UPOV
International Union for the Protection of New Varieties of Plants

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Technical Working Party for Agricultural Crops **TWA/50/5**

Fiftieth Session
Arusha, United Republic of Tanzania, June 21 to 25, 2021

Original: English
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NEW TECHNOLOGY USED IN DUS EXAMINATION

Document prepared by experts from Denmark and the United Kingdom

Disclaimer: this document does not represent UPOV policies or guidance

This document contains presentations to be made at the fiftieth session of the Technical Working Party for Agricultural Crops (TWA).

Annex I "Using new technology in DUS-testing", by an expert from Denmark
Annex II "Image Analysis in United Kingdom Agricultural DUS testing", to be made by an expert from the United Kingdom

[Annexes follow]

TystofteFonden

INNOVAR

Using new technology in DUS-testing

Preben Klarskov Hansen

INNOVAR – HORIZON 2020

NEXT GENERATION VARIETY TESTING FOR IMPROVED CROPPING ON EUROPEAN FARMLAND

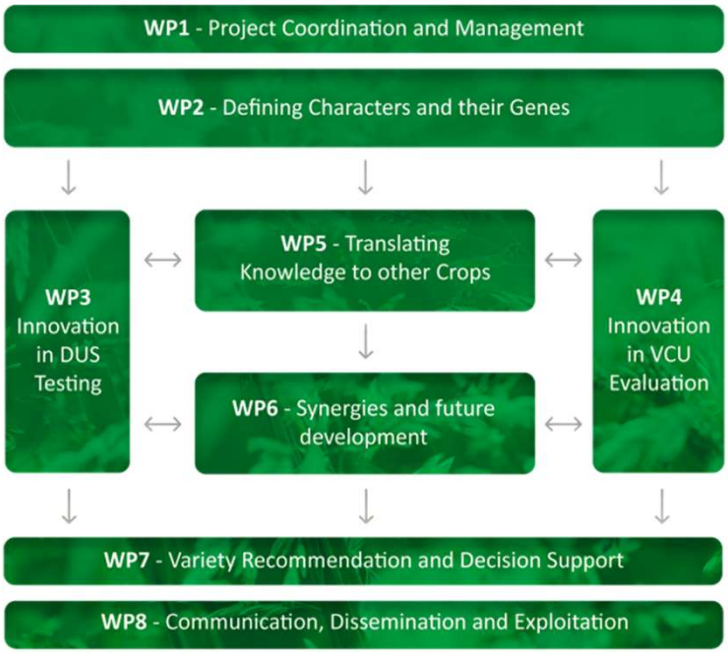
TystofteFonden

TystofteFonden

InnoVar will

Use winter wheat as a test crop to devise and demonstrate improved and more efficient methods of

- Intergrating new science into **DUS** and VCU testing processes
  - Genome Wide Association Studies
  - Sensor based phenotyping
  - Machine learning technology
- Combining DUS and VCU characters, and
- Incorporating variety information into descision-making on-farm
  - Varieties categorised into 'fit-for-purpose-groups' of High Performance Low Risk (HPLR - novel branding developed by *InnoVar*)



