Supplementary Tables

**TABLE S1** Properties of the soils from Quzhou and Huantai Experimental Stations

|  |  |  |
| --- | --- | --- |
| **Variable** | **Quzhou soil** | **Huantai soil** |
| Soil type | Cambisol | Cambisol |
| pH (soil:water ratio of 1:2.5)  ) | 7.7 | 8.2 |
| Soil organic C (g kg-1) | 7.6 | 8.4 |
| Soil inorganic C (g kg-1) | 7.8 | 5.2 |
| Total N (g kg-1) | 0.66 | 0.67 |
| Soil available K (mg kg-1) | 118 | 174 |
| Olsen-P (mg kg-1) | 15.9 | 5.2 |
| Soil bulk density (g cm-3) | 1.39 | 1.38 |
| SOC-δ13C (‰) | −22.2 | −22.5 |
| SIC-δ13C (‰) | −3.4 | −2.7 |

**TABLE S2** Contributions of carbonate dissolution to soil CO2 emissions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Location** | **Soil type** | **CO2 partitioning method** | **Soil** | **CO2** | **References** |
| **(SIC/STC)/%** | **(SIC/STC)/%** |
| **Carbonate rich soils** | USA | Desert soil | 13C natural abundance | 96 | 13 | Stevenson and Verburg, 2006 |
| France | Rendosol/Rendzina | 13C natural abundance | 74 | 27 | Bertrand et al., 2007 |
| Italy | Leptosols | 13C natural abundance | — | 15~40 | Inglima et al., 2009 |
| Slovenia | Rendzic leptosol | 13C natural abundance | — | 17 | Čater and Ogrinc, 2011 |
| Israel | Typic Calciorthid | 13C natural abundance | 86 | 30 | Tamir et al., 2011 |
| Slovenia | Rendzic leptosol | 13C natural abundance | — | 14 | Plestenjak et al., 2012 |
| Canada | Typic Hapludalf | 13C natural abundance | 28~34 | 62~74 | Ramnarine et al., 2012 |
| Antarctica | Typic Haploturbels | 13C natural abundance | 83 | 76 | Shanhun et al., 2012 |
| Belgium | Luvisol | Biotic/abiotic model | — | 60 | Buysse et al., 2013 |
| China | Loess soil | 13C natural abundance | 45 | 31~85 | Dong, 2013 |
| Australia | Rudosols/Regosol | 13C natural abundance | 85 | 95 | Lardner et al., 2015 |
| China | — | Soil sterilization at 120℃ | 46 | 33 | Ma et al., 2015 |
| China | Loess soil | Soil sterilization with HgCl2 | 50 | 54 | Meng et al., 2015 |
| Austria | Leptic Histosols | 13C natural abundance | — | 2.7 | Schindlbacher et al., 2015 |
| Tunisia | Calcari-Leptic  Cambisol | 13C natural abundance | 67 | 24~47 | Chevallier et al., 2016 |
| China | — | Soil sterilization at 120℃ | 46 | 35 | Ma et al., 2017 |
| China | Loess soil | Dry combustion | 42 | 27 | Meng et al., 2017 |
| China | Loess soil | 13C natural abundance | 38 | 24~38 | Yu, 2018 |
| France | Fluvisol | 13C natural abundance | 84 | 20~60 | Cardinael et al., 2019 |
| China | Typic Paleudalfs | 13C natural abundance | 36 | 31 | Zhang et al., 2019 |
| Trinidad and Tobago | Aquentic Eutrudepts | 13C natural abundance | 16 | 27 | Bramble et al., 2020a |
| Australia | Sodosol | 13C natural abundance | 13 | 51 | Fang et al., 2020a |
| Australia | Sodosol | 13C natural abundance | 14 | 42 | Fang et al., 2020b |
| China | Solonchaks | Soil sterilization at 120℃ | 42 | 56 | Wang et al., 2020 |
| China | Solonetz | Soil sterilization at 120℃ | 50 | 58 |  |
| **Soils amended with lime** | Finland | Peatland | 13C natural abundance | — | 53~70 | Biasi et al., 2008 |
| Japan | Andisol | Using Ca13CO3 as tracer | — | 77 | Dumale et al., 2011 |
| Japan | Ultisol | Using Ca13CO3 as tracer | — | 66 |  |
| China | Krasnozem | Using Ca14CO3 as tracer | **—** | 40 | Ge et al., 2012 |
| China | Brown rendzina | Using Ca14CO3 as tracer | **—** | 48 |  |
| China | Black rendzina | Using Ca14CO3 as tracer | **—** | 20 |  |
| China | Brown rendzina/ Krasnozem | Using Ca14CO3 as tracer | — | 18 | Huang et al., 2013 |
| Australia | Chromic Luvisol | 13C natural abundance | — | 75 | Ahmad et al., 2014 |
| China | Brown rendzina/ Krasnozem | Using Ca14CO3 as tracer | — | 27 | Xiao et al., 2014 |
| Australia | Luvisol | Using Ca13CO3 as tracer | — | 5 | Grover et al., 2017 |
| South Korea | Loamy skeletal | Using Ca13CO3 as tracer | — | 75 | Cho et al., 2019 |
| Trinidad and Tobago | Mollic Fluvaquents/  Kanhaplaquults | Using Ca13CO3 as tracer | — | 48 | Bramble et al., 2020b |
| **Total** |  |  | **Mean ± SE** | — | **42±4** |  |
|  |  | **95% confidence intervals** | — | **27~59** |  |

