



TC/49/33

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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

Geneva

TECHNICAL COMMITTEE**Forty-Ninth Session
Geneva, March 18 to 20, 2013****REVISION OF DOCUMENT TGP/8: PART II: TECHNIQUES USED IN DUS EXAMINATION,
NEW SECTION: EXAMINING CHARACTERISTICS USING IMAGE ANALYSIS***Document prepared by the Office of the Union*

1. The purpose of this document is to report on:
 - (a) results of the questionnaire on software and hardware used for image analysis;
 - (b) presentations on image analysis at the Technical Working Party on Automation and Computer Programs (TWC), at its thirtieth session; and
 - (c) development of Document TGP/8: Part II: Techniques Used in DUS Examination, New Section: "Examining Characteristics Using Image Analysis".

Background

2. The Technical Committee (TC), at its forty-eighth session, held in Geneva from March 26 to 28, 2012, considered the proposal for New Section: "Examining Characteristics Using Image Analysis," on the basis of document TC/48/19 Rev. "Revision of document TGP/8 Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability", Annex VII. The TC agreed to the development of a questionnaire by Mr. Gerie van der Heijden (Netherlands), the Technical Working Party on Automation and Computer Programs (TWC) Chairman and the Office of the Union, concerning software and hardware used for image analysis, which would be issued to the TC and TWC representatives of UPOV members. The results of the questionnaire were presented to the TWC at its thirtieth session, held in Chisinau, Republic of Moldova, from June 26 to 29, 2012 (see document TC/48/22 "Report on the Conclusions", paragraph 56).

UPOV Questionnaire on software and hardware used for image analysis

3. The TWC, at its thirtieth session held in Chisinau, from June 26 to 29, 2012, received a presentation by an expert from the Netherlands, entitled "Survey on Software and Hardware used for Image Analysis", which is reproduced in document TWC/30/39. The TWC agreed that information from France and Finland should be included in that document (see document TWC/30/41 "Report", paragraph 79).

4. Annex I to this document (in English only*) contains the analysis of UPOV Questionnaire on Image Analysis presented in document TWC/30/39 and the information provided by Finland and France.

5. The TC is invited to note the information on software and hardware used for image analysis, as set out in Annex I to this document.

AIM software for Image Analysis

6. The TWC, at its thirtieth session, received a presentation on the AIM software on management of image analysis, made by an expert from France, as reproduced in document TWC/30/31 and in Annex II to this document (in English only*). It noted the features of the AIM software was available in French, and that it could be made available free of charge by its developer (Group for Study and Control of Varieties and Seeds (GEVES)). The TWC suggested that training on use of this software and its translation into English would be essential for wide use. It also agreed that this software could be included in the list of exchangeable software. The TWC requested the Office of the Union to help translate the software into English (see document TWC/30/41 "Report", paragraphs 77 and 78).

7. The TC is invited to note that the recommendation of the TWC concerning the inclusion of the AIM software from France in document UPOV/INF/16 "Exchangeable Software," and the request for the Office of the Union to translate the AIM software into English, are considered in document TC/49/12.

Document TGP/8: Part II: Techniques Used in DUS Examination, New Section: "Examining Characteristics Using Image Analysis"

8. The TC, at its forty-eighth session, considered the proposal for New Section 12: "Examining Characteristics Using Image Analysis" in document TGP/8. The TC agreed that Subsection 12.1 "Introduction" of New Section: "Examining Characteristics Using Image Analysis" should be reworded to explain that image analysis would be an alternative method for observing a characteristic, rather than a principal method for observing a characteristic. The TC agreed that the TWC should develop Subsection 12.3 "Guidance on the use of image analysis" and agreed that a new section should be prepared on the basis of the discussion on documents TWC/29/19 "Image Analysis for DUS in the United Kingdom", TWC/29/21 "The Use of Image Tool in Measurements of Grain Length of Rye (*Secale cereale* L.), TWC/29/27 "Image Analysis in the Czech Republic" and TWC/29/29 "Image Analysis in the Netherlands". The drafters would be experts from Netherlands (first drafter), Czech Republic, Finland and the United Kingdom (see document TC/48/22 "Report on the Conclusions", paragraphs 56 to 58).

9. The TWC, at its thirtieth session, agreed that a draft for New Section - Examining Characteristics Using Image Analysis for document TGP/8 "Trial Design and Techniques Used in the Examination of Distinctness, Uniformity and Stability" should be prepared, by an expert from the Netherlands in collaboration with an expert from the European Union, for the TWP sessions in 2013 (see document TWC/30/41 "Report", paragraph 80).

