gest ($r = 0.89$).

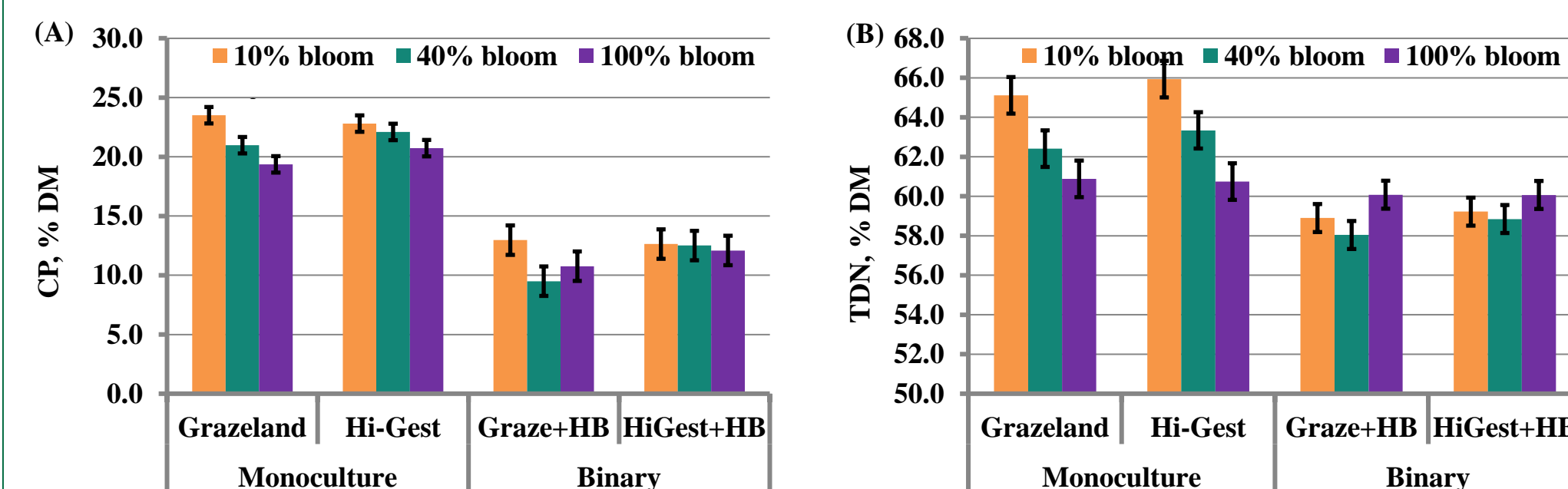


Fig. 3. Crude protein (CP; A) and total digestible nutrients (TDN; B) of forages (Means ± SE; %, DM basis).

-In monoculture, forages at maturity stage 3 had lower crude protein (CP; 20.0 vs. 23.1%; **Fig. 3A**) and total digestible nutrients (TDN; 60.8 vs. 65.5%; **Fig. 3B**) than those at maturity stage 1.

-No differences ($P > 0.05$) were observed between Graze+HB and Hi-Gest+HB for nutrient profiles.

