



Supplement of

Mulch application as the overarching factor explaining increase in soil organic carbon stocks under conservation agriculture in two 8-year-old experiments in Zimbabwe

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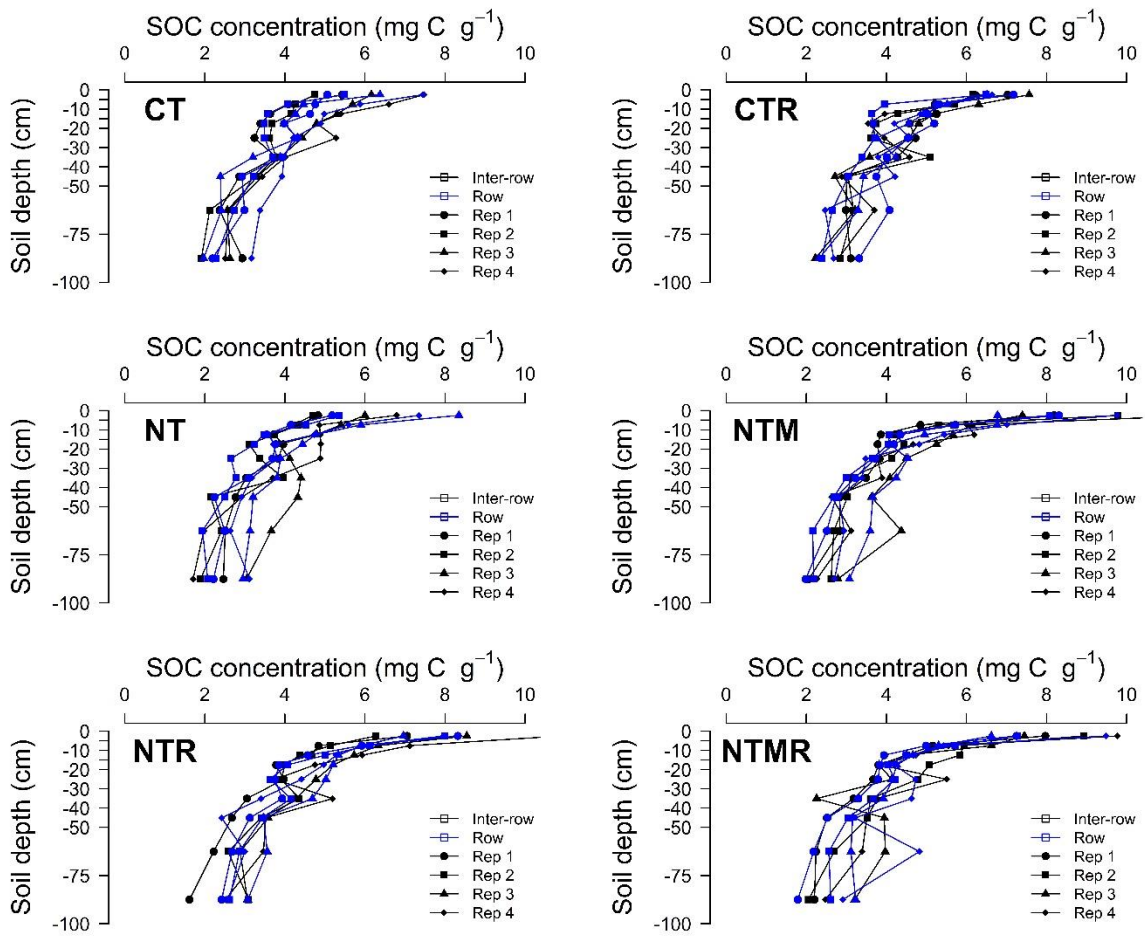


Figure S1. SOC concentration for the 100 cm soil profile at the Domboshava Training Centre (DTC) for each treatment and replicate (block).

