UPOV
International Union for the Protection of New Varieties of Plants

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Technical Working Party on Testing Methods and Techniques

TWM/4/31

Fourth Session
Cambridge, United Kingdom, June 2 to 5, 2026

Original: English
Date: June 5, 2026

REPORT

adopted by the Technical Working Party on Testing Methods and Techniques (TWM)

Disclaimer: this document does not represent UPOV policies or guidance

OPENING OF THE SESSION

1. The Technical Working Party on Testing Methods and Techniques (TWM) held its fourth session, in Cambridge, United Kingdom, from June 2 to 5, 2026.

2. The session was opened by Ms. Nuria Urquía Fernández (European Union), Chair of the TWM, who welcomed the participants.

3. The TWM was welcomed by Mr. Richard McIntosh, Controller for Plant Variety Rights, Department for Environment, Food and Rural Affairs (DEFRA), United Kingdom and received a presentation on DEFRA's activities, as provided in Annex I to this report.

ADOPTION OF THE AGENDA

4. The TWM adopted the agenda as provided in document TWM/4/1 Rev.

Software and statistical analysis methods for DUS examination

(i) United Kingdom software innovations: DUST and COYUs

5. The TWM received a presentation from Ms. Tess Vernon (United Kingdom) on "UK software innovations: DUST and COYUs", as provided in document TWM/4/11.

6. The TWM noted that a new version of the DUST software was being developed and would be made available to UPOV members.

7. The TWM noted that the COYU criterion using "splines" was currently being implemented in the United Kingdom in parallel with COYU "moving average" for comparison purposes.

(ii) Guidance on extrapolation when using Combined Over-Years Uniformity (COYU)

8. The TWM received a presentation from Ms. Trudyann Kelly (United Kingdom) on "Guidance on extrapolation when using Combined Over-Years Uniformity (COYU)", as provided in document TWM/4/12.

9. The TWM noted that document TWM/4/12 provided guidance on extrapolation to be considered for future inclusion in UPOV guidance.

10. The TWM noted that extrapolation was not recognized previously with COYU "moving average" and the graphics generated in DUSTNT were not clear enough to identify it. The TWM noted that the new COYU "splines" addressed extrapolation consistently, increasing robustness of decisions.

(iii) Comparison of COYU method: spline vs moving average

11. The TWM received a presentation from Ms. Aurore Philibert (France) on “Comparison of COYU method: spline vs moving average”, as provided in document TWM/4/15.

12. The TWM discussed the threshold levels used in the comparative study and whether specific thresholds levels should be established for individual crops. The TWM noted the offer from the United Kingdom to provide a larger data set for further analysis comparing results obtained using COYU splines and moving average.

(iv) Comparison of software for COYD, U

13. The TWM received a presentation from Mr. Frédéric Lafaillette (France) on “Comparison of software for COYD, U”, as provided in document TWM/4/28.

14. The TWM noted the general concordance of results and the cases where different decisions would be reached using the different software. The TWM noted that the software comparison was based on the outcomes of a ring test conducted in 2021 and utilizing a previous version of the DUSCEL software.

15. The TWM noted the explanation from France that further analysis would be conducted to understand the differences obtained using different software, prior to new comparisons with different crops and the inclusion of COYUs.

16. The TWM agreed that guidance in document TGP/8 could be revised for improved clarity on the procedures used to calculate the COYU criterion at a later stage.

(v) Minimum distance of varieties

17. The TWM received a presentation from Mr. Kun Yang (China) on “Minimum distance of varieties”, and noted that the presentation would be provided as a revised version of document TWM/4/3.

18. The TWM noted the challenges for DUS examination of crops with large number of applications being filed in China, including applications with small differences in characteristics of no commercial relevance. The TWM discussed the assessment of distinctness in relation to those characteristics.

19. The TWM discussed the use of DNA-based information in support of DUS examination. The TWM noted the offer from the International Seed Federation to collaborate on matters relating to essentially derived varieties.

(vi) Kora: Digital management of variety collections

20. The TWM received a presentation from Mr. Gabriele Mongiano (Italy) on “Kora: Digital management of variety collections”, as provided in document TWM/4/14.

21. The TWM noted that the software was currently being tested in Italy and expected to be released during the next months. The TWM discussed different aspects of the software, including the programming language, database features and particular use cases, such as selection of similar varieties. The TWM noted that a user guide was being developed and agreed to invite UPOV members to test the software and provide comments to Italy.

(vii) Work on molecular techniques in relation to DUS examination in Ukraine and short report of software and statistical analysis methods for DUS examination

22. The TWM received a presentation from Ms. Larysa Prysiazhniuk (Ukraine) on “Work on molecular techniques in relation to DUS examination in Ukraine and short report of software and statistical analysis methods for DUS examination”, as provided in document TWM/4/5.

23. The TWM noted the use of DNA-based information for enforcement, which could be conducted with support from the plant variety protection authority in some cases. The TWM noted the ongoing research in Ukraine to incorporate DNA-based information in support of DUS examination.

(viii) Revision suggestions on document TGP/8 "Trial design and techniques used in the examination of Distinctness, Uniformity and Stability"

24. The TWM received a presentation from Mr. Kun Yang (China) on "Revision suggestions on document TGP/8 'Trial design and techniques used in the examination of Distinctness, Uniformity and Stability'". The TWM noted that the presentation would be provided in a revised version of document TWM/4/4.

25. The TWM discussed whether document TGP/8 should be revised and agreed that guidance on additional techniques used by UPOV members could be developed for future inclusion in the document.

26. The TWM agreed to invite China with the support of Argentina, Brazil, Canada, France, Germany, Italy, Netherlands (Kingdom of the), Japan, Ukraine, United Kingdom and the International Seed Federation to identify missing topics and priorities for future development of guidance, as well as the UPOV members in charge of drafting any proposals.

27. The TWM agreed that discussions could be advanced during an online meeting to be scheduled by China during the first two weeks of September. The TWM noted that any proposals for future development of UPOV guidance would be presented by China for consideration by the Technical Committee.

Phenotyping and image analysis

(i) Artemis - Digital solutions for climate-resilient agriculture

28. The TWM received a presentation from Mr. Lennart Woltering, Alliance Bioversity and CIAT, on "Artemis - Digital solutions for climate-resilient agriculture", as provided in document TWM/4/18.

29. The TWM noted that "Artemis" provided a computer vision application specifically developed for smartphones use. The TWM noted that Artemis included a machine learning model that could count plant parts such as pods in beans and assess certain diseases. The TWM noted that the software had been developed to support plant breeding activities and discussed possibilities of use for the assessment of DUS characteristics.

30. The TWM noted that UPOV members should contact Mr. Woltering for access to the application and collaboration for further development.

(ii) Development of an image-based test for soybean variety identification

31. The TWM received a presentation from Ms. Ana Laura Vicario (Argentina) on "Development of an image-based test for soybean variety identification", as provided in document TWM/4/22 and TWM/4/22 Add.

32. The TWM noted that the project results where image-based markers achieved a sufficient level of correlation with molecular markers for identification of the Argentinian varieties used to train the model. The TWM noted that image-based markers would need to be calibrated for use with other varieties.

33. The TWM noted that the image-based markers would be used by Argentina for variety identification purposes in market control activities as a screening method, where varieties without match or any discrepancies with the declared variety identity would be further addressed using molecular markers.

34. The TWM agreed to invite Ms. Vicario to report further progress to the TWM, at its fifth session.

(iii) Validation of an artificial intelligence-based method for varietal identification of wheat, barley and soybean seeds using optical markers

35. The TWM received a presentation from Ms. Pilar Zorrilla de San Martin (Uruguay) on "Validation of an artificial intelligence-based method for varietal identification of wheat, barley and soybean seeds using optical markers". The TWM noted that the presentation would be provided as document TWM/4/29.

36. The TWM noted that the optical markers utilized showed complete accuracy on the identification of reference samples and high concordance in large-scale monitoring of seeds, as reported on the variety identification and enforcement activities conducted.

(iv) Phenotyping and image analysis at Naktuinbouw

37. The TWM received a presentation from Ms. Sanchari Sircar (Netherlands (Kingdom of the)) on "Phenotyping and image analysis at Naktuinbouw", as provided in document TWM/4/8 and TWM/4/8 Add.

38. The TWM noted the ongoing development of an artificial intelligence model to support the selection of similar varieties using flower photographs. The TWM noted that further development would be undertaken for calibration of the model.

(v) Image analysis in DUS testing

39. The TWM received a presentation from Mr. Lakjung Choe (Republic of Korea) on "Image analysis in DUS testing", as provided in document TWM/4/19.

40. The TWM noted that the machine assessment of color facilitated the identification of color chart references, which were confirmed by the DUS examiner.

Developments in molecular techniques and bioinformatics

(a) Cooperation between international organizations

(i) OECD Seed Schemes

41. The TWM received a presentation from Mr. Christophe Rouillard, Organisation for Economic Cooperation and Development (OECD), on "Recent developments in the application of biochemical and molecular techniques: 'Towards enhanced OECD / ISTA / UPOV cooperation'", as provided in document TWM/4/27.

42. The TWM noted that OECD would favor the potential development of common sets of molecular markers for maize, rapeseed, soybean, wheat and grass species such as *Lolium* spp.

43. The TWM noted the existence of public sets of molecular markers for the crops mentioned by OECD, some of which were mentioned in the UPOV survey on the use of molecular markers. The TWM agreed that international harmonization work should give priority to the use of such publicly available marker sets.

(ii) ISTA

44. The TWM received a presentation from Ms. Marie-Claude Gagnon, International Seed Testing Association (ISTA), on "Update on the activities of the ISTA Variety Committee (VARCOM)", as provided in documents TWM/4/23 and TWM/4/23 Add.

45. The TWM noted that ISTA had published DNA-based methods for the identification of varieties for maize, oats, pea, and wheat, and was developing a method for barley.

(iii) UPOV

46. The TWM received a presentation from the Office of the Union on developments in molecular techniques in UPOV, as provided in document TWP/10/4.

47. The TWM noted the report from Mr. René Mathis, France, on the ongoing discussions among experts considering the terminology on molecular markers used at UPOV, OECD and ISTA, including their level of convergence and possible need for harmonization. The TWM agreed to invite Mr. Mathis to report further progress at its fifth session.

(iv) International Organisation of Vine and Wine (OIV)

48. The TWM received a presentation from Mr. Enrico Battiston, International Organisation of Vine and Wine (OIV), on "The OIV key actions on grapevine genetic resources and the publication of the 3rd edition of the OIV ampelographic descriptors", as provided in documents TWM/4/20 and TWM/4/20 Add.

49. The TWM noted that Japan was developing molecular markers for the identification of grape varieties with the possibility of using the OIV markers and additional markers suitable for varieties in the collection.