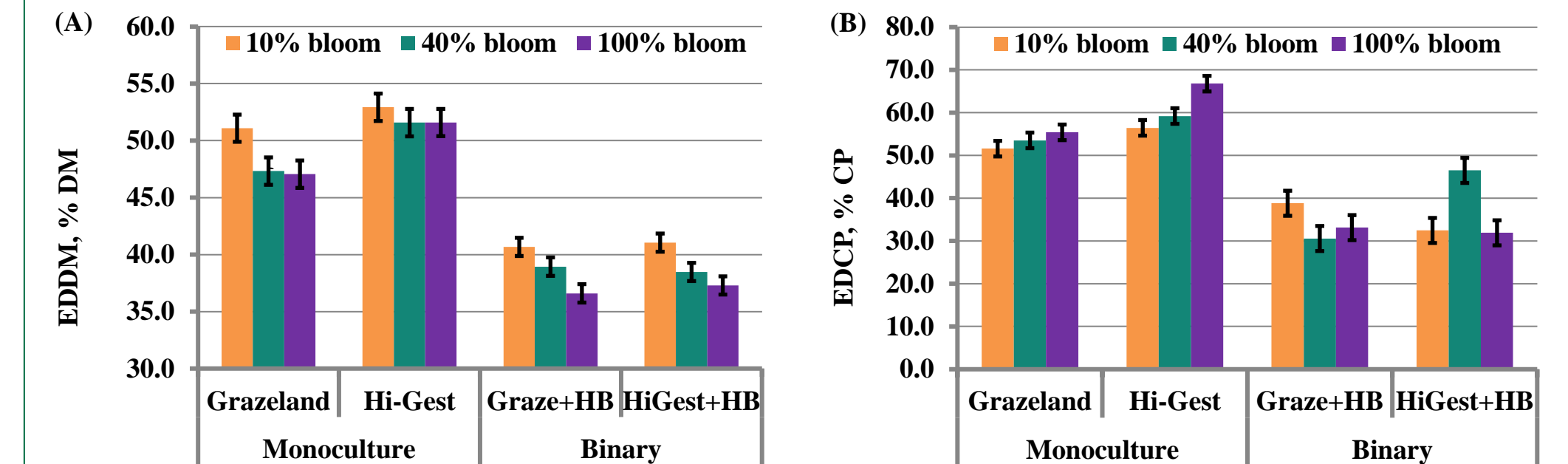


Fig. 4. Effective degradable dry matter (EDDM; A) and effective degradable CP (EDCP; B) of forages.

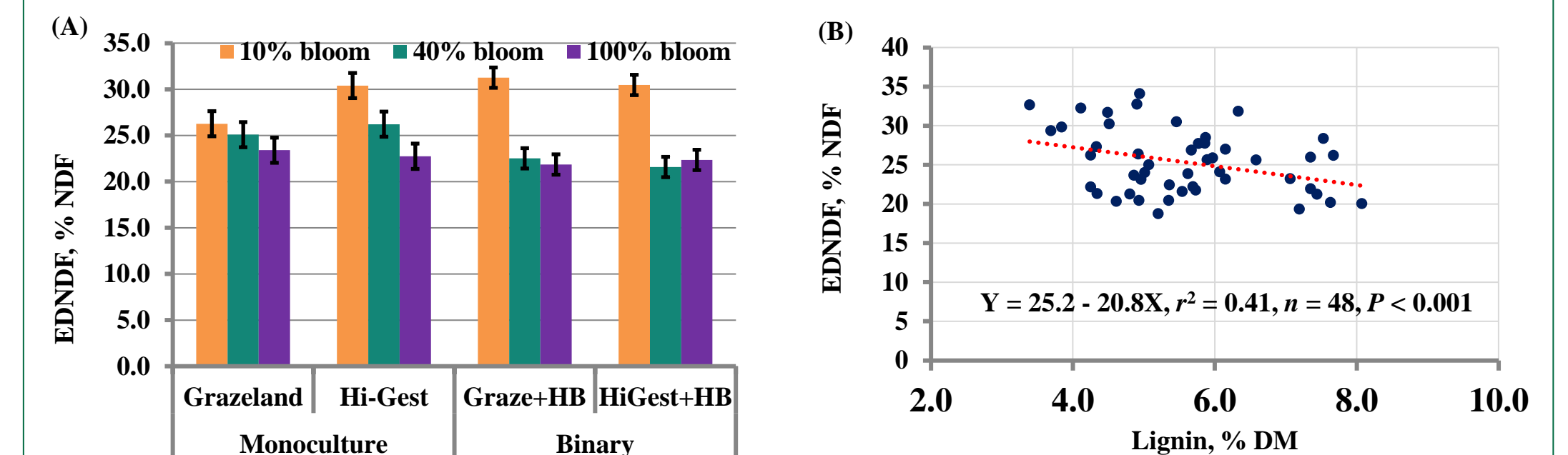


Fig. 5. Effective degradable neutral detergent fiber (EDNDF; A) and regression relationship (B) between forage lignin (Y; %, DM) and EDNDF (X; kg/ha) of forages.

- Hi-Gest had greater ($P < 0.05$) EDMD (**Fig. 4A**; 7.2% more; 52.0 vs. 48.5 %, DM), EDCP (**Fig. 4B**; 14.3% more; 63.0 vs. 55.1%, CP), and EDNDF (**Fig. 5A**; 6.2% more; 26.5 vs. 24.9%, NDF) relative to Grazeland.
- Hi-Gest+HB had greater EDCP (8.2% more; 37.0 vs. 34.2%, CP), but similar EDMD (38.8%, DM) and EDNDF (25.0%, NDF) relative to Graze+HB.
- As the maturity advanced, in both mono- and binary systems, EDMD, EDCP, and EDNDF declined ($P < 0.05$). Each percentage unit increase in lignin concentration decreased EDNDF by 2.1 percentage units (**Fig. 5B**).
- The stand establishment costs were \$458.70/ha (\$185.60/ac), \$233.44/ha (\$94.47/ac), \$351.50/ha (\$142.25/ac), and \$464.20/ha (\$198.10/ac) for Hi-Gest, Grazeland, Graze+HB, and Hi-Gest+HB, respectively

Conclusions and Implications

The Hi-Gest alfalfa (in both monoculture and binary systems) did not differ in DMY and nutrient profiles, but was greater in rumen degradation potential relative to AC Grazeland, suggesting Hi-Gest 360 alfalfa is a viable alternative legume in both monoculture and binary systems for the Black soil zone of Saskatchewan.

Acknowledgements

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