UPOV
International Union for the Protection of New Varieties of Plants

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Technical Working Party on Testing Methods and Techniques **TWM/3/15**

Third Session
Beijing, China, April 28 to May 1, 2025

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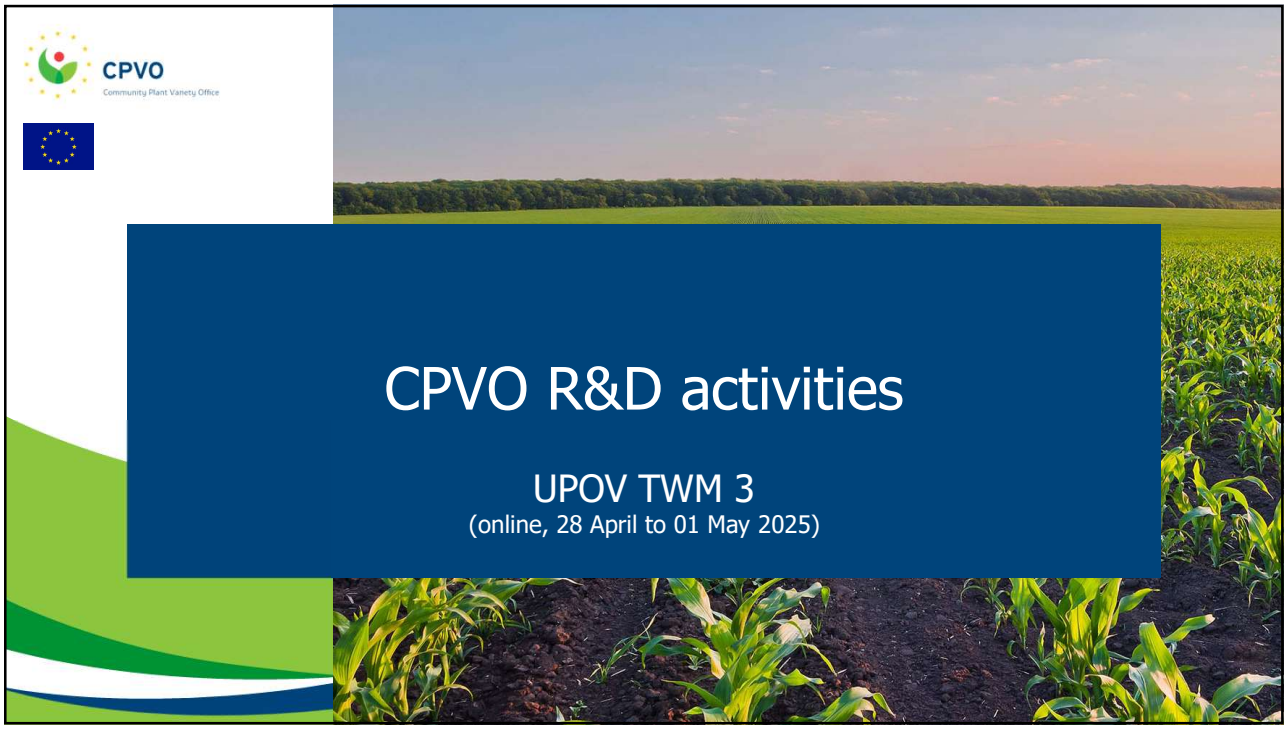
CPVO R&D ACTIVITIES

Document prepared by an expert from the European Union

Disclaimer: this document does not represent UPOV policies or guidance

The annex to this document contains a copy of a presentation “CPVO R&D activities”, to be made by an expert from the European Union, at the third session of the TWM.

[Annex follows]



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CPVO R&D Strategy 2021-2025

GUIDING VALUES
Quality, Cost-Effectiveness, Harmonisation, Timeliness and Accountability.

STRATEGIC GOALS
Contribute to implementing the Farm to Fork Strategy being part of the European Green Deal.
Act as centre of excellence for plant variety testing and exercise a network function for enhanced cooperation with European and other international partners.
Support R&D projects with the aim to optimize DUS testing within the CPVO network of Examination Offices, to strengthen EU Plant Variety Rights (PVR) in order to create a strong incentive for the development of improved varieties in line with the Commission Green Deal, and to facilitate enforcement.

