Can Grazing Selectivity Reduce Fatty Acid Intake Declines in Maturing Annual Forages?

Caleb Goossen[1], Sidney Bosworth[1], Jana Kraft[2]

[1]Department of Plant and Soil Sciences and [2]Department of Animal and Veterinary Sciences, The University of Vermont, Burlington, VT

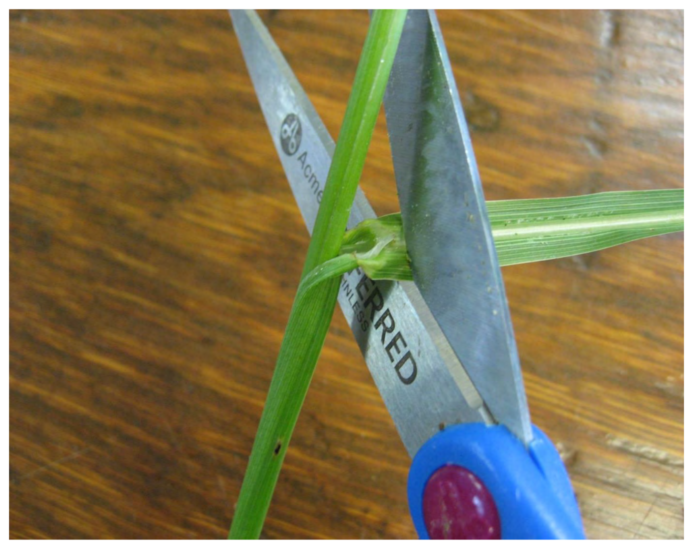
This study evaluates the fatty acid decline in annual forages, and their constituent components, as they mature.

Introduction

- Maximizing grazing availability is important to all organic dairy farmers, and particularly for grain-free "grassmilk" producers.
- Many producers in the Northeast are utilizing annual forage crops to provide supplemental grazing when perennial pasture is less productive *(e.g.,* early spring, mid-summer).
- Cool season perennial forage species are known to diminish in content of fatty acids (FA), particularly alpha-linolenic acid (ALA) as they mature, (Glasser *et al.*, 2013)
- Annual forages are known to quickly diminish in nutritive quality as they mature, as well as in content of ALA (unpublished data).
- ALA from forage is a key feedstock to, and driver of, the milk FA profile important to the marketing of "grassmilk".
- This study aimed to evaluate the reductions in FA content and nutritional quality of cool season and warm season annual forages of increasing maturity, in regards to both pseudostem and leaf blade fractions, and their summation on a whole plant basis.

Method

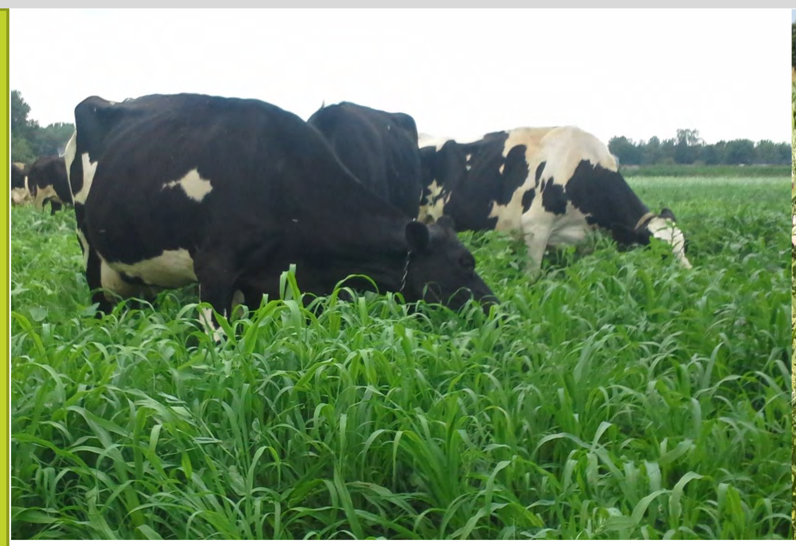
- Overwintered cereal rye *(Secale cereale)* and June planted pearl millet *(Pennisetum glaucum)* were sampled over the course of 9 and 19 days of grazing, respectively.
- Rye was harvested at 5 cm height and pearl millet at 15 cm height. All samples were divided to "leaf" (lamina) and "pseudostem" ("stem"; petiole + culm) components.
    - Pearl millet pseudostem portion from 1st sampling was composited across replications by necessity



- Forage nutritive quality was determined from near-infrared reflectance spectroscopy (NIRS) and FA determined by gas-liquid chromatography of fatty acid methyl esters.
- Milk/hectare and milk/tonne forage DM) calculated using the MILK spreadsheet (Schwab and Shaver, 2001; Undersander, 1993).