10. The TC is invited to note the plans for the development of a New Section: "Examining Characteristics Using Image Analysis" for inclusion in document TGP/8, Part II: Techniques Used in DUS Examination, as set out in paragraphs 8 and 9 of this document.

[Annexes follow]

* The TC-EDC, at its meeting on January 9 and 10, 2013, agreed that it would not be appropriate to translate the text for the forty-ninth session of the TC.

(IN ENGLISH ONLY)

ANALYSIS OF UPOV QUESTIONNAIRE ON IMAGE ANALYSIS

Prepared by Gerie van der Heijden (Netherlands)

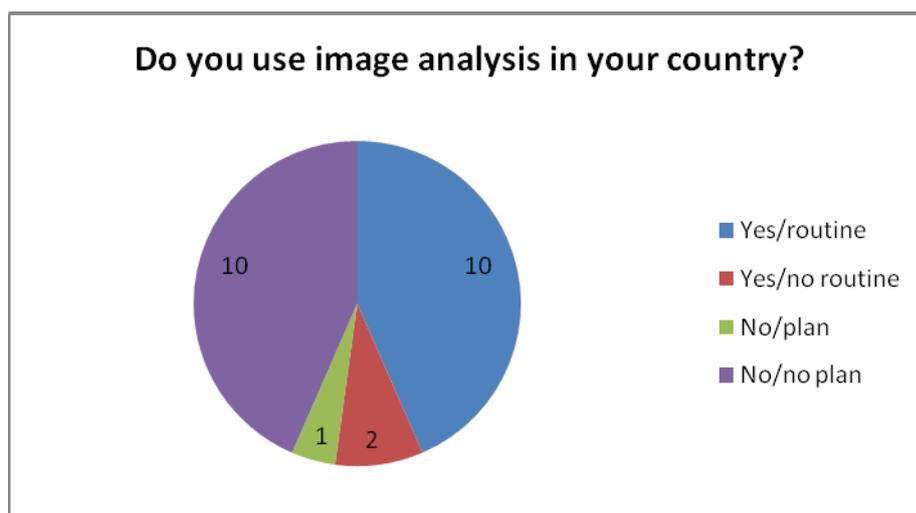
INTRODUCTION

1. A questionnaire on image analysis (see Appendix I to this Annex, which was an Annex to E-12/106) was sent to the UPOV members in April 2012. The aim of the questionnaire was to gain insight in the frequency and way of use of image analysis in the different member states.

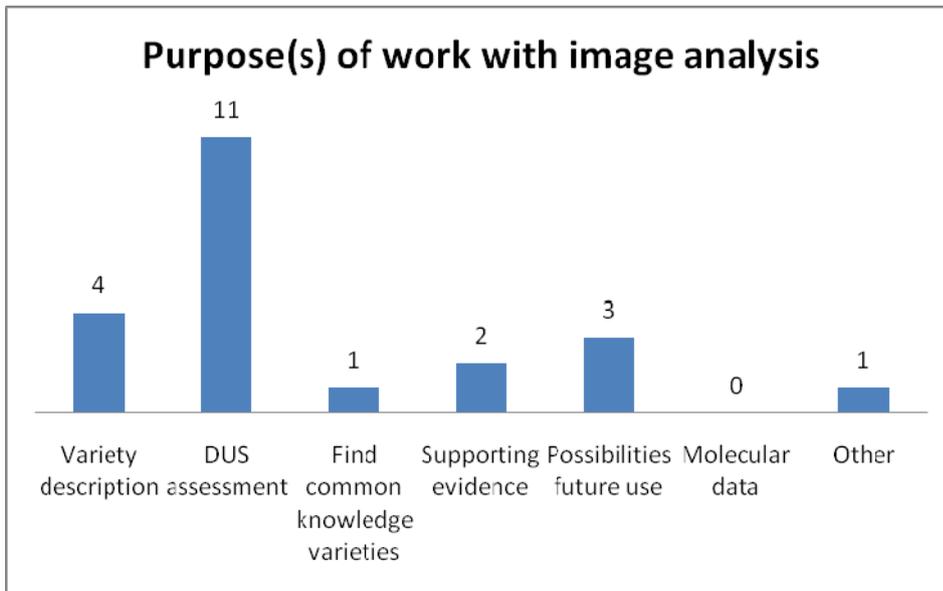
2. The questionnaire was returned by 21 UPOV members. The United Kingdom returned two questionnaires, one from England (NIAB) and one from Scotland (SASA), so there were 22 questionnaires in total. For sake of simplicity, England and Scotland are here treated as two different respondents. Results are shown in Appendix II to this Annex.

