

Supplementary Table S1: Average grain protein content of 26 NAM families across the three environments planted at Spillman Agronomy Farm, Pullman, WA.

Parental Information				GPC (%) of NAM families			
ID	Accession	Status	Origin	GPC14	GPC15	GPC16	Standard deviation
1	PI185715	Landrace	Portugal	15.0	13.3	12.4	2.41
2	PI283147	Landrace	Jordan	14.5	12.1	12.5	2.58
3	PI220431	Landrace	Egypt	14.1	12.1	11.1	2.50
4	CItr11223	Landrace	Croatia	14.7	12.1	12.5	2.34
5	VIDA	Cultivar	USA	14.5	11.2	11.4	2.53
6	PBW343	Cultivar	India	14.3	12.9	12.1	2.67
7	PI192569	Breeding Line	Mozambique	13.5	12.0	12.1	1.15
8	Dharwar Dry	Breeding Line	Mexico	13.3	11.1	11.4	1.22
9	PI9791	Landrace	Uzbekistan	14.5	11.8	12.7	2.40
10	PI43355	Landrace	Uruguay	14.1	12.6	13.5	1.24
11	PI262611	Landrace	Turkmenistan	14.26	11.9	12.2	2.50
12	PI82469	Landrace	North Korea	13.7	11.3	11.9	2.44
13	PI278297	Landrace	Greece	14.6	12.7	12.4	2.61
14	PI565213	Landrace	Bolivia	14.2	11.5	12.2	2.35
15	PI94567	Landrace	Israel	15.6	12.5	11.9	2.62
16	CItr15134	Landrace	Pakistan	13.8	11.2	12.2	2.49
17	PI210945	Landrace	Cyprus	14.8	13.7	13.4	1.02
18	PI192001	Landrace	Angola	13.4	11.6	12.2	1.16
19	PI572692	Landrace	Georgia	15.0	13.1	13.2	2.38
20	PI382150	Landrace	Japan	14.9	12.9	12.9	2.68
21	PI192147	Landrace	Ethiopia	14.8	12.2	12.6	2.71
22	CItr4175	Landrace	Philippines	14.2	12.7	13.5	1.18
23	PI8813	Landrace	Iraq	14.4	12.1	12.0	2.32
24	PI366716	Landrace	Afghanistan	13.9	12.1	12.4	2.36
25	CItr15144	Landrace	Saudi Arabia	14.0	12.8	13.7	1.14
26	PI470817	Landrace	Algeria	14.9	12.1	12.6	2.46

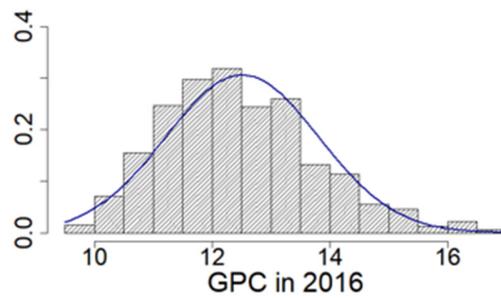
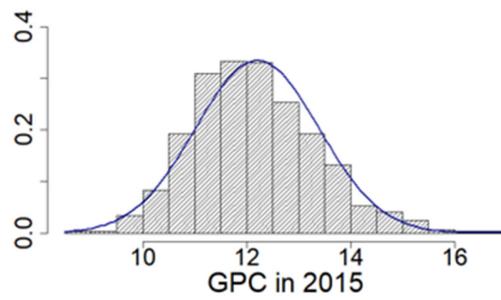
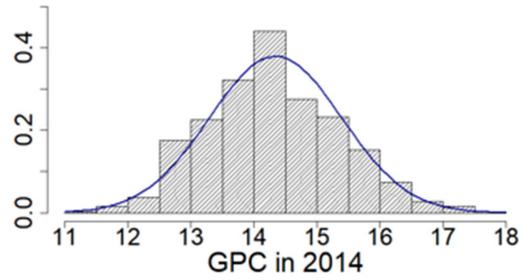
Supplementary Table S2. Phenotypic description and broad sense heritability of the grain protein content across the three environments (2014-16)

Environment	Grain protein content			Heritability
	Mean (%)	Minimum (%)	Maximum (%)	
2014	14.3	11.2	18.0	0.62
2015	12.2	8.7	16.8	0.36
2016	12.5	9.7	17.0	0.68