**TABLE S3** Contributions of root-derived respiration and soil native C release to total CO2 efflux from wheat- and maize-planted soil

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Crop type** | **Site** | **CO2 partitioning method** | **Crop age (days)** | **Root-derived CO2 (%)** | **Soil-derived CO2 (%)** | **References** |
| **Wheat** | Field(a) | 13C natural abundance | 190 | 25.2 | 74.8 | Kou et al., 2011 |
| Field(b) | 13C natural abundance | 190 | 29.2 | 70.8 |  |
| Field(c) | 13C natural abundance | 190 | 36.5 | 63.5 |  |
| Field(d) | 13C natural abundance | 190 | 37.2 | 62.8 |  |
| Laboratory | 13C natural abundance | 17 | 89.0 | 11.0 | Cheng, 1996 |
| Laboratory(e) | 13C continuous labeling | 60 | 31.6 | 68.4 | Pausch et al., 2013 |
| Laboratory(f) | 13C continuous labeling | 60 | 55.2 | 44.8 |  |
| Laboratory(g) | 13C pulse labeling | 230 | 39.8 | 60.2 | Sun, 2018 |
| Laboratory(h) | 13C pulse labeling | 230 | 41.5 | 58.5 |  |
| Laboratory(i) | 13C natural abundance | 32 | 58.6 | 41.4 | Xu et al., 2018 |
| Laboratory(j) | 13C natural abundance | 32 | 59.6 | 40.4 |  |
| Laboratory(k) | 13C natural abundance | 32 | 84.3 | 15.7 |  |
| Laboratory(l) | 13C natural abundance | 32 | 84.7 | 15.3 |  |
| Laboratory(m) | 13C natural abundance | 52 | 47.9 | 52.1 |  |
| Laboratory(n) | 13C natural abundance | 52 | 43.3 | 56.7 |  |
| Laboratory(o) | 13C natural abundance | 52 | 58.9 | 41.1 |  |
| Laboratory(p) | 13C natural abundance | 52 | 57.5 | 42.5 |  |
| Laboratory(q) | 13C natural abundance | 42 | 32.5 | 67.5 | Xu et al., 2019 |
| Laboratory(r) | 13C natural abundance | 42 | 28.6 | 71.4 |  |
| Laboratory(s) | 13C natural abundance | 42 | 32.8 | 67.2 |  |
| Laboratory(t) | 13C natural abundance | 42 | 31.1 | 68.9 |  |
| **Maize** | Field | 13C natural abundance | 158 | 28.0 | 72.0 | Rochette et al., 1999 |
| Field(u) | 13C natural abundance | 50 | 60.1 | 39.9 | Kumar et al., 2016 |
| Field(v) | 13C natural abundance | 50 | 50.8 | 49.2 |  |
| Laboratory | 14C pulse labeling/  13C natural abundance | 38 | 75.0 | 25.0 | Kuzyakov and Cheng, 2001 |
| Laboratory(w) | 13C natural abundance | 63 | 82.2 | 17.8 | Kuzyakov and Cheng, 2004 |
| Laboratory(x) | 13C natural abundance | 63 | 68.1 | 31.9 |  |
| Laboratory(y) | 13C natural abundance | 63 | 55.6 | 44.4 |  |
| Laboratory | 13C pulse labeling | 99 | 51.9 | 48.1 | Yang and Cai, 2005 |
| Laboratory(z) | 13C pulse labeling | 40 | 81.5 | 18.5 | Werth and Kuzyakov, 2008 |
| Laboratory(aa) | 13C natural abundance | 40 | 79.0 | 21.0 |  |
| Laboratory | 13C natural abundance | 146 | 28.5 | 71.5 | Werth and Kuzyakov, 2009 |
| Laboratory(ab) | 13C natural abundance | — | 71.8 | 28.2 | Li et al., 2010 |
| Laboratory(ac) | 13C natural abundance | — | 82.4 | 17.6 |  |