USE AND PURPOSE OF IMAGE ANALYSIS

3. In total ten respondents stated that image analysis is being used on a routine basis in their work, where France also uses it non-routine. Italy only uses it for non-routine purposes at the moment. Ten respondents do not use image analysis and have no further plans to use it, one country (Republic of Moldova) has plans to use it (see Figure 1 and Appendix II to this Annex).



4. The main purpose of image analysis is for DUS assessment. It is only occasionally used for variety description, finding common knowledge varieties or supporting evidence (see Figure 2 and Appendix II).



CROPS AND CHARACTERISTICS

5. The crops for which image analysis is being used are (in alphabetic order):

1. Barley	18. Rape
2. Brassica crops	19. Red clover
3. Brussels sprouts	20. Rice
4. Carrot	21. Running beans
5. Field bean	22. Rye
6. Flax	23. Seeds/grains various crops
7. Fodder radish	24. Sugar Beet (cotyledon)
8. French bean	25. Watercress
9. Impatiens	26. Wheat
10. Maize	27. White mustards
11. Oats	28. Willow (leaves)
12. Oilseed rape	
13. Onion	
14. Ornamentals	
15. Parsnip	
16. Pea	
17. Pelargonium	

6. Image analysis is mainly being used to measure the size and shape of seeds, leaves and roots/bulbs. A few ornamental crops like Pelargonium and Impatiens are listed. Also for these crops, the characteristics are size and shape related. France is the only country that uses it for color. No characteristics were mentioned which measure texture or variegation patterns.

7. All respondents who use image analysis on a routine basis, use it as intermediate data for the DUS decision. France also uses it to store information for future use.

TECHNICAL ISSUES

8. Eight respondents use a camera, five respondents use a scanner (two respondents use both options). All use a regular PC or workstation.

9. Every UPOV member has its own software system. Most respondents use commercially available software or open source software which they have adopted themselves. Only Italy uses off-the-shelf software. In some cases the software can be made available to other UPOV members (under conditions). See Appendix II for details.

10. The size of the data is hardly limiting with current disks. The largest reported database is about 300 GB.

RECORDING CONDITIONS

11. All respondents use some form of calibration for determining the size of an object. In general the lighting conditions are also standardized and verified. Color calibration is not mentioned.

[Appendix I follows]

UPOV QUESTIONNAIRE ON IMAGE ANALYSIS AS SENT TO UPOV MEMBERS

Please complete the following questions. You can attach a separate sheet(s) to provide a more complete answer if necessary (e.g. if you have different projects/purposes with image analysis).

Name of person answering the questionnaire:

Country:.....

Organization.....

Contact Information:

Address:

Tel:..... Fax:.....

E-Mail:

I. GENERAL QUESTIONS

1. Use of image analysis in your country

- Yes
 - Routine-basis
 - Non routine-basis
- No
 - Planning to use
 - No plans to use

** If the answer to the above question is "Yes", please go to the following questions. Otherwise please just return this sheet to the designated persons shown at the bottom of the circular.*

2. UPOV Technical Working Party(ies) and document references in which information has previously been provided:

- BMT [document reference: e.g. BMT/XX/XX]
- TWA [document reference:]
- TWO [document reference:]
- TWV [document reference:]
- TWF [document reference:]
- TWC [document reference:]
- TC [document reference:]
- CAJ [document reference:]

3. Purpose(s) of the work with image analysis:

- Variety description
- DUS assessment
- To find varieties of common knowledge to compare with candidate varieties in the DUS growing trials
- Supporting evidence in selected cases
- To evaluate possibilities of the method for future use
- Molecular data (e.g. banding patterns in electrophoresis gels)
- Other purpose, (please provide details):

4. Application of image analysis (species, characteristics, etc.)

5. Status of the image analysis data:

- Provided by breeder for information on voluntary basis
- Compulsory requirement for the breeder as part of the application
- As intermediate data to obtain information before the DUS decision
- To keep as retrievable information for use in other studies
- Other status, namely (please provide details):

6. Please provide a short indication of the costs and savings involved in applying image analysis.

7. Please provide other remarks, if any.

II. TECHNICAL QUESTIONS

* In the case of another person(s) (e.g. IT technicians) answering the following questions, please specify below the person's name, organization/title, telephone, fax number and e-mail address in order for us to contact them when necessary:

.....

