Divergent Breeding for Tiller Digestibility Modified Leaf, Sheath, and Stem Composition of Switchgrass (*Panicum Virgatum* L.)

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Introduction Switchgrass (*Panicum virgatum*. L.) is a cross-pollinated, C_4 species that is native to the prairies of temperate North America. Breeding to improve its forage quality has been conducted using post-heading, whole-tiller *in vitro* dry matter digestibility (IVDMD) as the selection criterion. One breeding cycle (C-1) for low IVDMD and three cycles for high IVDMD (C1, C2, C3) were completed in a switchgrass population adapted to the USA mid-latitudes. Sward trials demonstrated that whole plant IVDMD had been improved (Hopkins *et al*., 1993). The objective of this study was to determine the effect of breeding for tiller IVDMD on leaf, sheath, and stem digestibility and composition of plants of the derived populations.

Materials and methods Seedlings of each population were transplanted into a replicated (r=4) field nursery in eastern Nebraska, USA in 2002. A plot consisted of 50 plants on 1.1m centres. After heading, ten tillers of each plant from the C-1 and C3 populations were sampled in 2002 and 2003. Tillers were dissected into leaf, sheath, and stem. Panicles were excised. Neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), ash, N and IVDMD concentrations were determined using near infrared reflectance spectroscopy (NIRS) and wet laboratory procedures as described by Casler *et al*. (2004). Cell wall (CW) concentrations were calculated assuming NDF g/kg = cell wall g/kg.

Results Breeding for increased tiller IVDMD had a greater effect on sheath and stem IVDMD, ADL, cell wall, hemicellulose, cellulose, lignin, and cell wall digestibility than on the same leaf traits (Table 1). Leaf cell wall, hemicellulose, and cellulose concentrations of the C-1 and C3 populations did not differ. Stem hemicellulose and cellulose concentrations did not differ at $p<0.05$. The C3 plants with improved IVDMD differed from plants of the C-1 population by having lower stem and sheath cell wall and lignin concentrations.

Table 1 Mean digestibility (DMD), cell wall (CW), lignin (L), cellulose (C), hemicellulose (HC), and nitrogen (N) of leaf, sheath, and stem of switchgrass plants from a low (C-1) and high (C3) IVDMD population

Strain	Tissue	IVDMD (g/kg)	ADL (g/kg)	CW (g/kg)	HC(CW) (g/kg)	C(CW) (g/kg)	L(CW) (g/kg)	DMD(CW) (g/kg)	N (g/kg)
C-1	Leaf	672*	25.9*	589	500	448	43.5*	440*	16.4**
C3		682	23.8	586	500	450	39.9	453	16.8
SE		21	3.4	23	5	9	4.1	17	0.4
C-1	Sheath	581**	37.7**	704*	448**	489	53.5**	427**	6.4
C3		623	32.4	697	457	487	46.6	482	6.3
SE		21	3.3	7	8	10	4.0	29	1.0
C-1	Stem	464**	69.5**	756*	416	485^{+}	91.4**	291**	3.7**
C3		502	60.3	747	419	493	80.4	333	4.2
SE		16	4.8	15	15	13	6.5	16	0.3

+, *, ** Indicate populations differ at the 0.10, 0.05, and 0.01 levels of probability; SE = standard error. Two-year means are expressed on a dry weight or cell wall (CW) basis

Conclusions Leaf, sheath, and stem IVDMD, cell wall, cellulose, hemicellulose, and lignin concentration of switchgrass responded differently to breeding for tiller IVDMD indicating tissue specific regulation of plant composition. Breeding switchgrass for use in grazing systems should emphasize leaf and sheath composition. Stem composition can be modified to develop switchgrass cultivars for biomass energy.

References

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