

Measuring radiation in the environment following the Fukushima nuclear disaster, Japan

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After travelling to Taiwan in mid-July this year to visit the national synchrotron facility in Hsinchu, I was fortunate enough to visit Japan soon afterwards in late July/early August. I met up with long-time colleague **Prof Hiroshi Takesako** from Meiji University (Ikuta campus). We travelled to one of Meiji University's experimental field stations (established in 1945 after WWII) near Chiba city, which is northeast of Tokyo, not far from Narita airport. A group of scientists and technical staff from **Toshiba Company**, including **Dr Hirokazu Kanai**, undertook field trials at the station using a newly-developed, portable, two-dimensional gamma-ray visualization system known as a "Gamma Camera" (Fig. 1).



Fig. 1. The Toshiba "Gamma Camera" (under shade cover because of hot, bright sunny weather). (Lowe)

The gamma camera measures levels of ^{137}Cs fallout in the natural environment that arose from the Fukushima Daiichi nuclear disaster that followed the Tohoku earthquake and tsunami of 11 March, 2011. A video camera acquires an image of the target, in this case tea bushes and the upper soil profile beneath them (see Fig. 2), and then, over a period that depends on radiation and background levels, and other factors, measures real-time ^{137}Cs radiation levels using a two-dimensionally arrayed gamma-ray detector.

Fig. 2. The gamma camera and associated laptop computer measuring ^{137}Cs fallout from Fukushima on leaves and stems of tea bushes and in the underlying soil at the Meiji University experimental farm near Chiba. (Lowe)



The intensity and direction of gamma rays are displayed in the form of colour-coded pixels superimposed on the target image, ranging from blue (low) through greens and yellows to red (high) levels (Fig. 3). Portable shielding in the form of multiple sheets, each containing 10 kg of lead, can be hung on frames around, and placed beneath, the camera to help reduce background levels even further, both in the field and in the laboratory (Figs. 4 and 5). The camera has fixed a 60-degree view angle.

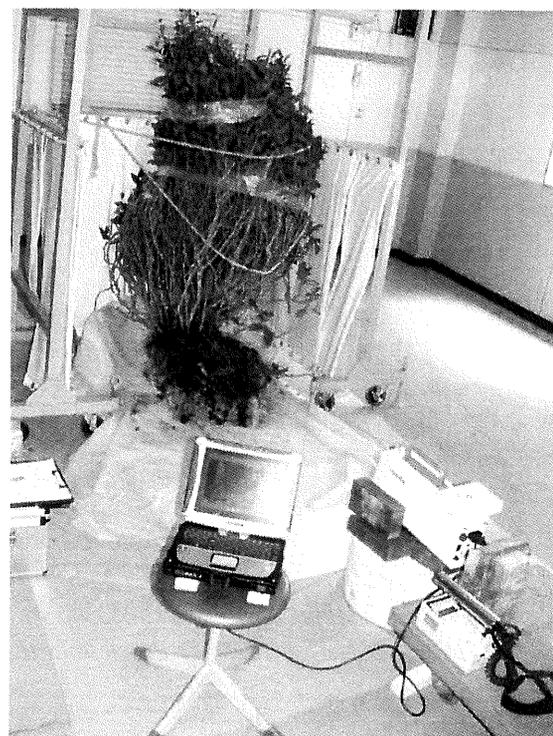


Fig. 3. Screen shot of laptop computer connected to the gamma camera showing real-time levels of ^{137}Cs on bushes and in the soil. Note three pixels in red representing "hot spots" (actually relatively low levels) at this site. A technician in white overalls is re-measuring the gamma radiation at one of the hot spots at top left with a hand-held detector. (Lowe)



Fig 4. Lead shielding being placed under and around the gamma camera in the field to help reduce natural background radiation levels so that the camera is more efficacious. (Lowe)

