

Field Book Documentation v5

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2025-02-12

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Field Book Documentation



Field Book

Introduction

Field Book is an open-source Android app that can be used to collect data on field research plots. When used in place of paper field books, it eliminates the need for data transcription and reduces the risk of errors. It runs on a wide range of inexpensive hardware, allowing consumer-grade technology to be used in environments where cost and inflexibility have been limiting factors. The source code for Field Book is available on [GitHub](#).

Getting Started

Field Book can be downloaded from the [Google Play Store](#) or can be installed manually from the latest [GitHub Release](#). After installing the app, all permissions should be accepted and sample data consisting of three fields and traits can be optionally loaded. The images in the documentation utilize the sample data.

Structure

Primary Field Book screen

Field Book contains a home screen with links to the major sections of the app. To use Field Book:

1. Import your [Fields](#)
2. Create [Traits](#)
3. Optionally modify any [Settings](#)
4. Navigate to [Collect](#)
5. [Export](#) data to a CSV (comma separated value) file

The Changelog can be accessed from the top toolbar to see new features and additions to the app.

Storage

Storage Location Definer

After installing and opening the app, you will be asked to create a new folder and define it as the **Storage location** on the device where files will be written. In Field Book this step is required. The selected **Storage location** can be changed in the [General Settings](#).

Storage location definer layout

Subdirectories

Fieldbook will create the following subdirectories within the selected **Storage location** directory:

- **field_import**: contains files to be imported into Field Book
- **field_export**: contains exported data files
- **plot_data**: data associated with plots (e.g., audio, photos)
- **resources**: allows the user to access photos/documents while collecting data (e.g., rating scales, field maps)
- **database**: contains automatic and manual database export files
- **trait**: contains trait files and the rust rating customizable scale
- **archive**: contains backups when exported fields are overwritten
- **geonav**: stores files created when using the geonav feature
- **updates**: stores .apk files downloaded for app updates

File transfer

To add your own files to the appropriate subdirectories you may need to manually transfer files from a computer. You can do this by connecting your Android device via a USB cable and changing its USB mode to allow file transfer. Each device manufacturer has slight variations for the appearance of this dialog.

Example settings for USB file transfer

Database

Field Book uses an internal SQLite database to store imported fields and traits, as well as all data collected with the app. The database schema is modelled after the Breeding API (BrAPI) standard, and is documented in the [Field Book Wiki](#)

The database is automatically backed up to the **database** directory at regular intervals. It can also be manually exported and imported in [Database Settings](#). This feature can be used to transfer data to a new device or for recreating issues when troubleshooting.

Fields

Overview

Experiments are represented in Field Book as **fields**. Fields are either imported from a file, from a BrAPI-enabled database, or created from scratch.

Each field has a unique name, an import date, and a set of **entries** which represent the experimental units on which data will be collected (e.g., plots, plants). Once data is collected and exported for a given field it will display the dates of last edit and export.

A sample field with a name, import/edit/export dates, and number of entries

When importing from a file, each row in the file represents an **entry**. Each entry within a field must have the following:

- A **unique identifier**, which is used internally by Field Book to associate data with the specific entry. It must be unique across all of your fields.
- A **primary identifier**, and a **secondary identifier**. These set the order of advancement through the field's entries, and can be whatever makes the most sense for your experiment. Most often they are numbers from the experimental design (e.g., row/plot, row/column, range/plot).

A sample field import file

Additional information such as variety name, pedigree, or treatments is optional, but can be included and viewed in the InfoBars or in the summary dialog on the collect screen.

The Fields screen layout with sample fields loaded

Field Book includes a set of sample field files. Samples `field_sample.csv`, `field_sample2.csv`, and `field_sample3.csv` represent typical wheat breeding fields, while `rtk_sample.csv` demonstrates the import format for entry location data (an additional `geo_coordinates` column). Imported entry coordinates can then be used with the [Geonav](#) feature.

Importing a new field

To import a new field into Field Book press the icon in the upper right-hand corner of the toolbar in the Fields section. Then, in the resulting dialog, select whether to import from a local file, from cloud storage (Dropbox, Google Drive, etc.), or via a [Brapi](#) connection.

A default import source can be set in [General Settings](#) to skip this dialog.

The Field import process

Selecting local will display a list of files in the `field_import` directory. Only `.csv`, `.xls`, or `.xlsx` files will appear in the import dialog. Filenames and column headers should exclude the following special characters:

Characters that are not allowed in file and column names

Files can be added to the import folder by downloading or transferring from a computer, as described in Storage.

