



Automated germination and vigour test  
for sugar beet seed

**phenotest**

## Rethinking seed quality

As a producer of sugar beet seed, we aim to provide only the best seeds to our customers. The most important feature that measures the quality of seeds is germination – the ability of seeds to germinate and produce "normal" plants.

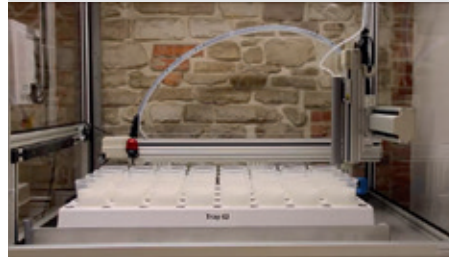
All official germination tests are therefore based on determining percentages of normal, abnormal and non-germinated seeds.

Usually these values are determined with a visual assessment. In the protocols of conventional germination studies, no further assessment of the quality of the plant is intended for a normally germinated seed. However, the quality of the plant has a significant impact on the speed of field emergence, the quality and homogeneity of the plants and the rate of their development. All of these factors significantly affect the expected yield. This is exactly where the phenoTest from Strube comes in.

## Phenotyping in all four dimensions

Together with the Fraunhofer Institute for Nondestructive testing, IZFP, we have developed a new test, the phenoTest. We use it to check the germination capacity and vigour of our sugar beet seeds in an automated and digital process. Instead of a visual assessment of germinating seeds (which is inevitably subjective), the seeds are x-rayed in closed containers using 3D computed tomography. We can repeat this any number of times during the germination process, whose dynamics we can thus track in "4D".

An image analysis program recognises the germinating seeds and seedlings and measures them in real time.



Watering of the germination pots containers



Standardised temperature and light exposure during germination



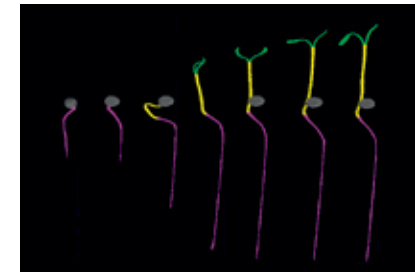
Samples are transported into the CT automatically



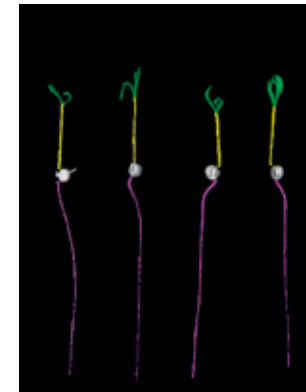
3D volume images are reconstructed from 2D x-ray images

## From germination capacity to vigour

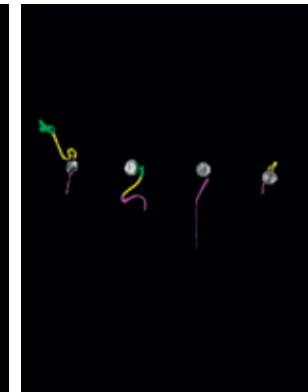
We phenotyp, i.e. describe, the individual seedlings in terms of size, volume and shape of their individual organs (root, hypocotyl and cotyledons, marked in colour in the x-ray images).



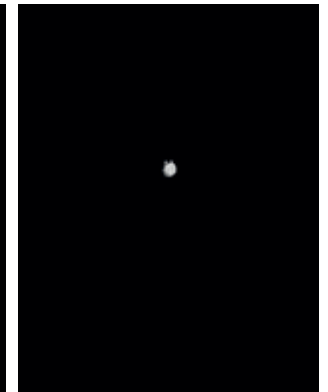
Germination of a single seed tracked over the time course



normally germinated



abnormally germinated



non-germinated

An algorithm classifies the seedlings as "normal", "abnormal" (indicating the type and degree of the aberration) and "non-germinated" and describes the quality of the individual plants. In addition, we receive 3D image data of each individual plant, documenting the results.

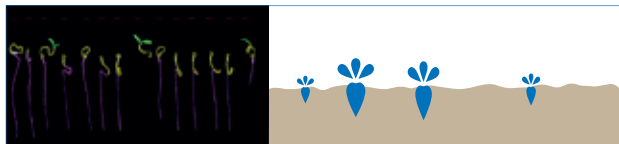
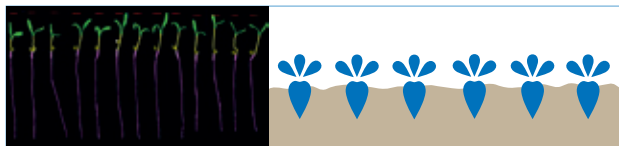
With all of this data we collected, we can make statements beyond the conventional determination of germination ability. We are also able to tell how quickly our seeds germinate and develop and how strong and resilient they are. That is how our phenoTest also determines the seedlings' vigour.

## What is the benefit of the phenoTest?

When we gain additional information about the quality of the individual plants and the dynamics of their growth, we can objectively measure the influence of, for example priming, pelleting, seed treatment, aging, etc. on the seeds' capacity to germinate and, above all, on its vigour and the homogeneity of a seed batch. The findings help us to further optimise our seed according to our insights.

phenotest

## Vigour and homogeneity



The speed of the field emergence, the quality of the individual plants and their vigour have a significant influence on the homogeneity in the field and on the stress tolerance of the growing plants.

The phenoTest detects heterogeneous seed batches, which would result in heterogeneous field emergence. These lots can be optimised by further seed processing or are excluded from commercialisation.

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