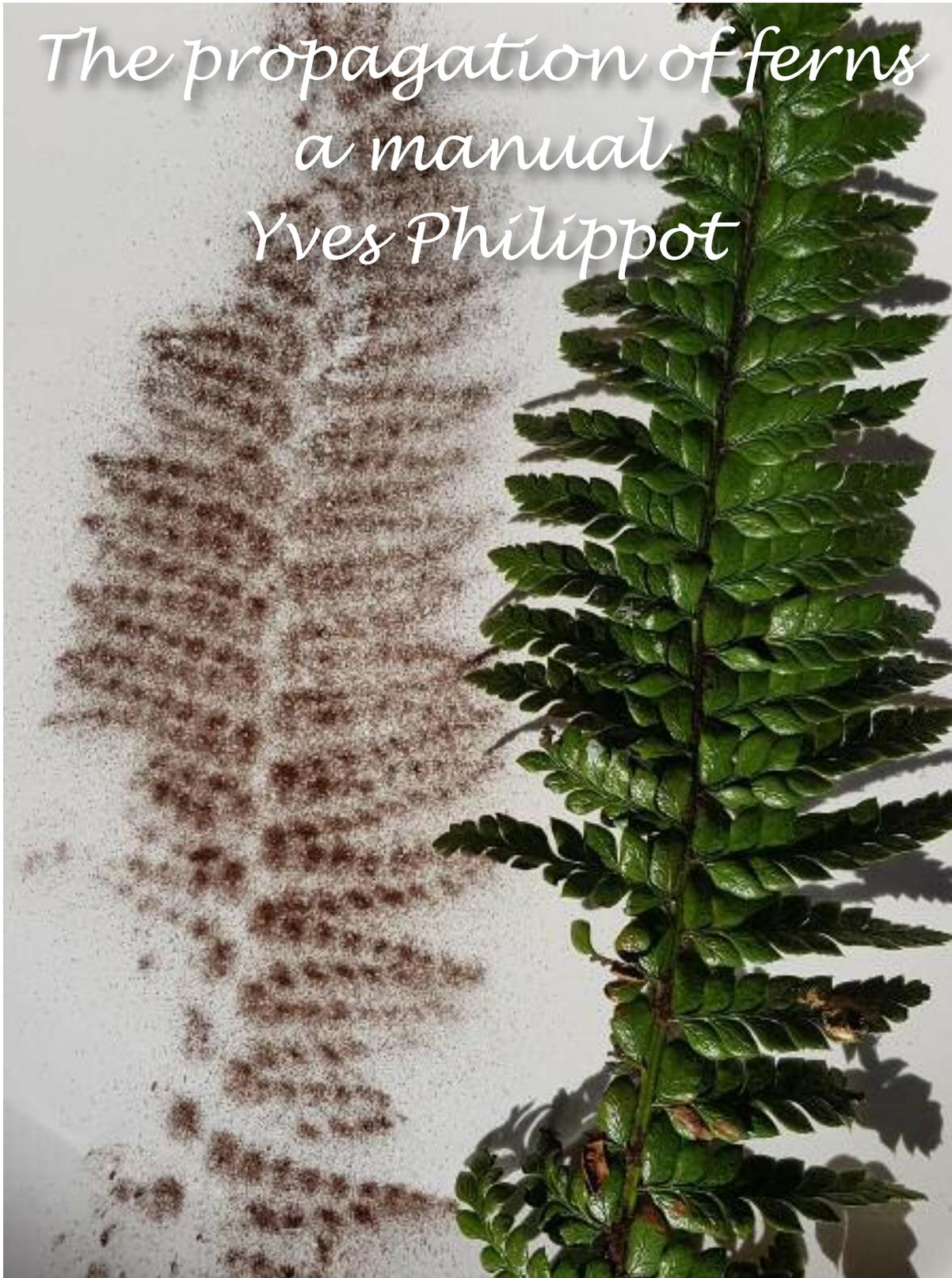


*The propagation of ferns  
a manual  
Yves Philippot*



By passion for Mediterranean, subtropical and other beautiful exotic ...