Once a file has been selected, the dropdown menus allow selection of the column names that correspond to Field Book's required columns. Pressing **IMPORT** will finish importing the field.

Cloud storage

If you choose to import from cloud storage, Field Book will open the device file manager allowing navigation to the file for import.

Navigating to a google drive file for cloud import

Creating a field

The Field creation process

To create a new field directly within Field Book press the icon on the toolbar. Set your field name and dimensions, choose which corner of the field will contain the first plot, and select zigzag or serpentine plot numbering. Unique IDs will be generated automatically.

Managing fields

To activate a field for data collection, select it from the list of fields.

Each row in the fields list displays the Date imported, Date edited, Date exported, and Number of entries.

Field management sorting steps

Pressing the icon to the right of the trial info opens a list of options:

- **Sort** provides a dialog to update the plot ordering. Populate the sort menu by pressing the icon, and selecting from the list of imported columns. Once columns have been added, change their relative priority by using the icon to drag and reorder them. Press the icon to toggle the sort between ascending and descending. Press the icon to remove a column.
- **Sync** connects to the server specified in [Brapi settings](#), updating the trial with new data that has been added from other sources since the last sync or import. This option will not work for trials imported from a file.
- **Delete** removes the trial and all associated data. A confirmation message will be shown first, to confirm that deletion is not triggered accidentally.

Traits

Overview

Data is collected in Field Book by defining different traits. Each trait layout is optimized for a specific type of data collection. The traits screen allows new traits to be defined and existing traits to be managed.

The Traits screen layout with sample data loaded

Creating a Trait

Traits can be created by pressing the large icon at the bottom right of the screen, or the same icon in the toolbar. For each format, the creation screen adjusts to indicate which fields are required. Trait names must be unique. Each trait is created by specifying a trait **format**, a trait **name**, optional **details**, and format-dependent fields such as **min**, **max**, and **default**.

Trait creation for a Numeric trait, and other format options

Managing Traits

Once created, traits can be manipulated using the following features:

Single trait changes

- **Reorder** an individual trait by pressing and dragging the icon on the far left of its trait line.
- **Copy**, **Edit**, or **Delete** an individual trait by pressing the icon on its trait line, then selecting the desired operation from a list.
- Set an individual trait to be **Visible** or **Invisible** on the [Collect](#) screen by checking/unchecking the checkbox on each trait line.

Single trait management menu

All trait changes

- Make all traits **Visible** or **Invisible** by pressing the icon in the toolbar.
- Open the trait **Menu** using the icon on right side of the toolbar to access additional operations affecting all traits.
- Within the menu, select **Sort** to reorder all traits according to one of the sort criterion (options include trait Name, Format, or Visibility)
- Select **Delete all traits**, then confirm, to remove every trait in the list.
- Select **Import/Export** to load new traits into Field Book and/or to save the current traits to a file.

All traits mangement menu

Trait imports and exports are similar to field imports/exports in that they rely on files stored in a dedicated folder, or on communication with a designated server using a [Brapi](#) connection.

?> When using local storage, trait lists are stored as `.trt` files in the `trait` folder. Technically `.trt` files are just `.csv` files with the extension renamed; exported `.trt` files can be opened as `.csv` if desired. However it is not recommended to manually edit and reimport these files, trait edits are best done within the application.

Collect

Overview

Field Book aims to increase the rate at which data can be collected by tailoring the input screen to fit the exact task. Only a single entry and trait are visible at a time during collection. This reduces the risk of error and allows trait-specific layouts to be used for data input.

The small green arrows are used to navigate between traits. The large black arrows are used to navigate between entries. Data is entered in the bottom area of the screen using a layout determined by the current trait. Data is saved to an internal database as it is collected.

Data collection screen

Collect Screen Details

Top toolbar

By default there are four buttons at the top of the screen (in addition to the back navigation arrow).

- **Search** opens a dialog to search for a specific entry.

The collect screen search tool

The search dialog provides a flexible interface for finding a specific entry within the current field. Select which imported data field to search by, what strategy to use to find a match, and enter a search string. Press Add to construct a complex search with an additional field and search string, or press OK to execute the search.

- **Resources** opens the **resources** directory and can be used to load reference images.
- **Summary** opens a dialog that displays all info for the current entry.

