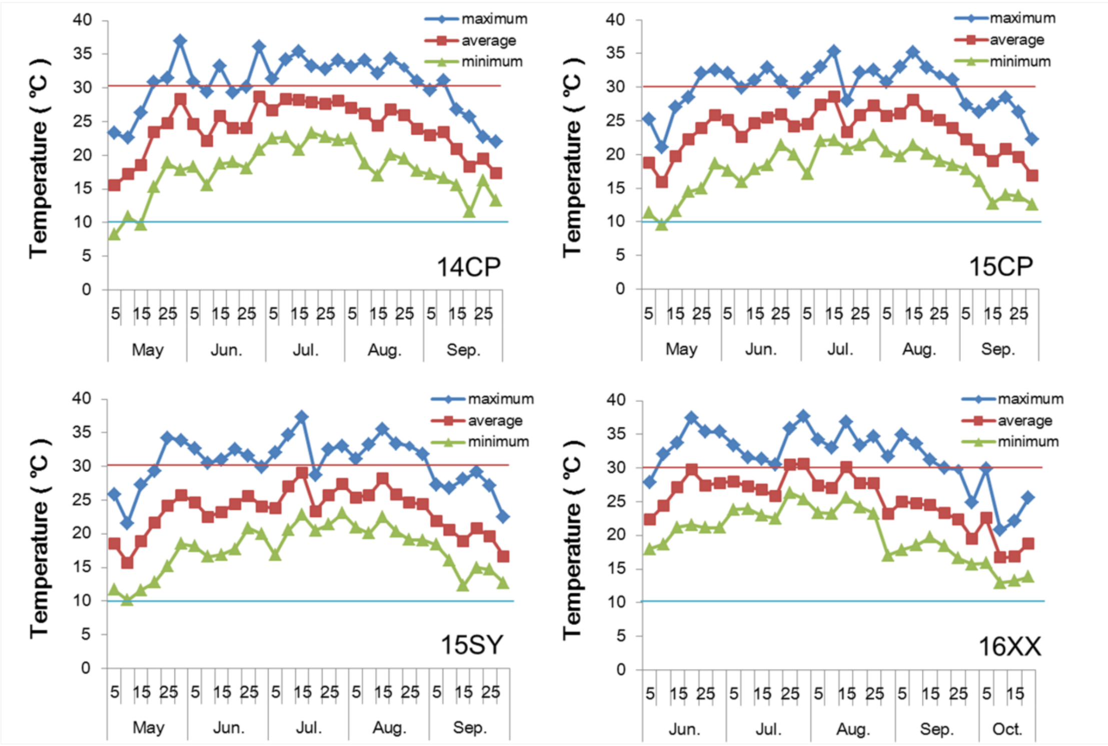
Appendix A Hybrids used in this study

Origin	Hybrid name	Year of release	Pedigree	GDDs for DPM in each environments			
				14CP	15CP	15SY	16XX
China	Jidan 102	1964	M14 × Tie133	—	1524	1439	1496
China	Qundan 105	1968	Aijin 525 × C103	1730	1719	1744	1660
China	Danyu 2	1968	Lu 9 × Zi 330	—	1552	1555	—
China	Danyu 3	1968	Daqiu 36 × Zi330	1730	1594	1584	1613
China	Danyu 6	1971	Lu 28 × Zi 330	1765	1622	1620	1654
China	Zhongdan 2	1972	Mo17 × Zi 330	1765	1661	1668	—
China	Luyuandan 4	1974	Yuanwu 02 × Weifeng 322	1557	1466	1482	1459
China	Jindan 8	1975	Hua 160 × Tai 183	1610	1466	1596	1563
China	Shandan 9	1976	Wu109 × Mo17	—	1674	1668	1647
China	Yandan 14	1980	Huangzaosi × Mo17	1730	1661	1569	1602
China	Jingza 6	1980	330 × Xu 052	—	1646	—	—
China	Danyu 13	1981	Mo17 × E28	1741	1707	1681	1665
China	Shengdan 7	1981	5003 × E28	—	1674	1608	—
China	Yedan 4	1983	Ye 8112 × Huangzaosi	1730	1646	1648	1610
China	Benyu 9	1991	7884Ht × Mo17Ht	—	1661	—	—
China	Sidan 19	1991	444 × Mo17	1637	1552	1569	1582
China	Jidan 28	1996	Huangyesi 3 × Huotanghuang 17	1790	1622	—	—
China	Yedan 13	1998	Ye 478 × Dan 340	1741	1694	1744	1685
China	Nongda 108	1998	178 × Huang C	1703	1686	1734	1702
China	Zhengdan 958	2000	Zheng 58 × Chang 7-2	1730	1742	1754	1702
China	Ludan 50	2000	Luyuan 92 × Qi 319	1741	1707	1660	—
China	Denghai 9	2000	DH65232 × 8723	1765	1674	1718	1699
China	Shengdan 16	2001	K12 × Shen 137	1741	1646	1694	1680
China	Xundan 20	2003	5098 × Xun 92-8	1816	1674	1660	1690
China	Dongdan 60	2003	A 801 × Dan 598	1883	1742	1823	—
China	Ludan 981	2003	Qi 329 × Lx5801	1816	1749	1681	1654
