[Case Study]

A bespoke approach to pollination control in hops

Part of the *Cannabacae* family of plants, *Humulus lupulus* – more popularly known as hops – is a dioecious plant that is grown around the world. Hops are primarily used in brewing and beverage applications, particularly as a key ingredient in beer, but also across medicinal and cosmetic applications.

The European Union (EU) produces 50,000 tonnes of hops annually, grown across 14 different EU countries. Among these countries, Germany accounts for 60% of the EU's hop-growing acreage and about 1/3 of the total surface area devoted to hop cultivation around the world[1]. As such, Germany is considered a world leader in hops cultivation and production.

HVG (Hopfenverwertungsgenossenschaft e.G) is a global hops service provider based in Germany. As one of the largest hops cooperatives in the world, and also a shareholder of Hopfenveredlung St. Johann GmbH, the largest and most modern hop processing plant in the world, HVG supports the global brewing industry through breeding, processing, marketing and selling hops worldwide.

The cooperative was originally founded in 1953 and has only grown since then. Today, it has 50 employees across its offices and its processing facilities, and exports approximately ca. 75% of its output.

HVG has used PBS International pollination control products since the inception of its hops breeding programme in 2017.

In 2017, HVG launched its own breeding programme, and implemented PBS International pollination control crossing bag solutions from the outset. Dr Florian Schüll, Head of the R&D department and analytical lab at HVG, works closely with Ms. Anna Baum from the breeding team at HVG, to advance HVG's breeding programmes and develop new varieties of hops, while also meeting demand for hops pellets and extracts that HVG supplies to brewers.

Challenges

Hops, like many crops, have faced significant challenges in recent years due to climate change. Growing conditions have changed year on year, with some years experiencing heavy rainfall while other years have been exceptionally dry.

To support the industry in combatting these challenges, part of HVG's work includes breeding hops varieties with desirable traits, such as drought or disease resistance, in addition to producing and selling hops products such as pellets and extracts.

However, resistance to adverse conditions is not the only factor in HVG's breeding programmes. Other desirable traits include resistance to pests to minimise the need for pesticides, and also increasing the quantity of high-quality alpha acids to offer improved bitterness profiles that are popular in many beers.

When planning the breeding goals for the year ahead, Dr. Schüll works closely with Ms. Baum to identify the specific desired traits, informed by feedback from the sales team relating to specific requests from brewers. The hops must then be crossed, planted, grown, and harvested – a process which can prove challenging in itself amid the backdrop of climate change and adverse weather conditions year-on-year.

As all of HVG's breeding takes place in the field, quality pollination control is essential to protect against adverse weather and external

Ms. Baum explains the workload:

"In one year, we will do about 20 crossings. One crossing can be about 100 seeds, so in one year we can end up planting about 2000 seeds, which is a lot for us as the planting and harvesting is all done manually."

Once new varieties are selected and harvested, they are then tested in the analytical lab to understand aroma profiles, bitterness, and other factors that might influence how a beer tastes.

Selecting the varieties of hops that survive the growing season and also contain all of these traits is a challenge, as Dr. Schüll explains:

"In the end, it can be tricky to meet every goal in one plant. If you're just looking for high bitterness from alpha acid content, we can offer many candidates. However, if you also want downy or powdery mildew resistance, or tolerance against spider mites, it can be hard to find a candidate that can offer all of those traits combined."

Furthermore, all of HVG's hops are grown in the field as opposed to greenhouses or indoor facilities, which means defence against external factors is even more important, as the vines are exposed to both the elements and other sources of pollen. Pollination control is therefore essential in managing the crossing process to prevent genetic contamination. Significant planning goes into identifying the most promising traits in hops, so quality pollination control is vital in ensuring that the planted seeds have the best possible chance of delivering the desired traits without fear of external contamination.

Solution

HVG's breeding team has used PBS International products since the inception of its breeding programme in 2017. As hops grow on vines, the traditional bag design featuring welds down three sides was not suitable. This is because the bags needed to be situated at specific points on the vine, meaning they required at least two openings (at the top and the bottom) to allow the team to secure the bag at the designated part of the vine. Initially the team commissioned custom sleeves from PBS International, featuring welds down two sides and openings at both ends, which could be placed over the top of the vine and pulled down to where it was needed. These sleeves could then be secured at the top and bottom around the vine, isolating the hops within.

