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## **S1. Supplementary materials and methods**

Additional information on soil analysis:

As for SOC and POXC, dry matter content was used to correct the contents of exchangeable base cations as well as potential cation exchange capacity (CEC) (ISO11465/1193).

As for soil texture,  $pH_{H_2O}$  was measured by the Centre Provincial de l'Agriculture et de la Ruralité (CPAR) in La Hulpe. Soil pH was measured in water with a 1 : 5 soil : solution mass ratio, according to the norm ISO-10390:2021 (Association Française de Normalisation 2021).

The other analyses were carried out at the Earth and Life Institute analytical platform (MOCA, UCLouvain, Belgium).  $pH_{KCl}$  was determined using a 1M KCl solution. We measured the potential CEC by percolation of 1 M ammonium acetate (naturally buffered at pH 7) on soil columns (Metson 1957). Exchangeable cations ( $Ca^{2+}$ ,  $Mg^{2+}$ ,  $K^+$ ,  $Na^+$ ) were measured by inductively coupled plasma-atomic emission spectroscopy (ICP-AES, © Thermo, Earth and Life Institute, UCL). The excess of reagent was eliminated by rinsing the soil column with ethanol. Ammonium, saturating the exchange complex of soil, was then desorbed using a 10% KCl solution at pH 3. The amount of ammonium released was determined by spectrophotometry (Spectroquant Test Ammonium, Merck Kit 114752) to determine the potential CEC. Base saturation was calculated by dividing the sum of exchangeable cations by potential CEC.

As the total SOC content analysis, nitrogen content was determined by dry combustion (vario MAX, © Elementar, MOCA, UCLouvain, Belgium). Inorganic carbon content was determined after a reaction with HCl in a closed chamber with a calcimeter working with an electronic pressure sensor (Sherrod et al. 2002). Following sample dry weight correction, inorganic carbon was subtracted from total carbon to obtain the organic carbon content.

## S2. Results obtained on three other QST indicators

Description of the indicators:

- i. One indicator associated to the early increase in soil mass soon after soil immersion in water: " $t_{max}$ ", which represents the time to reach the maximum mass value. A high  $t_{max}$  value means that the sample is filling with water gently without decomposing too quickly.
- ii. One indicator related to slopes in the decreasing part of the curve: " $slope_{30-60}$ ", which signifies the local slope linked to weight loss between 30 and 60 seconds.

The  $t_{max}$  and  $slope_{30-60}$  indicators are highly correlated with the fast-wetting of Le Bissonnais, suggesting that slaking plays an important role in the early stages of the QST (Vanwindekens et Hardy 2023).

- iii. One indicator linked to threshold values of mass loss: " $dt_{50-75}$ ".  $t_{50}$  and  $t_{75}$  represent the time needed to achieve 50% and 75% of relative mass loss between the maximum and the final mass of soil at the end of the QST experiment. " $dt_{50-75}$ " corresponds to the time between 50% and 75% of mass loss. This indicator correlates more closely to the slow-wetting test of Le Bissonnais, suggesting that clay dispersion and differential swelling play an important role in the intermediate to late stages of the QST (Vanwindekens et Hardy 2023).

**Table S 1 Descriptive statistics of some QST indicators of the surveyed fields**

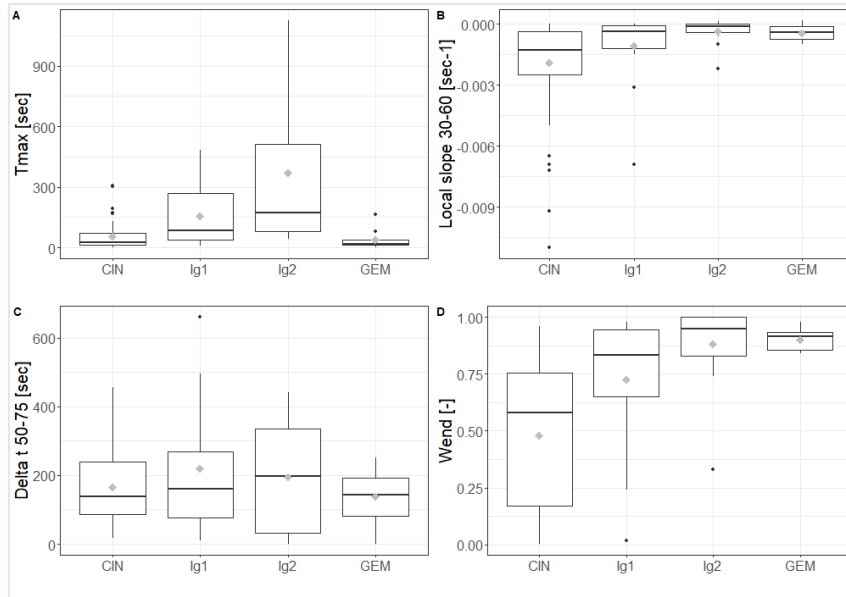
Indicator (unit)	Minimum	1st Quartile	Median	Mean	3rd Quartile	Maximum
$t_{max}$ (sec)	1	16	49	143	143	1124
$slope_{30-60}$ ( $sec^{-1}$ )	-1.10E-02	-1.50E-03	-4.70E-04	-1.24E-03	-1.38E-04	1.60E-04
$dt_{50-75}$ (sec)	0	79	142	176	248	662

