Supplementary Data

A moderate wetting and drying regime combined with appropriate nitrogen application increases grain yield and nitrogen use efficiency in rice

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Table S1. Analysis of variance of grain yield, N uptake, and NUE.

	Year (Y)	Irrigation regime (I)	nitrogen rate (N)	Y × I	Y × N	N × I	Y × I× N
Actual yield	247.9**	146.7**	166.4**	0.26**	2.39**	11.14**	0.67**
Panicles per m^2	NS	NS	80.6**	NS	NS	0.4*	NS
Spikelets per panicle	NS	NS	81.87**	NS	NS	1.23*	NS
1000-grain weight	NS	7.43*	8.49**	NS	NS	NS	NS
Full filled grains	60.05**	74.24**	14.81**	0.7**	0.53**	2.31**	2.17**
HI	320.4**	168.0**	14.6**	30.9**	NS	2.79**	1.36**
N uptake	NS	10.71**	1.37**	NS	NS	1.67**	NS
N in grains	9.11**	145.6**	24.97**	NS	NS	11.58**	NS
IE$_N$	13.58**	6.60**	102.7**	NS	NS	8.94**	NS
PFP$_N$	40.6**	96.50**	293.1**	NS	NS	1.08**	0.36**
HI$_N$	88.3**	104.1**	144.8**	NS	NS	4.09**	NS
WUE	10.57*	81.23**	3.15**	NS	NS	5.27**	NS

Note: HI, harvest index; IE$_N$, internal N use efficiency; PFP$_N$, partial factor productivity of applied N; HI$_N$, N harvest index; WUE, water use efficiency. *, **, and NS indicate significant differences at $P \leq 0.05$, $P < 0.01$, and $P > 0.05$, respectively.
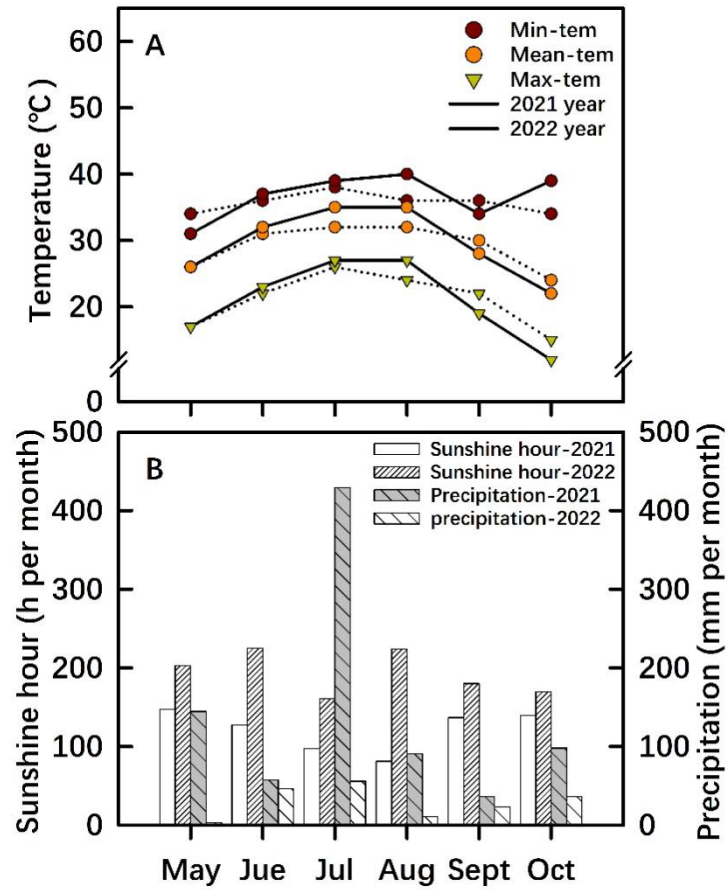
Figure. S1. Temperatures of mean, maximum and minimum (A), and sunshine hours (B) during the rice growing season in Yangzhou in 2021 and 2022.

