UPOV

International Union for the Protection of New Varieties of Plants

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Working Group on Biochemical and Molecular Techniques and DNA-Profiling in Particular

BMT/18/12 Add.

Eighteenth Session
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ADDENDUM TO NEXT GENERATION VARIETY TESTING FOR IMPROVED CROPPING ON EUROPEAN FARMLAND (INNOVAR)

Document prepared by an expert from the United Kingdom

Disclaimer: this document does not represent UPOV policies or guidance

The annex to this document contains a copy of a presentation on “Next generation variety testing for improved cropping on European farmland (InnoVar)”, made at the eighteenth session of the BMT.

[Annex follows]

ANNEX

AGRI-FOOD
& BIOSCIENCES
INSTITUTE

Leading | Protecting | Enhancing

Next generation variety testing for improved cropping on European farmland: InnoVar

Coordinator: Lisa Black (AFBI)

afbini.gov.uk

INNOVAR

- InnoVar is a Horizon 2020 'Research and Innovation Action' addressing the topic SFS-29-2018 "Innovations in plant variety testing"
- **Title:** "Next generation variety testing for improved cropping on European farmland" (Short name: "InnoVar")
- **Value:** €7,999,540
- **Partners:** 21 partners in 10 countries.
- **Coordinator:** AFBI
- **Duration:** 54 months; start date 1st October 2019

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Agri-Food and Biosciences Institute

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AFBI carries out high technology research and development, statutory, analytical, and diagnostic testing functions for Government, public bodies and commercial companies.

AFBI has three main areas of work:

- **Improvements to animal production**
- **Animal and plant health**
- **Natural and marine environment**

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Plant Testing Station - Crossnacreevy

Statutory testing:

- DUS – PRG and clover
- VCU – Grass and clover, wheat, barley, oats and rye
- Seed certification and testing

Research:

Soil health, arable weeds, cover crops, organic manures, pathogen loading, herbage quality

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Team

Participant No.	Participant organisation name	Type	Country
1 (Coord)	AgriFood and Biosciences Institute (AFBI)	RES	UK
2	University College Dublin, National University of Ireland, Dublin (UCD)	UNIV	IE
3	Agencia Estatal Consejo Superior Deinvestigaciones Cientificas (CSIC)	RES	ES
4	RSK ADAS Limited (ADAS)	IND	UK
5	Debreceni Egyetem (UNIDEB)	UNIV	HU
6	Universita Degli Studi Della Tuscia (UNITUS)	UNIV	IT
7	Tystoftefonden (TYST)	OTH	DK
8	IP Pragmatics Limited (IPPL)	SME	UK
9	International Centre For Agricultural Research In The Dry Areas (ICARDA)	Intl Org	LB
10	Alma Mater Studiorum - Universita Di Bologna (UNIBO)	UNIV	IT
11	Department Of Agriculture, Food And The Marine (DAFM)	OTH	IE
12	The Secretary Of State For Environment, Food And Rural Affairs (DEFRA)	OTH	UK
13	The Agriculture And Horticulture Development Board (AHDB)	RES	UK
14	Consiglio Per La Ricerca In Agricoltura E L'Analisi Dell'Economia Agraria (CREA-DC)	RES	IT
15	Origin Enterprises PLC (ORIGIN)	IND	IE
16	Universidad Politecnica De Madrid (UPM)	UNIV	ES
17	Stichting International Soil Reference And Information Centre (ISRIC)	RES	NL
18	Horta S.r.l. (HORTA)	SME	IT
19	CONSULAI - Consultoria Agro-Industrial, Lda. (CONSULAI)	SME	PT
20	National University Of Ireland, Maynooth (NUIM)	UNIV	IE
21	Lesprojekt – sluzby s.r.o., (LESP)	SME	CZ

The challenge…

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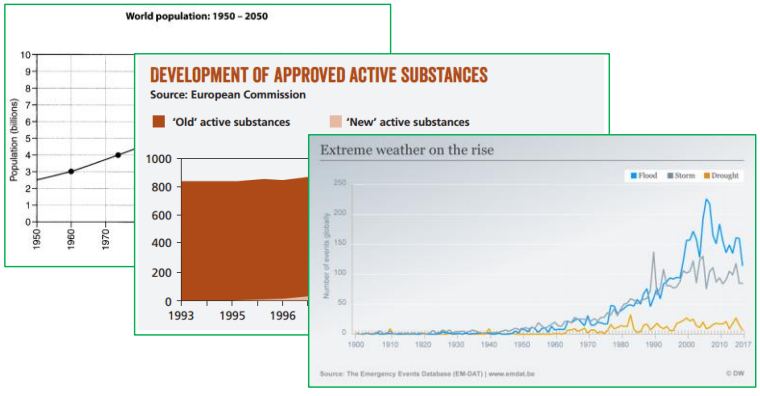
- Increasing population
- Decreasing inputs
- Climate change



The answer..

