

## ***Supplementary Materials***

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**Table S1**

Details of the four experimental stations.

Items	Gongzhuling	Zunhua	Luoyang	Nanchong
Location	Northeast China	North China Plain	Low reaches of Yellow River	Sichuan Basin
Latitude (°N)	43.54	40.12	34.63	30.78
Longitude (°E)	124.81	117.57	112.47	106.12
Altitude (m)	208	549	137	297
Crop data period	2012-2017	2009-2015	2012-2017	2011-2015
Weather data period	1980-2017	1980-2017	1980-2017	1980-2017
Climate type	Continental monsoon	Monsoon humid	Continental	Subtropical monsoon humid
Annual mean temperature (°C)	5.6	10.9	14.5	17.3
Annual total precipitation (mm)	594	725	632	987
Frost-free period (day)	144	182	220	290
Soil type (0–30 cm)	Black soil	Cinnamon soil	Fluvo-aquic soil	Lime purple soil
Organic carbon (g kg <sup>-1</sup> )	20.52	18.72	11.26	7.17
Total N (g kg <sup>-1</sup> )	1.34	1.13	0.70	0.63
PH	8.65	8.37	9.32	8.88
Bulk density (g cm <sup>-3</sup> )	1.19	1.41	1.55	1.41
Clay (%)	31.05	12.15	26.09	20.24

**Table S2**  
Cultivars tested at different locations.

Station	Maturity group	Cultivar	Year	
			Calibration	Validation
Gongzhuling	Early	JD 27	2013, 2014	2015, 2016, 2017
		XX 1	2014	2015, 2016
	Medium	XY 987	2015	2016, 2017
		XY 335	2009, 2010, 2011	2012, 2013, 2104, 2015, 2016
	Late	JK 968	2014	2015, 2016
		ZD 958	2009, 2010, 2011, 2012	2013, 2014, 2015, 2016
Zunhua	Early	DK 516	2014	2015, 2016
		NH 101	2013	2014, 2015
	Medium	XY 987	2016	2014, 2015
		XY 335	2015	2013, 2014
	Late	JK 968	2014	2015, 2016
		ZD 958	2011, 2012	2009, 2010
Luoyang	Early	DK 517	2014	2015, 2016
		NH 101	2015	2013, 2014
	Medium	DH 605	2016	2014, 2015
		XY 335	2013, 2014	2015, 2016
	Late	LY 66	2014	2013, 2015
		ZD 958	2012, 2013	2014, 2015, 2016
Nanchong	Early	CD 30	2011, 2012	2013, 2014, 2015
		ZD 958	2013	2014, 2015
	Medium	YD 30	2012	2013, 2014
		YR 8	2013, 2014	2011, 2012
	Late	JD 13	2011, 2012	2013, 2014
		GD 8	2011, 2013	2014, 2015

**Table S3**

CERES-Maize parameters.

Parameter	Definition	Variables influenced by the parameter
P1	Thermal time from seedling emergence to the end of the juvenile phase (expressed in degree days above a base temperature of 8 °C) during which the plant is not responsive to changes in photoperiod	Anthesis date
P2	Extent to which development (expressed as days) is delayed for each hour increase in photoperiod above the longest photoperiod at which development proceeds at a maximum rate (which is considered to be 12.5 h)	Anthesis date
P5	Thermal time from silking to physiological maturity (expressed in degree days above a base temperature of 8 °C)	Maturity date
G2	Maximum possible number of kernels per plant	Number of kernels per plant
G3	Kernel filling rate during the linear grain filling stage and under optimum conditions	Kernel dry weight
PHINT	Phylochron interval; the interval in thermal time (degree days) between successive leaf tip appearances	Final leaf number

**Table S4**

Identification matrix of integrated risk level.