Note: Temperatures are the monthly averages. Sunshine hours are monthly totals.
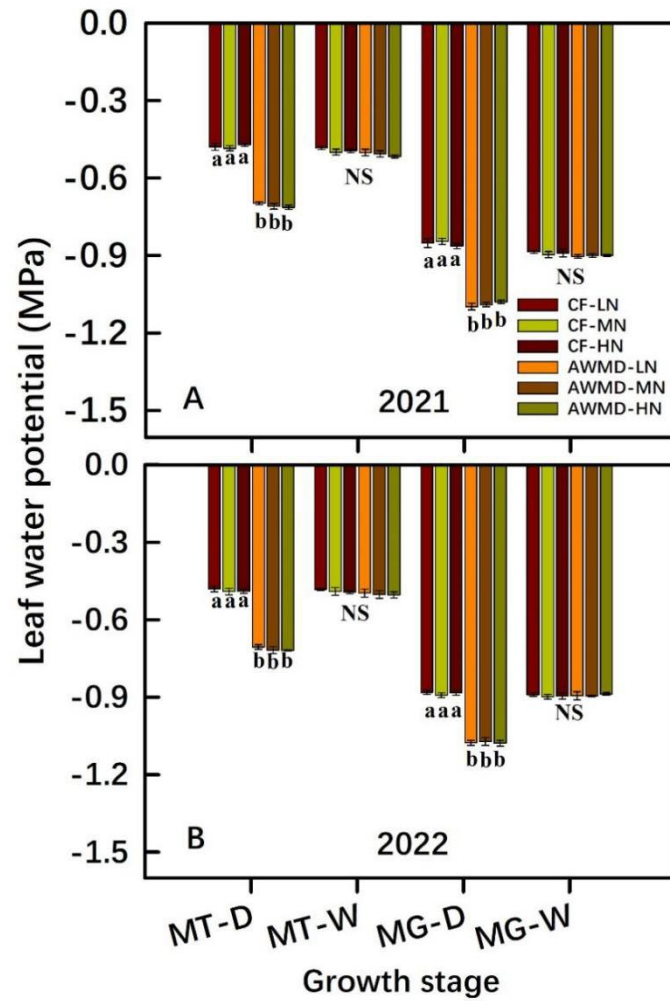
Figure. S2. Leaf water potentials of the *Japonica* rice cultivar Jinxiangyu 1 under various nitrogen rates and irrigation regimes in 2021 (A) and 2022 (B).

Note: MT-D and MG-D represent the SWP in AWMD were about −10 kPa during the mid tilling, heading and middle grain-filling stages, and MT-W and MG-W indicate 2 days after the plant was re-watering in AWMD, respectively. CF and AWMD represent continuously flooded and alternate wetting and moderate drying irrigation, respectively LN, MN and HN denote lower amount, middle amount and high amount of nitrogen application, respectively. Vertical bar represents the ±standard error of the mean. Different letters indicate statistical significance at the $P = 0.05$ level within the same measurement date.
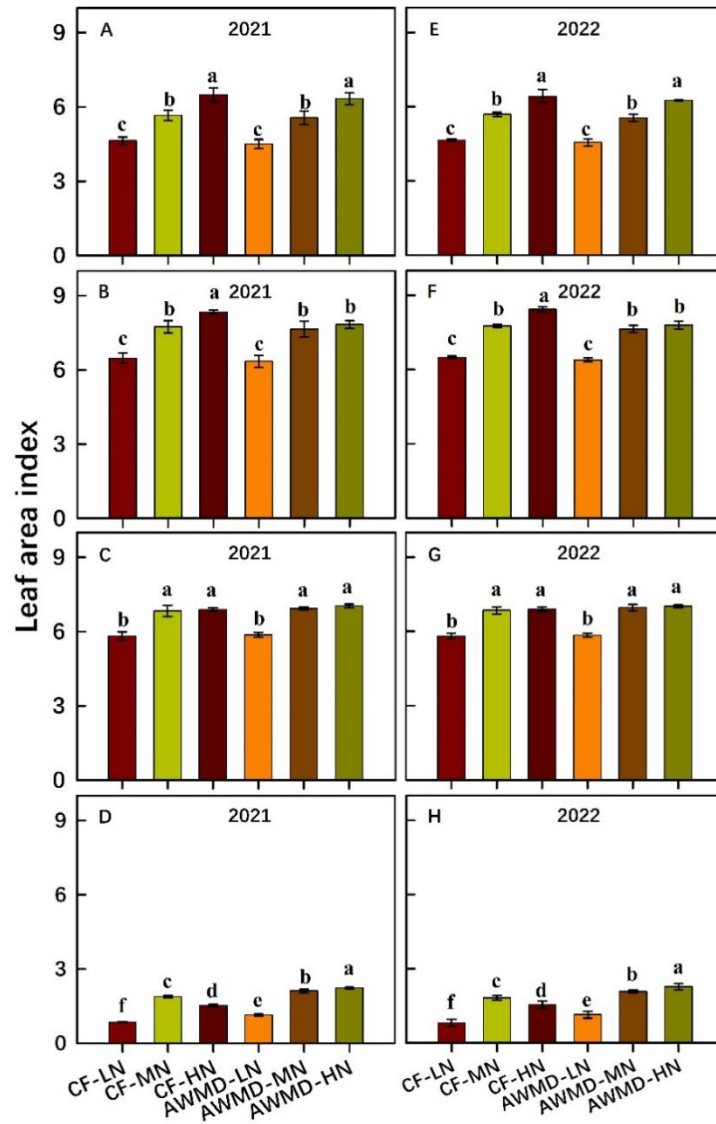
Figure. S3. Leaf area index (LAI) of the *Japonica* rice cultivar Jinxiangyu 1 under various N rates and irrigation regimes on jointing leaf area index (LAI) (A, E), heading LAI (B, F), effective LAI (C, G) and maturity LAI (D, H) respectively.

