

Genetic effects of physiological and morpho-agronomic traits in popcorn under water stress

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Received January 15, 2025;

Accepted June 2, 2025.

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SUPPLEMENTARY MATERIALS

Table S1 Estimates of the general combining ability (GCA) effects for agronomic, morphological, and physiological traits evaluated among S₇ popcorn lines grown under water-stressed (WS) condition

Trait/Line	WS									
	L61	L63	L65	L71	L75	L76	P2	P3	P6	P7
GY	-0.15	-0.11	0.01	-0.07	-0.65	0.39	0.29	0.34	-0.09	0.05
PE	5.22	-0.90	-1.31	1.05	-1.92	-1.32	-2.47	-1.51	0.58	2.59
PV	10.03	-5.09	-2.39	-2.07	-20.10	6.13	-0.17	4.48	0.49	8.69
GR	-1.45	-0.64	-2.79	-0.71	-3.21	1.75	1.99	1.26	1.30	2.50
EL	-0.07	0.59	-0.60	1.18	-1.16	0.77	1.19	-0.14	-1.08	-0.67
ED	-0.83	-0.30	0.06	-0.38	-0.29	0.53	0.36	0.62	-0.15	0.39
GW	-0.81	-0.32	0.79	0.85	-0.33	0.07	0.48	0.53	-1.24	-0.02
PH	-0.07	0.00	0.08	-0.07	-0.06	-0.08	0.08	0.07	0.04	0.01
TL	0.42	-0.82	-2.24	-6.34	0.71	0.78	2.64	3.87	-0.38	1.36
SD	-0.42	-0.38	-0.80	0.69	-0.41	0.67	0.86	0.08	-0.54	0.25
DM	0.01	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00
SPAD1	0.03	-0.89	0.66	2.19	-0.24	0.52	-0.06	0.83	-1.85	-1.19
SPAD2	0.03	-1.29	0.66	2.28	-1.45	0.20	0.27	1.38	-1.82	-0.27
SPAD3	0.17	-1.99	0.86	2.21	-2.36	0.06	0.70	1.62	-1.65	0.38
SPAD4	0.37	-2.13	0.92	1.60	-2.60	-0.70	0.40	0.00	-1.01	0.72
SPAD5	-0.19	-2.20	1.25	1.13	-2.98	-1.01	1.19	2.62	-0.83	1.01
SPAD6	-0.38	-2.05	1.49	1.94	-3.78	-1.13	1.46	2.71	-0.73	0.47
SPAD7	-0.51	-2.83	0.81	1.83	-5.41	-1.79	2.48	3.44	-0.04	2.03
SPAD8	-0.86	-1.75	2.26	0.11	-6.53	-1.03	2.29	2.52	0.81	2.17
NDVI1	-0.01	0.02	-0.01	0.02	-0.01	0.00	0.00	0.01	-0.01	-0.02
NDVI2	-0.01	0.01	0.00	0.02	-0.01	0.00	0.00	0.00	-0.01	0.00
NDVI3	-0.01	0.00	0.01	0.01	-0.02	0.00	0.00	0.01	-0.01	0.00
NDVI4	-0.02	-0.01	0.00	0.02	-0.01	0.00	0.01	0.01	-0.01	0.00
CTD1	0.39	0.05	0.19	0.03	0.25	-0.07	-0.16	-0.28	-0.18	-0.22
CTD2	0.10	0.08	-0.07	-0.41	-0.29	-0.11	0.23	0.11	0.12	0.24

Note: GY: grain yield; PE: popping expansion; PV: volume of expanded popcorn per hectare; GR: number of grains per row; EL: ear length; GW: weight of 100 kernels; PH: plant height; TL: tassel length; SD: stem diameter; DM: dry matter. SPAD, relative chlorophyll content index, measurements 1–8, at the planting, pre-tasseling, tasseling, silking, blister, milk, dough and dent, respectively; NDVI: normalized difference vegetation index, measurements 1–4, at the silking, blister, milk and dough, respectively; and CTD, canopy temperature depression measured, measurements 1 and 2, at the silking and dough, respectively.