Results

- Nutritive quality and FA content declined with advancing maturity on an entire plant basis.
- The proportion of ALA in leaf and pseudostem components remained largely stable.
- On an entire plant basis, decreases in ALA proportion relative to total FA content was due primarily to the increase of pseudostem dry matter yield as the plants matured, for both species.
- The dry matter yield, nutritive quality ,and fatty acid content of leaf components changed minimally over the span of the grazing cycle.
- Sugar content of pearl millet pseudostem components appears to have been influenced by both maturity stage, and time of harvest (time data not shown)



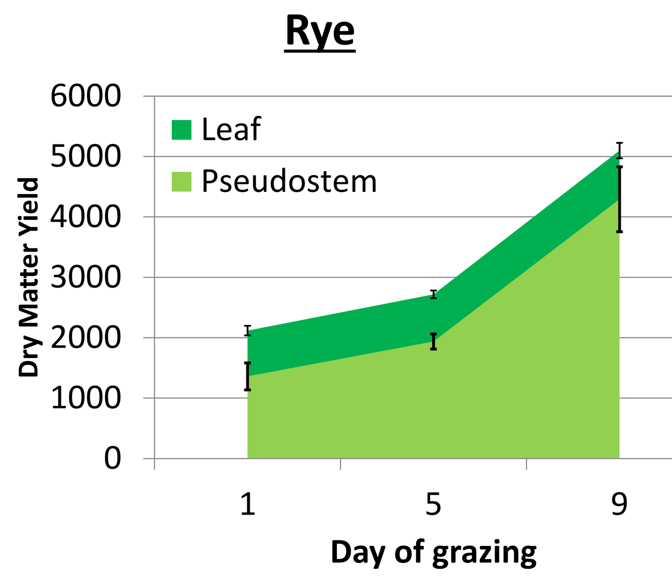


Figure 1) Dry matter yield (kg/hectare)

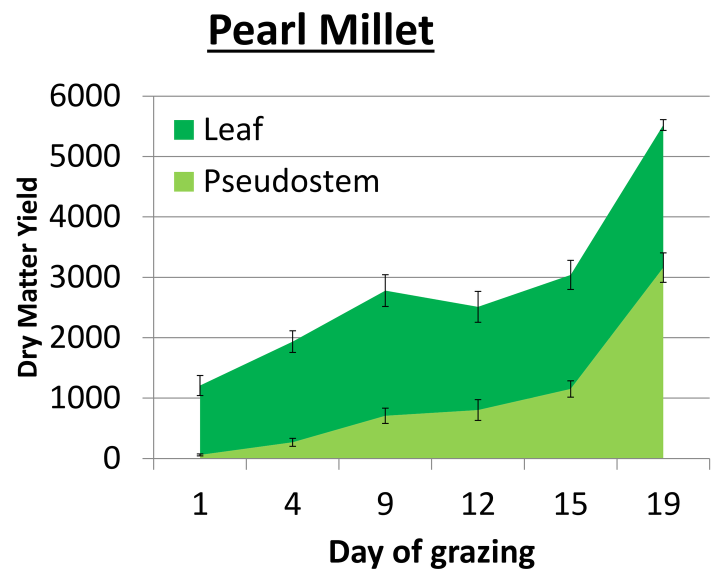


Figure 2) Dry matter yield (kg/hectare)

