Table S1. Coefficients of the correlations between soil temperature at 5-cm depth and heterotrophic respiration (Rh) in fallow and growing seasons.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Season** |  | **Treatment** | | | | | | | | | | | | | | | |
|  | **CM** | | | | **CMG** | | | | **PM** | | | | **PMG** | | | |
|  | **Plot** | | | | | | | | | | | | | | | |
|  | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| 2013-2014 | Fallow | a | 9.35 | 5.04 | 4.53 | 5.41 | 7.71 | 6.03 | 4.64 | 5.72 | 7.22 | 7.26 | 3.34 | 1.88 | 7.17 | 6.00 | 1.88 | 2.71 |
| b | 0.11 | 0.14 | 0.15 | 0.14 | 0.09 | 0.13 | 0.15 | 0.15 | 0.12 | 0.11 | 0.15 | 0.19 | 0.12 | 0.13 | 0.20 | 0.19 |
| R2 | **0.43\*** | **0.64\*** | **0.66\*** | **0.48\*** | 0.24 | **0.48\*** | **0.61\*** | **0.63\*** | **0.44\*** | **0.44\*** | **0.68\*** | **0.67\*** | **0.52\*** | **0.49\*** | **0.71\*** | **0.63\*** |
| 2014 | Growing | a | 0.06 | 3.00 | 0.37 | 0.26 | 0.54 | 0.30 | 0.18 | 0.25 | 0.97 | 0.004 | 0.71 | 0.01 | 0.37 | 0.17 | 0.01 | 2.81 |
| b | 0.26 | 0.10 | 0.18 | 0.20 | 0.17 | 0.19 | 0.22 | 0.21 | 0.17 | 0.34 | 0.15 | 0.34 | 0.19 | 0.22 | 0.32 | 0.14 |
| R2 | 0.23 | 0.03 | 0.16 | 0.11 | 0.18 | 0.16 | 0.16 | 0.21 | 0.20 | 0.36 | 0.06 | 0.37 | 0.18 | 0.26 | **0.43\*** | 0.12 |
| 2014-2015 | Fallow | a | 9.17 | 3.12 | 2.07 | 10.8 | 4.38 | 1.16 | 2.33 | 2.90 | 7.13 | 2.26 | 2.17 | 3.46 | 2.25 | 2.62 | 2.44 | 1.37 |
| b | 0.12 | 0.16 | 0.18 | 0.13 | 0.16 | 0.24 | 0.17 | 0.18 | 0.14 | 0.19 | 0.16 | 0.19 | 0.19 | 0.17 | 0.19 | 0.22 |
| R2 | **0.46\*** | **0.63\*** | **0.62\*** | **0.50\*** | **0.58\*** | **0.81\*** | **0.62\*** | **0.75\*** | **0.76\*** | **0.79\*** | **0.53\*** | **0.87\*** | **0.71\*** | **0.44\*** | **0.34\*** | 0.79 |
| 2015 | Growing | a | 1.46 | 14.5 | 270 | 84.6 | 2.05 | 1.44 | 16.1 | 14.6 | 1.24 | 0.80 | 0.43 | 17.8 | 2.69 | 0.97 | 1.79 | 6.91 |
| b | 0.15 | 0.08 | -0.05 | 0.01 | 0.15 | 0.16 | 0.06 | 0.06 | 0.16 | 0.20 | 0.20 | 0.07 | 0.13 | 0.18 | 0.16 | 0.11 |
| R2 | 0.09 | 0.05 | 0.02 | 0.00 | 0.10 | 0.11 | 0.04 | 0.06 | 0.08 | 0.32 | 0.23 | 0.03 | 0.07 | 0.24 | 0.22 | 0.28 |
| CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. Rh = a×exp(Soil temperature×b). \* *P*<0.05. Bold values represent statistically significant. | | | | | | | | | | | | | | | | | | |

Table S2. Cumulative CH4 emission (Mean±SD).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **CH4 emission (kg C ha-1 period-1)** | | | | | |
| **Fallow**  **season†** | **Growing season** | | | | **Annual** |
| **Early†** | **MD†** | **Late†** | **Total** |
| 2013-  2014 | CM | | 0.49 a | 512 a | 41.0 a | 20.6 a | 573 a | 573±373 a |
| CMG | | 0.15 a | 394 a | 55.8 a | 17.9 a | 467 a | 467±110 a |
| PM | | 0.38 a | 278 a | 62.7 a | 10.1 a | 351 a | 351±239 a |
| PMG | | 0.29 a | 303 a | 62.1 a | 9.51 a | 375 a | 375±157 a |
| *P* | MD | 0.91 | 0.18 | 0.22 | 0.13 | 0.22 | 0.22 |
| GM | 0.16 | 0.69 | 0.52 | 0.74 | 0.74 | 0.74 |
| MD×GM | 0.42 | 0.55 | 0.48 | 0.81 | 0.60 | 0.60 |
| 2014-  2015 | CM | | -0.12 a | 1042 a | 45.4 b | 24.0 a | 1112 a | 1112±280 a |