Key elements = Co-funding of R&D projects and promotion of BMT
(Biochemical and Molecular Techniques)

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IMODDUS

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IMODDUS working group activities

- **"I**ntegration of **MO**lecular **D**ata into **DUS** testing"
- CPVO BMT working group for the promotion of the use of bio-molecular techniques in DUS testing and variety identification.
- Set up by CPVO Administrative Council in the framework of its R&D Strategy in 2016 and confirmed in the revised Strategy in 2021.
- IMODDUS works as a **think-tank** for the development of strategies supporting the integration of BMT into DUS testing.
- IMODDUS has a **practical approach** which aims at assisting the CPVO in identifying and assessing **R&D projects proposals** for species where BMT could improve the **quality** and potentially the **cost efficiency of DUS testing**.

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Meetings of IMODDUS WG

1st meeting Paris, April 2016
2nd meeting Paris, Jan 2017
3rd meeting Paris, April 2018
no meeting in 2019, 2020 (INVITE, Covid19)
4th meeting online, Feb 2021
5th meeting Brussels, May 2022
6th meeting online, May 2023

7th meeting online, May 2024

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IMODDUS meeting 2024

- Update on regulatory proposal for NGT plants in the EU
- Monitoring of ongoing projects co-financed by CPVO
- Update on barley and raspberry projects at NIAB (UK)
- **Shared molecular DUS databases in the EU**
  → **Creation of a dedicated CPVO-WG for drafting guideline**.
- INVITE (WP3 and WP5): molecular tools and applications for DUS
  - GWAS for new markers correlated to DUS traits
  - Improved models for marker-based evaluation of D and U
- INNOVAR: molecular tools for wheat DUS testing

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CPVO co-funded R&D projects

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HarmoresColl

FINISHED

CPVO co-funded projects

- Aim: setting up a coordinated system at the European level to give access to reference material (isolates, controls and differentials) for performing disease resistance tests for DUS.

- Coordinators : **GEVES** (FR) and **NAKT** (NL)
- Project partners : CREA (IT), INIA (SP), SASA (UK), Euroseeds, breeding companies = Bayer, HM Clause, Sakata, Enza Zaden, Rijk Zwaan
- Granted co-financing in Dec 2019, duration = 4.5 years (Jan 2020 - June 2024)

→ website hosted by GEVES with list of reference material (seeds, pests) and associated data:

description of the material – species name, UPOV code, etc.
function of the material – control/differential/isolate
level of resistance of the variety
regulated status of the pest
harmonisation – yes/no
quality standard – **gold/silver**
contact details.

harmorescoll

→ 9 vegetable species
tomato, tomato rootstocks, spinach, pepper, pea, melon, lettuce, French bean, corn salad
- 154 varieties (controls or differentials in x pathosystems)
- 94 pests
= 775 host/pathogen couples

Report available here: https://cpvo.europa.eu/en/about-us/what-we-do/research-and-development

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Hydrangea

FINISHED

CPVO co-funded projects

"*Harnessing molecular data to support DUS testing in ornamentals: a case-study on Hydrangea.*

- Aim: develop an optimal molecular toolset that associates neutral and gene-specific markers to improve the management of the reference collection and secure field trials by checking the varietal identity of cuttings prepared from the collection before starting DUS examinations

- Coordinator : **GEVES**
- Project partners : Bundessortenamt (GER), INRAE (GDO-IRH, FR)
- Granted co-financing in Oct 2021, duration : 24 months (May 2022 - April 2024)

-H. macrophylla: 2,800 SNPs identified for management of reference collection → ~30% less comparators
41 useable routinely for confirming varietal identity.
-H. Serrata : subset of 33 SNPs enough for mangt ref coll. → ~69% less comparators
-H. paniculata : no set.
-No existing gene-specific markers showed 100% correlation to phenotype
(GWAS on new markers always possible in future).

