**Supplementary Materials for**

# Straw returning enhances grain yield and quality of three main crops: Evidence from a meta-analysis

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**Fig. S1** Geographical locations of the experimental sites in this meta-analysis.



**Fig. S2** Relationship between the response ratio (ln*R*) of grain yield and quality traits with the amount of straw return. A, grain yield; B, brown rice percentage; C, milled rice percentage; D, flour yield; E, chalky grain rate; F, chalkiness degree; G, grain volume; H, amylose content; I, gel consistency; J, flavor; K, grain hardness; L, sedimentation value; M, resistance/extensibility relation; N, wet gluten content; O, water absorption; P: oil/fat content; Q, protein content; R, histidine; S, threonine; T, valine; U, methionine; V, isoleucine; W, leucine; X, phenylalanine; Y, lysine; Z, arginine; AA, total amino acids concentration; AB, nitrogen (N) content; AC, phosphorus (P) content; AD, potassium (K) content; AE, Iron (Fe) content; AF, Zinc (Zn) content. The points represent the observations and the shaded areas around the regression lines represent the 95% confidence intervals (the 95%*CIs*).



**Fig. S3** Effects of straw return on grain yield (A), processing quality (B), appearance quality (C), cooking and eating quality (D), and nutritional quality (E) under different durations of straw return (< 3 years, 3-10 years, and > 10 years). Between-group heterogeneity (*Qb*) represents the effects of categorical variables. Significant *Qb* values (*p* < 0.05) indicate that the effects of categorical variables were significant. When the 95%*CIs* did not overlap with zero, the responses of variables to overall fertilization were considered as statistically significant (*p* < 0.05, with asterisks). The numbers in brackets represent the number of observations.



**Fig. S4** The linear relationship among the effect size of variances with the Spearman test. A positive (negative) *R*-value denotes a positive (negative) relationship (\*, *p* < 0.05; \*\*, *p* < 0.01; \*\*\*, *p* < 0.001).

**Table S1** Comparison between previous studies on the effects of straw return on crop grain yield and this study.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author** | **Treatment vs. Control** | **Overall** | | **Maize** | | **Rice** | | **Wheat** | |
| *N* | Change | *N* | Change | *N* | Change | *N* | Change |
| Ding et al. (2018) | Straw return vs. Straw removal |  |  |  |  | 288 | 5.4% |  |  |
| Han et al. (2018) | Straw incorporation vs. Straw removal | 75 | 13.4% |  |  |  |  |  |  |
| Zhao et al. (2019) | Straw incorporation vs. Straw removal | 601 | 12.3% |  |  |  |  |  |  |
| Liu et al. (2019) | Crop straw retention to field vs. Straw no retention | 2092 | 8.1% | 515 | 7.2% | 342 | 7.6% | 368 | 4.1% |
| Qi et al. (2019) | Crop residue returning vs. No crop residue returning |  |  |  |  |  |  | 351 | 8.3% |
| Qin et al. (2021) | Straw mulching vs. No straw returning |  |  | 197 | 9.0% |  |  |  |  |
| Qin et al. (2021) | Straw incorporation vs. No straw returning |  |  | 118 | 10.5% |  |  |  |  |
| Wang et al. (2021) | Straw mulching vs. No straw returning |  |  | 44 | 7.3% |  |  | 52 | 3.5%ns |
| Fan et al. (2021) | Straw return vs. Straw removal | 45 | 3.3% |  |  |  |  |  |  |
| Huang et al. (2021) | Straw mulching vs. No straw returning | 152 | 10.5% |  |  |  |  |  |  |
| Islam et al. (2022) | Straw return vs. Straw removal in mono-cropping systems | 256 | 11.8% | 218 | 12.5% |  |  | 38 | 8.0% |
| Islam et al. (2022) | Straw return vs. Straw removal in double-cropping systems | 815 | 5.5% | 336 | 7.9% |  |  | 479 | 3.7% |
| Qin et al. (2022) | Straw mulching vs. No straw returning |  |  |  |  |  |  | 376 | 30.0%ns |
| Han et al. (2022) | Straw mulching vs. No straw returning |  |  |  |  |  |  | 97 | 14% |
| Zhang et al. (2022) | Straw return vs. No straw return |  |  |  |  | 1801 | 18.0% |  |  |
| Yao et al. (2022) | Additional crop residues vs. No additional crop residues | 17 | 3% |  |  |  |  |  |  |
| Liu et al. (2023a) | Straw return vs. No straw return | 1245 | 7.7% | 608 | 8.7% | 236 | 5.0% | 401 | 8.1% |
| Liu et al. (2023b) | Crop residue return vs. No crop residue return | 390 | 6.9% |  |  | 54 | 5.6% |  |  |
| Zhang et al. (2023a) | Straw return vs. No straw return | 72 | 9.0% |  |  |  |  |  |  |
| Zhang et al. (2023b) | Straw return vs. No straw return | 30 | 10.0% |  |  |  |  |  |  |
| Li et al. (2023) | Straw amendment vs. No-straw amendment | 1002 | 8.9% |  |  | 70 | 6.4% |  |  |
| Liu et al. (2024) | Straw incorporation vs. Inorganic fertilizer application | 207 | 7.7% |  |  | 76 | 5.1% |  |  |
| **This study** | **Straw return vs. No straw return** | **280** | **4.3%** | **39** | **6.1%** | **123** | **6.9%** | **118** | **1.2%ns** |

Note: *N* means the number of paired observations. “ns” means the effect of straw return was not significant (*p* > 0.05).

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