



## Implementation of electronic data capture in EIAR sorghum breeding program

Amare Seyoum, Taye Tadesse, Habte Nida, Amare Nega, Adane G'Yohannes,  
Alemu Tirfessa, Michael Hassall, David Rodgers, Emma Mace, David Jordan





# Background

In 2012 the Bill and Melinda Gates Foundation funded the University of Queensland and IAR to improve the capacity of the sorghum breeding program in Ethiopia.

The project commenced with a benchmarking study which identified areas for improvement in the program, foremost among these was the need to increase the scale of the breeding program and improve the management of data generated by the program.

A number of data management technologies were identified and implemented in the breeding program.

This presentation will detail the process of implementing electronic field books and the impact on the program



# Talk structure

- Why use electronic field books?
- Requirements for implementing electronic field books
- Impact on the EIAR sorghum breeding program



# Why use electronic field books?

- Increased scale and efficiency
- Consistent format of data
- Store different types of data
- Enforce data standards
- Error reduction
- Improved sharing
- Backup

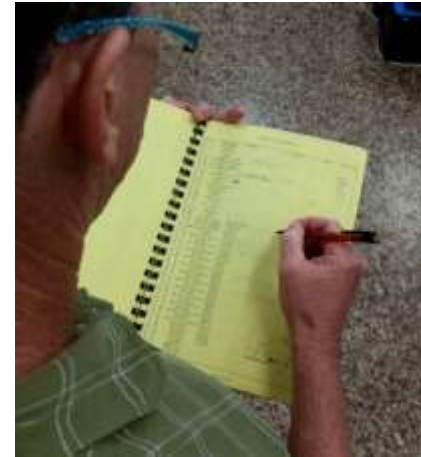




# Why use electronic field books?

Increased scale and efficiency

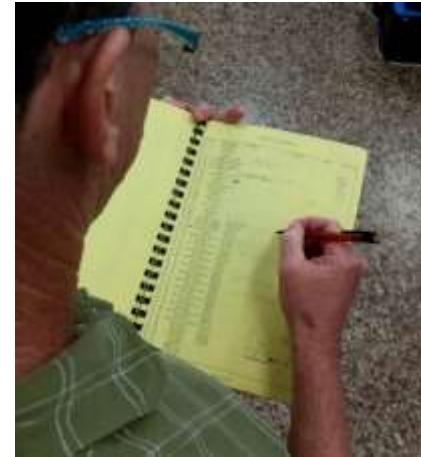
- Reduced time required to collect field data
  - eg flowering time automatically calculated from planting time
- No time required for data-entry after collection in the field (previously this took more than 1 month)





# Why use electronic field books?

- Consistent format of data
  - non-uniform scales, eg
    - height measured in meters vs centimetres
    - Yield measured in kg/ha vs tonnes/ha





# Why use electronic field books?

- Store different types of data
  - Qualitative data
    - Yes/No
    - Presence/Absence
    - Colours
  - Quantitative data
    - eg. Height





# Why use electronic field books?

- Enforce data standards
  - Consistent units for traits
  - Consistent maximum and minimum values for traits
  - Consistent names for traits
  - Consistent names for plots







# Why use electronic field books?

- Error reduction

Transcription errors, eg

- unreadable hand writing
- human error

Plot navigation aids





# Why use electronic field books?

- Improved sharing
  - Electronic sharing of files between stations
  - Merging of data collected by different field technicians at the same station (data collected is merged to a single database on a server computer and all electronic fieldbooks are updated with the latest version of the data)





# Why use electronic field books?

- Backup
  - Not reliant on a single copy of the field book





# Requirements for implementing electronic field books

- Choice of software application
- Standardisation of nomenclature (genotypes, trials, traits)
- Development of a standardised trait dictionary
- Data capture from external devices (eg digital scales and height stick)



# Choice of software application

There are a range of field-based electronic data capture applications available.