Note: CF and AWMD represent continuously flooded and alternate wetting and moderate drying irrigation，respectively. LN, MN and HN denote lower amount, middle amount and high amount of nitrogen application, respectively. Vertical bar represents the ±standard error of the mean. Different letters indicate statistical significance at the P = 0.05 level within the same year.
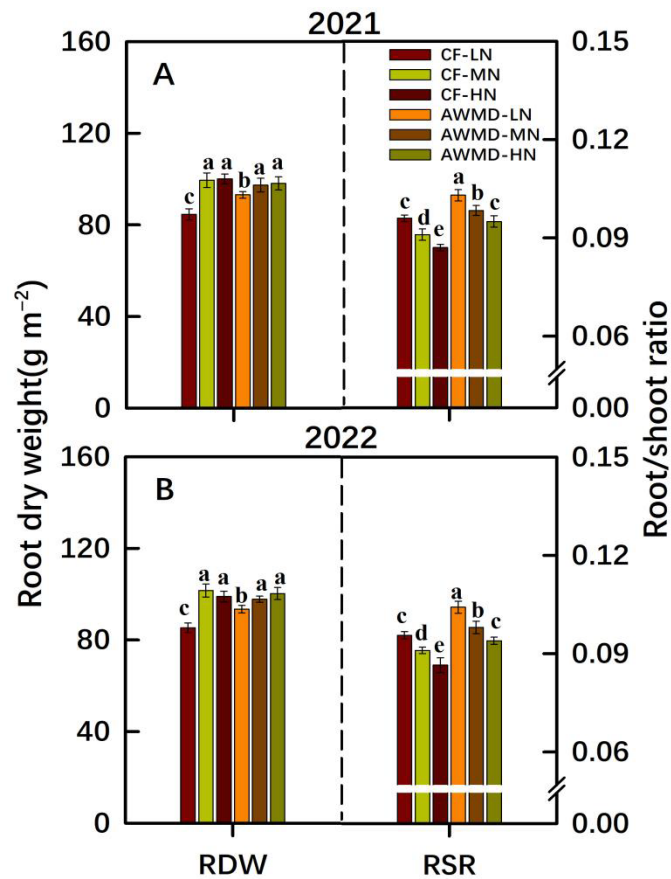
Figure. S4. Root dry weight (RTW) and root-shoot ratio (RSR) of the *Japonica* rice cultivar Jinxiangyu 1 under various nitrogen rates and irrigation regimes at the heading stage in 2021 (A) and 2022 (B).

