

Predictive Models for Biomass Yield of Switchgrass Based On Morphological Traits D.L. Price¹, M.D. Casler²

WISCONSIN UNIVERSITY OF WISCONSIN-MADISON

¹Department of Agronomy, Plant Breeding and Plant Genetics Program, University of Wisconsin, Madison, WI; ²USDA-ARS, U.S. Dairy Forage Research Center, Madison, WI.

*DLPrice2@wisc.edu

INTRODUCTION

Switchgrass has many valuable characteristics as a biofuel feedstock; in order to become commercially viable further improvements must be made to improve biomass yield and consequently increase ethanol production. Direct selection for biomass yield in switchgrass has proven difficult due to the many factors influencing biomass yield. The identification of morphological traits associated with biomass yield could increase the efficiency of breeding efforts if these traits can be used as indirect selection criteria. By allowing increased screening and greater intensity of selection for biomass yield within spaced-plant nurseries, these results may impact how phenotypic selection is used for switchgrass cultivar development. The objective of this research was to identify morphological traits in parent plants that are predictive of biomass yield within progeny plants.

Variable (units)	Max	Min	Mean	SD		0 0 -	00	2 7		mas	<u>;</u> 0F)		32F)	32F)	\$2F) It	ž2F) h	th t	E E E E E E E E E E E E E E E E E E E	gth f	gth 32F)	SEF) ath ath	gth from the formula of the formula	gth are the set of the	gth ce ce	gth ce ce	gth ce	Se th th (2F)	SE (2F) ath c (2F) se gth	gth See at 2E)	Se ath th t	Se gth 35F)	gth th th (2F)	gth ce ce	gth ce ce	gth ce see	SE th 1 th 2F)	gth ce
Yield Arlington 2009(Mg/ha)	17.4	7.2	12.0	2.0		2009 2010 201	d 20 d 20	d 20	STS	/ bio	-) gr		.) gr	.) gr +	ng (3 t leigh	ng (3 t ieigh ength	ng (3 t eigh ength leng	ng (3 t ength leng width	ng (3 t ength engt kuidth vidth	ng (3 t ength engt width vidth ss	ng (3 t ength engt leng e e e mete mete	ng (3 t ength engt leng e len es	ng (3 t eigh engt leng e len es mete	ng (3 t ength engt leng e e nete mete	ng (3 t ength engt leng e e nete mete	ng (3 t eigh engt leng es mete erend	ng (3 t ength ength width width e len es mete	ng (3 t eigh engt leng e e e e e e e e e e e	ng (3 t eigh engt engt eien es erenc	ng (3 t eigh engt leng es mete erend	ng (3 t eigh engt leng es mete erend	ng (3 t ength ength width e len es mete erend	ng (3 t ength ength width e len es mete	ng (3 t ength ength width e len es mete erend	ng (3 t eigh engt engt leng es mete	ng (3 t ength ength width width e len es mete	ng (3 t ength ength width width e len es mete
Yield Arlington 2010(Mg/ha)	36.6	9.5	20.2	5.2		yton yton	hfield	hfield	nate 5 tille	it dry	date verir	•	werir	werir It Picht	werir it eight cle h	werir it eight cle h cle le	werir it eight cle h cle le leaf	werir nt eight cle h cle k leaf leaf	werir it eight cle h cle h leaf leaf node	werir it eight cle h cle k leaf leaf node node	werir tut eight cle h cle h cle f leaf node node	werin tut eight cle le cle le leaf leaf node node node	werir tut eight cle le cle le leaf node node node node node	werir tut eight cle h cle k leaf leaf node node node umfe	werir tut eight cle h cle k leaf leaf node node node umfe	werir ht eight cle h cle h leaf leaf node node node node umfe	werir t eight cle h cle le leaf node node node umfe	werir t eight cle h cle h cle f leaf node node node umfe	werir ht eight cle h cle h leaf node node node node node umfe	werir ht eight cle h cle h leaf node node node node umfe	werir ht eight cle h cle h leaf node node node node	werir verir eight cle h cle h leaf leaf node node node umfe	werir verir eight cle h cle h leaf leaf node node node umfe	werir verir eight cle h cle h leaf leaf node node node umfe	werir ht eight cle h cle h leaf node node node umfe	werir ht eight cle h cle h leaf node node node umfe	werir ht eight cle h cle h leaf node node node node