(v) Development of molecular marker panels for variety registration and trade control

50. The TWM received a presentation from Ms. Ana Laura Vicario (Argentina) on “Development of molecular marker panels for variety registration and trade control”, as provided in documents TWM/4/21 and TWM/4/21 Add.

51. The TWM noted that Argentina had regulated the procedure for incorporating molecular markers in support of variety examination and market control activities, including selection of varieties, definition of molecular marker panel, data analysis, interpretation of results and maintenance of the markers. The TWM noted that since 2019, Argentina utilized the UPOV model “Combining Phenotypic and Molecular Distances in the Management of Variety Collections” of document TGP/15, for soybean variety examination.

52. The TWM discussed the process used in Argentina to select molecular markers in soybean and noted that more than 800 varieties had been considered, widely covering the varieties of common knowledge suitable for cultivation in the country. The TWM noted a larger set of molecular markers had been developed to support DUS examination and a smaller set of markers had been developed for variety identification in market control activities. The TWM noted the challenges faced in Argentina due to the public array of molecular markers no longer being available from a commercial provider and the solutions that allowed the continued use of the model.

53. The TWM noted that Argentina had used SNP variety data to develop PCR markers for low-cost variety identification in cotton and soybean.

(vi) Molecular markers: Public-private partnership, a Brazilian experience

54. The TWM received a presentation from Ms. Stefânia Araujo (Brazil) on “Molecular markers: Public-private partnership, a Brazilian experience”, as provided in document TWM/4/10.

55. The TWM noted the ongoing development of a molecular marker set for soybean in Brazil, organized in collaboration and with the same molecular markers used in Argentina and the United States of America. The TWM noted the challenges for resourcing the development of the project, which had been overcome thanks to a public-private partnership with a local plant breeders’ organization.

56. The TWM agreed to invite Brazil to report developments at its fifth session.

(vii) Molecular markers for DUS test in Italy

57. The TWM received a presentation from Ms. Lorella Andreani (Italy) on “Molecular markers for DUS tests in Italy”, as provided in document TWM/4/30.

58. The TWM discussed the challenges of databases containing DNA-based information and agreed that relevant governance matters should be addressed as early as possible in development projects. The TWM noted the report from the European Union that a data governance policy was being prepared for the databases being developed in the region and agreed to invite the European Union to report progress at its fifth session.

(viii) Community Plant Variety Office of the European Union (CPVO)

59. The TWM received a presentation from Ms. Cécile Collonnier (CPVO) and Ms. Claire Kamei (Netherlands (Kingdom of the)) on “CPVO co-funded project: International validation of a SNP marker set for tomato DUS testing”, as provided in a revised version of document TWM/4/26.

60. The TWM discussed a proposal to invite UPOV members to validate the set of molecular markers selected for tomato developed by the European Union in collaboration with China, Japan and the Republic of Korea. The TWM agreed that UPOV members should contact Ms. Collonnier for further information on the set of molecular markers for tomato.

61. The TWM discussed the main elements required to define a global set of molecular markers and agreed that obtaining authorization from breeders to utilize varieties for the project would be a critical factor. The TWM agreed that the use of public sets of markers could overcome this matter.

62. The TWM agreed to propose that UPOV communicate on the molecular marker sets developed by UPOV members, such as the marker sets for tomato. The TWM agreed that training would be required to support UPOV members using the molecular marker sets and interpreting results.

63. The TWM noted that the ISTA proficiency testing program was open to all laboratories and was currently running for wheat, using two public domain varieties.

(ix) Survey on the use of molecular marker techniques 2026

64. The TWM received a presentation from Ms. Claire Kamei (Netherlands (Kingdom of the)) on "Survey on the use of molecular marker techniques 2026", as provided in document TWP/10/4 Add.

65. The TWM agreed that the survey results provided relevant information to define priorities for future work, including the development of harmonized sets of molecular markers. The TWM agreed to propose that the survey be periodically updated.

66. The TWM noted the intervention from ISF that progress on the use of DNA-based information should be encouraged with the collaboration of breeders to ensure confidentiality of breeding strategies.

67. The TWM noted the report from United Kingdom that had recently published a study developed in collaboration with Austria and Italy on "Genome-wide association study (GWAS) identifies genetic loci controlling Distinctness, Uniformity, and Stability (DUS) traits in wheat". The TWM noted that marker–trait associations for DUS characteristics had been identified, including associations for 'seed: coloration with phenol'.

(x) Discussion on possible joint activities

68. The TWM discussed the possible development of harmonized sets of molecular markers with OECD and ISTA. The TWM agreed to invite participants at the TWM to analyze and validate, as appropriate, the following sets of publicly available molecular markers for international harmonization:

- Argentina (soybean): available as PDF file for download: https://www.boletinoficial.gob.ar/detalleAviso/primera/267999/20220804
  - Available as Excel spreadsheet for download: https://www.argentina.gob.ar/noticias/perfiles-moleculares-verificacion-e-identificacion-de-variedades-de-soja
  - Published list of markers: https://www.boletinoficial.gob.ar/detalleAviso/primera/288656/20230622

- European Union (tomato): https://cpvo.europa.eu/en/about-us/what-we-do/research-and-development

- International Organisation of Vine and Wine (OIV) (grapevine): see markers in slides 15 and 17 of document TWM/4/20 Add.

- United States of America (soybean): publication available at: https://www.betterseed.org/wp-content/uploads/Molecular-Marker-Article.pdf?shem=rimspwouoe

- UPOV Survey on the use of molecular markers per crop (marker sets in peer reviewed literature): see Excel spreadsheet as Annex to document TWP/10/4 "Molecular Techniques", available at: https://www.upov.int/en/about-upov/events/details?meeting-id=90352

69. The TWM agreed to invite UPOV members, organizations and interested experts to report the results of their analysis at its fifth session.

70. The TWM agreed to further consider whether guidance should be developed on the use of molecular marker sets, including interpretation of results.

71. The TWM noted the invitation from ISTA to develop a performance based approach for molecular marker tests, in partnership with interested UPOV members.

(b) Report of work on molecular techniques in relation to DUS examination

(i) CPVO R&D activities

72. The TWM received a presentation from Ms. Cécile Collonnier (CPVO), on “CPVO R&D activities”, as provided in document TWM/4/9.

73. The TWM noted that UPOV members were invited to contact the European Union for possible partnerships and future projects.

(ii) Exploring the potential use of UPOV model “Combining phenotypic and molecular distances in the management of variety collections” for bread wheat in France

74. The TWM received a presentation from Ms. Clarisse Leclair (France) on “Exploring the potential use of UPOV model ‘Combining phenotypic and molecular distances in the management of variety collections’ for bread wheat in France”, as provided in document TWM/4/24.

75. The TWM noted that France would continue developing the method, including the genotyping of the entire collection of varieties and the possible reduction of the total number of SNP markers required.

(iii) Exploring the use of genomic prediction approaches for variety collection management in barley

76. The TWM received a presentation from Ms. Vanessa McMillan (United Kingdom), on “Exploring the use of genomic prediction approaches for variety collection management in barley”, as provided in document TWM/4/17.

77. The TWM discussed the methodology used and results obtained, including the use of Random Forest models for genomic prediction and the level of correlation achieved between the SNP marker set and characteristics in Test Guidelines.

(c) Management of databases and exchange of data and material

(i) Construction and application of molecular fingerprint databases for vegetable varieties

78. The TWM received a presentation from Ms. Jun Ren (China) on “Construction and application of molecular fingerprint databases for vegetable varieties”, as provided in document TWM/4/13.

79. The TWM noted developments concerning the development of databases containing morphological and molecular data and the results obtained in support of variety examination and market control activities.

(ii) DUS Pheno/Geno database

80. The TWM received a presentation from Mr. Emerson Limberger, International Seed Federation (ISF), on “DUS Pheno/Geno database”, as provided in document TWM/4/16.

81. The TWM noted that the content of the presentation was under discussion at ISF. The TWM discussed the use of shared information in common databases and agreed that challenges related to data governance, including access to data and governance should be addressed before further action.

82. The TWM agreed to invite ISF in consultation with interested members and observers to further develop the proposal, including database governance, main use cases, database structure, operations at PVP offices and resource considerations for development and maintenance.

83. The TWM referred to the previous agreement to invite the European Union to report progress on its database governance policy at its fifth session and agreed to extend the invitation to other UPOV members.

84. The TWM recalled that document UPOV/INF/17 “Guidelines for DNA-Profiling: Molecular Marker Selection and Database Construction ("BMT Guidelines")” provided principles for the development of databases containing molecular profiles of plant varieties.

85. The TWM agreed that significant resourcing would be required to develop a common database for UPOV members. The TWM noted that UPOV was not in a position to resource such a proposal and agreed that any future work would rely on additional resources to be provided by UPOV members and observers.

(iii) Progress in the use of molecular markers to support tomato DUS testing at Naktuinbouw

86. The TWM received a presentation from Ms. Claire Kamei (Netherlands (Kingdom of the)), on "Progress in the use of molecular markers to support tomato DUS testing at Naktuinbouw", as provided in document TWV/60/7-TWM/4/6.

87. The TWM noted the identity verification procedures described which enabled reducing the size of growing trials and comparison of standard samples with new samples provided for maintenance purposes.

(d) The use of molecular techniques in the assessment of essential derivation

(i) A strategy to establish Genetic Similarity (GS) thresholds to support Essentially Derived Variety (EDV) evaluation:

88. The TWM received a presentation from Mr. Barry Nelson, International Seed Federation (ISF), on "A strategy to establish Genetic Similarity (GS) thresholds to support Essentially Derived Variety (EDV) evaluation", as provided in document TWM/4/25.

89. The TWM noted the report from the Office of the Union that the "Explanatory Notes on Essentially Derived Varieties under the 1991 Act of the UPOV Convention" (document UPOV/EXN/EDV) had been revised in 2023 and clarified that "[…] the existence of a relationship of essential derivation between varieties is a matter for the titleholder of the breeder's right in the initial variety concerned."

90. The TWM noted the efforts reported by SAA and ISF to communicate and explain the concept of EDV among breeders. The TWM noted that thresholds of genetic similarity agreed and under development by the breeders for cotton, maize, lettuce, mushroom, oilseed rape, ryegrass, soybean and wheat, as provided in document TWM/4/25.

(e) The use of molecular techniques for enforcement

(i) New developments in the use of DNA techniques for PBR enforcement in Peru

91. The TWM received a presentation from Mr. Diego F. Ortega Sanabria (Peru) on "New developments in the use of DNA techniques for PBR enforcement in Peru", as provided in document TWM/4/7.

92. The TWM noted that the new regulations updated the administrative measures for laboratories to perform DNA analysis considered in infringement cases in Peru. The TWM noted the advantages reported on the use of DNA techniques, providing right holders an expeditious measure for enforcement.

