Table S1 Information about tested rice varieties used in the experiment.

Variety	abbreviation	Female parent	Male parent	Type	Year	Area (10^4 mu)
Longliangyouhuazhan	LLYHZ	Longke638S	Huazhan	Super rice	2015	>1000
Longliangyouhuanglizhan	LLYHLZ	Longke638S	Huanglizhan	——	2016	>100
Longliangyou8612	LLY8612	Longke638S	Huahui8612	——	2019	<100
Longliangyou534	LLY534	Longke638S	R534	——	2016	>400
Longliangyou3189	LLY3189	Longke638S	R3189	——	2017	<100
Longliangyou1988	LLY1988	Longke638S	R1988	Super rice	2016	>200
Longliangyou149	LLY149	Longke638S	R149	——	2016	<100
Longliangyou1377	LLY1377	Longke638S	R1377	Super rice	2017	>200
Longliangyou1212	LLY1212	Longke638S	R1212	Super rice	2016	>100
Longliangyou1206	LLY1206	Longke638S	R1206	——	2016	>100
Longliangyou1125	LLY1125	Longke638S	R1125	——	2017	<100
Jingliangyouhuazhan	JLYHZ	Jing4155S	Huazhan	Super rice	2015	>1000
Jingliangyouhuanglizhan	JLYHLZ	Jing4155S	Huanglizhan	——	2018	<100
Jingliangyou8612	JLY8612	Jing4155S	Huahui8612	——	2018	<100
Jingliangyou3189	JLY3189	Jing4155S	R3189	——	2017	<100
Jingliangyou1988	JLY1988	Jing4155S	R1988	——	2018	<100
Jingliangyou1377	JLY1377	Jing4155S	R1377	——	2016	>200
Jingliangyou1212	JLY1212	Jing4155S	R1212	Super rice	2016	>200
Jingliangyou1206	JLY1206	Jing4155S	R1206	——	2017	<100
Jingliangyou1199	JLY1199	Jing4155S	R149	——	2018	<100
Jingliangyou1125	JLY1125	Jing4155S	R1125	——	2017	<100
Fengliangyou4	FLY4	Feng39s	Yandao4	——	2009	——

Data was from China Rice Data Center (https://www.ricedata.cn/). Super rice was designated by Ministry of Agriculture and Rural Affairs. FLY4 was used as the control variety since it was the control variety in variety certification. One hectare equals 15 Chinese Mu.

Table S2 Yield components of tested hybrid rice varieties in 2019 and 2020.

Variety	Panicles m^{-2}	Spikelets per panicle	Spikelets m^{-2}	Grain filling percentage (%)	Grain weight (mg)	Panicles m^{-2}	Spikelets per panicle	Spikelets m^{-2}	Grain filling percentage (%)	Grain weight (mg)
	2019					2020				
LLYHZ	227.1	230.6	52321.1	76.6	20.4	222	240	53173	75.9	19.8
LLY534	225.7	214.9	48562.2	80.3	19.9	210	233	49064	85.5	19.8
LLY1206	209.7	220.3	46220.5	84.0	21.6	221	214	47151	83.6	21.1
LLY8612	184.0	240.3	44026.3	80.7	22.1	191	263	50156	78.8	22.2
LLY149	177.8	202.7	36019.1	82.2	25.3	201	220	44174	83.2	24.4
LLY1377	208.6	230.1	47983.0	78.3	20.4	234	233	54466	71.9	20.3
JLYHZ	244.4	208.4	50854.9	82.5	18.3	231	211	48693	85.0	18.9
JLY1206	248.6	179.9	44693.9	81.9	20.2	229	213	48526	84.0	19.6
JLY1988	210.4	203.2	42758.5	87.8	20.7	222	216	47800	80.6	20.5
LLY1988	217.4	202.4	43875.3	76.4	22.3	199	204	40677	77.5	22.8
LLYHLZ	225.0	226.9	51129.6	79.7	20.8	219	207	45224	75.7	20.9
LLY3189	206.4	188.5	38976.0	80.5	25.2	187	205	38259	78.9	25.4
JLYHLZ	204.9	215.3	44020.9	82.9	19.4	238	249	59256	78.7	18.4
JLY8612	204.2	218.4	44522.2	77.8	19.6	203	243	49351	72.7	20.2
JLY1377	220.1	220.7	48543.1	81.2	19.4	230	235	53909	76.8	19.2
JLY3189	204.9	190.6	39026.1	85.4	23.2	222	183	40488	82.3	24.0
LLY1125	208.3	215.3	44804.0	79.6	18.8	211	267	56242	81.9	18.3
JLY1212	206.3	204.6	42076.3	82.1	19.6	217	219	47380	86.3	19.6
JLY1125	210.4	233.4	48996.2	81.7	17.8	223	242	53842	79.8	17.5
JLY1199	220.8	168.8	37293.2	77.4	22.8	217	202	43749	78.6	22.6
LLY1212	221.5	207.8	45864.3	77.0	20.7	222	198	43688	81.2	20.9
FLY4	194.6	186.3	36232.4	79.5	24.9	201	202	40573	72.4	24.6
LSD (0.05)	21.8	24.5	6042.4	4.4	1.0	24	27	5412	7.4	0.5