Table S2 Estimates of the general combining ability (GCA) effects for agronomic, morphological, and physiological traits evaluated among S₇ popcorn lines grown under well-watered (WW) condition

Trait/Line	WW									
	L61	L63	L65	L71	L75	L76	P2	P3	P6	P7
GY	-0.06	0.08	-0.35	-0.09	-0.29	0.43	0.26	0.06	-0.12	0.07
PE	5.05	-0.48	-1.05	1.87	-1.80	-0.76	-2.28	-2.45	0.45	1.44
PV	7.00	1.32	-9.46	-0.46	-8.59	9.13	1.81	-3.17	-2.06	4.49
GR	-0.57	1.05	-3.87	-1.38	-2.15	1.97	0.85	0.23	1.07	2.81
EL	0.39	0.80	-1.18	0.21	-0.62	0.71	1.63	-0.53	-0.95	-0.45
ED	-0.81	-0.17	-0.13	-0.24	0.01	0.41	0.13	0.51	-0.10	0.39
GW	-1.04	-0.28	0.80	0.64	-0.08	0.41	0.55	0.64	-0.99	-0.65
PH	-0.05	-0.02	0.03	-0.06	-0.02	-0.05	0.07	0.04	0.04	0.03
TL	0.39	0.65	-3.22	-4.52	0.96	-0.18	2.18	2.86	0.94	-0.05
SD	-0.47	-0.50	-0.75	0.40	0.07	0.17	0.84	0.28	-0.21	0.17
DM	0.01	0.00	-0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
SPAD1	-1.18	-0.77	0.88	2.08	0.28	0.18	-0.22	0.42	-1.23	-0.43
SPAD2	-1.19	-0.64	0.50	2.24	0.53	0.19	-0.58	0.48	-1.54	0.02
SPAD3	0.04	-1.29	0.28	1.47	-0.01	0.24	-0.13	2.22	-1.95	-0.88
SPAD4	1.04	-2.66	-1.03	2.08	0.38	-1.05	0.32	2.64	-0.98	-0.74
SPAD5	-0.76	-1.68	-0.09	2.08	-1.43	-0.54	0.19	1.85	-0.04	0.41
SPAD6	-1.19	-1.91	-0.06	1.53	-2.02	-1.10	1.53	3.17	0.09	-0.04
SPAD7	-1.71	-2.27	2.43	0.87	-3.91	-0.83	1.62	3.27	1.10	-0.57
SPAD8	0.49	-1.90	-0.03	-0.62	-4.43	-0.08	3.04	4.09	-1.59	1.03
NDVI1	-0.01	0.01	0.02	0.02	0.00	-0.01	0.00	-0.01	0.00	-0.02
NDVI2	0.00	0.01	0.00	0.01	0.00	0.00	0.00	-0.01	-0.01	0.00
NDVI3	0.00	0.01	-0.01	0.01	-0.01	-0.02	0.00	0.00	0.01	0.01
NDVI4	-0.02	0.03	0.01	0.01	0.01	-0.01	0.01	-0.01	0.00	-0.03
CTD1	-0.11	-0.21	-0.12	0.32	0.13	0.02	-0.10	0.03	0.09	-0.07
CTD2	0.12	0.24	0.00	0.11	0.36	0.18	-0.27	-0.47	-0.07	-0.21

Note: GY: grain yield; PE: popping expansion; PV: volume of expanded popcorn per hectare; GR: number of grains per row; EL: ear length; GW: weight of 100 kernels; PH: plant height; TL: tassel length; SD: stem diameter; DM: dry matter. SPAD, relative chlorophyll content index, measurements 1–8, at the planting, pre-tasseling, tasseling, silking, blister, milk, dough and dent, respectively; NDVI: normalized difference vegetation index, measurements 1–4, at the silking, blister, milk and dough, respectively; and CTD, canopy temperature depression measured, measurements 1 and 2, at the silking and dough, respectively.

Table S3 Estimates of the specific combining ability (SCA) effects associated with the crosses between S₇ popcorn lines for agronomic and morphological traits evaluated under well-watered (WW) condition

