inCiTe™ 3D X-ray Microscope
BrillianSe X-ray Detector

Applications in Agriculture and Nature

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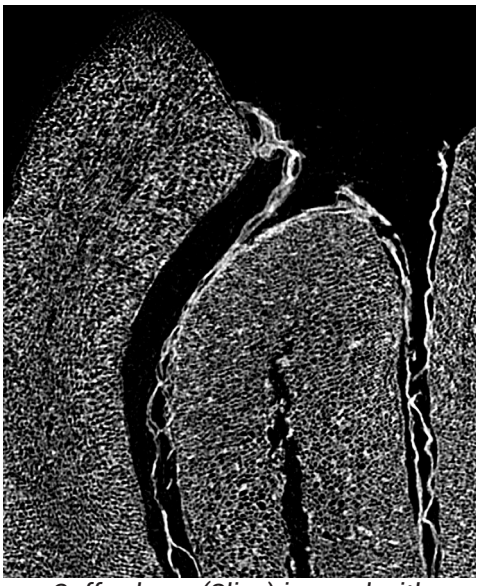
KA IMAGING™

INTRODUCTION: X-RAY IMAGING IN **AGRICULTURE**

X-ray imaging can play a significant role in agriculture by providing insights into the quality, structure, and composition of crops and agricultural products. Specifically, x-raying can be used for:

- **Quality assessment of seeds and grains** to assess grain quality and defects such as cracks, insect damage or hollow seeds that may affect the crop yield.
- **Detection of plant diseases and pests** to minimize crop damage, such as tunnels created by insects and fungal or physiological disorders.
- **Soil structure, compaction and root distribution** can be analyzed using X-ray computed tomography (CT) to understand soil health, nutrient availability, and fertilizer management strategies.
- **Post-harvest quality assessment** to evaluate the internal characteristic of harvested fruits, vegetables, and other perishable agricultural products. Internal defects such as cavities, bruises or foreign objects can be detected without damaging the product.



Coffee bean (Slice) imaged with BrillianSe™ 40 kV, 200 uA scan

DIFFERENT **TECHNIQUES DIFFERENT** NEEDS

There are many X-ray solutions currently available, each with its most suitable applications. Solutions currently on the market, however, cannot deliver high resolution images without compromising radiation dose.

X-ray radiography captures two-dimensional X-ray images of agricultural products, such as seeds, grains, or fruits providing you with information about internal structures, defects or for foreign objects. The overlapping of information in the projection/radiograph, however, can cause some difficulty in distinguishing defects/diseases.

X-ray computed tomography (CT) generates three-dimensional, high-resolution images of agricultural samples to analyze internal structures, root systems and soil profiles.

X-ray fluorescence (XRF) spectroscopy analyzes the composition of agricultural samples to determine soil nutrient concentrations, detect heavy metal contamination, or the mineral composition of plant tissues. XRF requires specific equipment and expertise for sample preparation.

X-ray diffraction (XRD) analyzes the crystalline structure of agricultural materials, such as soils, minerals, or plant tissues. It provides information about mineralogy, crystallinity, and phase identification. XRD equipment can be expensive, and the technique requires sample preparation and expertise in data interpretation.

X-ray fluorescence imaging (XFI) combines X-ray imaging and XRF spectroscopy to map agricultural samples. You are then able to visualize and quantify nutrient distribution, metal accumulation or chemical reactions within plant tissues. XFI systems can be complex and costly, limiting their widespread adoption in agriculture.

KA IMAGING'S SOLUTION: **MORE** RESOLUTION, **MORE** CONTRAST, **LOWER** RADIATION

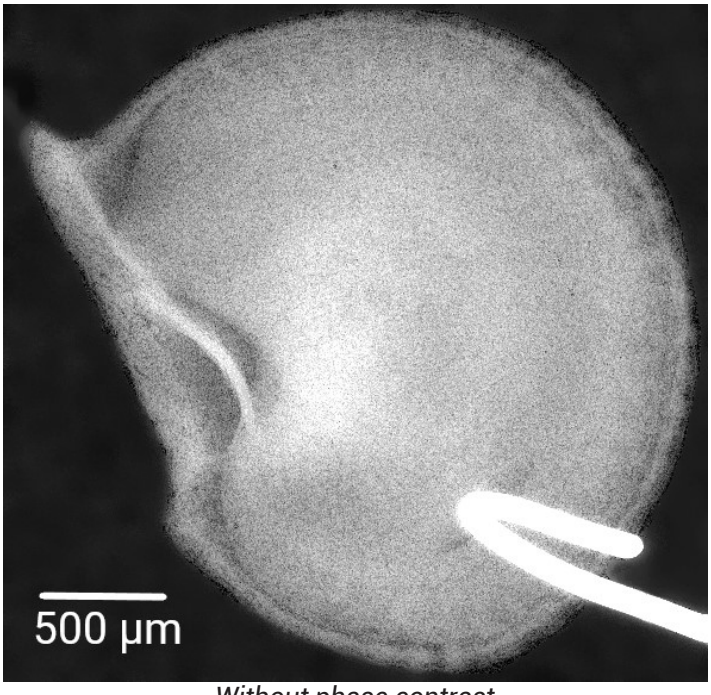
KA Imaging offers two unique products for agricultural x-rays:

