Morrow Plots Data Codebook

V01

This codebook contains information about the sources and methods used by the Morrow Plots Data Curation Working Group to compile longitudinal planting, treatment and yield data for the Morrow Plots experiment, and should accompany the data files.

Sharing and Access Information

 The Working Group suggests as a citation:

Morrow Plots Data Curation Working Group (2022): Morrow Plots Treatment and Yield Data. University of Illinois at Urbana-Champaign. https://doi.org/10.13012/B2IDB-7865141_V1

Background

The Morrow Plots at the University of Illinois at Urbana-Champaign (UIUC) are the longest-running continuous agricultural fields in the Americas. In 1876, ten half-acre plots were established to test the impact of crop rotation and fertilization on corn. In 1895, an astronomical observatory was built on plots 1 and 2, and plots 6-10 were eliminated from the experiment in 1903, leaving plots 3, 4 and 5. Over time, as new variables were added to the experiment, each of these three plots were divided into eight subplots.

The Morrow Plots Data Curation Working Group was established in 2018. Comprising agriculture and life sciences librarians, data management and curation specialists, an IT professional, and a science archivist, the working group seeks to identify archival records in digital and analog formats and aggregate, curate, and preserve the data in a usable and accessible format that can be broadly shared.

The dataset compiled by the Working Group includes planting, treatment and yield data recorded for the three enduring plots (3, 4 and 5) starting in 1888. Not all variables were recorded for all years of the experiment. Missing values are represented with NA.

For more in-depth information about the history of the experiment, please consult the sources listed in the Zotero library compiled by the Working Group.

Data Sources

Much of the compiled data comes from the yield tables and Excel tracker listed in the table below. The yield tables record the crop planted, treatment strategy employed, and annual yield for plots 3, 4 and 5 from 1888 to 1954. The Excel tracker provided by the Crop Sciences Department Farm Managers, picks up where the yield tables leave off and covers 1955 to 2021. The yield tables are spartan summaries formatted for print in the Century of Learning report, whereas the tracker is a much more detailed internal record that also includes planting dates, crop variety and treatment amounts, as well as various notes. The Notebook does not include yield data, but provides planting dates and variety names. Although the earliest records in the Notebook date back to 1876, we only extracted data for 1888 and afterward since that is the earliest year for which we have yield data.

The datasets were cleaned, standardized, and converted to Tidy format[1] using Excel and RStudio. Source files, code and detailed notes about the process are stored in a GitHub repository. Questions about the data can be directed to the Working Group at morrow_plots_data_curation@aces.illinois.edu.

This dataset was cross-referenced with the soil sample archive maintained by the Soils Lab led by Dr. Andrew Margenot. Those plots and years for which there is at least one soil sample are flagged as TRUE in the soil_sample field. The archive includes preserved soil samples dating as far back as 1904. Only a small amount remains from the earliest samples, in some cases just a few grams. More substantial quantities remain from the deep cores collected in 1913, 1923, 1933, 1997, and 2021. Shallower surface samples were taken regularly in the years spanning 1967-1997. During this time, the synthetically fertilized plots required soil testing to maintain adequate phosphorus (P) and potassium (K) levels and sampling was more consistent. Infrequent surface soil testing has continued since 1997, with the most recent additions to the archive being contributed in 2021. A handful of reference samples, collected from the grass border surrounding the plots, are also included in the archive. At the time of this publication, the Soils Lab is in the process of curating the soil inventory data so it can eventually be made available online.

The dataset will be updated as new yield data becomes available.

Data Source Files

Years	Resource	Source	Data File
1876-1913	Notebook	Archives	Morrow_notebook_1876-1913.csv
1888-1954	Yield Tables	Century of Learning report	1888-1954 Morrow Plot Crop Yields.xls
1955-2021	Excel Tracker	Allen Parrish	1955-2021_Plot_Info_By_Plot 12-3-2021.xls
1904-2021	Soil Inventory	Soils Lab	Morrow Plots Inventory Data.xlsx

[1] Wickham, H. (2014). Tidy Data. Journal of Statistical Software, 59, 1–23. https://doi.org/10.18637/jss.v059.i10