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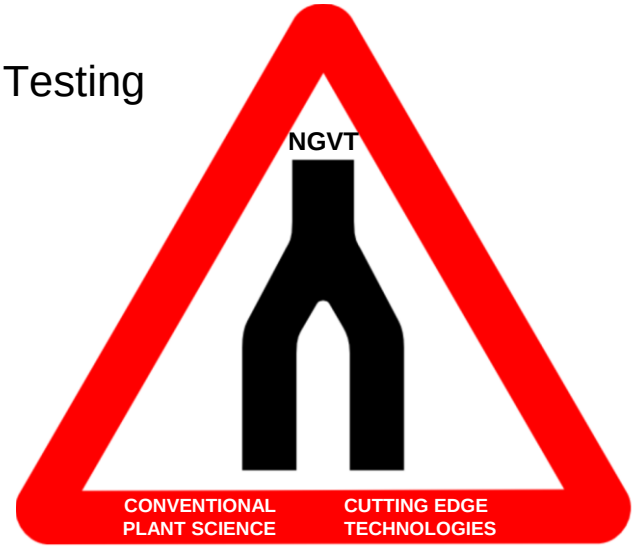
Next Generation Variety Testing (NGVT)



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INNOVAR FOCUSES ON WHEAT INITIALLY.....

.....AND THEN APPLIES WHAT IS LEARNED TO OTHER CROPS

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Why wheat?

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- Important calorie source accounting for 11.6% of gross EU agricultural crop value
- One of the most widely tested crops for DUS and VCU across the EU. In 2018, 112 bread wheat and 17 durum wheat applications for EU PVR were received by the CPVO.

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Why wheat?

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- Wheat breeding focussed on producing more **resilient** varieties
- New varieties
  - Disease resistance
  - Growth habit
  - Maturity
  - Resilience
  - Sustainability

After wheat.....

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- The ***deep*** approach for wheat will be used as a template to be applied to the variety trialling processes to other crops
  - Maize
  - Ryegrass
  - Legumes

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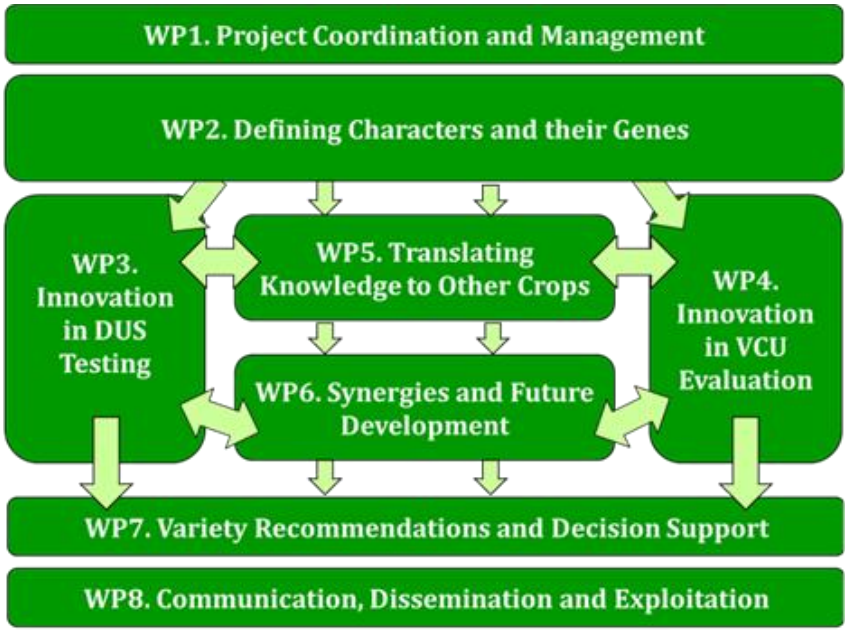

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Using wheat as a test crop, *InnoVar* will devise and demonstrate improved and more efficient methods of :

(1) integrating new science into variety testing processes,

(2) combining DUS and VCU characters, and

(3) incorporating variety information into decision-making on-farm.

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Capitalise on advances in new technologies...

The technologies...

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Phenotyping and Phenomics

Genomics

Machine Learning

The technologies…

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Phenotyping and Phenomics

- **InnoVar** will develop a database based on historic ***phenotyping data*** as the foundation.
- This will form the basis of a greatly expanded database that will capture standardized phenotyping data from standardized DUS and VCU trials across the EU.
- The database will also include ***phenomic data*** collected from selected trials using drone-based technologies to systemically assess the development and resilience of varieties.
- **Environmental data** will also be collected for field sites (soil, weather, etc.).