BrillianSe™ is a selenium (a-Se) CMOS direct conversion detector. It provides a unique combination of high spatial resolution and high Detective Quantum Efficiency (DQE) for energies up to 100keV. This combination enables efficient imaging at low flux and high energy, as well as propagation-based (grating-less) phase-contrast enhancement for improved sensitivity when imaging low-density materials.

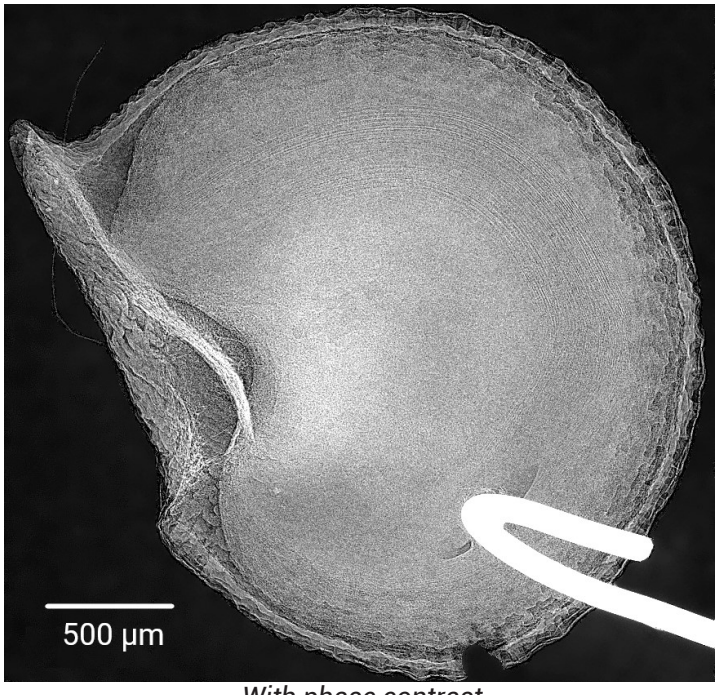
inCiTe™ 3D X-Ray Microscope is the first commercial scanner that utilizes BrillianSe™ x-ray detector and is designed with patented propagation-based, phase-contrast imaging to enhance detail of the fine structures that are typically X-ray transparent.

PHASE CONTRAST TECHNOLOGY FOR **SUPERIOR CONTRAST**

X-ray imaging of seeds supports quality control, research, contamination detection, and viability assessment. By providing a non-destructive and detailed view of the internal characteristics of seeds, X-ray technology assists in ensuring seed quality, enhancing agricultural practices, and supporting scientific investigations. Below, note how the phase contrast allows for better visualization of the bell pepper seed.



Without phase contrast



With phase contrast

INNOVATIVE TECHNOLOGY FOR FURTHER **ADVANCEMENTS**

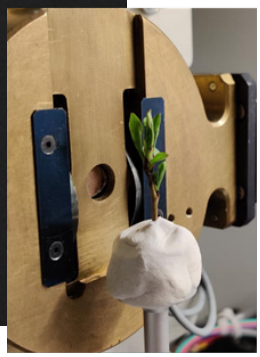
In this case, the **inCiTe™ 3D X-ray Microscope** was used to investigate xylem tissue in plant stems and leaves (dead, fixed, and CPD tissue).

The device is being used in a longitudinal study to investigate how vulnerable the plant is to drought stress.

The **inCiTe™ 3D X-ray Microscope** can image in plants at the highest speed and contrast. available in a micro-CT.

Propagation phase contrast X-ray imaging enables orders of magnitude improvement in detectability of features with weak X-ray absorption and low density materials such as plants, stems and leaves.

Note that the 2D phase image clearly shows nice boundary delineation enabling resolution of more features.



Contact our team if you have a sample or would like to try a new application.

Stem imaged with inCiTe 3D X-ray Microscope, 40 kV, 100 uA

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