Humble garden pea helps scientists develop 'cool,' noninvasive diagnostic test of seed quality

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Scientists from Kew's Millennium Seed Bank in the United Kingdom and the University of Graz, Austria, have developed a rapid, new method to diagnose seed quality non-invasively and in real time. The results are published online in the *Proceedings of the National Academy of Sciences* and have great significance for conservation ecology and agriculture.

By using infrared temperature measurement, seed viability results are achieved in less than two hours. Until now time-consuming germination tests, taking up to three days, were used to assess seed quality. Conventional tests are also destructive, which is not ideal when assessing the seeds of rare and endangered plants.

Dr. Ilse Kranner, from Kew's Millennium Seed Bank, and Prof. Gerald Kastberger (University of Graz, Austria) found that infrared cameras can be used to detect subtle changes in temperature when seeds take up water. These changes vary with viability.

The thermal profiles of hundreds of garden pea seeds (Pisum sativum) were recorded. For each individual seed 22,000 images were analysed to construct a library of "thermal fingerprints" that allowed the scientists to distinguish between viable and dead seeds in less than two hours.

When a dry seed takes up water, the sugar within the seed dissolves, and this process cools the seed down. The temperature of a single pea seed

falls rapidly by 2 to 3°C. Viable seeds maintain cool temperatures because they break down storage reserves into sugar.

In aged seeds, certain biophysical properties are affected that determine the speed of water uptake. Aged seeds also fail to break down their reserves, or can only break them down after a phase of repair, delaying the thermal profile. To date such processes were studied with destructive methods that involved grinding up seeds, whereas the new infrared-based method is a breakthrough in the non-invasive diagnosis of seed quality. It means viable seeds can be separated, re-dried and stored again.

Non-invasive techniques are widely used in medicine, for example CT scans of the body, and some airports also use infrared cameras to detect fever in passengers.

Importantly, the opportunity to select live and dead seeds prior to germination is a useful tool to improve studies into the fundamental principles of ageing and cell death, which are similar in plants, animals and humans. This research can potentially be applied in areas such as cancer research.

Wheat (Triticum aestivum) and rape seeds (Brassica napus) were also studied by the British-Austrian team to provide a proof of concept for agricultural seeds.

The seeds of 10% of the world's wild plant flora are safeguarded at Kew's Millennium Seed Bank at Wakehurst Place in West Sussex, with the aim to conserve a maximum of plant diversity for future generations.

More information: Doi:10.1073/pnas.0914197107

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