Use of disease and insect resistance characteristics in DUS examination

UPOV Technical Committee work shop 2017 - France GEVES

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Use of disease and insect resistance characteristics

- (a) **Context**, background
- (b) **Satisfy UPOV** characteristics criteria
- (c) Representation in **UPOV Test Guidelines**
- (d) Criteria, advantages and limits of the use
- (e) **Tools** to secure the use : net system, protocols, example varieties, identified isolates
- (f) **Challenges** : quantitative resistances, interaction with the genetic backgrounds, provide services to Examination Offices and companies,
  →progress for DUS tests

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Disease resistance tests : What for ?

Resistance bio tests

- Genetic ressources
- Breeding
- Registration /Protection

DUS
Characteristics with criterias

Fusarium/pea

- Comparison of a candidate to resistant and susceptible controls for characterisation
- Protocols for resistance tests
  Reproducible, practical, representative

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Context and background 1: Breeding for ?

Since 1960's, significative investments→ **important variety traits**

Large success and progress for vegetable and several field crop species**,** recognised and adopted by growers.

Continuous researchs in public and private sectors

→ Explore the relationship between the bio agressors and the varieties

For Authorities in charge of Agriculture, a necessity **to adopt genetic disease and insect resistances traits**, in relation with technical methods : bio control, crop rotation, association…

→ **Co-Construction to respond to the challenge for sustainable agriculture**

→ Breeding for resistances - **A challenge for Plant Production**

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Context and background 2

-**Large success for fungi, bacteria, virus**

-Limited for **insect**: except rice, coton (Heliothizea), eggplant (Leucinodes, leptinotaire, trialeurodes), melon (Vat gene against aphids), lettuce (Nasonovia aphid)

→ **large investments nowadays**

-**Vegetables** : 150 "host/ pest" couples

-**Field crop** : sunflower (downy mildew, rust, Orobranche), cotton (Bacterial blight, ramulose, mildew, nématodes…), sugar beet (nématodes), wheat (*Fusarium*, yellow rust), maize (*Fusarium, Helmintosporium*), lucerne (*Ditylenchus, Verticillium, Colletotrichum*…) …..

-**Fruit** : apple (scab/*Venturia*), apricot (Sharka), peach (Sharka, *Oïdium,* Aphids), banana (*Cercospora*)…

-Ornamental : not significant (complexity of genome, less pression …?)

-Forest: an other strategy through heterogeneous populations, not for DUS

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Satisfy UPOV DUS approach 1

We only consider ,

. Traits with simple genetic control (monogenic/polygenic)

→ **high heritability of the trait**

. **The phenotype**, in conformity with the Convention, not the genotype (except model 1)

. **Resistances** which are **significatively not dependant of the environment,**

. **High level of resistance**.

We do not consider VCU traits as tolerance, better ability….

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Satisfy UPOV criteria 2: as DUS characteristics

-**Reliable** → develop **bio tests** under controlled conditions with **recognised standards and protocols**

-Easy to describe and representative of the resistance in field:
1 (Susceptible)–9 (Resistant) or 1 (S) -2 (Intermediate R)-3 (R) or quantitative

-Spread into the DUS collection: satisfied as soon as the trait is sufficiently used by breeders.

-Practical : result in a reasonable delay and cost → Bio tests where the resistance is quickly revealed (generally 2 to 4 weeks after inoculation)

-**Published Recognised Methodology** and availability of the technologies

-Used for Description, **D, U and S**

-Not covered by Patent at any step

-Recognised by the user of the variety or any third party

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Representation in UPOV guide lines

-Since 1970's:

-Tomato : TMV, *Verticillium, Fusarium o.f.sp.l. strain* 0, Nématodes

-Bean : Virus 1, *Colletotrichum*

-Pea : *Fusarium o.f.sp.pisi strains 1, 5 and 6, Ascochyta pisi…*

-2017 :

.Tomato (11 bio pests/19 characteristics, 6 *), Melon (8/12, 3*), Pepper (6/10, 4 *), Cucumber (7), Bean (4/5), Pea (3/5), Lettuce (4/20, 1*), Corn salad(1/2), Spinach(1/3)….