Report available here: https://cpvo.europa.eu/en/about-us/what-we-do/research-and-development

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ToBrAg

CPVO co-funded projects

"*Updating DUS resistance tests (biotests and markers) according to pests' evolution:*
- Setting up resistance tests to ToBRFV for tomato and pepper
- Improvement of resistance test melon/Aphis gossypil"

- Coordinator : **GEVES** (FR)
- Project partners: EOs = NAKT (NL), INIA (ES), CREA (IT)
  + breeding companies = BASF, Bayer, Enza Zaden, Gautier Semences, HM Clause, Rijk Zwaan, Sakata, Takii, Vilmorin
  + research institute (INRAE, FR)
- Granted co-financing in Oct 2021, duration : 36 + 18 months (Feb 2022 - July 2026)

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SNPsNAP

CPVO co-funded projects

"*SNP markers for guiding DUS testing in winter oilseed rape: Validating the new model*"

- Second follow up of an earlier project which validated a set of SNP markers for KasPAR assays on bulk samples as a tool for the management of the reference collection (concluded in 2018).

The first follow-up allowed to develop a new method to use genetic data in the two different testing systems GAIA in France and COY in Germany: "new maize approach" (selection of varieties based on molecular networks) (concluded in 2021).

- Coordinator : **GEVES** (FR)
- Project partners: BSA (DE), INIA (ES), UKSUP (SZ)
  + observers: COBORU (PL), Tystofte (DK), UKZUZ (CZ), NIAB (UK), Euroseeds

- Granted co-financing in Oct 2023, duration : 24 months (May 2024 – April 2026)

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Lettuce

CPVO co-funded projects

"*International harmonization and validation of a SNP set for the management of lettuce reference collection*"

- Coordinator: **NAKT**
- EU project partners : GEVES, Bundessortenamt, INIA-CSIC and Euroseeds
- Granted co-financing in Sept 2024

  Duration : 36 months (Jan 2025 - Dec 2027)

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Under evaluation for co-funding by CPVO

Tomato DB

"*Development and implementation of an internationally accepted SNP database to assist the tomato DUS testing*"

- follow-up of previous IMODDUS tomato project where a 300 SNP markers set was validated by the European network of entrusted EOs and Asian offices (CAAS, China; Korean Seed & Variety Service, Rep. of Korea; NARO (NCSS), Japan).
- Aim = construction of an online depository platform containing molecular data of the varieties from the EU tomato reference collection useable by CPVO entrusted EOs to search for similar varieties (either by tools to be developed within the database itself or by models selected by the EOs).
- Coordinator: **NAKT**
- Project partners : GEVES, COBORU, NÉBIH, INIA-CSIC, CREA and Euroseeds
- Duration : 24 months

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Other initiatives

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- **Last annual meeting** in Firenze (IT) 11-13 June with stakeholder session.

-**Final conference** in Brussels 10 Dec 2024
+ INNOVAR 28 Nov 2024

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INVITE main genotyping innovations

- **Variety identification**
- Characteristic-specific molecular markers (**UPOV document TGP/15**)
- Combining phenotypic and molecular distances in the management of variety collections (**UPOV document TGP/15**)
  For self-pollinated, cross-pollinated crops
- **New approaches** using molecular data to support the assessment of D and U

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Genotyping tools for DUS

Species	Tools	Developed by	Application	Assessment of DUS and/or Performance (VCUS, Post-reg.)	TRL for DUS/VCU
Tomato	SNP markers	INRAe Avignon	Markers for 16 DUS traits identified by GWAS	DUS	3
Tomato	SNP markers - Taqman assays	ring test	Replacement of biotests for ToMV, TSWV, Fol-1	DUS	9
Maize	SNP (for KASP markers)	U. Hohenheim	Markers for DUS traits identified by GWAS	DUS	3
Wheat	KASP markers (from public chip)	NIAB	Markers for DUS traits identified by GWAS	DUS	3
Soybean	KASP markers	University of Hohenheim	Markers for DUS traits identified by GWAS	DUS	3
Potato	SNP markers	WUR	Markers for DUS traits identified by GWAS	DUS	3
Apple	SNP markers on PACE (Fluidigm)	IRTA	Markers for VCU traits (linked to Pl1 resistance gene, fruit colour, maturity, resistance to mildew, scab, *Phytophthora cactorum*)	Perf.	7
Apple	Epigenetic markers	INRAe Angers	Identification of Gala mutants	DUS	2-3
Apple	SNP markers	INRAe Angers	Identification of apple collection	DUS	4-5