1. Hardware used (make, model, type, etc.) by steps:

- To obtain images:
- To keep and process data:
- To show images on screen or paper:

2. Software used (make, title, version, etc.) by steps:

- To obtain images:
- To keep and process data:
- To show images on screen or paper

3. Is the hardware/software commercially available?

(To obtain images)

- Yes, from
- Partially, we added own routines/macros
- No, specifically developed
-

(To keep and process data)

- Yes, from
- Partially, we added own routines/macros
- No, specifically developed

(To show images on screen and paper)

- Yes, from
- Partially, we added own routines/macros
- No, specifically developed

4. With regard to the software specifically developed for you, is it also available to other UPOV members?

- Yes
- No
- Under certain conditions (please specify the condition below)

5. Please summarize the recording conditions (standardization of light, sampling density, camera type, calibration procedure, etc.)

6. Approximate volume of data kept (either Megabytes, or number of varieties, number of features, number of images, etc.)

7. Other remarks (if any):

NB: If you use image analysis for other work than variety testing (seed testing, checks for purity in maintenance, etc.) and you are willing to give information, please do so.

Please return the completed questionnaire no later than May 11, 2012 by e-mail to:

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[Appendix II follows]

Results of UPOV questionnaire on Image Analysis

Member state	1. Use of image analysis				2. UPOV Document	3. Purpose		
	Yes routine	Yes no routine	No/plan	No/No plan		Variety description	DUS assessment	Other
Czech Republic*	1				TWC/29/27		1	
Denmark*	1						1	
Georgia				1				
Germany*	1				TWO/29/17		1	Common knowledge varieties
Finland	1				TWC/29/21		1	
France	1	1			TWC/30/31		1	Future use and VCU
Ireland				1				
Israel				1				
Italy*		1				1	1	
Japan				1				
Latvia				1				
Republic of Moldova			1					
Netherlands*	1				TWC/29/29	1	1	Supporting evidence
Paraguay				1				
Poland*	1						1	
Russia				1				
South Africa				1				
Spain*	1					1	1	
Sweden*				1				
United Kingdom (NIAB)*	1				TWC/29/19	1	1	Supporting evidence
United Kingdom (SASA)*	1				TWA 33/10, TWC 22/7, TWC 26/21 REV, TWC 29/19 (Image-in), TWC 19/6 (Visor)		1	
United States of America				1				

*) Respondents in grey area have provided more information. See following pages.

Czech Republic

Application:

- Pea: leaves, stipules, standards, sepals
- Oilseed rape: petals, cotyledons

Technical

1. Hardware camera	1. Hardware processing	1. Hardware display	3. Commercially available	4. Available to other members
Sceye 3rd generation , proprietary light system	common PC	common PC		
2. Software recording	2. Software processing	2. Software display/print	3. Commercially available	4. Available to other members
Sceye	Matlab computational system, core + Image analysis toolbox (http://www.mathworks.com/)	outputs of Matlab are saved as common image files, no special software is required	Capture: http://www.sceye.eu/en/products/product-history . Process: partially, added own	No
5. Recording conditions	6. Volume of data		7. Other remarks	
Image obtained in dark chamber, resolution 300 pt, calibration using coin.	Per year: Pea 5 GB, Oilseed rape 20 GB.		Image analysis in the Czech Republic is still under development, primary goal: resting suitable characteristics for pea and oilseed rape	

Denmark

Application:

- Rape seed: Cotyledon, Petals and Siliqua
- Barley: Ear length, Ear length of awns
- Wheat. Ear length

Cost/saving:

Total cost for hard and software of applying image analysis are approximately 20.000 euros. Cost savings are mainly obtained in the image analysis of Rape seed characteristics of the siliqua. An advantage using image analysis is that it is possible to retrieve the image of the actual recorded data.

