

Development And Nutritive Value Of High Altitude-Grown Alfalfa and Meadow Bromegrass

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Abstract

Alfalfa (*Medicago sativa* L.) HarvXtra cultivar ‘NexGrow 6409’ and meadow bromegrass (*Bromus biebersteinii* Roem. & Schult) cultivar ‘Cache’ were planted as four replicated 0.74-ha monoculture stands on 26 August 2019. Stands were assessed at biweekly intervals during the establishment year, 2020, using mean stage by weight distribution of at least 40 stems of alfalfa as described by Fick and Muller (1989). Forty stems of the grass, meadow brome, were also assessed by weight distribution of growth stage (vegetative, elongation or reproductive; Moore et al., 1991). At each sampling, each replication was assessed for yield using three 0.1-m² quadrats clipped to a 7.6-cm stubble height; these quadrats were also used to calibrate a Farmworks® F100 rising plate meter. Each of the four replicated stands of each forage were further assessed for yield by walking a transect delineating one-third of each rectangular stand while taking at least 30 readings with a rising plate meter, which were averaged. Calibration samples were oven-dried at 60°C to constant weight. Stems clipped to a 0.76-cm height were collected along the opposite transect of each stand subsection, frozen in the field and stored at -20°C until freeze-dried. These samples were milled to pass the 1-mm screen of a Wiley mill and assessed for nutritive value using the near infrared spectroscopy (NIRS) Forage and Feed Testing Consortium extended equations for legume (alfalfa) or grass (meadow brome) hay. Stands were fully harvested to 0.76 cm and removed at the one-tenth bloom stage of alfalfa, initiating regrowth cycles. Before each full harvest, stems of alfalfa and meadow brome were cut at 7.6 cm, leaves and stems were separated, frozen in the field, freeze-dried, milled and analyzed, along with whole plant samples, using both NIRS and laboratory chemical analyses for neutral detergent-soluble carbohydrate components.

Introduction

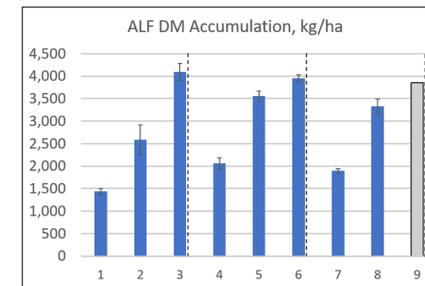
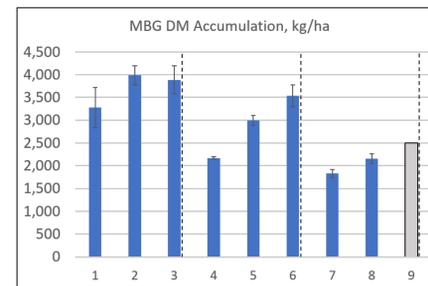
A very high concentration of non-fiber carbohydrate (NFC) has been observed in perennial legumes grown in the high-altitude West, on average about 46% of the dry matter composition compared with values closer to 25% in other climates.

This study was performed to compare the nutritional composition of alfalfa (ALF; *Medicago sativa* L.) with meadow bromegrass (MBG; *Bromus beibersteinii* Roem. & Schult.).

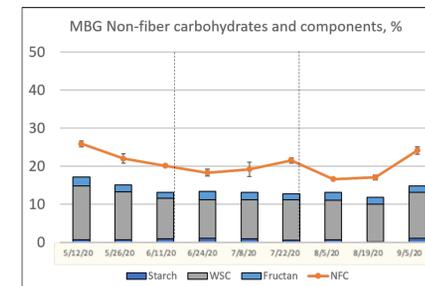
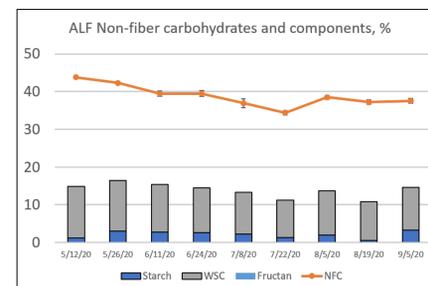
Methods