The collect screen summary tool

Summary shows detailed information for the current entry. Arrows at the bottom navigate forwards or backwards to other entries. By default the summary shows all of the imported data fields from the field file, but none of the collected trait values. Pressing the edit icon in the top toolbar opens a dialog to customize which data fields and traits are shown. Selecting a trait from the summary screen navigates to that trait.

Customizing the summary display

Lock adds restrictions on data input to prevent accidental changes. Pressing the icon multiple times will cycle through three states: - **Unlocked** is the default, unfrozen state that allows trait values to be entered, edited, or deleted. - **Locked** freezes the collect input so no values can be entered, modified, or deleted. - **Limited** freezes existing data but allows entry of new values.

More tools can be added to the toolbar in the [General Settings](#). Default tools can be removed from the toolbar in [Appearance Settings](#).

InfoBars

The collect screen InfoBar section

InfoBars display information about the current plot. InfoBar prefixes can be pressed to adjust which data field is displayed.

Selecting which data field is shown in the InfoBars

Trait navigation

The collect screen trait navigation section

The small, green arrows are used to move between the different traits that are currently active. Pressing the current trait will show a dropdown of all currently active traits.

Pressing the active trait to see the trait dropdown

Entry navigation

The collect screen entry navigation section

The large, black arrows navigate between different entries. Pressing and holding these arrows will continuously scroll. The longer the arrows are pressed, the faster the scrolling becomes.

Data input

The bottom half of the screen is used to input data. The elements and layout of this area change based on the trait that is currently active. Information for each specific trait format can be found in the Trait Formats pages.

Bottom toolbar

The bottom toolbar contains three buttons for data input:

- enters data by scanning a barcode.
- enters NA for when a phenotype is not available.
- deletes the entered data.

Export

Overview

Collected data is exported to `.csv` files. The Export dialog allows the user to customize how collected data is exported.

Export dialog details

Options

File Format

At least one format must be selected to export data. If both formats are selected, Field Book exports a single zipped file containing the files.

Table format exports each entry as a row and each trait as a column, creating a matrix of observed values. Metadata such as person and timestamp are excluded. If repeated measures have been collected, only the first value will be exported when using the table format.

Sample data exported in both formats

Database format exports each individual observation as a spreadsheet row, and includes columns for collected metadata such as the name of the person who collected the data and the timestamp of when the observation was collected.

Included Columns

The exported file can include only the unique identifier or all field columns that were imported.

The exported file can contain traits that are currently active or all traits that have been created.

Save Details

The default filename is automatically generated based on the current date and the name of the field.

After clicking save, you will see Field Book app citation information and an option to share the exported file with other apps or email. The exported file is stored in the `field_export` directory.

Other Customizations

Bundle media data produces a zipped file that contains the exported data along with images and audio files that have also been collected.

Overwrite previous export moves old files to `archive` directory.

The default export location can be modified in [General Settings](#).

Numeric Trait

Overview

The numeric trait format is used for quantitative traits like yield and height. Value minimum and maximums help reduce errors during collection. Details text is displayed under the trait name on the collect page.

Creation

Numeric trait creation dialog

Collect layout

Numeric trait collection interface

Categorical Trait

Overview

The categorical trait format is used when trait values fall into a set of discrete categories. Categories are individually added in the **Categories** section of the create screen. Details text is displayed under the trait name on the collect page.

Defined categories are displayed as buttons on the collect screen; a single category can be selected per entry.

Creation

Categorical trait creation dialog

Collect layout

Categorical trait collection interface

Date Trait

Overview

The date trait format is used to record dates. Details text is displayed under the trait name on the collect page.

On the collect screen, the current date is displayed by default and can be incremented forwards or backwards in single day intervals. A calendar date picker allows selection of a specific date.

Creation

Date trait creation dialog

Collect layout

Date trait collection interface

Percent Trait

Overview

The percent trait format is used to collect percentage-based phenotypes. In addition to the required trait name the default value, minimum, and maximum values can be adjusted. Details text is displayed under the trait name on the collect page.

On the collect page, percent values are recorded by adjusting the percent slider.

Creation

Percent trait creation dialog

Collect layout

Percent trait collection interface

Boolean Trait

Overview

The Boolean trait format is used to record TRUE/FALSE values. It is created with a trait name, default value, and optional details. On the collect page you can toggle between TRUE and FALSE as needed. Details text is displayed under the trait name on the collect page.

