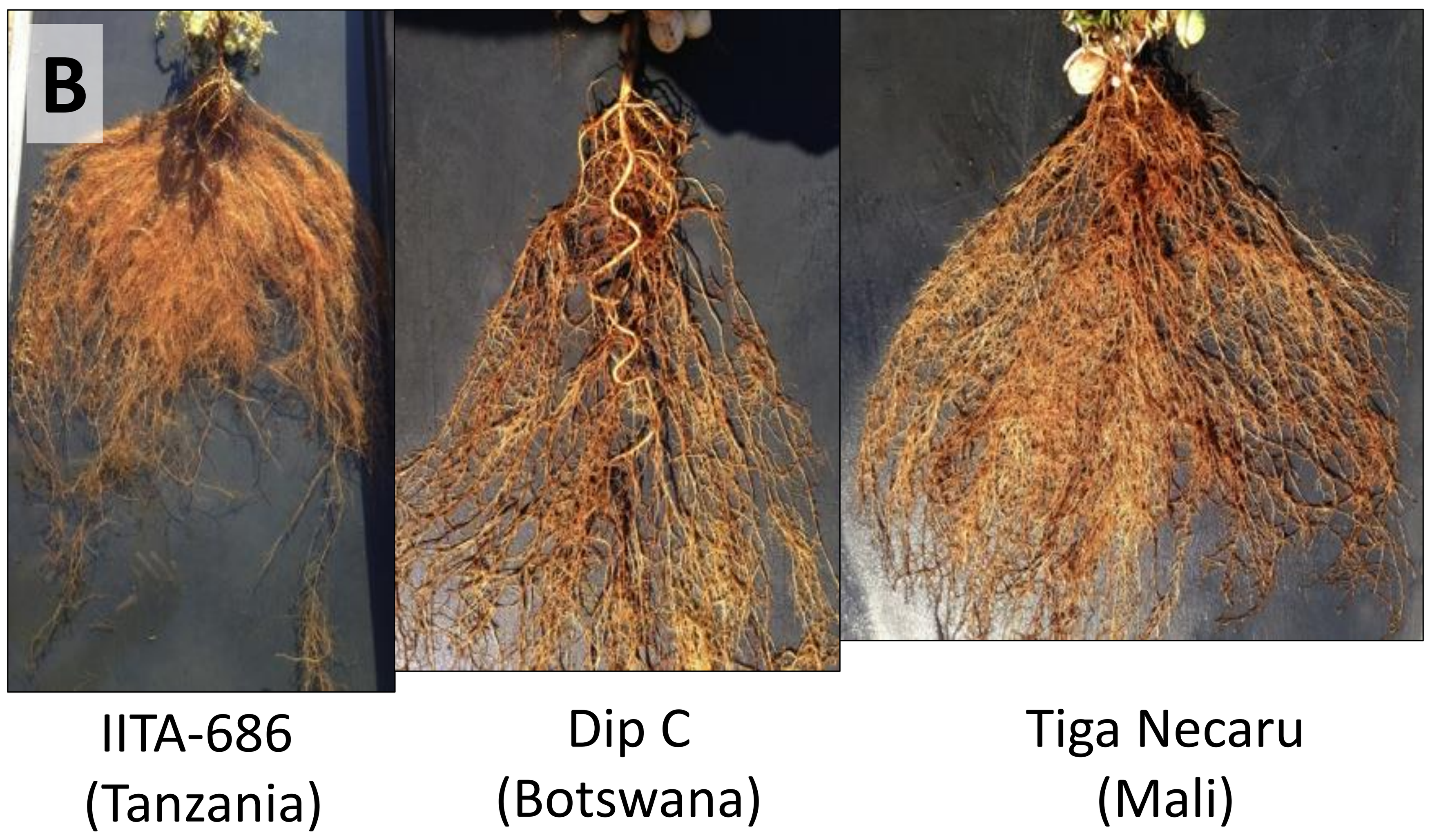
# Bambara groundnut physiology

## Phenotypic variation and trait analysis


***Figure 1**. Variations in seed and root systems in bambara groundnut. Bambara groundnut displays substantial phenotypic variation not only between accessions but also within accessions, with accessions largely existing as farmer landraces. (A) Seeds vary in terms of colour, pattern, size and shape. (B) Preliminary results show that different genotypes within the crop can display different root architectures. In sandy soils in a controlled environment glasshouses, DipC exhibits a prominent tap root whereas IITA-686 and Tiga Necaru have no clear tap root. The former appears to have its below-ground biomass more sparsely distributed, while IITA-686 seems to concentrate its roots nearer to the surface. Once these findings have been confirmed, the link between root morphology and drought tolerance can be investigated.*