- We used an alfalfa cultivar NexGrow HarvXtra (reduced lignin) 6409 with Roundup Ready technology and the meadow bromegrass cultivar Cache.
- Samples were taken at 14-day intervals. Samples included three 0.1 m² samples clipped to a height of 7.5 cm for yield determination and were used to calibrate a non-destructive rising plate meter. The rising plate meter was used to estimate forage dry matter along a diagonal pasture transect. Grab samples of the whole plant were collected, stored on ice in the field, frozen and freeze-dried for determination of the composition of the forage. Pastures were harvested 3 times at 42-day intervals, and stem-and leaf samples of both species were taken prior to each harvest.

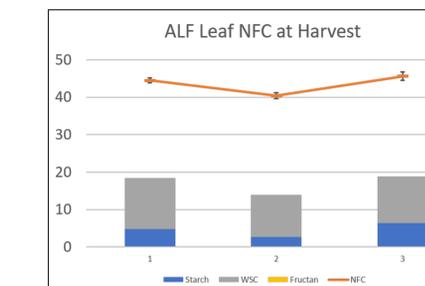
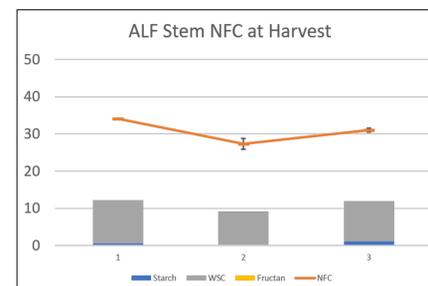
Results



- Our results show that the total harvest was ALF: 5.31 tons/acre (12 Mg/ha) and MBG: 4.43 tons/acre (Mg/ha)
- These charts demonstrate the dry matter accumulation in the alfalfa and meadow bromegrass, respectively. The dashed lines are indicative of the harvests and the bars represent the biweekly samples



- Freeze-dried forages represent the quality of pasture rather than hay. The orange line represents the total non-fiber carbohydrate concentrations in each graph and the stacked columns are the totals of starch, water-soluble carbohydrates and fructan. We found that reduced lignin alfalfa was no higher in NFC than other Roundup Ready alfalfa.
- The gap between the NFC and the total of water-soluble carbohydrates, starch and fructan is neutral detergent soluble fiber plus organic acids. This amounts to about 7% of MBG dry matter and 25% of ALF dry matter.



- The data below are from ALF stem and leaf samples. Note that neither have fructan. The mean ALF leaf concentration is 44% while the mean ALF stem NFC concentration is 31%
- The gap of 26% ALF leaf DM and 20% ALF stem DM is neutral detergent soluble fiber and organic acids.



TABLE 2 Nutritive value of alfalfa hay harvested from high-elevation stands in central Utah

| Altitude | NDF | NFC | TDN | Temperature | | | Average rainfall |
|-------------------|-----|-----|-----|-------------|------------|---------|------------------|
| | | | | Yearly high | Yearly low | Average | |
| 5,000-ft. alfalfa | 31% | 39% | 69% | 66°F | 32°F | 49°F | 8.63 in. |
| 6,000-ft. alfalfa | 32% | 36% | 69% | 64°F | 32°F | 48°F | 12.13 in. |
| 7,000-ft. alfalfa | 31% | 37% | 71% | 60°F | 28°F | 44°F | 7.91 in. |

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As shown in the table of alfalfa samples from a study by Matt Yost, below, the concentration of NFC does not increase with elevation.

Conclusion

Our data suggests that alfalfa has a higher nutritional composition than meadow bromegrass. Our data also suggests that the long sunny days and cool nights typical of the Mountain West, which are ideal for the growth of irrigated alfalfa, lead to the high observed levels of neutral detergent-soluble fiber. This is due to elevated photosynthesis as well as reduced respiration at night, which reduces the loss of carbohydrates produced during the day.

Acknowledgement

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