Creation

Boolean trait creation dialog

Collect layout

Boolean trait collection interface

Text Trait

Overview

The text trait format is used to record open-ended text. It is created with a trait name, optional default value, and trait details.

On the collect screen, text can be typed or dictated using the system keyboard.

Creation

Text trait creation dialog

Collect layout

Text trait collection interface

Photo Trait

Overview

The photo trait format is used to capture images. It is created with a trait name and optional details.

On the collect page, the camera icon opens the device camera to capture images. Multiple photos can be captured for each entry.

Captured photos are stored in `.jpg` format, and named by using underscores to join the entry's `unique_id`, the trait name, the photo number, and a timestamp. The resulting files are stored in a picture directory within a field-specific subdirectory of `plot_data`. An example photo filepath would be `plot_data/FIELD_NAME/picture/PHOTO_FILE_NAME.jpg`.

Creation

Photo trait creation dialog

Collect layout

Photo trait collection interface

Audio Trait

Overview

The audio trait format is used to record audio. It is created with a trait name and optional details.

On the collect page, press the button to begin recording audio. Press the button to stop recording. Press the button to play back the audio that has been recorded.

Recorded audio files are stored in `.mp3` format, and named with the entry's `unique_id` and a timestamp. The resulting files are stored in an audio directory within a field-specific subdirectory of `plot_data`. An example audio filepath would be `plot_data/FIELD_NAME/audio/AUDIO_FILE_NAME.mp3`.

Creation

Audio trait creation dialog

Collect layout

Audio trait collection interface

Counter Trait

Overview

The counter trait format is used to count numeric integer data, starting from zero. It is created with a trait name and optional details.

On the collect screen, the counter starts at zero and can be incremented or decremented via the **+1** and **-1** buttons.

Creation

Counter trait creation dialog

Collect layout

Counter trait collection interface

Disease Trait

Overview

The disease trait format is used for collecting ratings of both disease incidence and severity. It is created with a trait name and optional details. The incidence scale can be adjusted by editing the `disease_severity.txt` file in the `traits` directory.

On the collect screen, buttons showing numbers between **0-100** in 5 digit increments are used to record incidence, and **R**, **M**, and **S** are used to record severity. For each measurement, only a single incidence can be recorded while severity types can be combined. The `/` button allows varying incidence rates to be recorded (e.g., heterogenous response within a plot).

Creation

Disease trait creation dialog

Collect layout

Disease trait collection interface

Multicat Trait

Overview

The categorical trait format is used when trait values fall into a set of discrete categories. Categories are individually added in the **Categories** section of the create screen. Categories within a multicat trait must be unique. Details text is displayed under the trait name on the collect screen.

Defined categories will be displayed as buttons on the collect screen. Multiple categories can be selected per entry.

Creation

Multicat trait creation dialog

Collect layout

Multicat trait collection interface

Location Trait

Overview

The location trait is used to record the GPS coordinates of the device. It is created with a trait name and optional details.

On the collect page, pressing the button will record the current latitude and longitude. If the device is connected to an external location source, the coordinates from this source will be used instead of the device's internal GPS.

Creation

Location trait creation dialog

Collect layout

Location trait collection interface

Zebra Label Print Trait

Overview

The Zebra Label print trait format is used to print labels from an external printer. The trait is designed to work with Zebra's [ZQ500 Series](#) of ruggedized, mobile printers. It is created with a trait name and optional details.

To use this trait, the Zebra printer must first be paired via Bluetooth. Label size, barcode, specific data, and number of copies are selected and are saved as defaults. Pressing the print button will print the desired number of labels, each containing a barcode and ID for the specific entry, along with any additional selected data.

Creation

Zebra Label Print trait creation dialog

Collect layout

Zebra Label Print trait collection interface

Troubleshooting

Issues with label printing are often caused by incompatible Zebra mobile printer configurations. To troubleshoot, install the [Zebra Printer Setup Utility](#) and try the following steps:

1. Download the latest firmware for the mobile printer model from the [Zebra support page](#), unzip it, and send the unzipped .zpl file to the printer using the **Available Files** option in the Zebra Printer Setup Utility.
2. With the firmware updated, ensure the media type settings in **Media Settings** is correct for the type of label being used (usually **MARK**).

If the above steps don't fix the problem, printing a configuration label using **Printer Actions** in the Zebra Printer Setup Utility can help with further troubleshooting.