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Genotyping tools for DUS

Species	Tools	Developed by	Application : Management of reference collection / Traits/…	Assessment of DUS and/or Performance (VCUS, Post-reg.)	TRL for DUS/VCU
PRG	ddRAD-GBS derived SNP markers	Teagasc	Management of reference collection	DUS	4
PRG, Lucerne	Sequence capture	INRAe Lusignan, BioGEVES	Management of reference collection	DUS	3
Wheat	Genome wide SNP markers	NIAB	Management of reference collection	DUS	3
PRG, wheat, maize, soybean	Improved models for marker-based evaluation of D	BioSS	Support to assessment of Distinctness	DUS	5
PRG, Lucerne	New method (COYD-GP)	BioSS	Support to assessment of Distinctness	DUS	2
PRG, Lucerne	Improved models for marker-based evaluation of D and U	BioSS	Uniformity (DUS, maintenance, certification)	DUS	3
Lucerne	18000 GBS-generated SNP markers	CREA	Better discrimination between close varieties	DUS	3
Lucerne	DarTag markers	CREA	Better discrimination between close varieties	DUS	6-7
Maize	Genome-wide SNP markers	U. Hohenheim	Integration into prediction models	Perf.	3
Soybean	Genomic prediction	CREA - research	Breeding for drought tolerance	Perf.	3
Wheat	digital PCR	CREA - research	control of genotype content in seed samples	Controls	9

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Genotyping tools for DUS

Many markers developed for many crops :

- Trait specific markers identified for Tomato, Maize, Soybean, Potato, Apple
- Marker sets for management of reference collections : PRG, Lucerne, Wheat
- New marker-based models in support of the assessment of D and U : PRG, Lucerne, Wheat, Maize, Soybean
- Epigenetic & genetic markers for Variety Identification : Apple, Wheat
- Epigenetic & genetic indicators of sustainability (diseases, drought) : Apple, Wheat

Many technologies explored :

WGS, epigenetics, SNPs, Taqman, KASP, PACE (fluidigm), GBS, sequence capture, DarTag, digital PCR, …

"Technology readiness levels (TRL): Extract from Part 19 - Commission Decision C(2014)4995" (PDF). ec.europa.eu.

→ Diverse TRLs (from 2 to 9)
→ Follow-up projects necessary
→ IMODDUS

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Phenotyping tools for DUS

	Species	Tools	Traits	Assessment of DUS and/or Performance (VSCU, Post-reg.)	TRL for DUS/VCU
Organ shape, size, color	Apple	RGB cameras in the lab	Colour	DUS	3
	Apple	ShapeAnalyser software	Fruit shape and size	DUS, Perf.	3 for DUS (7 to 8 for research and breeding)
	Wheat	RGB cameras in the lab	Organ length on plants (stems, between nods, ears)	DUS, Perf.	3
	Rye-grass	Mobile phone	Inflorescence length and counting spikelets (cut plants)	DUS	6
	Tomato	Tomato analyser on mobile phone	Fruit green shoulder, size (volume), number of locules, time of maturity, shape and colour	DUS	7 to 8
	Maize	Earbox	Ear characteristics	DUS, Perf.	7 to 9

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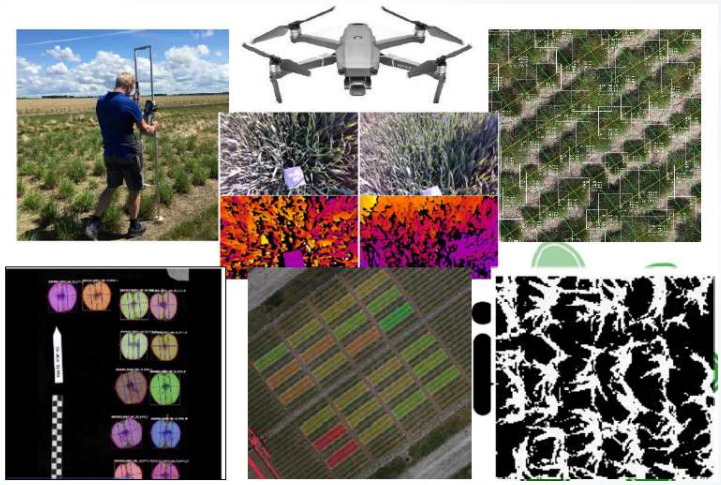
Phenotyping tools for DUS testing in the EU

→ **Survey** inside the network of EU EOs

→ **CPVO Workshop 27 March 2025**

Learn about existing tools and expertise

Discussions to identify common interests and support the elaboration of potential proposals by interested partners for future CPVO R&D calls…



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