At first we refused NASA, says the founder of the company PSI from Drásov near Brno. Now cosmonauts are using their products.

Martin Trtílek with a machine that uses light emitted from plants to determine whether they are stressed, how they are using water and whether they are dying.
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- **Martin Trtílek has succeeded in establishing a company with global prestige in Drásov near Brno.**
- **PSI has been developing and manufacturing instruments for plant research for more than 20 years. Now its owner also wants to focus on devices with broader appeal.**

An astronaut on the International Space Station may be conducting research into how the plant *Arabidopsis thaliana* thrives in zero gravity at this very moment. NASA has been studying this weed with small white flowers, a relative of the cabbage and white mustard, in space for many years. This April, the plant flew into orbit in a new growth chamber, and astronauts are monitoring what effect zero gravity has on it or, to be more precise, what effect zero gravity has on the substance from which the body of this plant, which is commonly found in the Czech Republic, is built. The cosmonaut takes a small FluorPen measuring instrument made not far from Brno and applies it to a green leaf, and all the required data can be seen on the display. There ends the moment of glory for this Czech device, at least until the next measurement is taken.

"Thanks to our work with NASA, the FluorPen has gained media coverage all over the world. I am delighted by this, as it is contributing in this way to the popularisation of science," says Martin Trtílek, who came up with the idea for a hand-held instrument that measures photosynthesis. Thanks to him, scientists can observe what's going on inside plants.

They are now using a FluorPen that's a little different from the terrestrial version on the space station. It can withstand more and can survive vibrations and radiation. "We put a lot of work into it. It would have been an embarrassment if they took it up there and it died on them," laughs Trtílek, and says that for such a small device it wasn't difficult to get all the certification necessary for use in space.

Martin Trtílek (49)

Studied electrotechnics at Brno University of Technology. He went into business while he was still at university and created his first instrument for plant research for a university in Illinois in the USA. In 1994, he founded the company Photon Systems Instruments (PSI) along with the scientist Ladislav Nedbal.

Trtílek is married with two adult children. His son has now also begun working at the company, though the company owner is in no hurry to hand the company over. "I have gradually trained myself to create defence mechanisms against all the problems that need to be solved. And that takes years of experience, and I can't just throw my son into it," he says.

In his free time, he likes sport. He goes diving and paragliding and rides a bike. He enjoys photography on his travels.

In addition to its space pen, Trtílek's company Photon Systems Instruments (PSI) also develops and manufactures hundreds of other pieces of equipment for plant research, many of which are globally unique. Instruments from Drásov can measure photosynthesis through fluorescence. To put it simply, they can use light to monitor processes that take place in a plant without the plant knowing about it.

Mendel's a great help

The Czech company could, however, have established co-operation with the American space agency twenty years earlier, when NASA contacted Trtílek to say it wanted an instrument for a project it was preparing to search for life on Mars.

At the beginning of the millennium, however, PSI couldn't afford it. It would have had to spend three years on the development of the instrument and then give it to NASA. For free. "The agency looks on the production of an instrument for research in space as a matter of prestige. I said no, lads, I can't do it. We didn't have the

capacity or the money. We couldn't afford to support that kind of research and production for three years," reminisces the head of PSI at its head offices in Drásov. Contact had been made, however, and it finally paid off in the end.

Today the company would have no problem providing such an instrument. In the twenty years since, PSI has won a place among the world's elite companies developing and manufacturing instruments for research into plants, algae and cyanobacteria. These instruments are used by elite universities, such as Cambridge, Oxford, Princeton and Stanford, as well as the Academy of Sciences, research centres and giant agricultural manufacturers such as the companies Monsanto and DuPont Pioneer. In Drásov, they often develop and produce instruments made to order and unique solutions for these organisations which scientists then use to perform various measurements and pieces of research.

Although Trtílek's company has global references, it still comes up against resistance to the fact that it is from the Czech Republic when it wants to win new customers abroad. "They look at us suspiciously. It would be simpler if we were Americans or Germans," believes the boss of PSI. The company always remembers that it comes from the land of Gregor Johann Mendel, the famous natural scientist, founder of genetics and discoverer of the basic laws of heredity. Trtílek believes new customers are more receptive to this.

We can foresee stress and bacteria

Trtílek realises that it's complicated to understand what his company actually does, so we leave the conference room and go outside and walk a few hundred metres among the greenhouses and fields to see it with our own eyes. The phenotyping line, which is also installed in Drásov, is one of the largest pieces of equipment made by PSI. To put it simply, it's a large greenhouse with a long conveyor belt inside on which there's a row of plants one after the other. They move through various analytic instruments which scan them and evaluate them according to stipulated requirements. The plants are then left to grow for a while before passing through screening again.

This lets the scientists know whether a plant is stressed, whether certain bacteria are spreading on it, how it is working with water, and whether it is dying. They can tell all this a few days before it starts to become evident on its flowers or crops. Lines like this are used during breeding, for example. Hardy individuals that have the kind of genetic make-up that will adapt better to the given conditions and thrive in them are looked for. "This has been done here for ten thousand years. Improvement was slow – farmers planted something, harvested it, looked at the result, chose the best individuals and then planted again, harvested… We can do it over a timescale of days or months," says Trtílek of the practical use of the line.