China	Zhongdan 808	2006	CL11 × NG5	1719	—	—	1687
China	Liaodan 565	2008	Zhong 106 × Liao 3162	1730	1686	1725	1703
China	Liangyu 88	2008	M 54 × S 12	1741	1661	1660	1678
China	Nonghua 101	2010	NH 60 × S12	1741	1608	1620	1671
China	Denghai 605	2010	DH 351 × DH382	1765	1694	1754	1723
China	Weike 702	2012	WK858 × 758-1	1816	1661	1775	1694
United States	PR3394	2002	PHP38 × PHN46	1730	1646	1725	1671
United States	Xianyu 335	2004	PH6WC × PH4CV	1662	1719	—	—
United States	Xianyu 420	2005	PH6WC × PH6AT	1719	1694	1660	1710
United States	32D22	2005	PH09B × PHPMO	—	1634	1668	1687
United States	Xianyu 508	2006	PH6WC × PH5AD	1719	1674	1694	1707
United States	Xianyu 252	2006	PH6JM × PHB1M	—	1594	1744	1683
United States	Xianyu 696	2006	PH6WC × PHB1M	—	1686	1608	1695
United States	Xianyu 698	2008	PH6WC × PH4CN	—	1608	1694	1665

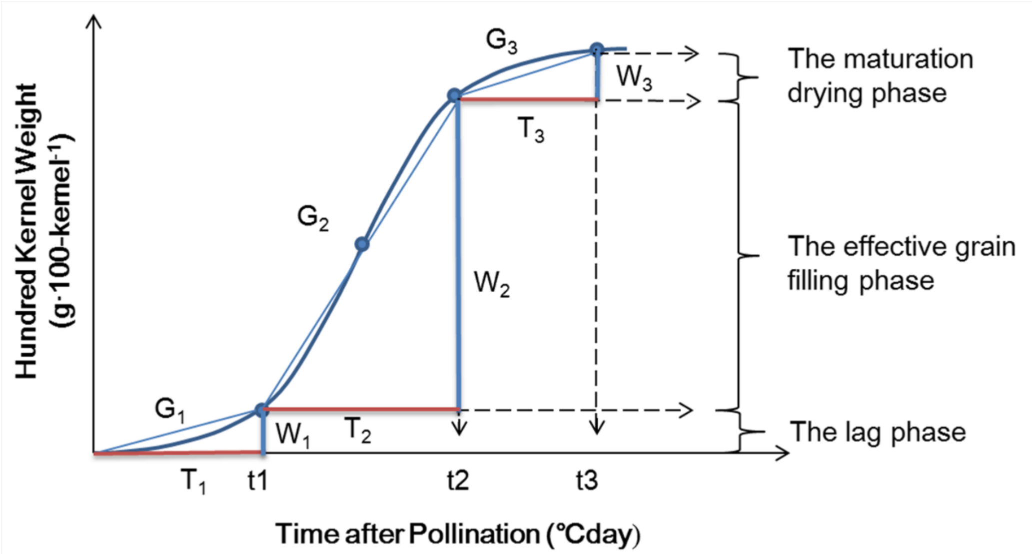
Origin	Hybrid name	Year of	Pedigree	GDDs for DPM in each environments			
United States	Xianyu 688	2010	PHJEV × PHRKB	—	1646	1660	1710
United States	Xianyu 738	2010	PH8JV × PHN5A	—	1674	1694	1702
United States	Xianyu 808	2012	PHTEF × PHRKB	—	1661	1734	1726
United States	Xianyu 027	2012	PHHJC × PH12RP	1719	1719	1725	1707
United States	Xianyu 023	2013	PH12P3 × PH12RP	1557	1646	1725	1669
United States	Xianyu 045	2013	PH1DP8 × PHRKB	—	1646	1754	1702
United States	Xianyu 836	2013	PHK3N1 × PH1G2H1	—	1694	1718	1690
United States	Xianyu 987	2014	PH11V8 × PH12TB	—	1608	1668	1669
United States	Xianyu 047	2014	PH1DP2 × PHRKB	1730	1646	1634	1671
United States	Xianyu 1266	2014	PH1CPS × PH1N2F	1703	1622	1734	1673