| CMG | | 0.07 a | 960 a | 47.5 b | 19.5 a | 1027 a | 1027±152 a |
| PM | | 0.06 a | 587 a | 169 a | 10.4 a | 767 a | 767±233 a |
| PMG | | 0.03 a | 1071 a | 144 a | 14.1 a | 1229 a | 1229±519 a |
| *P* | MD | 0.56 | 0.29 | **< 0.01** | 0.18 | 0.67 | 0.67 |
| GM | 0.51 | 0.22 | 0.60 | 0.95 | 0.27 | 0.27 |
| MD×GM | 0.38 | 0.09 | 0.54 | 0.54 | 0.12 | 0.12 |
| 2013-2015 | CM | | 0.18 a | 777 a | 43.2 b | 22.3 a | 842 a | 842±280 a |
| CMG | | 0.11 a | 677 a | 51.7 ab | 18.4 a | 747 a | 747±81.5 a |
| PM | | 0.22 a | 433 a | 116 a | 10.2 a | 559 a | 559±155 a |
| PMG | | 0.16 a | 687 a | 103 ab | 11.8 a | 802 a | 802±256 a |
| *P* | MD | 0.65 | 0.10 | **< 0.01** | **< 0.05** | 0.27 | 0.27 |
| GM | 0.48 | 0.43 | 0.85 | 0.79 | 0.47 | 0.47 |
| Year | **< 0.01** | **< 0.01** | **< 0.01** | 0.55 | **< 0.01** | **< 0.01** |
| MD×GM | 0.94 | 0.08 | 0.39 | 0.53 | 0.11 | 0.11 |
| MD×Year | 0.77 | 0.96 | **< 0.01** | 0.97 | 0.68 | 0.68 |
| GM×Year | 0.13 | 0.21 | 0.44 | 0.86 | 0.27 | 0.27 |
| MD×GM×Year | 0.23 | 0.28 | 0.80 | 0.75 | 0.31 | 0.31 |
| † Days of each period are provided in Table 1. CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two-was ANOVA between mid-season drainage (MD) prolongation, green manure (GM) application, and three-way ANOVA between MD prolongation, GM application and year. Different letters represent statistically significant difference at *P*<0.05, and bold values represent statistically significant. | | | | | | | | |

Table S3. Daily CH4 flux (Mean±SD).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **Daily CH4 flux (mg C m-2 day-1)** | | | | | |
| **Fallow**  **season†** | **Growing season** | | | | **Annual** |
| **Early†** | **MD†** | **Late†** | **Total** |
| 2013-  2014 | CM | | 0.21 a | 1421 a | 820 a | 37.5 a | 597 a | 174±113 a |
| CMG | | 0.06 a | 1095 a | 1116 a | 31.4 a | 486 a | 142±33.4 a |
| PM | | 0.16 a | 869 a | 697 a | 18.4 a | 351 a | 107±72.6 a |
| PMG | | 0.12 a | 947 a | 690 a | 17.3 a | 390 a | 114±47.7 a |
| *P* | MD | 0.91 | 0.31 | 0.13 | 0.13 | 0.22 | 0.22 |
| GM | 0.16 | 0.71 | 0.41 | 0.74 | 0.74 | 0.74 |
| MD×GM | 0.42 | 0.56 | 0.39 | 0.81 | 0.60 | 0.60 |
| 2014-  2015 | CM | | -0.05 a | 2266 a | 648 b | 51.0 a | 1112 a | 333±83.8 a |
| CMG | | 0.03 a | 2087 a | 679 b | 41.4 a | 1027 a | 307±45.6 a |
| PM | | 0.03 a | 1398 a | 1208 a | 23.6 a | 767 a | 230±69.9 a |
| PMG | | 0.01 a | 2551 a | 1025 a | 32.1 a | 1229 a | 368±155 a |
| *P* | MD | 0.56 | 0.58 | **< 0.05** | 0.22 | 0.67 | 0.67 |
| GM | 0.51 | 0.20 | 0.69 | 0.97 | 0.27 | 0.27 |
| MD×GM | 0.38 | 0.09 | 0.58 | 0.54 | 0.12 | 0.12 |
| 2013-2015 | CM | | 0.08 a | 1844 a | 734 a | 442 a | 854 a | 25.4±21.1 a |
| CMG | | 0.05 a | 1591 a | 897 a | 364 a | 757 a | 22.5±2.45 a |
| PM | | 0.10 a | 1024 a | 953 a | 202 a | 566 a | 16.8±4.67 a |
| PMG | | 0.07 a | 1586 a | 858 a | 237 a | 810 a | 24.1±7.67 a |
| *P* | MD | 0.64 | 0.27 | 0.49 | 0.06 | 0.26 | 0.27 |
| GM | 0.48 | 0.47 | 0.79 | 0.82 | 0.48 | 0.48 |
| Year | **< 0.01** | **< 0.01** | 0.64 | 0.23 | **< 0.01** | **< 0.01** |