It takes the employees at PSI between six months and a year to make this equipment. They do it all themselves, from lighting and cameras right up to the software that evaluates the results.

“This is our great strength. We have lower production costs and can handle everything ourselves. We produce great added value,” claims Trtílek.

And then he adds casually that the company is now producing this line for Oak Ridge National Laboratory in the USA. These are government laboratories where American scientists perform critical research in the national interest. The atom bomb, for example, on which Albert Einstein worked, was created there.

Photon Systems Instruments (PSI)

The company was founded in 1994 by Martin Trtílek along with scientist Ladislav Nedbal. PSI is engaged in the development, research and production of equipment for studying plants and algae.

The instruments made by the company, which is based in Drásov near Brno, are used by universities, research centres and large companies around the world. PSI makes 500 various devices that cost from a thousand to a million Euro. Last year, the company recorded turnover of 270 million Czech crowns. It employs 100 people and has branches in the USA and Australia.

PSI also performs basic research and tries out its instruments on plants from the field on the site, where it grows maize and sunflowers, for example, and publishes its results in academic journals. PSI makes as much as 90 percent of all its instruments for science and research. The rest are used by ordinary farmers – for example, winegrowers can measure the sugars in grapes using a WinePen.

An expert in microelectronics who talks the language of the biologists

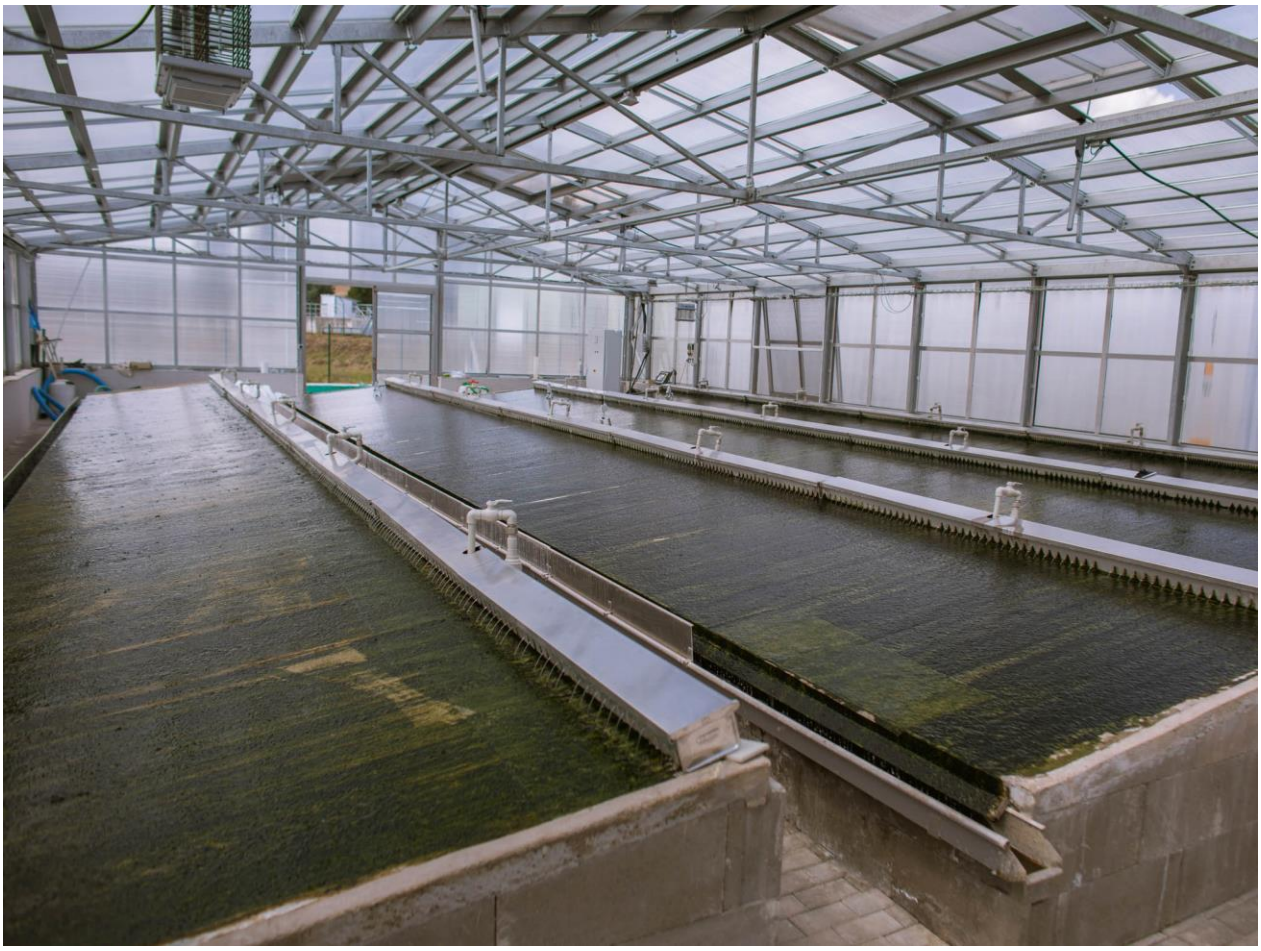
Martin Trtílek invented and produced his first instrument for plant research himself while he was still at university in the 1990s. He was working at the time for the Academy of Sciences, and the academy’s naturalist Ladislav Nedbal, who was at that time in the USA, approached Trtílek to ask if he would make him a fluorimeter. A fluorimeter is an instrument that measures the fluorescence in chlorophyll, the green colouring in plants. They then founded PSI together in 1994. They exported most of their production abroad, and it took several years before scientists in the Czech Republic got their hands on their products. “It was far from simple to convince people at home. They thought the money they spent on our instruments was just going in my pocket. Today, however, we have established good co-operation with a number of Czech universities,” says Trtílek of his work in the Czech Republic. His company, which he now owns outright, now has a hundred employees and a number of departments and laboratories. It makes hundreds of devices a year, the price of which ranges between a thousand and a million Euro. The company invests as much as 40 percent of its turnover in their development. Its turnover last year was around 270 million Czech crowns.

