Use of Plant Variety Protection by National Research Centers

INRA
French National Institute for Agricultural Research

The Benefits of Public-Private Partnership

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INRA's Charter on Intellectual Property

- Collaborative partnerships are increasing between public and private researchers
- INRA has a policy which combines the primacy of public service and support for innovation with private partners
- Through this **IP policy**, INRA wants to maintain its strategic ability to choose its industrial partners and to control conditions under which innovations achieved using public funds can be exploited

INRA's Charter on Intellectual Property

- INRA supports the protection of new plant varieties through the use of **certificates of PVP**
- PVP is an excellent compromise between the property rights and the free use of improved materials for the release of new varieties
- PVP provides free access to plant material as a genetic resource while ensuring a financial return for the creator of a new variety (DUS)
- INRA supports this system at a European level and worldwide

INRA's Charter on Intellectual Property

- **Patents** ensure both dissemination and protection of knowledge
- INRA demands the use of **Material Transfer Agreements** (MTA) for traceability of exchanges, guarantees on the confidentiality of the transfer, the ownership of the material, the control of the exploitation of the results – to be freed from any liability if inappropriate use

INRA's Charter on Intellectual Property

- **Public partners**: ownership is predefined by conventions governing the creation of Joint Research Units (JRU)
- **Private partners**: INRA claims full ownership of its own results, even when private partners participate in the funding of its research
- The private partner may benefit either from a prerogative of access to information or options for a license concerning the results

Examples of collaborative projects involving INRA and private partners in practical plant breeding

- 1- **winter rapeseed** – Michel Renard, INRA Rennes
- 2- **bread wheat** – Bernard Rolland and Maxime Trottet, INRA Rennes
- 3- **fruits** – Yves Lespinasse, INRA Angers-Nantes

1. Winter rapeseed

Modification of the fatty acid balance: towards LEAR (Low Erucic Acid Rapeseed) and then HOLLI (High Oleic and Low Linolenic) varieties

Back cross breeding strategy

'Primor' in 1973 (INRA) - the first LEAR line

then 'Jetneuf' in 1977 (RINGOT)

MAS strategy for Low Linolenic
INRA knowledge

'Stellar' low C18:3, coming from EMS treatment

'Low C18:3' trait X HQB (High Quality genetic Background)

F1 X HQB

B1F1 X HQB

B2F1 X HQB

B3F1

↓

B3F4 (**LL line**)

4 years instead of 16

Conversion of high yielding winter lines

'Basillic' 2010 (INRA)

122% cotation

2.6% linolenic acid content

The first LL line with less than 3%

Oleic acid content: same strategy

Seed mutagenesis - from 60 to about 80%

SNP markers developed (*INRA knowledge*)

Towards HOLLI varieties

To combine high oleic and low linolenic contents

INRA Patent on the *fad2* sequence

Breeding of HOLLI lines by private partners in progress

To reduce glucosinolate content in the meal

From 100 µmoles ('Jetneuf')

to 25 µmoles ('**Darmor**', 1983 - INRA/Serasem)
The first 00 line – with blackleg resistance

and then 12 µmoles ('**Samouraï**', 1989 - INRA/Serasem)
The first line with less than 18 µmoles

Plant development: Dwarf types

One gene: '*Bzh*'

An INRA patent on the sequence

Semi-dwarf F1 hybrids '**Lutin**' (INRA-Serasem) 1999 the first semi-dwarf hybrid , …, '**Intense** (2008) (INRA-Serasem)

Ogu-INRA Hybridization system (INRA Patent):

Selection of Hybrid/line composite Varieties

'Synergy' (1994- INRA/Serasem)
123% cotation
The first HL composite variety

'Standy', (2001-INRA/Serasem)

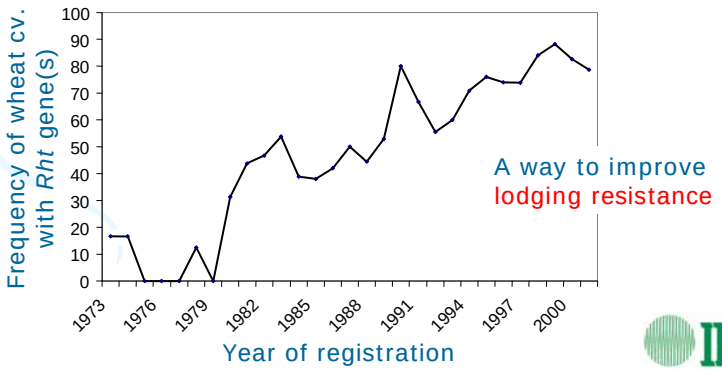
The INRA/Serasem varieties are co-obtentions

2- Bread Wheat

Evolution of the proportion of bread wheat cultivars with *Rht1* and/or *Rht2* dwarfing gene introduced from Cimmyt by INRA at the end of 1950s

1974, '**Courtot**' 1st dwarf variety (*Rht1+Rht2*) in France

1995-2010, ~80% of varieties registered in France carry *Rht1* or *Rht2*



Breeding bread wheat for disease resistance

- Introduction of resistance to eyespot from *Aegilops ventricosa*
  - Interspecific crossing and backcrosses: VPM resistant to eyespot (*Pch1*), yellow rust (*Yr17*); leaf rust (*Lr37*) and black rust (*Sr38*)

