Histological analysis of lignification in birdsfoot trefoil (*Lotus corniculatus*) stems and implications for management

S. R. Hunt and J. W. MacAdam

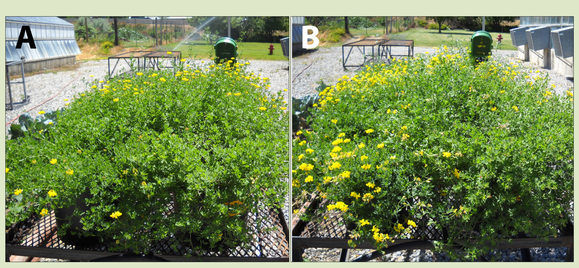
Dept. of Plants, Soils and Climate; Utah State University, Logan, UT 84322

Abstract

The 6th internode from the base of growing stems of birdsfoot trefoil (BFT; *Lotus corniculatus*), located approximately 7.5 cm (3 inches) from the soil surface, was selected for study because it is located at the recommended grazing height for this species. The lignification of this internode was studied during regrowth from elongation to maturation.

The 6th internode of alfalfa (*Medicago sativa*) was used as a control.

Internodes were sampled during 15 weeks of summer regrowth, hand sectioned, viewed under UV light and stained with phloroglucinol/HCl and toluidine blue O to observe lignin. Patterns of lignification were similar in BFT and alfalfa, which was previously studied by Engels and Jung. The most extensive lignification in both species occurred in the secondary xylem. After 4 to 5 weeks a lignified xylary ring formed in 6th stem internodes and grew to maximum thickness by approximately 7 weeks, which coincided with flowering. Because lignification decreases forage quality, and thickening of the xylary ring reduces the ability of cattle to harvest BFT at or below the 6th internode, our findings provide an anatomical basis for the recommendation to harvest BFT at approximately 6 weeks of regrowth.



BFT study plants in beginning bloom at 5.5 (A) and 6.5 (B) weeks of regrowth, the recommended time of harvest.

Objective

Following the example set by Engels and Jung (1998) in their analysis of alfalfa stem tissues:

- Document growth and lignification in BFT stems
- Relate stem development to management practices

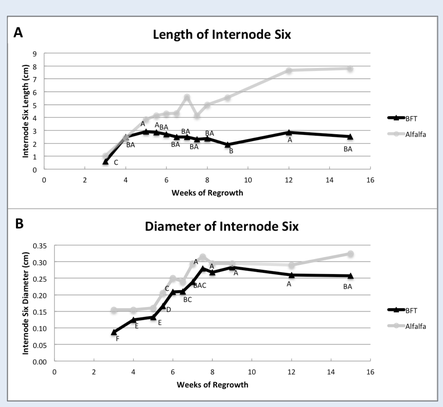
Materials and Methods

- Sample the 6th internode of stems during 15 weeks of outdoor summer regrowth
- Hand section internodes and stain with toluidine blue O to observe stem anatomy and lignification

Results

Stem and Internode Growth

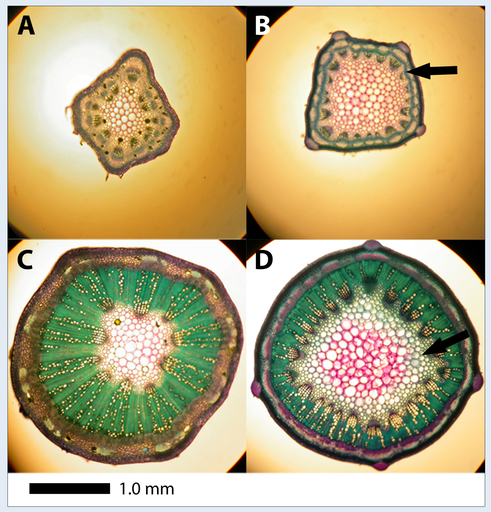
- Alfalfa stems grew faster and longer than BFT
- Length of BFT Internode 6 increased only between 3 and 4 weeks of regrowth
- Diameter increased until 7 weeks of regrowth.



Growth in length (Graph A) and diameter (Graph B) of BFT and alfalfa 6th stem internodes.

Lignification

- Secondary xylem showed the most extensive lignification in BFT and alfalfa
- After 4 - 5 weeks a lignified xylary ring formed in 6th stem internodes
- The lignified ring reached maximum thickness by approximately 7 weeks, coinciding with flowering
- Early flower occurs just before maximum lignification and is the recommended time to harvest

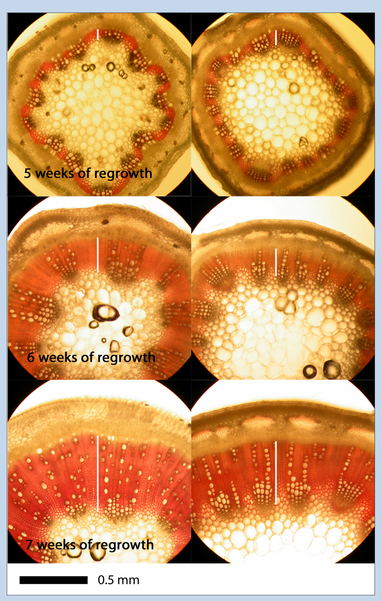


BFT (A, C) and alfalfa (B, D) 6th internode stem sections taken after 4 (A, B) and 12 (C, D) weeks of regrowth and stained with TBO. A lignified xylary ring develops earlier in alfalfa (B, arrow) than BFT. The lignified xylary ring of mature stems appears thicker at 12 weeks of regrowth in BFT (C) than in alfalfa (D).

Implications for Management

The recommendation to harvest BFT after 5 to 7 weeks of regrowth or at the appearance of early bloom is supported by the results discussed here.

- Extensive lignification at 7 weeks reduces stem digestibility and the ability of grazing ruminants to break stems
- Seven weeks of regrowth coincides with flowering
- Early flower, orabout 6 weeks of regrowth, is the appropriate time to graze BFT to optimize yield and quality



BFT (left) and alfalfa (right) stem sections after 5, 6 and 7 weeks of regrowth stained for lignin with phloroglucinol/ HCl. White lines mark the width of the lignified xylary ring, which expanded until 7 weeks of regrowth.

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