**Supporting information for:**

# Studying the effect of straw returning on the interspecific symbiosis of soil microbes based on carbon source utilization

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**Section S1. The distribution of carbon sources in ECO plates.**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| A | **Z0**<br>water | **Z1**<br>β-methyl-D-glucoside | **Z2**<br>D-galactonic acid γ-lactone | **Z3**<br>L-arginine |
| B | **Z4**<br>pyruvic acid methyl ester | **Z5**<br>D-xylose | **Z6**<br>D-galacturonic acid | **Z7**<br>L-asparagine |
| C | **Z8**<br>tween 40 | **Z9**<br>I-erythritol | **Z10**<br>2-hydroxy benzoic acid | **Z11**<br>L-phenylalanine |
| D | **Z12**<br>tween 80 | **Z13**<br>D-mannitol | **Z14**<br>4-hydroxy benzoic acid | **Z15**<br>L-serine |
| E | **Z16**<br>α-cyclodextrin | **Z17**<br>N-acetyl-D-glucosamine | **Z18**<br>γ-hydroxybutyric acid | **Z19**<br>L-threonine |
| F | **Z20**<br>glycogen | **Z21**<br>D-glucosaminic acid | **Z22**<br>itaconic acid | **Z23**<br>glycyl-L-glutamic acid |
| G | **Z24**<br>D-cellobiose | **Z25**<br>glucose-1-phosphate | **Z26**<br>α-ketobutyric acid | **Z27**<br>phenylethyl-amine |
| H | **Z28**<br>α-D-lactose | **Z29**<br>D,L-α-glycerol phosphate | **Z30**<br>D-malic acid | **Z31**<br>putrescine |

**Section S2. The straw amount in each experimental plot (1 $m^2$).**

Table S1. Test design (1 $m^2$).

| Treatments | Code value | | | Actual value | | |
|---|---|---|---|---|---|---|
| | Test factor A | Test factor B | Test factor C | Straw length cm | Straw amount $g/m^2$ | Straw buried depth cm |
| 1 | 1 | 1 | 1 | 20 | 850 | 20 |
| 2 | 1 | 1 | -1 | 20 | 850 | 10 |
| 3 | 1 | -1 | 1 | 20 | 350 | 20 |
| 4 | 1 | -1 | -1 | 20 | 350 | 10 |
| 5 | -1 | 1 | 1 | 10 | 850 | 20 |
| 6 | -1 | 1 | -1 | 10 | 850 | 10 |
| 7 | -1 | -1 | 1 | 10 | 350 | 20 |
| 8 | -1 | -1 | -1 | 10 | 350 | 10 |
| 9 | 1.682 | 0 | 0 | 25 | 600 | 15 |
| 10 | -1.682 | 0 | 0 | 5 | 600 | 15 |
| 11 | 0 | 1.682 | 0 | 15 | 1000 | 15 |
| 12 | 0 | -1.682 | 0 | 15 | 200 | 15 |
| 13 | 0 | 0 | 1.682 | 15 | 600 | 25 |
| 14 | 0 | 0 | -1.682 | 15 | 600 | 5 |
| 15 | 0 | 0 | 0 | 15 | 600 | 15 |

According to the three factors five levels quadratic orthogonal rotation experimental design, fifteen groups of experiments were carried out.

**Section S3. The changes of straw decomposition rates accured by the interaction of straw amount and buried delth.**

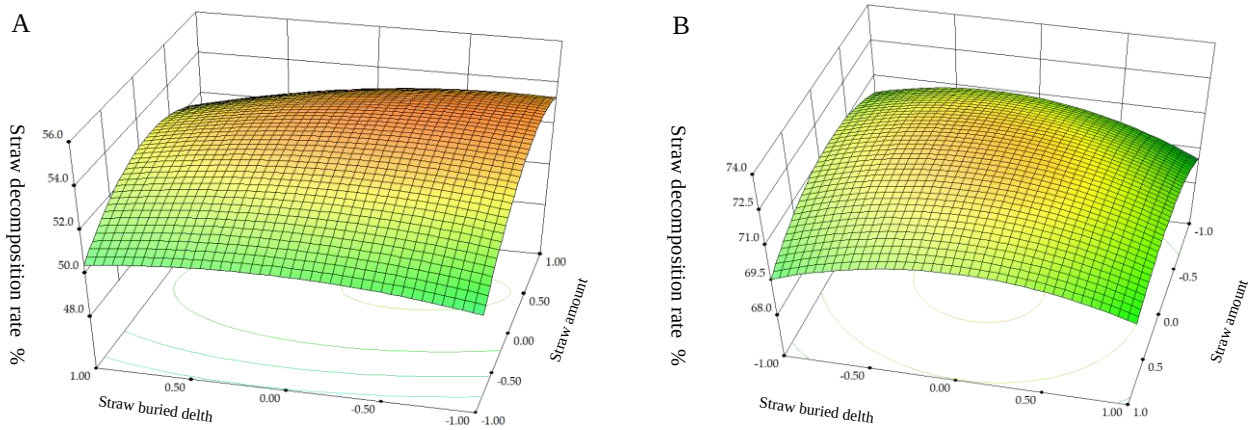


Figure S1. Straw decomposition rate caused by straw amount and buried delth.