Yield Arlington 2011(Mg/ha)	24.9	6.0	15.2	4.1		vrling vrling vrling	/ars /ars	/arsl	estin ass 5	plan	ing (∫ ∫ U	o flov ıeigh af hí	o flov ieigh af he	o flov ieigh af he oanie oanie	o flov ieigh af he oanic oanic oanic	o flov ieigh af he oanic oanic 2nd l 2nd l	o flov ieigh af he canic canic 2nd l 2nd l nteri	o flov leigh af he canic canic 2nd l 2nd l nter h of l	o flov leigh af he canic canic 2nd l 2nd l nter nter stem	o flov ieigh af he canic canic 2nd I 2nd I 2nd I stem	o flov leigh af he canic canic nter nter t of I circi	o flov leigh af he canic canic 2nd l 2nd l 2nd l nter stem circl	o flov leigh af he canic canic 2nd l 2nd l 2nd l nter stem circl	o flov leigh af he canic canic 2nd l 2nd l 2nd l her nter stem circu	o flov leigh af he canic 2nd I 2nd I 2nd I ter ter circu	o flov leigh af he canic 2nd I 2nd I 2nd I teri stem circu	o flov leigh af he canic canic nter nter circu	o flov leigh af h(canic 2nd I 2nd I 2nd I terr stem circ	o flov leigh af he canic 2nd I 2nd I 2nd I 2nd I canic circi	o flov ieigh af he canic canic and l 2nd l 2nd l 2nd l ater circu	o flov leigh af he canic 2nd I 2nd I 2nd I 2nd I terr stem circl	o flov ieigh af he canic canic and l 2nd l 2nd l 2nd l ater circu	o flov leigh af he canic 2nd I 2nd I 2nd I 2nd I aterr circl ount	o flov leigh af he canic 2nd I 2nd I 2nd I 2nd I atem circu	o flov leigh af he canic 2nd l 2nd l 2nd l 2nd l rteri circi ount
Yield Marshfield 2009(Mg/ha)	22.6	11.1	15.3	2.3		∠ ble ∠ ble ∠ ble	V ple		л Л Л Л	Jgle	DD to	1		DD to ant h ant h	DD t(ant h ag le ean j	DD to ant h ag le san l	DD to ant h ag le ean l ean l	DD to ant h ag le ean l ean l ean l	DD to ant h ag le ean j ean j ean j	DD to ant h ag le san j san j san j	DD to ant h ag le ean j ean j ean j ean s	DD to ant h ag le ean j ean j ean j ean j	DD to ant h ag le ean j ean j ean j ean j	DD to ant h ag le ag le ean j ean j ean j ean s own	DD to ant h ag le ag le ean j ean j ean j ean s own	DD to ant h ag le ag le ean j ean j ean j own	DD to ant h ag le ean j ean j ean j ean j ean j	DD to ant h ag le ag le ean j ean j ean j ean s own	ob to ant h ag le ean : ean : ean : ean : ean : own	DD to ant h ag le ean j ean j ean j ean j ean j ean j	DD to ant h ag le ag le ean j ean j ean j ean s ean s	DD to ant h ag le ag le ean j ean j ean j own	DD to ant h ag le ag le ean j ean j ean s own	DD to ant h ag le ag le ean j ean j ean j own	DD to ant h ag le ean j ean j ean j ean j ean j ean j ean j	DD to ant h ag le ag le ean j ean j ean j ean j ean j ean j ler c	DD to ant h ag le ag le ean j ean j ean j ean j ean j ler c
Yield Marshfield 2010(Mg/ha)	19.4	4.1	10.3	3.2		ži X žie	Ξ. Υ	, T	л Г	i Ñi		C	ז פֿ	ם מו	שיים אין פו																						
Yield Marshfield 2011(Mg/ha)	20.1	5.9	10.6	2.5	Yield Arlington 2009	OC		$) \bigcirc ($							$) \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ $) 0 0 0 0) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0																		
BLUP estimate	1.6	-1.4	0.0	0.6	Yield Arlington 2010 Yield Arlington 2011	0.2	$\bigcirc \bigcirc \bigcirc$	$) \bigcirc ($)()(
Dry mass 5 tillers(g)	64.8	15.7	42.6	8.8	Yield Marshfield 2009	0.2 0.2 0.1		$) \bigcirc ($	$\frac{1}{2}$		\mathcal{C}	$\tilde{\mathbf{C}}$)($) \bigcirc ($	$) \bigcirc \bigcirc$	$) \bigcirc \bigcirc$																					
Single plant dry biomass(g)	1027	98	600	183	Yield Marshfield 2010	0.1 0.1 0	0.1	\tilde{O}	$\widetilde{)}$	$\check{\bigcirc}$	ŎŎ	Ŏ)()	ŎŎŎŎŎ																					