Technical:

1. Hardware camera

PC and flatbed scanner (plustec A3)

1. Hardware processing

PC

1. Hardware display

PC

2. Software recording

Videometer image analysis progra

2. Software processing

Videometer image analysis progra

2. Software display/print

Microsoft picture viewer

3. Commercially available

No, specifically developed

4. Available to other members

Possible to buy if you contact:
<http://videometer.com/>
with a reference to The Danish AgriFish Agency, Department of Variety Testing

5. Recording conditions

The material samples (cotyledon and petals) shall be fixed on paper with adhesive plastic foil. The paper has preprinted barcode, plot number etc.. The paper with the fixed the material are put in the flatbed scanner. Before image analysis of each characteristic can begin the software should calibrated using a calibration sheet from the developer

6. Volume of data

Approximately 14 Gb per year

7. Other remarks

Germany

Applications:

- Pea, pelargonium, impatiens, willow (leaves)
- Rape, mustard, fodder radish (leaves, flowers)
- Red clover (Cotyledon leaves, first leaves)

Costs/savings:

Depending on crop and object savings are higher than costs.

Other remark:

There is a need for a programmer with special knowledge how (at least part-time). It is possible to scan images at first and to make measurements later when there is more time therefore.

Technical:

<p>1. Hardware camera</p> <p>flatbed scanner, digital camera</p>	<p>1. Hardware processing</p> <p>HP workstation xw4400</p>	<p>1. Hardware display</p> <p>19" monitor</p>		
<p>2. Software recording</p> <p>standard software (scanner, digital camera)</p>	<p>2. Software processing</p> <p>SCIL-Image with self-programmed routines</p>	<p>2. Software display/print</p> <p>JAVA program to retrieve images from database</p>	<p>3. Commercially available</p> <p>Recording: Yes, from HP and Canon. Process: No no. Display: partially</p>	<p>4. Available to other members</p>
<p>5. Recording conditions</p> <p>Scanner: scan calibration circle (Ø12cm) to get the resolution we don't use the color information digital camera: flash (ring flash) and background light</p>		<p>6. Volume of data</p> <p>2011: 80 GB image data (14.300 files)</p>	<p>7. Other remarks</p>	

Finland

Application

- Rye: grain length

Cost/savings:

After arranging the seeds for the picture and taking of photographs, the analysis takes only a portion of time compared to manual measurements. Accurate costs and savings of IA has not been done, but roughly 10-20% of time is needed by using IA in these measurements.

1. Hardware camera Canon EOS 500D	1. Hardware processing PC	1. Hardware display Dell screen		
2. Software recording	2. Software processing " UTHSCSA ImageTool for Windows Version 3.0	2. Software display/print Windows picture manager	3. Commercially available Capture: in camera shops, Process: downloadable from http://compdent.uthscsa.edu/dig/itdesc.html , Display: Windows Office 2012	4. Available to other members

5. Recording conditions

Calibration: Seeds are kept close to each others in the picture to avoid distortion by the objective. The ruler is used for calibration of the scale in the picture before taking the analysis picture. Scale of 1 cm is included in each varieties pictures for calibration in the IT program

6. Volume of data

7. Other remarks

130 MB/each
DUS year

France

Application

Crops:

- Carrot, Rape,
- Ornamentals,
- Seed/Grains various crops,
- Wheat,
- Barley,
- Maize,
- Oat,
- Pea.

Characters:

Width, Length, Area, perimeter, Curve length, Curve Width, Color, Mean distance, fineness of foliage, attack disease on leaves, how plant cover the ground, ...

1. Hardware camera	1. Hardware processing	1. Hardware display		
different cameras (Nikon, Canon, Sony, HP, Olympus) and scanners (Epson, HP)	HP workstation	HP workstation		
2. Software recording	2. Software processing	2. Software display/print	3. Commercially available	4. Available to other members
standard software (scanner, digital camera)	Aim Software (Own development) + ImageJ (with own macros, plugins)	Aim software	Yes, from GEVES	Yes
5. Recording conditions			6. Volume of data	7. Other remarks

Italy

Application

- Rice: grain size

Costs/savings:

Cost of system (software+scanner) € 8000.

Technical:

1. Hardware camera

Scanner Epson
Perfection V7000

1. Hardware processing

PC

1. Hardware display

Normal
monitor

2. Software recording

Winseedle
2010a

2. Software processing

Winseedle 2010a

2. Software display/print

Winseedle
2010a

3. Commercially available

Yes, Regent
instruments

4. Available to other members

Commercially
available

5. Recording conditions

Winseedle comes with an optical scanner and a special lighting system that minimizes shadows

6. Volume of data

7. Other remarks

The Netherlands

Applications:

