# Supplementary Materials for
# Meta-analysis of the Response of the Productivity of Different Crops to Parameters and Processes in Soil Nitrogen Cycle under Biochar Addition

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**S1. Data sources**

The published articles were searched on the Web of Science and Google Scholar (most recent search, October 15, 2020) by using the keywords (biochar OR black carbon) AND (nitrogen OR N OR nitrate OR ammonium OR mineral N OR inorganic N) AND (crop growth OR crop productivity OR crop yield OR crop biomass) AND (soil). The whole datasets were selected from 93 published articles in this study.

References for data compilation that related the effects of soil N cycle on different crops productivity under biochar addition in the fields, were used in this study. These information, including references regarding the relative indexes of different crops productivity (rice, maize, wheat, legumes, forage grass, cotton, tuber, vegetables , and sugarcane); soil N pools (i.e., total N (TN), microbial biomass N (MBN), inorganic N (IN) and $NH_4^+$-N and $NO_3^-$-N); microbial indicators are used (i.e., soil total microbial abundance (SMA), amoA and denitrifying genes (DENG) ) to indicate N transformations, N fixations (biological $N_2$ fixation, plant N uptake), and N losses (i.e., $NH_3$ volatilization, $N_2O$ emission, and N leaching) were listed in the Excel file of Supplementary Material.

The fail-safe numbers and funnel plots were presented in the Table S1-S3 and Figure S1, respectively, to elucidate the publication bias. If the fail-safe number was > 5*n*+1 (where *n* is the number of datasets) or the data of effect sizes falling in the funnel area, the result from the datasets should be no publication bias (Rosenthal and Rosnow, 1984; Rothstein et al., 2006).

**S2. Results**

As shown in Table S1, values of the fail-safe number of crop productivity, the productivities of rice, maize, wheat, legumes, tuber, vegetables, and forage grass were much larger than the values of 5*n*+1. The fail-safe number of cotton productivity was less than the values of 5*n*+1. However, the data of effect size of cotton productivity was overall falling in the funnel area (Fig. S1). Therefore, the results from the datasets were without publication bias to the disparate crop productivity.

Moreover, the fail-safe number values of TN, MBN, $NH_4^+$-N, $NO_3^-$-N, SMA, amoA, DENG, $N_2O$ emission, $NH_3$ volatilization, N leaching, biological $N_2$ fixation, and plant N uptake were much larger than the values of 5*n*+1 (Table S2-S3), and thus these results from the datasets were without publication bias. However, the fail-safe number value of inorganic N was less than the values of 5*n*+1 (Table S2), and the data of effect sizes of inorganic N was not overall falling in the funnel area (Fig. S1). Thus, the result from the datasets could be publication bias.

**Table S1** Values of fail-safe number of crop productivity (CP), and the productivities of rice, maize, wheat, legumes, tuber, vegetables, forage grass, and cotton in the investigated datasets.

| **Index** | **CP** | **Rice** | **Maize** | **Wheat** | **Legumes** | **Tuber** | **Vegetables** | **Forage grass** | **Cotton** |
|---|---|---|---|---|---|---|---|---|---|
| Sample size (*n*) | 697 | 98 | 153 | 134 | 132 | 60 | 53 | 45 | 16 |
| $5n + 1$ | 3486 | 491 | 766 | 671 | 661 | 301 | 266 | 225 | 81 |
| Fail-safe number | 763500 | 5791 | 38120 | 22946 | 48064 | 14214 | 4261 | 578 | 66 |
| Observed significance level | < 0.0001 | < 0.0001 | < 0.0001 | 0.0032 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | 0.0001 |
| Target significance level | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Does bias affect the trend | No | No | No | Yes | No | No | No | No | Yes |