| MD×GM | 0.94 | 0.09 | 0.32 | 0.52 | 0.11 | 0.11 |
| MD×Year | 0.77 | 0.76 | **< 0.01** | 0.92 | 0.66 | 0.67 |
| GM×Year | 0.13 | 0.22 | 0.40 | 0.86 | 0.27 | 0.27 |
| MD×GM×Year | 0.23 | 0.35 | 0.86 | 0.71 | 0.33 | 0.32 |
| † Days of each period are provided in Table 1. CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two-was ANOVA between mid-season drainage (MD) prolongation, green manure (GM) application, and three-way ANOVA between MD prolongation, GM application and year. Different letters represent statistically significant difference at *P*<0.05, and bold values represent statistically significant. | | | | | | | | |

Table S4. Cumulative N2O emission (Mean±SD).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **N2O emission (kg N ha-1 period-1)** | | | | | |
| **Fallow season†** | **Growing season** | | | | **Annual** |
| **Early†** | **MD†** | **Late†** | **Total** |
| 2013-  2014 | CM | | 0.15 a | -0.02 a | 0.00 a | 0.11 ab | 0.11 ab | 0.24±0.09 a |
| CMG | | 0.33 a | 0.02 a | 0.01 a | 0.22 a | 0.25 a | 0.58±0.48 a |
| PM | | 0.22 a | 0.01 a | 0.00 a | 0.18 a | 0.19 a | 0.41±0.10 a |
| PMG | | 0.33 a | 0.00 a | -0.03 a | -0.01 b | -0.03 b | 0.30±0.15 a |
| *P* | MD | 0.74 | 0.59 | 0.13 | 0.08 | 0.06 | 0.67 |
| GM | 0.19 | 0.21 | 0.44 | 0.37 | 0.42 | 0.39 |
| MD×GM | 0.73 | 0.08 | 0.17 | **< 0.01** | **< 0.01** | 0.10 |
| 2014-  2015 | CM | | 0.18 ab | -0.03 a | 0.01 a | -0.02 a | -0.04 a | 0.14±0.31 a |
| CMG | | 0.12 b | -0.01 a | -0.00 a | 0.05 a | 0.05 a | 0.17±0.21 a |
| PM | | 0.11 b | -0.02 a | 0.01 a | -0.04 a | -0.04 a | 0.07±0.27 a |
| PMG | | 0.34 a | 0.02 a | 0.01 a | 0.07 a | 0.10 a | 0.44±0.19 a |
| *P* | MD | 0.22 | 0.38 | 0.80 | 0.98 | 0.75 | 0.43 |
| GM | 0.16 | 0.23 | 0.90 | 0.22 | 0.18 | 0.13 |
| MD×GM | **< 0.05** | 0.78 | 0.94 | 0.79 | 0.75 | 0.21 |
| 2013-2015 | CM | | 0.16 a | -0.02 a | 0.00 a | 0.04 a | 0.03 a | 0.19±0.17 a |
| CMG | | 0.23 a | 0.00 a | 0.00 a | 0.14 a | 0.15 a | 0.38±0.26 a |
| PM | | 0.17 a | -0.00 a | 0.01 a | 0.07 a | 0.08 a | 0.24±0.16 a |
| PMG | | 0.33 a | 0.01 a | -0.01 a | 0.03 a | 0.03 a | 0.37±0.12 a |
| *P* | MD | 0.37 | 0.30 | 0.85 | 0.33 | 0.44 | 0.80 |
| GM | 0.07 | 0.10 | 0.74 | 0.53 | 0.44 | 0.09 |
| Year | 0.26 | 0.52 | 0.58 | **< 0.05** | **< 0.05** | 0.06 |
| MD×GM | 0.41 | 0.50 | 0.75 | 0.12 | 0.11 | 0.72 |
| MD×Year | 0.76 | 0.59 | 0.50 | 0.36 | 0.19 | 0.39 |
| GM×Year | 0.62 | 0.63 | 0.92 | 0.13 | 0.11 | 0.63 |
| MD×GM×Year | 0.16 | 0.25 | 0.65 | **< 0.05** | **< 0.05** | **< 0.05** |
| † Days of each period are provided in Table 1. CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two-was ANOVA between mid-season drainage (MD) prolongation, green manure (GM) application, and three-way ANOVA between MD prolongation, GM application and year. Different letters represent statistically significant difference at *P*<0.05, and bold values represent statistically significant. | | | | | | | | |

Table S5. Daily N2O flux (Mean±SD).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **Daily N2O flux (mg N m-2 day-1)** | | | | | |
