



Using image analysis in DUS tests for rape cotyledons

Kathrin Zepf, Thomas Drobek

Biostatistik, Informationsverarbeitung,

Kommunikationstechnik

Bundessortenamt

Osterfelddamm 80

30627 Hannover



Introduction

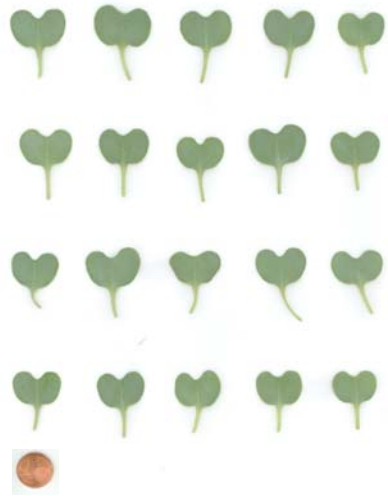
- Bundessortenamt responsible for tests for Plant Breeders Rights and National List
- measurement of characteristics using image analysis a practicable method in the DUS tests (test for **d**istinctness, **u**niformity and **s**tability)
- calculate characteristics like length, width and area of parts of plants from images



Image analysis support variety testing

- Standardized algorithm removes the subjective inaccuracy in measurement results
- Characteristics, which are difficult to measure manually, can be assessed more exactly
- Amount of work can be reduced.
- Visual assessments of characteristics can be replaced by measurements.
- Additional characteristics can be used for DUS testing

Measure rape cotyledons



- a routine method at the Bundessortenamt since 1998
- about 700 varieties in three replications per year
- 20 cotyledons are measured per variety and replication
- $700 \times 3 \times 20 = 42.000$ objects per year
- length of cotyledons varies from 10 to 15 mm

Program and technique



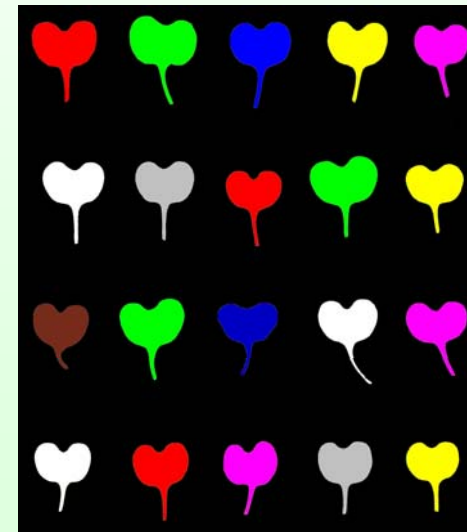
- cotyledons are fixed on a paper sheet
 - digitalized by a flat bed scanner
 - images receive unique file names
 - running an image analysis routine automatic
-
- determines the objects (cotyledons) and calculates the characteristics
 - results are stored in a text file

Program and technique

- program language C, runs inside the toolbox SCIL-Image (Dutch program with standard image analysis routines)

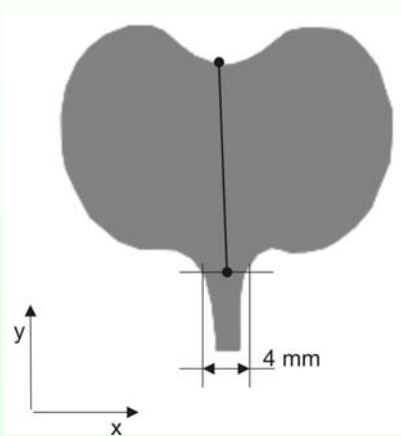


Original image
(scanned cotyledons)



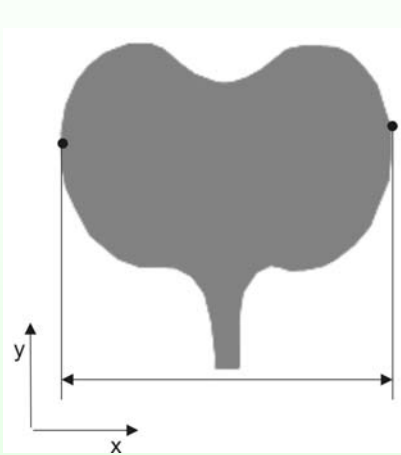
Objects
(„labeled“ image)