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Translated from the [original](#) French by Google and Yves Philippot

*Propagation of plants*

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*The propagation of ferns:  
a manual  
- Yves Philippot -*

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*The photos are from the author.*

It was after a trip to Réunion a few years ago that my passion for Pteridophytes really arose.

My garden is small, located on a north slope bordering the Arz valley in the Redon marshes in Brittany. The conditions are very good for the hardy ferns, which flourish in the shade of oaks, ash trees, elder trees... A cold greenhouse of 25 m<sup>2</sup>, insulated with double glazing, allows, in winter, to keep above cold ferns from 0 ° C. The veranda houses the most delicate species, which are heated to around 19 ° C during the day and 14 ° C at night.

The collection is one thing - I have about two hundred species, apart from those in the growing room - but my interest has really focused on the propagation of tropical and subtropical species, mainly by sowing spores.

After having researched the information necessary to start my experiments, I started my first boxes, with mixed success due to an insufficiently mastered growing technique.

Despite everything, I persevered, and, one day, traveling through the city of Vannes, I discovered, in an underground passage leading to a parking lot, a large tuft of *Polypodium* well installed next to a neon lighting, alone source of light from which this fern benefited.



*Polypodium* sp. in an underground passage in Vannes.



*Cybotium barometz* sporelings on clay balls.

From this observation, and after bibliographical research and contacts with specialists, I developed my approach to sowing and growing young fern plants in growing room.

I first fitted out an old refrigerator cabinet to accommodate the plantlet boxes, then two growing rooms totaling around thirty cubic meters.

Whether the propagation is carried out in a growing room or in any other favorable





Sori on the underside of a fertile frond of *Niphidium crassifolium*.



Sori of *Arachniodes webbiana*, more or less covered by an indusium.



Sporangia: You can clearly see the mechanical rings that, stretching under the effect of heat, tear the walls of the sporangia, releasing the spores.



Fertile frond and spores of *Asplenium hemionitis*.



Spores before sieving.

### *How to collect them?*

Beforehand, make sure that the spores are ripe. When the sori form under the leaves, they are very clear; they will darken as they ripen. But do not pick the leaves whose sori are too dark: the spores will have already been released. This can be seen with a botanist's magnifying glass, magnified ten times, with the mechanical rings open.

If the spores appear to be ripe, the leaf should be cut. If in doubt, it is possible to pick pieces of the fronds from several points of the plant; it is generally the spores located on the basal pinnae that are ripe first.

Culture is carried out in the most sterile environment possible; some authors recommend disinfecting the leaves by washing them with a chlorine solution dosed between 5 and 10%; as far as I'm concerned, I have never practiced this disinfection.

The samples are then placed in a large paper envelope or on a plate covered with paper, and stored in a dry and temperate room. Under the effect of heat, the spores will be released in a few hours, at most a few days.



Fertile leaf and spores of *Polystichum neolobatum*.



Sifting the spores with a tea bag.

The best, then, is to empty the envelope in a white plate, to differentiate between the spores and the waste of leaves, indusia ..., which must be separated. With a small paintbrush, sweep the bottom of the plate to isolate the larger debris and group the spores. At this stage, there is still tiny waste, which it is desirable to remove by sieving.

#### [How to sift them?](#)

Sieving is important because everything other than the spores are carriers of germs that can develop in the sporeling box. I have frequently seen a film of algae cover the substrate before the prothallia had time to appear. Sometimes, centrifugal fungal attacks will destroy all the prothallia.

I have made tests with many utensils - colanders... - and materials - fabrics, veil... The spores being extremely fine, the best I have found for the moment is the bag used for the loose tea from "Les Jardins de Gaïa", sold in organic stores. The format is 10 by 13 cm.