GNSS Trait

Overview

The GNSS trait format is used to acquire high-accuracy GPS coordinates from an external, Bluetooth-connected device. While other traits only capture phenotypic or observational data, the GNSS trait is intended to be used to capture metadata about the plot itself. This metadata can be used in conjunction with the [Geonav](#) feature to automatically navigate through the field.

Creation

GNSS trait creation dialog

Collect layout

GNSS trait collection interface

Details

When first navigating to a GNSS trait, the collect screen will show a button that will show a list of devices that can be accessed to provide a location for this trait.

GNSS device select dialog

Once a device is selected the screen will populate with a series of values from the GNSS receiver output including high-accuracy latitude and longitude coordinates, current Coordinated Universal Time (UCT), the Horizontal Dilution of Precision (HDOP, a measure of the suitability of satellite positioning in the sky, ideally 1 or below), the number of available satellites, the altitude, and accuracy.

GNSS receiver output

Pressing will record an instantaneous GPS reading. Toggling the average option will record an average of incoming location data for 5s, 10s, or manually (whereby all manually collected location points are averaged to create a representative value).

GNSS average options

When recording data for an entry with existing coordinates, a warning message will be displayed to confirm that the existing coordinates will be updated.

GNSS update warning

If errors occur while collecting gnss data (e.g., socket cannot be established), users may have to manually disconnect/reconnect to the external device.

USB Camera Trait

Overview

The USB camera trait format is used to capture images with an external camera. It is created with a trait name and optional details.

On the collect screen, once a camera is connected via USB, it can be opened using . Once connected, press the icon to access it and capture images. Multiple photos can be captured for each entry.

Captured photos are stored in .jpg format, and named by using underscores to join the entry's `unique_id`, the trait name, the photo number, and a timestamp. The resulting files are stored in a `usb-camera` directory within a field-specific subdirectory of `plot_data`. An example photo filepath would be `plot_data/FIELD_NAME/usb-camera/PHOTO_FILE_NAME.jpg`.

Creation

USB Camera trait creation dialog

Collect layout

USB Camera trait collection interface

GoPro Trait

Overview

The GoPro trait format is used to capture images with an external, Bluetooth-connected GoPro camera. It is created with a trait name and optional details.

On the collect screen, once a GoPro is connected via Bluetooth, it can be opened using the button. Once connected, press the icon to access it and capture images. Multiple photos can be captured for each entry.

Captured photos are stored in .jpg format, and named by using underscores to join the entry's `unique_id`, the trait name, the photo number, and a timestamp. The resulting files are stored in a `gopro` directory within a field-specific subdirectory of `plot_data`. An example photo filepath would be `plot_data/FIELD_NAME/gopro/PHOTO_FILE_NAME.jpg`.

Creation

Gopro trait creation dialog

Collect layout

Gopro trait collection interface

Settings

Settings screen layout

Field Book settings are grouped into eight subcategories:

- [General Settings](#) allow modification of system defaults and optional collection tools
- [Profile Settings](#) set the identity of the person collecting data.
- [Appearance Settings](#) change language, app colors, icons, or layouts.
- [Behavior Settings](#) change default collecting and file sharing actions.
- [Geonav Settings](#) allow a positioning device to be paired and used for field navigation.
- [Sound Settings](#) toggle sound notifications for collection activities.
- [Brapi settings](#) connect to an external data source using the Breeding API (BrAPI).
- [Database settings](#) allow the database to be imported, exported, or reset.

The **Search Bar** at the top of the screen can be used to quickly find and navigate to a specific setting.

Searching for a specific setting

General Settings

General settings screen layout

System Defaults

Define storage location

Opens the Storage dialog to define or update the **Storage location** on the device.

Default import source

Set the default field and trait import source to one of the provided options so the app doesn't ask each time.

Default import options

Default export source

Sets the default export location to one of the provided options so the app doesn't ask each time.

Default export options

Optional Collect Tools

Next entry with no data

Adds a button to the Collect top toolbar that skips to the next entry without data.

Location collected

Set the method for collecting location while using Field Book. Can be at the level of the field, the plot, or the individual observation.

Location collect options

Move to entry via barcode

Adds a icon to the Collect top toolbar. When pressed, it opens the device camera to move to an entry by scanning a barcode. The barcode must match a unique ID within the active trial.

Datagrid

Adds a icon to the Collect top toolbar. When pressed, it displays a grid of all the recorded values for each entry and trait. See more details in the [Datagrid](#) section.

