Chemiluminescence imaging of plants using a deep cooled CCD

Chemiluminescence imaging combines the sensitive detection of chemiluminescence with the ability to locate and quantify the light emission. Imaging makes use of the high sensitivity and specificity, low background and wide dynamic range of chemiluminescence to quantitate and localize analytes down to the level at which this can be achieved by emission of single photons.

It requires high sensitivity combined with long exposure times in order to be able to detect the few photons emitted by the chemical reaction of interest with the living organisms.

Deep-cooled CCD camera

Dr. Colleen Doherty, Assistant Professor of Molecular and Structural Biochemistry at NSCU investigates the connections between time and stress in plants, using time as a tool to interrogate the signalling networks that allow a plant to perceive and respond to a stress. This helps to understand how changes in temporal patterns (earlier springs, warmer nights) affect the productivity of crop species.

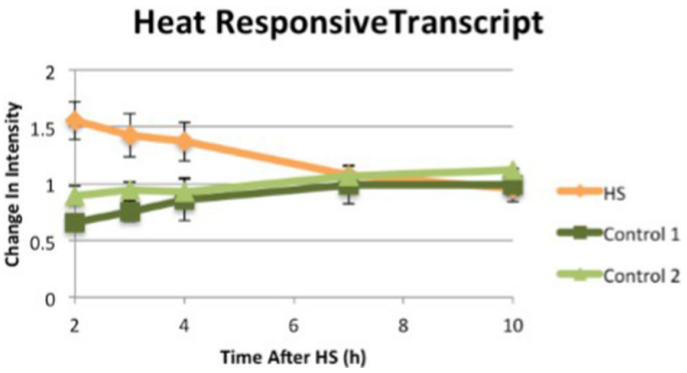

Figure 1: Heat Responsive Transcript

In her set-up, she uses a Raptor Photonics Eagle CCD camera in her study of the circadian rhythm in plants. Using Arabidopsis modified to express firefly luciferase Photinus Pyralis on a known heat shock gene she was able to observe unexpected expression in the roots of the plants. Both images were taken with 5min exposure and are about 45min apart before and after the heat shock. The increased luminescence is clearly visible in the roots.

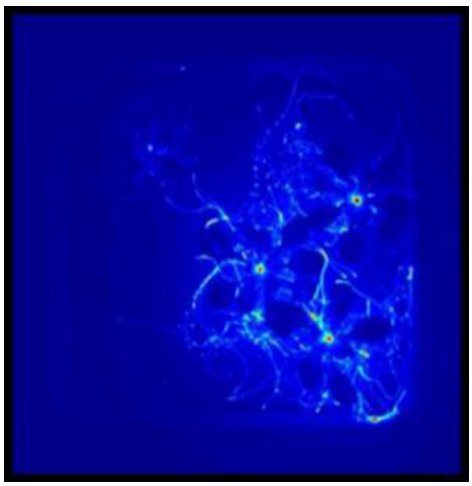

Figure 2: 5 min exposure before heat shock

Exposing a CCD for this period of time will cause the build-up of dark current on the sensor, which will degrade the quality of the picture. To counter this the camera needs to be deep cooled, in this case to -90°C. As you can see from figure 2 and figure 3, the quality of both images at 300 seconds is excellent.

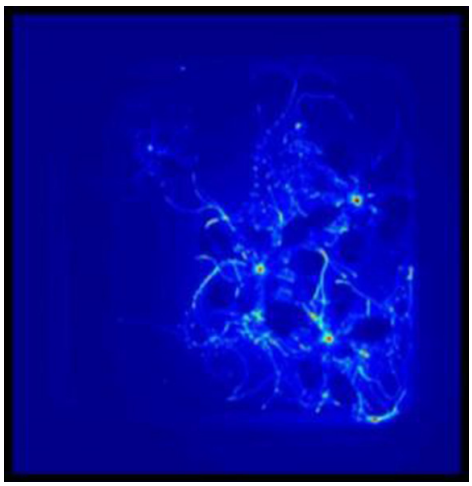

Figure 3: 5 min exposure after heat shock

Figure 4: Eagle CCD

- **Low read noise of <2.3e-**
- **Dual read-out rates of 75kHz and 2MHz, binning options up to 64×64**
- **7-year vacuum guarantee.** Protection and integrity of the sensor
- **Extremely low dark current.** Deep cooled to greater than -110°C delta enables long exposure times
- **Back illuminated 1MP and 4MP sensors from e2v.** Enables large field of view imaging
- **13.5µm x 13.5µm pixels (4MP).** Enables ultra-sharp image resolution
- **High QE: >90% @ 525nm and 50% @ 380nm & 720nm.** Optimum photon collection

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