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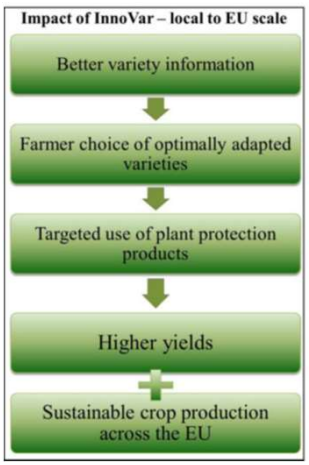
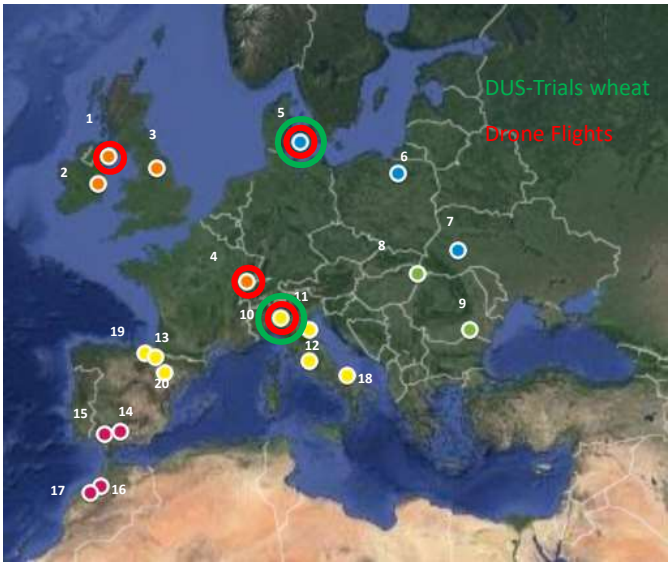
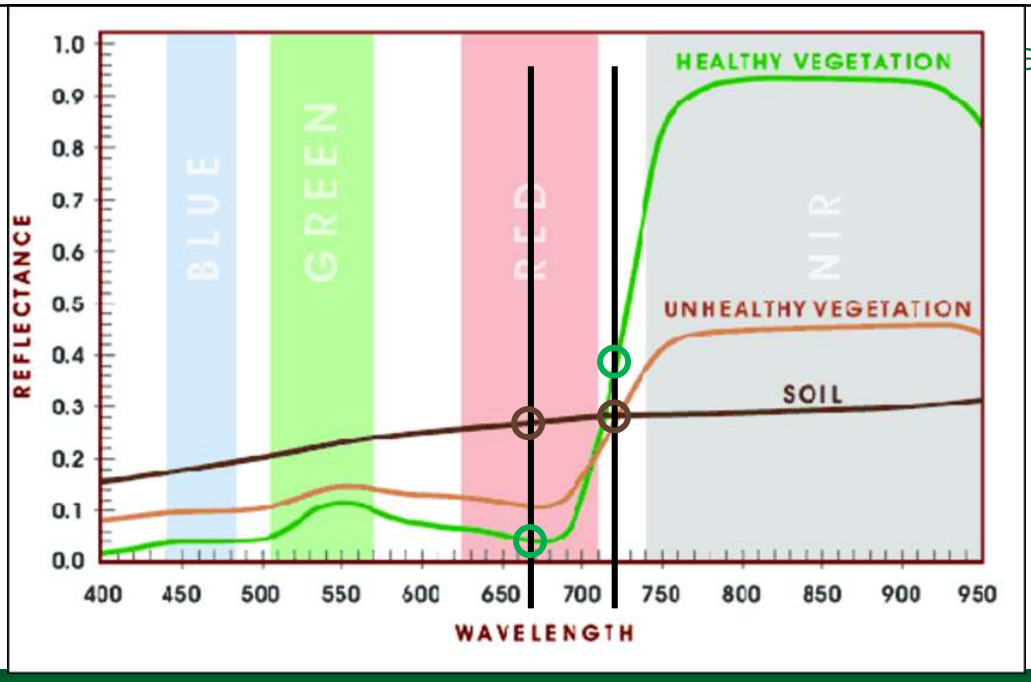


All VCU/DUS Trial sites

TystofteFonden

1	Maritime North	AFBI	Crossnacreevy, Belfast
2	Maritime North	UCD	Newcastle, Kildare.
3	Maritime North	ADAS	North Yorkshire
4	Maritime North	AGROSCOPE	Nyon
5	Continental	TF	Teglværksvej, Tystofte,
6	Continental	Origin	Village -Balcyny (Ostróda)
7	Continental	Origin	Nastasiv, Ternopil oblast
8	Pannonian	DE	Nyíregyháza
9	Pannonian	Origin	Fundulea
10	Maritime South	CREA-DC	S. Angelo Lodigiano
11	Maritime South	HORTA	Ca' Bosco, Ravenna
12	Maritime South	UNITUS	Viterbo
13	Maritime South	UPM	Navarra
14	Mediterranean	CSIC	Santaella (Córdoba)
15	Mediterranean	UPM	Escacena (Huelva)
16	Mediterranean	ICARDA	Marchouch Village
17	Mediterranean	ICARDA	Sidi El Aidi Village
18	Maritime South	HORTA	Foggia
19	Maritime South	UPM	Álava
20	Maritime South	UPM	Zaragoza