The first two numbers in the shared environments represent the measured year: CP, Changping in Beijing; SY, Shunyi in Beijing; XX, Xinxiang in Henan.

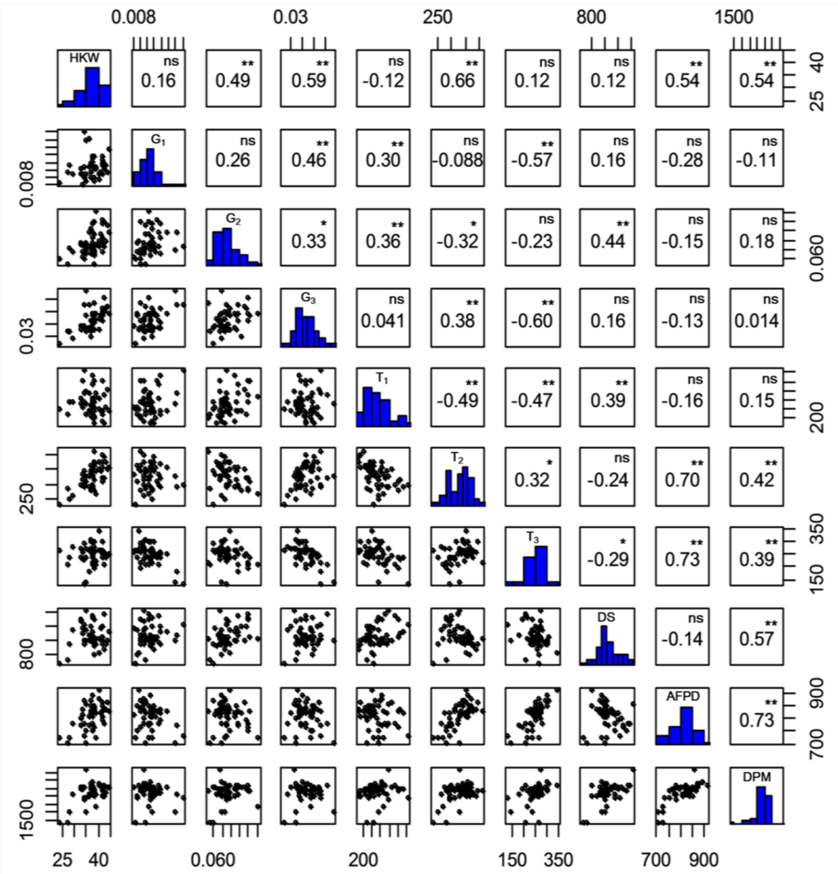
"—" Indicated that the data were missing.