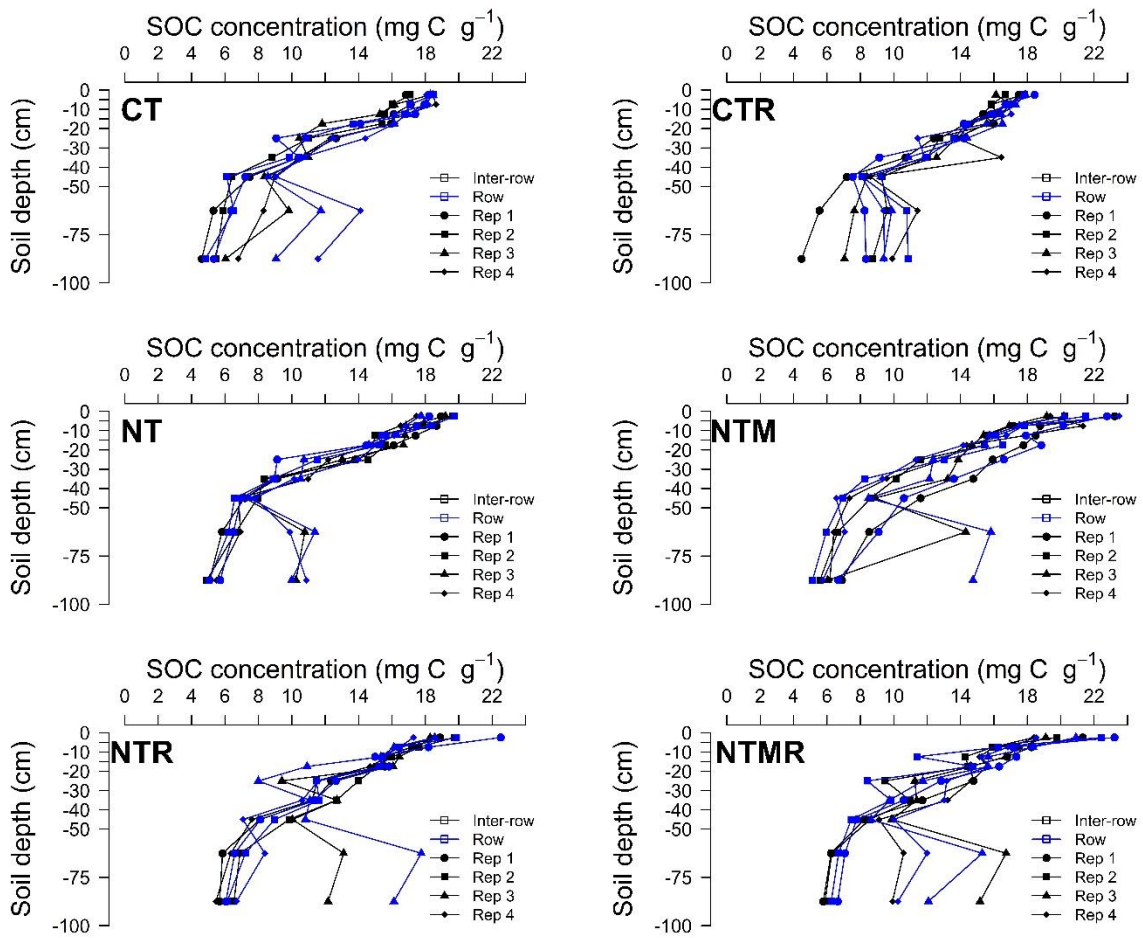


Figure S2. SOC concentration for the 100 cm soil profile at the University of Zimbabwe farm (UZf) for each treatment and replicate (block).