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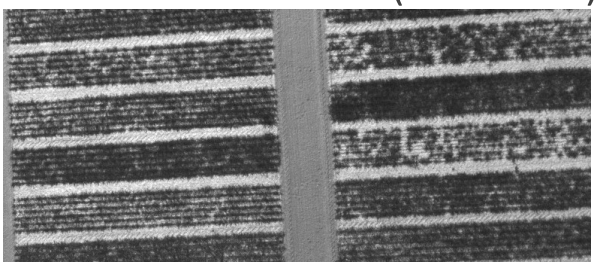
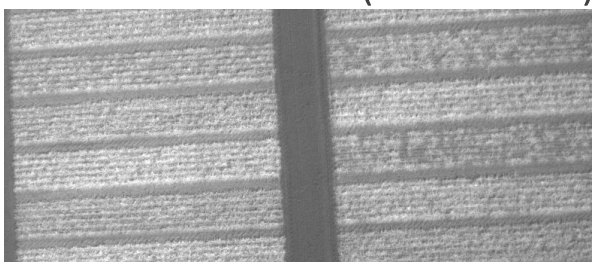
Red camera (668nm)



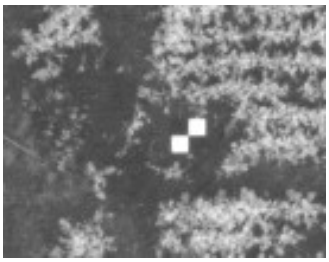
NIR camera(717 nm)



TystofteFonden

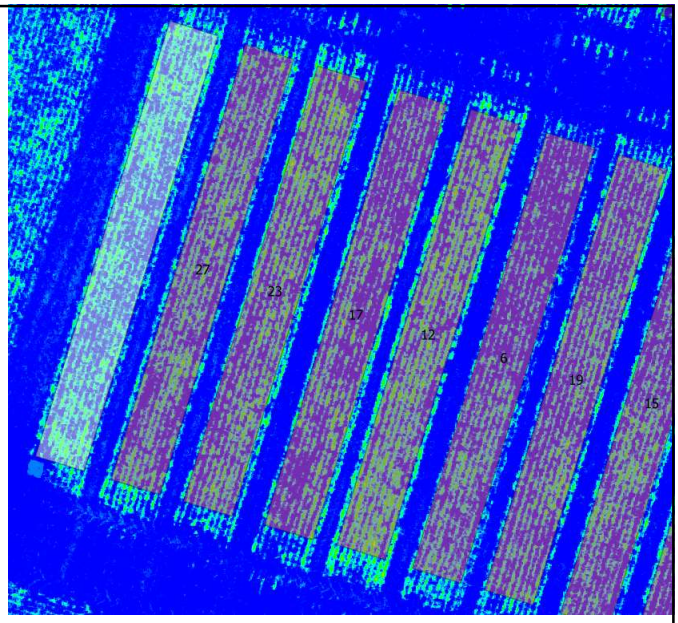
Process in collection of drone images

- Generating flight plan
  - Trial area, altitude, overlap between images
- Flying - image collection
- Stitching of single images -> mosaic
- Geo referencing of mosaics
  - Ground control points
  - Time series
- Crop part of plot to analyse
- Image analysis
- Statistical analysis