Over a white plate, I gently push the spores with a small brush into the bag, then tap the bag with the handle of the brush. Be careful, the spores are very light, they fly away at the slightest draft: it is advisable to use a mask. It is also necessary to work with very dry material. They stick easily to brushes, plates... Of course, cleaning or replacing the equipment between each species is essential to avoid mixing of spores.

#### *How to condition and preserve them?*

The duration of the germination power of ferns varies according to the species and the storage conditions. Some species produce so-called chlorophyll spores: the spores are green; this is particularly the case with the *Osmonda*. In these species, the shelf life of the spores is very short, in the order of one to two weeks. This type of spore must therefore be sown as soon as it is harvested.

For non-chlorophyllian species, the literature tells us that conservation ranges from a few weeks (*Cyathea*) to several decades, or even more than a hundred years (*Marsilea*).

To optimize conservation, it is important to store the spores in very good conditions: a paper that will not retain moisture to avoid mold and a temperature of 4 to 5 ° C. It is also possible to freeze the spores at -20 ° C, but I do not have any experience with this practice yet.



Chlorophyll spores of *Osmunda regalis*.



Ready-to-store spore pouches in the refrigerator.

I store the spores in very small envelopes that I make with organic baking paper (non-greasy); it is possible to use aluminum foil. Then, I put this folding in a small plastic bag that closes with a zip to avoid mixing of spores. This allows spores to be stored in the refrigerator for several weeks, but the earlier they are sown the better.

### Sowing spores

#### *Which containers for plantlets?*

The containers must be airtight to maintain constant humidity, and translucent to allow light to pass through, therefore in glass or plastic. Plastic food boxes are ideal. I use indifferently two models of dimension 13 cm x 10 cm x 6 cm, and 10 cm x 10 cm x 7 cm. If they are not new, these containers should be disinfected with bleach.

#### *How to prepare the substrate?*

Several culture media are possible, mineral type: pozzolan, clay ball, crushed brick, etc., or organic type. As far as I'm concerned I use a sifted mixture composed of peat 2/5, heather earth 2/5, perlite 1/5. This substrate must be well moist, but not soaked.

This medium must be sterilized. Several methods are possible for this: sprinkle with boiling water, put in the microwave for 10 min at maximum power, or in the traditional oven at 220 ° C for 20 min. It is this last method that I prefer. Generally, I prepare a large quantity, the surplus of which is stored in small sachets in the freezer.

Once the substrate has cooled, check that it is sufficiently humid, and add water if necessary. Be careful, the dosage of water is important: too much water will promote the development of algae and mold, and not enough will not allow prothallia to develop. In addition, fertilization is carried out thanks to humidity: it will therefore be necessary, during the development of the prothallia, to check the humidity occasionally and to vaporize water if necessary. For any water added after sterilization of the substrate, it is advisable to use either distilled water or boiled water. In theory, the water in the water service is free of germs; contamination is more likely to occur through the spray bottle, which should be remembered to disinfect regularly with bleach.

#### *How to do the sowing?*

Put substrate in the sporeling boxes to a thickness of about 2 cm, and smooth without too much tamping with the back of a spoon.

To sow, I open my small spore storage envelopes and, using a small brush, drop them in a cloud above the box. The sowing should not be too dense, otherwise it will encourage the development of moulds. We are often tempted to sow tight, especially when we have a large amount of spores available, but this is a mistake. Do not pack the substrate after sowing.

When sowing is finished, close the box tightly with its lid and identify it. For that, I use a labelling machine which allows to print self-adhesive labels; it is also possible to write on the box (not on the lid or on hang tags, which can be inadvertently inverted, which is a source of later identification problems). I note the name of the species, the origin and the date of sowing.

#### *How to store the sporeling boxes?*

The spores, in order to develop into prothallia, need light; for this reason, it is necessary to place the sporeling boxes either near a window (but never exposed to direct sunlight) or, if there is an installation, under artificial lighting. Attention, the development of the prothalli until the formation of plantlets is long. It usually takes several months, and sometimes well beyond a year. It is therefore important to take this element into consideration, as the storage space will be occupied over a long period of time.