- Flax : length, width of seed; Under construction: length, width and ratio length/width of boll
- Sugar beet: length, width, area cotyledons:
- French beans and Running beans: length (excluding beak), width, total length and degree of curvature of pod; length of beak
- Pea: length, width, degree of curvature of pod
- Carrot: length, max. width, ratio length/width, width of crown, form factor, mean width, ratio width/length of root; Under construction: root shape

Technical

<p>1. Hardware camera</p> <p>D90 + AF-S Nikkor 18-105mm/3.5-4.5</p>	<p>1. Hardware processing</p> <p>HP Compaq</p>	<p>1. Hardware display</p> <p>HP Compaq</p>		
<p>2. Software recording</p> <p>NKremote 1.2 software for Windows</p>	<p>2. Software processing</p> <p>ImageJ with custom made plugin.Windows Excel, Genstat for statistical analysis</p>	<p>2. Software display/print</p> <p>Microsoft Office Picture Manager</p>	<p>3. Commercially available</p> <p>Camera hardware/software commercially available; Processing: ImageJ specifically developed. Windows Office and Genstat commercially available (own routines added)</p>	<p>4. Available to other members</p> <p>To be discussed</p>

5. Recording conditions

Calibration with use of calibration disc.
Standardization of light – variable per crop, determination of the exposure of the photographed objects (shutter time, diaphragm and the quantity of light) is based on the histogram which is available via the software (NKremote) for the camera.

Specific requirements per crop such a orientation of the objects, e.g. carrot all carrots need to be oriented horizontal.

6. Volume of data **7. Other remarks**

Poland

Applications:

- Our application is measuring 8 characteristics of oilseed rape and white mustard using scanned bitmap pictures. Results are written to database

Technical:

1. Hardware camera

HP Scanjet 4850

1. Hardware processing

1. Hardware display

2. Software recording

HP Software

2. Software processing

Skaner-Sten

2. Software display/print

Skaner-Sten

3. Commercially available

Process and display:
specifically developed

4. Available to other members

No

5. Recording conditions

Calibration: we have to scan the model of colour and size and test it using "Skaner" application.

6. Volume of data

about 1000 images per year, (6GB per year)

7. Other remarks

Spain

Applications:

- Characteristics of grain (length and width) in rice, chickpea, etc

Technical:

1. Hardware camera

COLOR VIDEO
CAMERA; MODEL:
JVC TK-C1481B

1. Hardware processing

COMPUTER: DELL
DIMENSION
DIM5000, INTEL
PENTIUM4 3GHZ,
256 MB RAM

1. Hardware display

LCD
MONITOR;
DELL E1705C

2. Software recording

MIP 4
ADVANCED
5.01.02

2. Software processing

MIP 4 ADVANCED
5.01.02

2. Software display/print

MICROSOFT
EXCEL 2007

3. Commercially available

Yes, from Digital Image
Systems (DIS)

4. Available to other members

No

5. Recording conditions

LIGHT= 2 36W
SAMPLING DENSITY: 12 – 50 grains for variety
CAMERA TYPE: color video camera
CALIBRATION PROCEDURE: We use a ruler as reference
and we follow the calibration instructions of the program.

6. Volume of data

approx 50 KB
per variety

7. Other remarks

Sweden

Remark:

We are using a seed scanner for analysis of "other species" in cereals. This machine uses image analysis (a camera connected to a computer with programs for the different cereal species) for distinguishing between the seed in the sample and other seeds. In a sample it sorts out around 10% of the seeds, both of other seeds and seeds that are somehow considered not OK, so instead of manually going through 1000 gr the analyst can go through around 100 gr. This saves a lot of time. The scanner can be loaded with up to 30 samples and works even during nights.

United Kingdom (NIAB)

Applications:

- Oilseed.rape: cotyledon measurements;
- Oilseed.rape: siliqua measurements;
- Oilseed.rape: flower measurements;
- Field.Bean: leaf measurements;
- Field.Bean: siliqua measurements;

Technical:

1. Hardware camera	1. Hardware processing	1. Hardware display	3. Commercially available	4. Available to other members
Digital SLR (Olympus E-1 camera), Kaiser R2-CP Image Capture Set	Optiplex 788, quadcore with 64 Bit operating system	Dual PC monitors	No	No
2. Software recording	2. Software processing	2. Software display/print		
Bespoke program Analysis application written in C++ and Olympus Studio Controller	Bespoke program Analysis application written in C++ and Olympus Studio Controller	Bespoke program Analysis application written in C++ and Olympus Studio Controller		

