

# research update



Welcome to the second PBS International Research Update. This edition covers research across a range of species. The theme linking the findings relate to the different ways that the choice of pollination bags can impact your breeding programme.

We believe investment in **duraweb®** pollination bags makes sound economic sense, bringing the science of nonwoven fabrics to plant breeding.

Conducted on four different continents the research inside highlights some of the benefits of PBS pollination bags for increased seed set, reduced seed losses and overall financial impact.

We hope you will find it a thought provoking read whether you are responsible for budgets, breeding results or simply getting the best for your organisation.

## key findings

Cost per successful cross in *Miscanthus* trials are 33% lower using PBS International bags than glassine ✓

**duraweb®** bags achieve 13% more seeds than other bags in oil palm trials ✓

Research under way to boost seed yields for commercial forestry ✓

Trials show **duraweb®** bags lead to higher *Sorghum* seed quality and 19% greater flower survival for *Pinus elliotti* ✓

## get in touch

To share your thoughts on any of the research in this update or suggest ideas for future research contact us at [support@pbsinternational.com](mailto:support@pbsinternational.com)



## 12% more successful crosses

Aberystwyth University's Institute of Biological, Environmental and Rural Sciences (IBERS) has a *Miscanthus* breeding programme to develop sustainable renewable bioenergy crops.

The number of successful crosses can be a limiting factor on the programme. This study compared three types of pollination bag to understand the impact on the seed set, and the cost and pace of the *Miscanthus* breeding programme.

They compared three types of bag - glassine paper, white paper with a plastic panel and PBS International **duraweb**® bags - in both inter and intraspecific crosses, in greenhouse and in isolation chamber conditions.

Their results showed that **duraweb**® had a 12% higher success rate in crosses than either glassine or paper bags (which were not significantly different from each other), and that the PBS bags were suitable for re-use, in contrast to the paper alternatives.

Bag Type	Crosses Attempted	Successful Crosses	Success Rate	Cost per Successful Cross
Glassine	180	54	30%	£167
Paper & Plastic	118	45	38%	£131
<b>duraweb</b> ®	<b>266</b>	<b>119</b>	<b>45%**</b>	<b>£112</b>

\*\* = Significantly different from Paper & Plastic, Glassine at the 1% probability level

The researcher calculated that the total cost of a cross at IBERS is in the region of £50, so maximising success rates has financial implications. **duraweb**® bags were the most expensive bags to buy, but the higher success rate meant that the cost per successful cross was £55 (33%) cheaper than glassine and £19 (15%) cheaper than paper & plastic, even before the possibility of re-use is considered. As this study involved over 500 crosses, increasing the success rate by using PBS International bags could reduce the total cost by over £27,500.



## \$97 more revenue per bag

The last research update shared NBPOL's finding that PBS pollination bags had greater "usability" than canvas or "Tyvek style" Polyethylene (PE) bags in oil palm seed production. Subsequently the researchers counted the number of saleable seeds produced per bag, and revealed highly significant differences.

**duraweb**® bags produced significantly more seeds than the alternatives, an average of 129 more saleable seeds than PE bags and 65 more than canvas. Assuming \$1/seed and a 75% germination rate, this equates to \$97 incremental revenue from a single **duraweb**® bag vs a PE bag.

Both the PE and canvas bags encountered problems that did not affect the **duraweb**® bags. Some PE bags accumulated substantial volumes of water that had to be manually syringed out. The canvas, meanwhile, suffered from weevil intrusion. In normal conditions bunches from affected bags would be discarded to avoid possible contamination.

The researchers conclude that for quality of seeds PBS International bags are the best choice, and also the best choice from an economic perspective. Although costs were not analysed as part of the research, the researchers were confident that the extra seed yield and labour efficiency more than offset any extra cost increase.

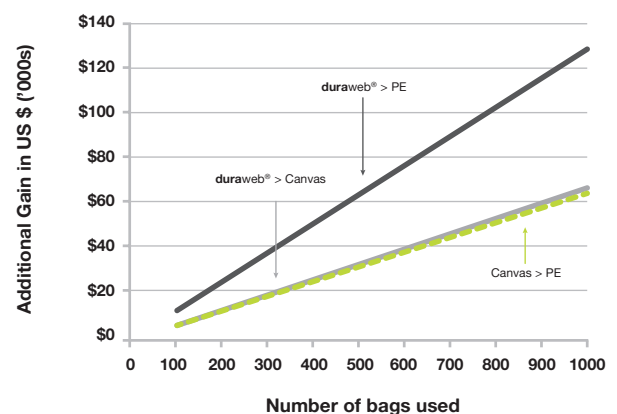
	<b>duraweb</b> ®	Canvas	PE
Presence of insects	None	Yes	None
Presence of water	None	Damp material	Standing water in some
Seeds per bag	1098*	1033	969

\* = significantly higher than canvas and PE at 0.001% probability level



	Canvas vs PE	<b>duraweb</b> ® vs canvas	<b>duraweb</b> ® vs PE
Incremental seed yield	64	65	129
Implied additional revenue / bag	\$48	\$49	\$97