| **Fallow season†** | **Growing season** | | | | **Annual** |
| **Early†** | **MD†** | **Late†** | **Total** |
| 2013-  2014 | CM | | 0.06 a | -0.06 a | 0.03 a | 0.20 ab | 0.11 ab | 0.07±0.03 a |
| CMG | | 0.14 a | 0.05 a | 0.19 a | 0.41 a | 0.26 a | 0.18±0.14 a |
| PM | | 0.10 a | 0.02 a | -0.00 a | 0.34 a | 0.20 a | 0.12±0.03 a |
| PMG | | 0.14 a | 0.00 a | -0.30 a | -0.01 b | -0.04 b | 0.09±0.05 a |
| *P* | MD | 0.74 | 0.57 | 0.14 | 0.08 | 0.06 | 0.67 |
| GM | 0.19 | 0.23 | 0.68 | 0.37 | 0.42 | 0.39 |
| MD×GM | 0.73 | 0.07 | 0.20 | **< 0.01** | **< 0.01** | 0.10 |
| 2014-  2015 | CM | | 0.08 ab | -0.06 a | 0.10 a | -0.04 a | -0.04 a | 0.04±0.09 a |
| CMG | | 0.05 b | -0.01 a | -0.02 a | 0.11 a | 0.05 a | 0.05±0.06 a |
| PM | | 0.05 b | -0.03 a | 0.10 a | -0.09 a | -0.04 a | 0.02±0.08 a |
| PMG | | 0.14 a | 0.05 a | 0.09 a | 0.16 a | 0.10 a | 0.13±0.05 a |
| *P* | MD | 0.22 | 0.39 | 0.92 | 0.99 | 0.75 | 0.43 |
| GM | 0.16 | 0.22 | 0.91 | 0.22 | 0.18 | 0.13 |
| MD×GM | **< 0.05** | 0.74 | 0.93 | 0.75 | 0.75 | 0.21 |
| 2013-2015 | CM | | 0.07 a | -0.06 a | 0.06 a | 0.08 a | 0.04 a | 0.06±0.05 a |
| CMG | | 0.10 a | 0.02 a | 0.08 a | 0.26 a | 0.16 a | 0.11±0.08 a |
| PM | | 0.07 a | -0.00 a | 0.10 a | 0.12 a | 0.08 a | 0.07±0.05 a |
| PMG | | 0.14 a | 0.02 a | -0.18 a | 0.07 a | 0.03 a | 0.11±0.04 a |
| *P* | MD | 0.37 | 0.30 | 0.74 | 0.40 | 0.42 | 0.80 |
| GM | 0.07 | 0.09 | 0.83 | 0.46 | 0.46 | 0.09 |
| Year | 0.26 | 0.54 | 0.78 | **< 0.05** | **< 0.05** | 0.05 |
| MD×GM | 0.42 | 0.42 | 0.78 | 0.20 | 0.10 | 0.70 |
| MD×Year | 0.76 | 0.68 | 0.61 | 0.42 | 0.18 | 0.39 |
| GM×Year | 0.61 | 0.72 | 0.99 | 0.13 | 0.11 | 0.64 |
| MD×GM×Year | 0.16 | 0.18 | 0.67 | 0.07 | **< 0.05** | **< 0.05** |
| † Days of each period are provided in Table 1. CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two-was ANOVA between mid-season drainage (MD) prolongation, green manure (GM) application, and three-way ANOVA between MD prolongation, GM application and year. Different letters represent statistically significant difference at *P*<0.05, and bold values represent statistically significant. | | | | | | | | |

Table S6. Cumulative Rh (Mean±SD).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **Cumulative Rh (Mg C ha-1 period-1)** | | | | | |
| **Fallow season†** | **Growing season** | | | | **Annual** |
| **Early†** | **MD†** | **Late†** | **Total** |
| 2013-  2014 | CM | | 2.54 a | 0.61 a | 0.25 b | 0.67 a | 1.52 a | 4.06±0.15 a |
| CMG | | 2.32 a | 0.50 a | 0.22 b | 0.72 a | 1.44 a | 3.77±0.88 a |
| PM | | 2.28 a | 0.39 a | 0.53 a | 0.90 a | 1.82 a | 4.10±0.61 a |
| PMG | | 2.51 a | 0.50 a | 0.46 a | 0.75 a | 1.71 a | 4.22±0.39 a |
| *P* | MD | 0.83 | 0.37 | **< 0.01** | 0.10 | 0.12 | 0.40 |
| GM | 0.96 | 0.97 | 0.27 | 0.53 | 0.59 | 0.77 |
| MD×GM | 0.20 | 0.37 | 0.67 | 0.18 | 0.94 | 0.48 |
| 2014-  2015 | CM | | 2.76 a | 1.05 a | 0.24 b | 1.30 a | 2.59 a | 5.34±1.33 a |
| CMG | | 2.60 a | 0.95 a | 0.19 b | 1.09 a | 2.23 a | 4.83±0.81 a |
