



**TWC/26/21 Rev.**

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**INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS**  
GENEVA

**TECHNICAL WORKING PARTY ON AUTOMATION AND  
COMPUTER PROGRAMS**

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MEASUREMENT OF PLANT CHARACTERISTICS USING DIGITAL IMAGES

*Document prepared by experts from United Kingdom*

## Measurement of plant characteristics using digital images



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Niall Green, Tom Christie, George Campbell

## Why automate measurements?

- Reduce costs
  - Select characteristics
  - Often benefit when can measure several characteristics on same image
  - Need to optimise process
- Improve consistency
- Develop new measurements
  - Stored images provide testbed
- Images can be reviewed long after normal measurement time
  - Quality assurance
  - Evidence in case of challenge
- Produce images for reference collection management



## UK Vegetable DUS Centre

Collaboration between *Science and Advice for Scottish Agriculture (SASA)* and *Biomathematics & Statistics Scotland (BioSS)* since 2000

- Now in routine use:
  - Pea: pod, leaflet, stipule, petiole, peduncle
  - Parsnip: root
  - Broad bean: leaves
  - After validation against manual measurement and cost-benefit study
- Other crops and characteristics in development
  - Brassica cotyledons, pods; Broad bean seeds ...
- Software developed - *Imagin*
  - Fortran routines accessed by a Visual Basic Graphical User Interface
  - Demo later



## Types of characteristics

- Measurements of overall size
  - e.g. length/width, area
- Specific dimensions
  - e.g. curvature and see later
- Complex measurements
  - e.g. dentation, curvature
- Colour-based measurements
  - Needs careful set up
  - In Scotland, leaving as visual scoring
- New characteristics
  - Need to go through process of approval for use in UPOV guideline



## Outline of process

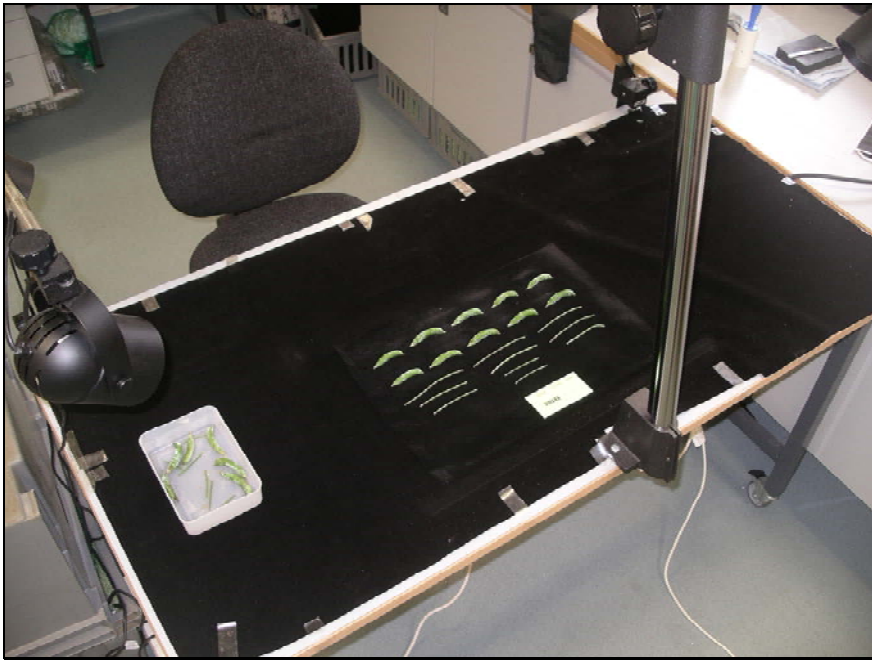
- Take digital image of sample
  - Costly bit (collection, preparation and layout of plant parts)
  - Require optimisation – compromise between quality and cost
  - Could do in the field (*in situ*) or in controlled conditions
- Images - digitised RGB
  - for each pixel, have coords and R, G & B values
- Need to identify and label objects (positioning and colour can be useful)
- Identify outlines and landmarks (set orientation helps)
- Make measurements
- Rescale measurements (coin)

