Crop-Innovations

A charity providing demand-driven seed research in under-utilised species

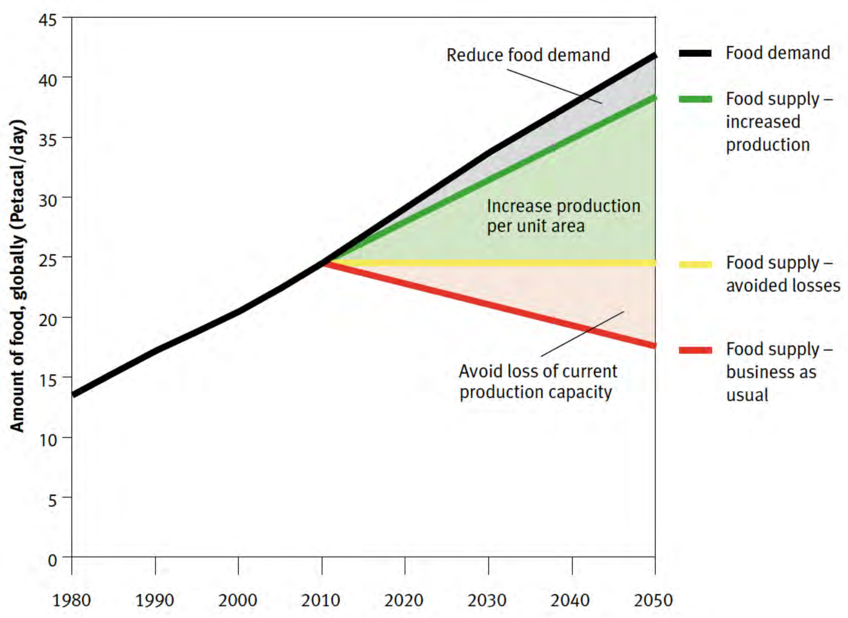
Heather Sanders[1,2], John Beeching[1,3], Charlotte Allender[4], Rod Scott[1,5] 1. Dept. Biology and Biochemistry, University of Bath, Claverton Down, Bath, BA2 7AY, U.K., 2. h.sanders@crop-innovations.org, 3. j.beeching@crop-innovations.org, 4. School of Life Sciences, University of Warwick, Wellesbourne Campus, Warwick, CV35 9EF, U.K. c.allender@crop-innovations.org, 5. r.scott@crop-innovations.org

Abstract

Improved exploitation of under-utilised species is, in part, constrained by difficulties with seed production and quality. In particular, factors including seed size, efficient seed set, seed germination, storage conditions and nutritional content are issues that inhibit further utilisation of a species. Crop-Innovations provides research capabilities and expertise to understand the cause of a specific seed problem. Our organisation can then coordinate activities to resolve the problem and work to provide improved seed that will enhance utilisation of the crop. This will be achieved by building networks of researchers and managing collaborations. Our staff can work directly on the species of interest, or research can, initially, be conducted in model systems and knowledge transferred to the crop. For example, current research on *Arabidopsis* has identified a small number of genes that play a key role in regulating seed size. Homologues have been identified in crop plants and the discoveries are being applied to improve yields. Crop-Innovations can assist with finding funding sources and writing applications for funding. Previous and on-going projects that aim to improve seed quality of under-utilised species are presented.

1. The challenge

Future agriculture will need to produce higher yields with fewer losses. Monoculture farming systems leaves our food supply vulnerable to pests and climate change.



Above: monocultures leave our food supply vulnerable.
Right: Graph from the final report of the CGIAR Commission on Sustainable Agriculture and Climate Change showing our increasing demand for food and the expected shortfall.