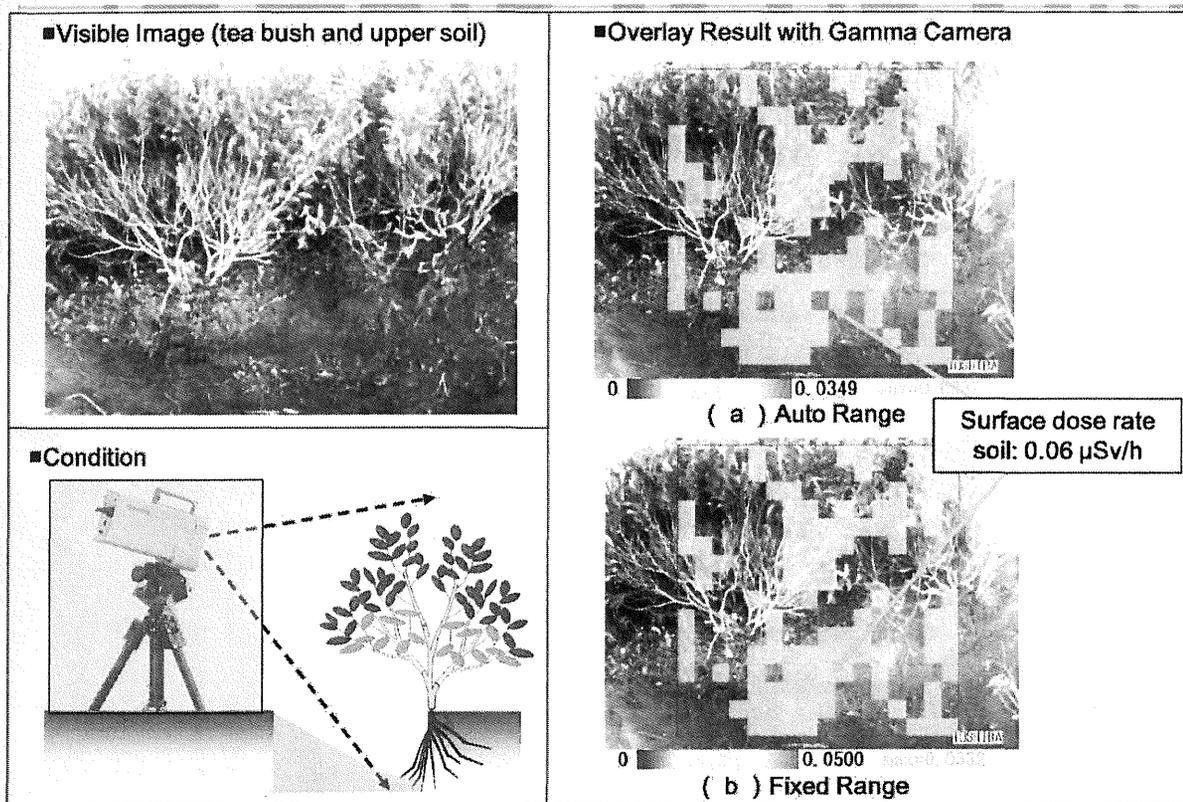
Fig. 5. Gamma camera set up in a laboratory situation indoors with full lead shielding in the white 'sheets' hanging alongside and placed beneath the camera. Note also 10-kg lead blocks right next to the camera itself. (Lowe)



The Toshiba crew has been measuring and mapping radiation levels around the damaged Fukushima nuclear power plant and it is now assessing levels at more distant sites to see how far the radiation has spread. The levels at the Chiba experimental station were very low, seemingly about 1/100th or less than those measured near Fukushima. The measurements on the tea plants and the soils took about an hour to acquire at Chiba. Where levels are much higher, the radiation from a “hot spot” can be identified at the camera sensor from around 30 seconds to about 3 minutes.

The results of the measurements are displayed as a composite set of image, the units being microsieverts per hour ($\mu\text{Sv/h}$), as illustrated in Fig. 6.

Typical Image by Gamma Camera



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Fig. 6. Results as displayed/presented by Toshiba to illustrate radiation levels at the Meiji University experimental farm at Chiba. Provided by Dr Hirokazu Kanai (Toshiba Corporation). (Lowe)

Acknowledgments

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