DJI Matrice 210 RTK V.2

Micasence RE
dual sensor



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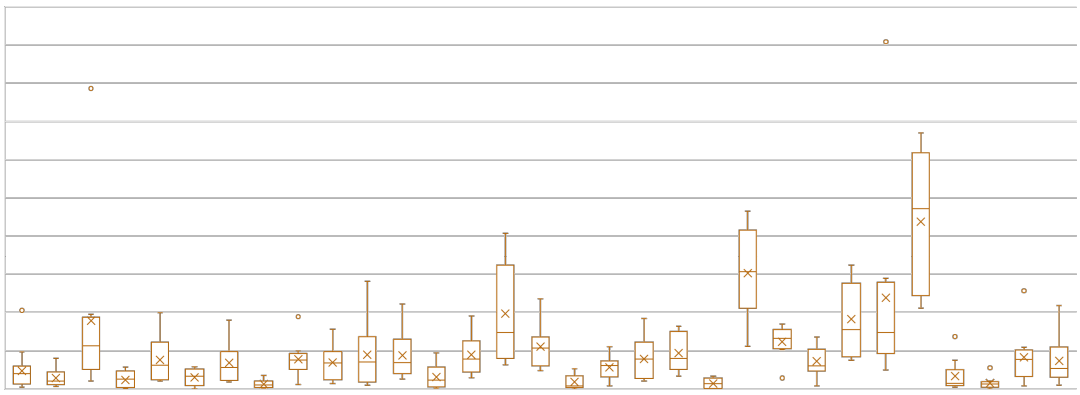


TystofteFonden

Expected possibilities: description

- UPOV 4: Plant growth habit
  - Analysis of width of wheat row
- UPOV 7: Ear emergence
  - Analysis of change in reflection in time series of images
- UPOV 9: Flag leaf: glaucosity of blade
  - Analysis of relationship between blue and green reflection
- UPOV 13: Plant length
  - Hight estimation from sequiential images
- UPOV 17: Ears: Scurs or awns
  - Analysis of change in reflection
- UPOV 27: Seasonal type:
  - Plant hight, differences in reflection

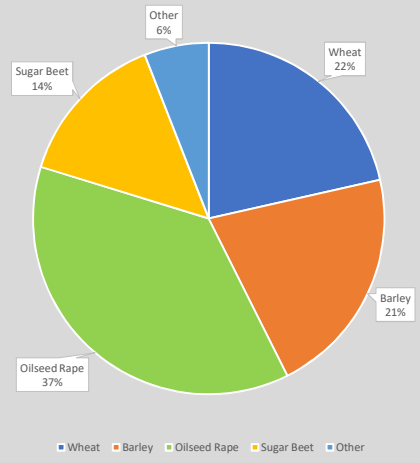
https://www.h2020innovar.eu/

[Annex II follows]

Image Analysis in United Kingdom Agricultural DUS testing

Alex Talibudeen

UPOV TWA 55 (June 2021)



DUS test applications

Agricultural crop species tested at NIAB, United Kingdom*

- Wheat – 141
- Barley – 139
- Oilseed Rape – 244
- Sugar Beet - 94
- Oats – 22
- Field Beans – 16
- Fodder Kale – 1

(*Total applications 2020/21)