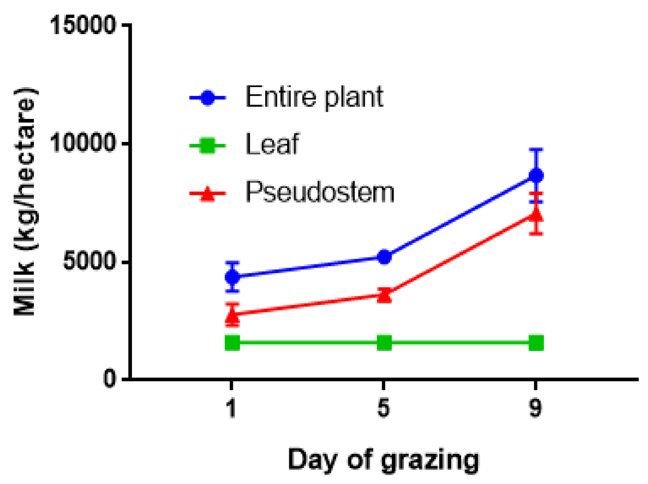


Figure 3) Milk (kg/hectare)

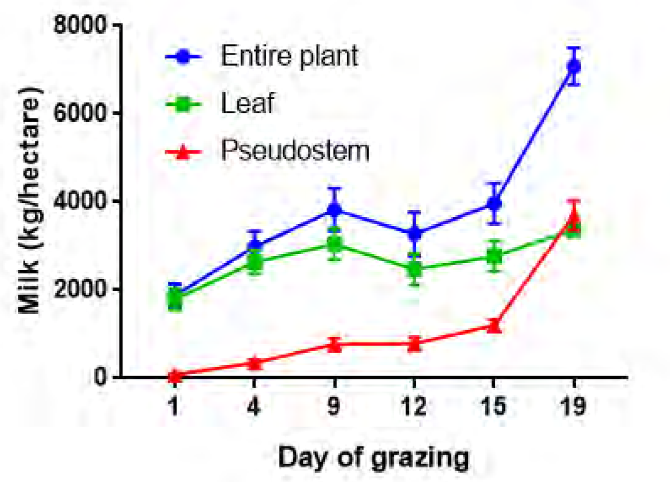


Figure 4) Milk (kg/hectare)

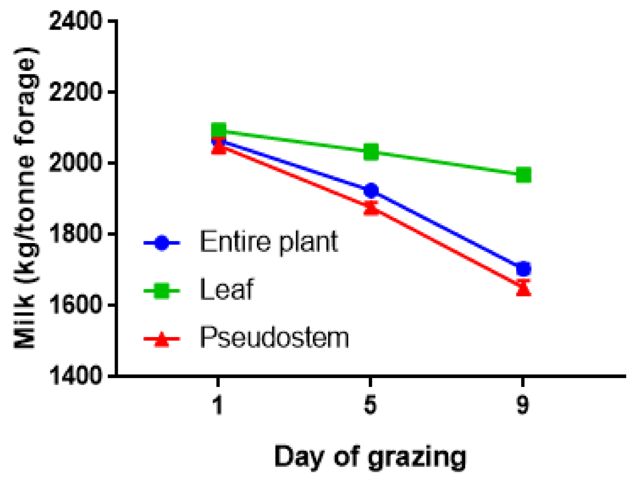


Figure 5) Milk (kg per metric ton of forage)

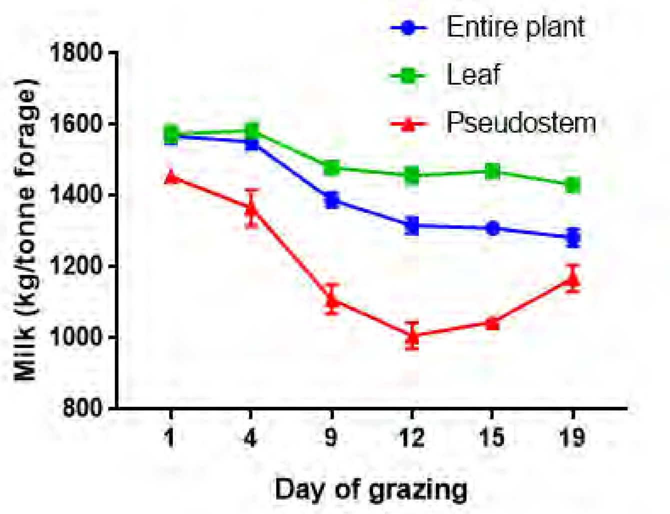


Figure 6) Milk (kg per metric ton of forage)

