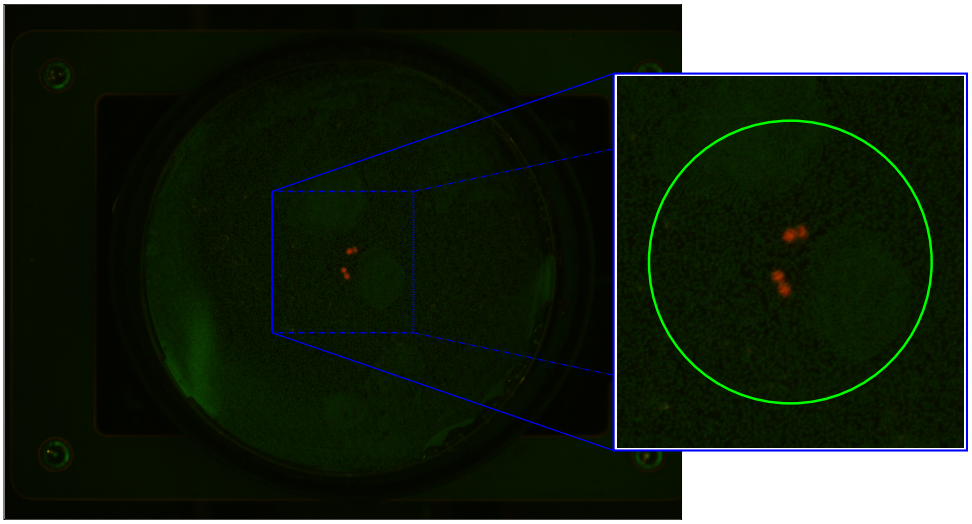
Germination Detection Assistance Tool
gdat v0.1 – Quick guide

Michael Henke, Evgeny Gladilin

e-mail: {henke, gladilin}@ipk-gatersleben.de
Research Group Image Analysis
Leibniz Institute of Plant Genetics and Crop Plant Research (IPK Gatersleben)
OT Gatersleben, Corrensstraße 3, 06466 Seeland, Germany

March 5, 2020

A tool to identify the point of germination within florescence images



Contents

1 Introduction

gdat was developed as assistance tool aiming to provide computer aided support during the detection of time point of germination (to be precise: the time point of first occurrence of the shoot at the surface). The tool is designed to process a set of fluorescence images (Fig. **??**) in a fully automated way.

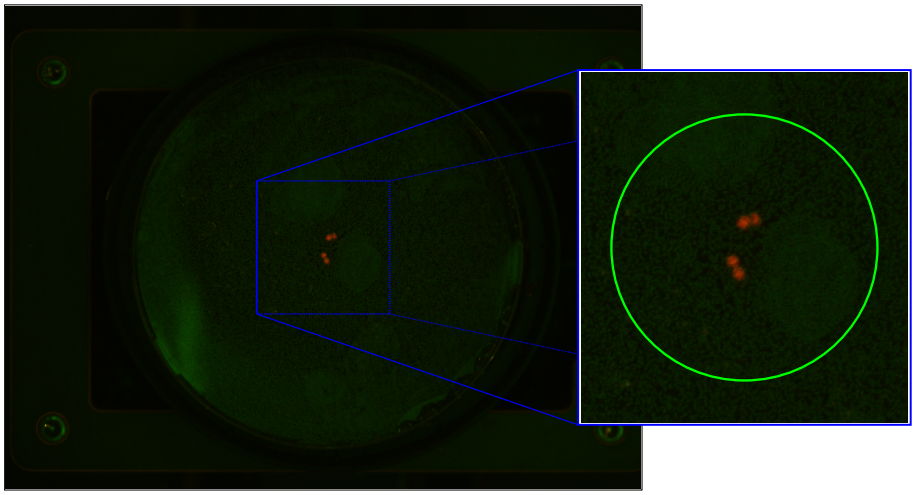


Figure 1: Example image of a single pot together with an detail enlargement. The small red dots are the first two leaves of two arabidopsis plants.

The detection of germination and the first occurrence of the shoot is an important information for many biological questions. To detect the first occurrence of shoots one can make use of the fact that chlorophyll containing plant organs are fluorescing red. Therefore, the occurrence of such red pixels within an image can be taken as indicator for germination/occurrence of a shoot. After a very short calibration, the tool automatically counts the number of red dots within a defined radius around the expected plant location. The number of red dots is further used to determine if plant material is visible or not.

1.1 Key Features

The gdat is implemented to automatically process a set of fluorescence images consisting ether of one, six or 12 plants in order to calculate the number of red pixels within each spot. The results are written into a database file.