| PM | | 2.75 a | 0.87 a | 0.47 a | 1.29 a | 2.64 a | 5.38±1.14 a |
| PMG | | 2.39 a | 0.88 a | 0.47 a | 1.31 a | 2.67 a | 5.05±0.41 a |
| *P* | MD | 0.78 | 0.43 | **< 0.01** | 0.25 | 0.14 | 0.79 |
| GM | 0.52 | 0.77 | 0.37 | 0.31 | 0.31 | 0.41 |
| MD×GM | 0.80 | 0.74 | 0.35 | 0.20 | 0.23 | 0.85 |
| 2013-  2015 | CM | | 2.65 a | 0.83 a | 0.24 b | 0.98 a | 2.05 a | 4.70±0.72 a |
| CMG | | 2.46 a | 0.72 a | 0.20 b | 0.90 a | 1.74 a | 4.30±0.19 a |
| PM | | 2.51 a | 0.63 a | 0.50 a | 1.09 a | 2.23 a | 4.74±0.84 a |
| PMG | | 2.45 a | 0.69 a | 0.47 a | 1.03 a | 2.19 a | 4.64±0.36 a |
| *P* | MD | 0.73 | 0.24 | **< 0.01** | **< 0.05** | **< 0.05** | 0.51 |
| GM | 0.56 | 0.83 | 0.16 | 0.23 | 0.28 | 0.38 |
| Year | 0.33 | **< 0.001** | 0.41 | **< 0.01** | **< 0.001** | **< 0.001** |
| MD×GM | 0.78 | 0.42 | 0.92 | 0.88 | 0.43 | 0.60 |
| MD×Year | 0.86 | 0.92 | 0.95 | 0.85 | 0.87 | 0.84 |
| GM×Year | 0.54 | 0.80 | 0.61 | 0.68 | 0.76 | 0.56 |
| MD×GM×Year | 0.46 | 0.78 | 0.40 | 0.06 | 0.37 | 0.85 |
| † Days of each period are provided in Table 1. CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two-was ANOVA between mid-season drainage (MD) prolongation, green manure (GM) application, and three-way ANOVA between MD prolongation, GM application and year. Different letters represent statistically significant difference at *P*<0.05, and bold values represent statistically significant. | | | | | | | | |

Table S7. Daily Rh (Mean±SD).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **Daily Rh (g C m-2 day-1)** | | | | | |
| **Fallow season†** | **Growing season** | | | | **Annual** |
| **Early†** | **MD†** | **Late†** | **Total** |
| 2013-  2014 | CM | | 1.09 | 1.69 | 4.96 | 1.21 | 1.58 | 1.23±0.05 |
| CMG | | 1.00 | 1.40 | 4.36 | 1.31 | 1.50 | 1.14±0.27 |
| PM | | 0.98 | 1.23 | 5.86 | 1.63 | 1.89 | 1.24±0.18 |
| PMG | | 1.08 | 1.58 | 5.11 | 1.36 | 1.78 | 1.28±0.12 |
| *P* | MD | 0.83 | 0.67 | 0.13 | 0.10 | 0.12 | 0.40 |
| GM | 0.96 | 0.93 | 0.21 | 0.53 | 0.59 | 0.77 |
| MD×GM | 0.20 | 0.35 | 0.88 | 0.18 | 0.94 | 0.48 |
| 2014-  2015 | CM | | 1.18 | 2.28 | 3.34 | 2.77 | 2.58 | 1.60±0.40 |
| CMG | | 1.11 | 2.07 | 2.67 | 2.32 | 2.23 | 1.44±0.24 |
| PM | | 1.17 | 2.08 | 3.38 | 2.93 | 2.64 | 1.61±0.34 |
| PMG | | 1.02 | 2.09 | 3.39 | 2.99 | 2.67 | 1.51±0.12 |
| *P* | MD | 0.78 | 0.80 | 0.10 | **< 0.05** | 0.14 | 0.79 |
| GM | 0.52 | 0.78 | 0.15 | 0.32 | 0.31 | 0.41 |
| MD×GM | 0.80 | 0.75 | 0.14 | 0.20 | 0.23 | 0.85 |
| 2013-  2015 | CM | | 1.13 | 1.99 | 4.15 | 1.99 | 2.08 | 1.42±0.22 |
| CMG | | 1.05 | 1.74 | 3.51 | 1.81 | 1.87 | 1.30±0.06 |
| PM | | 1.08 | 1.66 | 4.62 | 2.28 | 2.26 | 1.43±0.25 |
| PMG | | 1.05 | 1.84 | 4.25 | 2.18 | 2.23 | 1.40±0.11 |
| *P* | MD | 0.73 | 0.63 | **< 0.05** | **< 0.01** | **< 0.05** | 0.51 |
| GM | 0.56 | 0.89 | 0.08 | 0.23 | 0.28 | 0.38 |
| Year | 0.35 | **< 0.05** | **< 0.01** | **< 0.01** | **< 0.001** | **< 0.001** |
| MD×GM | 0.78 | 0.38 | 0.64 | 0.76 | 0.44 | 0.60 |
| MD×Year | 0.86 | 0.92 | 0.43 | 0.43 | 0.84 | 0.84 |
| GM×Year | 0.54 | 0.79 | 0.54 | 0.63 | 0.78 | 0.56 |