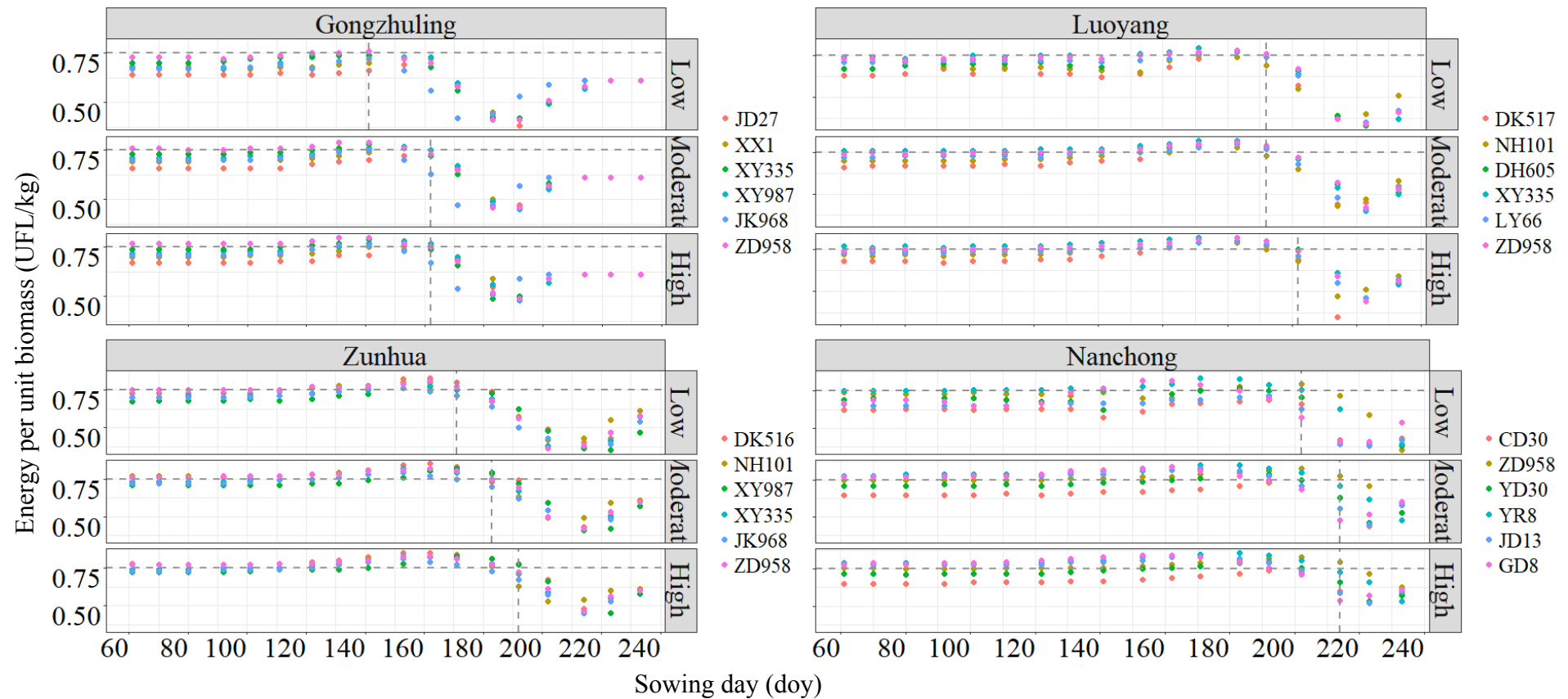
Frost Poor silage quality	Low	Medium	High
Low	Low	Medium	High
Medium	Medium		
High			