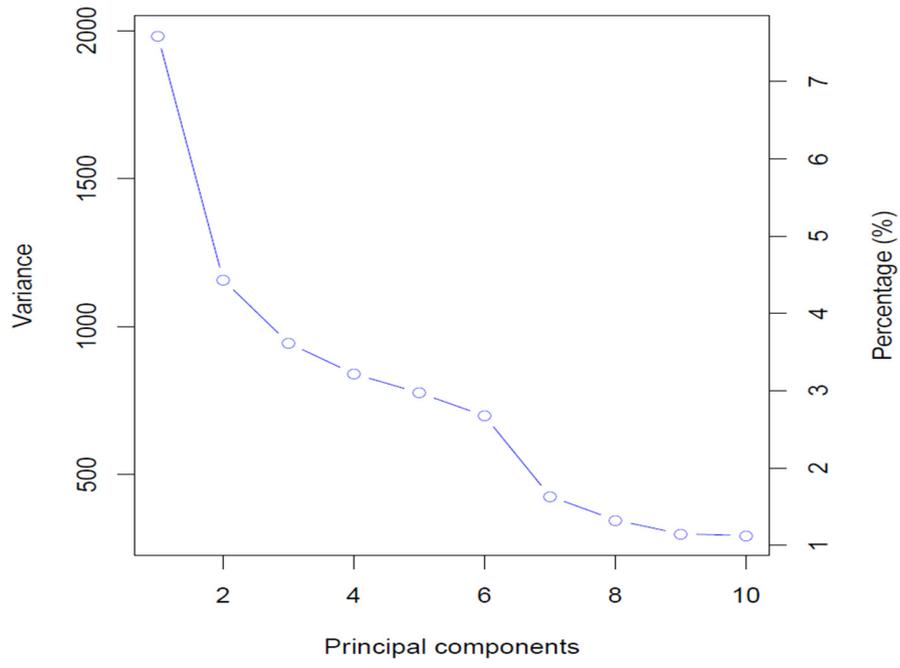
Supplementary Table S3: Average grain protein content and standard deviation for families selected to have less variation. The origin represents countries of the NAM population founder parents.

ID	Parental Information		GPC (%) of NAM families			
	Accession	Origin	2014	2015	2016	Standard deviation
1	PI210945	Cyprus	14.8	13.7	13.4	1.02
2	CItr15144	Saudi Arabia	14.0	12.8	13.7	1.14
3	PI92569	Mozambique	13.5	12.0	12.7	1.15
4	PI92001	Angola	13.4	11.6	12.2	1.16
5	CItr4175	Philippines	14.2	12.7	13.5	1.18
6	Dharwar Dry	Mexico	13.3	11.1	11.4	1.22
7	PI43355	Uruguay	14.1	12.6	13.5	1.24

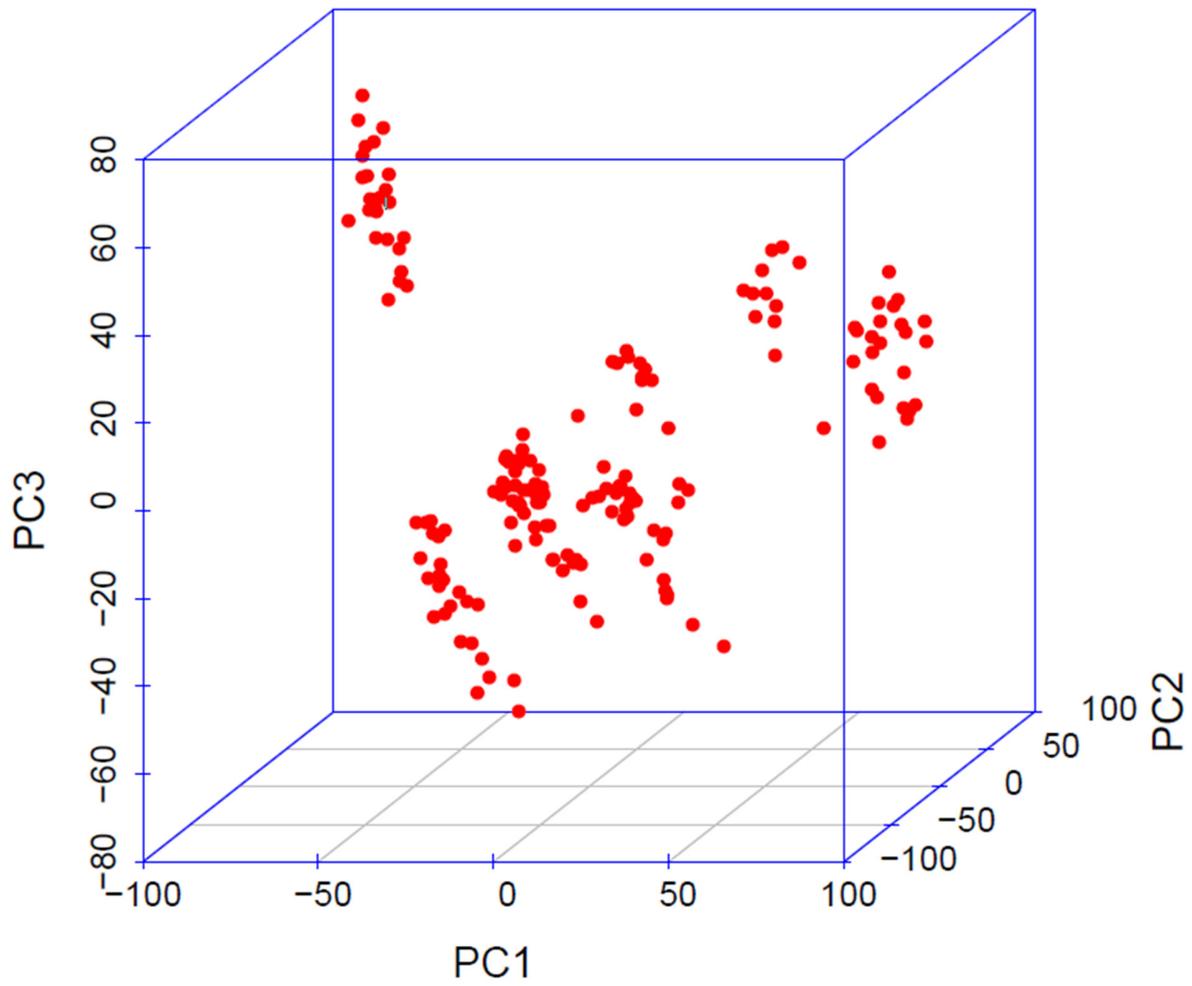
Supplementary Figure S1: Distribution of average GPC for environments 2014, 2015, and 2016. The X-axis shows the environments, namely, 2014, 2015, and 2016, the Y-axis shows the density of individuals.