For hardy species, which do not require a high temperature, it is possible to keep the boxes in an unheated room, a cold greenhouse... But development will be accelerated at a temperature of around 20°C.

For tropical species the temperature should be kept around 25°C.

#### *What follow-up for the boxes after sowing?*

Once stored in a suitable place, the boxes do not require special supervision, at least initially. I do not recommend opening them during the first weeks because of the risk of introducing pathogens. Gradually, the prothallia will develop; a slight greening appears on the surface of the substrate after a month, sometimes much more, then gradually the prothallia will appear. Depending on the species, the appearance can be different: intense green or more or less light, in a very thin layer or more "mossy" in appearance... The appearance can also vary according to the density of the sowing.



**Beginning of prothallium development.**

It may happen that the sowing has been too dense and that the prothalli are too tight; this can promote the appearance of fungal attacks, algae, etc. In this case, it is sometimes possible to save the prothalli which appear healthy by transplanting them into a new plantlet box. For my part, I have tried several natural treatments - cinnamon powder, etc. -, without success.



**Prothallus in progress of development.**



**Transplanting of prothallia.**



**Contaminated by mould.**

### *How to cultivate in a growing room?*

Growing mainly tropical or subtropical species, and for reasons of rationalization and efficiency, I have chosen to set up two growing rooms, with constant temperature and programmed artificial lighting. These two rooms are totally insulated, for one with 8 cm of polyurethane foam insulating panels; the other is an old cold room also insulated with polyurethane foam. Each is approximately 8 m<sup>2</sup> (16 m<sup>3</sup>). I installed a set of shelves spaced apart from each other by about 30 cm. Each shelf is lit by a LED tube whose

characteristics allow to obtain a lighting of approximately 1,400 lumens (24 W). The LEDs are of the cold type, at 6,200 K. Since ferns only produce leaves, this type of tube is the most suitable; moreover, it is commonly sold for household lighting. It is therefore unnecessary to use so-called horticultural LEDs for ferns.



**Sporelings undergoing centrifugal fungal attack.**

Each shelf is approximately 70 cm wide by 1.5 m long, which allows packaging of approximately 80 sporeling boxes illuminated by a single 24 W (1.5 m) LED tube.

Some shelves are used for the storage of a large quantity (14 per 1.80 m shelf) of mini-greenhouse of 24 cm x 37 cm x 25 cm, where the plantlets are transplanted in mini-clods (between 40 and 60 per greenhouse), then in a 6 cm pot (15 per greenhouse). A few larger translucent plastic storage boxes are also used for plants whose development requires them to be removed from mini-greenhouses.



**Boxes of sporelings in growing room under LED lighting.**

As the LED tubes give off a little heat and thanks to the insulation of the rooms, the heating only turns on very rarely. On the other hand, a ventilation triggered by thermostat allows to evacuate all the excessive heat.

There is no automatic control of humidity. Since the seed boxes are airtight, the control is carried out visually, and the water supply is carried out sparingly if necessary.

**Mini-greenhouses in growing room.**

In mini-greenhouses, humidity is maintained at a high rate thanks to a bed of sand or clay balls. When it is too high for a long time, fungal attacks are possible; it is therefore necessary to allow the evacuation of excess humidity by periodically opening the ventilation shutters of the mini-greenhouses.



### *How to transplant the plantlets?*

It is very common for some plantlets to appear much faster than others; they are generally intruders, often *Pteris*. I recommend extracting them fairly quickly, as their root system will quickly occupy a large volume, competing with other plantlets. Waiting too long will make the extraction process difficult and destabilize the substrate and the desired plantlets.