### Impact of seed yield on incremental revenue





## growing production of loblolly seeds



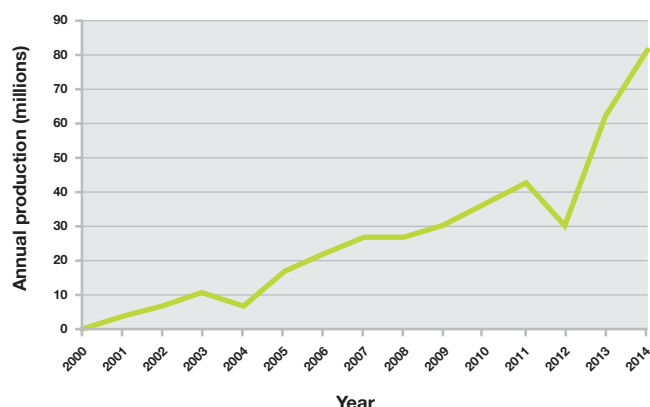
Some of our customers in the USA use PBS International bags for breeding *Pinus taeda*, a commercially important species grown for timber and pulp. Typically our 3D bags are used for breeding improved varieties, with commercial seeds produced via open pollination or, increasingly, via mass production of specific crosses. Production of specific crosses has grown rapidly in the last 10 years, as the genetic gain is seen to more than offset the incremental costs.

PBS discovered that up to half the potential seed yield is lost each year due to damage caused to the flowers and/or lower-seeds-per-cone than open pollination, costing millions of dollars of potential seed-sale revenue.

PBS International is working with the North Carolina State University Cooperative Tree Improvement Program and its members to find a better bag for production of specific crosses, to increase seed yields for the same amount of effort during the labour-intensive flowering period. Both material type and product design are being considered, and already interesting insights are emerging.

Field trials began in March 2014 and full data will be available after cone collection in late 2015, although initial data on flower survival shows promising results.

**Annual mass production of specific crosses of loblolly pine seedlings**



“Use of appropriate pollination bags can have a real business impact both in the breeding program and in operational production of specific crosses. Working with PBS to help develop a better pollination bag has been fascinating, and we’re delighted by the results we’ve seen to date”.

**Steve McKeand, Director, North Carolina State University Cooperative Tree Improvement Program**

## continuous improvement with Embrapa



*Sorghum* is widely grown in Brazil. Embrapa’s sorghum programme in Minas Gerais seeks to accelerate its pace with a second breeding cycle during the winter season. Migratory birds often tear the paper bags, eating seed and affecting the results.

Robert Scheffert of Embrapa compared PBS International bags to the traditional paper bags in June 2013. Unfortunately the bird pressure observed was lower than in a typical year. Nonetheless he observed a much higher quality of grain than normal. He is re-running the trial in 2014.

Separately, work was undertaken with the Embrapa Forestry Team’s researcher Valderes de Sousa in Paraná. She compared their in-house bags to the PBS 3D.65 bags in their *Pinus elliotti* hybridisation programme. They found fewer damaged strobili with the PBS bags than their existing home-made version and a 19% greater flower survival rate.





The research in this update alone shows that PBS pollination bags, compared to the alternatives, result in:

- **More successful crosses**
- **Less contamination**
- **More seeds**
- **Healthier seeds**

We are always open to bringing our expertise in material technology to new challenges. To further this, in February 2014 we expanded our team to include

Dr Daljit S. Virk as our Technical Manager. He has helped us to pull together, analyse and interpret results from the various trials we are working on, and to turn this into advice about how we develop our products and research in the future.

His career has spanned more than 45 years as a geneticist and plant breeder, University Professor, Senior Research Fellow and International Projects Coordinator. He has worked extensively in South Asia, various African countries, and in the UK at Bangor University on Internationally Funded projects on crops such as millet, maize, sorghum, rice, wheat and pulses. He earned his PhD and Doctor of Science degrees from Birmingham University, UK

If you have a topic you would like to research or a pollination control problem you would like to improve, contact us at [support@pbsinternational.com](mailto:support@pbsinternational.com)

## don't risk your reputation

**Don't gamble with inferior products. Here's why our customers trust our bags:**

Halts unwanted pollen ✓

Maintains plant health ✓

Best air flow ✓

Superior weather resistance ✓

Demonstrates yield improvements ✓

Makes sound economic sense ✓

**duraweb®**

## recommended bags

	3D	2D.1	2D.2	2D.3	2D.4	Tent
Oil Palm				✓	✓	
Forestry	✓	✓	✓			
Small Grains	✓	✓	✓			✓

## our materials

duraweb® technology is strong against abrasion and tearing

Sunlight can pass through material - UV stable

Flexible and foldable

Highly effective barrier to pollen grains

Moisture and air can pass through

Rain doesn't affect duraweb® properties

For more information go to [www.pbsinternational.com](http://www.pbsinternational.com)

PBS International, Salter Road, Scarborough, YO11 3UP, UK

+44 (0)1723 587 231