Hybrid	GY	PE	PV	GR	EL	ED	GW	PH	TL	SD	DM
L61/L63	0.12	1.81	9.21	-0.51	-0.58	-0.06	-0.25	0.03	0.23	0.14	0.00
L61/L65	0.76	-1.56	16.39	1.89	0.38	0.26	0.40	0.20	5.20	1.13	0.02
L61/L71	-0.20	-0.62	-4.09	2.43	0.70	-0.46	-0.24	0.00	-1.12	-0.40	0.03
L61/L75	0.61	1.37	18.50	5.93	2.32	2.46	1.09	0.11	2.78	0.36	0.01
L61/L76	0.61	3.75	35.10	0.68	0.67	0.41	0.72	0.00	-0.80	-0.20	-0.01
L61/P2	0.22	-0.62	6.99	1.51	1.92	-0.20	0.18	0.06	2.39	-0.08	0.00
L61/P3	0.38	-0.65	11.37	4.46	1.79	1.77	-0.53	0.06	2.43	-0.18	0.01
L61/P6	0.28	0.59	10.05	2.98	1.27	-0.06	0.20	0.06	5.21	0.40	0.05
L61/P7	0.01	0.38	2.98	0.15	0.23	-0.11	-0.14	-0.03	2.65	-0.18	0.02
L63/L65	-0.40	1.34	-7.40	-2.64	-0.33	0.07	-0.76	0.05	0.26	-0.06	-0.01
L63/L71	0.14	-0.89	4.28	-1.12	0.08	-0.51	-0.08	-0.09	1.05	-0.48	0.03
L63/L75	0.79	1.15	25.29	4.50	2.31	1.10	1.94	0.07	1.72	0.42	0.02
L63/L76	0.42	-0.86	6.04	1.23	1.19	0.86	0.19	0.06	1.71	0.88	0.01
L63/P2	0.39	-0.20	7.62	2.71	0.28	1.02	0.27	0.07	0.81	0.48	0.03
L63/P3	0.39	-0.80	6.21	3.60	2.53	0.08	0.06	0.14	-0.57	0.14	-0.02
L63/P6	0.46	-0.62	7.62	2.47	2.23	1.24	1.65	0.14	0.46	0.27	0.00
L63/P7	0.91	-1.16	18.22	1.47	0.18	-0.03	0.06	0.11	4.22	-0.20	0.00
L65/L71	0.03	-3.28	-7.01	2.11	1.65	0.42	0.87	0.03	1.74	0.14	-0.01
L65/L75	0.59	1.69	17.07	4.61	2.34	2.13	1.56	0.08	2.55	1.17	0.06
L65/L76	1.22	-2.99	13.73	4.32	2.35	1.42	1.02	0.13	0.46	1.06	0.03
L65/P2	0.09	-2.21	-6.81	-3.13	-0.36	-0.83	0.73	0.09	-2.93	-0.82	-0.04
L65/P3	0.54	1.14	14.96	0.87	1.28	0.03	0.80	0.07	0.66	-0.01	0.04
L65/P6	0.32	4.05	19.11	3.56	1.73	1.13	-0.36	0.13	2.10	0.65	0.01
L65/P7	0.63	5.37	35.80	2.76	0.76	0.47	0.68	-0.08	0.24	-0.20	-0.02
L71/L75	0.11	-0.60	3.95	-2.54	0.42	-0.18	0.01	0.06	5.22	0.06	0.02
L71/L76	1.00	-0.08	28.20	0.97	0.05	-0.61	-0.05	0.09	-3.99	0.23	0.01
L71/P2	0.01	-1.11	-0.41	2.72	0.35	1.44	0.38	0.10	2.85	0.58	0.02
L71/P3	0.54	-1.48	11.06	5.94	1.91	1.17	0.63	0.12	2.16	-0.54	0.00
L71/P6	0.47	-0.84	12.60	3.55	0.58	1.52	0.78	0.12	-0.73	0.36	-0.01
L71/P7	1.06	-7.36	5.32	3.88	1.77	1.19	1.11	0.13	-1.20	-0.26	-0.02
L75/L76	0.08	-2.76	-7.61	0.60	1.43	0.23	-0.01	0.05	2.49	-0.07	-0.01
L75/P2	0.67	1.39	16.85	3.63	2.00	1.44	0.77	0.03	2.45	0.26	0.00
L75/P3	-0.46	-2.04	-16.17	2.16	0.49	0.20	-0.55	-0.07	2.53	0.76	-0.01
L75/P6	0.09	0.73	2.03	-0.33	-0.41	-0.30	-0.94	0.00	-0.71	-0.44	-0.01
L75/P7	-0.26	-1.41	-12.66	-1.42	0.35	-0.35	0.77	0.09	2.05	0.01	-0.01
L76/P2	-0.57	-2.43	-22.01	2.67	1.03	0.67	0.12	0.10	4.37	0.05	0.03
L76/P3	0.59	1.35	17.73	-0.20	0.40	0.08	-0.04	0.00	1.67	1.71	0.00
L76/P6	-0.29	2.36	-1.33	3.89	-0.49	0.97	1.55	0.05	2.14	-0.09	0.02
L76/P7	-0.20	3.67	7.19	0.22	-0.02	-0.19	0.80	0.00	-0.46	-0.53	-0.02
P2/P3	-0.02	1.11	0.92	-0.04	-2.13	0.24	0.21	0.00	-1.16	-1.15	0.00
P2/P6	0.62	5.18	33.28	-1.16	-0.78	-0.75	-0.49	-0.04	2.49	-0.11	-0.03
P2/P7	-0.11	-1.19	-5.67	-0.82	1.49	-0.33	0.74	0.01	-2.34	0.95	0.04
P3/P6	-0.35	0.19	-9.12	-1.42	-0.71	-0.36	0.60	0.04	-1.95	-1.01	-0.01
P3/P7	-0.11	1.32	3.29	0.78	-0.82	-0.01	-0.16	-0.10	-1.00	0.33	-0.03
P6/P7	-0.52	-2.58	-20.74	-3.40	0.88	-0.98	-0.19	0.01	-0.58	0.03	0.01

Note: GY: grain yield; PE: popping expansion; PV: volume of expanded popcorn per hectare; GR: number of grains per row; EL: ear length; GW: weight of 100 kernels; PH: plant height; TL: tassel length; SD: stem diameter; DM: dry matter.

