[Case Study]

Preserving French Olive Production with PBS International Tents

The impact of climate change on olive growing is well-reported, with rising temperatures and decreased precipitation leading to decreased olive yields. Edy Spagnol, a phytosociologist working across the Pyrénées-Orientales, Aude, Hérault regions of France, is using PBS tents to better understand and classify existing olive varieties; identify which varieties are most likely to achieve desired yields; and investigate how best to breed varieties that can withstand changing climates.

Introduction to olive trees

The olive tree species bearing edible fruits is the *Olea europaea*. On cultivated olive trees, only 1 to 10% of the fertilised flowers will become fruit which is only borne on two-year-old wood, i.e. on the branches that developed the previous spring. The fruit growth phase occurs in the summer and is a critical period for olive development and the subsequent harvest. At this stage especially, the climate plays a key role in determining the size of olive that will be produced.

The biggest pressure on the olive cultivation sector is devising strategies to mitigate the impact of climate change[1]. Even though well-adapted to typical Mediterranean conditions, the extreme heatwaves combined with the low rainfall in the summers of 2020 and 2024 have heightened the importance of being able to select and grow olive varieties that have the best chance of survival.

The olive cultivation sector's biggest challenge at present is climate change, with extreme heatwaves and minimal rainfall during the summer months having a detrimental impact on yields.

Cultivating French olives of known origin

Although Spain and Italy dominate the European olive industry, French growers spend a great deal of time and effort in cultivating the best varieties and conditions in their olive orchards. Most olive oil comes from small outfits in designated regions in France with strict legal controls on quality, variety, and yield.

M. Edy Spagnol is a phytosociologist working with three regions of olive producers – Aude, Hérault and Pyrénées-Orientales – under the **Conservatoire des Oliviers de Durban Corbières (CODC)** in Toulouse, France, and alongside the **ADNid** which certifies 100% regional products. Phytosociology is a subset of plant science that deals with extant, or surviving, plant communities and puts particular emphasis on their classification.

Prior to laboratory investigations in 2014/15, it was not possible to distinguish between different olive varieties. Some varieties were being named differently in different regions when they were the same, while others were not being differentiated correctly, according to data from ADNid. Using ten germplasm markers from the CODC studies in the field, academic groups from the **Centre National de la Recherche Scientifique (CNRS)** sites in Lille and Toulouse, and M. Spagnol contributed to a standardised naming convention and the establishment of a genetic architecture of self-incompatibility in olives. It was confirmed that three olive family genera *Olea*, *Phillyrea* and *Fraxinus* share the same self-incompatibility system[2]. The lab results from inserting a single grain of known origin pollen to create an olive fruit were verified in the field to produce identical olives, in terms of both genetic origin and physical characteristics such as shape.

Finding the pollen producers

PBS International tents were used to perform phytosociology surveys in total confinement during the critical two-months potential flowering period. Controlled conditions were created for three plants of different monotype cultivated varieties (cultivars) that are found in the three French regions of interest. These include the dominant variety (Olivière Lucques), the original monotype (from 500–600-year-old mother plant but with no pollen) and the potential pollen-carrying variety.

The results found that almost 80% of cultivated olive trees in the three regions do not carry pollen. The potential of the pollen carrying variety was only realised after two to three years (to allow fruit bearing) plus two years of phytosociological surveys under the tents under controlled environments. These findings would prove to be significant when planning further studies under increasingly challenging environmental conditions.

Citadel tents for pollination control

M. Spagnol adopted the pollination control tents (PCTs) for his phytosociology work from PBS International after colleagues at the CNRS reported on the benefits of PCTs and PCBs in their research2. M. Spagnol uses the Citadel mini tents and covers for his olive production studies at CODC.

PBS International Citadel tents offer a flexible solution to achieve ultimate pollination control for both single and multiple plot isolation. The tents are available in three types of duraweb® materials to suit any environment, which function as a highly effective barrier against pollen grains while also allowing sunlight, moisture, and air to pass through.

Citadel tents create a microclimate in which contained plants can thrive. They have been evaluated in extreme conditions across three continents to ensure reliability and robustness for use year after year. The tents are available in three sizes:

- The Citadel Mini has a depth and width of 63.5cm, a height of 120cm, and one 30x15cm window – ideal for isolating one or two plants.
- The Citadel Midi has a width of 1.5m and depth of 3m and is available in either 1.5m or 2m height, with the option to have multiple 35x25cm windows – ideal for outdoor polycrosses, multiplying up, and creating hybrid seeds.
- The Citadel Maxi offers ultimate flexibility, with its modular design allowing users to build a tailored solution – available in widths that are multiples of 1.5m, depths in multiples of 3m, and heights of either 1.5m or 2m, in addition to 35x25cm windows.

Added climate protection

The location and weather in the Toulouse region requires specific anti-storm and anti-hail protection with integrated irrigation under the tents. Another climate consideration is the reduction of hot temperatures during heatwave hours.