Critical values based on LSD test (0.05) were used for comparison in each parameter among different varieties.

Table S3 Dry matter accumulation and harvest index of tested hybrid rice varieties in 2019 and 2020.

Variety	TDW_PM	TDW_HD	TDW_GF	HI	TDW_PM	TDW_HD	TDW_GF	HI
	2019				2020			
LLYHZ	1662.5	946.5	716.1	49.0	1607.5	1226.65	380.84	49.5
LLY534	1633.0	1133.6	499.3	47.6	1612.7	1215.97	396.71	51.5
LLY1206	1692.8	1021.0	671.8	49.6	1629.9	1164.94	464.97	50.9
LLY8612	1648.7	975.8	672.8	47.7	1700.7	1210.40	490.31	51.5
LLY149	1554.7	1065.4	489.2	48.1	1730.8	1248.42	482.42	51.8
LLY1377	1617.5	1158.9	458.6	47.4	1807.0	1299.94	507.07	44.0
JLYHZ	1587.6	1051.4	536.2	48.6	1572.7	1162.86	409.86	49.6
JLY1206	1585.2	978.5	606.7	46.7	1516.9	1157.81	359.11	52.5
JLY1988	1617.6	957.9	659.7	48.2	1647.2	1127.92	519.31	47.9
LLY1988	1661.7	1069.3	592.4	44.9	1545.6	1251.29	294.27	46.4
LLYHLZ	1843.0	1129.1	713.9	46.0	1654.0	1282.67	371.37	43.3
LLY3189	1692.6	1020.6	672.1	46.7	1555.9	1252.06	303.85	49.4
JLYHLZ	1461.4	951.3	510.1	48.4	1671.5	1119.30	552.20	51.2
JLY8612	1522.1	912.1	610.0	44.5	1521.1	1125.91	395.20	47.6
JLY1377	1592.5	953.8	638.7	48.0	1614.1	1140.71	473.35	49.2
JLY3189	1601.5	1070.2	531.3	47.9	1572.8	1229.01	343.77	50.8
LLY1125	1402.5	935.0	467.5	47.8	1645.0	1152.94	492.05	51.3
JLY1212	1434.5	1008.9	425.6	47.4	1537.8	1200.76	337.07	52.0
JLY1125	1548.6	963.8	584.8	45.9	1538.0	1157.72	380.33	48.8
JLY1199	1605.4	996.0	609.3	41.0	1609.2	1172.98	436.20	48.4
LLY1212	1686.5	1104.6	581.9	43.3	1648.2	1230.58	417.61	45.0
FLY4	1476.2	931.1	545.1	48.6	1558.0	1305.22	252.76	46.2
LSD (0.05)	202.9	88.2	201.8	3.7	147.23	97.43	152.47	3.06

Critical values based on LSD test (0.05) were used for comparison in each parameter among different varieties. TDW-Total dry weight, PM-physiological maturity, HD-heading stage, GF-grain filling period, HI-harvest index.