Table S4 Estimates of the specific combining ability (SCA) effects associated with the crosses between S₇ popcorn lines for agronomic and morphological traits evaluated under well-watered (WW) condition

Hybrid	GY	PE	PV	GR	EL	ED	GW	PH	TL	SD	DM
L61/L63	0.00	-0.67	-1.28	-1.46	-2.22	-0.27	0.81	-0.03	-0.44	-0.63	-0.06
L61/L65	-0.15	1.14	-0.94	-1.84	-0.99	-0.31	-1.10	0.01	-0.19	-0.27	-0.04
L61/L71	0.02	1.13	0.57	0.46	0.00	0.06	1.09	-0.11	-1.67	0.37	-0.03
L61/L75	0.03	0.96	3.33	0.22	0.41	-0.56	-0.21	-0.01	2.59	-0.37	-0.02
L61/L76	-0.47	-2.19	-12.55	-2.01	0.48	-1.07	1.29	0.01	-1.89	0.09	-0.02
L61/P2	0.36	-0.13	9.75	2.14	0.59	0.36	0.00	0.00	4.20	-0.13	-0.01
L61/P3	0.28	1.15	9.67	2.66	1.56	-0.50	-0.97	-0.01	3.27	0.22	-0.01
L61/P6	0.84	4.25	32.51	4.45	0.95	1.02	1.47	0.07	4.75	0.06	-0.01
L61/P7	-0.48	2.32	-7.35	-3.29	-2.64	-0.22	0.26	0.05	3.74	-0.66	-0.01
L63/L65	0.37	-0.27	6.45	2.01	1.64	0.35	-0.10	0.03	1.67	-0.23	-0.01
L63/L71	0.50	-0.53	10.01	2.77	2.92	1.16	0.87	-0.02	3.92	0.08	-0.01
L63/L75	0.27	8.48	20.06	-0.50	-0.39	-0.20	1.20	0.09	-1.42	0.35	-0.01
L63/L76	-0.03	-0.99	-3.59	1.53	0.16	0.45	-0.03	0.01	0.47	-0.61	-0.01
L63/P2	-0.24	-1.28	-6.21	-3.99	-1.39	-1.62	-0.42	-0.10	4.88	-0.01	-0.01
L63/P3	0.33	-7.04	-4.47	4.81	2.58	1.19	0.69	0.06	-0.22	-0.04	-0.01
L63/P6	0.41	-1.31	4.79	1.30	1.16	-0.11	0.55	0.01	0.51	-0.22	-0.01
L63/P7	-0.10	-2.63	-9.35	1.59	0.91	0.45	-1.70	0.08	1.94	0.97	0.00
L65/L71	-0.16	-0.10	-3.49	-1.20	0.25	-1.44	-1.72	0.00	1.13	0.38	0.00
L65/L75	0.32	5.48	24.44	-0.59	-0.41	0.51	0.56	0.02	2.31	0.29	0.00
L65/L76	0.20	-0.05	3.64	-0.11	1.07	1.58	1.63	0.03	-0.79	0.82	0.00
L65/P2	-0.27	-2.54	-9.52	-0.73	-0.19	-0.63	-1.88	0.01	-1.99	-0.55	0.00
L65/P3	-0.13	3.06	0.14	-1.33	-0.19	-0.85	-0.89	-0.02	1.66	-0.98	0.00
L65/P6	0.38	1.08	8.54	-0.16	1.67	-0.87	0.17	0.05	-1.34	0.69	0.00
L65/P7	0.27	-1.78	4.80	2.24	0.85	-0.04	0.75	0.03	-0.03	-0.19	0.00
L71/L75	0.23	1.41	9.21	2.53	0.78	0.86	0.62	0.13	2.28	-0.05	0.01
L71/L76	0.06	-0.96	-0.83	-0.35	-0.47	0.02	-0.22	0.07	0.16	0.75	0.01
L71/P2	0.48	1.79	15.33	4.52	1.22	1.15	-0.87	0.12	-2.94	-0.22	0.01
L71/P3	0.53	-1.76	5.31	3.53	3.50	1.51	0.49	0.10	-3.99	0.58	0.01
L71/P6	0.09	1.06	6.04	3.97	1.36	1.96	-0.77	0.04	2.76	-0.61	0.01
L71/P7	0.20	-2.72	1.98	-1.69	0.38	0.76	1.22	0.08	-2.55	0.97	0.01
L75/L76	0.39	1.15	10.73	2.81	1.62	1.75	1.15	0.18	6.81	0.58	0.01
L75/P2	-0.12	-0.01	-3.29	-0.17	-0.35	-0.41	0.21	-0.13	-2.01	-1.44	0.01
L75/P3	-0.54	-2.91	-17.61	-1.17	-0.92	-0.11	-0.48	-0.10	-3.70	0.24	0.01
L75/P6	0.50	1.63	18.28	2.93	0.92	2.70	1.31	0.10	1.44	0.33	0.02
L75/P7	-0.17	-0.71	-3.27	0.99	0.84	1.49	-1.06	0.00	-4.99	0.35	0.02
L76/P2	0.33	1.80	10.04	-1.59	-0.91	0.37	-0.09	0.06	0.45	0.03	0.02
L76/P3	0.34	1.28	11.64	2.75	2.01	-0.05	0.12	0.05	2.60	0.25	0.02
L76/P6	0.70	0.04	18.30	3.07	1.84	0.73	-0.28	0.08	0.76	-0.43	0.02
L76/P7	0.56	-1.83	5.43	-0.01	-0.51	-0.24	0.93	0.03	2.30	-0.02	0.02
P2/P3	0.45	-1.57	8.66	2.34	1.97	-0.74	1.28	0.09	-1.01	-0.12	0.03
P2/P6	-0.25	0.55	-6.27	1.59	1.83	-0.47	-0.94	0.01	5.11	-0.24	0.03
P2/P7	0.69	-0.01	17.21	1.26	1.97	1.21	2.93	0.09	3.70	0.70	0.03
P3/P6	0.60	-2.24	10.18	5.58	1.99	0.85	0.16	0.17	5.10	-0.02	0.03
P3/P7	0.42	-1.47	7.40	3.31	2.37	0.34	0.27	0.05	2.17	1.05	0.03
P6/P7	-0.10	-0.31	-5.74	-1.05	-0.96	0.27	0.44	0.01	0.41	0.18	0.04