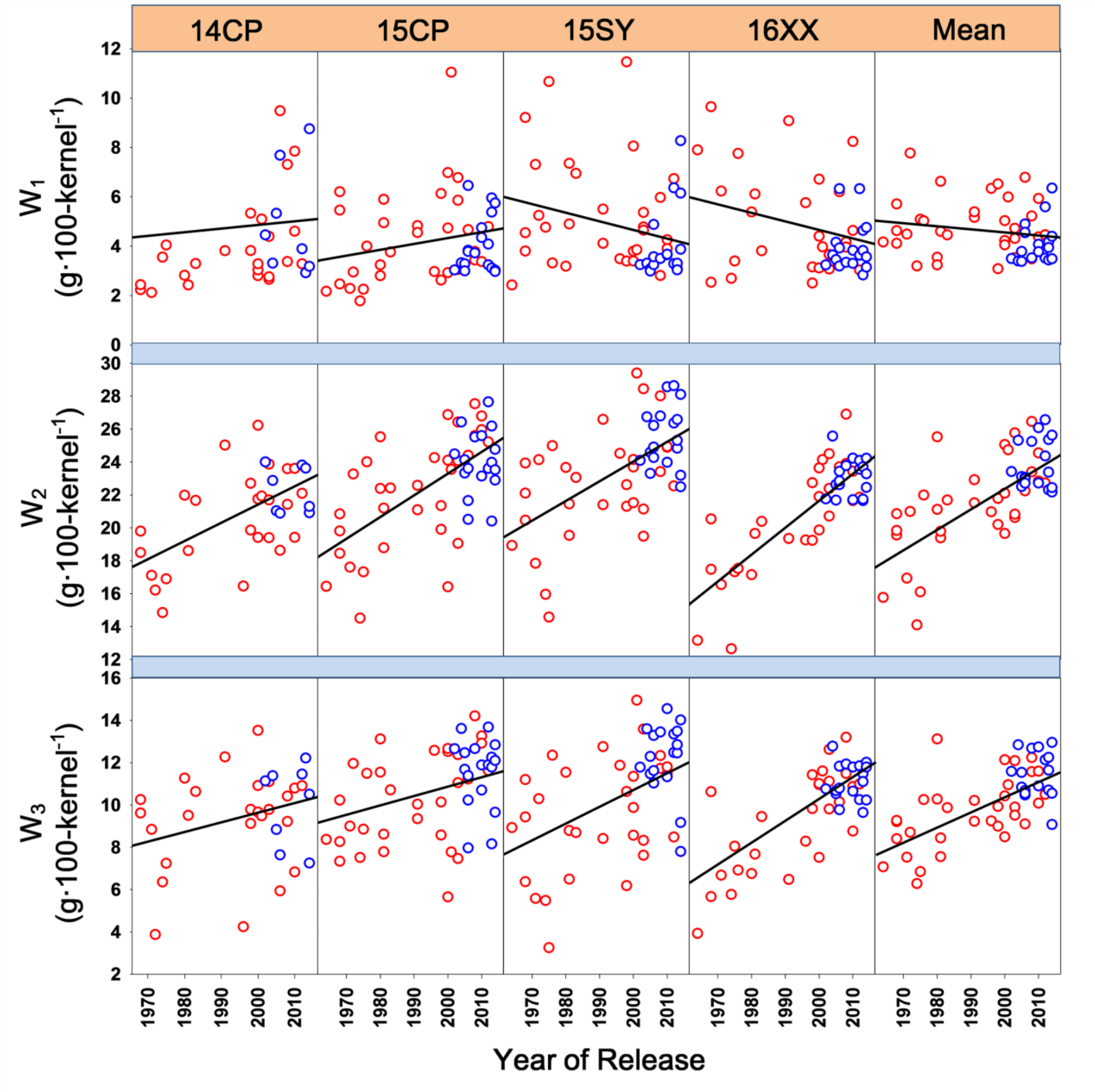
Appendix B Air temperatures during the maize growth period in four environments. Each datum represents the mean of five days. The red and green lines show the highest critical temperature and lowest critical temperature, respectively, for maize grain filling.



Appendix C Schematic diagram illustrating the models used to describe the grain filling process. W_1, W_2 and W_3 represent the accumulation of grain weight; G_1, G_2 and G_3 represent the grain filling rate; and T_1, T_2 and T_3 represent the grain filling duration at different grain filling phases.



Appendix D Correlation coefficients among hundred kernel weight (HKW), grain filling characteristics and growth period-related traits. Above the diagonal are the correlation coefficients between all pairs of traits. The diagonal represents the histogram for the frequency distribution for each trait. Below the diagonal, scatter points are the distributions between all pairs of traits.



Appendix E Simple linear regressions of the accumulation of grain weight (W_1, W_2, W_3) at different grain filling phases in the year of maize hybrid release in each of the four environments [(Changping in 2014 and 2015 (14CP, 15CP), Shunyi in 2015(15SY), Xinxiang in 2016 (16XX)] and the mean of all four environments for the hybrids. Chinese hybrids are denoted by red circles, and U.S. hybrids are denoted by blue circles. Solid lines show the fitted model. The horizontal axis represents the year of hybrid release, and the slope of the line represents the decadal change of hybrids.