Note: CF and AWMD represent continuously flooded and alternate wetting and moderate drying irrigation,respectively. LN, MN and HN denote lower amount, middle amount and high amount of nitrogen application, respectively. Vertical bar represents the ±standard error of the mean. Different letters indicate statistical significance at the $P = 0.05$ level within the same year.
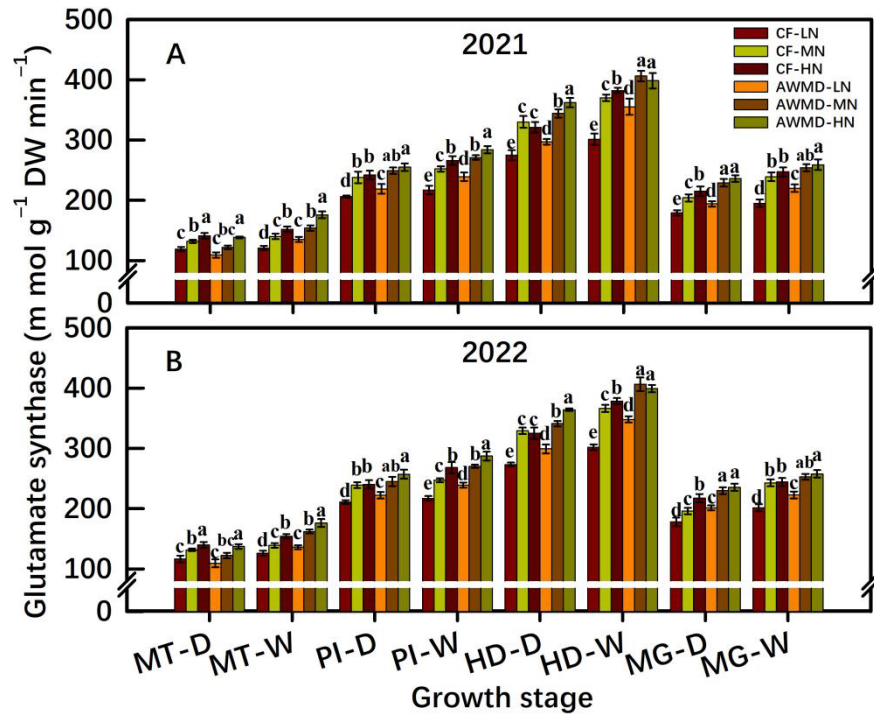
Fig. S5. Activities of glutamate synthase (GOGAT) in the root of the Japonica rice cultivar Jinxiangyu 1 under various nitrogen rates and irrigation regimes.

Note: MT-D, PI-D, HD-D, and MG-D represent the SWP in AWMD was about −10 kPa, and MT-W, PI-W, HD-W and MG-W indicate 2 days after the plant were re-irrigation in AWMD, during the middle tilling, panicle initiation, heading and middle grain-filling stage, respectively. CF and AWMD represent continuously flooded and alternate wetting and moderate drying irrigation, respectively. LN, MN and HN denote lower amount, middle amount and high amount of nitrogen application, respectively, during the growing season. Vertical bar represents the ±standard error of the mean. Different letters indicate statistical significance at the *P* = 0.05 level within the same measurement date.
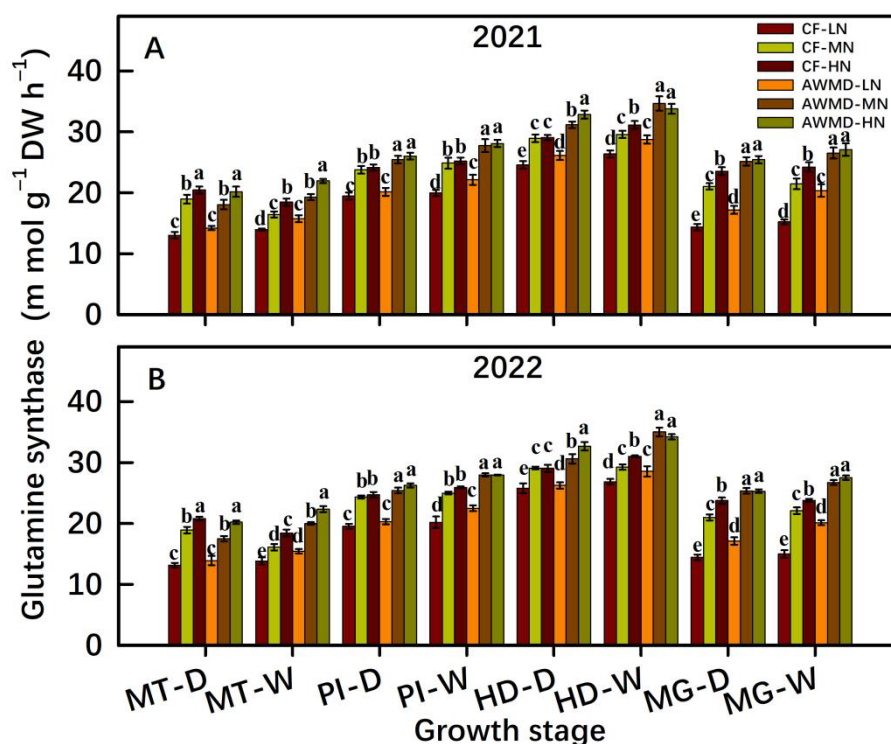
Figure. S6. Activities of glutamine synthase (GS) in the root of the *Japonica* rice cultivar Jinxiangyu 1 under various nitrogen rates and irrigation regimes.