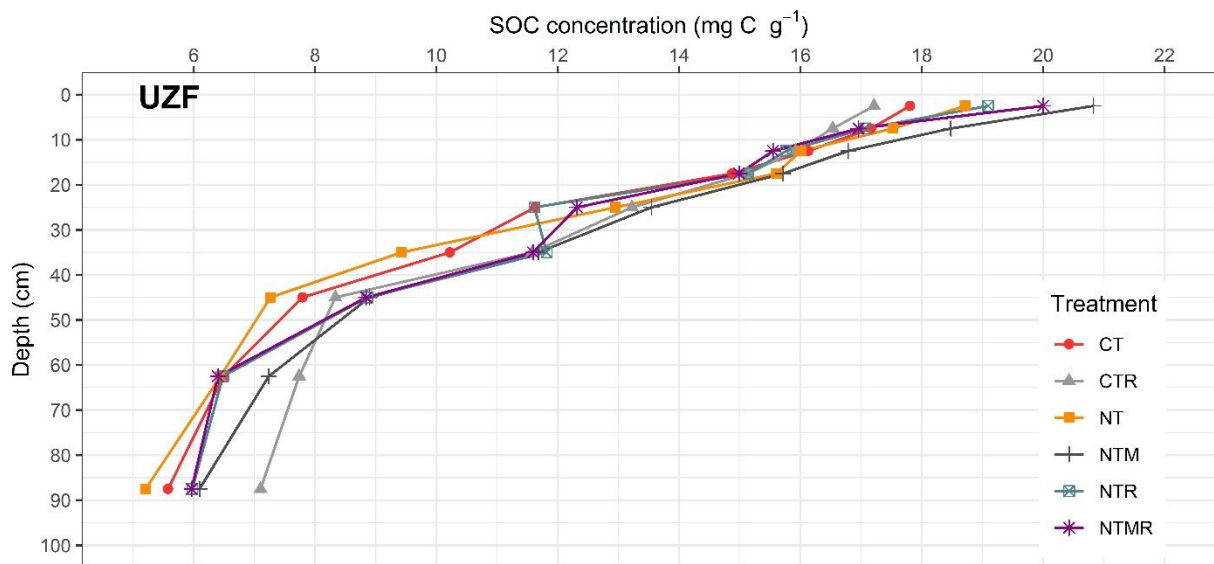
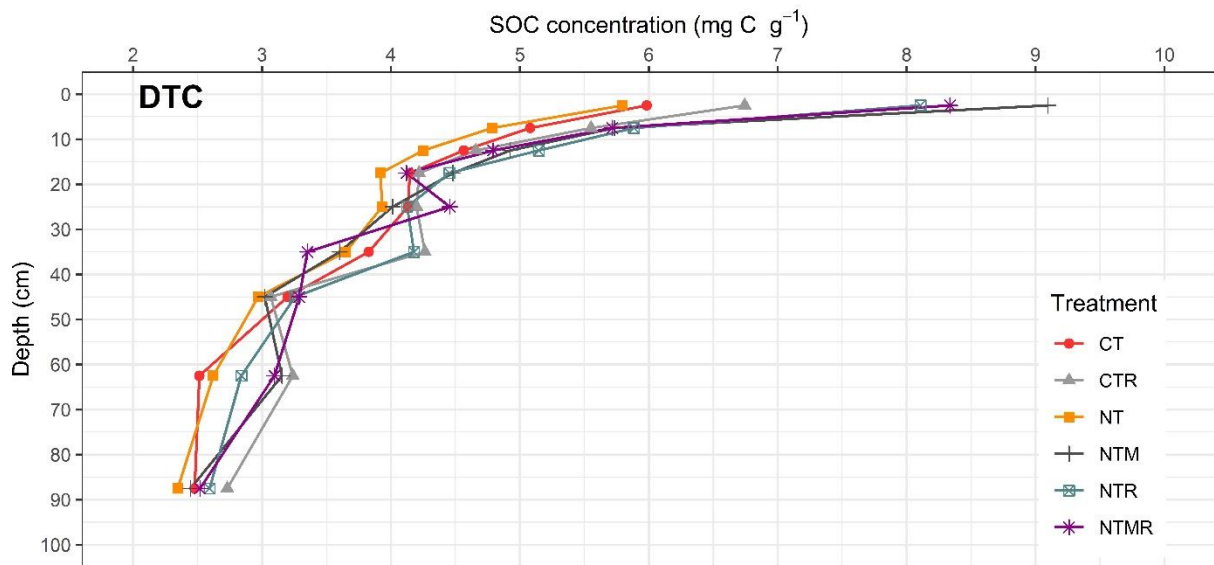


Figure S3. Mean SOC concentration for the 100 cm soil profile for each treatment excluding “outliers” below 50 cm at the University of Zimbabwe farm (UZF).

