Supplementary Material

Table S1. Broad sense heritability (H^2) of grain yield (GY), carbon isotope composition ($\delta^{13}C$), oxygen isotope composition ($\delta^{18}O$) and nitrogen isotope composition ($\delta^{15}N$) in mature kernels and the correlation coefficients of the genetic correlations (r_g) between the three different stable isotopes and GY

Values were calculated using data of the 12 growing conditions (i.e. combinations of water, nitrogen, and year treatment) assayed

Variable	H^2	r_g with GY
GY	0.80 ± 0.19	
$\delta^{13}C$	0.96 ± 0.13	-0.96 ± 0.03
$\delta^{18}O$	0.64 ± 0.07	-0.63 ± 0.23
$\delta^{15}N$	0.86 ± 0.01	-1.00 ± 0.03

Table S2.   Correlation coefficients of the genetic correlations (r_g) of carbon isotope composition ($\delta^{13}C$), oxygen isotope composition ($\delta^{18}O$) and nitrogen isotope composition ($\delta^{15}N$) in mature kernels with grain yield (GY)

Values were calculated for each of the four different combinations of water and nitrogen regimes, using data of the three years. HN, nitrogen fertilised; LN, unfertilised

	r_g	s.e.
Rainfed-LN		
GY *vs* $\delta^{13}C$	–0.96	0.06
GY *vs* $\delta^{18}O$	–0.98	0.16
GY *vs* $\delta^{15}N$	–1.00	0.09
Rainfed-HN		
GY *vs* $\delta^{13}C$	–0.92	0.12
GY *vs* $\delta^{18}O$	–0.73	0.35
GY *vs* $\delta^{15}N$	–1.00	0.21
Irrigated-LN		
GY *vs* $\delta^{13}C$	–0.94	0.05
GY *vs* $\delta^{18}O$	–0.49	0.39
GY *vs* $\delta^{15}N$	–0.60	0.25
Irrigated-HN		
GY *vs* $\delta^{13}C$	–1.00	0.03
GY *vs* $\delta^{18}O$	–1.00	0.44
GY *vs* $\delta^{15}N$	–1.00	0.09

Table S3. **Correlation coefficients of the genetic correlations (r_g) of carbon isotope composition ($\delta^{13}C$), oxygen isotope composition ($\delta^{18}O$) and nitrogen isotope composition ($\delta^{15}N$) in mature kernels with grain yield (GY)**

Values were calculated for the set of landraces and genotypes independently, using data of the four different combinations of water and nitrogen regimes for the 3 years

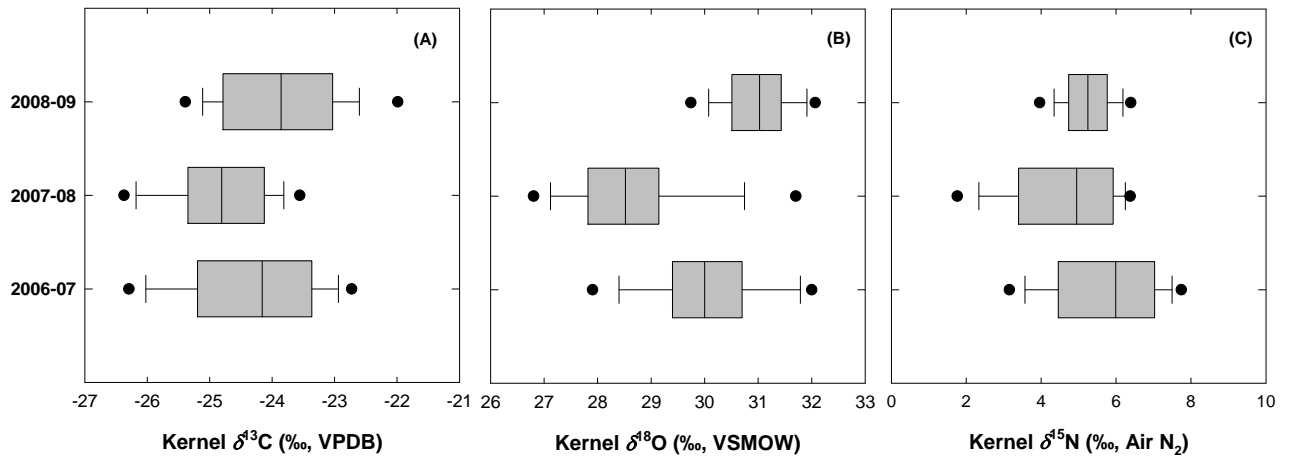|	r_g	s.e.
	Landraces	
GY *vs.* $\delta^{13}C$	–0.79	0.22
GY *vs.* $\delta^{18}O$	–1.00	0.05
GY *vs.* $\delta^{15}N$	–0.87	0.24
	Cultivars	
GY *vs.* $\delta^{13}C$	–0.29	0.57
GY *vs.* $\delta^{18}O$	0.37	0.35
GY *vs.* $\delta^{15}N$	–1.00	0.21