Note: MT-D, PI-D, HD-D, and MG-D represent the SWP in AWMD was about −10 kPa, and MT-W, PI-W, HD-W and MG-W indicate 2 days after the plant were re-irrigation in AWMD, during the middle tilling, panicle initiation, heading and middle grain-filling stage, respectively. CF and AWMD represent continuously flooded and alternate wetting and moderate drying irrigation,respectively. LN, MN and HN denote lower amount, middle amount and high amount of nitrogen application, respectively, during the growing season. Vertical bar represents the ±standard error of the mean. Different letters indicate statistical significance at the $P = 0.05$ level within the same measurement date.
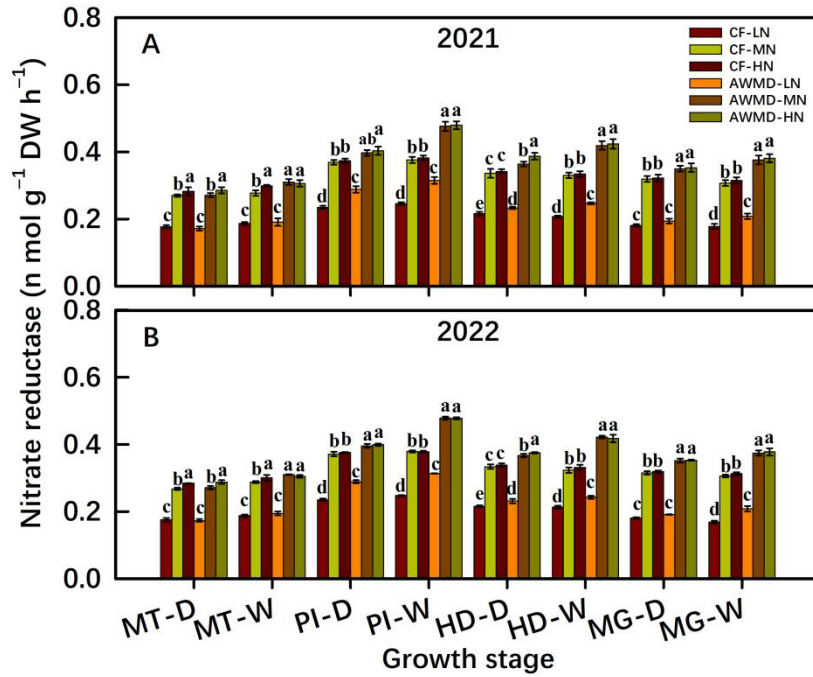
Figure. S7. Activities of nitrate reductase (NR) in the root of the *Japonica* rice cultivar Jinxiangyu 1 under various nitrogen rates and irrigation regimes.

Note: MT-D, PI-D, HD-D, and MG-D represent the SWP in AWMD was about −10 kPa, and MT-W, PI-W, HD-W and MG-W indicate 2 days after the plant were re-irrigation in AWMD, during the middle tilling, panicle initiation, heading and middle grain-filling stage, respectively. CF and AWMD represent continuously flooded and alternate wetting and moderate drying irrigation, respectively. LN, MN and HN denote lower amount, middle amount and high amount of nitrogen application, respectively, during the growing season. Vertical bar represents the ±standard error of the mean. Different letters indicate statistical significance at the *P* = 0.05 level within the same measurement date.