When the prothalli, after fertilization, have produced plantlets with two or three leaves, at this stage they are only 2 to 3 cm; it is possible to transplant in mini-clod trays. The longer we wait for the plantlets to grow, the more complicated the transplanting will be due to the degradation of the roots caused during the operation. But this is quite theoretical because, in fact, it is common for various reasons to delay and to be forced to transplant much larger plants. In this case, it is for example possible to completely soak the substrate in order to separate it from the plantlets, and to easily remove the latter without damaging the roots.

For transplanting, several situations are possible. Either the plants in the box have developed evenly, or the growth is uneven. In the first case, we will transplant all the plantlets in the box. In the second, only sufficiently developed plantlets will be taken delicately. Several successive operations of this type are therefore possibly to be considered.



Young plantlets ready for transplanting.



Transplanted *Cibotium barometz* plantlet in a plate of mini-clods.

The plantlets, at this stage, are very fragile; they must be taken with care, using a flat-tipped pliers, type philatelist's pliers. If the substrate is too dry, it is important to moisten it well so that the roots, which can be very long, do not break during extraction.

If the sowing is dense, individualized sampling is difficult; several plantlets must then be transplanted at the same time. Transplanting is carried out by making a hole in the substrate with a stick or the point of a pencil, and by inserting the roots of the plantlet up to the collar. Be careful not to bury the plantlets too much, the leaves appearing at ground level. Do not pack the substrate too tight or overwater. The nature of the transplanting substrate that I use is substantially identical to that of the plantlet boxes; it may vary slightly depending on the origin and brands of the components.



Plantlet ready for transplanting: the roots can be long.



Freshly transplanted plantlets in plates of mini-clods.

The resumption of plantlets after transplanting does not pose a problem if the roots have been preserved. The mini-clod plates are immediately placed in mini-greenhouses on a bed of moistened clay balls. As plantlets dehydrate quickly, it is important not to leave them out in the open for too long.



*Goniophlebium subauriculatum* in 6 cm pot.



*Macrothelypteris torresiana* in its basket hydroculture.

Like plantlet boxes, mini-greenhouses should be placed in the light, but not exposed to direct sunlight: near a window, in a greenhouse, or under a light in a growing room.

At this stage, the culture is carried out under stifling, that is to say that the ventilation flaps of the mini-greenhouses are closed. They are only opened if there is an excess of humidity producing too much condensation, which can lead to fungal attacks.

When the plantlets have sufficient development, they can be transplanted into various pots and continue their development in a mini-greenhouse or in translucent storage boxes, in a growing room or in a suitable room



Early plantlet development on pinnae of *Woodwardia prolifera*.

### *How to deconfine plants?*

Whether the plants are grown in a growing room, veranda, greenhouse or other favorable room, they thrive in a confined atmosphere at high humidity. Leaving this protected environment is tricky, because the young ferns dehydrate very quickly. This “deconfinement” must therefore be done gradually, over several days, by gradually ventilating the mini-greenhouse or the storage box. It is also possible to place one or more plants in a transparent plastic bag and open it or drill holes in it regularly.

### **Vegetative propagation**

#### *Rhizome cuttings and division*

Vegetative propagation is certainly the easiest way to get new plants in small quantities. Many ferns have creeping rhizomes from which it is possible to take a segment, *Davallia*, *Phlebodium*, *Polypodium*, *Phymatosorus*, *Stenochlaena* ... For these, choose a rhizome end with a beautiful terminal bud and having roots; install it in a substrate made up of peat, heather earth and sand, burying it very lightly, almost horizontally, the upper part of the rhizome remaining visible. Other ferns produce crowns or grow in clumps; for these, it is possible to practice divisions.

### *Transplanting leaf plantlets*

Certain ferns have the particularity of producing bulbils or leaf plantlets. *Woodwardia radicans*, *Woodwardia unigemmata*, *Blechnum longicauda*, *Cyrtomidictium lepiddocolon* ... will generate one, or even several bulbils at the ends of their long arched fronds which, when touching the ground, will develop roots and form fronds. In these species, it is easy to take these new plants.