Flowering date(Days after June 30)	39.2	20.8	27.7	3.3	Yield Marshfield 2011	0.2 0.1 0.1	0.2 0.2	2 (20		$\sum_{i=1}^{i}$	\bigcirc	(O(OOC	OOOO	OOOOO	OOOOOO(OOOOOOO	OOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO				OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO	OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO			
GDD to flowering (accumulated GDD base 50F) 1948	1516	1695	83	BLUP estimate Drv mass 5 tillers	0.4 0.7 0.5	0.5 0.5	50.4 0010		\square																											
GDD to flowering(accumulated GDD base 32F)	4391	3635	3936	140	Single plant dry biomass	0.2 0.1 0.1	0.1 (0.2 0	.2 0.2					$\mathcal{D}($)00																						
Plant height(cm)	222	145	184	15	Flowering date	-0.1 0 0.2	0.1 (0.2 0	.1 0.2	0	/			$\mathcal{O}($	200																						
Flag leaf height(cm)	154	87	124	12	GDD to flowering (50F)	-0.1 0 0.2	0.1 (0.20	.1 0.2	0	1	/($\mathcal{O}($		2000	20000	OOOOOO(2000000000000000000000000000000000000	2000000000000000000000000000000000000		$\begin{array}{c} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 $															
Mean panicle height(cm)	151	99	125	11	Plant height	-0.1 0 0.2	0.1 0) 0.2 0) 0.2 0	.1 0.2	0.4 (1 1).3 0.3	0.3																									
Mean panicle length(cm)	77.8	42.7	60.1	7.4	Flag leaf height	0.1 0.1 0.1	0.1 0	0.2 0	.2 0.6	0.4 0).3 0.3	0.3 0).	9	9	9	9	9 1000	9 100000	9 1000000	9 10000000	9 0000000	9 0000000	9 000000	9 000000	9 0000000	9 0000000	9 00000000	9 0000000	9 20000000	9 10000000	9 10000000	9 10000000	9 10000000	9 20000000	9 20000000	9 20000000
Mean 2nd leaf length(cm)	59.5	29.6	47.8	4.9	Mean panicle height	0.1 0.1 0.1	0.1 0	0.2 0	.2 0.4	0.4 0	0.1 0.2	0.1 0).9	9 0.	9 0.8	9 0.8	9 0.8	9 0.8	9 0.8	9 0.8 000000			9 0.8 0000000									9 0.8 0000000		9 0.8 0000000			
Mean 2nd leaf width(mm)	14.4	8.3	10.9	1.1	Mean panicle length	0 0.1 0.1	0.1 0.1	0.1 0	.2 0.1	00).2 0.2	0.2 ().7	0.	0.2 0.4	0.2 0.4	0.2 0.4																				
Mean internode length(cm)	26.3	16.9	21.6	1.8	Mean 2nd leaf width	0 -0.1 -0.1	-0.2 -0.1	0-0	.2 0.5	-0.1	0 0	0.5 0).1	0.	0.4 0.3	0.4 0.3 0.3 0.3 0.1 0.1 0	0.4 0.3 0.3 0.1 0.1 0.1	0.1 0.1 0 0.1 (0.1 0.1 0 0.1	0.1 0.1 0 0.1	$0.4 \ 0.3 \ 0.3$	0.1 0.1 0 0.1															
Mean # of nodes(count)	7.0	4.8	5.9	0.4	Mean internode length	-0.1 0 0	0 0	0.1	0 0.2	0.1	0 0	0 0	0.6	0.	0.5 0.7	0.5 0.7 0.5	0.5 0.7 0.5 0.3	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2	0.5 0.7 0.5 0.3 0.2
Mean stem diameter(mm)	4.8	2.8	3.8	0.4	Mean # of nodes	0.2 0 0.1	0.1 0	0.1 0	.2 0.3	0.4 0).2 0.2	0.2 0).3	0.	0.5 0.4	0.5 0.4 -0.1	0.5 0.4 -0.1 0 -	0.5 0.4 -0.1 0 -0.1 -0	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4	0.5 0.4 -0.1 0 -0.1 -0.4
Crown circumference(cm)	136	22	86	17	Mean stem diameter	-0.1 0 0.1	0 0.1	0.2 0	.1 0.7	0.1 ().1 0.1	0.1 0).5) 2	0. 0	0.5 0.5 03 03	0.5 0.5 0.3	$0.5 \ 0.5 \ 0.3 \ 0.4$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 \qquad \bigcirc $	$0.5 \ 0.5 \ 0.3 \ 0.4 \ 0.4 \ 0.4 \ 0.1 $
Tiller count(count)	313	46	112	38	Tiller count	0.2 0.1 0.1	0 (0.1 0	.2 -0.3	0.7 -0).2 -0.2	-0.2	0	С.	0 0.1	0 0.1 0	0 0.1 0 0-	0 0.1 0 0 -0.3 -0	0 0.1 0 0 -0.3 -0.1 0.	0 0.1 0 0 -0.3 -0.1 0.2 -0.3	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 (0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7	0 0.1 0 0 -0.3 -0.1 0.2 -0.3 0.7 (
	77	0	10	F	Tiller density	0 0 0	0 0.1	-0 1 0	1 -0 4	-0 1 -0) 1 -0 1	-0.1-0).3 -().	0.4 -0.4	0.4 -0.4 -0.1	0.4 -0.4 -0.1 0 -	0.4 -0.4 -0.1 0 -0.2 -0	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -(0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.4	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3	0.4 -0.4 -0.1 0 -0.2 -0.1 -0.3 -0.4 -0.5 0.3