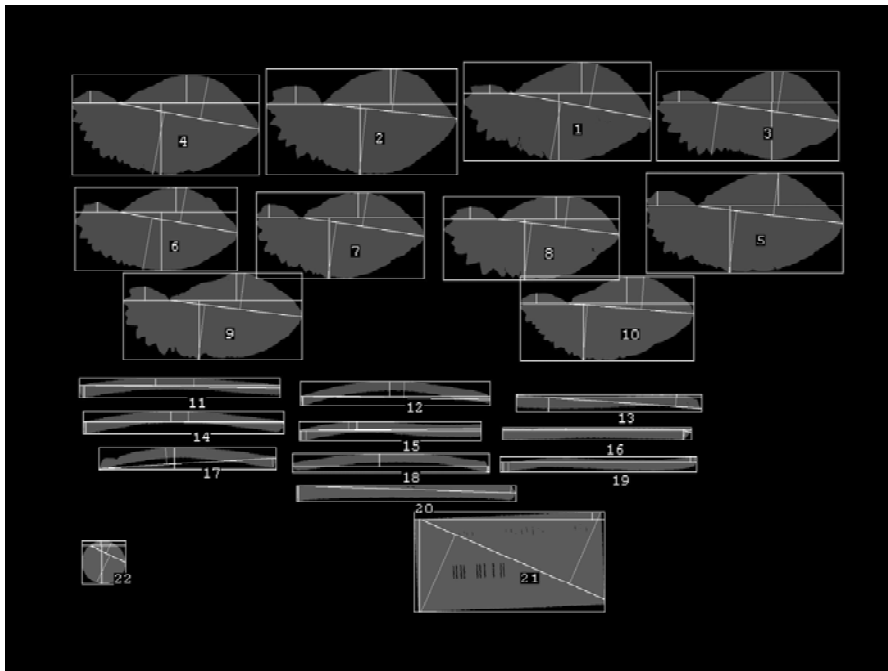


## Tips

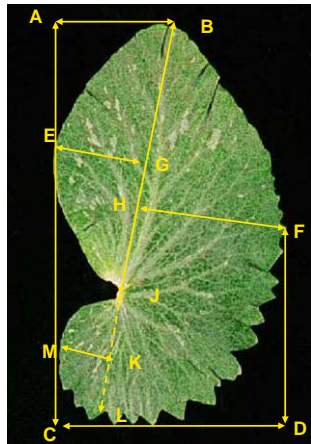
- Consistent photographic conditions
  - Within year but also from year to year
  - Oblique lighting
- Black background
  - Helps in identification of objects and tends to reduce photographic problems
- Objects should not touch or overlap
  - Heavy glass sheet on stipules/leaflets to flatten leaves (small measurement error associated with leaf folding when flattened)
- Scaling object
- QA issues in labelling and naming
  - barcodes