Appendix F Differences of grain filling related traits in hybrids from different eras

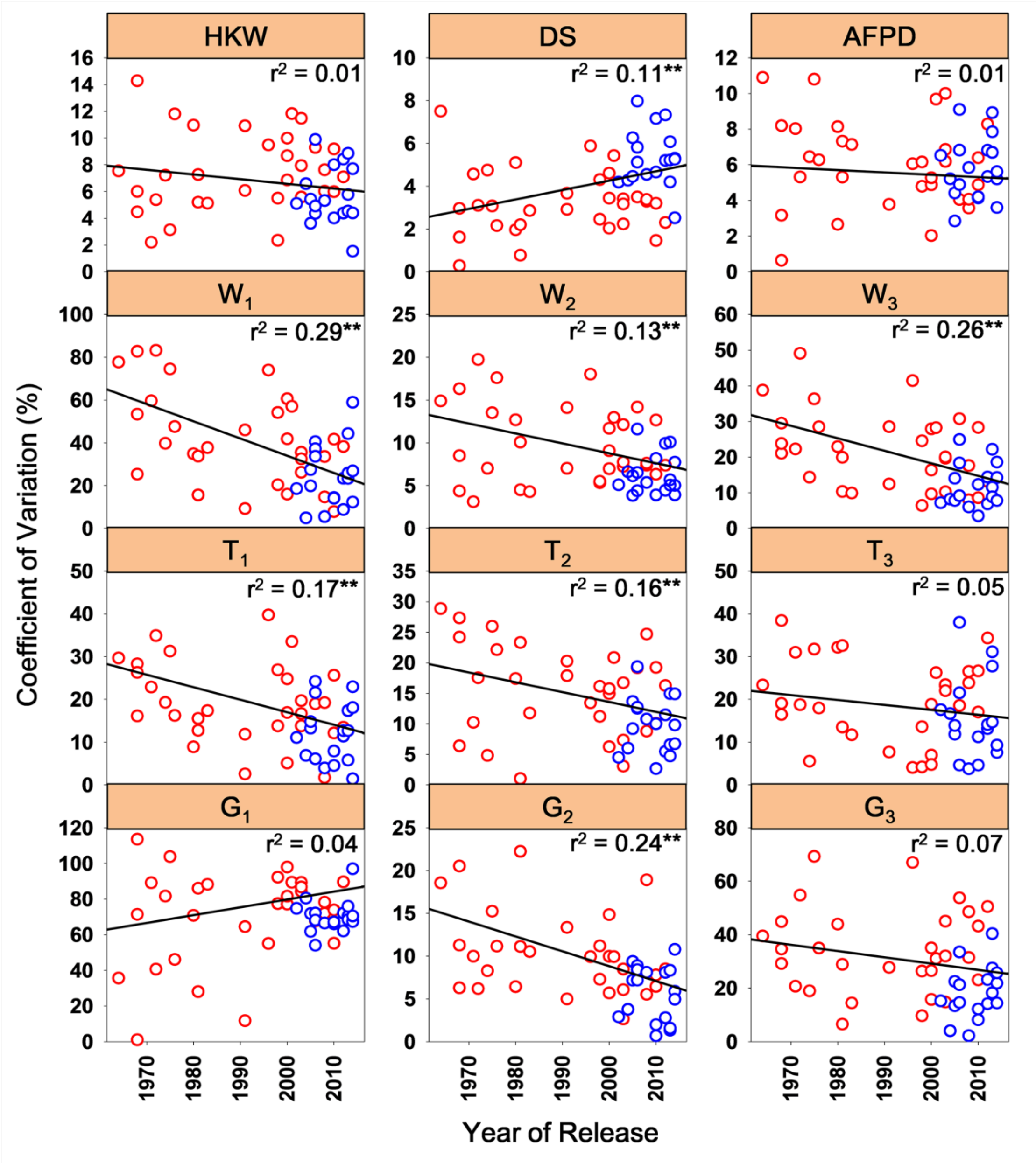
Eras	W_1 (g ·100-kerenl^{-1})	W_2 (g ·100-kerenl^{-1})	W_3 (g ·100-kerenl^{-1})
1960s	4.65 ±0.74 a	19.00 ±2.23 b	8.48 ±1.02 cd
1970s	5.11 ±1.67 a	18.02 ±3.35 b	7.92 ±1.59 d
1980s	4.49 ±1.32 a	21.50 ±2.44 a	9.85 ±2.13 abc
1990s	5.30 ±1.37 a	21.48 ±1.01 a	9.52 ±0.52 bc
2000s	4.38 ±0.95 a	23.29 ±1.87 a	10.96 ±1.18 ab
2010s	4.42 ±0.95 a	23.94 ±1.57 a	11.41 ±1.17 a
	T_1 (℃day)	T_2 (℃day)	T_3 (℃day)
1960s	232.04 ±19.66 a	299.97 ±18.72 b	214.34 ±53.96 b
1970s	243.71 ±28.46 a	265.30 ±22.82 c	246.73 ±25.50 ab
1980s	235.30 ±41.01 a	311.13 ±13.66 b	223.69 ±51.36 b
1990s	242.51 ±23.90 a	294.38 ±25.01 b	226.84 ±37.97ab
2000s	229.24 ±33.32 a	346.89 ±31.91 a	256.18 ±30.46 ab
2010s	224.19 ±18.08 a	357.35 ±17.32 a	270.72 ±30.23 a
	G_1 (g ·100-kernel^{-1} ·℃day^{-1})	G_2 (g ·100-kernel^{-1} ·℃day^{-1})	G_3 (g ·100-kernel^{-1} ·℃day^{-1})
1960s	0.014 ±0.004 a	0.065 ±0.005 b	0.043 ±0.016 ab
1970s	0.012 ±0.003 a	0.069 ±0.008 ab	0.034 ±0.010 b
1980s	0.014 ±0.005 a	0.070 ±0.005 ab	0.046 ±0.008 a
1990s	0.014 ±0.004 a	0.074 ±0.009 a	0.043 ±0.009 ab
2000s	0.012 ±0.002 a	0.068 ±0.008 ab	0.044 ±0.007 ab
2010s	0.013 ±0.002 a	0.067 ±0.003 ab	0.044 ±0.006 ab

