Supplementary Tables

Supplementary Table S1. Summary of QTL mapping studies for bioenergy traits involving sweet sorghum.

Reference	Population/Parents[1]	Population size and generation	Number of trials (trial names)	Number of markers (technology[2])	Number of groups (total length, in cM)	QTL mapping[3] (software)
Murray *et al.* (2008a, 2008b)	Rio (S) × BTx623 (G)	176 $F_{4:5}$	3 (WE05, CS05, CS06)	259 (SSR, AFLP)	10 (1,836.0)	SMA, IM and CIM (WinQTLCart)
Ritter *et al.* (2008)	R9188 (S) × R9403463-2-1 (G)	184 F_6	2 (RB1-2)	228 (AFLP, SSR)	16 (2,012.9)	SMA, CIM (WinQTLCart)
Murray *et al.* (2009)	Diverse panel	125 lines	3 (CS06, CS07, ITH07)	469 (SSR, SNP)	-	GWAS (TASSEL)
Shiringani *et al.* (2010) and Shiringani and Friedt (2011)	M71 (G) × SS79 (S)	188 $F_{5:6}$	4 (GG1-2, RH1-2)	157 (AFLP, SSR, EST-SSR)	11 (1,028.3)	CIM (PLABQTL)
Guan *et al.* (2011)	Shihong137 (G) × L-Tian (S)	186 F_2, 186 $F_{2:3}$	4 (E1-4)	118 (SSR)	15 (1,884.6)	CIM (WinQTLCart)
Felderhoff *et al.* (2012)	Rio (S) × BTx623 (G)	185 $F_{3:4}$	4 (CS09.1, CS09.2, CS10, WE10)	381 (SNP)	10 (3,359.0)	SMA, IM, CIM (WinQTLCart)
Lv *et al.* (2013)	Diverse panel (43 S + 76 G)	119 lines	4 (S10-11, H10-11)	51 (SSR)	-	GWAS (TASSEL)
Burks *et al.* (2015)	Diverse panel	252 lines	3 (13EF, 14EF, 13 DS)	42,926 (SNP)	-	GWAS (GAPIT)
Harris-Shultz *et al.* (2015)	Honey Drip (S) × Collier (S)	130 F_2 (map), 92 F_2 (QTL)	1 greenhouse trial	4,547 polymorphic, 353 mapped (SNP)	19 (not available)	SMA, CIM (JMP Genomics)
Mocoeur *et al.* (2015)	E-Tian (S) × Ji2731 (G)	209 F_2, 196 $F_{2:3}$, 175 $F_{2:5}$	5 (CN1, DK1, DK2, CN2, CN3)	374 (PAV, SSR)	10 (1,430.3)	SMA, IM, CIM (MapQTL)
Wang *et al.* (2016)	Shihong137 (G) × L-Tian (S)	181 F_7	4 (E1-4)	181 (SSR)	10 (2,415.3)	CIM (WinQTLCart), Q × E (QTLNet)
Bai *et al.* (2017)	Rio (S) × BTx623 (G)	189 F_{6-8}	3 (2013-5)	126 (SSR, INDEL)	10 (1,418.7)	ICIM (IciMapping)
Disasa *et al.* (2018)	Sorcoll 163 (G) × Gambella (S)	192 $F_{2:3}$	2 (MARC, Dhera)	76 (SSR)	10 (2,531.3)	SMA, IM, ICIM (IciMapping)
Brenton *et al.* (2016, 2020)	Diverse panel (132 S + 20 G + 238 B)	390 lines	3 (2013-5)	232,303 (SNP)	-	GWAS (GAPIT)
This study	Brandes (S) × Wray (S)	272 $F_{2:6}$ (map), 223 $F_{2:6}$ (QTL)	3 (T1-3)	3,767 (SNP)	10 (1,368.8)	MIM, MT-MIM (OneQTL)

[1] S: sweet sorghum, G: grain sorghum, B: biomass sorghum; [2] SSR: simple sequence repeats, AFLP: amplified fragment length polymorphism, EST: expressed sequence tag, SNP: single nucleotide polymorphism, PAV: presence-absence variation, INDEL: insertion-deletion; [3] GWAS: genome-wide association study, SMA: single markers analysis, IM: interval mapping, CIM: composite interval mapping, Q × E: QTL by environment interaction, ICIM: inclusive CIM, MIM: multiple interval mapping, MT-MIM: multi-trait MIM

Supplementary Table S2. Soil analysis of the experimental areas, located at Embrapa Milho e Sorgo, Sete Lagoas, MG, Brazil. Area 1 was used for Trials 1 and 2, and Area 2 for Trial 3.