Note: GY: grain yield; PE: popping expansion; PV: volume of expanded popcorn per hectare; GR: number of grains per row; EL: ear length; GW: weight of 100 kernels; PH: plant height; TL: tassel length; SD: stem diameter; DM: dry matter.

Table S5 Estimates of the specific combining ability (SCA) effects associated with the crosses between S₇ popcorn lines for physiological traits under water-stressed (WS) condition

Hybrid	SPAD1	SPAD2	SPAD3	SPAD4	SPAD5	SPAD6	SPAD7	SPAD8	NDVI1	NDVI2	NDVI3	NDVI4	CTD1	CTD2
L61/L63	1.28	1.16	0.95	1.40	1.83	1.74	5.26	-0.99	0.01	0.02	0.02	-0.07	0.18	-0.13
L61/L65	3.93	4.37	3.23	3.45	4.07	3.71	-0.61	0.47	-0.03	0.02	-0.01	0.04	-0.82	-0.25
L61/L71	-2.00	-0.61	-0.05	-2.50	-1.08	-0.58	1.90	1.28	0.03	-0.01	-0.01	0.01	-0.10	0.33
L61/L75	2.50	0.15	2.05	2.36	0.64	2.61	4.98	5.22	0.01	0.02	0.03	0.04	-0.42	0.41
L61/L76	-2.40	-3.97	-4.33	-3.10	-0.60	-3.08	-0.84	1.75	0.03	0.00	0.00	0.00	0.39	0.56
L61/P2	-0.98	1.03	0.40	0.77	1.60	2.93	2.12	-2.67	-0.05	-0.01	-0.02	0.01	-0.11	0.32
L61/P3	1.10	3.15	3.11	3.61	1.44	1.65	-1.11	1.91	0.00	0.00	0.01	0.03	0.48	-0.42
L61/P6	-0.36	0.22	1.21	-0.42	-0.94	1.66	-2.92	4.11	0.01	0.00	-0.01	-0.03	0.31	1.03
L61/P7	0.54	-0.10	-0.55	0.25	-2.65	-2.65	-2.13	0.88	0.00	-0.02	0.01	-0.01	0.35	0.18
L63/L65	-0.42	-1.44	-1.18	-1.72	-0.88	-3.95	-2.79	0.93	0.02	0.00	0.02	-0.02	-0.19	1.00
L63/L71	-2.41	-3.36	-4.66	-3.70	-3.39	-2.13	-1.94	-1.59	-0.04	0.00	0.00	0.02	0.37	0.28
L63/L75	1.62	5.00	4.51	3.90	4.06	4.92	4.46	3.94	0.01	0.01	0.03	0.04	-0.31	0.03
L63/L76	1.53	0.45	-0.08	2.56	2.49	2.36	-1.22	1.88	0.04	-0.03	-0.06	-0.04	0.37	0.14
L63/P2	1.27	2.18	2.19	1.14	1.52	-0.09	2.38	3.62	0.03	0.01	0.00	-0.01	-0.17	-0.83
L63/P3	0.89	-1.76	-0.77	-1.99	0.09	0.22	-0.83	0.46	0.00	-0.01	-0.02	0.01	-0.02	0.23
L63/P6	1.73	1.94	1.40	0.38	0.47	0.60	1.43	2.37	0.01	0.01	0.04	0.05	-0.42	0.35
L63/P7	2.57	4.02	4.48	5.98	1.24	3.76	1.69	1.04	0.02	0.00	0.00	0.01	-0.04	0.56
L65/L71	3.37	3.15	2.89	4.42	3.89	4.43	5.72	3.83	0.02	0.01	-0.03	-0.02	0.47	-0.10
L65/L75	5.24	4.95	4.95	4.75	3.43	3.01	4.03	3.60	-0.03	-0.02	0.01	0.03	0.18	0.81