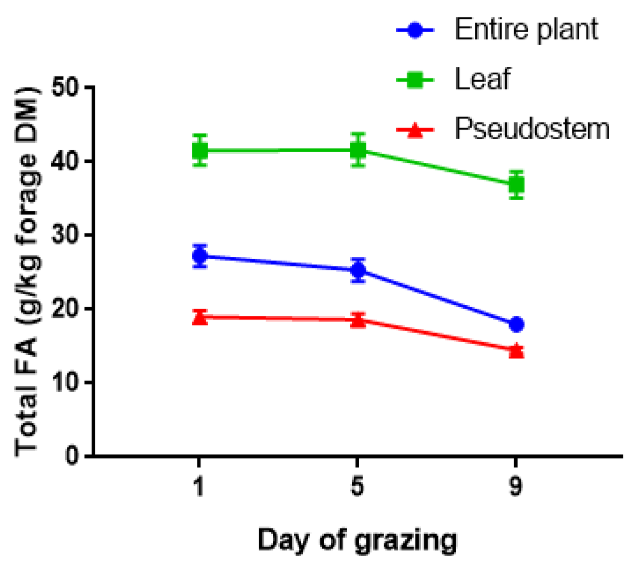


Figure 7) Total FA (g/kg forage DM)

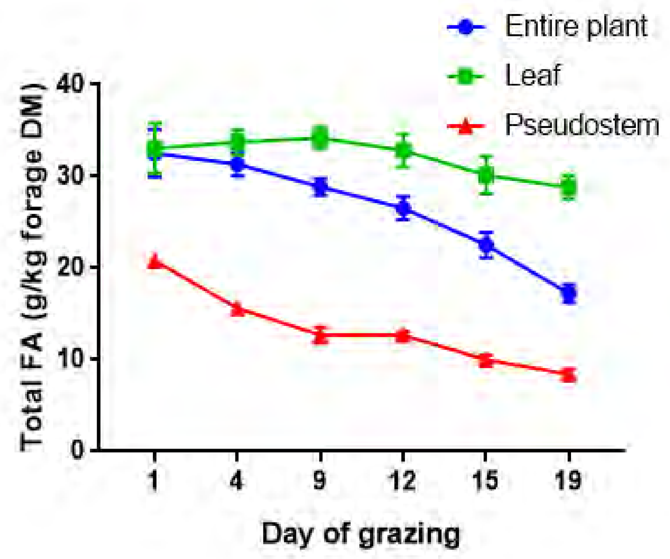


Figure 8) Total FA (g/kg forage DM)

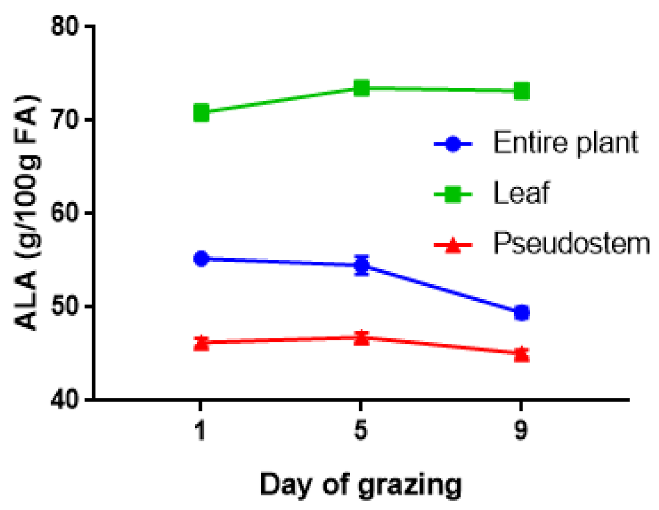


Figure 9) ALA (g/100g total FA)