Since 2019, M. Spagnol has been trialling different combinations of nets to use above the individual plant PBS tents as one large shelter from the strong sunlight, heat, high winds and precipitation during the summer months. Working with varieties from the Aude, Hérault and Pyrénées-Orientales regions, the key considerations are to optimise flowering and pollen effectiveness. He evaluated three overlaying green nets, a single green net and finally a single white net. First results in 2024 showed that an increased fruit yield of 10-15% is possible using the PBS tents and the protective net shield.

35% of the varieties cannot withstand extreme conditions of the heatwaves combined with the lack of rain and therefore irrigation. This can lead to competition between certain varieties of the same group that results, to varying degrees, in reduced fruit quantity and size. Avoiding planting them close together helps to avoid such conflicts of size and maturity, however there is still work to done to understand the behaviour of these complex varieties during heatwave periods.

The challenge now is to reintroduce the monotypes that are carriers of endemic pollen in each cluster of the three regions. These exist because the plants introduced from other countries or other regions have not had enough time to acclimatise or have been introduced without testing.

New studies

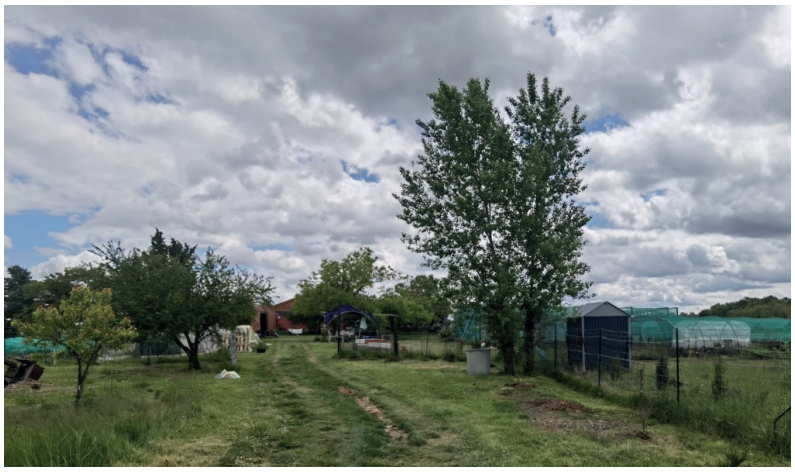
In 2024, new research was published that showed a supergene controls the self-incompatibility systems in *Olea europaea*[3]. The discovery of these new genetic markers is now being used to identify pollination groups, and all new “fathers” are checked by DNA analyses to ensure they are characterised correctly prior to crossing.

A large study is underway to see if true pollen carriers exist in endemic olive trees of the three regions. This is based on the scientific work performed by Bruno Moulia[4], which has looked at the effect of strong winds as an extreme environmental stressor for olive growing. With the number of varieties in decline, the challenge is to find which combinations can produce high-performance resilient plants under unpredictable climate conditions.

M. Spagnol is now setting up phytosociological studies to compare varieties and genetic monotypes using PBS tents and Alt’ Drosso A400 nets during the two possible months of flowering. They are looking at the quality and quantity of the plants as well as potential changes in plant cell nuclei, depending on the pollinators. This will define if for some cultivars the nuclei morphology is relatively consistent or confirm initial phytosociological observations suggesting it can be diverse.

To do this, the plants are in market garden greenhouses and separated into groups of four plants per PBS tent. This includes all varieties to maximise the combinations available in a single (two year) fruit-bearing cycle.

M. Spagnol and his colleagues are using the PBS International Midi tents to perform phytosociological testing in total confinement during the olive plants’ two-month potential flowering period.



M. Spagnol previously collaborated with colleagues at the CODC, CNRS, and ADNid to develop a standardised naming convention and establish a genetic architecture of self-incompatibility in olives.

The DNA analyses mentioned above are required to correctly identify and barcode their groups and haplotypes. This allows the selection of the highest potential pollen-productive combinations so their pruning can be staggered over several seasons to give the best chance of continuous harvest. Once the branches have at least doubled in number of buds, the plants must be monitored closely to observe the optimal amount of sap and vessels to move on to the next stage. Moving to the nursery, these cultivars are then cloned to ensure the heritage of these endemic pollinators is safeguarded and preserved. The success rate for seedling production in the nursery has already increased from 50 – 90%.

The results of these ground-breaking studies to find the most promising heritage varieties best adapted to face the challenges of sustainable olive production will be reported in a future PBS Research Update.

As the work continues, M. Spagnol recognises the importance of PBS International products in his research. He states:

"I would not have believed the difference that pollination control products could make had I not seen it for myself. We are indebted to PBS International, as without these materials, we would not have been able to do the phytosociology work we are doing."

References

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PBS International, Salter Rd, Eastfield, Scarborough YO11 3UP
T: +44 (0)1723 587 231
sales@pbsinternational.com

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