**Table S 2 Descriptive statistics of some QST indicators of the surveyed fields per CA-types (mean  $\pm$  standard deviation)**

Indicator (unit)	CIN	Ig1	Ig2	GEM	All CA fields
<i>Number of fields</i>	10	3	4	2	19
<i>Number of samples</i>	59	16	21	12	140
$t_{max}$ (sec)	53 $\pm$ 67	157 $\pm$ 163	370 $\pm$ 375	37 $\pm$ 46	143 $\pm$ 233
$slope_{30-60}$ (sec <sup>-1</sup> )	-1.93E-03 $\pm$ 2.33E-03	-1.09E-03 $\pm$ 1.81E-03	-3.60E-04 $\pm$ 6.11E-04	-4.46E-04 $\pm$ 3.95E-04	-1.24E-03 $\pm$ 1.93E-03
$dt_{50-75}$ (sec)	166 $\pm$ 109	219 $\pm$ 190	195 $\pm$ 153	139 $\pm$ 75	176 $\pm$ 134

$t_{max}$ , which represents the time required to reach the maximum sample mass, is shorter for GEM and CIN compared to Ig1 and Ig2. A higher  $t_{max}$  implies that the soil samples slowly fill with water without undergoing rapid decomposition. For the  $slope_{30-60}$  indicator, a steeper slope is observed in CIN samples. No marked difference was observed for the  $dt_{50-75}$  indicator. CIN samples exhibit the lowest Wend values, which represents the fraction of the sample that has not undergone disaggregation.

It should be noted that  $t_{max}$  largely exceeds the values reported by Vanwindekens and Hardy (2023), where measurements were mainly within the range of 0 to 30 seconds for plowed fields and 0 to 90 seconds for reduced tillage fields.



**Figure S 1** Box fields of four of the *QuantiSlake Test* indicators across the four *CA-types*. Boxes show the median (thick line) and average (grey diamond).

### **S3. Raw values of soil properties**

Table S3 is available in an Excel file.

#### S4. Correlation matrix of soil properties

It should be noted that samples for QST were taken at depths ranging from 2 to 7 cm, distinct from those collected for chemical properties (0-30 cm).