  VPM (INRA) was widely diffused to private and public breeders in France and abroad

  - '**Roazon**' (1976): 1st variety with high resistance to eyespot
  - '**Renan**' (1989): resistance to eyespot, rusts, Fusarium
  - 2001-2010: a mean of 4 to 5 varieties with the resistance to eyespot of VPM are registered each year in France (20 % of the varieties registered)
  - In 2004, the varieties carrying *Yr17-Lr37* genes were grown on more than 50% of the French bread wheat acreage

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Durable resistance to yellow rust

- Analysis of resistances of 'Renan'

'Renan' : 3 stable QTLs for resistance to yellow rust expressed at different growth stages

The complexity of resistance and the expression of QTLs from tillering to heading may explain the durability

The objective is to help breeding new cultivars with all the QTLs for durable resistance

Transfer to private breeders markers of QTLs and optimal combinations

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Creation of multi-resistant wheat varieties

- Cooperative programme with private wheat breeders to develop cultivars resistant to the most frequent diseases in the main wheat growing regions.
- Collaboration began in 1983 with GIE Club5 and CETAC and is still running.
- It will be enhanced with **BreedWheat Integrated French Project** which will allow to go farther with wheat genetics and genomics.
  - Improved wheat for yield, quality, stress tolerance
  - High throughput phenotyping, genotyping and use of genetic resources
  - Federate 26 partners in France and Europe, among which 11 private companies.

INRA

Creation of multi-resistant wheat varieties

- Since '**Roazon**' and '**Renan**' which open the way to using new genes for resistance in wheat breeding, INRA released new varieties adapted to low input farming:
- '**Virtuose**' (1998), '**Farandole**' (1999), '**Koreli**' (2005), '**Barok**' (2008), '**Flamenko**' and '**Folklor**' (2010).
- During this period, varieties adapted to low input were registered by private breeders as well. Some varieties of Club5 members derived from Club5 – INRA cooperation.
- From 1985 to 2010, about 20 INRA or Club5 varieties have germplasm created in cooperation in their pedigree.
- During the same time, fungi overcame some genes for resistance and some varieties became susceptible. This showed the necessity to strategies to improve the durability and diversity of resistances

Breeding varieties adapted to low input crop management

- High level of competition aptitude against weeds
- Aptitude to recover after a limited in time nitrogen stress
- High or moderate level resistance to the most frequent disease
- Aptitude to maintain grain quality after a stress
- **Result**: with a reduce use of herbicide (not every year) – a maximum of one fungicide – and a decrease of N fertilisation of 30-50 Kg / ha:
  Maintain the quality of the grains
  With less than 10% yield decrease
  Increase gross margin

3. Fruits

A collaboration between public (INRA) and private (CEP-Innovation: most of the French fruit nurserymen**)**

- Specific agreements for breeding new fruit varieties as apples, pears, apricots…
- An agreement between INRA - Agri Obtentions and CEP Innovation for editing, propagating and developing worldwide the new 100% INRA fruit varieties and INRA-CEP co-obtentions (50-50%)
- An association of the 2 partners in pre-competitive research through Integrated European Projects

A collaboration between public and private (CEP-Innovation)

- Apricot breeding - 2006-2020
- Pear breeding - 2004-2020

Agreement revised each 5 years

Common objectives :

- resistance to main diseases and pests
- high quality of the fruit
- regular production and low cost for training

Mutual decision of release but development of the new variety under the responsibility of the private partner.

In 1996, a new collaboration for apple breeding between INRA (public) and NOVADI (16 French apple nurserymen) - today a partnership **for breeding and launching new INRA varieties as 'Ariane' (DUS 2003)**

Now, POMALIA (NOVADI, grower organizations, marketers) has in charge the development of 'Ariane': planting 500 ha in 5 years.

Platerine ®

Ferdouce

Genetics and breeding on Fruit Species at INRA: a high involvement in European Integrated Projects and an answer to the fruit chain by providing new varieties

1- Integrated Projects as

HiDRAS (2003-2007): identification of QTLs for apple fruit firmness, acidity, sugar, juiciness...

ISAFRUIT (2006-2010): genetics of fruit quality for apricot, peach, apple - markers for application in breeding

2- These pre-competitive researches are implementing the applied breeding works for facing the new challenges as pesticide ban, improvement of fruit quality for increasing consumption, climate change...

INRA

Genetics and breeding on Fruit Species at INRA: a high involvement in European Integrated projects and an answer to the fruit chain by providing new varieties

- A new project **FruitBreedomics** (EU call 2010) concerns « **Genomics for increasing breeding efficiency in fruit trees** »: Europe is leading the researches on fruit genetics in identifying QTLs for fruit quality, health-related traits, disease resistances, plant architecture. This new project could valorise all the pre-competitive works by translating into directly applicable breeding tools and providing pre-breeding material.
- Our private partner is a member of **Fruit Breedomics** as in **HiDRAS** and **ISAFRUIT**

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