Calculated characteristics - length



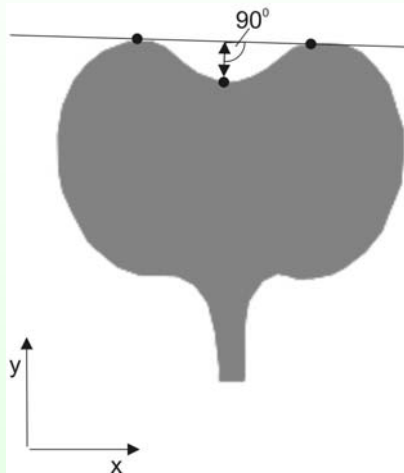
- distance between the inclination at the top and the point where the width of the petiole is about 4 mm
- special problem by manual measurements
- time-consuming and error-prone
- image analysis algorithm makes the measurement more precise

Calculated characteristics - width



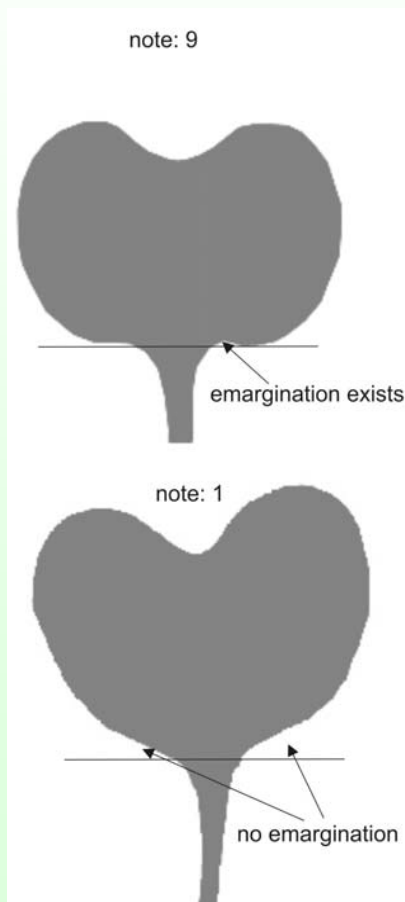
- distance between two lines perpendicular to the minimum and maximum coordinate
- widest horizontal distance of the cotyledon in x direction

Calculated characteristics - size of emargination at the upper part



- the vertical maxima of lobes of cotyledons are determined
- the distance perpendicular to an imaginary line between this two points and the deepest point of the emargination
- not have been determined quantitatively without using image analysis
- only possibility a visual assessment of the form of upper part of cotyledons

Calculated characteristics - emargination at the lower edge



- visual assessment with two possible states of expression
- emargination is present value 9 – is not present value 1
- image analysis of a defined algorithm gives more exact results than visual assessment

Calculated characteristics - area



- exact area in square millimetres (mm^2) by counting the pixels
- manual measurement of such unsymmetrical areas can be done only approximately



Results and discussion

- practical and useful method in DUS tests
- well approved in practice at the Bundessortenamt
- resolution of the image of 200 dpi, a precision of 0.1 mm is reached
- use of new characteristics has the potential to considerably improve distinctness of varieties

Image analysis –Species & Objects




Species / object	Measured characteristics	Example object
pea / leaves	length width distance between bottom and width area	
pelargonium / leaves	length width	
impatiens / leaves	length width length without stem length of stem area	

Image analysis –Species & Objects




Species / object	Measured characteristics	Example object
willow / leaves	length without stem width length of stem area	
rape, mustard, fodder radish/ cotyledon leaves	length width distance between top and bottom on upper site area	
rape / flower leaves	length width distance between bottom and width area	

Image analysis –Species & Objects

Species / object	Measured characteristics	Example object
red clover / cotyledon leaves	length width area	
red clover / first leaves	length width area	



Using image analysis in DUS tests for rape cotyledons

Kathrin Zepf, Thomas Drobek

Biostatistik, Informationsverarbeitung,
Kommunikationstechnik
Bundessortenamt
Osterfelddamm 80
30627 Hannover

thomas.drobek@bundessortenamt.de