Table S4 Number of differentially expressed genes between LLYHZ, JLYHZ, and JLY1212 in spikelets at flowering stage in 2020

Comparison	up	down
LLYHZ vs JLYHZ	2124	1768
LLYHZ vs JLY1212	1900	1775
JLYHZ vs JLY1212	779	1044

Table S5 The overlapping genes differentially expressed between LLYHZ and JLYHZ and between LLYHZ and JLY1212 in panicle at flowering stage

Location	Group	Gene name	Gene function
Growth and yield			
LOC_Os07g45570	down	OsBLE2	Aldolase; Root length.
LOC_Os03g48740	down	OsIAAGLU|OsIAGT1	Dwarfism; Tillering; Auxin catabolism
LOC_Os02g49370	down	OsHAP3E	Panicle flower; Dwarfism; Leaf angle; Floral organ formation
LOC_Os01g25484	up	PSR1|OsNiR	Shoot regeneration; Nitrate assimilation
LOC_Os05g13900	up	OsPRP|RePRP1.1	Root growth; Root cell elongation; ABA sensitivity
LOC_Os07g23660	up	RePRP2.1	Root; Root growth; Root cell elongation; ABA sensitivity
LOC_Os01g54270	up	D10|OsCCD8|OsCCD8b	Root; Strigolactone biosynthesis; Crown root length
LOC_Os07g23640	up	RePRP2.2	Root; Root growth; Root cell elongation; ABA sensitivity
LOC_Os01g45550	up	OsPIN3t	Culm leaf; Tiller angle; Crown root development; Root gravitropism; Drought tolerance
LOC_Os02g17780	up	OsCPS|OsCPS1	Dwarfism; Gibberellin biosynthesis
LOC_Os09g37330	up	SAUR39	Dwarfism; Leaf angle; Root growth; Regulation of auxin level and transport
LOC_Os03g49880	up	OsTB1|FC1|SCM3	Culm leaf; Tiller growth
LOC_Os06g12210	up	BU1|OsbHLH174	Seed; Leaf angle; Grain size; Brassinosteroid sensitivity
LOC_Os07g38130	up	OsFOR1|PGIP	Panicle flower; Regulation of floral organ number
LOC_Os05g39990	up	NA	Flowering; Dwarfism; Cell wall extensibility; Flowering time
LOC_Os05g51360	up	OsEBS	Panicle flower; Plant height; Leaf size; Grain number
LOC_Os05g50890	up	OsJar1|OsGH3.5|OsGH3-5	Sterility; Seed development
LOC_Os04g45330	up	OsYABBY5|OsYAB3|TOB1	Panicle flower; Spikelets morphology
LOC_Os02g44630	up	OsPIP1;1|RWC1	Germination dormancy; Seed germination
Grain quality			
LOC_Os06g04200	down	Wx	Eating quality; Seed amylose content.
LOC_Os01g44220	down	OsAPL2|osagpl2-3|OsAGPL2|GIF2	Eating quality; Starch biosynthesis
LOC_Os05g33570	down	FLO4|OsPPDKB|ppdk|OsC4PPDK	Eating quality; Seed protein and lipid content
LOC_Os08g09230	down	OsSSIIIa|Flo5	Eating quality; Seed starch content
LOC_Os08g40930	down	OsISA1|OsPHS8	Eating quality; Seed starch content

