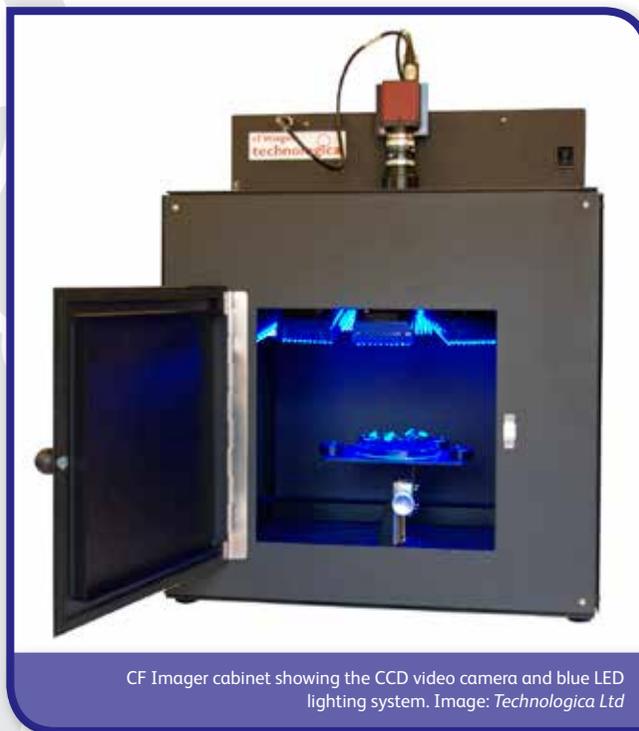


University of Essex spin-out company Technologica¹ was set up in 2001 to develop and market a range of instruments for advanced plant science research. From the outset, the company focused on the development of chlorophyll fluorescence imaging technology to measure active photosynthesis, an important indicator of the physiological condition of a plant². The technology was incorporated into Technologica's unique CF Imager system³, which enables rapid and non-invasive screening of plant samples. The CF Imagers developed by Technologica can analyse the physiological responses of plants, such as growth rates, to the experimental application of herbicides, genetic modification or stress conditions. The benefits to agricultural and horticultural businesses mean these systems have been supplied to commercial and academic plant laboratories around the world for over a decade.

Impetus for establishing Technologica came from research carried out by Dr Kevin Oxborough in the laboratory of Professor Neil Baker⁴ at the Department for Biological Sciences, University of Essex. Oxborough developed the scientific algorithms that could be used in a practical instrument to measure a range of chlorophyll fluorescence parameters⁵. Support for the research that would eventually be associated with the development of the CF Imager sold by Technologica came from BBSRC funding to Baker in 1994 and 1998, several other research funding bodies and the University of Essex.

“My main research interests are in factors that determine the efficient use of light in photosynthesis and the effects of environmental stress on photosynthesis. The development of the chlorophyll fluorescence imaging system has enabled new insights into many aspects of plant physiology in leaves, but also at cellular and sub-cellular levels,” says Baker. “Spinning out the imaging technology as a commercial operation made a great deal of sense; it’s now available to a worldwide market and helping, for example, to develop crops for improved tolerance to environmental stresses.”

One of Technologica's customers, Barry Elsdon of Syngenta⁶ has used one of Technologica's CF Imagers to better understand the relationship between maize and one of Syngenta's biggest-selling active ingredients. “Chlorophyll



CF Imager cabinet showing the CCD video camera and blue LED lighting system. Image: Technologica Ltd

fluorescence imaging has been used to influence decision making regarding follow-up of certain novel chemical analogues in relation to their phytotoxicity [toxic effect on plants]. We've also used the device in mode of action detection to good effect for providing robust useable

IMPACT SUMMARY

Spinout company Technologica, established in 2001 by researchers from the University of Essex, has developed a novel chlorophyll fluorescence imager (CF Imager).

The CF Imagers enable users to monitor the effects of environmental stress or the application of herbicides on plant growth and yield.

Since 2004, Technologica has sold more than 50 complete systems to academic users and agri-businesses, such as Syngenta and Monsanto, around the world.

data. The fact that the CF Imagers can accommodate high-throughput screening and enable rapid imaging of transient effects has distinct positive implications relating to glasshouse time and resource efficiencies.”

Gauging plant growth

In 2001, Oxborough developed a practical concept for a chlorophyll fluorescence imaging instrument using increasingly sensitive charged-coupled device (CCD) video cameras. He also approached John Bartington, a specialist in sensor technology at the University of Essex, about a critical aspect of fluorescence imaging – a lighting system that would be exceptionally linear and stable over a wide range of light and have a uniform spectral output. In response, Bartington developed a ‘pulse-width-modulated’ lighting system using LEDs and obtained a patent for the technology.

Following a two-year period of intensive collaboration between Oxborough and Bartington, a practical commercial design for an instrument was prepared. Bartington sold

the domain and corporate registration of Technologica Ltd to the University of Essex and, for two years from 2004, the CF Imager was manufactured under licence from the university⁷. In 2006, Technologica became an independent company with Bartington as the managing director and majority shareholder; Baker and Oxborough are also shareholders and remain as consultants.

The CF Imagers produced by Technologica are able to detect differences in photosynthetic performance caused by stress⁸, metabolic disturbances, patchiness in pores for respiration called stomata⁹, and can gauge potential plant growth and yield¹⁰. The systems are usually housed in cabinets that exclude outside light (although they are removable for some applications) and are sufficiently robust for laboratory bench and in-situ screening. Technologica's CF Imagers employ unique blue LED lighting to provide the consistent lighting required for detailed measurements of fluorescence, and high performance CCD cameras, controlled by the company's bespoke software¹¹. For rapid handling of plant material, it is possible to automatically identify and analyse 96 individual samples and screen up to six well plates a minute¹². Samples can also be handled in Petri dishes and plant pots.

A global market

Since 2004, the company has sold over 50 complete systems with a total turnover in excess of £750,000. Bartington is the managing director and majority shareholder of Technologica, while Baker and Oxborough are also shareholders and remain as consultants to the company. Customers for the CF Imager have included, for example, university departments in the UK and abroad, commercial firms, such as agri-business Syngenta and Monsanto, and plant laboratories in the Far East. In addition, the company has agents representing the business in China, India, Japan, Korea, Taiwan and Turkey.



Small well plate and seedlings on CF Imager's adjustable stand.
Image: Technologica Ltd

“CF Imager systems have proved their reliability and are setting the standard for chlorophyll fluorescence imaging. Our patented technology is ready to use ‘straight out of the box’ and provides plant biologists with easy to set up, automated, programmable analysis routines,” says Bartington. “The development work carried out at the University of Essex was vital to the success of the system – and the support of Professor Baker and Dr Oxborough continues to play an important role in our operations.”

This collaboration between Technologica and the university's research scientists continues to be a springboard for the development of new and innovative products. A plant conditioning system called IsoLight is currently being developed in conjunction with Dr Tracy Lawson, a senior research scientist at the University of Essex, which aims to provide high intensity light for growth and experimental treatment of plants.

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This company is included in BBSRC's spinout/SME database.