Fig. S1. Box-and-whisker plots for the different stable isotopes measured within each growing season. The boundary of each box closest to zero indicates the 25th percentile, the line within the box marks the median, and the boundary of the box furthest from zero indicates the 75th percentile. Whisker caps to the left and right of each the box indicate the 10th and 90th percentiles, respectively.
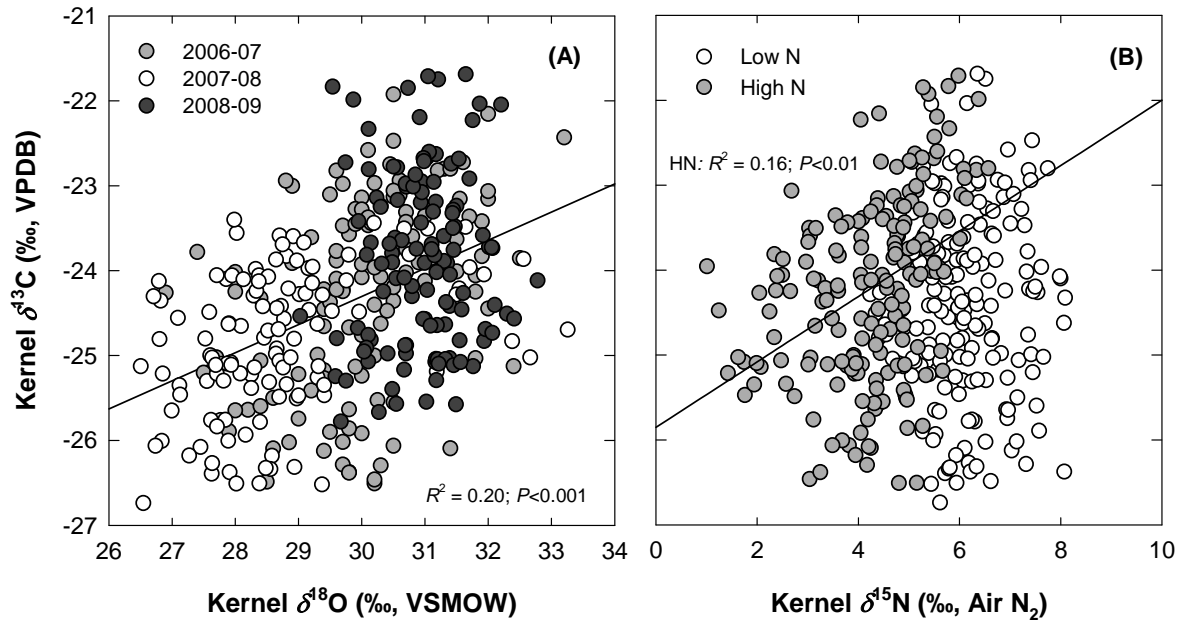
Fig. S2. The relationship between carbon isotope composition (δ^{13}C) and (A) oxygen isotope composition (δ^{18}O) and (B) nitrogen isotope composition (δ^{15}N) in mature kernels. Each point represents a replicate within each water, nitrogen, genotype and year treatment (n = 360). For each of the two isotope compositions in the horizontal axis, different symbols were used in the relationships dependent on the factor showing the highest associated percentages of the sum of squares in the ANOVA analysis displayed in Table 1.