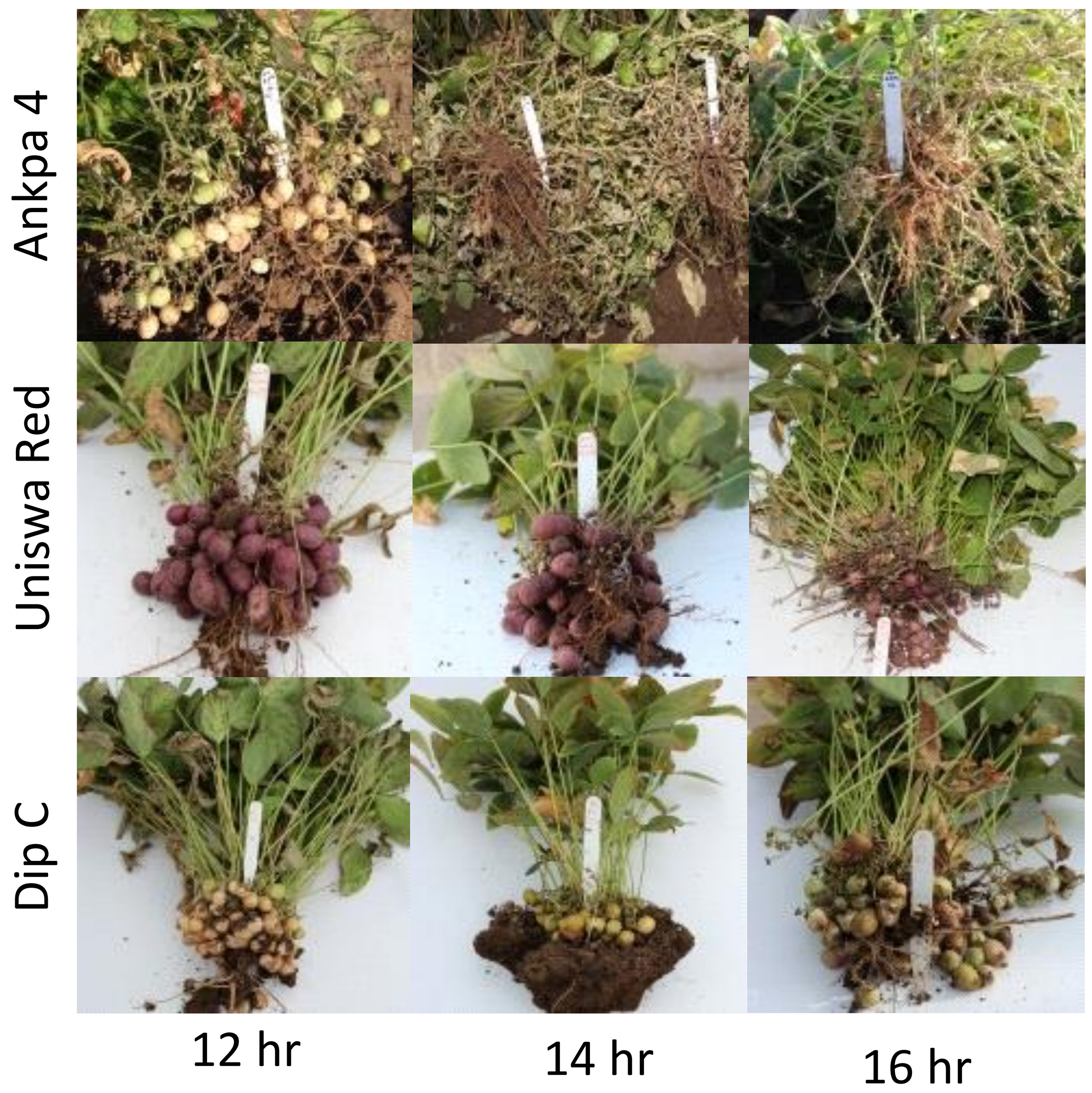

## Drought tolerance

Bambara groundnut (*Vigna subterranea* (L.) Verdc.) demands little from the soil and so is capable of growing in (free-draining) nutrient poor and low pH soils where most crops would not thrive. In addition to being relatively disease free, it is widely reported to be a drought tolerant crop. Mechanisms behind its drought tolerance are beginning to be understood in terms of genetics and plant physiology. Its extensive root system (Fig. 1), sensitive responses in terms of canopy size, stomatal control and phenology (early flowering and seed setting) all likely play important roles.

## Photoperiod insensitivity

Many bambara groundnut landraces show some degree of photoperiod sensitivity which can limit the range of latitudes where it can successfully be grown, with a 12 hour day-length most permissive for reproductive development. By screening the existing germplasm accessions were found with less sensitivity to long day-lengths (e.g. Dip C) and those that even yielded better under longer day-lengths (e.g. IITA-686) (Fig. 2). Evaluation of crop performance was quantified by using the tropical FutureCrop glasshouses at Nottingham, UK where we can controlled the day-length that the plants receive.


***Figure 2**. Investigating photoperiod sensitivity. Photoperiod experiments were conducted in three climate controlled glasshouse treatments at 12, 14, and 16 hours of day-length. Data were collected on growth and development. Genotypes that were divergent for photoperiod sensitivity were subsequently crossed to form mapping populations.*




- *Qualitative short day: Ankpa 4*
- *Quantitative short day: Tiga Necaru, Lun T, Getso & Gresik*
- *Quantitative long day: IITA-686 and DodR*
- *Less-sensitive types: Dip C, Uniswa Red and S19-3*

***Countries of origin**. Ankpa 4: Nigeria. Dip C: Botswana. Dodr: Tanzania. Getso: Nigeria. Gresik: Indonesia. IITA-686: Tanzania. Lun T: Sierra Leone. S19-3: Namibia. Tiga Necaru: Mali. Uniswa Red: Swaziland.*

## Significance of plant physiology in crop improvement

A rich understanding of both the existing phenotypic variation and the physiological mechanisms underlying important traits like drought tolerance and photoperiod sensitivity complement genetic analyses to give an more accurate understanding of a crop like bambara groundnut. This is essential for measuring crop diversity and performance in particular agro-environments. Crop breeding can further improve adaptation/suitability, including in terms of socioeconomic values, for wider uptake by farmers and consumers.