Move to unique identifier

Adds a icon to the Collect toolbar. When pressed, it opens a text entry dialog. Move to a specific entry by typing or scanning its unique id into the text field.

The move to unique identifier dialog

Profile Settings

Profile settings screen layout

Profile

Person

Sets the first and last name of the person operating Field Book. This information is stored with each collected measurement as metadata and is included in the database [Export](#) format.

Set person dialog

Reset Profile

Unsets the first and last name of the person operating Field Book.

Require Person

If enabled, prevents using Field Book unless Person is set. And adds a time between verification setting, which can be set to one of three intervals.

Choice of profile verification intervals

Crashlytics

Unique ID

Creates a unique ID for use in generating more specific crash logs. This helps the development team when troubleshooting and improving Field Book

Appearance Settings

Appearance settings screen layout

Application

Theme

Allows users to modify specific colors or the entire theme of Field Book.

Theme options within appearance settings

Language

Allows the user to change the Field Book language to one of 14 different options.

Language options

Tutorial

Adds a icon to the toolbar that enables the tutorial. The tutorial provides contextual information throughout the app.

Collect Screen

Customize toolbar icons

Allows the user to change which default toolbar buttons are displayed on the Collect screen.

Turn default toolbar options on/off

Number of Infobars

Allows the user to change the number of Infobars that are displayed on the Collect screen.

Choice of number of Infobars

Quick GoTo

Changes the read-only primary/secondary order on the Collect screen to edit texts that can search and move to specific entries.

Editable primary/secondary order

Behavior Settings

Behavior

Behavior settings screen layout

Cycling traits advances entry

When enabled, once all active traits have been cycled, the app automatically advances to the next entry.

Map volume keys to entry navigation

Allows volume keys to be used to move to next/previous entry. Note that this disables the volume buttons being able to change the device volume when Collect is open.

Return key signal

Allows the user to choose the behavior of the return key signal that can be included when scanning barcodes: next plot, next trait, or do nothing.

Choice of return key signal behavior

Disable left/right entry arrow

Disables the left, right, or both entry arrows unless data has been collected to ensure an entry isn't skipped during data collection.

Choice of direction disabled

Disable file sharing

Turns off the share dialog that opens by default when data is exported.

Use day of year

Changes the date trait format to record date values as numbers counting up from Jan 1, rather than traditional dates. For example 96 instead of 2023-04-06.

Skip entries across active trait

When advancing entries, skips either entries that already have data for the active trait, or entries that already have data for all traits.

Choice of skip behavior

Flip Flop Arrows

Switches the collect screen arrows so that the small green arrows advance entries and the large black arrows advance traits.

GeoNav Settings

GeoNav settings screen layout

Enable Geonav

Enables the device to move between entries based on GPS data. Requires entries to have GNSS data.

Search Method

The method used to match GPS location to entry. Defaults to the distance method.

GeoNav search method options

GeoNav Log

Turns on GeoNav logging to a logfile stored in `/storage/geonav/log.txt`

Update Interval

Changes the time between GeoNav location updates. Can be set to 1s (default), 5s, or 10s

GeoNav interval options

Pair Device

Opens Bluetooth interface to pair to an external GPS device

Sound Settings

Sound settings screen layout

Sounds

Primary order sound

Makes a sound when the primary order changes. Useful for knowing when to move to the next field row.

Entry navigation sound

Makes a sound when the entry changes on the Collect screen. Can alert to accidental entry advancement.

Cycle traits sound

Makes a sound when all the active traits have been cycled through. Useful for knowing when to move to the next entry.

Delete Observation Sound

Makes a sound when a recorded value is deleted in the Collect screen.

Speech

Text to Speech

Enables text to speech. When enabled, choose one of the five available languages. The device will read data as it is entered in the Collect screen.

Text to speech language options

BrAPI Settings

Configuration

BrAPI Configuration Settings

BrAPI Base URL

Set the server URL when importing via BrAPI.

BrAPI Base URL setting

Authorize BrAPI

Open the authorization page to login to the BrAPI server and allow Field Book to communicate with it.

BrAPI Version

Set the version of the BrAPI specification that will be used to communicate with the server. Defaults to V2.

BrAPI version setting

Page Size

Set the page size for BrAPI server responses. Defaults to 1000.

BrAPI page size setting

Chunk Size

Set the chunk size. Defaults to 500.