- three pre-defined pot arrangements (single pot, 6 tray, 12 tray)
- automated detection of plant locations within each pot
- variable ROI definition (to define the search area around the expected plant location)
- definition of a minimal red intensity (values below are not taken into account for the calculation)
- automated calculation and storage of the results

The user can adjust diverse algorithmic parameters to influence the behaviour of the calculation.

2 Quick Start

2.1 How to install?

After unpacking the zip archive following two folders will be generated:

```
gdat
├── mask
└── quickGuide
```

The *gdat* folder contains the pre-compiled executable of the computer program, example grid layout files, a readme- and a license file. Please, read both text files carefully before starting the program. The *quickGuide* folder contains a copy of this file. Example data can be download from the project page as described in Sec. 3. The *mask* folder contains the image mask to cut out the individual pots from the images. Plants are expected at the centre of the indicated regions.

2.2 How to run?

The gdat comes compiled in two versions, one for Linux- and one for Windows-based operation systems, respectively. To run the program the user has to install the MATLAB Runtime Environment. Since the gdat was developed, tested and compiled under MATLAB 2018b, we recommend to install exactly the same version, i.e. MCR 2018b, which can be downloaded from the official MATLAB side Install and Configure the MATLAB Runtime.

2.2.1 Linux

Under Linux-based operation systems one has to open a terminal and switch to the folder which contains the gdat . Then type

```
./run_gdat.sh /path/to/your/MATLAB/Runtime/v95
```

where */path/to/your/MATLAB/Runtime/v95* specifies the path to the locally installed MATLAB Runtime Environment (version 2018b - v95).

2.2.2 Windows

To run the program under Windows double-click on the icon of the provided executable in the Windows file explorer or start it with its name from the command line.

2.3 The Interface Layout

The major elements of the software interface include an **Input-area** at the upper part and an **Output-area** at the lower part of the GUI as shown in Fig. 2.
At the input area, the user can select the folder containing the input images, define the underlying pot layout and set the algorithmic parameters. All images at the input folder are required to have the same format and layout (see, Sec. 3). After the input folder was selected the first image is processed according to the defined settings. A live feedback at the lower part of the GUI (Fig. 2) is given directly.
For each spot an enlargement is given including the number of red dots found within the specified circle at the upper left corner (see Fig. 3). The colour of the circle indicates the probability of the absence of a shoot under the current settings:

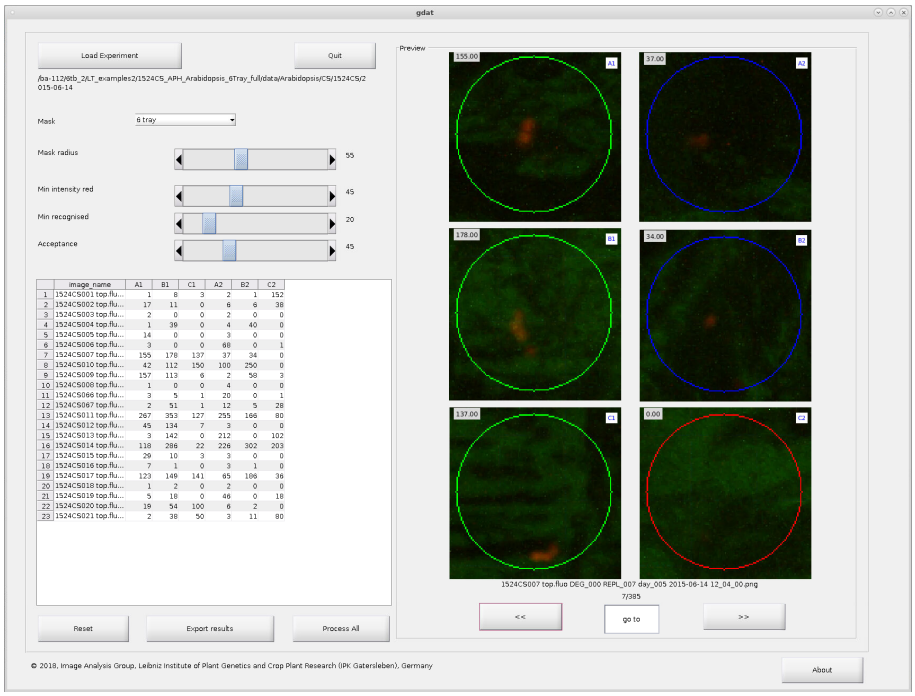


Figure 2: The graphical user interface (GUI) of the gdat .