NIAB
world-class experience, skills and resources

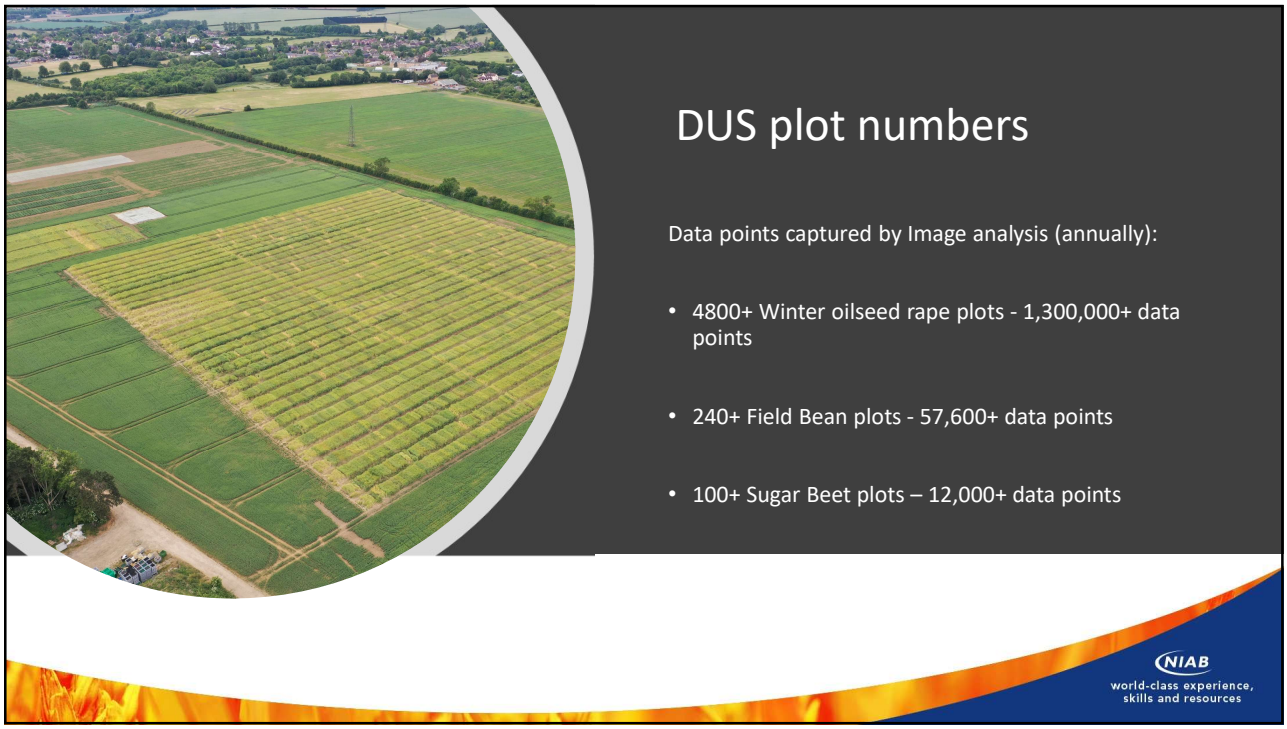