MATTERS FOR INFORMATION

Reports on developments in UPOV

93. The TWM noted a report from the Office of the Union on developments in UPOV, as provided in document TWP/10/6.

Reports from members and observers

94. The TWM noted the information on developments in plant variety protection from members and observers provided in document TWM/4/2. The TWM noted that reports submitted to the Office of the Union until June 5, 2026, would be included in the final version of document TWM/4/2.

Other matters for information

95. The TWM noted the information provided in the following documents:

(i) Development of guidance and information materials (document TWP/10/1)
(ii) Notification of additional characteristics and states of expression (document TWP/10/2)
(iii) Measures to improve support provided for DUS examination (document TWP/10/3)
(iv) Technical Questionnaire, section 4.2: “Method of propagating the variety” (document TWP/10/5)

DATE AND PLACE OF THE NEXT SESSION

96. At the invitation of United States of America, the TWM agreed to hold its fifth session in Alexandria, Virginia from May 10 to 13, 2027.

CHAIR

97. The TWM agreed to propose to the TC that it recommend to the Council to elect Mr. René Mathis (France) as the next chair of the TWM.

MEDAL

98. The TWM thanked Ms. Nuria Urquía Fernández for chairing the TWM and noted that she was awarded a UPOV bronze medal in recognition of chairing the TWM from 2024 to 2026.

FUTURE PROGRAM

99. The TWM agreed that documents for its fifth session should be submitted to the Office of the Union by March 26, 2027. The TWM noted that items would be deleted from the agenda if the planned documents did not reach the Office of the Union by the agreed deadline.

100. The TWM proposed to discuss the following items at its fifth session:

1. Opening of the session
2. Adoption of the agenda
3. Matters for consideration
   - 3.1 Software and statistical analysis methods for DUS examination (papers invited)
   - 3.2 Phenotyping and image analysis (papers invited)
   - 3.3 Developments in molecular techniques and bioinformatics (papers invited)
     - (a) Cooperation between international organizations (papers invited)
     - (b) Reports of work on molecular techniques in relation to DUS examination (papers invited)
     - (c) Governance, management of databases, exchange and confidentiality of data and material (papers invited)
     - (d) The use of molecular techniques in the assessment of essential derivation (papers invited)
     - (e) The use of molecular techniques in variety identification (papers invited)
     - (f) The use of molecular techniques for enforcement (papers invited)
4. Matters for information
   - (a) Reports from members and observers (written reports to be prepared by members and observers)
   - (b) Report on developments in UPOV (general developments, including variety denominations, information databases, exchange and use of software and equipment, guidance and information materials)
5. Date and place of the next session
6. Future program
7. Adoption of the Report on the session (if time permits)
8. Closing of the session

VISIT

101. On June 3, 2026, the TWM visited the facilities of Niab, at Cambridge. The TWM was welcomed by Mr. Mario Caccamo, CEO and received a presentation on the activities of Niab, as provided in Annex II to this report. The TWM received presentations from the following experts:

- Ms. Karen Lucas-Greef, United Kingdom Plant Variety Rights Office (PVRO), Animal Plant Health Agency (APHA) (see Annex III)
- Mr. Adam Gauley, Agri-Food and Biosciences Institute (AFBI) (see Annex IV)
- Ms. Margaret Wallace, Niab (see Annex V)
- Mr. Robert Jackson and Mr. Greg Deakin, Niab (see Annex VI)

102. The TWM visited the field trials for barley and field bean variety examination and the Niab facilities for gene transformation, research projects and glasshouses, imaging and data sciences, pathology growth rooms, DUS testing and seed certification.

103. *The TWM adopted this report at the end of the session.*

[Annex I follows]

Department for Environment, Food & Rural Affairs

UK Introduction

4th Session, UPOV Technical Working Party on Testing Methods and Techniques (TWM/4)

2nd June - 5th June 2026

Cambridge, United Kingdom

Richard McIntosh

UK Controller of Plant Variety Rights

Published: May 2026
Classification: OFFICIAL

1

Department for Environment, Food & Rural Affairs

TWM/4

The UK is delighted to be hosting the 4th session of the TWM

Welcome to Cambridge

2

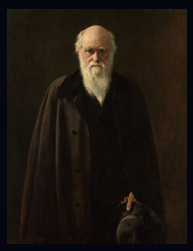
Department for Environment, Food & Rural Affairs

Cambridge is a city steeped in history, innovation, and global collaboration

Gravity, ***Principia Mathematica*** (1687), Sir Isaac Newton

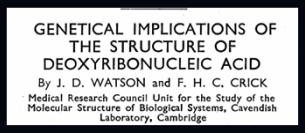
Charles Jervas' portrait of Isaac Newton

Evolution, *The Origin of the Species (1859),* Charles Darwin



John Collier's 1881 portrait of Charles Darwin.

Structure of DNA (1953). Franklin, Crick, and Watson


GENETICAL IMPLICATIONS OF THE STRUCTURE OF DEOXYRIBONUCLEIC ACID
By J. D. WATSON and F. H. C. CRICK
Medical Research Council Unit for the Study of the Molecular Structure of Biological Systems, Cavendish Laboratory, Cambridge

Nature, 4361 (1953)

126 affiliates of University of Cambridge have received Nobel Prizes, more than those of any other institution

Nobel Prize | University of Cambridge

3

Department for Environment, Food & Rural Affairs

Excellence in Plant Science

Cambridge is home to the Sainsbury Laboratory, University of Cambridge

THE SAINSBURY LABORATORY
UNIVERSITY OF CAMBRIDGE

The Sainsbury Laboratory combine experimental biology and computational modelling to understand the regulatory systems that underpin plant growth and development. Core funding by The Gatsby Charitable Foundation.

Home | Sainsbury Laboratory

4

Department for Environment, Food & Rural Affairs

United Kingdom of Great Britain and Northern Ireland

One of the world's largest economies
Population 68.4m
Area of 94,354 square miles

Service sector	80.5 % of GDP
Industry and construction	18.7 %
Agriculture	0.8 %

OECD 2024

Image: NASA Earth Observatory/Michala Garrison

5

Department for Environment, Food & Rural Affairs

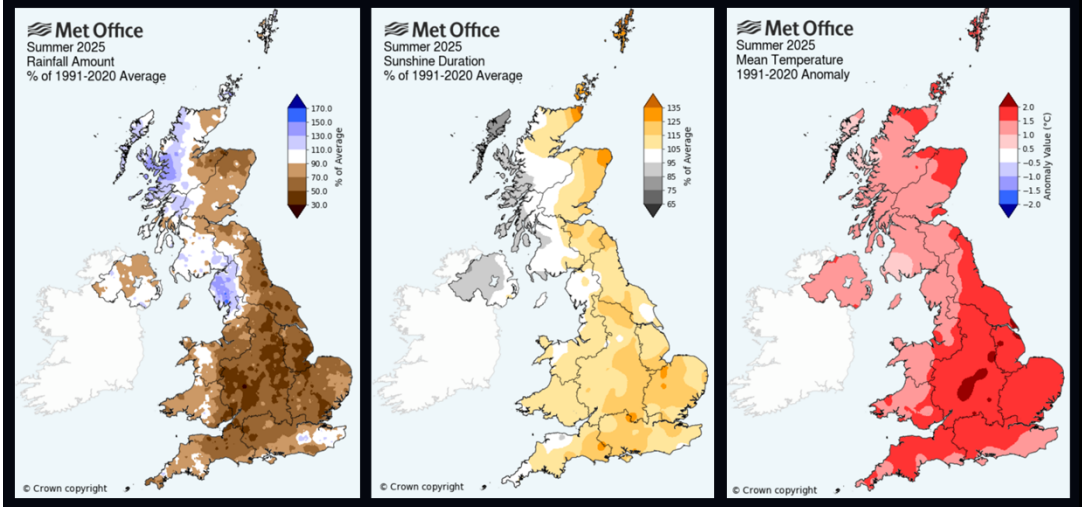
6

Department for Environment, Food & Rural Affairs

A changing climate

In summer 2025: below average rainfall, above average sunshine, and four heatwaves

Summer 2025 is the warmest on record for the UK - Met Office



7

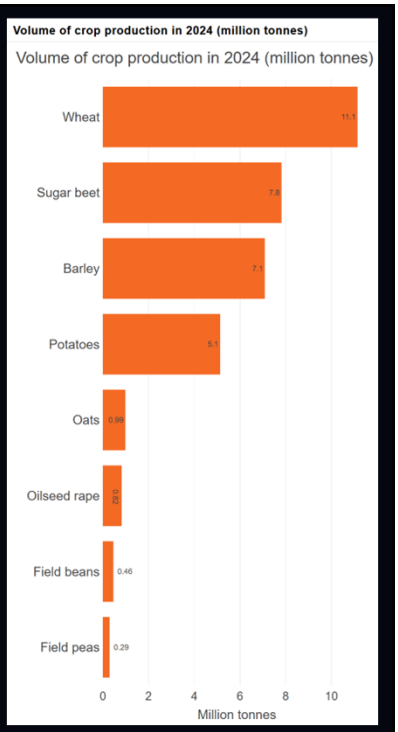
Department for Environment, Food & Rural Affairs

Agriculture and Horticulture in the UK

In 2024:

- The **utilised agricultural area** was 17 million hectares, covering 69% of land in the UK.
- The **total arable area** was 6.2 million hectares.
- The **cereal crops area** was 3.0 million hectares.

Defra, 2024



Agriculture in the UK Dashboard

8

Department for Environment, Food & Rural Affairs

Plant breeding successes

- Improvements in cereal yields
- Low glycosidic nitrile barley
- Extended season production in strawberries
- Researchers at The Sainsbury Laboratory have created a tomato that is resistant to powdery mildew infection
- Research in wheat to reduce the potential for acrylamides

9

Department for Environment, Food & Rural Affairs

Plant breeding successes, and into the future with gene editing

Sugar beet, oilseed rape, tomatoes and dandelions: four projects win major funding to support UK agriculture

£ 21.5 million in new funding will back 15 innovation projects

John Innes Centre, February 2026

Defra Farming Innovation Programme funding

10

Department for Environment, Food & Rural Affairs

History of Plant Breeders' Rights in the UK

The UK has a long history with UPOV:

1961	The first UPOV convention was written in 1961. The UK signed the convention in 1962.
1964	The first Convention comes into force in 1968, and is implemented by the 1964 Plant Varieties and Seeds Act
1997	The UK signed the 1991 convention in 1999. The Plant Varieties Act 1997 ratifies the 1991 convention.

Plant Varieties and Seeds Act 1964

Plant Varieties Act 1997

11

Department for Environment, Food & Rural Affairs

Delivery and Administration

The Plant Variety Rights Office (PVRO) administers Plant Breeders' Rights on behalf of the UK.