5. Recording conditions

The Digital System is based on a digital camera using 2 11w lights @ 6000k which equate to natural light. The camera is suspended above a level surface. A reference object is incorporated into every picture. The IA program links with the Olympus studio Controller. The controller has special routines to handle camera aperture white noise etc. The linkage program has been specifically adapted by a consultant to allow menu driven options for each crop and to allow the entry of plot numbers. Once the controller has taken a picture the file is downloaded and re-opened by the IA program running in the background. The IA program will automatically analyze the picture and store the results in a data file. This allows the user to move any touching or irregular objects, thus equating to a live system. However the Controller can be used in isolation, storing the images to be batch processed at a later time. Once all plots have been photographed and analyzed via the batch process, thumbnail images can be examined and any outliers can be removed.

6. Volume of data

300 GB

United Kingdom (SASA)

Applications:

- Pea: Stipule. measurement, Petiole. measurement, Pod measurement, Peduncle measurement; Leaflet measurement, Seed shape measurement;
- Parsnip: Root measurement;
- Brassica crops: Cotyledon measurement;
- Brussels Sprout: Sprout measurement;
- Watercress: Foliage measurement;

Costs/savings:

Automated image measurements perform at least as well as manual measurements. Overall costs between manual (more recording) and imaged (more collection) measurements are about the same – but IA enables measured characters to be recorded which could not be done manually (e.g. leaflet area). Image library becomes available 1) For reference; 2) For data checking 3) for subsequently developed characters

Other remark:

We have downloaded a copy of the freely available Image-J software and have used it to investigate the possibility of assessing seed shape in large seeded crops but as yet we have not used this method in relation to variety testing.

Technical:

<p>1. Hardware camera</p> <p>Canon EOS 450 DSLR (lab) Nikon D700 DSLR (studio)</p>	<p>1. Hardware processing</p> <p>SASA network</p>	<p>1. Hardware display</p> <p>SASA network PCs (Dell) and printers (various)</p>	<p>3. Commercially available</p> <p>camera and display yes, processing software no</p>	<p>4. Available to other members</p> <p>No</p>
<p>2. Software recording</p> <p>Canon</p>	<p>2. Software processing</p> <p>Imag-in' Automatic Measurement Program (Biomathematics and Statistics Scotland) and 'Portfolio' v8.5 image database (Extensis).</p>	<p>2. Software display/print</p> <p>Portfolio</p>		

5. Recording conditions

The Digital System is based on a digital camera using 2 11w lights @ 6000k which equate to natural light. The camera is suspended above a level surface. A reference object is incorporated into every picture. The IA program links with the Olympus studio Controller. The controller has special routines to handle camera aperture white noise etc. The linkage program has been specifically adapted by a consultant to allow menu driven options for each crop and to allow the entry of plot numbers. Once the controller has taken a picture the file is downloaded and re-opened by the IA program running in the background. The IA program will automatically analyze the picture and store the results in a data file. This allows the user to move any touching or irregular objects, thus equating to a live system. However the Controller can be used in isolation, storing the images to be batch processed at a later time. Once all plots have been photographed and analyzed via the batch process, thumbnail images can be examined and any outliers can be removed.

6. Volume of data

300 GB



Groupe d'Étude et de contrôle
des Variétés Et des Semences



AIM

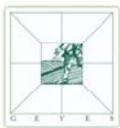
Management of Image Analysis

Experience from France

June 26 to June 29, 2012 (*Chisinau, Republic of Moldova*)

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PROGRAM OF THE TALK

- ✿ GENERAL ARCHITECTURE OF AIM APPLICATION
- ✿ Major reasons which have justified the implementation of Image analysis solution like Aim
- ✿ MAIN FUNCTIONALITIES PROVIDED BY AIM APPLICATION
- ✿ DATA MODEL OF AIM

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BEFORE TO START

This presentation is not a training course on how to use ImageJ or on particular method of image analysis but rather on a tool that we've developed using to manage different projects :

- dealing with image analysis
- With on the one hand **ImageJ**
- and on the other hand a **Database**.

This tool named AIM (A = Analysis , IM = IMage) pilot the backoffice to declare, display, store, launch, retrieve,

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GENERAL ARCHITECTURE

The Aim application is based on the following architecture

A front office → Graphic Interface written with the development tool Windev to manage studies (Declare, Retrieve, Export, Calculate, Levels of agregation, ...)