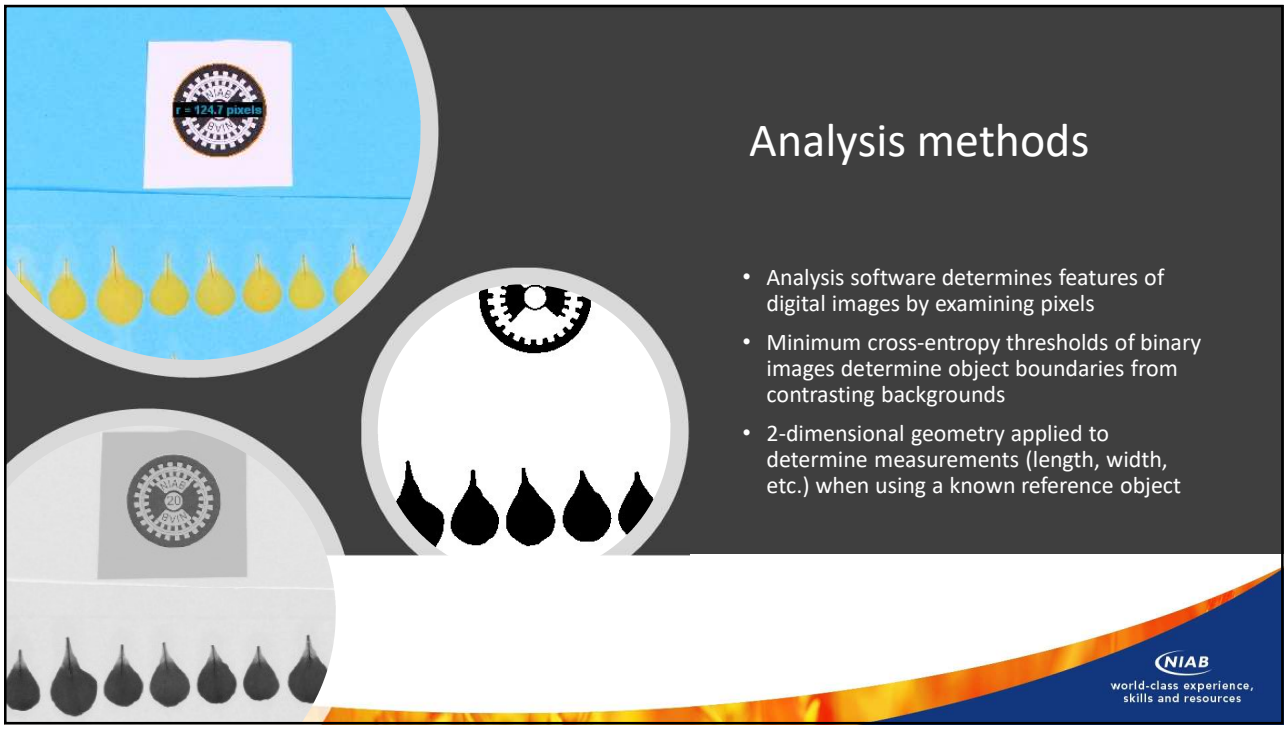