- **PVRO** = Controller of Plant Variety Rights (Defra) and Animal and Plant Health Agency (APHA).
- **Defra** oversees the **legislation and sets the policy** in collaboration with the Welsh Government, Scottish Government and the Department of Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland.
- **APHA deliver and administer** grants of UK Plant Breeder' Rights

Department for Environment, Food & Rural Affairs

Animal & Plant Health Agency

Llywodraeth Cymru Welsh Government

Department of Agriculture, Environment and Rural Affairs

Scottish Government Riaghaltas na h-Alba

12

UPOV PRISMA Application Tool | UPOV Plant Variety Submission

Department for Environment, Food & Rural Affairs

Delivery and Administration

Applications are made to the PVRO (APHA) using UPOV PRISMA. Can apply for Variety Listing at the same time for agricultural and vegetable varieties – a requirement prior to marketing.

↓

APHA organise Distinctness, Uniformity and Stability (DUS) testing (required for PBR & VL), and Value for Cultivation and Use (VCU) testing (required for VL only).

↓

Information on PBR and VL applications is published in the Plant Varieties and Seeds Gazette.

↓

Once listed, seed of a variety must be certified, a quality assurance process which ensures seeds are sufficiently pure, healthy and viable.

Department for Environment, Food & Rural Affairs

Animal & Plant Health Agency

Llywodraeth Cymru Welsh Government

Department of Agriculture, Environment and Rural Affairs

Scottish Government Riaghaltas na h-Alba

13

Department for Environment, Food & Rural Affairs

Animal & Plant Health Agency

Llywodraeth Cymru Welsh Government

Scottish Government Riaghaltas na h-Alba

Department of Agriculture, Environment and Rural Affairs

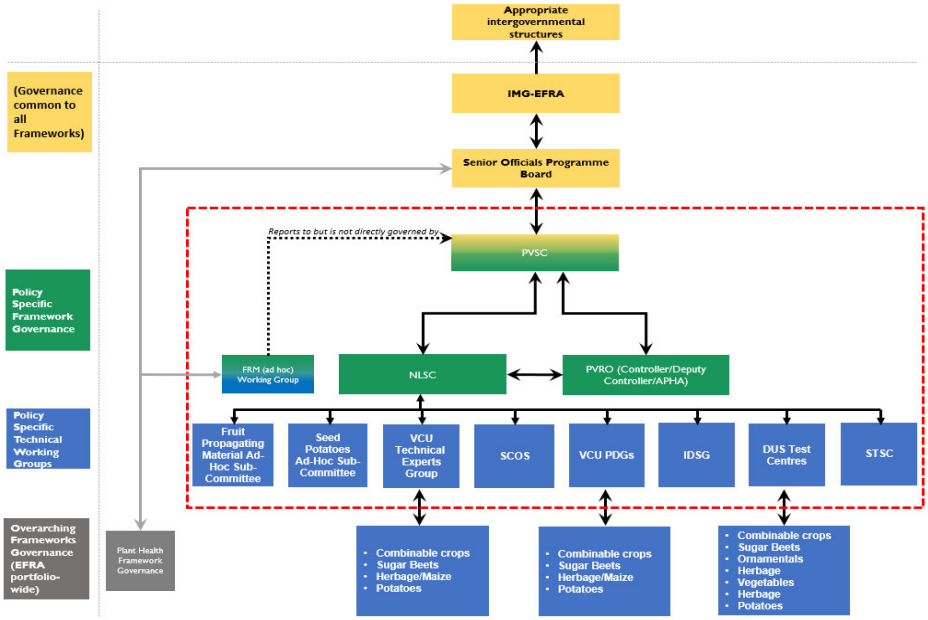
Decision-making in the UK

- The main fora for official level discussion and decision-making are the Plant Varieties and Seeds Committee (PVSC) and the National Lists Seeds Committee (NLSC).
- The key decisions that may be taken are:
  - policy decisions concerned with legislative amendments,
  - temporary marketing derogations,
  - equivalence recognition requests;
  - international representation;
  - resolution of issues;
  - reviewing and amending the Common Framework;
  - and procurement of services for PBR and variety registration.

14

Department for Environment, Food & Rural Affairs

PVS Governance in the UK



15

Department for Environment, Food & Rural Affairs

DUS testing in the UK

- UK DUS protocols based on UPOV Technical Guidelines and are publicly available: DUS protocols for testing plant varieties - GOV.UK (www.gov.uk)
- UK technical experts are members of several UPOV working groups.
- **3 DUS Test Centres** specialising in specific species:
  - The Agri-Food and Biosciences Institute (**AFBI**), Northern Ireland
  - **Niab**, England
  - Science and Advice for Scottish Agriculture (**SASA**), Scotland

16

Department for Environment, Food & Rural Affairs

AFBI

Leading provider of scientific research and services to government, non-governmental organisations and commercial organisations. Sponsored by the Department of Agriculture Environment and Rural Affairs (DAERA).

DUS (& VCU) testing undertaken in Crossnacreevy, Northern Ireland.

DUS testing for:

- Festulolium
- Hybrid ryegrass
- Italian ryegrass
- Perennial ryegrass
- White clover

17

Department for Environment, Food & Rural Affairs

Niab

- Independent science-based crop research organisation.
- Undertake statutory work on behalf of HMG.
- Headquarters in Cambridge, England.
- DUS testing for:
  - Barley
  - Field bean
  - Fodder kale
  - Oat
  - Small naked oat
  - Sugar beet
  - Wheat
  - Winter oilseed rape (swede rape)
  - 800+ ornamental varieties

18

Department for Environment, Food & Rural Affairs

SASA

- A Division of the Scottish Government Agriculture and Rural Economy Directorate, SASA's primary role is to provide scientific services and advice in support of Scotland's agriculture and wider environment.
- Based in Edinburgh, Scotland.
- DUS testing for:
  - Field pea
  - Potato
  - Swede
  - Turnip rape
  - Vegetable peas

SASA Helping Scotland Grow

19

Department for Environment, Food & Rural Affairs

Animal & Plant Health Agency

Llywodraeth Cymru Welsh Government

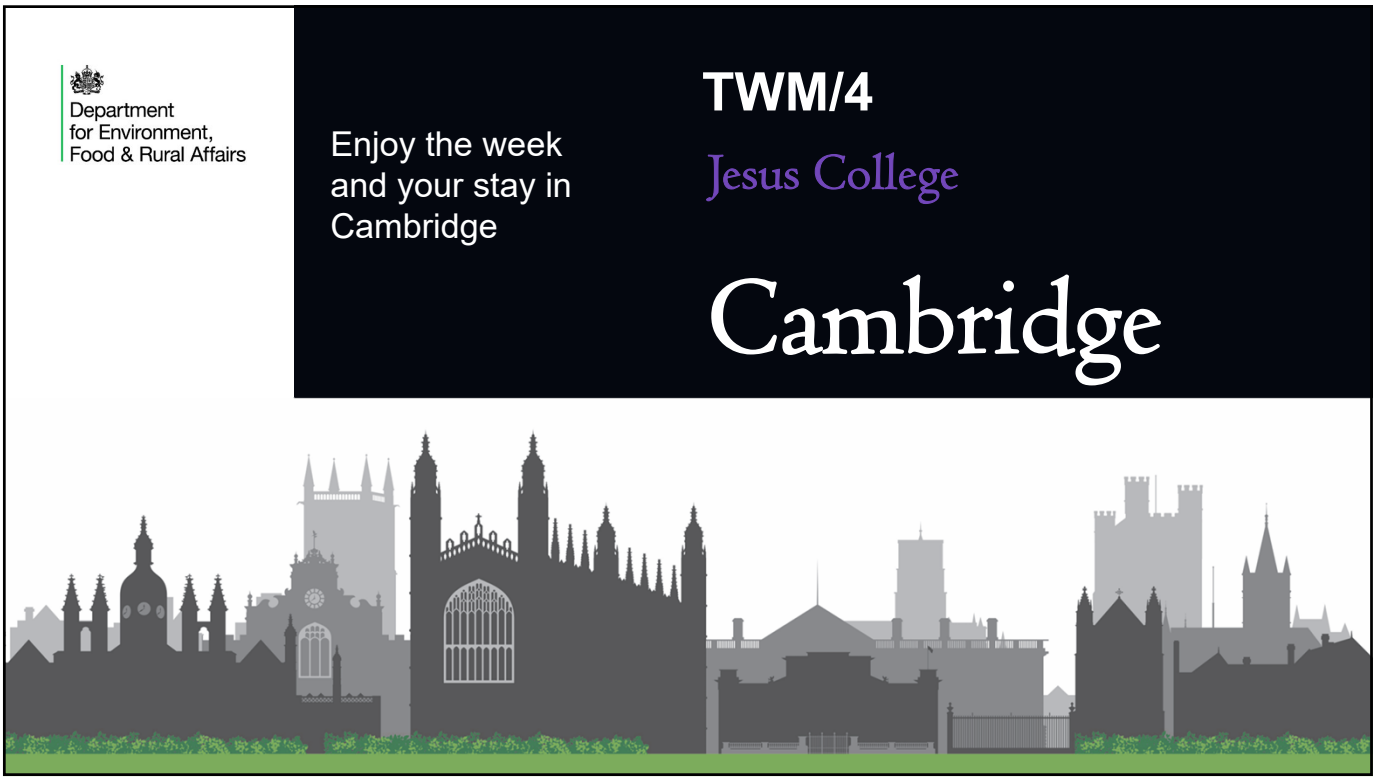
Scottish Government Riaghaltas na h-Alba

Department of Agriculture, Environment and Rural Affairs

First UK Plant Varieties and Seeds Strategic Roadmap

- England, Scotland, Wales and Northern Ireland - are working together to develop the first UK Plant Variety and Seeds (PVS) Strategic Roadmap.
- It seeks to set out a shared vision, key priorities and actions and to be delivered in partnership with industry and stakeholders over the next 5 years.
- The roadmap will also reflect the forthcoming **UK-EU Sanitary and Phytosanitary (SPS)** agreement which is expected to take effect next year. The objective of the agreement is to facilitate smoother trade between the UK and the EU.
- We are anticipating alignment with the EU on marketing requirements for plant and forest reproductive material, as well as plant variety rights.

20



21

[Annex II follows]

Plant Science into Practice

Mario Caccamo

CEO

1

Farming must undergo a transformation…

We need to grow enough nutritious crops for an increasing population while

- reducing use of synthetic fertilisers and pesticides,
- protecting biodiversity,
- reducing greenhouse gas emissions, and
- adapting to climate change.

All these goals must be achieved without offshoring the associated climate and environmental impacts.