L65/L76	0.57	-0.57	-1.70	-0.72	1.56	6.39	9.22	9.90	-0.03	0.01	0.02	-0.01	-0.27	-0.11
L65/P2	-1.01	-4.97	-4.57	-4.78	-1.67	1.20	3.28	1.51	0.00	0.02	0.02	0.01	0.05	0.63
L65/P3	-2.43	-1.08	-2.63	-3.07	0.80	1.72	3.61	4.56	0.03	0.02	0.02	-0.02	-0.12	-0.49
L65/P6	1.18	2.98	2.35	6.63	4.32	3.93	5.40	4.63	0.04	0.02	0.02	0.00	-0.03	-0.17
L65/P7	-2.49	-0.53	-0.54	-0.67	-0.05	0.33	0.90	5.20	0.00	0.01	0.02	0.02	0.45	-0.19
L71/L75	-1.08	-2.67	-2.76	-2.16	-0.78	1.80	1.67	2.15	0.03	0.00	0.02	0.02	-0.53	1.09
L71/L76	0.75	1.54	1.12	0.70	-0.35	0.08	-4.68	-3.45	-0.06	-0.01	-0.02	-0.02	0.25	0.10
L71/P2	0.80	2.04	1.39	0.98	0.32	0.45	-1.21	-0.37	0.05	0.02	0.02	0.00	0.01	-0.10
L71/P3	3.54	2.26	0.03	1.76	1.62	2.47	2.15	2.24	-0.06	0.00	0.05	-0.01	-0.03	0.39
L71/P6	0.32	-0.54	-0.40	-2.25	1.70	0.38	2.67	5.15	0.04	0.02	0.02	0.02	0.13	0.47
L71/P7	3.59	1.45	-1.36	-1.75	0.80	-1.59	-0.23	4.32	0.03	0.00	-0.02	-0.01	-0.09	0.45
L75/L76	1.52	2.04	2.16	2.76	3.33	-0.31	-0.53	0.89	0.01	0.02	0.02	0.01	0.03	-0.85
L75/P2	1.33	0.38	2.25	1.94	2.03	1.20	3.80	3.83	-0.04	-0.02	-0.01	-0.01	0.53	-0.15
L75/P3	1.01	-0.97	-1.21	-1.55	-1.17	-0.28	1.29	-1.26	-0.03	0.00	0.00	-0.03	0.78	-0.26
L75/P6	-3.65	-4.47	-3.47	-1.29	-1.82	-0.40	0.98	2.38	0.04	-0.04	-0.02	-0.02	0.61	0.99
L75/P7	-1.71	-3.08	-1.49	-2.02	-0.56	0.89	3.61	-0.41	0.03	0.02	0.01	0.02	0.16	-0.66
L76/P2	-0.34	0.65	0.47	4.94	1.86	2.05	2.91	4.70	0.02	0.02	0.02	0.01	-0.43	0.03
L76/P3	4.94	6.57	7.78	4.88	4.33	2.13	5.11	6.27	-0.03	-0.01	-0.01	0.02	-0.11	0.02
L76/P6	3.56	2.57	2.42	3.98	2.35	0.71	0.67	3.08	0.00	-0.01	0.01	0.02	0.33	-0.43
L76/P7	-1.58	-3.01	-4.44	-4.85	-2.82	1.17	2.20	-0.45	0.03	0.00	0.01	-0.02	-0.20	0.28
P2/P3	-0.65	0.74	1.27	-0.88	0.00	0.55	-0.59	0.75	0.01	-0.02	-0.02	-0.02	0.05	0.58
P2/P6	1.47	-0.29	-0.99	-1.95	-2.65	-1.51	-2.60	-2.47	-0.03	-0.01	-0.02	-0.02	-0.12	-0.86
P2/P7	4.37	5.39	5.79	5.55	5.48	4.48	1.36	-0.14	0.07	0.05	0.03	0.04	-0.01	0.25
P3/P6	2.22	0.49	1.42	1.43	-0.45	-2.13	0.39	-5.43	0.04	0.01	0.01	0.02	-0.29	0.02
P3/P7	-3.22	-2.99	-1.90	0.00	-0.05	-1.87	-0.18	-0.03	-0.02	-0.03	0.00	-0.01	-0.02	-0.66
P6/P7	2.20	0.05	0.34	-0.74	-0.90	0.98	-2.72	-5.25	-0.03	0.01	-0.06	-0.07	0.15	-0.01