Plot Divisions

As new variables were added to the experiment, the plots were subdivided in a series of phases. In Phase I (1876-1903) the field was divided into three plots. In Phase II (1904-1954), each plot was divided in four. In Phase III (1955-1966), they were further divided into eight, which persist into present day. For more information on plot divisions and phases, please see Aref and Wander (1997).[2]

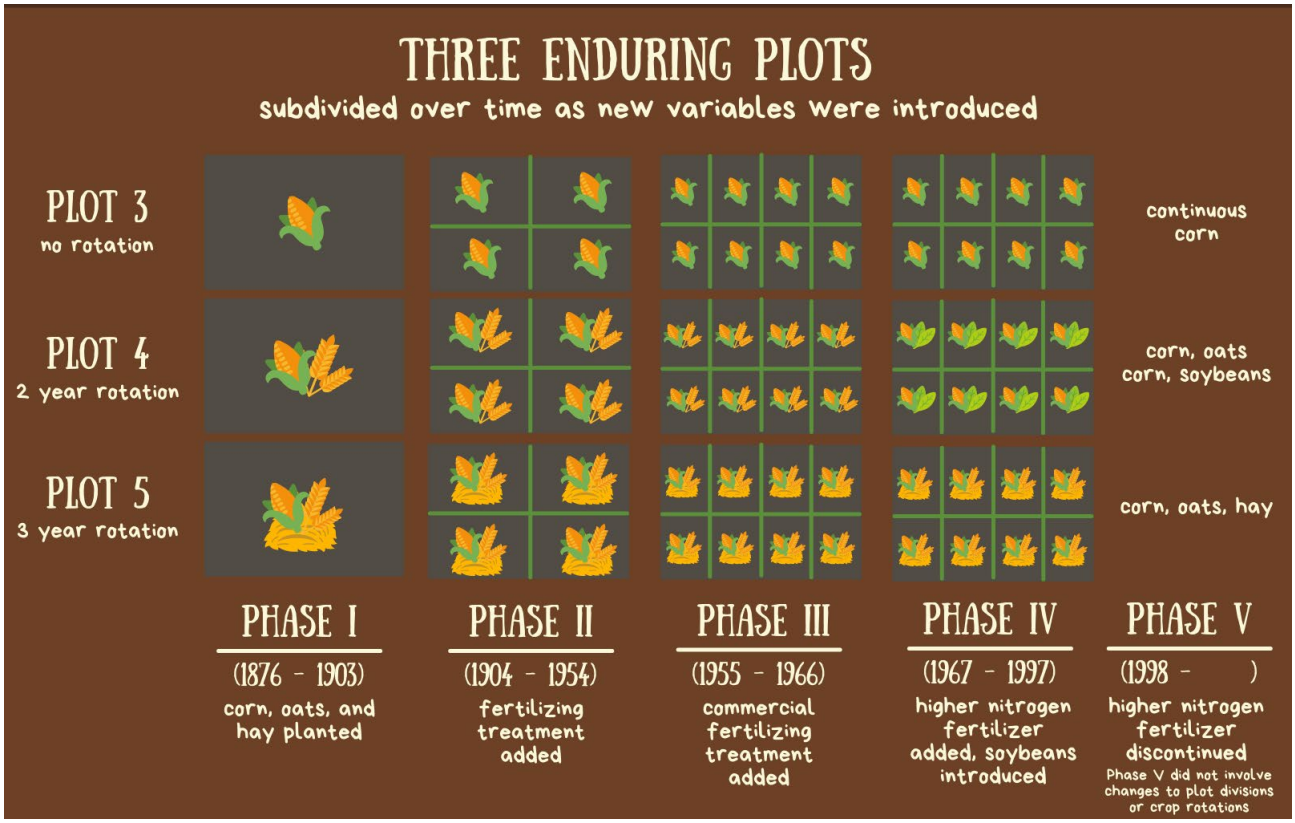


Figure 1. Illustration of plot divisions over time from the Morrow Plots Infographic.