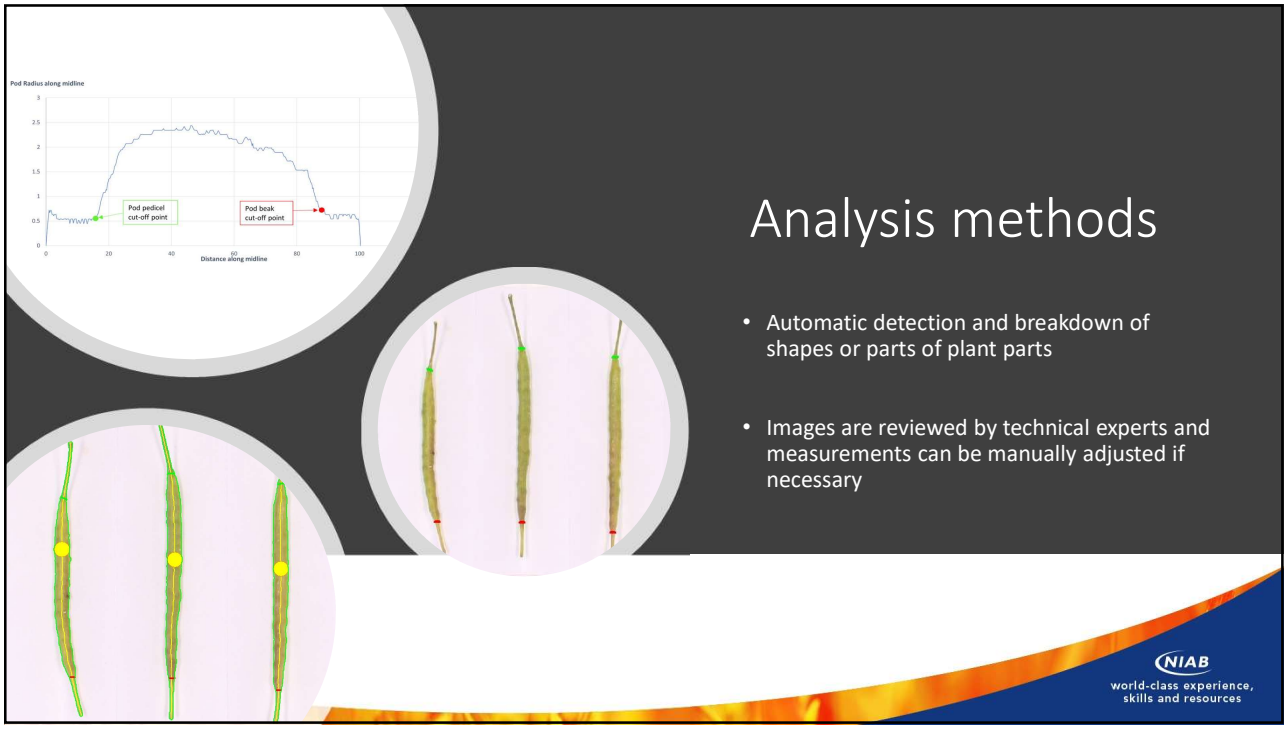
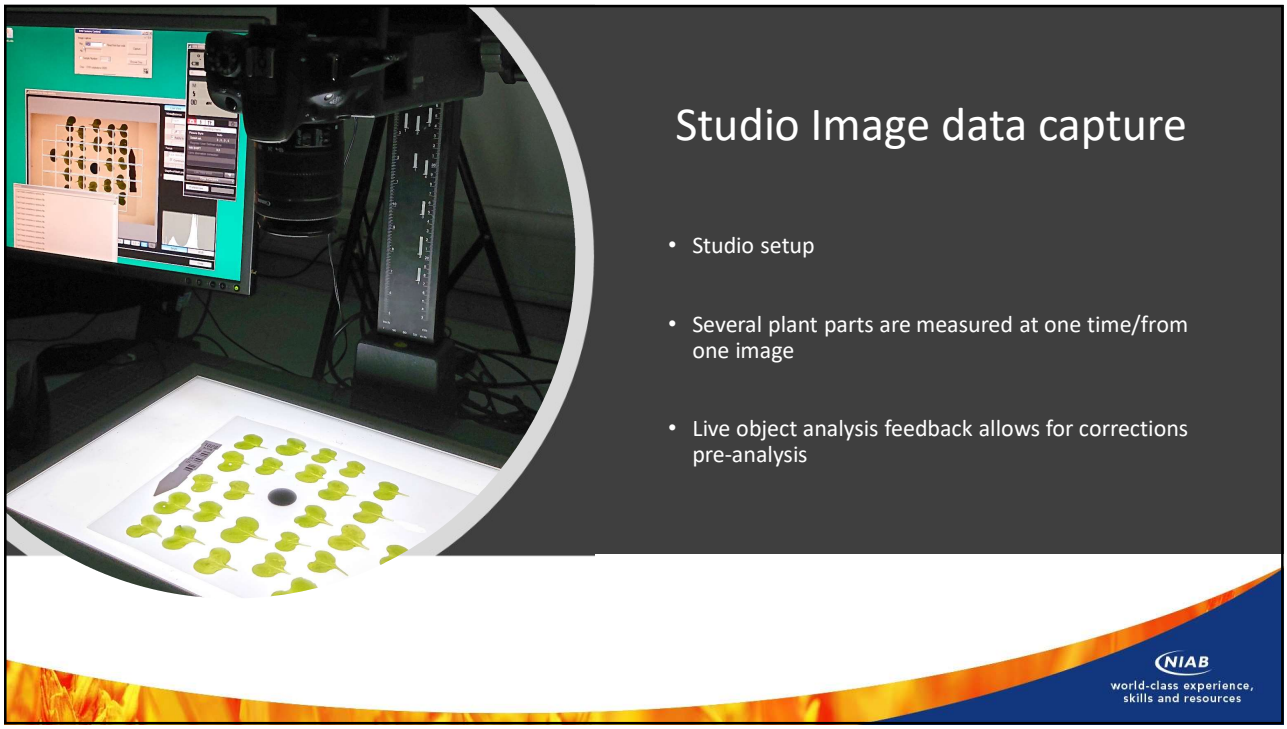