Note: SPAD, relative chlorophyll content index, measurements 1–8, at the planting, pre-tasseling, tasseling, silking, blister, milk, dough and dent, respectively; NDVI: normalized difference vegetation index, measurements 1–4, at the silking, blister, milk and dough, respectively; and CTD, canopy temperature depression measured, measurements 1 and 2, at the silking and dough, respectively.

Table S6 Estimates of the specific combining ability (SCA) effects associated with the crosses between S₇ popcorn lines for physiological traits under well-watered (WW) condition

Hybrid	SPAD1	SPAD2	SPAD3	SPAD4	SPAD5	SPAD6	SPAD7	SPAD8	NDVI1	NDVI2	NDVI3	NDVI4	CTD1	CTD2
L61/L63	0.10	-1.84	-1.89	-1.19	-4.99	-4.31	-0.30	2.36	0.02	-0.02	-0.05	0.04	-1.22	-1.81
L61/L65	1.95	1.15	0.48	1.66	1.72	1.44	4.03	-5.88	0.00	0.00	-0.01	-0.06	0.42	0.22
L61/L71	0.55	-0.95	-0.54	0.14	1.92	1.55	-3.61	0.44	0.02	0.00	0.02	0.11	0.48	0.24
L61/L75	0.49	0.79	1.00	1.78	0.86	4.50	8.71	4.79	0.05	0.01	0.02	-0.05	-1.10	0.03
L61/L76	1.12	-0.30	-1.95	-1.42	1.27	0.48	0.69	2.30	0.02	0.02	0.00	0.06	-0.42	-1.13
L61/P2	-0.75	0.60	0.52	0.53	1.90	0.68	2.34	1.32	0.00	0.00	-0.01	-0.10	-0.13	0.63
L61/P3	1.71	2.24	1.14	0.65	0.98	-1.69	1.46	3.81	-0.02	0.01	-0.01	-0.16	0.77	1.16
L61/P6	-1.17	0.43	3.81	2.57	2.40	1.02	1.53	6.45	-0.01	0.00	0.03	-0.05	0.51	0.59
L61/P7	-2.27	-3.00	-1.16	-3.34	-2.22	-3.34	-1.91	-4.78	-0.09	0.00	0.00	0.05	0.61	0.40
L63/L65	-0.57	-0.33	4.00	0.05	-3.53	-1.10	-4.88	-1.46	0.01	0.00	0.07	0.00	1.08	0.21
L63/L71	0.17	-1.10	-2.12	-1.26	-0.23	-0.26	1.18	3.30	-0.01	0.00	0.01	0.03	-0.82	-0.47
L63/L75	1.84	3.04	-0.44	0.91	2.54	2.49	3.50	1.25	0.03	0.02	0.00	0.04	0.14	0.71
L63/L76	0.47	1.45	1.87	-0.13	1.43	0.47	-0.65	0.16	0.04	0.00	0.01	0.06	-0.35	-0.44
L63/P2	-1.50	-0.61	-0.69	-0.27	1.99	0.24	-3.10	-1.53	0.02	-0.01	-0.02	0.03	-0.63	0.01
L63/P3	0.29	0.93	-1.94	-0.42	0.63	0.34	0.55	2.29	0.02	-0.03	-0.02	0.02	0.64	-0.89
L63/P6	1.28	1.68	-0.10	0.47	0.56	0.14	0.39	5.24	0.03	0.01	0.05	-0.02	0.78	0.61
L63/P7	2.54	3.65	0.63	2.89	2.41	2.45	3.06	4.51	0.06	0.01	0.00	-0.03	-0.43	0.32
L65/L71	3.22	2.56	2.81	2.61	4.35	1.42	5.24	1.36	-0.03	-0.01	0.01	0.06	-0.01	0.03
L65/L75	5.56	1.39	0.36	0.15	3.76	2.64	5.53	1.17	-0.02	-0.03	0.02	-0.03	-0.82	-0.29
L65/L76	0.09	-1.33	-2.33	-2.18	4.64	4.29	5.88	8.45	-0.08	0.00	-0.11	-0.13	-0.27	-0.01
L65/P2	-1.45	-3.76	-5.06	-3.63	0.10	-0.11	0.13	4.50	0.01	0.02	0.04	0.09	0.11	-1.35