We chose the Fieldscorer application because it is:

- very user-friendly
- mature field scoring application (>10 years) with a large number of users (flexibility to work across multiple crops and users)
- time and date stamp of every data-point
- suitable for any android device including phones and tablets
- freely available via

<http://www.katmandoo.org/Help/Fieldscorer4Android/index.html>



# Standardisation of nomenclature

- Trial nomenclature

e.g. MS17SGP01

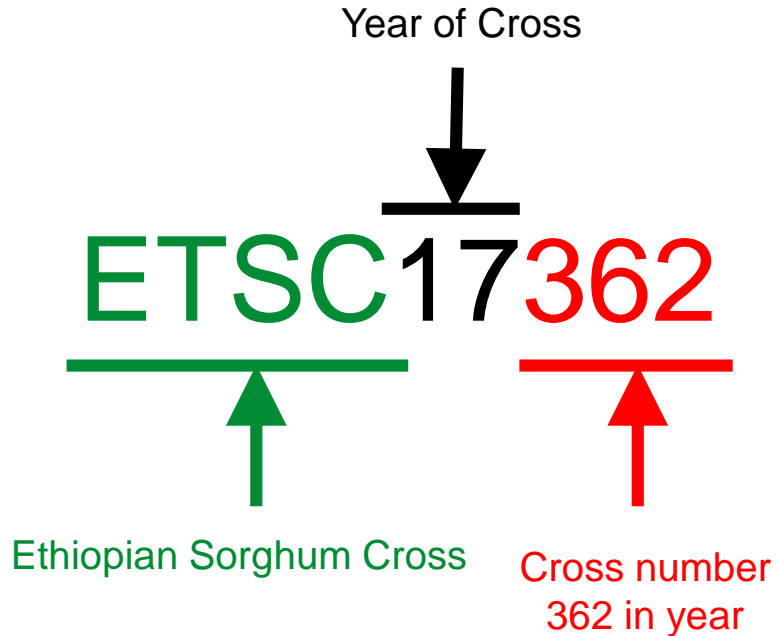
## Things to consider

- Short
- Informative
- Consistent length
- No gaps or special characters



# Standardisation of nomenclature

- Genotype nomenclature



Generation	Name
F1	F1_ETSC 15001
F2	F2_ETSC 15001-1
F3	F3_ETSC 15001-1-1
F4	F4_ETSC 15001-1-1-1
When fixed(Lines)	ETSC 15001-1-1-1
	ETSC 15001-1-1-2
	ETSC 15001-1-2-3
	ETSC 15001-1-2-4
	ETSC 15001-1-3-5
	ETSC 15001-1-3-6
	ETSC 15001-1-4-7
	ETSC 15001-1-4-8



# Development of a standardised trait dictionary

- Traits
  - HGT: Height between 150 and 400 inclusive
  - STG: Stay-green rating between 0 and 10 inclusive
  - DTF: Days to 50% Flowering
  - RST: Disease score between 1 and 9 inclusive
  - Yield: tonnes per hectare





# Data capture from external devices

Bluetooth barcode reader and scales automatically capture weights from harvest packets from field trials and nurseries and enters data into the relevant data fields in Fieldscorer





# Data capture from external devices

Bluetooth barcode reader and height stick with barcode measurements can be used to rapidly capture height data from the field

Conventional  
2 days x 2 people



Barcode heights with  
electronic field book  
 $\frac{3}{4}$  day x 1 person





# Impact

- All of the sorghum field stations across Ethiopia (10+) now use Fieldscorer routinely
- Data points collected by the program have increased more than 10-fold due to changes in the scale of the program associated with modernization.
- Despite this increase:
  - data available for analysis within weeks rather than months
  - data errors have been greatly reduced
  - Data sharing has been significantly enhanced

<b>Year</b>	<b>Level of implementation</b>
2013	Testing
2014	>13K data-points from Melkassa
2015	>400K data-points from 6 locations
2016	>400K data points from 6 locations
2017	>500K data points from 10 locations



# Conclusion

- Overall the efficiencies generated by electronic data capture in combination with additional technological mechanization and new statistical methods, has enabled the sorghum breeding program to increase population sizes and data collected more than 10-fold.
- It is anticipated that these changes should result in large increases in genetic gain and better sorghum varieties for Ethiopian farmers.



# Acknowledgements

## EIAR (Crop directorate)

Taye Tadesse

Habte Nida

Amare Seyoum

Alemu Tirfessa

Amare Nega

Adane Gebreyohanes

Sewmehon Siraw

Tamirat Bejiga

Kidanemariam Wagaw

Tokuma Legesse

Moges Mokenen



Working together with the  
Queensland Government



Queensland  
Government

BILL & MELINDA  
GATES *foundation*



Australian Government

Australian Centre for  
International Agricultural Research

## UQ Team

David Jordan

Emma Mace

Michael Hassall

David Rodgers