Trtílek still stands firmly at the head of the whole company. The company makes instruments and comes up with new research methods for the whole world based on his ideas. He sees his contribution as lying in the fact that he can, as he puts it, “speak both languages”. “I studied microelectronics and also had an education in biology and understand it. They are usually incompatible languages for most people, but when you can interpret them for people, you gain a

great advantage," says the head of PSI. This understanding is, according to him, also an advantage over the competition, as the company not only knows how to make instruments, but also understands what can be done with them and how.

Now he is trying to train his employees in this bilingual approach. He's not thinking of leaving the company. "There's no one to hand it over to. There's always someone wanting to buy it, but I don't see any point in that. The ideal thing would be for our key people here to make it on their own, but they don't want to as they know how much responsibility comes with that," he realises.

He's now having trouble turning his ideas into business. He has so many ideas that his company doesn't have the capacity to implement them all, and he's considering handing some of them over to someone else. "I offered to give the South Moravian Innovation Centre a few things that we have come up with but don't have the capacity to develop further," he says.



Plates purifying waste water.

Photo: Tomáš Škoda

One of these ideas is the wastewater purification that PSI has been testing in Drásov for a while in co-operation with the local water treatment plant. Trtílek reached an agreement with them for some of the water from the plant to flow through one of the company's greenhouses. This greenhouse contains four long series of concrete plates covered by a thin layer of algae over

which the water flows. “A wastewater treatment plant doesn’t clean water. It works by removing the sediments and bacteria it contains mechanically and breaking down other compounds. It can’t break down heavy metals, hormones or drug residues, however, and these remain in the water,” says Trtílek. The algae on the plates work as a biological filter and absorb substances that the bacteria in the treatment plant do not break down. Clean, almost drinkable, water then leaves the greenhouse. The system they have in place here purifies only a proportion of the water from a small treatment plant. More space and more money would be needed for a municipal wastewater treatment plant, and that’s a lot to ask of PSI. It is, therefore, looking for someone to get the project off the ground on a larger scale.

Farming in a container

PSI is now completing the development of a spectrometer. This is a basic instrument essential to any biology laboratory. It measures the intensity of the light under which plants grow. “The light meters that exist today do not measure the spectrum of light. As they do not record this information, each light meter measures a little differently,” claims Trtílek. The head of PSI sees additional uses for it, however, such as in offices where companies can use the instrument to find out if a room has the right kind of light to avoid damage to employees’ eyes. The mass production of these devices is easy business for PSI. It can manufacture a large quantity of them and sell them at lower prices than its scientific instruments. According to their boss, however, they do not provide such added value and there’s a good chance that someone else will copy the device soon. Although the company is doing very well from the production of unique devices for science, its boss is also determined to focus on more ordinary equipment for “the masses” so that he can see the practical results of his work. He doesn’t find out what the scientists are investigating with the use of his instruments very often.

Containers for urban farming could become a mass product from the company workshop. PSI has, originally for scientific purposes, managed to transform a shipping container into a special growth chamber. One of the company’s phenotyping lines mentioned above can be enclosed in one of these containers, and thanks to the fact that the container is mobile it can be taken in the fields and used to study plants in the terrain. Two investors from Canada have, however, decided to use the container for urban farming in the city where there is no room for people to cultivate their own fruit and vegetables.

The container works on the principle of a vertical farm and can be placed on the side or roof of a building. “The container is sterile inside and has artificial lighting, so it’s easy to maintain predefined conditions. The crops aren’t destroyed by mould or pests and do not have to be sprayed,” says Trtílek. The head of PSI thinks they can be used to grow the kind of crops that are imported – bananas and pineapples, for example – in order to save on transport. The company is now to be making a number of these containers for the enthusiastic Canadians to try out, and we will see whether they catch on on a massive scale. And this is just one of the ideas that would otherwise be gathering dust in Trtílek’s drawer.