2. Food for the Future

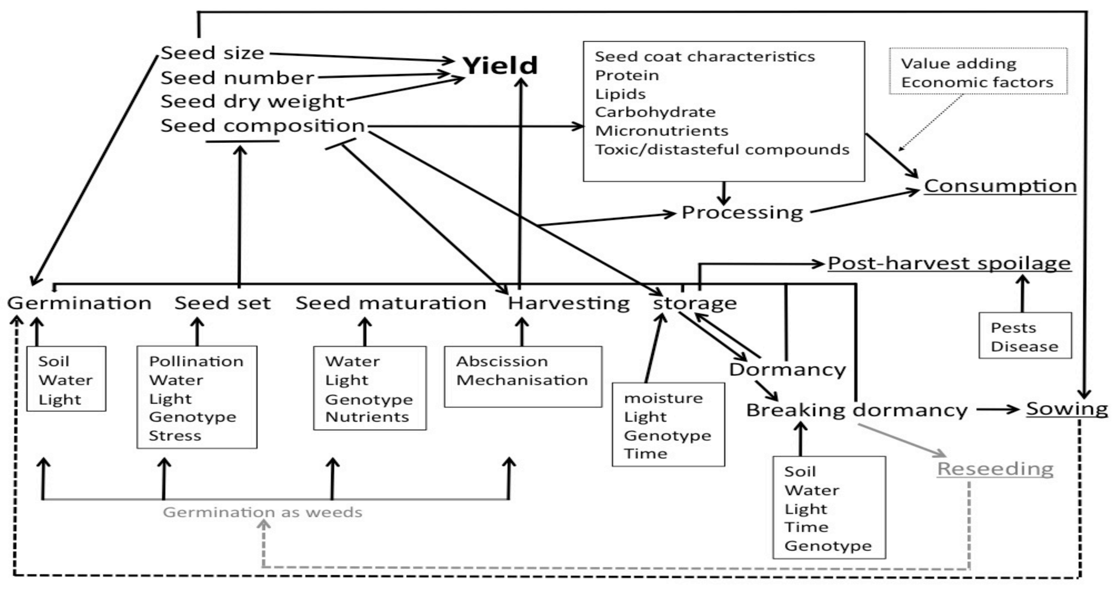
Using a diversity of crop species, that are able to grow in different climates or on marginal lands, creates more robust yields and farming communities better able to cope with climate change.

Using a diversity of species such as the baobab tree (left) ensures food security for future generations

3. The seed cycle

Interplay of factors affecting seed usage, production and quality. Problems occur in all different stages of the farming process.

Research currently focuses on major crops and work is needed to solve problems with under-utilised crops.

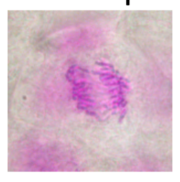


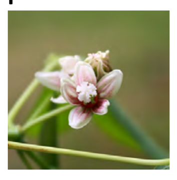
4. What we do

Crop-Innovations conducts demand-driven research on seed of under-utilised crops with the aim of increasing the value of the crop to the grower.

Our expertise

The Crop-Innovations team can bring expertise and experience in the following areas:

 Plant molecular genetics, genetic engineering and molecular biology

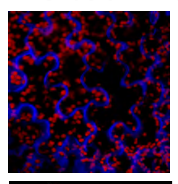
 Plant reproductive development and plant structure

 Seed development and structure, seed systems

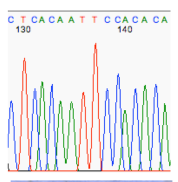
Writing funding applications

Our techniques

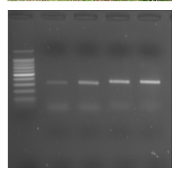
The techniques that can be employed to achieve our goals include, but are not limited to:

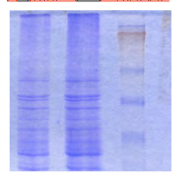
 Laser scanning, electron scanning, light and fluorescence microscopy

