

Supplementary Table S1. The main ecological factors of the twelve production areas.

Area	Available nitrogen (mg/kg)	Available phosphorus (mg/kg)	Available potassium (mg/kg)	Organic matters (g/kg)	Soil pH
Hunyuan	32.13	11.33	123.4	10.48	8.59
Shanyin	41.06	11.03	147.7	15.61	8.50
Dingxiang	33.98	13.80	134.1	15.61	8.22
Xingxian	32.19	30.02	89.7	4.46	8.62
Yangqu	71.40	28.65	261.7	21.41	7.88
Yuci	33.98	20.97	281.3	18.06	7.98
Taigu	32.19	9.28	103.6	20.74	8.72
Xixian	24.99	8.60	58.0	8.03	8.67
Qinxian	35.77	7.39	155.6	16.95	8.34
Yuanqu	23.21	21.06	234.1	3.57	8.53
Zezhou	23.25	7.58	140.1	14.72	8.40
Yangcheng	137.00	58.82	222.2	6.15	8.50

Supplementary Table S2. The variation analysis of foxtail millet nutrient component contents in twelve production areas.

	Moisture content (%)	Crude fat content (%)	Amylose content (%)	Amylopectin content (%)	Amylose/Amylopectin
Max	9.13	5.58	24.74	81.31	4.84
Min	6.75	3.30	14.61	47.98	2.41
Mean	7.65	4.48	19.07	67.61	3.66
SD	0.63	0.63	2.84	9.03	0.75
CV (%)	8.23	14.01	14.88	13.36	20.62

Supplementary Table S3. Eigenvalues of correlation matrix and eigenvectors of corresponding matrices for foxtail millet nutritional quality traits.

Primary component	Principal Component Number					
	1	2	3	4	5	
Eigenvalue	5.09289	3.80511	3.09467	2.16103	1.34744	
Percentage of variance (%)	28.29384	21.13953	17.19260	12.00575	7.48576	
Cumulative (%)	28.29384	49.43337	66.62597	78.63171	86.11748	
Load factor	MC	0.11823	0.12689	0.25101	0.49163	-0.07349
	CFC	-0.35225	-0.18821	-0.01899	0.13634	-0.01729
	ACC	0.20855	0.03443	0.44533	0.09297	-0.12083
	AP	-0.11059	0.45043	0.12601	0.10934	0.15159
	AP/ACC	-0.23714	0.27702	-0.29121	0.04841	0.15044
	AP+ACC	-0.04171	0.42671	0.24599	0.12818	0.10512
	V	0.25389	0.10880	-0.29138	-0.29879	0.25365
	Cr	0.40811	0.04022	-0.11980	-0.03620	0.08726
	Mn	0.24651	-0.20474	0.17005	0.05319	0.34022
	Fe	0.37301	-0.06551	-0.17653	0.08202	0.30591
	Co	-0.16524	0.13542	0.32380	-0.13898	0.45648
	Ni	0.28525	0.23939	0.09543	-0.32442	-0.08800
	Cu	0.28645	0.04426	-0.28115	0.26409	0.01050
	Zn	0.03813	0.09753	-0.34686	0.42198	-0.17650

Se	-0.00878	-0.42245	0.07570	0.22778	0.00137
Sr	0.03519	0.09876	0.00116	-0.36574	-0.55986
Mo	-0.21405	0.29698	-0.29503	0.06960	0.05289
Sn	0.27931	0.24979	0.10818	0.19320	-0.27954

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Supplementary Table S4. The correlation analysis between foxtail millet nutritional quality traits and ecological factors. \* and \*\* indicate significance at 0.05 and 0.01, respectively.

	Altitude	Longitude	Latitude	Average temperature	≥10°C effective accumulated temperature	Diurnal temperature range	Average precipitation	Average humidity	Soil pH	Organic matters	Available nitrogen	Available phosphorus	Available potassium
MC	0.017	0.76*	-0.029	-0.111	-0.467	0.309	0.113	0.347	-0.005	-0.253	0.043	0.027	0.059
CFC	-0.408	-0.621	-0.637*	0.536	0.331	-0.516	0.586	0.471	-0.018	-0.082	0.046	-0.01	0.203
ACC	0.283	0.64*	0.084	-0.28	-0.361	0.218	-0.225	0.026	-0.07	-0.269	-0.196	-0.131	0.258
AP	-0.426	0.308	-0.176	0.378	-0.106	-0.083	0.267	0.168	0.124	-0.502	0.531	0.601	0.223
AP/ACC	-0.522	-0.249	-0.163	0.462	0.238	-0.174	0.356	0.124	0.187	-0.13	0.458	0.425	-0.138
AP+ACC	-0.307	0.478	-0.137	0.264	-0.207	-0.01	0.178	0.163	0.094	-0.545	0.431	0.515	0.284
V	0.42	-0.056	0.701*	-0.47	0.028	0.376	-0.657*	-0.728*	-0.057	0.244	0.032	-0.029	-0.212
Cr	0.577	0.396	0.873***	-0.817**	-0.12	0.801**	-0.794**	-0.389	-0.305	0.365	-0.523	-0.477	-0.2
Mn	0.346	-0.123	0.158	-0.43	-0.387	0.167	-0.144	0.104	-0.702*	0.364	-0.288	-0.135	0.43
Fe	0.713*	0.197	0.828**	-0.802**	-0.13	0.721*	-0.818**	-0.433	-0.453	0.168	-0.368	-0.474	0.042
Co	-0.731*	-0.15	-0.588	0.685*	0.234	-0.613	0.509	0.425	0.204	-0.617	0.039	0.259	0.336
Ni	0.359	0.51	0.638*	-0.528	-0.238	0.467	-0.584	-0.479	0.054	0.184	-0.182	-0.084	-0.294
Cu	0.685*	0.318	0.859**	-0.796**	-0.054	0.905***	-0.793**	-0.38	-0.39	0.213	-0.299	-0.471	-0.059
Zn	0.317	0.164	0.365	-0.259	0.292	0.525	-0.428	-0.323	-0.009	0.052	0.046	-0.125	0.009
Se	0.245	-0.161	-0.176	-0.144	-0.436	-0.097	0.236	0.278	-0.247	0.113	-0.045	-0.271	0.006
Sr	-0.138	0.234	0.333	-0.179	0.396	0.337	-0.287	-0.296	0.492	0.414	-0.554	-0.385	-0.636*
Mo	-0.539	-0.05	-0.136	0.516	0.501	-0.116	0.198	0.022	0.488	-0.483	0.321	0.206	-0.193
Sn	0.350	0.97***	0.572	-0.505	-0.246	0.693*	-0.529	-0.258	0.265	-0.134	-0.218	-0.29	-0.381