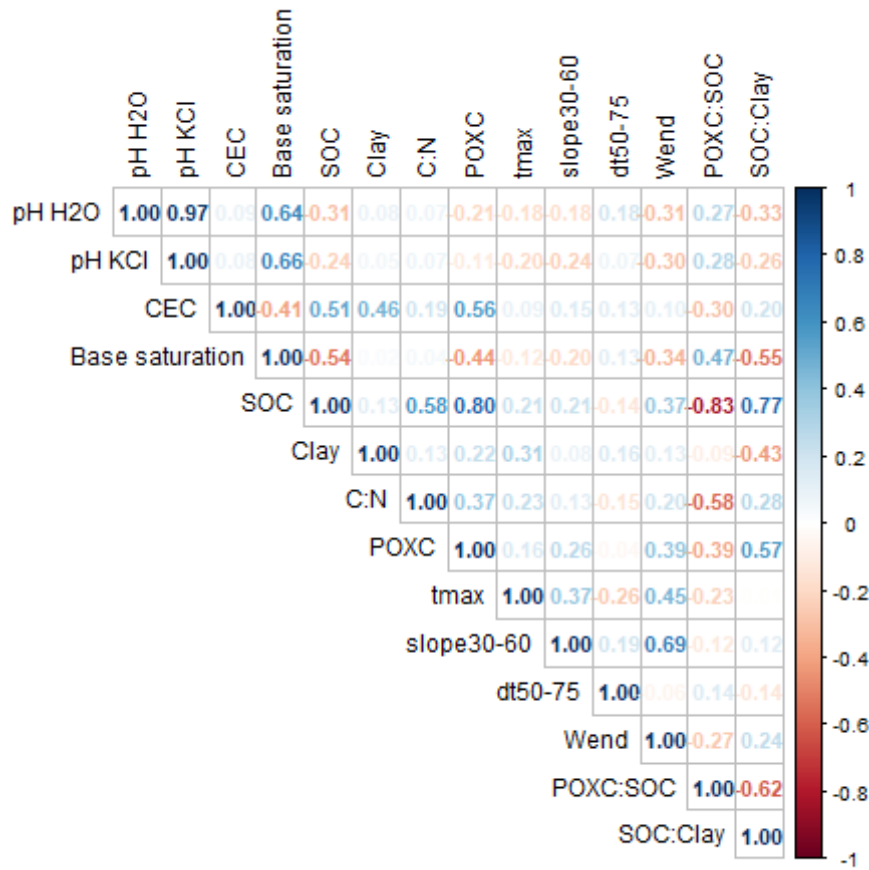
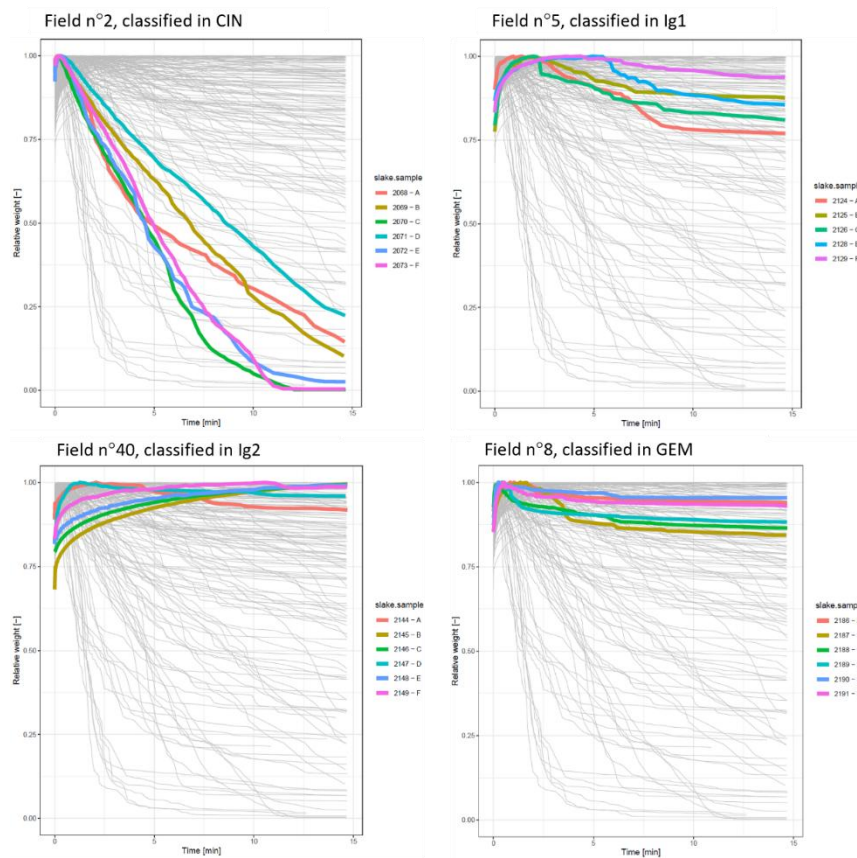


Figure S 2 Correlation matrix of soil properties

### S5. QST curves of four CA fields, representative of their respective CA-type.

Curves are designed by Vanwindekens and Hardy (2023). Figure S 3 shows the QST curves of four different fields. Some soil samples were completely degraded (e.g. field 2), while others have practically remained intact after immersion (e.g. field 40).



**Figure S 3 QST curves of four Conservation Agriculture fields, representative of their respective CA-type**