 Controlled growth environments

 Genetic mapping, sequence analysis and phylogenetics

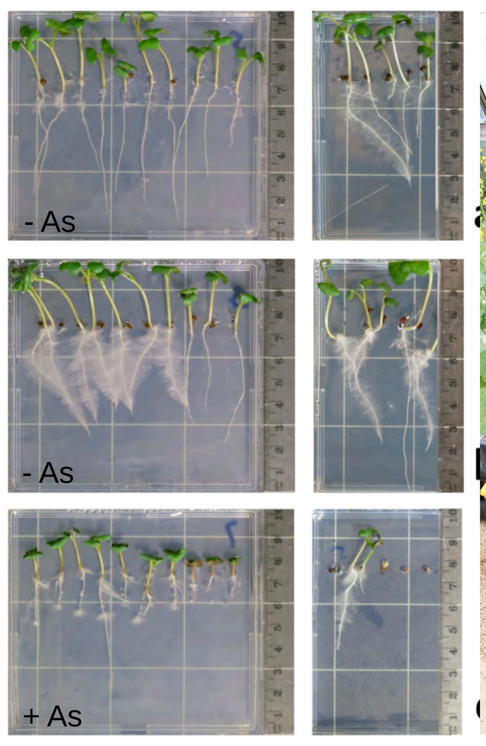
 Gene functionality assays

 Gene cloning and expression analysis

 Protein analysis

5. Ongoing projects: Arsenic tolerance of germinating seedlings

Studies of *Brassica juncea* grown in the presence of arsenic reveal seedling germination ability and levels of arsenic in the subsequent seed.



Left: *Brassica juncea* plant
Middle: seedling growth studies
Right: Hydroponics to apply arsenic

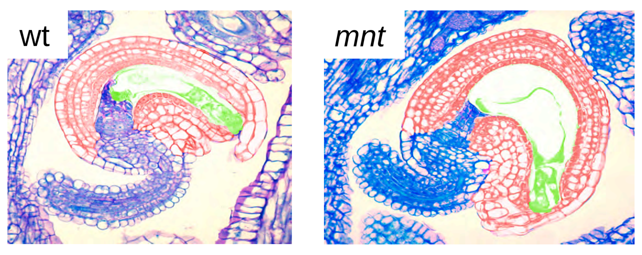
Part of the Ph.D. work of Jane Li (below) at the University of Bath

6. Ongoing projects: Genetic control of seed size

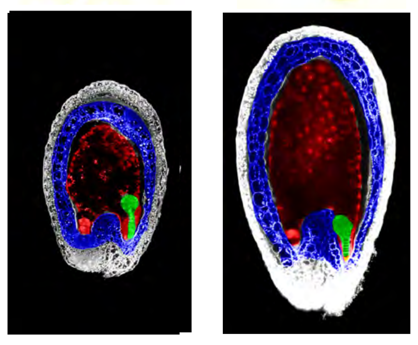
Studies in the model plant *Arabidopsis* reveal molecular mechanisms that control seed size, information that can be used for crop improvement.

a. Increasing integument size increases seed size

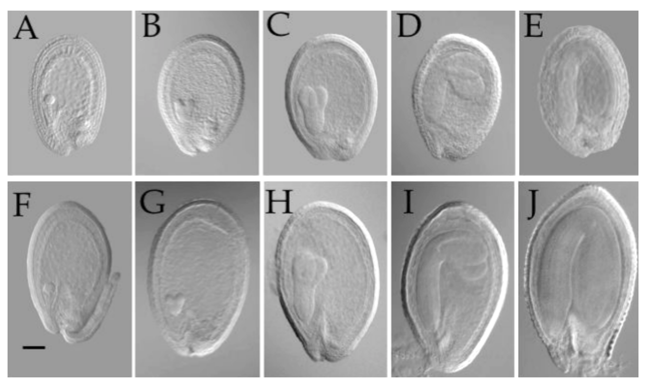
The *Arabidopsis megaintegumenta* (*mnt*) mutant has increased seed weight.