Table S1. Subsoil bulk density (g cm^{-3}) from pits outside the experimental plots at Domboshava Training Centre (DTC) and the University of Zimbabwe (UZF). Associated errors are standard errors ($N = 4$).

| Depth (cm) | Site | |
|------------|---------------------|---------------------|
| | DTC | UZF |
| 30-40 | 1.49 (± 0.01) | 1.47 (± 0.01) |
| 40-50 | 1.47 (± 0.01) | 1.49 (± 0.00) |
| 50-75 | 1.49 (± 0.01) | 1.48 (± 0.01) |
| 75-100 | 1.51 (± 0.01) | 1.48 (± 0.01) |

Table S3. SOC stocks per soil layer at the Domboshava Training Centre (DTC) and University of Zimbabwe Farm (UZF) after 8 years of different tillage, residue and crop management systems. Means in the same row followed by different superscript letters are significantly different and associated errors are standard errors (N = 4). CT: conventional tillage, CTR: conventional tillage with rotation, NT: no-tillage, NTM: no-tillage with mulch, NTR: no-tillage with rotation, NTMR: no-tillage with mulch and rotation.

| Site | ESM (Mg C ha ⁻¹) | Approximate soil depth (cm) | SOC stocks (Mg C ha ⁻¹) | | | | | | LSD | Significance |
|------|---------------------------------|-----------------------------------|-------------------------------------|--------------------------|--------------------------|-------------------------|--------------------------|--------------------------|-------|--------------|
| | | | CT | CTR | NT | NTM | NTR | NTMR | | |
| DTC | 650 | 0-5 | 3.9 ± 0.73 ^c | 4.4 ± 0.18 ^{ab} | 3.8 ± 0.35 ^c | 5.9 ± 0.60 ^a | 5.3 ± 0.51 ^b | 5.4 ± 0.34 ^b | 0.94 | p < 0.001 |
| | 690 | 5-10 | 3.5 ± 0.73 ^b | 3.9 ± 0.15 ^a | 3.3 ± 0.20 ^b | 4.0 ± 0.21 ^a | 4.1 ± 0.28 ^a | 4.0 ± 0.18 ^a | 0.45 | p < 0.05 |
| | 720 | 10-15 | 3.3 ± 0.53 | 3.4 ± 0.22 | 3.1 ± 0.23 | 3.6 ± 0.36 | 3.7 ± 0.23 | 3.5 ± 0.18 | 0.62 | ns |
| | 705 | 15-20 | 2.9 ± 0.47 | 3.0 ± 0.21 | 2.8 ± 0.22 | 3.2 ± 0.18 | 3.1 ± 0.23 | 2.9 ± 0.17 | 0.56 | ns |
| | 1400 | 20-30 | 5.8 ± 1.04 | 5.7 ± 0.32 | 5.5 ± 0.42 | 5.6 ± 0.25 | 5.8 ± 0.33 | 6.2 ± 0.49 | 1.08 | ns |