A back office → Image analysis software with the freeware ImageJ to define processing applied on images
Database software with Hyperfile or Oracle to store data provide by the graphic interface and Image analysis

```
graph TD; subgraph Front_Office; GI[Graphic Interface (Windev)]; end; subgraph Back_Office; DB[Database (HyperFile/Oracle)]; IAS[Image analysis software (ImageJ)]; end; GI <--> DB; GI <--> IAS;
```

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Main reasons

The main purpose of Aim is to centralized and shared image analysis at GEVES

Through this main goal :

- Centralized processing
- Ease processing
- Share our knowledge and experiences
- Standardize the results and controls
- Use benefits offer by database (Integrity, Access rights, Backup, Query, Link with other information system,)

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MAIN FUNCTIONALITIES

Through differents examples we are going to show the use of AIM application :

- 1^{er} – How to define and store macros Image-J
- 2nd – How to declare the framework of studies
- 3^{èm} – How to launch processing on images
- 4^{èm} – How to integrate measurement calculate by processing on images into database
- 5^{èm} – How to define and calculate new variables dynamically
- 6^{èm} – How to group/aggregate results (to the variety, to the replicate,...)

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Main functionalities

Example 1 : Assess how plant cover the ground

Context = The user has a list of images of several varieties and he wants to assess how each of these varieties cover the ground.

- Define a macro to separate the plant covering from the uncovered ground and measuring the ratio.
- Declare the framework of the study.
- Load images and launch analysis on each image.
- Open and store the file result.

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Main functionalities

Example 3 : Assess attack disease on leaves

Context = The user has several varieties and he wants to assess the attack of disease on leaf in controlled environment. He scans one image per variety and on each image he's got several leaves.

- Define a macro to calculate the ratio between the area cover by disease and the area of leaf
- Define the framework of the study.
- Load images, select macros ImageJ and launch processing.
- Open the file result and integrate its content into database.
- Transform area from pixels to square millimeters

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Main functionalities

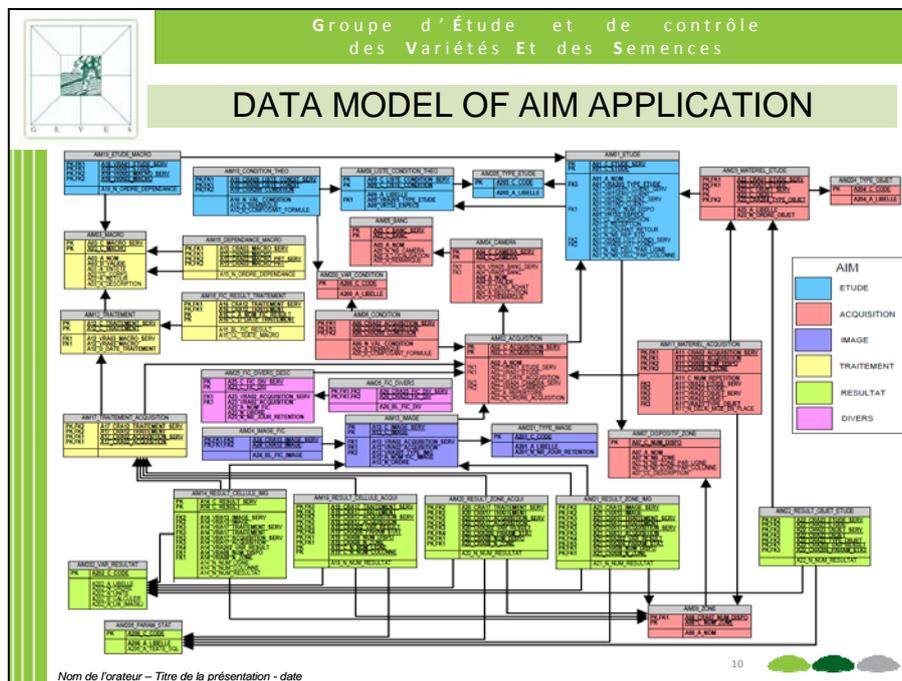
Example 3 : Assesment of fineness of foliage

Context = The user has several varieties of carrot and he wants to assess the fineness of foliage. He scans one image per variety and on each image he's got several leaves

- Define a macro to calculate the ratio between area of leaves and perimeter of leaves.
- Define precisely the framework of the study.
- Load images, select macros ImageJ and launch processing.
- Open the file result and integrate its content into database.
- Define several grouping to get results for :
 - Each Replicate
 - Each Variety
 -

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[End of Annex II and of document]