CROP POLLINATION – IT'S IN THE BAG!

Richard Horsnell • richard.horsnell@niab.com
Alison Bentley • alison.bentley@niab.com
Bethany Love • bethany.love@niab.com

The challenges of developing improved crop varieties to meet the demands of population growth and climate change are immense. With more people to feed and less land available for growing crops, breeders need to develop higher yielding varieties. There is also mounting scientific evidence that suggests climate change may impact on our current farming practices. Future UK crop varieties are expected to need to be better adapted to hotter and drier climates. Pests and diseases previously not seen in the UK may also become more prevalent as warmer conditions favour their survival and spread. It is now widely acknowledged that breeding new varieties that are higher yielding, pathogen resistant, drought-tolerant or better adapted to regional growing pressures and environments is crucial for ensuring future food security.

Controlled crossing is a common technique used in plant breeding that enables closely or distantly related individuals to recombine in order to produce new genetic material. Plants are crossbred to introduce characteristics from one variety or line into a new genetic background. In wheat (an inbreeding crop), the male organs of the flower are removed to make sure the plant cannot self pollinate, a process called emasculation (Figure 1a). The emasculated flower is bagged and the cross is completed when pollen from a suitable male donor is introduced onto the stigma of the emasculated flower (Figure 1b). A Pollination Bag (PB) is then secured over the fertilised flower to prevent the entry of other pollen grains which would contaminate the cross. The choice of PB is important as it provides a barrier against entry of foreign pollen, and creates a suitable environment for the developing seeds.

In this Innovate UK project, led by pollination bag specialist PBS International, we are testing custom made PBs to determine the potential to improve the efficiency of crop breeding. The bags are constructed from non-woven materials (Figure 1c) and will be compared against the industry standard PBs. Variation in pollen structure and size (Figure 2) will influence the choice of fabrics to be used.

At NIAB the performance of different PBs is being tested on wheat, a key staple

Figure 1. (a) Removal of anthers from a wheat ear and (b) pollination of emasculated wheat ear, and (c) a selection of some of the pollination bags being tested

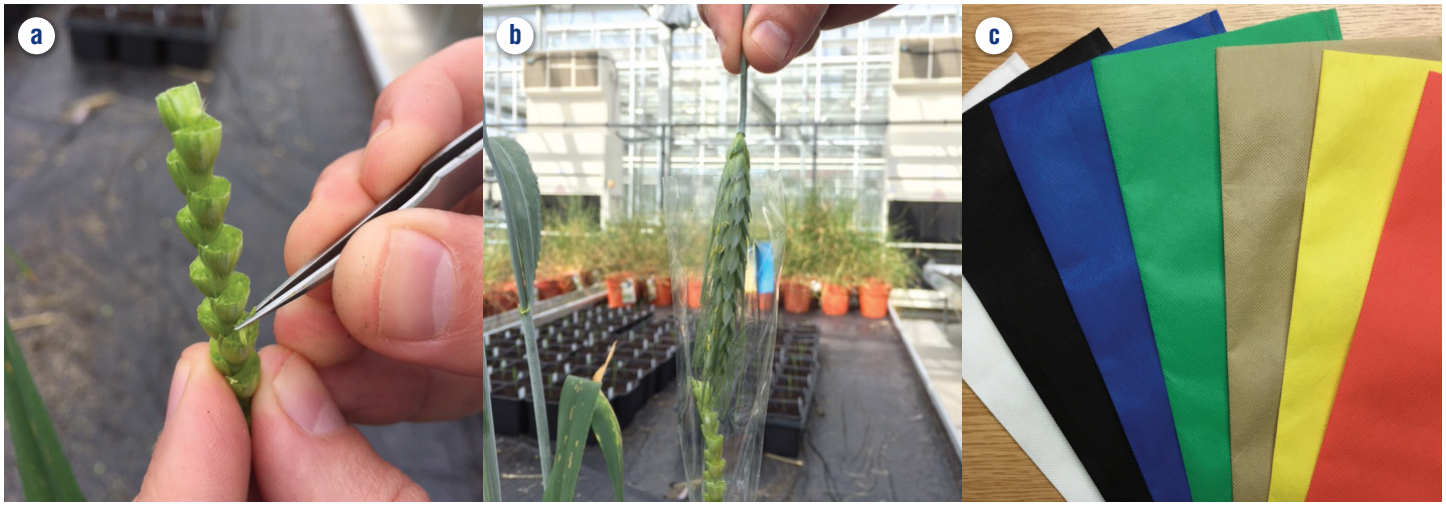
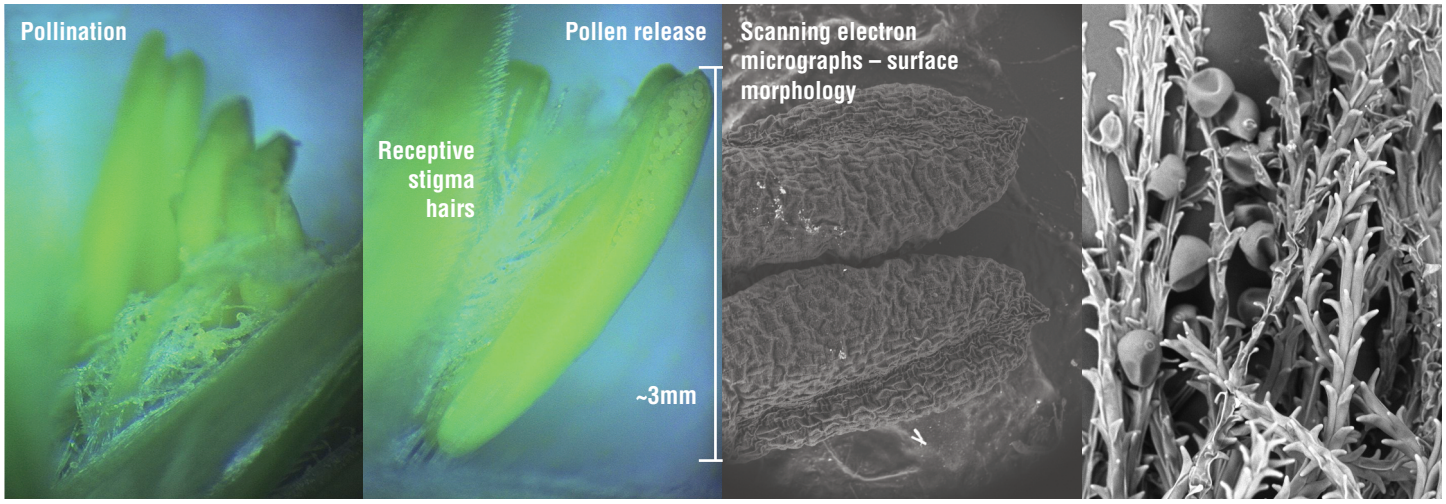