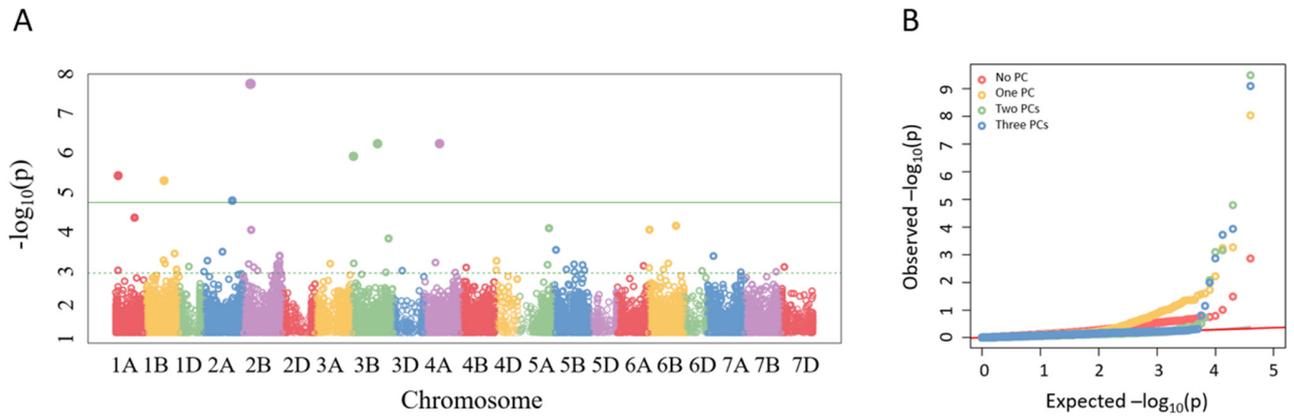
Supplementary Figure S2: Variation explained in the NAM₁₇₅ population by each principal component obtained in this study.



Supplementary Figure S3: Population structure inferred from principal component analysis and illustrated with the first three principal component's.

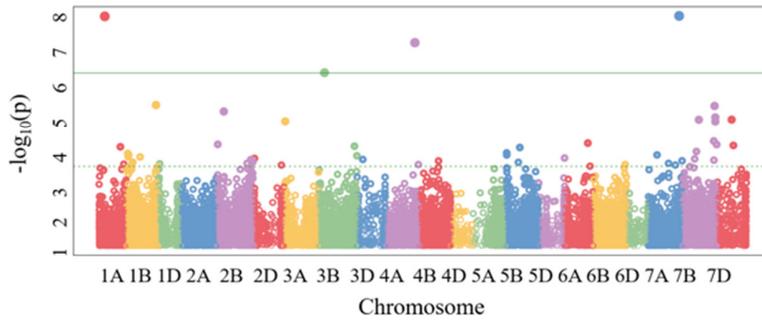


Supplementary Figure S4: Manhattan plot representing the position of significant markers controlling the grain protein content stability. The threshold used for the significant association is a Bonferroni correction of 0.05 (A). Quantile-Quantile (Q-Q) plot of marker-trait association study using different principal components as a covariate in the BLINK model for grain protein content stability (B).

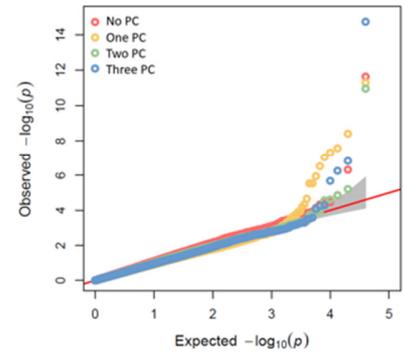


Supplementary Figure S5: Manhattan plot representing the position of significant markers controlling the grain protein content. The threshold used for significant association is a Bonferroni correction of 0.05 (A). Quantile-Quantile (Q-Q) plot of marker-trait association study using different principal components as a covariate in the BLINK model for grain protein content (B).

A



B



Supplementary Figure S6: Linkage disequilibrium analysis on the population using complete set of the marker data.