DUS plot numbers
Data points captured by Image analysis (annually):
• 4800+ Winter oilseed rape plots - 1,300,000+ data points
• 240+ Field Bean plots - 57,600+ data points
• 100+ Sugar Beet plots – 12,000+ data points
NIAB
world-class experience, skills and resources


Image Analysis
Tool for collecting measured data
Aims and benefits:
• reduce costs and time
• aids consistency of measurements
• reduce risk of human error and dependency on expertise
• traceability of sample measurements
NIAB
world-class experience, skills and resources


r = 124.7 pixels
Analysis methods
• Analysis software determines features of digital images by examining pixels
• Minimum cross-entropy thresholds of binary images determine object boundaries from contrasting backgrounds
• 2-dimensional geometry applied to determine measurements (length, width, etc.) when using a known reference object
NIAB
world-class experience, skills and resources


Pod Radius along midline
Pod pedicel cut-off point
Pod beak cut-off point
Distance along midline
Analysis methods
• Automatic detection and breakdown of shapes or parts of plant parts
• Images are reviewed by technical experts and measurements can be manually adjusted if necessary
NIAB
world-class experience, skills and resources


Studio Image data capture
• Studio setup
• Several plant parts are measured at one time/from one image
• Live object analysis feedback allows for corrections pre-analysis
NIAB
world-class experience, skills and resources


In-field image data capture
• Mobile application
• Image capture and analysis within plots
• Features oblique angle image correction
• Multiple users with minimal resources
NIAB
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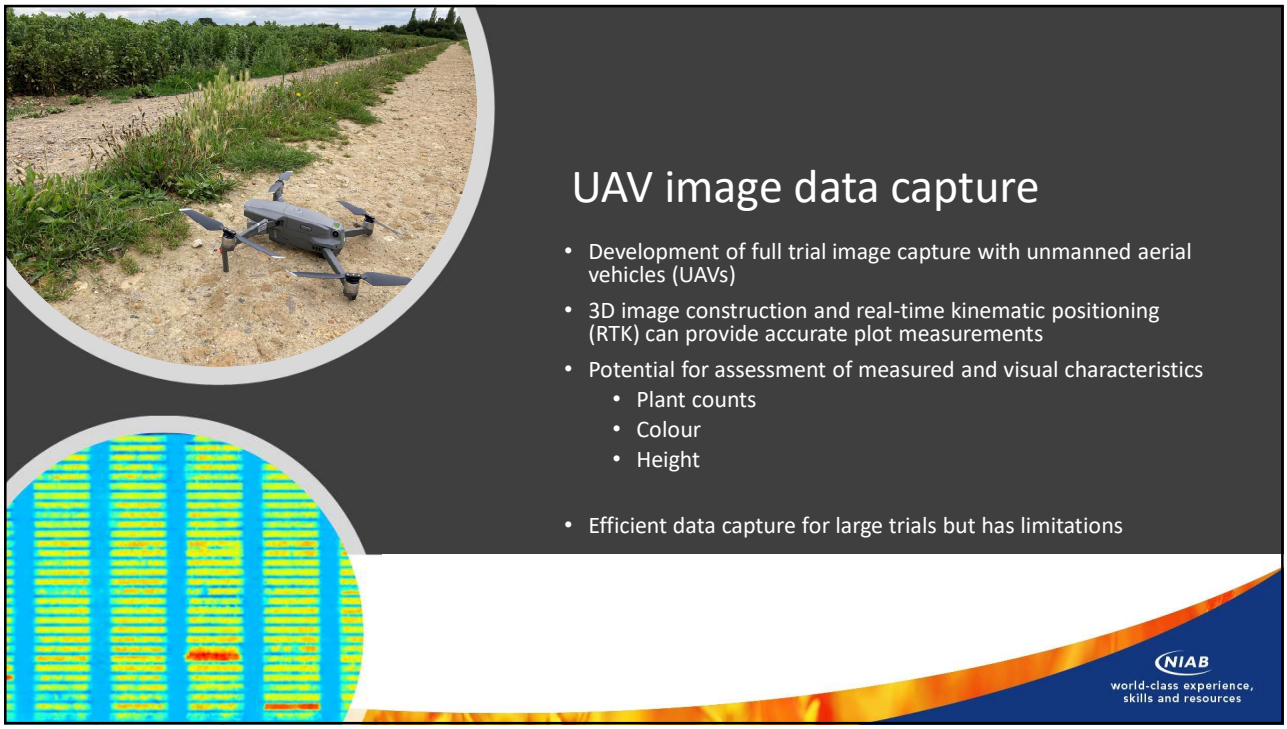

[End of Annex II and of document]