

Digitalization of Plant Genetic Resources Management

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Introduction

Considering the need of digitalization and handling of huge data, a mobile based application technology for data collection named Field book is developed by Kansas State University, United States of America and International Maize and Wheat Improvement Centre (CIMMYT), Mexico. This mobile app can be used to collect any kind of field or lab data and reduces manpower and papers; increases accuracy and authenticity. Field book is an open-source Android app that is used to collect data on field which is very useful for the field functionaries for collection of geographical information, information with geo-tagged photos and audio records. By working with an open-source platform and inexpensive hardware, created an app that will replace paper field books and their associated transcription errors, and allow current technology to be used in environments where cost and inflexibility have been limiting factors. The simplicity of the Field book will allow adoption of the app without a steep learning curve. With low cost, accessible solutions, transformational capacity in electronic data collection and management will be essential to realizing a contemporary green revolution. This application can be used to collect field data on exploration/collection of germplasm and characterization of germplasm with appropriate customization of the application. The ICAR-Indian Institute of Millets Research (IIMR) has already customized this app to collect field data on characterization of millets genetic resources viz., Sorghum, Pearl millet, Finger millet, Foxtail millet, Barnyard millet, Little millet, Kodo millet and Proso millet. We have also customized the app for collecting passport data during the exploration.

Getting started and working structure of field book

Field book can be downloaded from *Google Play Store* on your mobile phones and tablets. Upon installation, the app will ask the user if they wish to load sample data and turn on the tutorial. The source code for Field book is available on GitHub. Once Field book has been installed and opened, it will create several folders in the devices memory.

Field export: exported data files are stored in this folder

Field import: this is the folder that Field book will look for new files

Plot data: data associated with plots (audio and photos) are organized into this folder based on the name of the imported file

Resources: this folder can hold pictures and files that can be helpful when out in the field and is accessible from the main data collection screen

Database: this folder contains files that are exported when backing up the database

Trait: this folder contains backed up trait files and the rust rating customizable scale

Settings

The settings menu is the main location for configuring Field book. The options in this menu are used to import files, load traits, change profile information, export data, change the language, and toggle different advanced settings. This menu will be the first thing that is seen when installing Field book. Data cannot be collected until both a field file has been loaded and traits have been created.

Creating Files

Field files can be created in MS-Excel with the information on the serial number, name of the genotype, pedigree of the genotype, location of DUS testing, replication, bed number etc., Field book can load both CSV and XLS files. Filenames and column headers should exclude the following characters: / ? < > \ * | ”

Field book import files should, at the least, include three columns: a unique ID, a primary order, and a secondary order. Each entry should be assigned a unique identifier. This unique ID is used internally to associate data with a specific entry and should be globally unique. The unique ID for the experiment on characterization of sorghum germplasm can be created viz., crop code (three letters), season (K for Kharif, LK for Late Kharif, R for Rabi and S for Summer) and year of characterization (two digit number). For example, the Sorghum-Kharif-2018 and First genotype can be read as SORK18001. When importing files, Field book will check to see if the unique ID is unique within the file being imported. In addition, two columns must be included as a basic navigation ordering. These are referred to as the Primary and Secondary Order. The user can select these columns based on how they traditionally walk through the field.

Traits

Twelve different data types can be taken using the trait file. They are numeric, categorical, date, percent, rust rating, text, boolean, multi-category, location, counter, photo and audio. Different trait formats utilize different layouts and features to streamline how the data is collected. Data is collected in field book by creating traits (Ex.) for sorghum characterization all 27 agro-morphological traits are created as SOR GERM file. The traits screen allows for the management of the current traits within Field Book and lets the user create new traits or modify existing traits.

Traits can be created by pressing the add trait button at the bottom of the screen. Each trait has a custom creation menu that indicates which fields are required. Traits cannot share the same name. Each trait has options to make data collection easier. The menu icon on each line allows each trait to be deleted, copied, or edited. The checkbox allows traits to be active or hidden on the main layout screen. Traits can be reordered by dragging and dropping the icon on the right of each trait line.