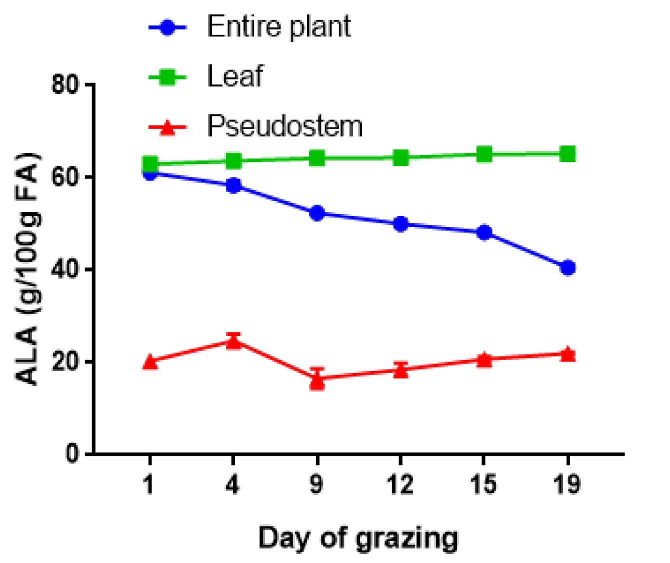


Figure 10) ALA (g/100g total FA)

Results, continued

Table 1 Rye nutritive quality, sampled at 5 cm

Day of grazing	Height *(cm)*	Component	Crude Protein *(g kg⁻¹of DM)*	NDF *(g kg⁻¹ of DM)*	dNDF48 *(g kg⁻¹ of DM)*	NDFD48 *(g kg⁻¹ of NDF)*	Sugars *(g kg⁻¹ of DM)*
Day 1 5/12/16	40	**Entire plant**	**136**	**452**	**360**	**796**	**164**
		Leaf 36.7%	204	440	354	805	124
		Stem 63.3%	96	459	363	790	186
Day 5 5/18/16	57	**Entire plant**	**127**	**514**	**384**	**750**	**147**
		Leaf 28.8%	204	472	376	798	103
		Stem 71.2%	95	531	387	729	164
Day 9 5/24/16	92	**Entire plant**	**82**	**627**	**410**	**657**	**122**
		Leaf 15.5%	180	517	391	758	99
		Stem 84.5%	65	647	414	639	127

Table 2 Pearl millet nutritive quality, sampled at 15 cm

Day of grazing	Height (cm)	Component	Crude Protein *(g kg⁻¹ of DM)*	NDF *(g kg⁻¹ of DM)*	dNDF48 *(g kg⁻¹ of DM)*	NDFD48 *(g kg⁻¹ of NDF)*	Sugars *(g kg⁻¹ of DM)*
Day 1 7/18/16	54	**Entire plant**	**184**	**573**	**409**	**715**	**60**
		Leaf 95.5%	188	570	407	715	59
		Stem 4.5%	80	635	446	702	78
Day 4 7/21/16	74	**Entire plant**	**164**	**569**	**393**	**691**	**75**
		Leaf 86.7%	175	563	390	693	74
		Stem 13.3%	93	608	413	679	79
Day 9 7/26/16	107	**Entire plant**	**171**	**620**	**405**	**656**	**48**
		Leaf 75%	190	601	401	667	47
		Stem 25%	114	675	419	621	50
Day 12 7/29/16	117	**Entire plant**	**147**	**641**	**418**	**655**	**43**
		Leaf 68.8%	175	613	413	673	42
		Stem 31.2%	86	702	432	615	46
Day 15 8/1/16	133	**Entire plant**	**120**	**667**	**438**	**658**	**62**
		Leaf 62%	150	634	425	671	58
		Stem 38%	71	722	459	636	67
Day 19 8/5/16	139	**Entire plant**	**90**	**693**	**443**	**639**	**74**
		Leaf 43%	144	645	421	653	58
		Stem 57%	49	730	459	629	87

Conclusions

- Whole plant analysis may underestimate the quality and fatty acid content that is actually consumed from grazed annual forages.
- Management that allows for grazing selectivity may ameliorate some of the quality decline of maturing annual forages, as well as the content of fatty acids, particularly ALA, by maintaining a steady leaf intake relative to pseudostem.
- Quality decreases associated with later maturity are resultant from both declines in the nutritive quality of stem and leaf components, and a greater amount of pseudostem material relative to the total.

NORTHEAST SARE Sustainable Agriculture Research & Education

Thank you to the Choiniere Family Farm and to Alan Howard for assistance with statistical analysis

Funding for the work reported here was provided by the USDA Sustainable Agriculture Research and Education Program.