

## Aberystwyth University

### *Towards Miscanthus combustion quality improvement: the role of flowering and senescence*

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1 Supplementary Table 1. Predicted means for N, P, K, Na, ash, and MC from REML Genotype and Harvest analysis at available flowering states  
2 (flowered vs non-flowered) for diverse *Miscanthus* genotypes from trait trial in Aberystwyth (Wales, UK). Genotype LM1 is *Miscanthus x*  
3 *giganteus*. Genotype categories are based on flowering and senescence phenotypes where the 1<sup>st</sup> letter denotes flowering category (exertion of first flag leaf on or before: 21<sup>st</sup>  
4 July 2009=early (E); 25<sup>th</sup> August = mid (M)); after 25<sup>th</sup> August = late (L), or not at all = non (N); 2<sup>nd</sup> letter denotes senescence category based upon the loss of >80%  
5 greenness before: 23<sup>rd</sup> October (E); 24<sup>th</sup> November (M); or later (L). Blank cells indicate insufficient material at harvest time.

Genotype	log N % w/w			log P mg kg <sup>-1</sup>			log K mg kg <sup>-1</sup>			log Na mg kg <sup>-1</sup>			logit ash % DM			logit MC % DM		
	Harvest			Harvest			Harvest			Harvest			Harvest			Harvest		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
EE1	-0.080	-0.434	-0.472	3.111	2.740	2.291	3.958	3.098	2.459	2.149	2.031	1.889	-3.343	-3.830	-4.327	1.043	0.120	-1.783
EE2	0.109	-0.317	-0.363	NA	2.806	2.519	NA	2.936	2.480	NA	2.154	2.021	-2.925	-3.863	-4.175	1.304	-0.163	-1.996
EE3	-0.151	-0.462	-0.503	3.222	2.799	2.486	2.867	3.110	2.650	2.187	2.065	2.114	-2.847	-3.484	-3.826	1.385	-0.046	-1.618
ME1	-0.220	-0.433	-0.534	2.240	2.438	2.397	2.629	3.408	2.530	2.063	2.178	2.057	-3.430	-4.032	-4.566	1.053	0.172	-1.717
ME2	-0.162	-0.369	-0.565	2.597	2.506	2.363	2.807	3.497	2.592	2.203	2.301	2.142	-3.265	-3.956	-4.599	1.047	0.110	-1.785
ME3	-0.121	-0.437	-0.522	2.955	2.626	2.426	3.208	2.992	2.745	2.181	2.128	2.038	-3.054	-3.876	-4.195	1.638	0.246	-1.451
MM	-0.057	-0.274	-0.522	2.783	2.834	2.447	2.753	3.540	2.597	2.182	2.388	2.129	-2.878	-3.468	-4.134	1.228	0.292	-1.726
LM1	0.038	-0.377	-0.407	3.143	2.630	2.566	4.138	3.277	3.139	2.173	2.275	2.335	-3.046	-4.130	-4.201	1.485	0.177	-0.962
LM2	0.051	-0.391	-0.427	3.188	2.682	2.482	4.179	3.414	3.229	2.169	2.309	2.328	-2.941	-4.050	-4.137	1.512	0.203	-0.741
			-0.439			2.587			3.259	*	*	2.374	*	*	-4.009	*	*	-0.895
LM3	-0.133	-0.455	-0.583	2.823	2.695	2.592	3.008	3.095	2.885	2.136	1.969	2.088	-3.101	-3.999	-4.242	1.339	0.460	-0.982
		-0.534	-0.615		2.693	2.449		3.077	2.452	*	2.207	2.027	*	-3.999	-4.537	*	0.333	-1.780
LL	-0.105	-0.335	-0.257	3.219	2.832	2.861	3.039	3.395	3.474	2.300	2.211	2.410	-2.910	-3.731	-3.757	1.504	0.438	-0.642
			-0.269			2.835			3.329	*	*	2.315	*	*	-3.794	*	*	-0.690
NE1	-0.097	-0.485	-0.577	3.115	2.284	2.640	3.943	3.086	2.502	2.132	2.210	1.786	-3.532	-4.361	-4.807	0.838	0.177	-1.634
NM1	0.012	-0.433	-0.607	3.235	2.565	1.394	4.207	3.049	2.707	2.542	2.399	1.922	-2.953	-4.452	-4.805	1.480	0.326	-1.251
NM2	-0.192	-0.402	-0.480	2.650	2.590	2.336	2.873	3.224	2.959	2.139	2.521	2.227	-3.297	-3.763	-4.214	1.196	0.577	-1.261
NL1	0.115	-0.318	-0.253	3.313	2.921	3.045	4.229	3.532	3.540	2.105	2.052	2.115	-2.582	-3.439	-3.537	1.607	0.729	-0.675
NL2	0.072	-0.225	-0.196	3.247	2.791	2.994	4.089	3.563	3.526	2.427	1.991	1.952	-2.739	-3.593	-3.703	1.453	0.444	-0.480