However, although sleeves are a popular method of pollination control for many hops growers, the HVG team wanted to explore a way to secure the pollination control products without running the risk of damaging the hops when pulling the sleeve down the vine, and also avoided the breeders getting scratched by the plants as they pulled the sleeve into position. Thus, the team worked closely with PBS International to devise an alternative solution consisting of open sleeves, with only one welded side.

Dr. Schüll describes the design:

"It is a simple design but offers significant advantages. The sleeve is open on one side, which helps because you can then lay the vine on the floor on top of the open sleeve. You can then do the crossing or pollination, and then pull the sleeve over the plant and secure it closed. It's a much simpler approach."

Once placed, the hops vines can then grow in the field safely protected by the secured PBS International sleeve. Not only do the custom sleeves act as a form of protection against external contamination, but as they are left *in situ* until harvest, they also serve as a visual cue to the breeding team about where specific pollination activity has occurred, as Ms. Baum explains:

"We don't fertilise the whole vine, only specific regions, which are then covered by the sleeve. The sleeves also show us at a glance exactly which part of the vine is fertilised, which makes it easier during harvest. It's an optical indicator of what to leave in the field, which is especially handy considering we can have 4,000 plants growing at a time, and the harvest is done manually."

As the pollination sleeves are left on the vines until harvest, they serve as a useful visual indicator of which hops have been treated / pollinated.

Custom sleeves for pollination control

In addition to a wide range of standard bags and tents for pollination control across multiple crop types, PBS International also offers a custom design service. All PBS International products are manufactured at the company HQ in Scarborough, England, and the team works closely with plant breeders around the world to both offer expert advice on the most suitable bags or tents for specific needs, and custom designs in cases where more bespoke solutions are needed.

PBS International produces small, medium, and large bags – both with and without windows, in 2D and 3D structures – and patented pollination control tents in mini, midi, and maxi sizes. All products are made using PBS International's proprietary family of **dura**web® materials, which is scientifically proven to bring superior results to plant breeding programmes.

Compared with other pollination control products, peer-reviewed research has found that **dura**web® offers proven benefits such as:

- **Enhanced genetic integrity**
- **Reduced risk of contamination**
- **Increased seed yield**
- **Demonstrated economic impact.**

In addition to **dura**web® material, all bags and custom bag products feature PBS International's signature **dura**weld® technology – the ultra-strong welding process that is used to fuse the sides of bags together. Unlike gluing or stitching, this welding method ensures maximum protection, as bags do not separate and there are no holes for pollen to pass through.

For hops breeders, this means that are now three different options already in design and use to support your hops needs –

1. **Standard pollination control bags;**
2. **Sleeves that feature two openings at each end, which can be pulled down the vine;**
3. **Open sleeves, which can be tied around the vine exactly where they are needed.**

In addition to these three designs, we also offer bespoke customisation across our range of **dura**web® materials and sizes, allowing us to develop tailored solutions that enable perfect crossing in the breeding cycle.

Next Steps

2025 marked the first year of HVG using the new customised open sleeves, and the team is already pleased with the ease of use the updated design offers and the results from this year's breeding programme.

Ms. Baum explains:

"The harvest this year was really good. We're still awaiting the checks in the analytical lab, but so far we've had a good harvest."

As HVG plans for its next breeding season in 2026, the team is eager to work with the PBS International team again to further optimise the custom design for use in the field. Ms Baum explains:

"Currently, the open sleeves are around the same size as the previous sleeves once they have been wrapped up and secured around the plant. Hops vines can have a lot of leaves, meaning there can be a lot of plant matter contained within a single sleeve, so we would like to experiment with larger open sleeves to see if more air around the plant can optimise the growing conditions post-pollination."

Ultimately, the team is pleased with the outcomes from using the open sleeves. Dr. Schüll concludes:

"So far, from everything we've seen, we don't have any issues with cross-pollination. We trust the protection that the sleeves offer, and have no reason to consider any alternatives."

To learn more about how PBS International bags can support your hops cultivation, visit: https://www.pbsinternational.com/key-sectors/hemp-hops-cannabis/

References

1. 'Hops', European Commission, https://agriculture.ec.europa.eu/farming/crop-productions-and-plant-based-products/hops_en [accessed 17 November 2025]

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