LOC_Os06g12450	down	ALK|SSIIa	Eating quality; Gelatinization temperature; Gel consistency
LOC_Os03g55090	down	Pho1	Seed; Seed starch content; Grain maturation
LOC_Os03g61120	down	OASA1	Sterility; Trp level in grain; Fertility; Germination ability
LOC_Os05g03040	up	RSR1	Seed; Seed amylose content; Grain size
Stress tolerance			
LOC_Os06g16270	down	OsHSBP2	Heat shock tolerance
LOC_Os01g70310	down	OsbHLH001|OsICE2	Salinity tolerance; Salinity tolerance; Regulation of Na and K homeostasis
LOC_Os02g33770	down	Osgtgamma-1;	Salinity tolerance; Salinity tolerance
LOC_Os01g64000	down	NA	Sterility; Salinity tolerance. Fertility.
LOC_Os11g35500	down	Xa21	Bacterial blight resistance; Bacterial blight resistance
LOC_Os02g51110	up	Lsi1|OsNIP2;1|OsLsi1	Other soil stress tolerance; Si uptake; Pests resistance
LOC_Os06g36560	up	OsMIOX	Drought tolerance
LOC_Os03g03370	up	DSM2	Other stress resistance; Drought and oxidative stress tolerance
LOC_Os09g25850	up	OsGL1-1|WSL2	Drought tolerance; Synthesis of leaf cuticular wax; Drought tolerance; Cuticle permeability
LOC_Os10g11980	up	OsAT1	Blast resistance; Spotted leaf. Resistance to Magnaporthe grisea and Xanthomonas oryzae pv oryzae
LOC_Os03g20550	up	OsWRKY55|WRKY55a|WRKY55b	Resistance to Magnaporthe grisea; Lateral root growth
LOC_Os05g31140	up	OsEGL1	Blast resistance; Resistance to Magnaporthe grisea; Lesion mimic
LOC_Os12g03040	up	ONAC131	Blast resistance; Resistance to Magnaporthe grisea
LOC_Os11g03300	up	ONAC122|OsNAC10	Blast resistance; Resistance to Magnaporthe grisea
LOC_Os08g35760	up	OsGLP1	Dwarf; Blast resistance; Semi-dwarf