METHODS

From an advanced breeding nursery that had previously undergone selection for increased biomass yield, 140 parent plants were selected from 70 families. The selected parents plants were split into three pieces and transplanted to a separated nursery at Arlington, WI. Half-sib seed from each parent was used to conduct replicated seeded-plot yield trials at Arlington, WI and Marshfield, WI during 2009-2011. Plant morphological traits were measured on parent plants during 2010 and 2011.

Predictive models were generated to predict biomass yield at each location by year combination based on plant morphological traits using a best subset selection procedure and accounting for linear dependencies between traits. Models were also fitted to a best linear unbiased prediction (BLUP) of biomass yield based on all locations and years.





Table 1. Summary of plant morphological traits and biomass yield used for predictive model development.

Figure 3. Pearson correlation coefficients of plant morphological traits and biomass yield. Red figures indicate negative corelations and blue positive. Shape indicates the strength of correlation.

	ARL2011	ARL2010	ARL2009	MSH2011	MSH2010	MSH2009	BLUP1	BLUP2	BLUP3	BLUP4	BLUP5	BLUP6	BLUP7	BLUP8	BLUP9	BLUP10
Adjusted R ²	0.075	0.025	0.049	0.974	0.034	0.022	0.080	0.079	0.086	0.071	0.084	0.077	0.091	0.075	0.089	0.082
Residual standard error	3.791	5.131	1.909	2.351	3.177	2.236	0.567	0.567	0.565	0.569	0.565	0.568	0.563	0.568	0.564	0.566
Residual degrees of freedom	135	137	136	136	135	138	136	136	135	137	135	136	134	136	134	135
Overall f-value	3.84	2.75	3.41	6.00	2.21	4.08	5.02	4.96	4.25	6.28	4.20	4.85	3.79	4.77	3.73	4.09
Overall p value			0.010	0.001	0 071	0.045			0 002		0 002			0 002		0 001

Figure 1. Morphological traits measured in replicated spaced-plant nursery of 140 parents







Table 2. Traits selected and model descriptives for best model for each location by year combination, and the ten best models based on BLUP estimates of biomass yield. Filled boxes indicate inclusion of a trait within each model.

CONCLUSIONS

The results of this research demonstrate the challenges of selecting for increased biomass yield in switchgrass within spaced plant nurseries. While limited predictive ability was observed using individual and combinations of plant morphological traits, models using multiple subsets of traits were highly significant. This result suggests that a variety of traits likely contribute to biomass yield and may be valuable as selection criteria especially under

Figure 2. Replicated yield trial of half-sib progeny at two locations and three years

RESULTS

Variation was observed for all plant traits measured. Correlations between morphological traits ranged from -0.5 to 1. Correlations between individual traits and biomass yield were <0.2. Unique best models were identified for each location by year environment. Predictive capabilities were limited, based on adjusted R². Using BLUP estimates of biomass yield based on all environments resulted in greater predictive power. This trend was observed using multiple subsets of traits as predictors of BLUP estimates.

high selection intensity. Specifically it was observed that increased plant height, reduced 2nd leaf width, and decreased internode length were factors in multiple best models. Future work will include the evaluation of direct selection for specific traits and heritability estimation of morphological traits.

ACKNOWLEDGEMENTS

We are grateful for support provided by the Gabelman-Shippo Graduate Fellowship program and the Dwayne Rohweder Forage Extension Award at the University of Wisconsin–Madison in support of this research.



UID: 71668