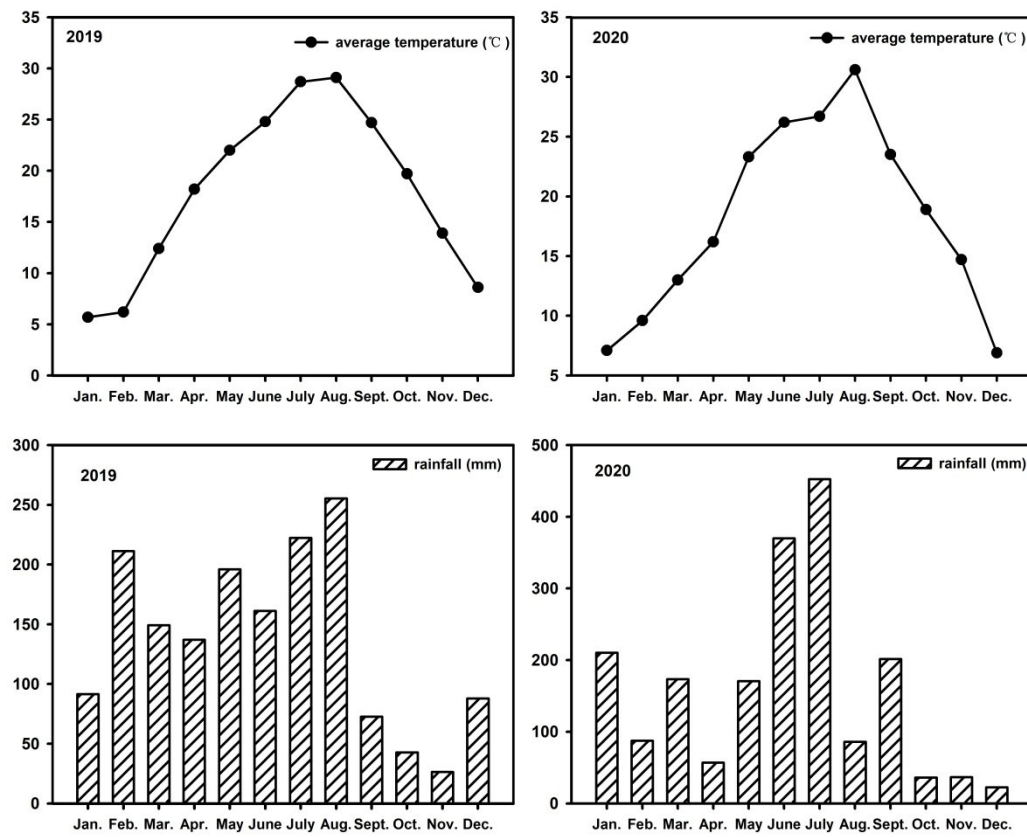


## Supplementary data



**Figure S1.** Weather data in the experimental location Hangzhou in 2019 and 2020.

**Table S1.** Heatmap data of soil bacterial community at genus level to be involved in greenhouse gas emission influenced by the mulching cultivation.