This transformation will be driven by **innovation** and enabled by strong **partnerships** and **collaborations.**

2


1919
The National Institute of Agricultural Botany is established by Sir Lawrence Weaver under the motto 'Better Seeds: Better Crops'. The Institute is a response to the need for quality seed and improved varieties in safeguarding food supplies post-WW1.
The NIAB Crest sits above the original entrance to the 1921 NIAB Building on Huntingdon Road.
1920s
The National Institute of Agricultural Botany's Huntingdon Road HQ is opened in 1921, and the OSTS joins the Institute.
The first Fellows Scheme is launched and a regional trials network is established.
1930s
NIAB issues the first Farmers' Leaflets across a range of crops, precursor to the Recommended, Descriptive and National Lists today.
The Institute pioneers the use of randomised trial design in 1936 and releases authenticated stocks of proven state-bred varieties in 1939.
NIAB adopts the new 'randomised control trial' system in place of large scale, multi-site unreplicated trials which had been the mainstay of early variety testing.
1940s
NIAB launches the first winter wheat Recommended List in 1944, and introduces virus-tested potato seed into Northern Ireland in 1946.
A seed production committee is formed to supervise home-produced seed and Hill Farm, near Cambridge, becomes NIAB's seed production farm in 1947.
1950s
The 1-9 trait scoring system is used for the first time in the 1952 NIAB Recommended List.
The first Fellows Crop Conference is held in 1952, with a Cereal Field Approval Scheme introduced in 1956.
The first international seed analysts training course begins in 1954 and NIAB becomes the technical co-ordination centre for international seed certification schemes in 1958.
A new seed multiplication branch handles the increase in state-bred varieties and seed production for trials.
1960s
NIAB's Huntingdon Road Building extension opens in 1960, with the regional centre network expanding to 13 in 1961.
OSTS celebrates 50 years in 1967 with NIAB celebrating its golden anniversary in 1969.
The first vegetable advisory leaflet is issued in 1961.
In 1964 MAFF commissions NIAB for the first time to test varieties for distinctness, uniformity and stability (DUS) and conduct statutory performance trials.
1970s
DUS (distinctness, uniformity and stability) and VCU (value for cultivation and use) statutory variety testing is defined under a new NIAB: MAFF contract following UK accession to the European Community.
The PVRO (Plant Variety Rights Office) moves to NIAB's Huntingdon Road site.
NIAB's Hill Farm is sold and Park Farm at Histon is bought. The granary on Whitehouse Lane is redeveloped into new offices, laboratories and storage for the seed certification department in 1973.
1980s
VARTEST field and laboratory services are launched in 1983 alongside seed testing services via OSTS. Electrophoresis is used by NIAB for the first time in varietal ID in 1980 and by 1989 a new molecular biology laboratory opens which complements biochemical and image analysis technology.
NIAB opens the Library Building at Huntingdon Road in 1983 and becomes the single European Centre for PBR tests for ornamentals.
1990s
In 1996 the National Institute of Agricultural Botany formally moves into the private sector and officially changes its name to NIAB. The National Institute of Agricultural Botany Trust is created with responsibility for land and assets.
NIAB SeedStats service is launched in 1993.
2000s
Genetic research and pre-breeding capabilities are established at NIAB in 2005. NIAB extends its applied agronomy research and farm knowledge transfer and advisory services with the creation of NIAB TAG in 2009.
The MacLeod Complex research and plant breeding glasshouses open at Park Farm in 2009.
2010s
Sophi Taylor Conference Centre opens its doors in 2013
NIAB extends its potato research capabilities with the creation of NIAB CUF in 2014 and moves into the soft and top fruit sector with the integration of East Malling Research to form NIAB EMR in 2016. BCPC joins NIAB in 2018.
Park Farm redevelopment begins in 2017, followed by the Lawrence Weaver Road site in 2018. And it is the end of an era as the Huntingdon Road HQ is sold in 2019.
NIAB celebrates 100 years of plant science in 2019.
2020s
NIAB moves out of Huntingdon Road in 2020, via the new Lawrence Weaver Road site, with all Cambridge staff based at Park Farm by 2025. New buildings and additional labs and offices continue to be added to the site.
The Crop Science Centre, an alliance between NIAB and the University of Cambridge, opens in 2020, based at Lawrence Weaver Road.
Genetic Technology (Precision Breeding) Act passes into law in 2023
NIAB becomes Niab in 2025.
Niab
Plant Science into Practice

3


Niab
VISION:
A thriving world powered by crop science
MISSION:
We pioneer crop science for the benefit of society
VALUES:
Integrity first, drive Impact and promote Diversity

4

Strategic Programmes

These programmes are designed to ensure Niab remains at the forefront of agricultural innovation and continues to deliver value across the UK cropping system.

- Climate Smart Farming
- Resource Use Efficiency
- Underutilised and Functional Crops
- Productive and Profitable Cropping

Niab Plant Science into Practice

5

Niab Today

"We pioneer crop science for the benefit of society"

- Headquarters in Cambridge
- East Malling horticultural R&D centre in Kent
- 9 UK regional field trials centres
- 100+ UK field trial sites, 140k+ plots
- 330 staff (incl crop scientists, plant breeders, agronomists, crop specialists)

NIAB Plant Science into Practice

6

We are a *science-led service organisation*

Outcomes

- **Better Crops**
- **Better Data**
- **Better Farming**

Services

- **Crop Improvement**
  - Real-world **application** of genomics and genetics
- **Independent Validation & Certification**
  - Unrivalled **breadth and scale** of capability and access to data
- **Cropping Systems Evidence**
  - **Independence** and close interaction with the farming community

NIAB Plant Science into Practice

7

Harnessing Genetic Diversity

NIAB Plant Science into Practice

8

9

National Trials Platform for Independent Validation

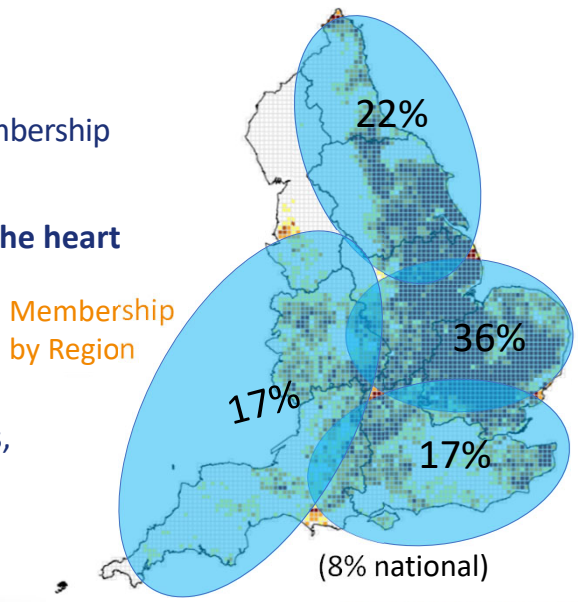
- Over 100 field trials sites supporting over 100,000 plots, across seven areas
- Host farmers working alongside Niab's trials team
- Niab's area operating bases aligned with distribution of trials work
- Accredited, qualified and experienced staff equipped with the latest technology
- Supported by direct access to technical specialists and agronomists.

niab.com @niabgroup

10

Agronomy Membership

- No other UK research organisation has a membership on the scale of Niab
- Our memberships and partnerships are **at the heart of what we do**, and enable Niab to have:
  - a dialogue with industry
  - a significant impact on practice
- Our relationships with farmers and growers, and local membership centres are key



Niab Plant Science into Practice

11

Strategic position as **translators**

Technology readiness levels

Translation Space

TRL1 Discovery	TRL2 Invention	TRL3 POC	TRL4 Early Development	TRL5 Late Development	TRL6 Pre-commercial	TRL7	TRL8 Launch	TRL9 Commercial	Advice and Support
	BBSRC		Defra	Defra, InnovateUK, Public Bodies				Market	

Universities & Research Institutes

Products & Services Development

Market needs & opportunities

Breeders
Agri-Tech
Ag-Chem
Farming Businesses

We partner — *We lead* — *We partner*

Niab Plant Science into Practice

12

Precision Breeding at Niab

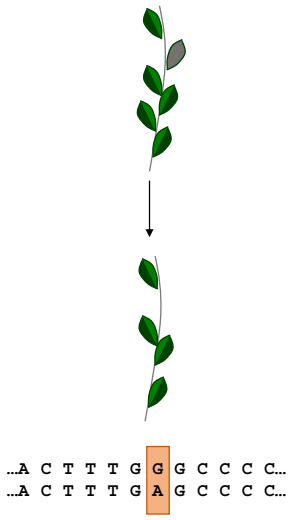
We host the largest crop precision breeding facility in the UK, and one of the largest in the world.

- In any given time, the pipeline runs 30-40 projects.
- The team expertise covers cereals, Solanaceae, brassicas and other UK crops.
- The labs occupied 1,000m2 with access to plant growth cabinets of various sizes including walk-in rooms.
- The team is 15+ strong with expertise in tissue culture, transformational, construct assembly and crop regeneration.

NIAB Plant Science into Practice

13

Genome Editing



We can introduce the mutation directly without having to make crosses.

The change is also precise, much more than other methods (that is why we call it *precision breeding*).

CRISPR-CAS9 is the technology we use (that was only developed 10 years ago).

Jennifer Doudna & Emmanuelle Charpentier were awarded the 2020 Nobel Prize Chemistry for their contribution to the development of this technology.

Niab Plant Science into Practice

14

The Opportunity

Our technology and know-how can condense crop development cycles into much shorter programmes.

We can combine biotechnology, genomic prediction, data science, crop breeding and agronomic expertise to design, implement and deploy crop improvement programmes at speed and scale.