**Table S5**

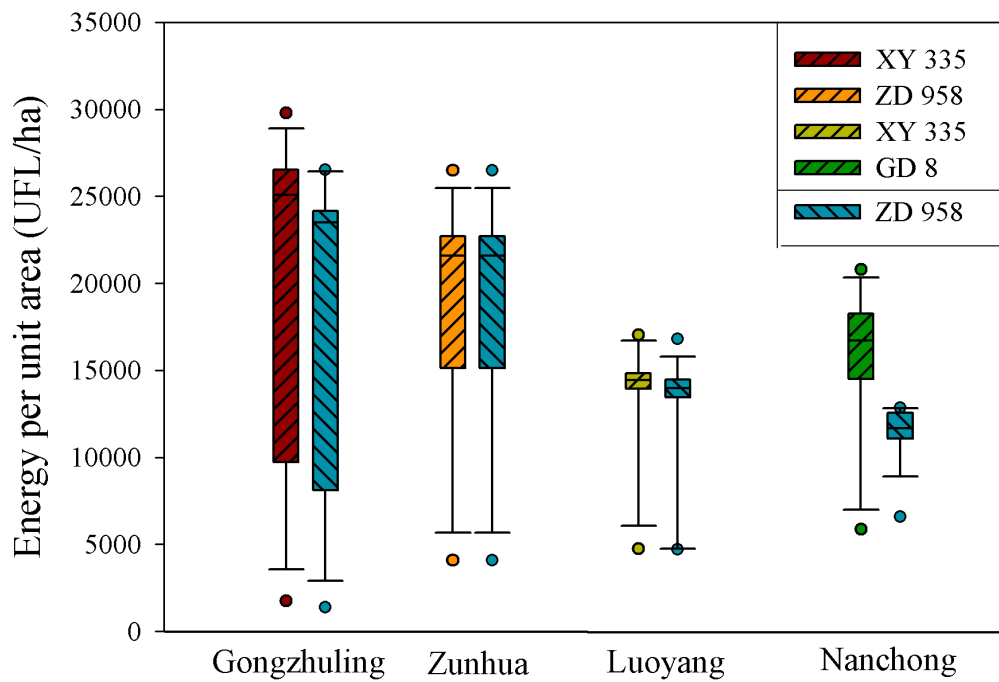
*RMSE*, *RRMSE*, *CRM* and  $R^2$  for the simulation of anthesis day, maturity day and biomass at each station.

Stations	Gongzhuling		Zunhua		Luoyang		Nanchong	
	c	v	c	v	c	v	c	v
Anthesis day(d)								
RMSE	2.00	3.16	1.43	3.33	1.63	2.54	3.20	4.15
RRMSE	2.38%	3.82%	2.22%	5.09%	3.16%	4.81%	4.12%	5.24%
CRM	0.006	0.019	0.001	0.010	0.007	0.025	0.000	0.008
$R^2$	0.66	0.38	0.47	0.84	0.31	0.31	0.89	0.87
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Maturity day(d)								
RMSE	1.90	3.32	3.00	5.92	3.13	3.77	6.00	5.69
RRMSE	1.38%	2.38%	2.40%	4.55%	3.13%	3.73%	4.63%	4.40%
CRM	-0.005	0.000	-0.015	0.007	0.001	-0.001	-0.005	0.013
$R^2$	0.95	0.87	0.93	0.78	0.79	0.73	0.76	0.85
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Biomass								
(kg/ha)								
RMSE	888.64	726.95	700.43	1098.42	780.00	1247.08	894.90	691.85
RRMSE	3.77%	3.00%	3.50%	5.24%	4.42%	6.77%	5.26%	4.04%
CRM	-0.007	-0.021	-0.016	-0.006	-0.009	0.000	0.024	-0.013
$R^2$	0.93	0.91	0.83	0.71	0.95	0.75	0.92	0.91

c for calibration and v for validation.



**Fig. S1** Energy per unit biomass (*EPUWHB*, UFL/kg) for the combinations of cultivars and sowing dates at three poor silage quality risk levels in each station (the sowing date after the vertical line is not available; the first two were early-maturing cultivars, the middle for medium and the last two for late).



**Fig. S2** Energy per unit area (UFL/ha) for the optimum cultivar and ZD 958 at each station.