| Category                | Microbe           | CK-PI    | BM-PI    | CK-HD    | BM-HD    |
|-------------------------|-------------------|----------|----------|----------|----------|
| Methanogenic bacteria   | Methanobacterium  | 0.000938 | 0        | 0        | 0.000554 |
|                         | Methanolinea      | 0.000445 | 0        | 0        | 0.000554 |
| Methanotrophic bacteria | Methylocaldum     | 0.000513 | 0.00246  | 0.00164  | 0.005762 |
|                         | Methylococcus     | 0.026292 | 0.055058 | 0.067501 | 0.089393 |
|                         | Methylomonas      | 0.020758 | 0.073076 | 0.046221 | 0.082031 |
|                         | Methyloparacoccus | 0.001918 | 0.025524 | 0.002123 | 0.008819 |
|                         | Methylosarcina    | 0.027123 | 0.032661 | 0.023958 | 0.049168 |
|                         | Methyloversatilis | 0.056788 | 0.112903 | 0.161146 | 0.068164 |
|                         | Methylobacter     | 0.017916 | 0.026403 | 0.033377 | 0.034923 |
|                         | Methylocystis     | 0.340776 | 0.380144 | 0.240219 | 0.226578 |
|                         | Methylogaea       | 0.0015   | 0.00242  | 0.004418 | 0.005289 |
|                         | Nocardia          | 0.000515 | 0.002489 | 0.004926 | 0.006316 |
| Organic decomposition   | Streptomyces      | 0.00687  | 0.009382 | 0.010495 | 0.018801 |
|                         | Syntrophorhabdus  | 0.37414  | 0.498595 | 0.499822 | 0.530512 |
|                         | Mycobacterium     | 0.062448 | 0.073567 | 0.096336 | 0.093036 |
|                         | Pseudomonas       | 0.00387  | 0.001023 | 0.037299 | 0.003136 |
|                         | Dehalogenimonas   | 0.164211 | 0.238048 | 0.22911  | 0.27139  |
|                         | Georgfuchsia      | 0.028758 | 0.046258 | 0.055211 | 0.069127 |
|                         | Rhizomicrobium    | 0.288196 | 0.329226 | 0.361877 | 0.268236 |
| Nitrogen fixation       | Ktedonobacter     | 0.009798 | 0.01238  | 0.03081  | 0.024152 |
|                         | Sideroxydans      | 0.163912 | 1.176299 | 1.779927 | 2.220718 |
|                         | Nitrospira        | 0.12786  | 0.096099 | 0.090731 | 0.138919 |
| Nitrification           | Nitrospira        | 0.301947 | 0.241455 | 0.234005 | 0.251962 |
|                         | Thiobacillus      | 0.095359 | 0.188368 | 0.203669 | 0.157033 |
| Denitrification         | Azospirillum      | 0.005516 | 0.00294  | 0.003336 | 0.021849 |
|                         | Bacillus          | 0.00826  | 0.00895  | 0.012129 | 0.020852 |
|                         | Pseudomonas       | 0.00387  | 0.001023 | 0.037299 | 0.003136 |
|                         | Ralstonia         | 0.001454 | 0.000519 | 0.004366 | 0.001035 |
|                         | Flavisolibacter   | 0.069294 | 0.089169 | 0.084458 | 0.098238 |
|                         | Acinetobacter     | 0.001006 | 0.00048  | 0.01862  | 0.002597 |
|                         | Chromobacterium   | 0.000987 | 0.000438 | 0.003876 | 0.035229 |
|                         | Flavobacterium    | 0.005555 | 0.000956 | 0.001649 | 0.008311 |
|                         | Hyphomicrobium    | 0.017412 | 0.034536 | 0.076832 | 0.031958 |
|                         | Geobacter         | 1.815637 | 1.720515 | 2.35395  | 2.583129 |
| Iron-sulfate reducer    | Desulfatiglans    | 0.071574 | 0.103849 | 0.101799 | 0.110119 |
|                         | Desulfobacca      | 0.024338 | 0.02957  | 0.053848 | 0.04088  |
|                         | Desulfobulbus     | 0.021712 | 0.017888 | 0.020348 | 0.035106 |
|                         | Desulfocapsa      | 0.005435 | 0.005488 | 0.01537  | 0.008951 |
|                         | Desulfovibrio     | 0.021691 | 0.034788 | 0.072577 | 0.078035 |
|                         | Desulfuromonas    | 0.000494 | 0.005401 | 0.010998 | 0.004704 |

|                     |          |          |          |          |
|---------------------|----------|----------|----------|----------|
| Sulfuritalea        | 0.004471 | 0.014022 | 0.020047 | 0.038184 |
| Thermodesulfovibrio | 4.665419 | 5.369562 | 6.284261 | 5.731618 |

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