15

Pre-breeding | Crop genetics | Crop transformation | Precision breeding

Plant breeders' rights | Bioinformatics | Physiology

Pathology | Seed certification | AI and data sciences | Plant characterisation

Analytical services | Farming systems | Precision farming | Sustainable systems | Soils and rotations

Crop waste reduction | Regenerative agriculture | Disease, weed and pest management | Data analytics | Crop evaluation

Agronomy | Consultancy | Training | Field and glasshouse trials

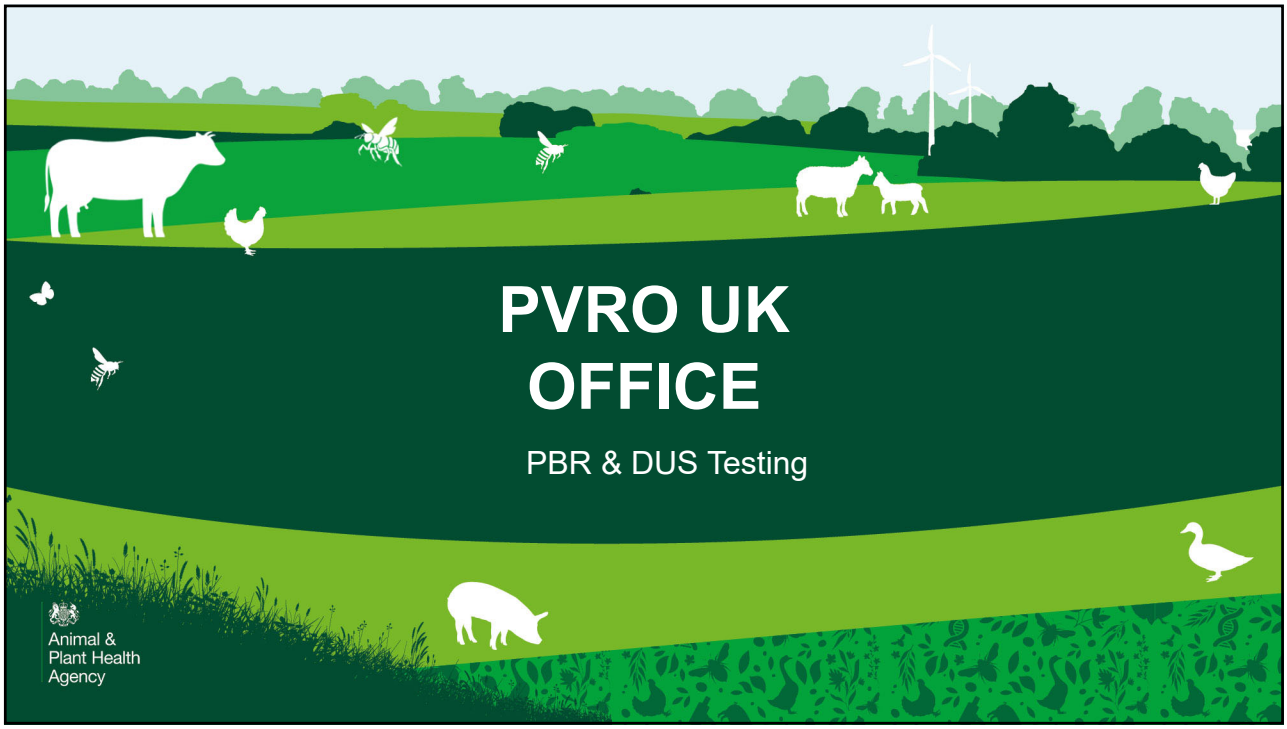
Niab

A unique independent research organisation capable of transferring innovations in plant science into practical agriculture

16

17

[Annex III follows]



1

UK Plant Breeders Rights

The Plant Variety Rights Office has Administered Plant Breeders Rights (PBR) since 1964

Animal & Plant Health Agency

2

Plant Variety Rights Office (PVRO) is the coordinating centre for DUS & VCU testing in the UK

APHA has contracts for DUS testing with the UK test centres

UK DUS Test Centres:

NIAB (England)

AFBI (Northern Ireland)

SASA (Scotland)

Animal & Plant Health Agency

3

UPOV PRISMA Application Tool | UPOV Plant Variety Submission

The Seeds Gazette is published on the UPOV website.

Delivery and Administration

Applications are made to the PVRO (APHA) using UPOV PRISMA. Can apply for Variety Listing at the same time for agricultural and vegetable varieties – a requirement prior to marketing.

APHA organise Distinctness, Uniformity and Stability (DUS) testing (required for PBR & VL), and Value for Cultivation and Use (VCU) testing (required for VL only).

Information on PBR and VL applications is published in the Plant Varieties and Seeds Gazette.

Once listed, seed of a variety must be certified, a quality assurance process which ensures seeds are sufficiently pure, healthy and viable.

Animal & Plant Health Agency

4

Actual applications received in UPOV PRISMA 2025 v No. for UK testing

Crop sector	Total submissions for 2025	No. UK commissioned DUS tests for 2025 submissions
Agricultural	308	272
Fruit	66	0
Ornamental	104	11
Vegetable	301	9
Total	779	292

Animal & Plant Health Agency

5

6

[Annex IV follows]

AGRI-FOOD & BIOSCIENCES INSTITUTE

Leading | Protecting | Enhancing

Dr Adam Gauley

AFBI Crossnacreevy

Agronomy and Plant Sciences Branch

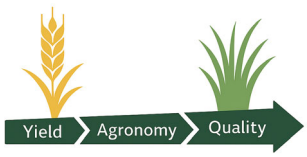
afbini.gov.uk

1

Variety testing at AFBI Northern Ireland

DUS **Distinctness Uniformity Stability**

VCU **Value for Cultivation and Use**



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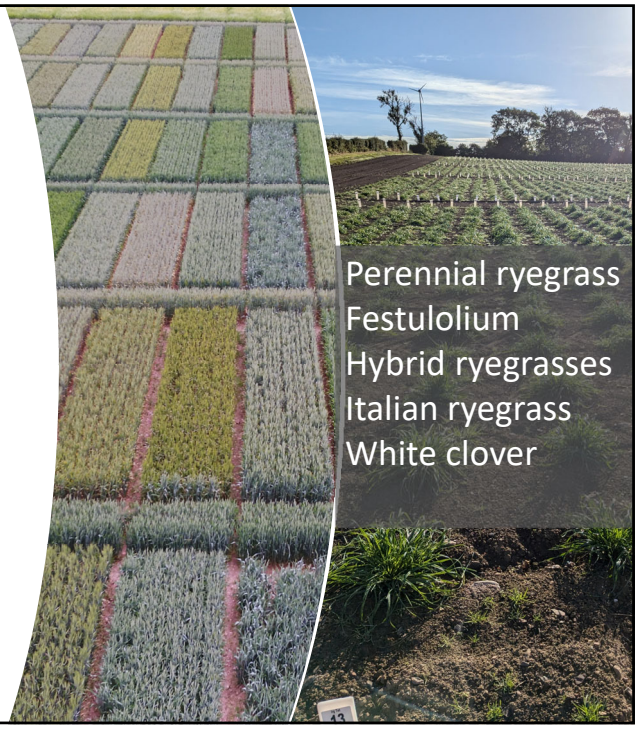
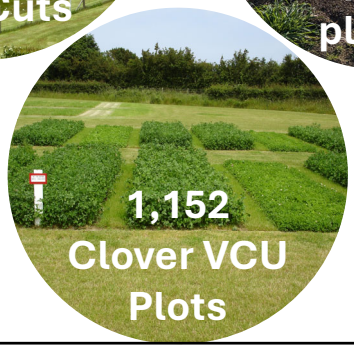
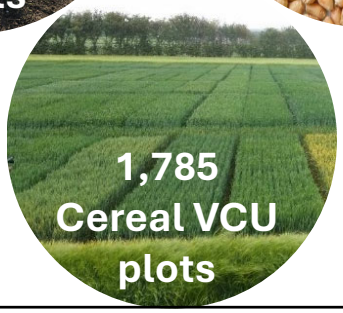


Perennial ryegrass
Festulolium
Hybrid ryegrasses
Italian ryegrass
White clover

2

Annual variety testing





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3

Perennial Ryegrass Routine Characters

CPVO TP/4/2	UPOV TG/4/8	Character	Method of assessment and recording
1GD	1*	**Plant: ploidy**	TQ declaration / laboratory
2D	2	**Plant: vegetative growth habit (without vernalization)**	Visually scored
3D	5	**Leaf: intensity of green colour (without vernalization)**	Visually scored
4D	6	**Plant: width (after vernalization)**	Measured
5D	7	**Plant: vegetative growth habit (after vernalization)**	Visually scored
6D	8	**Plant: height (after vernalization)**	Measured
7D	–	**Leaf: intensity of green colour (after vernalization)**	Visually scored
9D	10	**Plant: tendency to form inflorescences (without vernalisation)**	Visually scored
10D	11*	**Plant: time of inflorescence emergence (after vernalization)**	Visual + time recorded
11D	12	**Plant: natural height at inflorescence emergence**	Measured
12D	–	**Plant: habit at inflorescence emergence**	Computed derived (UK 11/10)
13D	14*	**Flag leaf: length**	Measured
14D	15*	**Flag leaf: width**	Measured
15D	16	**Flag leaf: length/width ratio**	Computed derived (UK 14/15)
16D	17*	**Plant: length of longest stem (incl. inflorescence)**	Measured
17D	18	**Plant: length of upper internode**	Measured
18D	19	**Inflorescence: length**	Measured
19D	20	**Inflorescence: number of spikelets**	Counted
20D	21	**Inflorescence: density**	Computed derived (UK 24/31)
21D	22	**Inflorescence: outer glume length (basal spikelet)**	Measured
22D	23	**Inflorescence: basal spikelet length (excluding awn)**	Measured

UK Approved additional Characters

CPVO TP/4/2	UPOV TG/4/8	Character	Method
N/A	N/A	**Plant: natural height (after vernalization)**	Measured
N/A	13	**Plant: width at inflorescence emergence**	Measured
N/A	N/A	**Plant: vegetative spring development**	Computer derived (UK 5–60)
N/A	N/A	**Plant: vegetative growth habit**	Computer derived (UK 5/70)
N/A	N/A	**Plant: vegetative attitude in spring**	Computer derived (UK 5/60)
N/A	N/A	**Plant: vegetative shape in spring**	Computer derived (UK 60/90)
N/A	N/A	**Plant: seasonal width**	Computer derived (UK $\sqrt{(11\times70)}$)
N/A	N/A	**Flag leaf: size**	Computer derived (UK $\sqrt{(14\times15)}$)
N/A	N/A	**Inflorescence: total basal spikelet length**	Computer derived (UK $\sqrt{(24\times35)}$)
N/A	N/A	**Inflorescence: spikelet protuberance**	Computer derived (UK 35–34)
N/A	N/A	**Inflorescence: glume span**	Computer derived (UK 35/34)
N/A	N/A	**Plant: volume**	Computer derived (UK $\sqrt{(11\times10)}$)
N/A	N/A	**Inflorescence: total length of spikelets**	Computer derived (UK 31×35)
N/A	N/A	**Inflorescence: total length of glumes**	Computer derived (UK 31×34)
N/A	N/A	**Inflorescence: awns**	Observation
N/A	N/A	**Seedling: fluorescence**	