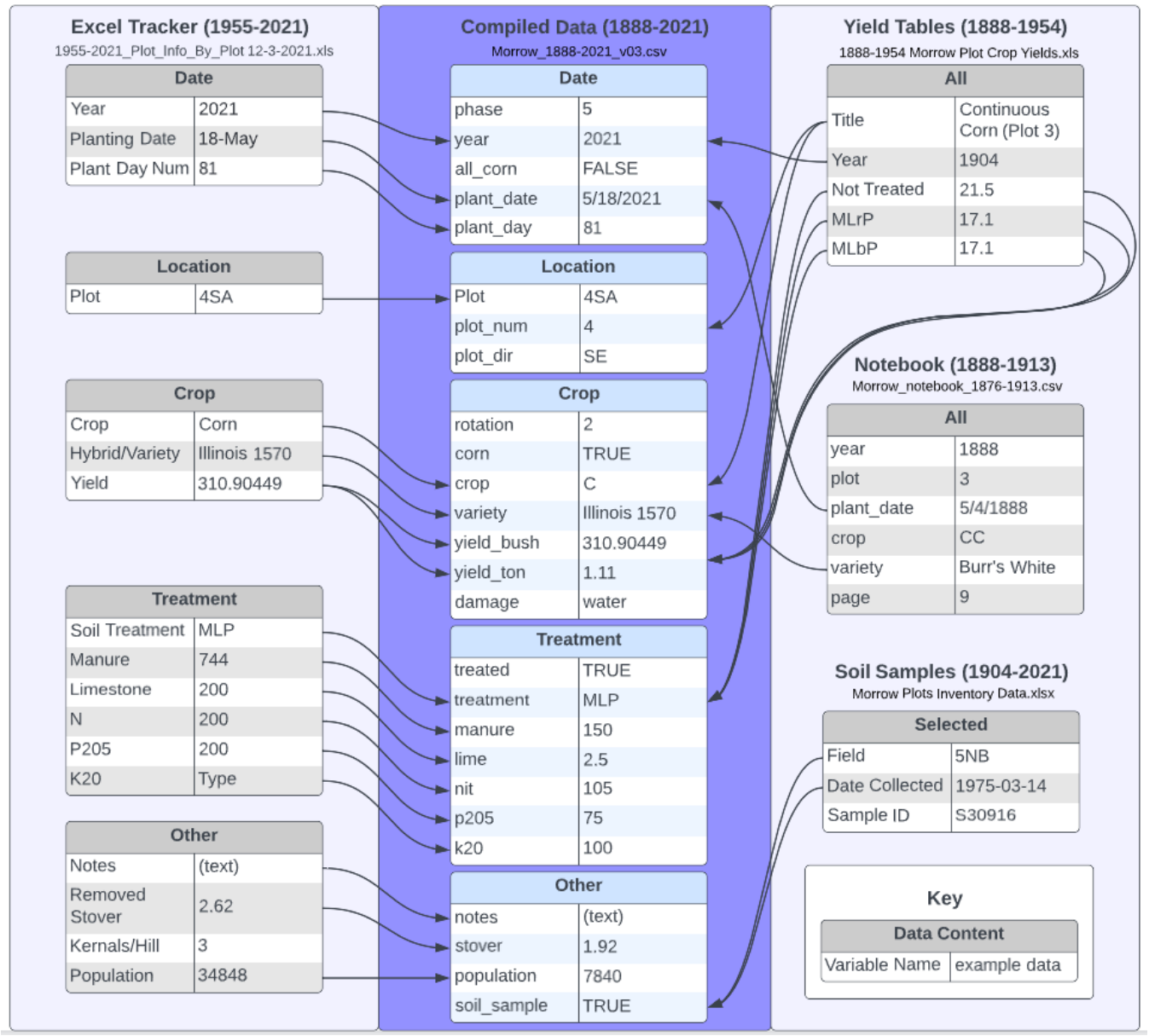
To allow comparisons across all phases of the experiment, we imposed the eight-subplot structure on data from Phases I and II. Since yield and treatment amounts were recorded as rates per acre, and not as totals, the amounts recorded in the data remain unchanged. As a result, rows for 1888-1954 have nearly identical values, varying only in the plot and plot_dir variables. For example, 1888 data for plot 3 that originally occupied one row in the table became eight rows, one for each of the eight eventual subplots, all with identical treatment and yield amounts.

