Functional trait diversity and drought tolerance of enset - a key food security crop in Ethiopia

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Background

Enset (*Ensete ventricosum* (Welw.) Cheesman), or false banana, is a tall herbaceous perennial crop cultivated as part of a diverse agrisystem in the densely populated Ethiopian highlands, where it provides food security to over 20 million people.

Known as the 'tree against hunger', enset requires little labour, has high yield, can be harvested in any season, and its fermented food products can be stored for years[1]. In addition, enset has numerous uses, such as medicine, fibre, shelter, mulch and animal feed.

For a vegetatively-propagated crop, enset has surprisingly high genetic and phenotypic diversity[2]. Some landraces are purported to be drought tolerant, a valuable trait in a country that is vulnerable to high climatic variability and periodic famines[3]. However, the degree and means by which enset tolerates drought remains to be studied.

Left: the diverse enset agrisystem grown on smallholder farms (photo R. Chase). Right: the enset food products can be left in fermentation pits for years and taken out when needed (photo G. Blomme).

Study Area

Although wild *E. ventricosum* occurs in other East African countries, domesticated enset is only grown in the temperate highland ecozone of southwest Ethiopia (Fig 1), where it is by far the crop with the highest production[4].

Over the last 30 years, the region's climate has been characterized by increasing temperatures and spatial and temporal variability in the short *Belg* rainfall season, resulting in the more frequent occurrence of drought[5,6].

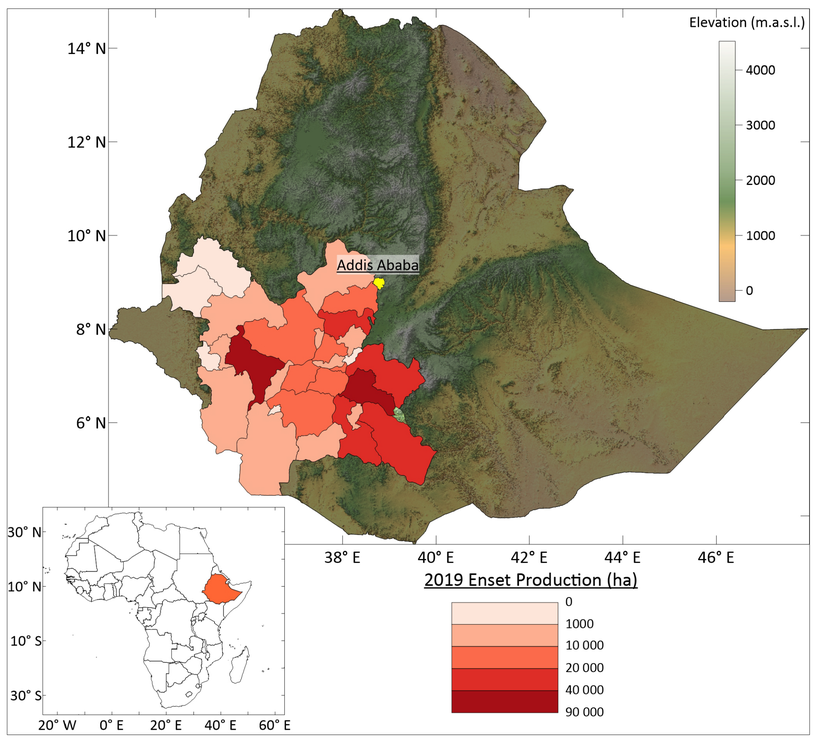
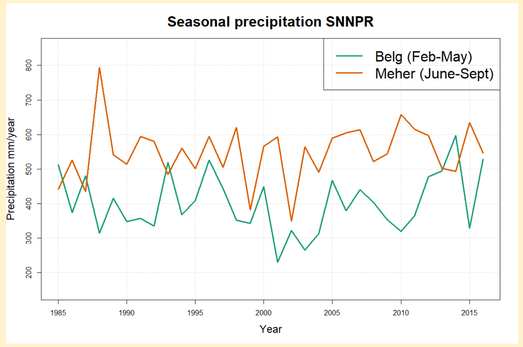


Figure 1. Enset-growing region of southwest Ethiopia, where production of enset is highest (up to 90k hectares in 2019 in the dark red zones)[4].

Methods

The project includes the following approaches studying data across a range of scales:

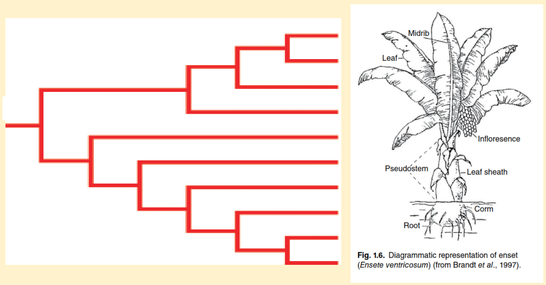
1) Statistical analyses of 30-year historical crop (CSA reports[4]) and climate data (based on CRU TS data[7]) at national, regional and local scales.



2) Phenotypic characterization of two field collections and three altitudinal farm transects using a list of traits of functional and morphological diversity + a farmer survey on enset landrace preferences and use.

3) Three drought tolerance experiments: i) growtainer, ii) greenhouse and iii) field trial to evaluate putative drought tolerant and susceptible genotypes using morphological and physiological parameters.

4) Mapping phenotypic data from the study to upcoming genetic data in order to explore the genetic basis of traits, such as drought tolerance.



Aim and Objectives

To better understand enset's functional trait diversity and drought tolerance, this study will:

1) Investigate enset production/yield dynamics and its response to past climatic trends in the context of the wider enset agrisystem;

2) Characterize enset's phenotypic traits to better understand landrace diversity, and how it varies across environments;

3) Evaluate enset's response to water stress to identify the extent and means of its drought tolerance;

4) Elucidate the genetic basis of enset phenotypic traits, including those linked to drought tolerance.

Key Questions

- How does enset production respond to climatic trends and events such as drought?
- What is the extent of functional trait diversity and how does it vary across environments?
- What is the extent of drought tolerance in a range of genotypes?
- Which landraces are most drought tolerant and by what mechanisms?
- Do phenotypic traits correlate with genetic groups?
- Are some genetic groups more drought tolerant?

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