Area	1		2	
Sampling depth (cm)	0-20	20-40	0-20	20-40
pH (H_2O)	4.00	4.90	6.00	6.10
H^+Al ($cmol_c \cdot dm^{-3}$)	10.99	8.55	7.39	7.36
O. M. ($g \cdot kg^{-1}$)	4.32	3.84	5.28	4.63
C (Total)	2.51	2.23	3.07	2.69
SC ($cmol_c \cdot dm^{-3}$)	2.34	1.70	10.58	10.30
CEC ($cmol_c \cdot dm^{-3}$)	12.62	10.25	17.97	17.66
V (%)	18.55	16.55	58.88	58.32
Al Sat. (%)	32.36	32.06	0.38	0.48

H^+Al: potential acidity; O. M.: organic matter; C: organic carbon; SC: sum of cations (Ca^{2+} + Mg^{2+} + K^+); CEC: cátion exchange capacity; V: cation saturation ratio; Al Sat.: aluminum saturation indicator.

Supplementary Table S3. Akaike (AIC) and Bayesian (BIC) information criteria for selecting genetic variance-covariance structures G_L ($L = 3$ trials). The smallest values are in bold and represent the most likely structure per trait according to each criterion.

Matrix	Description	#parameters	Criterion	FLW	HGH	FBY	JUC	BRX	SUC	RSU	FIB
ID	Diagonal with identical variances	1	AIC	13360.29	18405.91	15348.41	10804.37	8379.86	8324.38	2005.42	7498.52
			BIC	13377.09	18422.70	15365.18	10821.15	8396.64	8341.15	2022.20	7515.29
DIAG	Diagonal with heterogeneous variances	$L = 3$	AIC	13129.82	18393.70	15262.75	10767.95	8380.52	8326.04	1918.04	7393.47
			BIC	13157.81	18421.69	15290.71	10795.91	8408.49	8354.00	1946.01	7421.43
CS	Compound symmetry with identical variances	2	AIC	13193.50	18193.94	15283.09	10761.62	8234.04	**8170.12**	1969.28	7449.13
			BIC	13215.89	18216.32	15305.45	10783.99	8256.42	**8192.50**	1991.65	7471.51
CS_{Het}	Compound symmetry with heterogeneous variances	$L + 1 = 4$	AIC	12897.62	**18170.27**	15188.97	10724.35	**8233.85**	8170.92	NC	7331.68
			BIC	12931.21	**18203.85**	15222.52	10757.90	**8267.41**	8204.48	NC	7365.23
AR1	First-order autoregressive with identical variances	2	AIC	13179.60	18206.80	15266.22	10760.11	8247.86	8180.86	1971.80	7443.29
			BIC	13201.99	18229.18	15288.58	10782.48	8270.23	8203.23	1994.17	7465.67
$AR1_{Het}$	First-order autoregressive with heterogenous variances	$L + 1 = 4$	AIC	12899.61	18179.41	15180.77	10719.39	8246.78	8180.39	NC	**7326.68**
			BIC	12933.19	18212.99	15214.32	**10752.94**	8280.34	8213.95	NC	**7360.24**
UNST	Unstructured	$L(L + 1)/2$	AIC	**12868.72**	18173.50	**15161.20**	**10717.16**	8234.93	8174.64	**1876.25**	7327.04
		$= 6$	BIC	**12913.50**	18218.27	**15205.93**	10761.90	8279.68	8219.38	**1921.00**	7371.78

Traits: days to flowering (FLW), plant height (HGH, in cm), fresh biomass yield (FBY, in t · ha^{-1}), juice extraction yield (JUC, in %), total soluble solids (BRX, in °Brix), sucrose content (SUC, in %), reducing sugar content (RSU, in %) and fibers (FIB, in %). NC = model did not converge.

Supplementary Table S4. Summary of raw data, physical map (imputed and filtered markers), and genetic maps from GBS-derived markers relative to the *Sorghum bicolor* chromosomes (v2.1).

Chromosome	Number of markers			Genetic map	
	Raw	Physical map	Genetic map	Length (cM)	Density (SNPs/cM)
1	71,878	8,109	594	207.67	2.86
2	59,518	9,489	512	181.19	2.83
3	59,958	8,382	414	111.88	3.70
4	51,905	7,206	396	145.88	2.71
5	33,491	5,826	308	128.00	2.41
6	40,664	6,975	364	123.03	2.96
7	33,905	4,893	327	132.16	2.47
8	31,969	2,790	212	102.28	2.07
9	38,524	5,964	330	120.77	2.73
10	39,429	6,373	310	115.97	2.67
Total	461,241	66,007	3,767	1,368.83	2.75