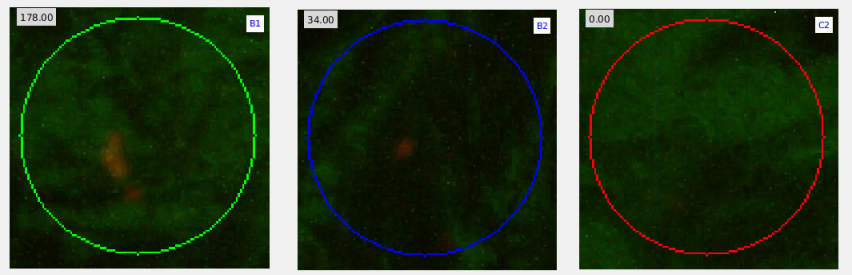


Figure 3: Enlargement of the visual feedback panel. Each plot stands for an individual expected plant location.

red probability no plant visible; number of found red pixels below the defined threshold

blue probability plant material is visible; number of found red pixels leads to the assumption that there could be some plant material visible

green plant visible; number of found red pixels is higher then the user-defined threshold for acceptance

2.4 First Run

The typical steps to analyse an experiment (a time series of images) are:

1. (optional) set the layout of the pots (single pot, 6 tray (default), 12 tray)
2. select an input folder (containing a time series of images)
3. (optional) adapt the parameter settings
4. analyse a few images "manually" one by one to find the right value for *min intensity red*
5. (optional) set the threshold values for the visual feedback
6. call "Process all" to run the automated analysis
7. export/save the results

To run the program, the user has to first set the expected pot layout before an experiment can be loaded. Once the folder was found and successfully imported, the first image is automatically analysed.
The user now has the chance to adapt some algorithmic parameters. These parameters are:

radius radius $[pixel]$ of the sample spot; all pixel within a circle of the defined radius are considered for calculation. The preview of the selected sample spot are automatically updated after every change.

Min intensity red minimal intensity for red pixels; defines a threshold value

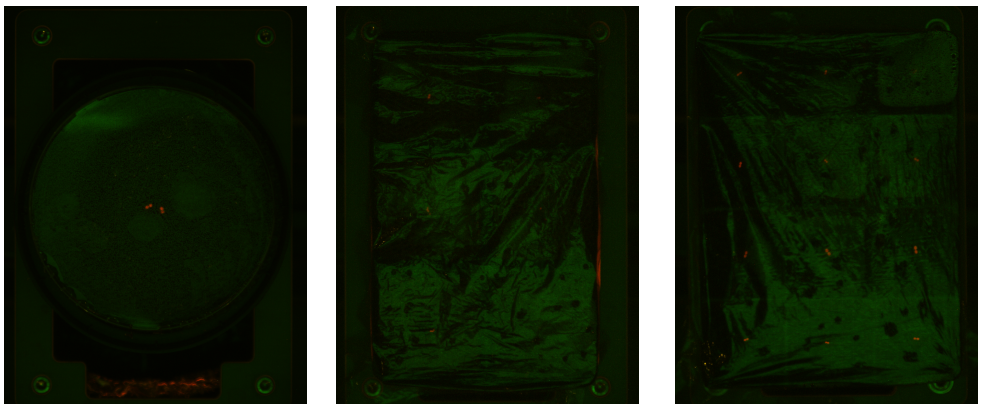
Min recognised defines a threshold value: absolute number red of pixels with an intensity higher then "Min intensity red" found withing the circle of radius "radius" which indicates that there could be some plant material visible

Accepted defines a threshold value: absolute number red of pixels with an intensity higher then "Min intensity red" found withing the circle of radius "radius" at which one could be suer that there is plant material visible

By clicking on one of the preview images, the user can switch between the full RGB image and an image containing only the for the calculation considered red pixels.

3 Provided example data

The gdat comes with three sets of example images consisting of a few images of three different pot layouts: 1) single pot, 2) 6 tray, and 3) 12 tray
The images can be download separately from the project page at https://ag-ba.ipk-gatersleben.de/gdat.html



(a) single pot (b) Six tray (c) Twelve tray

Figure 4: Example images for each processabel pot configuration.

A Funding

todo

B Acknowledgments

We would like to thank ... gott und der welt für alles und nichts ... todo.

C Links

For details of the abc facility we refer to the description on companies web side (https://www.abc.com/products/image.html).

D References

[1] todo, todo, todo

E Terms of use

1. The gdat and the example image data are distributed for non-commercial usage WITHOUT ANY WARRANTY under the terms described in the EULA license. See the included *EULA.txt* file for details.

2. The user manual is intellectual property of the Image Analysis Group of the IPK Gatersleben. The user may download and use the tool and information available on our web site.

Copyright