Data Migration

The map below visualizes how the various data sources were combined to create the compiled dataset. The center column represents the compiled data, and the columns on either side represent the specific fields pulled from each source. Fields have been grouped by topic to make the map easier to understand. Those groupings are not represented in the data files themselves.

[2] Aref, S., & Wander, M. M. (1997). Long-Term Trends of Corn Yield and Soil Organic Matter in Different Crop Sequences and Soil Fertility Treatments on the Morrow Plots. Advances in Agronomy. https://doi.org/10.1016/S0065-2113(08)60568-4

Morrow Plots Data Migration Map



Data Dictionary

Variable	Description	Data Type	Prescribed Values/ Format	Unit of Measurement	Sample Data
phase	important stages of the experiment when plot size, crop rotation or treatments changed	integer	1-5	-	3
year	year planted and harvested	date	YYYY	-	1955
plot	label indicating plot number, North/South location, and A/B/C/D subplot (see Data Sources section above for an important note about plot names)	string	3NA; 3NB; 3NC; 3ND; 3SA; 3SB; 3SC; 3SD; 4NA; 4NB; 4NC; 4ND; 4SA; 4SB; 4SC; 4SD; 5NA; 5NB; 5NC; 5ND; 5SA; 5SB; 5SC; 5SD	-	4SD
plot_num	plot number only	integer	3-5	-	4
plot_dir	N/S and E/W location	string	NE; NW; SE; SW	-	SE
rotation	number of years in the crop rotation schedule for this plot	integer	1-3	-	2
corn	flag making it easy to group corn in rotation and continuous corn	T/F	TRUE; FALSE	-	TRUE
crop	crop planted this year with separate values for corn in rotation (C) and continuous corn (CC)	string	A [alfalfa]; C [corn]; CC [continuous corn]; H [hay]; O [oats]; S [soybeans]	-	C
variety	crop variety name	free text	-	-	Illinois 1570
all_corn	whether this was a year when corn was planted in all plots	T/F	TRUE; FALSE	-	TRUE
yield_bush	yield for all crops except hay	integer	-	bushels/acre	95.6
yield_ton	yield for hay	integer	-	tons/acre	3.48
treated	whether this plot was treated that year	T/F	TRUE; FALSE	-	TRUE

Variable	Description	Data Type	Prescribed Values/ Format	Unit of Measurement	Sample Data
treatment	the treatment plan for this plot	string	none; MLrP; MLbP; 0LNsPK; MLrPNsPK; LNPK; LHNPK; MLP	-	MLbP
manure	the specific amount of manure applied to this plot this year	integer	-	lbs/acre	600
lime	the specific amount of lime applied to this plot this year	integer	-	tons/acre	2
nit	the specific amount of nitrogen applied to this plot this year	integer	-	lbs/acre	200
p205	the specific amount of phosphorus (on an oxide basis) applied to this plot this year	integer	-	lbs/acre	200
k20	the specific amount of potassium (on an oxide basis) applied to this plot this year	integer	-	lbs/acre	200
stover	amount of stover or straw removed	integer	-	tons/acre	2.62
population	number of plants based on counts from hand harvesting	integer	-	plants/acre	28,000
plant_date	date crop was planted	date	MM/DD/YYYY	-	5/19/1955
plant_day	nth day in the year	integer	-	-	139
soil_sample	whether there is at least one soil sample for this plot and year	T/F	TRUE; FALSE	-	TRUE
damage	known sources of significant damage to crops that year	free text	-	-	Destroyed by animals too thin to harvest
notes	any notes that do not fit in other fields	free text	-	-	Manure Application: Liquid Dairy manure applied at 10,067 gal/acre: 192 lbs of P205 applied

Treatment Codes	
H	High potency treatment
K	Potassium (oxide)
L	Limestone
M	Manure
N	Nitrogen
P	Phosphorus (oxide)
bP	Bonemeal phosphate
rP	Rock phosphate
sP	Superphosphate

Treatment Data

Please note that nutrient-specific inputs (N, P and K) in manure treatments are imprecise due to lack of measured nutrient and water content of the manure.

Yield Data

On rare occasions, yield totals may be significantly lower than expected or missing entirely due to damage from various causes (e.g. squirrels or other animals eating crops before they can be harvested). These instances are flagged by a text entry in the damage variable noting the cause if known.