L65/P3	-0.86	2.42	-0.47	3.92	2.24	-1.58	0.74	6.29	0.03	0.03	0.06	0.03	-0.25	0.64
L65/P6	1.33	1.07	-4.27	-2.05	-0.90	2.83	1.15	8.33	-0.01	0.01	0.04	0.13	-0.58	-0.52
L65/P7	0.03	0.44	-1.07	0.14	3.92	3.53	1.68	2.97	0.04	-0.01	0.04	0.03	-0.25	0.29
L71/L75	-0.14	-0.57	2.26	2.23	1.76	2.98	2.59	3.87	0.01	0.03	0.07	0.06	-0.56	-0.43
L71/L76	-1.24	0.47	2.31	0.57	-0.20	0.46	2.07	3.38	0.02	-0.02	-0.01	-0.02	0.12	0.48
L71/P2	-0.68	-2.86	-2.72	-2.38	-2.90	-0.94	3.38	2.23	-0.01	0.02	0.04	0.02	-0.19	0.04
L71/P3	1.72	-1.11	-2.70	-3.00	1.74	1.49	-1.10	0.38	0.00	-0.02	-0.01	-0.08	-0.06	0.00
L71/P6	0.17	1.67	1.58	-0.34	1.64	-2.00	-0.79	5.56	0.01	0.03	0.01	0.13	0.31	-1.30
L71/P7	0.97	2.04	-3.53	-2.51	-1.85	0.31	-1.29	-3.13	0.01	0.00	-0.01	-0.02	-0.09	-0.32
L75/L76	0.36	2.34	-0.51	4.67	4.31	1.22	2.26	-0.81	0.04	0.02	0.00	0.06	0.28	0.20
L75/P2	1.66	0.85	0.23	-0.31	1.18	2.45	-1.20	3.88	-0.01	0.02	-0.01	-0.02	-0.07	0.62
L75/P3	-0.22	-1.58	-0.22	-0.69	1.65	-2.55	-0.51	-1.37	0.01	0.02	-0.01	0.00	-0.14	0.38
L75/P6	-2.10	-2.26	-0.58	-1.03	-1.09	-0.18	-3.91	-2.89	-0.04	-0.01	-0.04	-0.07	0.10	-0.75
L75/P7	-0.37	-1.06	0.95	-0.44	-0.21	2.19	-1.77	3.22	-0.04	0.01	-0.03	0.01	0.23	0.29
L76/P2	1.39	2.29	3.81	1.83	-0.44	3.27	-0.28	-1.01	0.03	0.00	0.04	-0.03	-0.05	1.13
L76/P3	2.15	0.97	2.00	-0.03	1.69	1.13	-1.19	-1.09	0.01	-0.01	-0.01	-0.03	0.15	0.86
L76/P6	2.63	-0.54	-1.86	-2.57	-2.31	1.71	1.81	1.85	-0.03	-0.02	0.03	0.05	-0.55	0.36
L76/P7	1.40	-0.41	-0.50	2.79	-0.03	2.51	2.48	1.43	-0.07	-0.02	0.06	0.06	0.45	0.78
P2/P3	-0.76	-1.56	-3.53	0.36	-0.87	-1.10	-0.21	-6.41	-0.04	-0.02	-0.08	-0.06	0.26	-1.68
P2/P6	2.16	1.89	-1.06	1.16	2.09	0.51	0.19	-1.50	-0.04	0.00	-0.02	-0.06	-0.50	-0.38
P2/P7	-0.11	1.22	2.67	3.55	1.90	1.47	0.36	2.24	0.05	0.02	0.02	0.12	-0.07	0.40
P3/P6	0.89	-0.57	1.23	1.77	-1.24	0.37	-1.96	2.39	0.03	0.01	0.04	0.04	0.07	-0.25
P3/P7	-1.61	-4.90	-1.81	-5.57	-2.56	0.27	6.01	1.90	-0.02	-0.02	-0.01	0.15	-0.50	0.29
P6/P7	0.94	0.99	0.46	-0.85	-1.13	-1.02	0.22	-0.93	0.03	0.02	-0.04	-0.14	-0.23	0.33

Note: SPAD, relative chlorophyll content index, measurements 1–8, at the planting, pre-tasseling, tasseling, silking, blister, milk, dough and dent, respectively; NDVI: normalized difference vegetation index, measurements 1–4, at the silking, blister, milk and dough, respectively; and CTD, canopy temperature depression measured, measurements 1 and 2, at the silking and dough, respectively.