7 Shaded cells indicate values pertaining to plants that had flowered, italicised cells indicate values are for non-flowered plants but where flowered data also exist in one or  
8 more of the four replicates, in which case these values are presented on a line underneath and shaded.

Supplementary Table 2. Correlation matrices between nitrogen, sodium, potassium, phosphorus, chlorine, silica, moisture content, ash and higher heating value (HHV) based on flowering (a) and senescence (b), genotype and harvest from the REML analyses of stem data for diverse *Miscanthus* genotypes across three harvest points (summer, autumn and spring) in 2009-2010 as part of trait trial in Aberystwyth (Wales, UK).

(a)

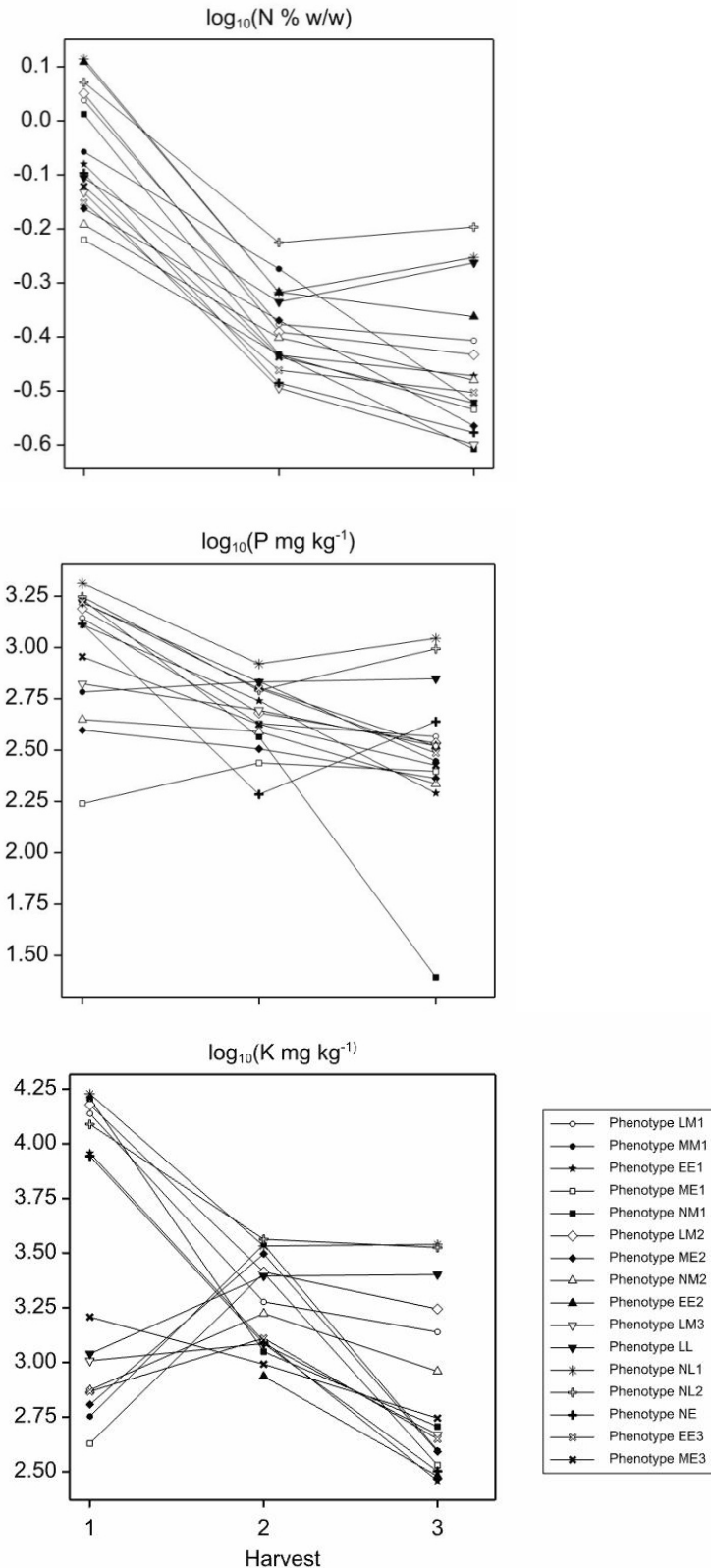
<b>N</b>	1								
<b>Na</b>	0.08	1							
<b>K</b>	0.686	0.407	1						
<b>P</b>	0.77	0.119	0.565	1					
<b>Cl</b>	0.561	0.425	0.896	0.47	1				
<b>Si</b>	0.719	-	0.521	0.734	0.528	1			
<b>MC</b>	0.405	0.396	0.74	0.386	0.713	0.307	1		
<b>Ash</b>	0.883	0.095	0.754	0.757	0.735	0.892	0.513	1	
<b>HHV</b>	-	-	-	-	-	-	-0.5	-	1
	<b>N</b>	<b>Na</b>	<b>K</b>	<b>P</b>	<b>Cl</b>	<b>Si</b>	<b>MC</b>	<b>Ash</b>	<b>HHV</b>