| MD×GM×Year | 0.46 | 0.68 | 0.45 | 0.07 | 0.38 | 0.84 |
| † Days of each period are provided in Table 1. CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two-was ANOVA between mid-season drainage (MD) prolongation, green manure (GM) application, and three-way ANOVA between MD prolongation, GM application and year. Based on the analysis of Tukey’s test, there were no significant differences among the treatment. Bold values represent statistically significant. | | | | | | | | |

Table S8 Spearman’s rank correlation coefficients between greenhouse gases (GHG) and applied carbon.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **GHG** | **Season** | | **Applied carbon** | | | | |
| **GM§** | **W¶** | **BB‡** | **Sum of GM, W, and BB** | **Total†** |
| CH4 | Fallow | | -0.19 | **-0.81\*** | -0.52 | **-0.78\*** | 0.67 |
| Growing season | Early | 0.29 | **0.71\*** | **0.81\*** | **0.83\*** | -0.57 |
| Midseason drainage | 0.09 | 0.14 | 0.24 | 0.07 | -0.38 |
| Late | -0.13 | 0.21 | 0.33 | 0.28 | -0.19 |
| Total | 0.29 | **0.71\*** | **0.81\*** | **0.83\*** | -0.57 |
| Annual | | 0.29 | **0.71\*** | **0.81\*** | **0.83\*** | -0.57 |
| N2O | Fallow | | 0.34 | -0.21 | -0.26 | -0.12 | 0.38 |
| Growing season | Early | 0.53 | -0.43 | -0.02 | -0.05 | 0.33 |
| Midseason drainage | -0.28 | 0.38 | 0.64 | 0.14 | -0.52 |
| Late | 0.08 | **-0.88\*\*** | -0.28 | -0.55 | 0.14 |
| Total | 0.08 | **-0.90\*\*** | -0.21 | -0.57 | 0.10 |
| Annual | | 0.34 | -0.62 | -0.28 | -0.33 | 0.55 |
| Rh | Fallow | | -0.16 | **0.78\*** | 0.38 | 0.55 | -0.48 |
| Growing season | Early | 0.23 | **0.78\*** | 0.62 | **0.86\*** | -0.52 |
| Midseason drainage | -0.32 | -0.02 | 0.02 | -0.36 | -0.33 |
| Late | 0.18 | **0.71\*** | 0.57 | **0.71\*** | **-0.78\*** |
| Total | 0.11 | **0.71\*** | 0.69 | 0.67 | **-0.83\*** |
| Annual | | -0.02 | **0.88\*\*** | 0.55 | 0.67 | **-0.81\*** |
| §: Aboveground of green manure (GM), ¶: Aboveground of weed (W), ‡: belowground biomasses (BB) of green manure and weed, †: Sum of GM, W, root and rice straw, \*: *P*<0.05, \*\*: *P*<0.01. Bold values represent statistically significant. | | | | | | | |

Table S9 Spearman’s rank correlation coefficients between N2O emission and applied nitrogen.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Season** | | **Applied N** | | | | |
| **GM§** | **W¶** | **BB‡** | **Sum of GM, W, and BB** | **Total†** |
| Fallow | | 0.34 | 0.28 | -0.05 | 0.26 | 0.33 |
| Growing season | Early | 0.53 | 0.19 | 0.05 | 0.33 | 0.33 |
| Midseason drainage | -0.28 | 0.05 | 0.33 | -0.14 | -0.52 |
| Late | 0.08 | -0.31 | -0.10 | -0.17 | 0.14 |
| Total | 0.08 | -0.38 | -0.14 | -0.19 | 0.10 |
| Annual | | 0.34 | 0.02 | -0.10 | 0.14 | 0.33 |
| §: Aboveground of green manure (GM), ¶: Aboveground of weed (W), ‡: belowground biomasses (BB) of green manure and weed, †: Sum of GM, W, root and rice straw, \*: *P*<0.05, \*\*: *P*<0.01. Bold values represent statistically significant. | | | | | | |

Table S10 Application rates of biomass carbon (Mean±SD).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **C application rate (Mg C ha-1)** | | | | | | |