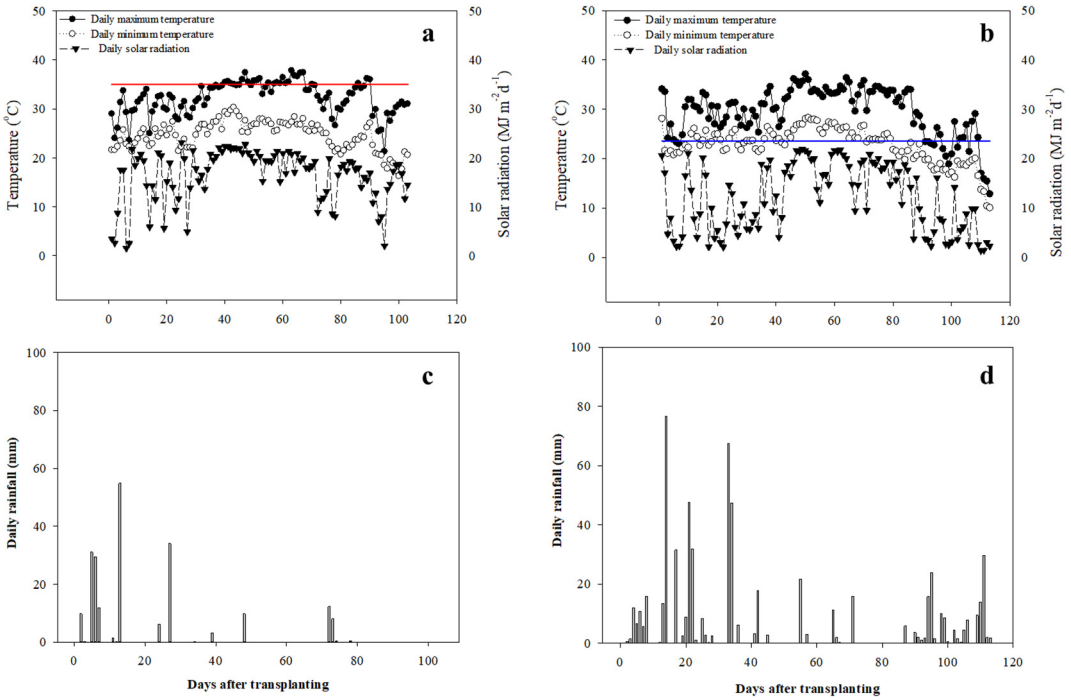

Figure S1 Climate conditions during rice growing period in 2019 and 2020

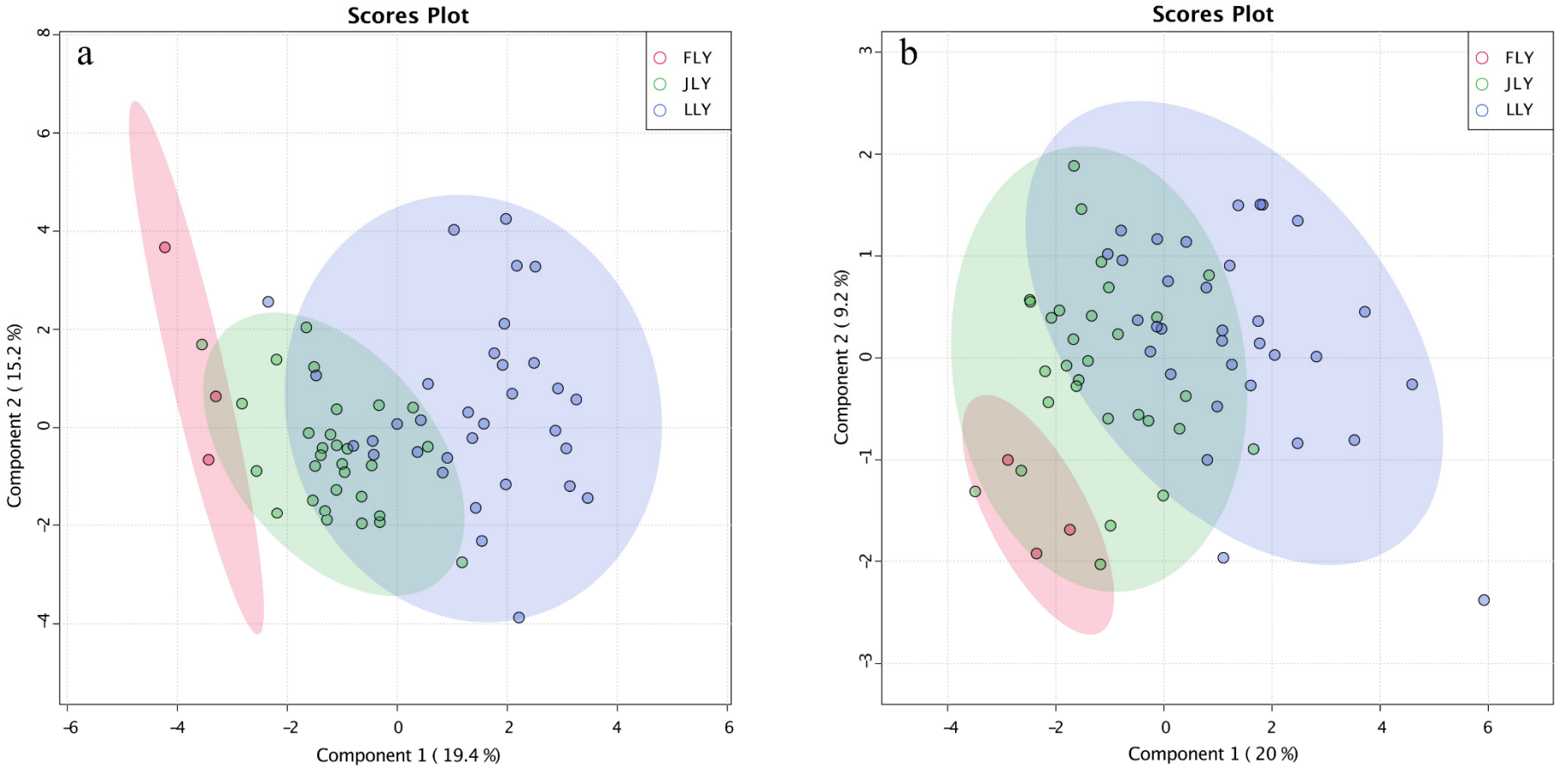

Figure S2 Scores plots of hybrid varieties with Longke638S as the female parent (LLY), those with Jingke4155S as the female parent (JLY) and the control variety (Fengliangyou4, FLY) based