A: 150 days of straw returning; B: (A+150) days of straw returning

**Section S4. The changes of straw decomposition rates accured by the interaction of straw length and buried delth.**

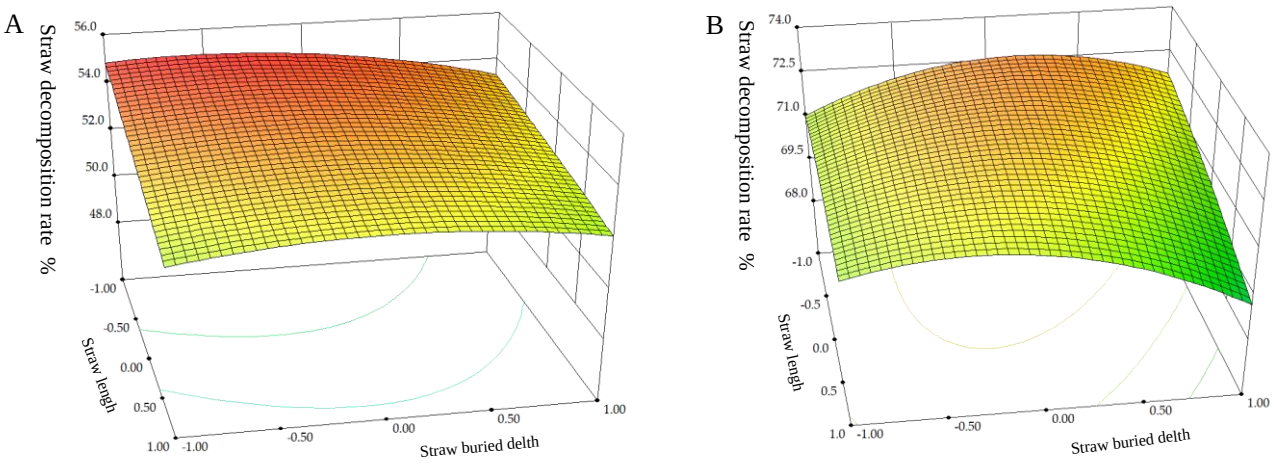


Figure S2. Straw decomposition rate caused by straw length and buried delth.

A: 150 days of straw returning; B: (A+150) days of straw returning

**Section S5. The partial results of path analysis.**

Table S2. The determination coefficient and residual path coefficient of PA.

| Time (day) | One year decomposition period | | Two year decomposition period | |
|---|---|---|---|---|
| | Determination coefficient | Residual path coefficient | Determination coefficient | Residual path coefficient |
| 30<br>A+30 | 0.988 | 0.111 | 0.975 | 0.158 |
| 60<br>A+60 | 0.967 | 0.182 | 0.977 | 0.153 |
| 90<br>A+90 | 0.984 | 0.126 | 0.986 | 0.118 |
| 120<br>A+120 | 0.969 | 0.176 | 0.969 | 0.175 |
| 150<br>A+150 | 0.973 | 0.164 | 0.987 | 0.116 |

**Section S6. The meteorological conditions of the experimental site.**

Table S3. The meteorological conditions of the experimental site during the test.

| Year | Month | Average temperature ℃ | Average maximum temperature ℃ | Average minimum temperature ℃ | Average rainfall mm | Average sunshine time hour |
|---|---|---|---|---|---|---|
| 2019 | Jan | -14.4 | -7.6 | -20.2 | 2.4 | 172.8 |
| | Feb | -10.2 | -2.9 | -16.9 | 0.3 | 179.9 |
| | Mar | -0.3 | 7.1 | -7.4 | 11.5 | 240.8 |
| | Apr | 7.5 | 14.9 | 0.2 | 13.4 | 266.6 |
| | May | 15.1 | 22.3 | 8.8 | 105.8 | 240.5 |
| | June | 19.1 | 24.4 | 14.1 | 106.8 | 272.0 |
| | July | 23.2 | 28.0 | 19.3 | 215.3 | 250.8 |
| | Aug | 20.2 | 24.3 | 17.2 | 250.1 | 180.9 |
| | Sep | 15.8 | 23.0 | 9.3 | 104.8 | 289.0 |
| | Oct | 7.2 | 14.5 | 0.7 | 9.5 | 238.9 |
| | Nov | -5.9 | -0.7 | -10.8 | 17.7 | 200.4 |
| | Dec | -16.2 | -10.9 | -21.4 | 23.8 | 184.7 |
| 2020 | Jan | -17.4 | -10.7 | -23.4 | 2.4 | 213.9 |
| | Feb | -12.3 | -6.2 | -18.7 | 12.6 | 227.5 |
| | Mar | -1.4 | 4.2 | -6.8 | 9.4 | 287.0 |
| | Apr | 6.5 | 13.3 | -0.4 | 16.9 | 301.6 |
| | May | 15.1 | 21.4 | 9.1 | 77.3 | 306.7 |
| | June | 19.2 | 24.3 | 15.0 | 171.4 | 280.6 |
| | July | 23.7 | 29.2 | 18.7 | 71.2 | 349.3 |
| | Aug | 21.2 | 26.1 | 17.3 | 209.3 | 251.5 |
| | Sep | 15.8 | 20.5 | 12.1 | 194.2 | 205.3 |
| | Oct | 6.2 | 12.3 | 0.9 | 24.3 | 223.3 |
| | Nov | -4.7 | 0.3 | -9.4 | 36.6 | 188.5 |
| | Dec | -16.8 | -11.4 | -21.7 | 2.0 | 212.7 |

The data comes from Harbin Meteorological Bureau