| **Rice straw** | **GM and weed** | | | | | **Annual** |
| **Aboveground biomass** | | | **Belowground biomass** | **Total** |
| **GM** | **Weed** | **Total** |
| 2013-  2014 | CM | | 2.31 | 0 | 1.47±0.12 a | 1.47±0.12 ab | 0.60±0.18 a | 2.06±0.28 a | 4.37±0.28 a |
| CMG | | 0.36±0.14 | 1.32±0.21 a | 1.68±0.12 ab | 0.60±0.15 a | 2.28±0.04 a | 4.59±0.04 a |
| PM | | 0 | 1.16±0.25 a | 1.16±0.25 b | 0.52±0.17 a | 1.68±0.42 a | 3.99±0.42 a |
| PMG | | 0.44±0.17 | 1.51±0.39 a | 1.96±0.50 a | 0.36±0.06 a | 2.31±0.54 a | 4.62±0.54 a |
| *P* | MD | na | na | 0.66 | 0.90 | 0.05 | 0.36 | 0.36 |
| GM | 0.44 | **< 0.05** | 0.27 | **< 0.05** | **< 0.05** |
| MD×GM | 0.08 | 0.07 | 0.28 | 0.29 | 0.29 |
| 2014-  2015 | CM | | 1.12 | 0 | 1.92±0.45 a | 1.92±0.44 a | 0.60±0.17 a | 2.52±0.59 a | 3.64±0.59 a |
| CMG | | 0.79±0.29 | 1.48±0.21 a | 2.27±0.14 a | 0.61±0.11 a | 2.88±0.22 a | 4.00±0.22 a |
| PM | | 0 | 1.84±0.31 a | 1.84±0.31 a | 0.63±0.24 a | 2.47±0.53 a | 3.59±0.53 a |
| PMG | | 0.58±0.20 | 1.60±0.22 a | 2.18±0.30 a | 0.67±0.13 a | 2.85±0.16 a | 3.97±0.16 a |
| *P* | MD | na | na | 0.92 | 0.59 | 0.57 | 0.86 | 0.86 |
| GM | 0.05 | **< 0.05** | 0.78 | 0.10 | 0.10 |
| MD×GM | 0.53 | 0.98 | 0.88 | 0.96 | 0.96 |
| 2013-2015 | CM | | na | 0 | 1.69±0.39 a | 1.69±0.39 a | 0.60±0.16 a | 2.29±0.49 a | 4.00±0.58 a |
| CMG | | 0.58±0.31 | 1.40±0.21 a | 1.98±0.34 a | 0.60±0.12 a | 2.58±0.35 a | 4.30±0.35 a |
| PM | | 0 | 1.50±0.44 a | 1.50±0.44 a | 0.58±0.20 a | 2.08±0.61 a | 3.79±0.49 a |
| PMG | | 0.51±0.19 | 1.55±0.30 a | 2.07±0.40 a | 0.51±0.19 a | 2.58±0.47 a | 4.30±0.50 a |
| *P* | MD | na | na | 0.84 | 0.63 | 0.35 | 0.45 | 0.45 |
| GM | 0.26 | **< 0.01** | 0.59 | **< 0.01** | **< 0.01** |
| Year | **< 0.01** | **< 0.01** | 0.06 | **< 0.01** | **< 0.01** |
| MD×GM | 0.10 | 0.20 | 0.54 | 0.45 | 0.44 |
| MD×Year | 0.71 | 0.75 | 0.08 | 0.63 | 0.63 |
| GM×Year | **< 0.05** | 0.46 | 0.34 | 0.86 | 0.86 |
| MD×GM×Year | 0.47 | 0.19 | 0.40 | 0.49 | 0.49 |
| na: not analyzed, CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two- or three-way ANOVA. Different letters represent statistically significant difference at *P*<0.05, and bold values represent statistically significant. | | | | | | | | | |

Table S11 Application rates of plant biomass and fertilized nitrogen (Mean±SD).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Treatment** | | **N application rate (kg N ha-1)** | | | | | | | |
| **Plant biomass** | | | | | | | **Annual** |
| **Rice straw** | **GM and weed** | | | | | **Total** |
| **Aboveground biomass** | | | **Belowground biomass** | **Sub total** |
| **GM** | **Weed** | **Total** |
| 2013-  2014 | CM | | 53.9 | 0 | 39.6±3.59 ab | 39.6±3.59 b | 16.0±4.33 a | 55.6±7.92 b | 110±7.92 b | 190±7.92 a |
| CMG | | 20.0±9.01 | 50.7±4.90 ab | 70.7±7.56 a | 20.3±5.71 a | 91.0±49.5 a | 145±11.1 a | 195±11.1 a |
| PM | | 0 | 35.0±6.16 b | 35.0±6.16 b | 14.4±5.19 a | 49.5±10.2 b | 103±10.2 b | 183±10.2 a |