(b)

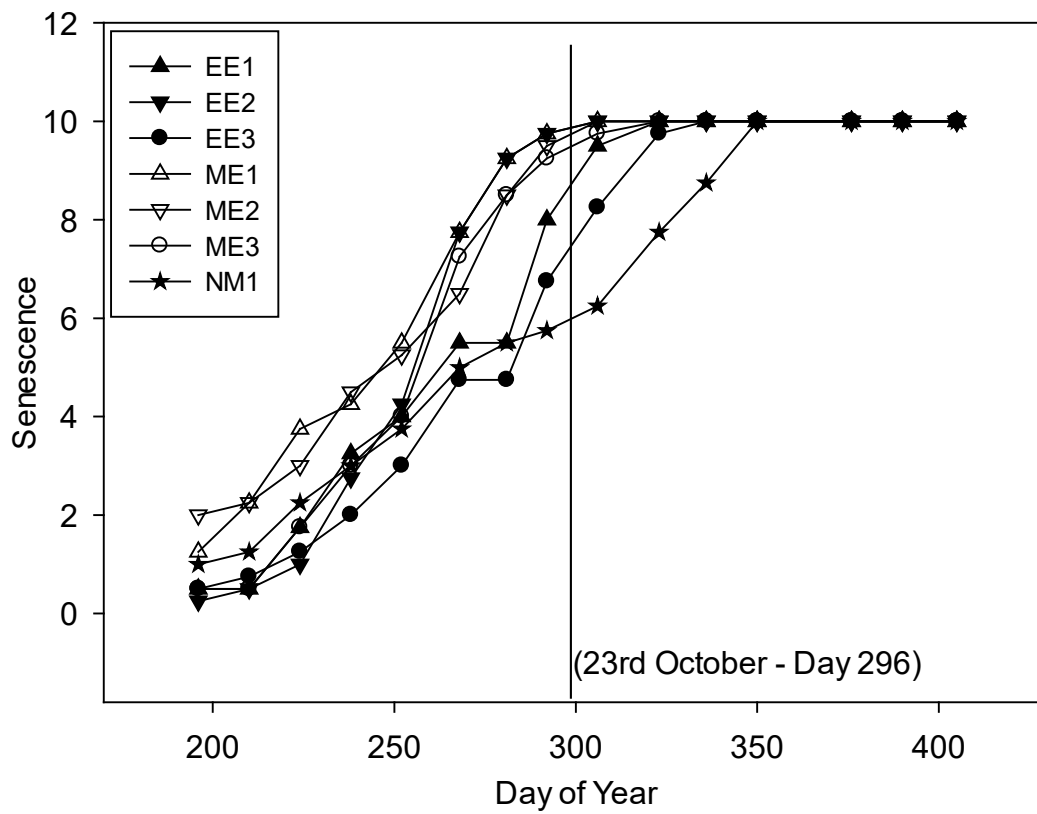
<b>N</b>	1								
<b>Na</b>	0.122	1							
<b>K</b>	0.686	0.429	1						
<b>P</b>	0.756	0.13	0.566	1					
<b>Cl</b>	0.569	0.395	0.891	0.488	1				
<b>Si</b>	0.666	-	0.456	0.706	0.507	1			
<b>MC</b>	0.372	0.445	0.754	0.399	0.756	0.308	1		
<b>Ash</b>	0.857	0.08	0.731	0.754	0.74	0.884	0.523	1	
<b>HHV</b>	-	-	-	-	-	-	-	-	1
	<b>N</b>	<b>Na</b>	<b>K</b>	<b>P</b>	<b>Cl</b>	<b>Si</b>	<b>MC</b>	<b>Ash</b>	<b>HHV</b>