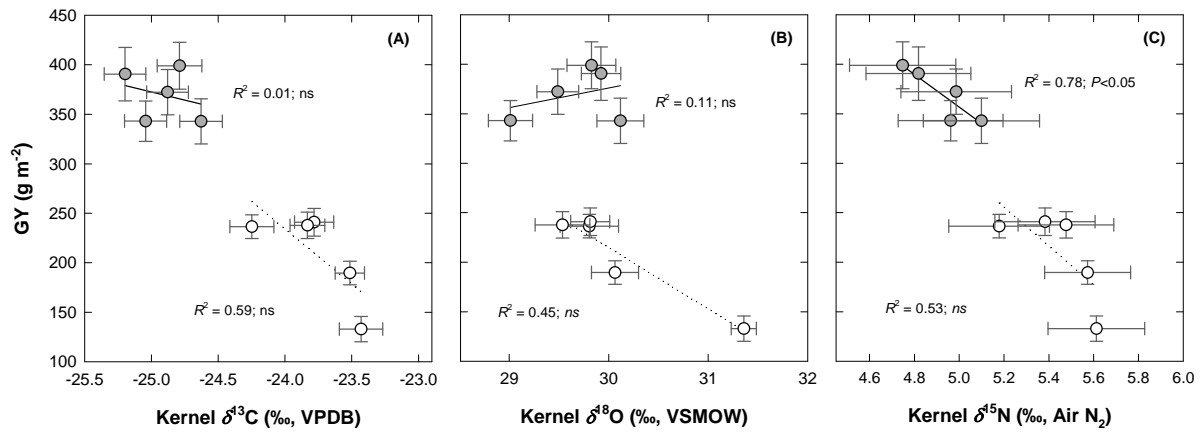
Fig. S3. Relationship between grain yield (GY) and the stable isotope composition of (A) carbon ($\delta^{13}C$), (B) oxygen ($\delta^{18}O$) and (C) nitrogen ($\delta^{15}N$) in mature kernels within the set of landraces and modern cultivars. Each point represents the mean ± s.e. of each genotype studied across the 12 growing conditions (i.e. combinations of water, nitrogen, and year treatment) ($n = 36$).
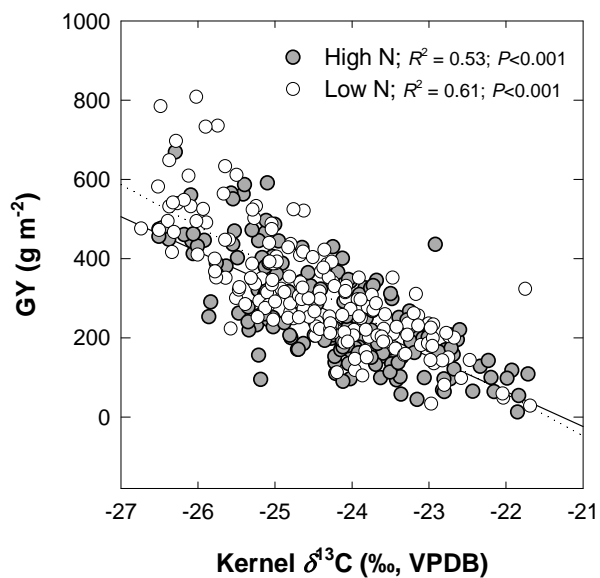
Fig. S4. Relationships between stable carbon isotope composition ($\delta^{13}C$) of mature kernels and grain yield (GY) across nitrogen fertilised (solid line) and unfertilised (broken line) conditions. Each point represents a replicate within each water, nitrogen, genotype and year treatment ($n = 360$). Filled and open symbols correspond to values from nitrogen fertilised and unfertilised trials, respectively.