. Sunflower (downy mildew), lucerne (six characteristics)

.Ornamental and fruit : no one, no necessity for D

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Criteria, advantages of the use

-**Structure the DUS reference collection** with important characteristics → optimise the set of close varieties → reduce the cost with an input

-**Permit to use the UPOV** option 'Marker used as a predictor of traditional characteristic' , **BM MODEL 1**

Example: Verticillium /Tomato « OK »; Nématodes/Tomato « * mind »

-Develop harmonization, common data bases and process to use it

Limits of the use

-Necessity to test all the collection, including susceptibles, to use them for **D**

-Test the Uniformity → the bio tests consider it

-Interaction with genetic background

-Quarantine status : mind for TYLCV-Tomato//possible for TSWV-tomato-pepper, Xanthomonas bean

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Tools to secure the use : Net system to provide information

. **Recognized protocols → Harmonize what and how ?**

.Controls (S, IR, R) : validated, available, healthy

.Reference isolates : validated, available, stable, representative of natural conditions (250 pests organisms stored at GEVES)

.Protocols, notation, scales, interpretation: validated, repeatable, reproducible

.Several initiatives :

ISF WG DRT / ESA / CPPSI / France MATREF / HARMORES CPVO

→EO's develop a system with the applicants to permit:

.the applicants to caliber their methodology, candidates varieties and declare true levels of resistance,

. the EO's to check DUS material with reliability,

in conformity with the DUS system.

DRT,Diseare resistance terminology – CPPSI, Collaboration for Plant Pathogen Strain Identification

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Example : Harmonization of isolates

- Pepper tobamoviruses for pepper

		Tested	Validated	Selected
Nb of strains	**TMV: 0**	5	2	**1**
	PMMoV: 1.2	5	2	**1**
	PMMoV: 1.2.3	4	1	**1**
	PVY: 0	4	1	**1**

↳1 isolate: easy notation, reproducible, validated as TMV:0

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Challenges 1 :

1-**Quantitative resistances**:

Challenge to contribute to sustainable agriculture.

Consider them if the level of resistance is significatively high,

→ **A minimum distance between S , IR and R**
→ ***Clear Distinction***
→ ***Uniformity : check the continuous expression into the variety (no discontinuity from plant to plant of the candidate)***

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Quantitative resistances: What ?

Cumulate disease polygenic resistances, co associate them to production factors (crop rotation, grafting, conduct, elicitors, stimulants, environnent….)

- **One genetique origin** : Melon (Fom 1-2), Tomato (*Pyrenochaeta*), Bean (*Pseudomonas*)
- **Several genetic origins**: Tomato (*Clavibacter*), Bean (*Xanthomonas)*
- **Different mecanisms**: Pepper (*Phytophthora*, CMV, PVY…)
- **2017:** Melon (*Pseudomonas, powdery mildew,* WMV, CABYV…), Tomato (TYLCV…), Cauliflower (*Plasmodiophora, club rrot*), Carrot (*Alternaria*), Onion (*Fusarium*…), Squash (*Powdery mildew*, ZYMV, CMV, PRSV), Strawberry (*Phytophthora cactorum*, *Colletotrichum*), Lettuce (virus yellowings, *Fusarium*), Pea (*Ascochyta*, PSBMV) ….

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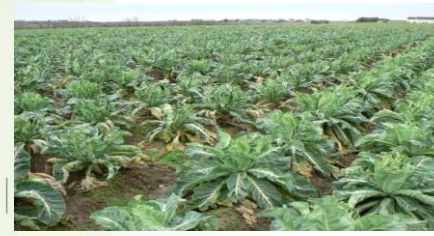

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Challenges 2 :

2 - Interaction with the genetic background :

more and more genetic crosses → Modification of the expression of the phenotype (modificators and regulators genes…, new genes of resistances….) (Nématodes/Tomato…)

→ Adapt biotests to this challenge (concentration…)

3 - Disease resistance Test Laboratories : it's a technology.

Develop **easy access to these laboratories for the examination offices**

→ Cooperation – share mutualised services

DUS data bases, Markers, disease resistance tests..→ improve D

Share the impacts to progress for DUS tests

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Thanks for your attention

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