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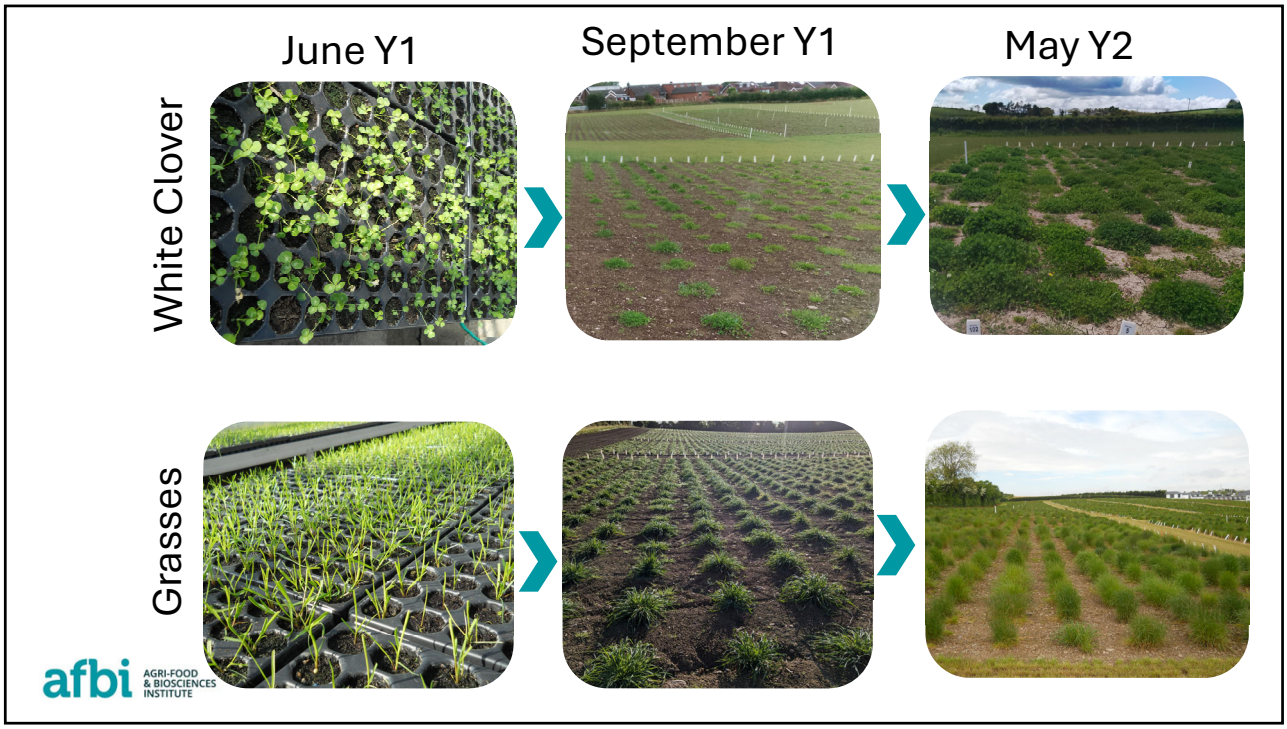
4


June Y1
September Y1
May Y2
White Clover
Grasses
afbi
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5


Mean time of inflorescence character set
• Mean time of inflorescence
• Plant height
• Plant width
• Flag length and width
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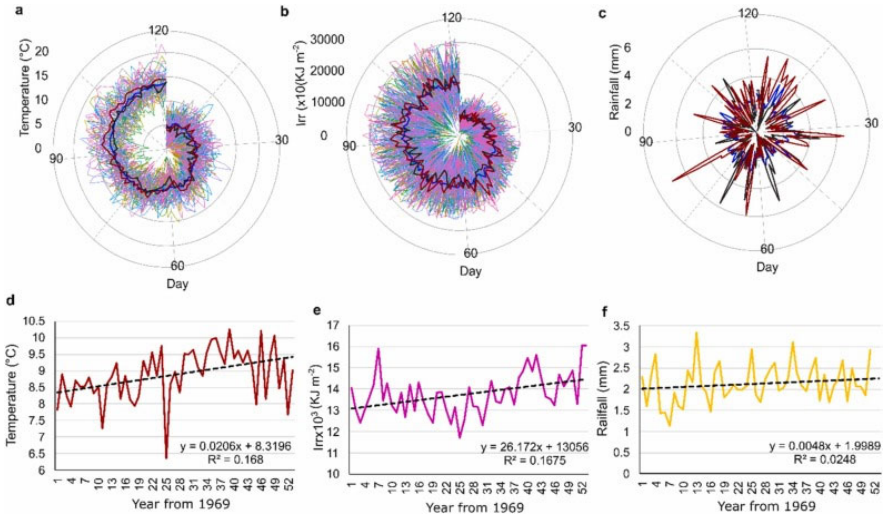
6

Annual variation and drift in meteorological records



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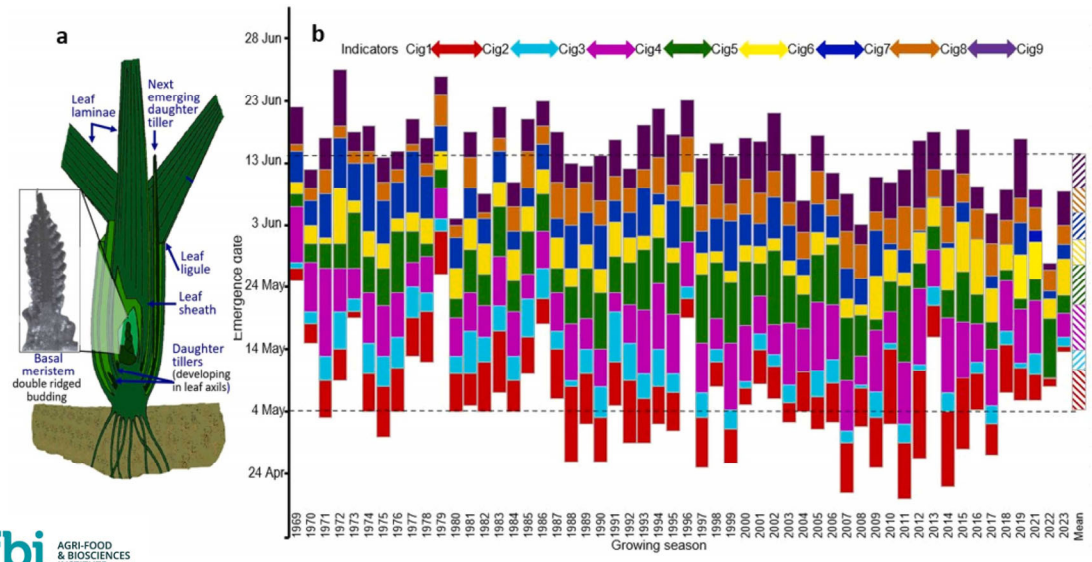
Gilliland, Black, Watson, Widdowson, Gauley., *Field Crops Research* (2025)

7

Fifty-four years of ryegrass ear phenology reveals climate change responses

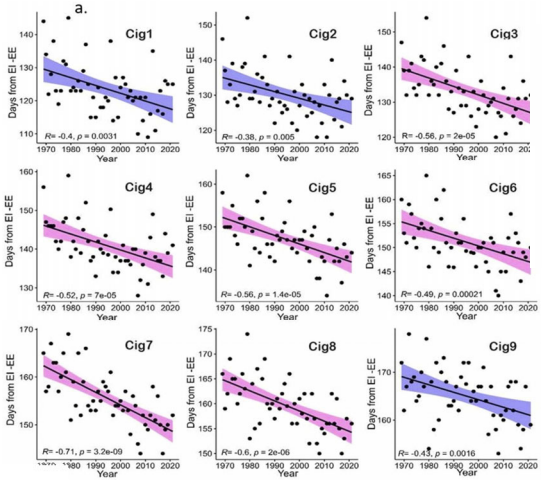


afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

Gilliland, Black, Watson, Widdowson, Gauley., *Field Crops Research* (2025)

8

Associations between timing of individual indicator groups and climate parameters.



Gilliland, Black, Watson, Widdowson, Gauley., *Field Crops Research* (2025)

9

INNOVAR

invite

Thank you

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

10

[Annex V follows]

DUS at Niab

Margaret Wallace

1

DUS at Niab

Service delivery to the UK government for England and Wales - DEFRA, APHA PVS

- Defra – Department for Environment, Food and Rural Affairs
- APHA PVS – Animal and Plant Health, Plant Varieties and Seeds

1. DUS for Plant Breeder's Rights and National Listing
2. Seed Certification
3. Training
4. Policy and technical advice, and representation

Niab
Plant Science into Practice

2

DUS for Plant Breeder's Rights and National Listing

Niab is the DUS test centre for

- Cereals: Wheat, Barley, Oats
- Brassicas: Winter Oilseed Rape (Canola) and Fodder Kale
- Pulses: Field Beans
- Sugar beet
- Ornamental species

Niab
Plant Science into Practice

3

Winter oilseed rape DUS test process

- Three separate trials (field and glass) consisting of >8000 plots
- Main field trial (autumn sown) - two identical trials sown in two locations. One trial location is selected for all assessments.
- Long rotations – minimise risk of volunteers
- Accurate drilling with no carry over
- Minimum input, no seed treatments, PGR's etc
- All plots treated the same
- Irrigation if required
- Genotyping used to authenticate seed stocks

Niab
Plant Science into Practice

4

Winter oilseed rape DUS test process

Autumn sown main trial

Spring sown alternativity trial - assessment of seasonality

Niab
Plant Science into Practice

5

Winter oilseed rape DUS trial planning

- Randomised trial
- 3 replicates are sown and assessed for visual characteristics
- Types of plot
  - DUS candidates
  - Reference varieties (cyclic planting)
  - Example varieties
  - Side by side visual assessments (third year of test only)

Niab
Plant Science into Practice

6

Winter oilseed rape DUS visual characteristic scoring

- Quantitative and qualitative visual assessments carried out by Technical Experts in field plots
- Visual assessments by a single observation of a group of plants

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Glasshouse cotyledon trial

- Seedling trial for measurement of cotyledon characteristics
- All candidates and reference varieties sown in trays to produce seedlings across 2 replicates
- Image analysis software used to take measurements from 40 seedlings for each variety.