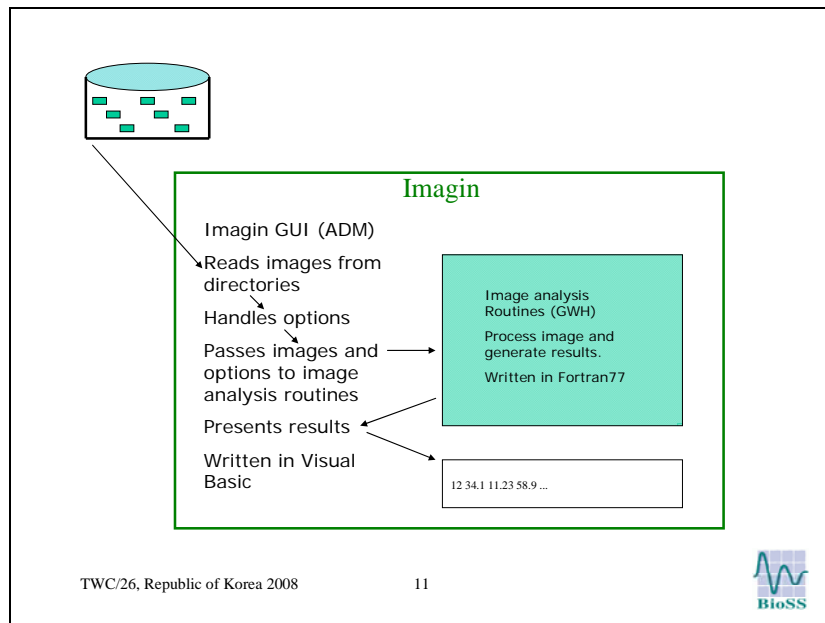


### Pea automated stipule measurements



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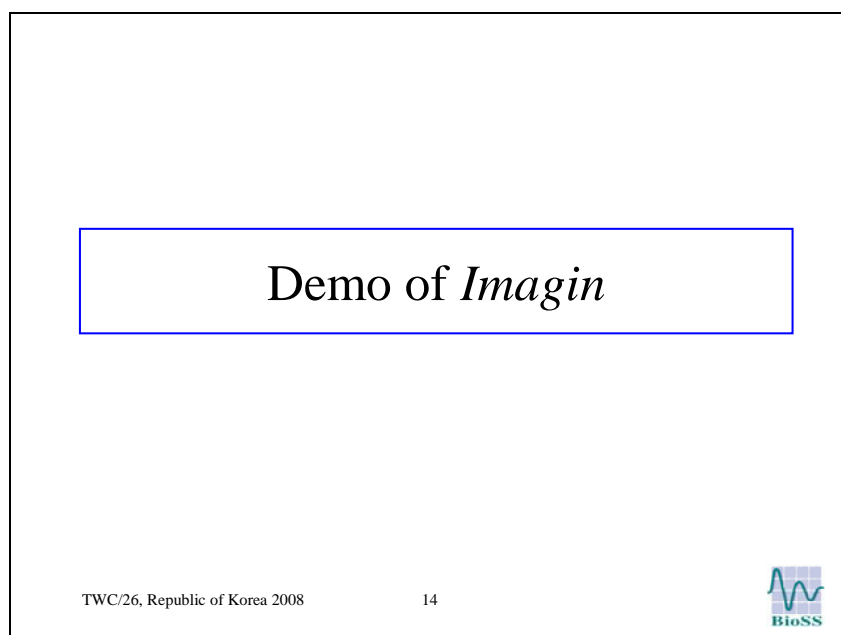
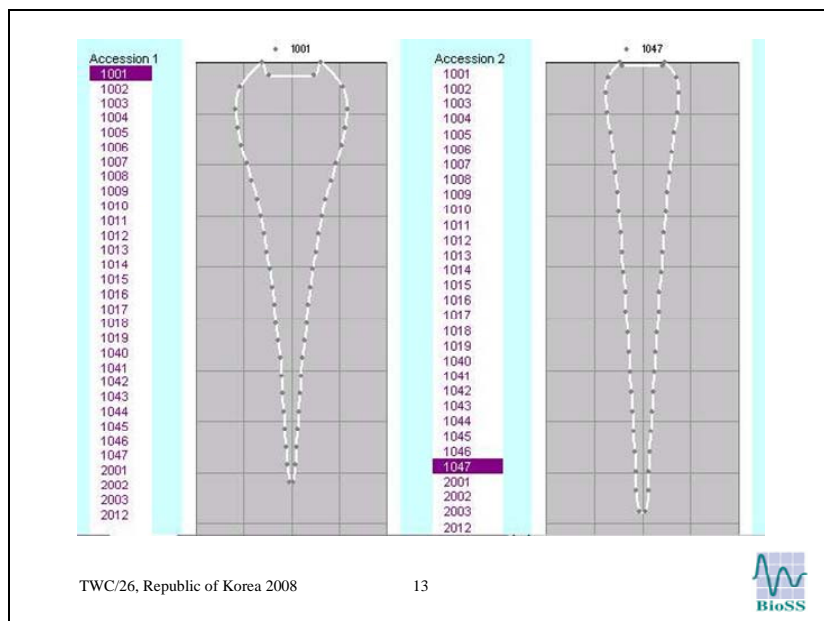
<u>Character</u>	<u>UPOV</u>
A-C Stipule: length	Existing
C-D Stipule: width	Existing
Stipule Area	New
B-J Stipule: length from axil to tip	New
M-K Stipule: Length of lobe below axil	New
<u>Petiole: length</u> is measured in the same image as the stipule	Existing
Stipule: margin dentation	R&D
J-L, J-K, K-L, E-G, F-H, G-H	R&D



## Average image

Area of current development

- Have many images from same variety
- Want to represent by single shape – concept of average shape
- Have developed for parsnip roots and stipules so far



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