*Woodwardia prolifera*, *Woodwardia orientalis*, *Asplenium bulbiferum*, *Asplenium daucifolium*, *Tectaria gemmifera* ... will form leaf plantlets from bulbils on the fronds. In the natural environment, these plantlets will fall to the ground, and some may give rise to new plants if the conditions are favorable. It is possible to take these from the mother plant and transplant them in a mini-greenhouse. I have practiced it in particular with *Woodwardia prolifera* and *Asplenium bulbiferum*.



Plantlets on pinnae of *Woodwardia prolifera*.



Transplanting of plantlets taken from pinnae of *Woodwardia prolifera*.



*Woodwardia prolifera* plantlets developing in a transplant box.



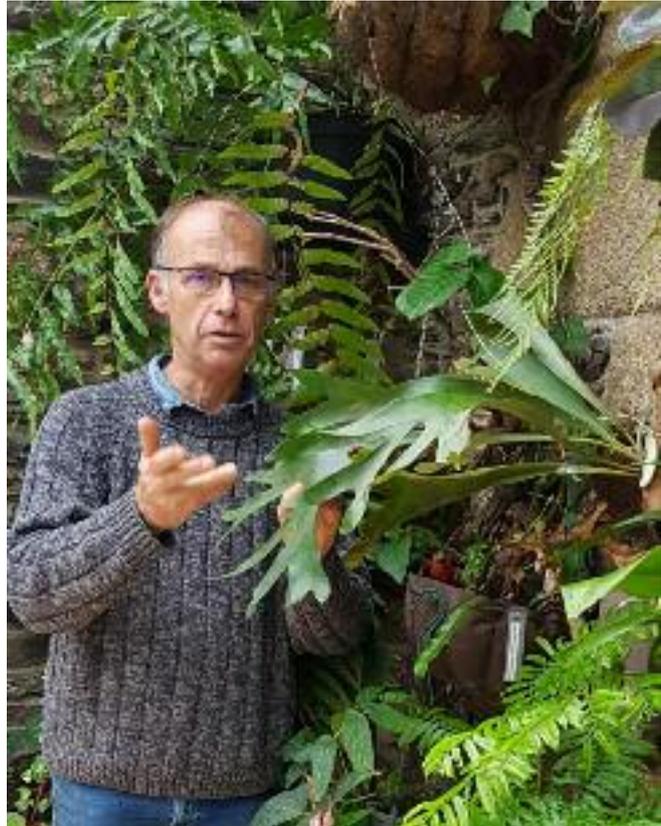
Plantlets on *Asplenium bulbiferum* frond.

### **Conclusion**

The choice of the type of propagation technique can therefore be variable depending on the morphology of the species and the number of plants that it is desired to obtain. If one or two is desired, division or rootstock cutting will be a quick fix. On the other hand, the sowing of spores will be essential for species where vegetative reproduction is not possible, and if one wishes to obtain a significant number of plants; but the germination period can be long, a few months for some species, several years for others ...

[Yves Philippot](#)

My passion for the living world, insects, snakes, rodents, birds that in my childhood shared my room or occupied aviaries in the back of the garden, and my interest in environmental education led me to work, for twenty eight years, within the Branféré Animal and Botanical Park, in Morbihan, owned by the Fondation de France. I initially developed educational activities there, the culmination of which was the creation of <<the School for Nature and People>>. I then held the position of technical and zoological director, and contributed to the renewal of the Park. The authors in plants goes back to my training as a landscaper, but my affection for pteridophytes really got



worse during a trip to Reunion. I started to plant many hardy species and developed fern propagation by plantlet spores. In 2015, with a nephew, Antoine Ruellan, landscaper DPLG from the School of Versailles, we created the garden “The collector of the shadow” at the International Garden Festival of Chaumont-sur-Loire. It was the opportunity to present nearly two hundred species of ferns in an unusual environment. This garden won the Design Award. Today retired, I continue my research on the propagation of ferns and like to share the knowledge that I have been able to acquire, in particular via specialized groups on Facebook.

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