1. About data set

Title: Dataset supporting the thesis “Belowground carbon sequestration potential of apple trees”.

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Organisations: 1. University of Reading and 2. NIAB East Malling

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Description: This data set supports the investigation into belowground carbon sequestration potential of apple trees. Each of the five experiments had their own specific aims in determining the positive or negative effects on the amount of belowground carbon that could be stored over the life span of orchards. This included the planning, growing and end of orchard life stages. The five factors that were investigated were: 1) rootstock variety, 2) scion variety, 3) increasing atmospheric temperature, 4) orchard age, 5) stored soil C post-grubbing. The raw data has been provided for each experiment on Excel spreadsheets with additional documentation for the DNA results for ITs and 16s (soil fungi and bacteria) linked to differences under rootstock varieties.

The data was collected from soil samples in either pot/rhizotron, in glasshouse or polytunnels, or from three field-based experiments of longer-term plantations. The soil samples from the glasshouse or polytunnel experiments were hand collected as the trees were being removed from the containers, they were grown in. The samples were then placed into labelled bags before lab analysis was conducted. The field-based studies used hand cores to collect samples 30cm from the tree’s trunk and 30cm deep into the soil from the surface, and again placed in labelled bags, stored at 5oC before lab analysis was conducted. Further information on the laboratory analysis methods used to collect the raw data and how the soil and biomass samples were collected can be found in the associated chapters in the thesis that this data set supports.

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1. Terms of Use.

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1. Project and Funding.

Title: Belowground Carbon sequestration potential under apple trees. PhD project

Dates: October 2019- March 2024

Funding organisations: NIAB East Malling, University of Reading, Collaborative Training Partnership (CTP\_FCR), AHBD, BBSRC, Berry Gardens Growers, Marks and Spencer, Worldwide fruits, National Association of Cider Makers, Worshipful Company of Fruiterers and Mid Kent Growers.

Grant Number: CTP PhD studentship (CTP\_FCR\_2019\_5, BB/T508986/1).

1. Contents:

The file of master sheets contains the raw data for five experiments presented on the excel spread sheets as calculated from the various laboratory experiments carried out as explained within the thesis. Blank cells represent data that was not collected, due to time and cost restrictions (so subsets were analysed not full data sets). Some samples went missing and so testing was not able to be completed.

The five experiments were:

1, The impact of commercial apple rootstocks on belowground C sequestration (Chapter 2 of thesis). Raw DNA data is also included in this section including excel spread sheets and others as well as an excel spreadsheet for the coding of these samples that were analysed by LGC Genomics Germany for ITs and 16s (soil fungi and bacteria). DNA data was divided into two soil regions rootzone (RZ - samples collected from 1cm around the roots) and rhizosphere soil (RS - soil samples brushed directly off the roots). All trees planted in Rhizotrons and had daily fertigation.

Variables within the data: -

* Commercial rootstocks used- smallest M9 used in the desert apple industry, and two intermediate growth M106 and MM106 more used in the cider industry. There were also four filled Rhizotrons which were not planted.
* Soil sampling regions in the soil Bulk (areas with no roots), rootzone (1 cm around the roots) used for all carbon assessments, and rhizosphere soil (directly of the roots and only for DNA).
* Four collection points of soil and biomass, one prior to planting in May, one six weeks later in June 2020, one 13 weeks (mid-August), and the final harvest at the end of September 2020.

*File name - soil\_C\_different\_rootstock\_sizes.xlsx*

2, Scion mediated effects on belowground carbon sequestration (Chapter 3).

Variables within the data: -

* Mix of rhizotron and pot grown trees (planters had different volumes of soil). Rhizotrons grown trees only grew for six months before being harvested first and were in glasshouse and had daily fertigation. Pot grown trees were kept in polytunnels, no daily fertigation, one foliar feed in July of the second season (2022). Harvest of pots divided between two time points 12 months and eighteen months post-harvest.
* Five different scions grafted onto M9 Rootstock. Three desert apple Gala, Cox’s Orange Pippin (COP), and Braeburn and two cider scions Dabinett and Michelin. Total number of each scion collected per harvest was six (some scions had been reduced see thesis for information).
* Four soil collections points (Prior to planting March 2021, Harvest 1 at six months (rhizotron grown trees) in September 2021, harvest two at twelve months (first set of pot grown trees approx. 30 trees) March 2022 and the final harvest at eighteen months (final set of pot grown trees) September 2022.
* Two soil regions were collected at each the first two harvest points, bulk soil where roots were not present and rootzone soil (1 cm round the root) and at the final soil collection in September 2022 only rootzone soil was available as the roots had become pot bound.
* Biomass of both above and belowground of trees collected at the threes harvest post planting (September 2021, March 2022 and September 2022).

*File name – soil\_C\_under\_different\_scions.xlsx*

3, Incremental increases in ambient temperature effects on belowground carbon sequestration of apple trees (Chapter 4).

Variables within the data: -

* Eight scions under which soil samples were collected.
* Atmospheric temperatures of the three tunnels – ambient, approximately over the year of +2oC and +4oC.
* Seasonal soil collections March, June, September and December 2021.
* Microbial biomass data only collected on a subset of data and only at the March and September soil collection points (harvests).

*File name – soil\_C\_increasing\_atmospheric\_temperature.xlsx*

4, Soil carbon content across different age of trees in cider orchards (Chapter 5).

Variables within the data: -

* Age of the orchards being sampled.
* Locations within Somerset (across three farms).
* Scions being grown (three Dabinett, Somerset Red streak and Tremlett’s bitter).
* Rootstocks of the trees (five different scions the intermediate growth habits).
* Youngest orchards had soil improvements added around the time of planting.

*File name – soil\_C\_under\_ageing\_orchards.xlsx*

5, The fate of stored soil carbon following grubbing of an apple orchard (Chapter 6).

Variables within the data: -

* Two different scions grafted onto M9 rootstocks, and the grass alleyways
* Soil collection points over and eight-month period across 2022 from January to September.

*File name – soil\_C\_following\_grubbing.xlsx*

1. Methods:

The methods used to collect the raw data and methods of analysis; programmes used are described in the thesis of the same name in experimental chapters 2-6.

Permissions have been acquired from landowners for the collection of samples for experiments and for the publishing of data collected, as well as from the companies who ran lab analysis, LGC genomics Germany, NRM (Carwood) Reading UK, and Forest Research UK, who stated that the data sets were my property, as well as NIAB East Malling where the PhD work was carried out.