BrAPI chunk size setting

Server Timeout

Set the time limit in seconds to wait for a response from the server before timing out. Defaults to 2 minutes.

BrAPI server timeout setting

Advanced Auth Settings

BrAPI Advanced Auth Settings

OIDC Flow

BrAPI server authentication version. Defaults to OAuth2 Implicit Grant.

BrAPI OIDC flow setting

OIDC Discovery URL

The location of the OIDC discovery JSON document.

BrAPI OIDC url setting

BrAPI Variables**Value vs Label Display**

Sets desired field for display when using a categorical trait the comes from a BrAPI Variable.

BrAPI Value vs Label setting

Community Servers**Scan a server barcode**

Add a BrAPI server by scanning a URL barcode.

Advanced

Access servers from the BrAPI community.

BrAPI database whitelist

Database Settings

Database settings screen layout

Import database

Imports a database from an exported database file. This replaces the current data in the app.

Database import dialog

Export database

Exports the internal database. Contact the development team if you need data recovered or are having issues and send the file that is exported.

Database export dialog

Delete database

Wipes all data from the app.

Database delete confirmation

Beta Settings

Beta settings screen layout

Repeated Measures

Turns on repeated measures. When turned on, a green plus symbol appears next to the trait value entry box on the collect screen.

Collect screen value entry with repeated measurements enabled

When pressed it creates a new entry field for collecting an additional observation on the same plot for the same trait.

!> To export data that includes repeated measures make sure to chose the **Database** format or to use **BrAPI**. These formats allow repeated measures to be differentiated by timestamp. If exporting in **Table** format then only the latest measurement will be included.

Barcodes

To improve data entry, Field Book includes built-in barcode scanning features that use the device camera to collect data or move to a specific entry.

Most Android devices are also compatible with external barcode scanners that connect via USB or Bluetooth and act as a hardware keyboard. They can be used to directly capture data from barcodes into any input field that uses the device keyboard, including many traits.

Examples

Plant height

Barcoded height sticks can be used to rapidly capture plot height values. Attaching the Android device to the stick makes it possible to accurately capture height without having to hold both the height stick and the device.

Plant height measurement via barcoded height stick

Leaf length

Example leaf length collection via length barcodes

Leaf angle

Example leaf angle barcodes

Resources

The three types of barcodes described above are available for [download on GitHub](#) as printable files.

BrAPI (Breeding API)

Overview

BrAPI is an application programming interface for plant breeding. It allows Field Book to directly communicate with compatible databases to import fields and traits and export collected data. This eliminates the need to manually transfer files and enables Field Book to offer more sophisticated features including field and trait metadata and data syncing.

Setup

BrAPI can be set up in the [Brapi settings](#). To use BrAPI, set the base URL to the URL of a valid BrAPI server and authorize it. Once authorized, Field Book will be able to communicate with the server to import fields and traits and export data.

Example BrAPI URL authorization

Import fields

The BrAPI field import process

To import a field using BrAPI, press in the top toolbar, select BrAPI as the source, and press the **Load Fields** button

Field Book will import a list of possible fields (known as **studies** in the BrAPI standard) from the BrAPI Base URL set in the [Brapi settings](#).

Available fields can be filtered by program and trial using the menu options in the top toolbar. The list can be filtered by **Observation Level** using the dropdown below the server URL.

If the returned list of fields contains more than a single page, the **Next** button will advance to the next page. Once a field has been selected, the field structure can be previewed by pressing the **Preview Field** button

Previewed fields are imported by pressing the **Save** button.

!> Any field can be exported locally, but only fields that have been imported via BrAPI are able to export data via BrAPI. And only if that data is also collected using BrAPI-imported traits.

Import traits

Depending on the BrAPI server, fields may have linked traits that are imported with the field. Additional traits can be imported via BrAPI by selecting import from the Traits menu, then selecting BrAPI.

The BrAPI trait import process

Field Book will import a list of possible traits (known as `observationVariables` in the BrAPI standard) from the BrAPI Base URL set in the [Brapi settings](#).

Traits are selected and then imported by pressing the **Save Traits** button. Traits can be imported individually or in groups.

Field Book will report **Selected traits saved successfully**, and return to the traits screen with the imported traits selected.

Export data

Once data has been collected it can be exported via BrAPI by pressing **Export** and selecting BrAPI from the Export Data options.