| | 1430 | 30-40 | 5.5 ± 0.16 | 6.1 ± 0.24 | 5.3 ± 0.33 | 5.2 ± 0.30 | 6.0 ± 0.46 | 4.9 ± 0.40 | 0.93 | ns |
| | 1450 | 40-50 | 4.7 ± 0.37 | 4.6 ± 0.11 | 4.4 ± 0.56 | 4.5 ± 0.31 | 4.8 ± 0.26 | 4.8 ± 0.36 | 0.84 | ns |
| | 3510 | 50-75 | 8.9 ± 0.67 | 11.4 ± 0.26 | 9.2 ± 1.12 | 7.6 ± 2.35 | 10.0 ± 0.79 | 10.9 ± 1.34 | 1.83 | ns |
| | 3215 | 75-100 | 8.0 ± 1.08 | 8.9 ± 0.56 | 7.6 ± 0.81 | 8.0 ± 0.57 | 8.4 ± 0.93 | 8.1 ± 0.81 | 2.09 | ns |
| UZF | 460 | 0-5 | 8.2 ± 0.15 ^{cd} | 8.0 ± 0.14 ^c | 8.6 ± 0.21 ^{cd} | 9.6 ± 0.37 ^a | 8.8 ± 0.17 ^{bc} | 9.2 ± 0.32 ^{ab} | 0.67 | p < 0.001 |
| | 410 | 5-10 | 7.2 ± 0.17 | 6.9 ± 0.11 | 7.3 ± 0.15 | 7.7 ± 0.32 | 7.1 ± 0.12 | 7.1 ± 0.22 | 0.58 | ns |
| | 460 | 10-15 | 7.5 ± 0.16 | 7.3 ± 0.16 | 7.5 ± 0.28 | 7.8 ± 0.38 | 7.3 ± 0.06 | 7.3 ± 0.37 | 0.73 | ns |
| | 510 | 15-20 | 7.9 ± 0.25 | 7.8 ± 0.11 | 7.9 ± 0.09 | 8.2 ± 0.41 | 7.7 ± 0.14 | 7.4 ± 0.20 | 0.62 | ns |
| | 930 | 20-30 | 11.6 ± 0.63 | 12.9 ± 0.26 | 12.8 ± 0.36 | 13.1 ± 0.78 | 11.0 ± 0.89 | 12.3 ± 0.90 | 1.98 | ns |
| | 1260 | 30-40 | 12.8 ± 0.49 | 15.4 ± 0.96 | 13.1 ± 0.30 | 14.5 ± 1.35 | 14.8 ± 0.45 | 14.2 ± 0.88 | 2.51 | ns |
| | 1270 | 40-50 | 11.1 ± 0.82 | 12.2 ± 0.36 | 10.4 ± 0.14 | 12.1 ± 1.25 | 12.1 ± 0.59 | 12.3 ± 0.37 | 2.22 | ns |
| | 2890 | 50-75 | 23.0 ± 3.13 | 25.6 ± 2.70 | 22.4 ± 2.57 | 16.8 ± (5.22) | 24.9 ± 5.34 | 28.7 ± 5.99 | 12.91 | ns |
| | 2860 | 75-100 | 18.5 ± 2.24 | 23.2 ± 2.83 | 19.9 ± 3.41 | 20.1 ± 1.98 | 22.4 ± 5.01 | 26.5 ± 5.99 | 9.36 | ns |

Table S4. Seasonal organic carbon inputs (Mg C ha⁻¹) to soil for different treatments at Domboshava Training Centre (DTC) and the University of Zimbabwe (UZF). Means in the same column followed by different superscript letters are significantly different and associated errors are standard errors (N = 4). CT = conventional tillage, CTR = conventional tillage with rotation, NT = no tillage, NTM = no tillage with mulch, NTR = no tillage with rotation, NTMR = no tillage with mulch and rotation, LSD = least significance difference.