Unfertilised ovules. Scale = 20 µm

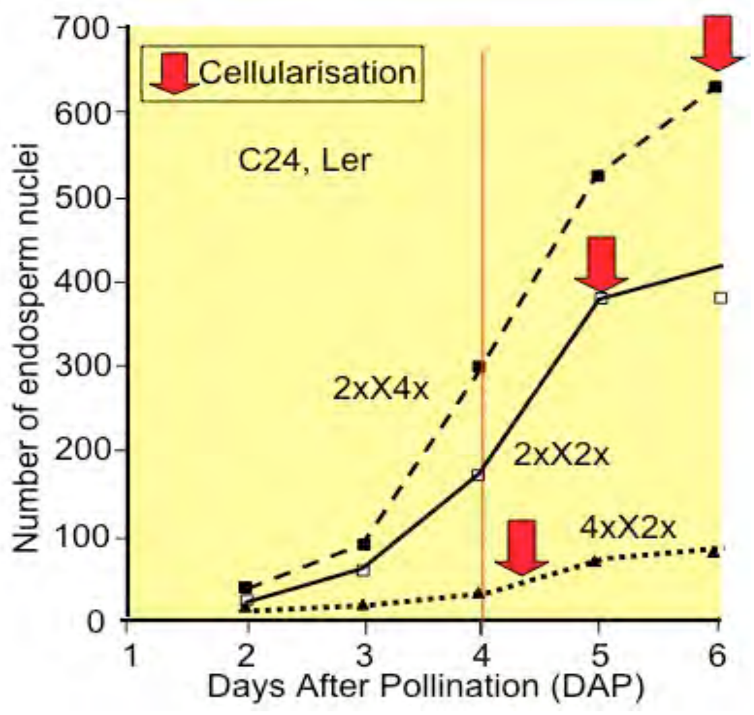


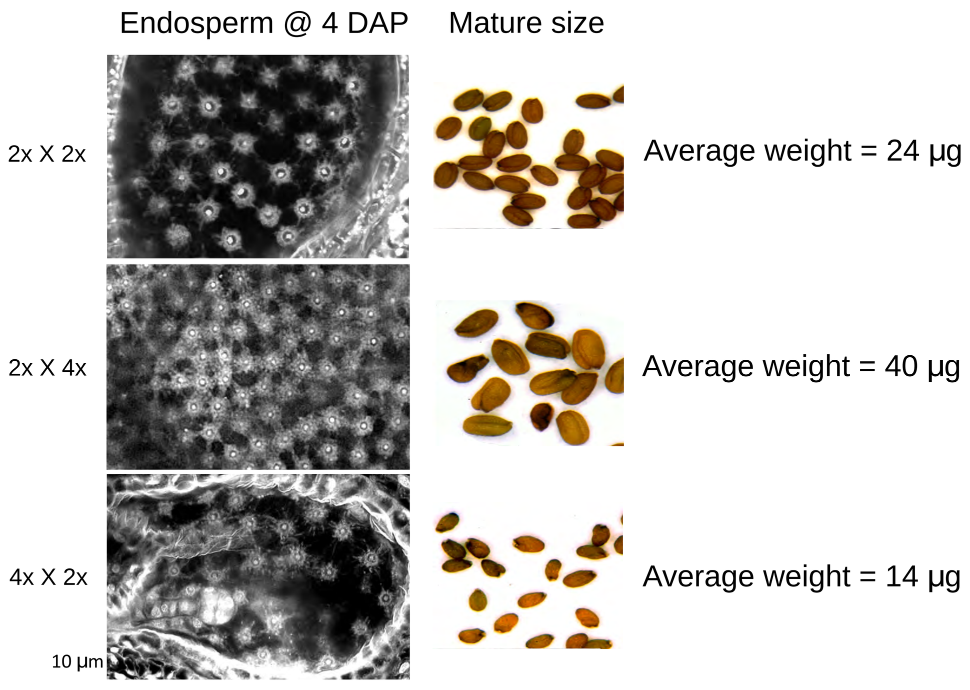
MNT regulates the number of cells in the integument – *mnt* mutants have more cells in the integument. Scale = 100 µm



Post-fertilization growth of wildtype (A-E) and *mnt* (F-J) seeds. Scale = 100 µm

b. Endosperm development is an important determinant of final seed size





Future directions: Transfer of knowledge to other species, in particular to indigenous crops.

7. Ongoing projects: Flowering and seed set in *Abelmoschus manihot*

Investigation of *Abelmoschus manihot* (slippery cabbage) reproductive development to identify optimal conditions for propagation and regeneration of the plants.

http://farm1.staticflickr.com/87/232848609_f3f07a0b5f_z.jpg

Flowers (left) and seeds (middle, scale = 3 mm) of *A. manihot* are not produced by plants growing in Taiwan. Seedlings (right, scale = 5 mm) are being grown for studies to ascertain the cause.

In collaboration with AVRDC The World Vegetable Center

These results will enable characterisation and conservation of *A. manihot* genetic diversity.

Conclusions

Crop-Innovations partners agricultural development organisations, bringing scientific knowledge and expertise for demand-driven research. The results of our research enable better use of under-utilised species, and increase the value of neglected and indigenous crops. Thus, Crop-Innovations provides support to farmers through organisations working at grass-roots levels to promote sustainable agriculture and conservation.

Crop-Innovations
Is a U.K. registered charity no. 1112295
www.crop-innovations.org

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