Lists of traits can be created and transferred between different devices using the Import/Export option on the toolbar. Trait lists are stored in the trait folder. Once a field file has been designed, it can be transferred to the Android device via apps like shareit, drop box or manually with a USB cable.

Exporting data

Collected data can be exported to CSV files. The export dialog allows the user to customize how collected data is exported. Two different formats can be selected viz., database or table. The export file can include only the unique identifier or all field columns that were imported. The export file can contain all traits currently active or all traits for which data has been collected. The filename is automatically generated based on the current date and the name of the file that was imported into the app.

Database

The database can be backed up and transferred between tablets. When exporting the database, two different files are exported: one containing the database, and one containing the user settings when the database was exported. To re-import the database, both files need to be present in the database folder.

Acknowledgements

1. **Trevor Rife**, Developer, Kansas State University
2. **Jesse Poland**, Project Lead, Kansas State University

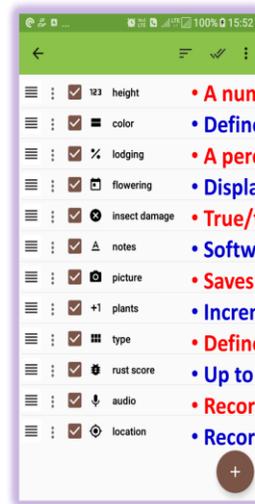
References

Rife, T. W., & Poland, J. A. (2014). Field book: an open-source application for field data collection on android. *Crop Science*, **54**: 1624-1627.

Field Book Manual, 2015. Volume 3.



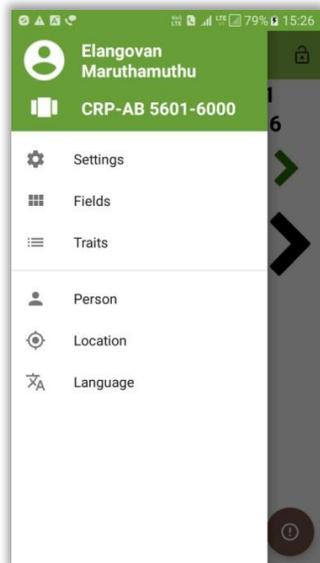
-  **Toolbars**
-  **Infobars**
-  **Trait navigation**
-  **Plot navigation**
-  **Data input**



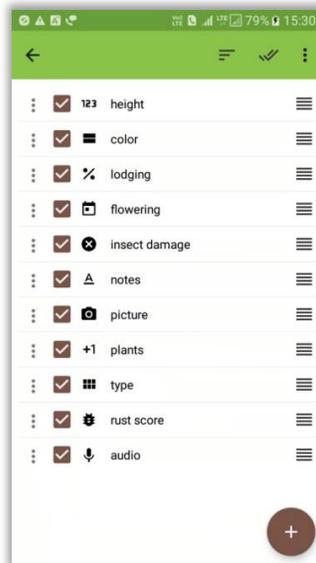
- A numeric keypad
- Define up to twelve buttons
- A percent scrollbar
- Displays the current date
- True/false button
- Software keyboard for input
- Saves a jpg file with the plot name
- Increments the current count value
- Defines more than twelve buttons
- Up to 21 different scale values
- Records an mp3 file
- Records the latitude and longitude

Different Sections of Field book

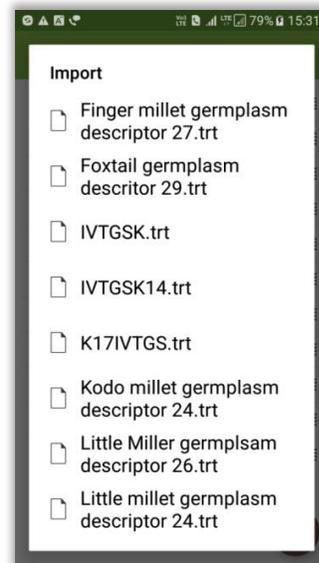
Different data formats for creation of trait fil