Genomics

Machine Learning

InnoVar trial sites – Ring test

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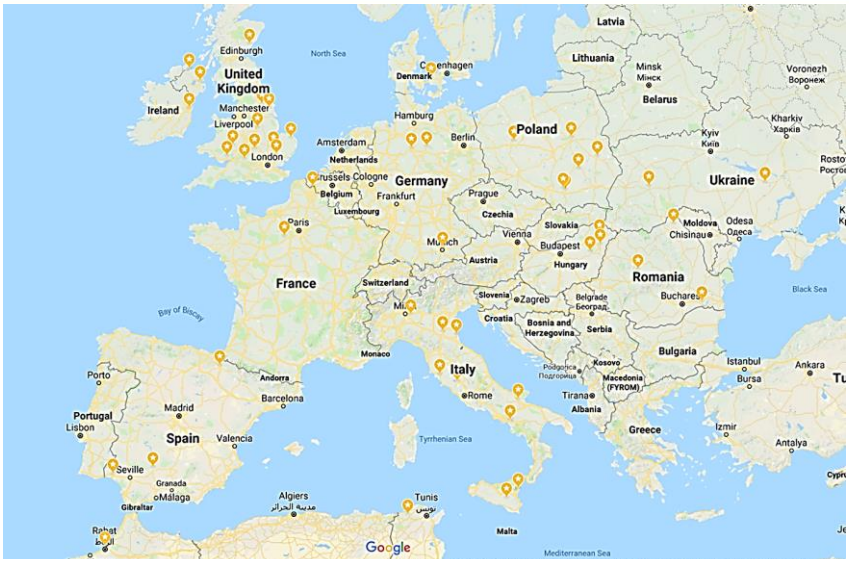

The technologies…

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Phenotyping and Phenomics

Genomics

Machine Learning

- For the DUS and VCU varieties of interest, **InnoVar** will collate existing and *de novo* genetic (SNP) data within the database.
- This data, combined with phenotypic and phenomic data will be used to determine genetic similarity thresholds of relevance to DUS.
- SNP data, combined with phenotypic and phenomic data will also be used in genome-wide association studies to identify genomic loci and markers associated with DUS and VCU traits of interest.

The technologies…

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Phenotyping and Phenomics

Genomics

Machine Learning

InnoVar will apply machine learning to standardized environmental, phenotypic, phenomic and genomic data sets created within the project in order to determine the potential of more refined models and algorithms to contribute to DUS and VCU testing.

Next generation variety testing..

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- help identify crop characteristics and "**sustainability criteria**" associated with the capacity of new varieties to maintain yield under more **variable conditions** and under **more sustainable crop management practices**
- Develop methods and tools to integrate "**sustainability criteria**" into performance testing under a range of agro-ecological environments, soil types and on-farm conditions
- improve precision and speed of methods for **variety testing**
- address the specificities of **the two key methods** of variety evaluation and look for synergies between them

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Recap: How are new varieties tested?

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DUS

1	Coleoptile	anthocyanin colouration
2	Plant	growth habit
3	Flag leaf	anthocyanin colouration
4	Plants	% recurved leaves
5	Ear	time of ear emergence
6	Flag leaf	glaucosity of sheath
7	Flag leaf	glaucosity of blade (lower side)
8	Ear	glaucosity
9	Culm	glaucosity of neck
10	Anthers	anthocyanin colouration
11	Plant	length (stem, ear, awns and scurs)
12	Straw	pith in cross section
13	Ear	shape in profile
14	Ear	density
15	Ear	length excluding awns and scurs
16	Awns or scurs	present
17	Awns or scurs	distribution
18	Awns or scurs	length
19	Ear	colour
20	Ear	Apical rachis segment
21	Lower glume	shoulder width
22	Lower glume	shoulder shape
23	Lower glume	beak length
24	Lower glume	beak shape
25	Lower glume	extent of internal hairs
26	Lowest lemma	beak shape
27	Grain	colour
28	Grain	colouration with phenol

VCU

1	Seed	TGW
2	Plant	emergence
3	Plant	winter hardiness
4	Plant	leaning
5	Plant	stem lodging
6	Plant	root lodging
7	Plant	ripening date
8	Plant	straw length
9	Ear	sprouting
10	Plant	mildew
11	Plant	yellow rust
12	Plant	brown rust
13	Plant	fusarium ear blight
14	Plant	septoria tritici
15	Plant	septoria nodorum
16	Plant	brown rust
17	Plot	plant population
18	Plot	shedding
19	Plot	combine losses
20	Plot	bird damage
21	Grain	yield
22	Grain	moisture content
23	Grain	specific weight
24	Grain	protein
25	Grain	hagberg fallinn number
26	Grain	endosperm texture
27	Grain	bread making quality
28	Grain	biscuit making quality

What will InnoVar achieve?

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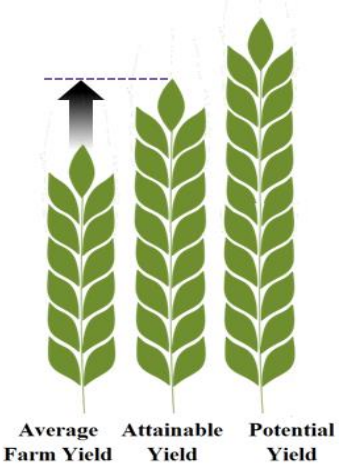
Develop tools and models that augment current plant testing practices

Examine the transfer of the InnoVar approach in wheat to other major crops

Plan wide-ranging dissemination, promoting uptake of results

Develop an App for farmers to promote "High Performance Low Risk" varieties



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Thank you

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