| PMG | | 23.6±7.54 | 60.4±18.6 a | 84.1±23.1 a | 11.4±1.96 a | 95.5±23.6 a | 149±23.6 a | 199±23.6 a |
| *P* | MD | na | na | 0.62 | 0.50 | **< 0.05** | 0.91 | 0.91 | 0.91 |
| GM | **< 0.01** | **< 0.001** | 0.80 | **< 0.001** | **< 0.001** | 0.17 |
| MD×GM | 0.19 | 0.18 | 0.14 | 0.48 | 0.48 | 0.48 |
| 2014-  2015 | CM | | 24.7 | 0 | 60.5±28.7 a | 60.5±28.7 ab | 21.0±9.18 a | 81.5±37.8 ab | 106±37.8 ab | 186±37.8 a |
| CMG | | 39.5±14.8 | 65.8±8.08 a | 105±21.9 a | 26.0±6.82 a | 131±25.4 a | 156±25.4 a | 206±25.4 a |
| PM | | 0 | 48.2±8.82 a | 48.2±8.82 b | 19.2±7.33 a | 67.4±10.4 b | 92.1±10.4 b | 172±10.4 a |
| PMG | | 29.4±8.80 | 70.1±7.42 a | 99.5±11.0 a | 24.1±4.06 a | 124±9.30 a | 148±9.30 a | 198±9.30 a |
| *P* | MD | na | na | 0.62 | 0.37 | 0.62 | 0.39 | 0.38 | 0.38 |
| GM | 0.11 | **< 0.001** | 0.19 | **< 0.001** | **< 0.001** | 0.08 |
| MD×GM | 0.32 | 0.74 | 0.98 | 0.79 | 0.79 | 0.79 |
| 2013-2015 | CM | | na | 0 | 50.0±22.0 ab | 50.0±22.0 b | 18.5±7.15 a | 68.6±28.8 b | 108±25.3 b | 188±25.3 a |
| CMG | | 29.8±15.4 | 58.2±10.1 ab | 88.0±23.9 a | 23.1±6.58 a | 111±28.1 a | 150±19.1 a | 200±19.1 a |
| PM | | 0 | 41.6±9.94 b | 41.6±9.94 b | 16.8±6.41 a | 58.4±13.5 b | 97.7±11.3 b | 178±11.3 a |
| PMG | | 26.5±15.4 | 65.3±14.1 a | 91.8±18.7 a | 17.8±7.38 a | 110±22.4 a | 149±16.6 a | 199±16.6 a |
| *P* | MD | na | na | 0.88 | 0.69 | 0.11 | 0.41 | 0.41 | 0.41 |
| GM | **< 0.01** | **< 0.001** | 0.20 | **< 0.001** | **< 0.001** | **< 0.05** |
| Year | **< 0.01** | **< 0.01** | **< 0.01** | **< 0.001** | 0.87 | 0.87 |
| MD×GM | 0.11 | 0.30 | 0.39 | 0.54 | 0.55 | 0.54 |
| MD×Year | 0.49 | 0.26 | 0.43 | 0.48 | 0.48 | 0.48 |
| GM×Year | 0.62 | 0.50 | 0.31 | 0.39 | 0.39 | 0.39 |
| MD×GM×Year | 0.90 | 0.63 | 0.41 | 0.88 | 0.88 | 0.88 |
| na: not analyzed, CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. *P* values represent the results of two- or three-way ANOVA. Different letters represent statistically significant difference at *P*<0.05, and bold values represent statistically significant. | | | | | | | | | | |

Table S12 Number of panicle, 1000-grain weight, and brown rice yield (Mean±SD).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Treat-**  **ment** | **Panicle number** | | **1000-grain weight** | | **Brown rice yield** | |
| **(number m-2)** | | **(g 1000grain-1)** | | **(Mg ha-1)** | |
| **2014** | **2015** | **2014** | **2015** | **2014** | **2015** |
| CM | 345±19.6 a | 312±34.5 a | 22.8±0.28 a | 22.3±0.18 a | 442±60.8 a | 306±83.4 a |
| CMG | 340±23.2 a | 328±31.0 a | 23.0±0.25 a | 22.4±0.29 a | 445±44.8 a | 351±39.8 a |
| PM | 308±28.3 b | 323±25.9 a | 23.1±0.72 a | 21.5±0.37 b | 442±39.0 a | 318±57.2 a |
| PMG | 332±16.7 ab | 335±14.6 a | 22.6±0.33 a | 21.5±0.26 b | 424±33.8 a | 316±74.2 a |
| CM: Conventional mid-season drainage, CMG: Conventional mid-season drainage with green manure application, PM: Prolonged mid-season drainage, PMG: Prolonged mid-season drainage with green manure application. Different letters represent statistically significant difference at *P*<0.05. | | | | | | |