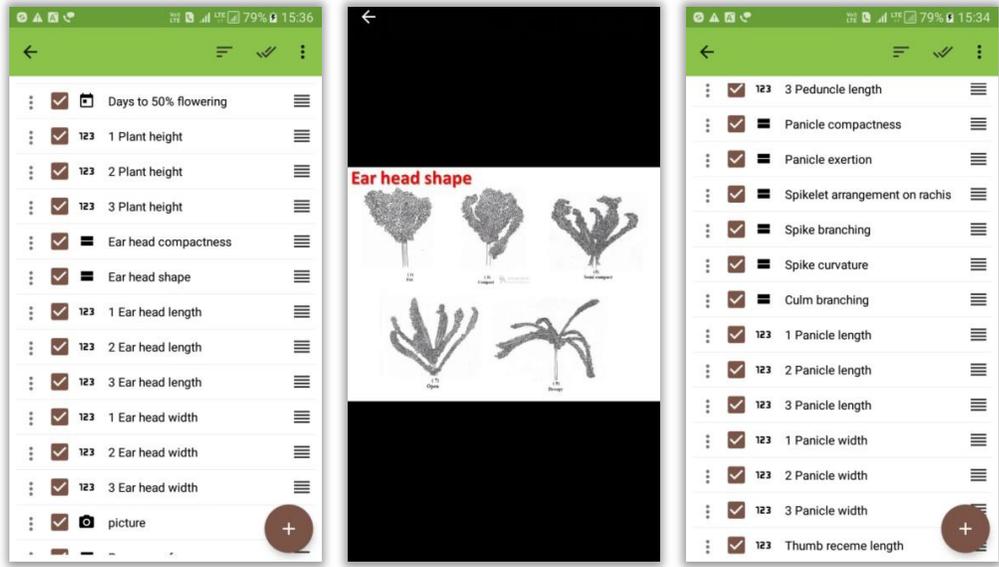
First page of Field book



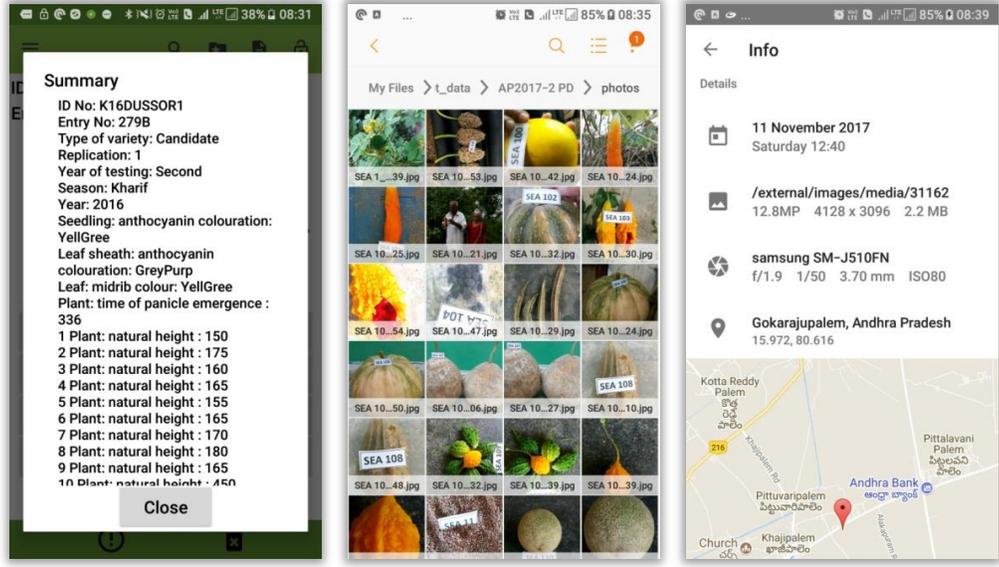
Sample trait file



Importing trait file



Sorghum germplasm trait file Finger millet ear head shape as resource file Finger millet germplasm trait file



Summary of data collection Auto-labelling of germplasm collection Geo-tagging of collected germplasm