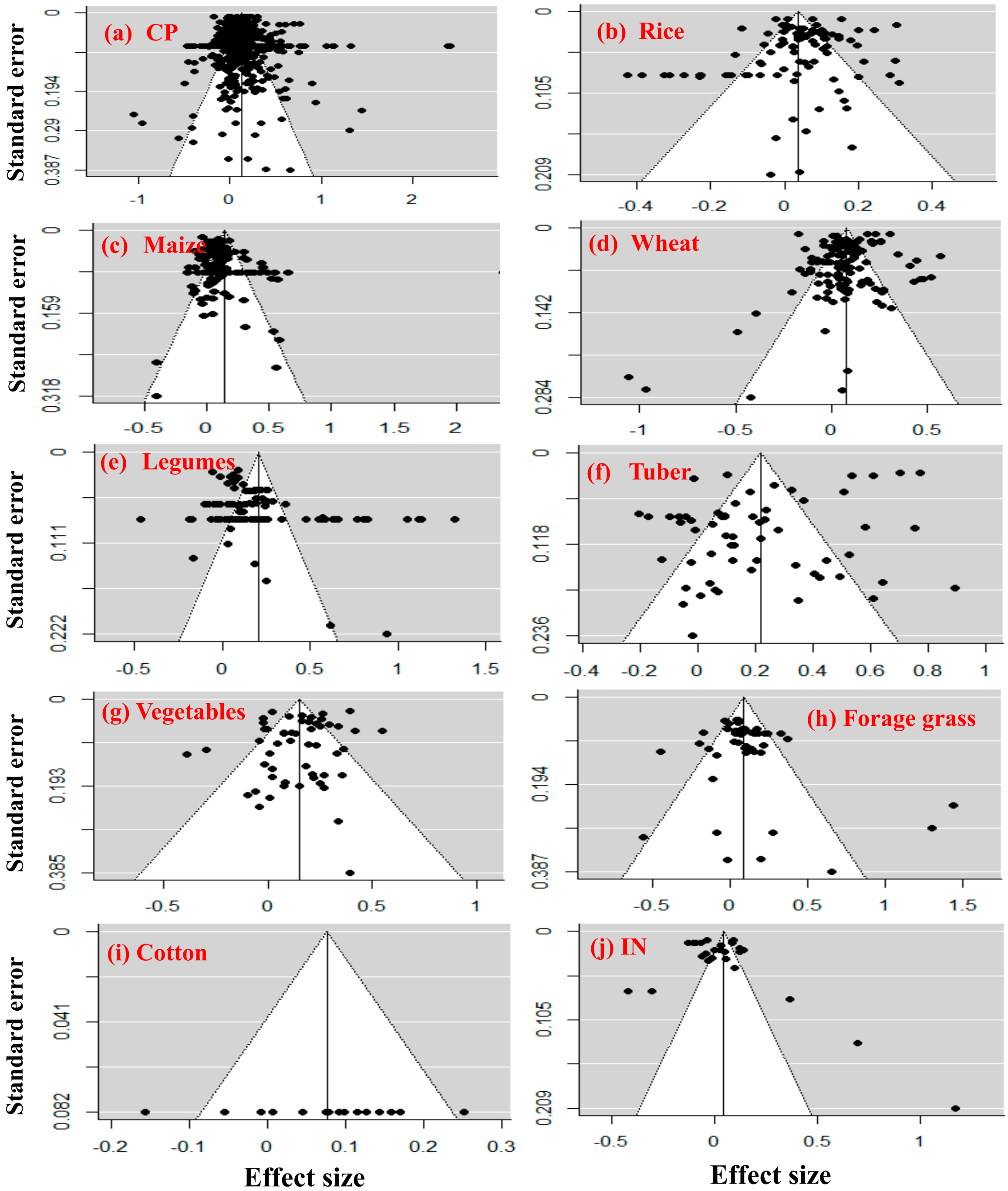


**Figure S1** Funnel plots of the effect sizes of abundance of (a) crop productivity, the productivities of (b) rice, (c) maize, (d) wheat, (e) legumes, (f) tuber, (g) vegetables, (h) forage grass, (i) cotton, and (j) inorganic N (IN) in the investigated datasets.

**Table S2** Fail-safe number values of soil total N (TN), microbial biomass N (MBN), $NH_4^+$-N, $NO_3^-$-N, inorganic N (IN), soil microbial abundance (SMA), and amoA including archaeal ammonia (AOA) and bacterial ammonia (AOB) oxidizers in the investigated datasets.

| Index | TN | MBN | $NH_4^+$-N | $NO_3^-$-N | IN | SMA | amoA |
|---|---|---|---|---|---|---|---|
| Sample size (*n*) | 221 | 33 | 109 | 122 | 27 | 29 | 50 |
| 5*n* + 1 | 1106 | 166 | 546 | 611 | 136 | 146 | 251 |
| Fail-safe number | 256140 | 262 | 9166 | 1813 | 115 | 7927 | 3939 |
| Observed significance level | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Target significance level | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Does bias affect the trend | No | No | No | No | Yes | No | No |

**Table S3** The values of fail-safe number of soil denitrification genes (DENG: including nitrite reductase genes (nirK and nirS), nitrate reductase gene (narG), and nitrous oxide reductase gene (nosZ)), $N_2O$ emission ($N_2OE$), $NH_3$ volatilization ($NH_3V$), soil N leaching (NL), biological $N_2$ fixation (BNF), and plant N uptake (PNU) in the investigated datasets.

| Index | DENG | $N_2OE$ | $NH_3V$ | NL | BNF | PNU |
|---|---|---|---|---|---|---|
| Sample size (*n*) | 48 | 173 | 39 | 23 | 19 | 149 |
| 5*n* + 1 | 241 | 866 | 196 | 116 | 96 | 746 |
| Fail-safe number | 4037 | 31118 | 1529 | 1089 | 436 | 71151 |
| Observed significance level | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |
| Target significance level | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Does bias affect the trend | No | No | No | No | No | No |

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