10 Supplementary Table 3. Plant characteristics of the 16 *Miscanthus* genotypes (two species and their  
 11 hybrids) studied, including: plant basal diameter (mm), transect count (a relative measure of stem  
 12 number), height of tallest stem (mm), canopy height (mm) and dry matter single plant biomass (g).  
 13 Genotype categories are based on flowering and senescing phenotypes where the 1<sup>st</sup> letter denotes flowering category  
 14 (exertion of first flag leaf on or before: 21<sup>st</sup> July 2009=early (E); 25<sup>th</sup> August = mid (M)); after 25<sup>th</sup> August = late  
 15 (L), or not at all = non (N); 2<sup>nd</sup> letter denotes senescence category based upon the loss of >80% greenness before:  
 16 23<sup>rd</sup> October (E); 24<sup>th</sup> November (M); or later (L).

Genotype	Species	Plant basal diameter	Transect count	Tallest stem height	Max canopy height	Stem diameter	Dry matter biomass
EE1	<i>M. sinensis</i>	363	35	1910	1175	4.4	785
EE2	<i>M. sinensis</i>	263	35	1340	1000	3.1	307
EE3	<i>M. sinensis</i>	438	38	1590	988	4.1	597
ME1	Hybrid	488	31	2130	1513	4.6	1017
ME2	Hybrid	563	39	1960	1563	4.0	1468
ME3	Hybrid	325	27	1045	938	4.0	261
MM1	<i>M. sinensis</i>	500	36	2035	1613	4.8	1438
LM1	Hybrid	638	22	2450	2625	7.3	3773
LM2	Hybrid	525	17	2435	2550	8.2	2001
LM3	<i>M. sinensis</i>	488	27	2000	1750	6.4	1900
LL	<i>M. sinensis</i>	450	29	1718	1575	5.7	1940
NE	Hybrid	513	32	1410	1688	3.8	534
NM1	<i>M. sacchariflorus</i>	1163	35	1533	1825	15.4	1363
NM2	<i>M. sacchariflorus</i>	738	21	898	1025	3.3	218
NL1	<i>M. sinensis</i>	425	26	1355	1700	5.5	1506
NL2	<i>M. sinensis</i>	338	17	805	1075	6.1	898



Supplementary Fig. 1. Genotypic trends and interactions with harvest for stem N, P, and K in diverse *Miscanthus* genotypes. Genotype categories are based on flowering and senescing phenotypes where the 1<sup>st</sup> letter denotes flowering category (exertion of first flag leaf on or before: 21<sup>st</sup> July 2009=early (E); 25<sup>th</sup> August = mid (M)); after 25<sup>th</sup> August = late (L), or not at all = non (N); 2<sup>nd</sup> letter denotes senescence category based upon the loss of >80% greenness before: 23<sup>rd</sup> October (E); 24<sup>th</sup> November (M); or later (L).



Supplementary Fig. 2. Senescence progression (recorded as loss of greenness, where 10=100%) in early senescing genotypes, and genotype NM1, of *Miscanthus* grown in 2009 trait trial in Aberystwyth (Wales, UK). Central line indicates day of autumn harvest (23<sup>rd</sup> October, 2009).