| Site | Treatment | Seasons | | | | | | | |
|------|--------------|--------------------------|--------------------------|---------------------------|---------------------------|---------------------------|--------------------------|---------------------------|---------------------------|
| | | 2013/14* | 2014/15 | 2015/16* | 2016/17 | 2017/18* | 2018/19 | 2019/20* | 2020/21 |
| DTC | CT | 1.42 ± 0.15 ^b | 1.01 ± 0.17 ^b | 1.41 ± 0.05 ^b | 1.22 ± 0.16 ^b | 0.67 ± 0.09 ^b | 0.67 ± 0.19 ^b | 0.51 ± 0.09 ^c | 0.51 ± 0.11 ^b |
| | CRT | 0.42 ± 0.02 ^c | 1.17 ± 0.09 ^b | 0.23 ± 0.02 ^c | 1.27 ± 0.12 ^b | 0.54 ± 0.15 ^b | 0.74 ± 0.22 ^b | 1.07 ± 0.09 ^b | 0.50 ± 0.14 ^b |
| | NT | 1.18 ± 0.10 ^b | 1.23 ± 0.23 ^b | 1.22 ± 0.16 ^b | 1.35 ± 0.19 ^b | 0.69 ± 0.06 ^b | 0.61 ± 0.09 ^b | 0.47 ± 0.03 ^c | 0.49 ± 0.05 ^b |
| | NTM | 2.22 ± 0.07 ^a | 2.25 ± 0.09 ^a | 2.29 ± 0.12 ^a | 2.27 ± 0.18 ^a | 1.81 ± 0.07 ^a | 1.79 ± 0.13 ^a | 1.79 ± 0.10 ^a | 1.57 ± 0.08 ^a |
| | NTR | 0.51 ± 0.08 ^c | 1.28 ± 0.02 ^b | 0.22 ± 0.04 ^c | 1.50 ± 0.12 ^b | 0.52 ± 0.11 ^b | 0.71 ± 0.13 ^b | 1.25 ± 0.24 ^b | 0.53 ± 0.10 ^b |
| | NTMR | 0.62 ± 0.02 ^c | 2.23 ± 0.16 ^a | 0.36 ± 0.07 ^c | 2.02 ± 0.09 ^a | 0.45 ± 0.12 ^b | 2.04 ± 0.14 ^a | 1.76 ± 0.14 ^a | 1.45 ± 0.01 ^a |
| | LSD | 0.27 | 0.38 | 0.24 | 0.46 | 0.33 | 0.51 | 0.38 | 0.27 |
| | Significance | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 |
| UZF | CT | 0.77 ± 0.09 ^b | 0.94 ± 0.11 ^b | 1.25 ± 0.13 ^b | 1.18 ± 0.05 ^c | 0.99 ± 0.11 ^b | 0.64 ± 0.05 ^c | 0.40 ± 0.07 ^{bc} | 1.02 ± 0.06 ^{cd} |
| | CRT | 0.64 ± 0.07 ^b | 1.06 ± 0.13 ^b | 1.77 ± 0.31 ^{ab} | 1.57 ± 0.06 ^{cd} | 0.73 ± 0.15 ^{bc} | 0.80 ± 0.03 ^b | 0.32 ± 0.05 ^{cd} | 1.20 ± 0.01 ^c |
| | NT | 0.74 ± 0.07 ^b | 1.08 ± 0.09 ^b | 1.36 ± 0.05 ^b | 1.36 ± 0.13 ^{ed} | 0.78 ± 0.02 ^b | 0.71 ± 0.05 ^c | 0.50 ± 0.08 ^b | 0.84 ± 0.02 ^d |
| | NTM | 1.65 ± 0.04 ^a | 2.10 ± 0.19 ^a | 2.57 ± 0.08 ^a | 2.10 ± 0.11 ^b | 2.02 ± 0.01 ^a | 1.98 ± 0.04 ^a | 1.70 ± 0.05 ^a | 2.05 ± 0.08 ^b |
| | NTR | 0.66 ± 0.13 ^b | 0.97 ± 0.13 ^b | 2.17 ± 0.70 ^{ab} | 1.74 ± 0.03 ^c | 0.60 ± 0.09 ^b | 0.78 ± 0.04 ^b | 0.22 ± 0.02 ^d | 1.07 ± 0.11 ^c |
| | NTMR | 0.70 ± 0.05 ^b | 2.01 ± 0.15 ^a | 1.91 ± 0.41 ^{ab} | 2.71 ± 0.07 ^a | 0.93 ± 0.11 ^a | 2.02 ± 0.04 ^a | 0.31 ± 0.07 ^{cd} | 2.28 ± 0.07 ^a |
| | LSD | 0.46 | 0.37 | 1.16 | 0.26 | 0.31 | 0.14 | 0.12 | 0.20 |
| | Significance | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 |

*Season when cowpea in rotation treatments was grown after maize was grown in the previous season.