Different letters within a column indicate a significant differences at $\alpha = 0.05$.

Appendix G Differences of growth period related traits in hybrids from different eras

Eras	Trait				
	DS (℃day)	AFPD (℃day)	DPM (℃day)	DS/DPM (%)	AFPD/DPM (%)
1960s	849.51 ±53.65 ab	746.34 ±50.07 b	1595.85 ±97.90 c	53.24 ±1.09 a	46.76 ±1.09 b
1970s	859.65 ±61.02 ab	759.43 ±41.21 b	1619.07 ±90.07 bc	53.07 ±1.54 a	46.93 ±1.54 b
1980s	893.28 ±26.63 a	773.09 ±29.36 b	1666.37 ±28.11 ab	53.61 ±1.47 a	46.39 ±1.47 b
1990s	889.99 ±31.15 a	784.48 ±37.64 b	1674.77 ±54.50 ab	53.15 ±1.10 a	46.83 ±1.18 b
2000s	867.90 ±37.01 ab	833.50 ±30.28 a	1701.15 ±35.53 a	51.01 ±1.58 b	49.01 ±1.77 a
2010s	841.54 ±23.72 b	849.21 ±29.50 a	1690.75 ±29.31 a	49.78 ±1.31 b	50.22 ±1.31 a

Different letters within a column indicate a significant differences at α = 0.05



Appendix H Changes in the coefficients of variation (*CVs*) of HKW and grain filling characteristics across the shared environments. Chinese hybrids are denoted by red circles, and U.S. hybrids are denoted by blue circles. Solid lines show the fitted model. The horizontal axis represents the year of hybrid release, and the slope of the line represents the change of hybrids.

Appendix I Differences of *CV* between Chinese local and U.S. exotic hybrids

Origin	Trait												
	DS	AFPD	DPM	HKW	T_1	T_2	T_3	G_1	G_2	G_3	W_1	W_2	W_3
China	3.19 b	5.85 a	2.68 a	8.27 a	17.03 a	14.07 a	20.94 a	80.17 a	8.70 a	34.65 a	33.97 a	9.48 a	18.33 a
U.S.	5.31 a	5.78 a	2.21 a	5.71 b	12.01 a	9.76 b	15.03 a	70.31 b	5.67 b	18.46 a	24.42 a	6.30 b	11.98 a

Different letters within a column indicate a significant differences at α = 0.05.