on traits related with grain yield, quality and nitrogen use efficiency in 2019 (a) and 2020 (b).

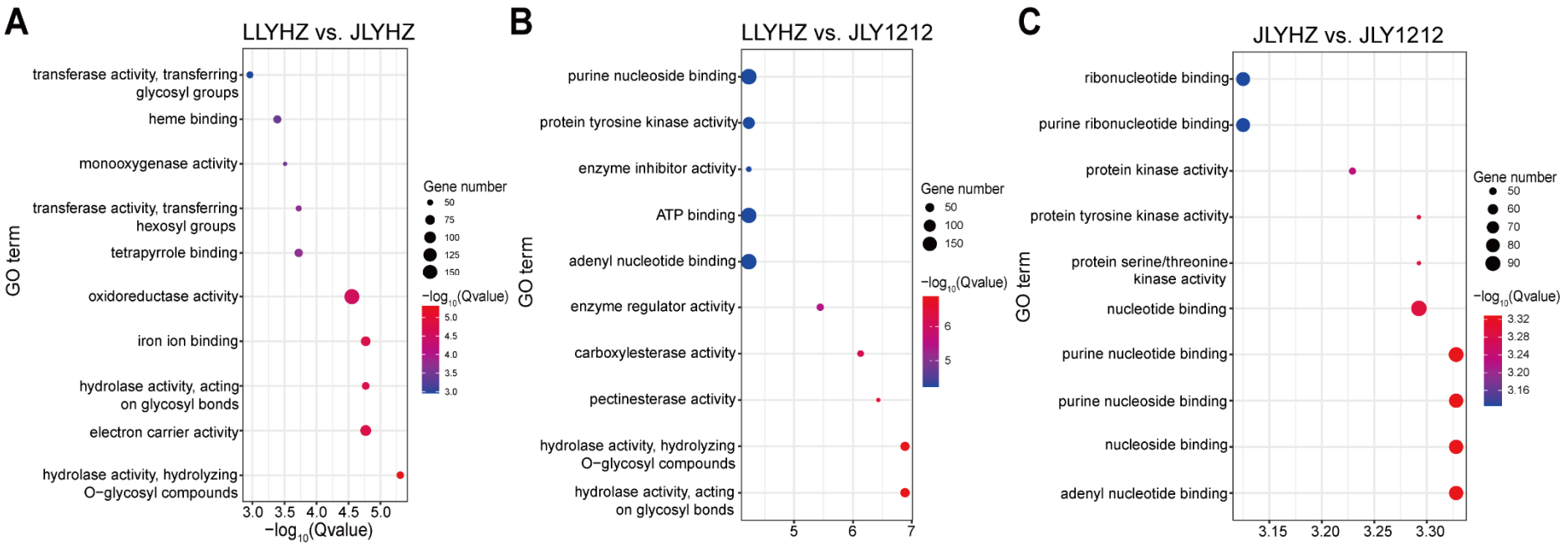

Figure S3 GO analysis of the molecular function of up-regulated genes in spikelets at flowering stage between LLYHZ and JLYHZ (A), between LLYHZ and JLY1212 (B), and between JLYHZ and JLY1212 (C).