Figure 2. Pollen size and surface characteristics will influence the choice of PB material
(Images taken at the Cavendish Laboratory, University of Cambridge)

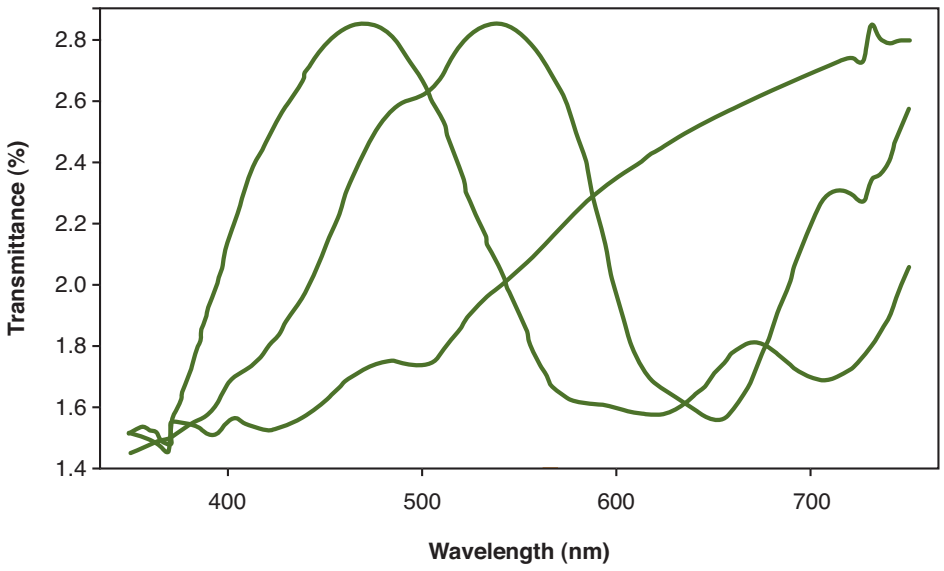


crop. The polymer composition and micro-structural design of the fabrics comprising the bag are critical to ensure maximum performance. Measurements of light transmittance (Figure 3), humidity and air permeability through the different PB fabrics will provide information to determine which fabrics are best suited for seed development. Each crossing attempt is being monitored for disease incidence to ensure the micro-climate inside the bag is not favourable for pest and/or pathogen survival.

At NIAB we have completed just over 100 crosses in wheat that will provide data on how each PB performs in relation to disease incidence and severity, seed yield, seed weight and germination rate, pollen contamination and usability. A pollen viability study will determine if there are changes in reproductive potential associated with the different PB materials. This is a collaborative project involving both commercial and academic partners and similar approaches are being undertaken by the partner organisations on different crop species.

Combining data on pollen characteristics, material design and environmental effects will enable the design and manufacture of PBs which are most suitable for the plant breeding industry. The correct choice of PB could maximise seed set and therefore reduce both the time and costs associated with improving crop varieties through controlled crossing programmes. The pressing need to increase yields whilst mitigating the environmental impacts of climate change means plant breeding will play a crucial role in producing crop varieties adapted to meeting these demands.

Figure 3. Differential light transmittance patterns through a range of coloured material
(Data collected by project partners at the Non-Woven Innovation Research Institute)



Acknowledgements

This project is funded by InnovateUK and is a collaboration between NIAB and the following institutes and organisations:

Debbie Lovatt, PBS International

Daljit Virk, PBS International

Hannah Senior, PBS International

John Clifton Brown, IBERS

Sarah Purdy, IBERS

Anne Maddison, IBERS

Mariell Trebowicz, Nonwovens Innovation and Research Institute

Estelle Guillemois, Nonwovens Innovation and Research Institute

Eefke Van Eden, Nonwovens Innovation and Research Institute

The article has been reproduced from NIAB TAG's membership magazine *Landmark* (May 2016 edition).