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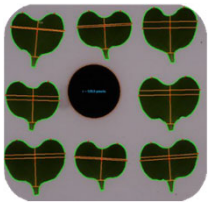
Visual Assessments and Measured Data

- Distinctness is assessed statistically in a combined over years/modified joint regression analysis
- Uniformity is assessed by both visual observations of off-types and statistically on measured data
- Stability is inferred from uniformity
- Measurements are obtained through image analysis on cotyledons, petals and pods sampled from field and glasshouse plots. >2 million data points recorded annually using Image Analysis

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Cereals DUS Test Process

- Applications
- Test cycle - Year 1
- Test cycle - Year 2
- Assessment of D, U and S
- Further testing (if required)

- Recommendations to the DUS test centre group (Niab, APHA, IDSG & NLSC)
- Recommendations from the TC Group to the NLSC for decision making
- Final report and Descriptions

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VCU authentications for National Listing

- There are separate seed submissions for DUS and Value for Cultivation and Use (VCU) trials
- A VCU validation sample from one of the VCU trial sites is sent to Niab for each candidate
- DUS and VCU seed samples are compared by protein electrophoresis
- If there is doubt of authenticity then side-by-side field plots are sown for comparison

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Wheat DUS laboratory tests

- Seed colouration with phenol (Nov-Dec)
  - Test carried out on 100 submitted seeds
  - Absent or very light (note 1) to very dark (note 9)

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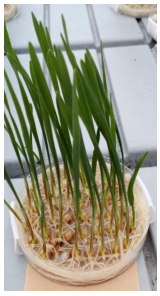
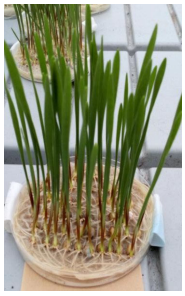
Wheat DUS laboratory tests

- Coleoptile trial (November)
  - Test carried out on 100 submitted seeds
  - Strength of anthocyanin colouration
  - Absent or very weak (note 1) to very strong (note 9)





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Field plot establishment

- Three field trials: winter wheat, spring wheat and vernalisation trial
- Park Farm Trial Ground
- Long rotations – minimise risk of volunteers
- All plots treated the same
- No seed treatments or PGRs
- Minimise grazing or anything else that may affect the natural expression of the plant – trial monitoring and protection
- Irrigation if required

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Field plot layout

- Cross block wheat and barley
- Oats are in a separate trial
- Plots are 9m long, 6 rows wide
- Two samples per plot (3 rows each)
- 2 replicates (Population of 2,000 plants)
- Types of plot
  - DUS candidates
  - Reference varieties
  - Example varieties
  - Replacement stock validations
  - VCU authentications
  - Side-by-side visual comparisons (third year of test only)

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Assessing Uniformity

- Visual assessment on the basis of off-types
- Population standards and acceptance probabilities detailed in UPOV guideline and UK protocol
- Different standards apply for hybrid varieties
- If off-types exceed the standards the applicant is notified and invited to visit the plots

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Assessing Stability

- Stability inferred from uniformity
- Uniformity of parent lines is important for the stability of hybrid varieties



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Database

- All species
- Application details
  - Including parental lines
  - Breeding lineage
- Observation data
- Molecular data
- Photographs
- Similar variety search
  - Can link data collected using different protocols and test guidelines
- Production of reports and variety descriptions

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Reporting results to the DUS Test Centre

- The UK Combinable Crops DUS Test Centre group meets twice per year for Cereals
- Results are presented end of September for Winter and Spring Wheat
- Test Centre Group comprised of:
  - Cereal DUS crop experts
  - Interdepartmental statistician's group (IDSG) representative
  - APHA representatives
  - National List and Seeds Committee (NLSC) representatives

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Areas of research

Image Analysis

- Studio Imaging
- Unmanned Aerial Vehicles

Molecular Techniques

- Markers as a method of examining DUS characteristics
- Genomic prediction

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Information

- www.niab.com
- **Landmark** https://www.niab.com/news-views/publications-resources/landmark-magazine

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21

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22

[Annex VI follows]

Artificial intelligence in plant variety testing

Introduction, limitations, ethics and regulatory frameworks, and LLMs for protocol design

UPOV TWM visit to Niab • June 2026 • Not legal advice

1

Part 1 — Introduction

What AI means in the context of testing methods and techniques

2

Why AI matters for TWM

AI is moving from research tool to evidence infrastructure

- Phenotyping: images, sensors, high-throughput characteristic data
- Genotyping and bioinformatics: markers, variety collections, EDV-related questions
- Statistics and software: decision support, anomaly detection, documentation
- Official testing needs repeatability, fairness and auditability

3

A working definition of AI

For this session, keep it practical

- AI systems use data and algorithms to produce outputs such as predictions, classifications or summaries
- Machine learning learns patterns from examples rather than relying only on explicit rules
- Generative AI produces text, images or code-like outputs from prompts
- The important question is: what role does the output play in the decision chain?

4

What AI can do well

Especially in technical testing contexts

Useful strengths	But only when...
Process large volumes of images or measurements	The task is clearly defined
Detect consistent patterns across datasets	Training data are representative
Support repeatable scoring or triage	Validation reflects the intended use
Summarise documents and protocols	Outputs are interpreted in context
Flag anomalies for expert review	The system is monitored over time

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5

What AI cannot do reliably on its own

The limits that matter for official or quasi-official testing

AI struggles with	So humans still provide
Causal interpretation	Biological interpretation
Unseen conditions and distribution shift	Methodological judgement
Rare classes and rare events	Challenge and appeal pathways
Ambiguous or inconsistent labels	Context about trial design and data quality
Policy judgement and proportionality	Accountability for final decisions

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6

A simple AI workflow

Most applications follow the same logic

Data	Model	Output	Decision
Images **Measurements** **Metadata**	Learns patterns from examples	Score Classification Recommendation	Human review Method rule Audit trail

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Where AI might enter variety testing

Different use cases create different levels of consequence

Low consequence	Medium consequence	Higher consequence
Drafting text Image sorting Data cleaning	Characteristics scoring support Variety collection triage Anomaly detection	Evidence for official decisions Enforcement support Automated thresholds

Governance should scale with the consequence of error.

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Part 2 — Should we be scared?

AI limits, failure modes and what “good enough” means

9

So… should we be scared?

A balanced answer for AI in plant variety testing.

Not scared — but not casual. Treat AI like a method component: validate, document and govern it.

Low consequence
Drafting summaries
Protocol wording
Training questions

Medium consequence
Image triage
Anomaly flags
Scoring support

Higher consequence
Official decisions
Thresholds
Enforcement support

Use proportionate controls: stronger evidence and oversight as the consequence of error increases.

10

Why the question feels urgent

For technical testing: not fear vs. hype — informed caution.

Hype
Big claims and big headlines can exaggerate both benefits and dangers.

Speed
Tools improve quickly, while skills, policies and habits take time to catch up.

Opacity
Many systems are hard to inspect, making trust and auditability harder.

International variation
Different authorities may face different legal, data and operational constraints.

Evidence pressure
AI outputs can look precise even when validation evidence is limited.

Method credibility
Official testing depends on repeatability, transparency and challengeable evidence.

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Should we be scared of AI?

Humans are the problem

AI is not conscious and does not understand consequences

It can be highly useful for narrow, well-defined tasks

Risks increase when outputs are treated as authority rather than evidence

The right response is validation, documentation and human oversight

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Reasons to be cautious

A practical risk taxonomy for AI in testing methods.

Reliability
AI can be confidently wrong. Validate against the intended use, not just generic benchmarks.

Bias & blind spots
Performance can vary by crop, country, device, year, protocol and data source.

Data & privacy
Images, measurements, genotypes and metadata may have access and reuse restrictions.

Cybersecurity
Prompt injection, data leakage and tool access controls become part of the method risk.

Over-reliance
Automation bias can make outputs feel more authoritative than they are.

Synthetic evidence
Generated text, images or data can create plausible-looking but unreliable material.

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Reliability: plausible ≠ correct

Especially important for LLMs, summaries and protocol drafting.

Question or source material → **AI model** → **Answer (may be wrong)**

Red flags: treat as “needs checking”

No source trail or cannot show where a claim came from

Very confident tone on uncertain or contested topics

Numbers, thresholds or protocol clauses without provenance

Advice that conflicts with the agreed method, guidance or local rules

Invented citations, document titles or regulatory requirements

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Part 3 — Ethics and regulatory frameworks

International governance for AI used in testing methods

15

Why ethics matters in technical testing

Ethics is not separate from method quality

Fairness: similar varieties should be treated consistently

Transparency: applicants and authorities need understandable procedures

Accountability: someone must own the method and decision process

Contestability: there must be a way to query or challenge outputs

16

Data ownership becomes data stewardship

International testing raises the importance of trust

- Raw measurements, images, genotypes and metadata may have different sensitivities
- Derived models and outputs may be owned or controlled separately
- Cross-border collaboration needs clear agreements on access and reuse
- Good stewardship includes provenance, consent, security and retention rules

17

Raw data vs derived model assets

A distinction that matters in collaborative AI

Raw or primary data	Derived assets
Images, measurements, molecular data	Trained model weights
Trial metadata and scoring notes	Feature representations and embeddings
Variety collection information	Risk scores or characteristic predictions
May be subject to access or confidentiality rules	Validation reports and thresholds

18

The international regulatory landscape

There is no single global AI law

Global principles	Hard law	Regulator-led	Standards
OECD UNESCO G7	EU AI Act Data protection Product/safety law	UK approach Sector guidance Existing law	NIST AI RMF ISO/IEC 42001 Internal SOPs

For international work: expect convergence around risk management, not identical rules.

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19

Common principles across frameworks

Different systems, similar themes

- Safety, security and robustness
- Transparency and explainability
- Fairness and non-discrimination
- Accountability and human oversight
- Privacy, data governance and traceability

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20

Part 4 — Using LLMs: a worked example

21

How to use LLMs

- Good at: drafting, summarising, translating “notes → tidy output”, structuring a plan
- Not good at: being an authority on labels/regulations; real-time local facts; “truth”
- The mindset: draft + critique + final human sign-off

22

Prompts

- Role & context (“I’m a UK arable farmer…”)
- Goal (“make a job sheet / brief / checklist…”)
- Constraints (“max 150 words, bullets, plain English…”)
- Data (your notes, numbers, dates)
- Output format (“give: 1) checklist 2) record fields 3) risks…”)

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Live example: asking an LLM a better question

Task: update a simple image-capture protocol for plant variety testing

Aim: use AI as a drafting assistant, not the authority

We will show:

A weak prompt

A stronger prompt

How to proofread the answer

How to force the LLM to expose uncertainty

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Weak prompt:

Update this image capture protocol for AI analysis.

- Discuss what happens:
  - Does it invent details?
  - Does it make confident changes without saying why?
  - Does it change the method rather than just improve the document?
  - Does it give you something polished but not auditable?

Strong prompt:

Use only the uploaded protocol as source material unless clearly labelled as a suggestion for expert review. Do not invent new technical thresholds, acceptance criteria, regulatory obligations, or validation requirements.
Your task is to improve clarity, structure, auditability and reviewability.
Return: revised protocol text, change log, assumptions or ambiguous wording needing expert review, items that should not be finalised without technical approval. Give the output as a docx file.

What this example shows

What this example shows

Better prompts give better answers (hopefully!)

LLMs are useful for structure, clarity and change logs

They must not invent technical criteria – they will if you give them the chance

Always ask the model to critique its own answer

Human review, validation and version control remain essential

Take-home message: Draft with AI. Decide with experts.

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27

Final message

AI can support testing methods — if it is treated as part of the method

Do not fear AI as a concept; do not trust it as an authority

Use it first where the consequences are low and review is strong

For official use, require evidence: validation, documentation and auditability

International confidence depends on shared standards, not just clever models

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28

28

[End of Annex VI and of report]