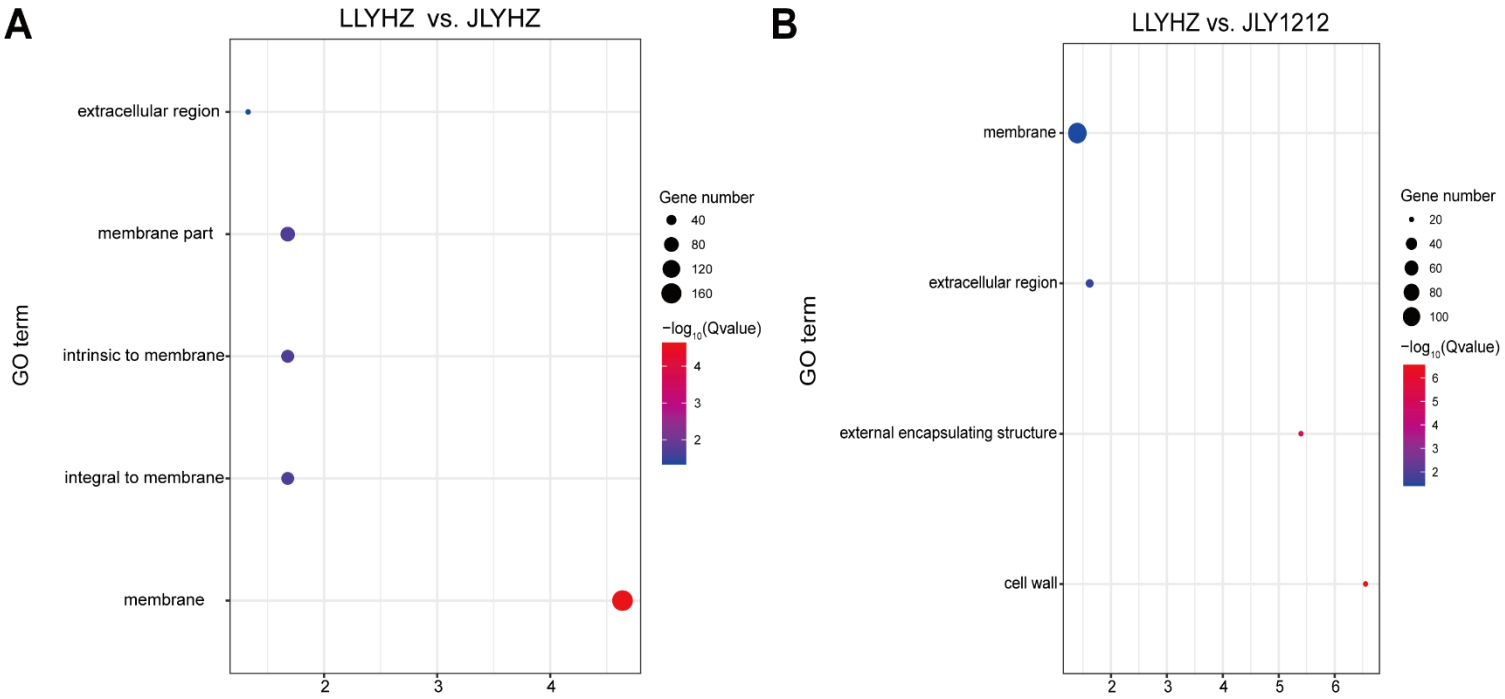

Figure S4 GO analysis of the cellular component of up-regulated genes in spikelets at flowering stage between LLYHZ and JLYHZ (A), and between LLYHZ and JLY1212 (B).