Note: a―High CO2 concentration and high nitrogen (N) fertilization; b―High CO2 concentration and low N fertilization; c―Low CO2 concentration and high N fertilization; d―Low CO2 concentration and low N fertilization; e―Monoculture; f―Intercropping; g―No N fertilization; h―N fertilization; i―Atmospheric CO2 concentration and low N fertilization, growing for 32 days; j―High CO2 concentration and low N fertilization, growing for 32 days; k―Atmospheric CO2 concentration and high N fertilization, growing for 32 days; l―High CO2 concentration and high N fertilization, growing for 32 days; m―Atmospheric CO2 concentration and low N fertilization, growing for 52 days; n―High CO2 concentration and low N fertilization, growing for 52 days; o―Atmospheric CO2 concentration and high N fertilization , growing for 52 days; p―High CO2 concentration and high N fertilization, growing for 52 days; q―Low phosphorus (P) and cultivated varieties Mat; r―Low P and cultivated varieties Mcit; s―High P and cultivated varieties Mat; t―High P and cultivated varieties Mcit; u―No N fertilization; v―N fertilization; w―Normal light length; x―Prolonged light length; y―Strong prolonged light length; z―14C pulse labeling method; aa―13C natural abundance method; ab―No N fertilization; ac―N fertilization.

**TABLE S4** Rhizosphere effects of wheat and maize on SOC decomposition

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Crop type** | **Site** | **CO2 partitioning method** | **Crop type** | **Rhizosphere effect (%)** | **References** |
| **Wheat** | Laboratory | 13C natural abundance | 17 | -37 | Cheng, 1996 |
| Laboratory | 13C natural abundance | 110 | 96 | Cheng, 2003 |
| Laboratory | 13C continuous labeling | 60 | 86 | Pausch et al., 2013 |
| Laboratory(a) | 13C natural abundance | 56 | 40 | Wang et al., 2016 |
| Laboratory(b) | 13C natural abundance | 84 | 18 |  |
| Laboratory(c) | 13C pulse labeling | 230 | 47 | Sun, 2018 |
| Laboratory(d) | 13C pulse labeling | 230 | 59 |  |
| Laboratory(e) | 13C natural abundance | 32 | 176 | Xu et al., 2018 |
| Laboratory(f) | 13C natural abundance | 32 | 248 |  |
| Laboratory(g) | 13C natural abundance | 32 | 51 |  |
| Laboratory(h) | 13C natural abundance | 32 | 113 |  |
| Laboratory(i) | 13C natural abundance | 52 | 178 |  |
| Laboratory(j) | 13C natural abundance | 52 | 108 |  |
| Laboratory(k) | 13C natural abundance | 52 | 237 |  |
| Laboratory(l) | 13C natural abundance | 52 | 165 |  |
| Laboratory(m) | 13C natural abundance | 42 | 265 | Xu et al., 2019 |
|  | Laboratory(n) | 13C natural abundance | 42 | 403 |  |
|  | Laboratory(o) | 13C natural abundance | 42 | 392 |  |
|  | Laboratory(p) | 13C natural abundance | 42 | 461 |  |
|  | Laboratory | 13C natural abundance | 45 | 325 | Yin et al., 2019 |
| **Maize** | Field(q) | 13C natural abundance | 50 | 126 | Kumar et al., 2016 |
| Field(r) | 13C natural abundance | 50 | 35 |  |
| Laboratory | 14C pulse labeling/  13C natural abundance | 38 | 6 | Kuzyakov and Cheng, 2001 |
| Laboratory(s) | 13C natural abundance | 63 | -32 | Kuzyakov and Cheng, 2004 |
| Laboratory(t) | 13C natural abundance | 63 | -13 |  |
| Laboratory(u) | 13C natural abundance | 63 | -7 |  |
| Laboratory | 13C pulse labeling | 99 | 79 | Yang and Cai, 2005 |
| Laboratory(v) | 13C natural abundance | — | -22 | Li et al., 2010 |
| Laboratory(w) | 13C natural abundance | — | -38 |  |

Note: a―Growing for 56 days; b―Growing for 84 days; c―No N fertilization; d―N fertilization 250 kg ha-1; e―Atmospheric CO2 concentration and low N fertilization, growing for 32 days; f―High CO2 concentration and low N fertilization, growing for 32 days; g―Atmospheric CO2 concentration and high N fertilization, growing for 32 days; h―High CO2 concentration and high N fertilization, growing for 32 days; i―Atmospheric CO2 concentration and low N fertilization, growing for 52 days; j―High CO2 concentration and low N fertilization, growing for 52 days; k―Atmospheric CO2 concentration and high N fertilization, growing for 52 days; l―High CO2 concentration and high N fertilization, growing for 52 days; m―Low P and cultivated varieties Mat; n―Low P and cultivated varieties Mcit; o―High P and cultivated varieties Mat; p―High P and cultivated varieties Mcit; q―No N fertilization; r―N fertilization; s―Normal light length; t―Prolonged light length; u―Strong prolonged light length; v―No N fertilization; w―N fertilization.

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