Before the export is finalized, Field Book will display a summary of BrAPI Export statistics. These include a breakdown of the number of new vs synced(imported) vs edited observations, as well as skipped observations. The same statistics are displayed for images.

The BrAPI data export process

Pressing the **Export** button uploads the observations to the external BrAPI database.

Datagrid

Overview

DataGrid is accessed by pressing the icon in the toolbar. DataGrid displays a matrix of entries and traits in the active field. This view allows rapid identification of missing values. Pressing an individual cell moves the collect screen directly to the corresponding entry and trait.

The Datagrid tool, showing a grid of entries, traits, and collected values

Settings

The column used for the row header can be changed by pressing the icon in the toolbar.

Changing the row header from `plot_id` to `plot`

GeoNav

Overview

GeoNav is used to automatically navigate between entries in the field based on the location of a high precision GNSS device. This feature requires field entries to have high-precision location data collected via the [GNSS Trait](#) or included in the field import file. Imported coordinates must be in **Lat;Long** format in a single `geo_coordinates` column. Refer to the `rtk_sample.csv` file in the `field_import` directory as an example.

To use GeoNav, navigate to the [Geonav Settings](#) and enable GeoNav. Turn on Bluetooth, and pair your external receiver. Navigate to the Collect screen and look for a confirmation message that says **Rover communications established**

The GeoNav confirmation message

Once the rover is connected, Field Book will automatically display the nearest plot in the bottom toolbar. Press the icon on the right to jump to the plot.

The bottom toolbar showing the nearest plot for manual geonavigation

To enable automatic geonavigation, press the icon that appears on the right in the top toolbar. It will change to a icon indicating that automatic geonavigation is enabled. Field Book will automatically switch to the nearest entry as the device moves around the field, displaying the following message on each switch.

The automatic geonavigation notification

Example

GeoNav automatic navigation demonstration

Recommendations

This section provides the original hardware recommendations from when the Geonav feature was first developed in conjunction with the Breeding Insight OnRamp project. It also includes instructions for deploying the suggested devices to use the GeoNav feature in the field.

While not covered in the original recommendations, Emlid's new [Reach RX](#) device is also suitable for Geonav, and comes with a simplified setup process. Devices from other manufacturers should also work with the Geonav feature, as long as they broadcast using the NMEA protocol.

Supplies

- Survey tripod
- Survey post (optional depending on rover case)
- Tablet
- RTK Hardware (Base):

- [Emlid RS2](#)
- RTK Hardware (Rover)
 - [Emlid RS2](#) OR
 - [Emlid M2](#) + Antenna + cable + LoRa radio + microUSB cable + battery

Instructions (field use)

1. Turn on BASE and ROVER, wait for both to broadcast WIFI hotspots
2. In TABLET settings, join ROVER WIFI.
3. In Reach3 app, navigate to ROVER WIFI settings. Connect ROVER to BASE WIFI.
4. Go back to TABLET settings, now connect TABLET to BASE WIFI
5. In Reach3 app, connect to BASE. Navigate to Base Settings. Wait until the BASE collects enough data to report a “single” position in the left hand corner and click apply.
6. In Reach3 app, connect to ROVER. Navigate to BT settings and turn on ROVER BT. Turn off and on again if you’ve forgotten the BT password (currently it is 1111).
7. Go back to TABLET BT settings. Turn on TABLET BT. Select ROVER from list of available devices and input password when prompted.
8. Finally, navigate to FIELDBOOK. Start collecting data. When prompted for GNSS trait, select ROVER.

Emlid’s own documentation for the RS2 and M2 can be found here ([RS2 docs](#)) and here ([M2 docs](#))

Kits and Cases

Complete kits and matching 3D Cases for M2 hardware are available for purchase online:

- <https://e38surveysolutions.com/products/reach-m2-with-gnss-antenna>
- <https://cults3d.com/en/3d-model/tool/emlid-reach-m2-case-estuche-gnss-gps-rtk>

Training Resources

In addition to this documentation, we have created training materials that can be used to introduce Field Book to breeders and technicians. These materials are also useful for bringing existing users up-to-speed with new features. This [training presentation](#) introduces Field Book's core features and key settings with accompanying excercises.

The exercises in the the training slides are based on the `training_sample.csv` field file which is copied into the `field_import` directory on install and is imported as part training.

The training sample field in exercise 3

About

The About screen

The About screen provides helpful information about Field Book including the version number and changelog. It also includes an update tool to check the availability of newer versions.