Training course packages targeting food operators on the adoption and management of the technological innovations

PRECISION PROTECTION SYSTEMS

Late blight on potatoes: detection and treatment

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1. FoodLAND technical innovation for local food supply chains: concepts and approaches

The FoodLAND project has the ambition to impact on a large number of supply chains and communities, hence the process of food operators' capacity development has to be tailored and as much participative as possible. Accordingly, one of the assumptions of FoodLAND is that sustainable and nutrition-responsive farming systems can be achieved basically by strengthening the capacity development, and specifically by **a)** empowering farmers and processors through the implementation of capacity building processes and concrete opportunities; **b)** creating or consolidating cooperation and shared knowledge to overcome the lack of coordination among food operators; **c)** addressing the inefficient use of resources; **d)** trying to address and build resiliency to the high vulnerability of food systems to climate change; **e)** enhancing the integration of supply chains by creating commercial and stakeholders' networks; **f)** improving the responsiveness of the production sector to the market demand.

To implement these elements of capacity development, FoodLAND proposed the adoption of specific innovations, among which the organizational ones, to create strong and responsive links between producers and encompassing all the intermediate actors along the food value chain, such as researchers, SMEs, NGOs, local and national authorities. In order to ease the creation of those links and guarantee the sustainability over time of the results, 14 Food Hubs will be created in 6 countries as part of the organizational innovations. Food Hubs are conceived as multi-actors centers of innovation where to develop or enhance the organizational and operational conditions enabling local food supply chains (D3.6).

Functional to the implementation of the Food Hubs and of the innovations, the training courses were designed – in form of capacity development activities – as a two-phase process. Firstly, a training session focused on general, preparatory topics was provided to farmers as described and reported in D3.5 ("Group Introductory Training", GIT). According to the project GA, GIT broad set of goals were: to enhance the knowledge of consumers' nutritional needs and market opportunities, and to boost the notions about climate change, sustainability, resilience, and food culture. Secondly, a specific training session were organized to provide food operators with practical information on the adoption and management of the innovations tested at lab / small scale level and to contribute to validating them at appropriate scale.

However, as the whole approach has been designed by FoodLAND to ensure the inclusion of the local actors from the first moment, both the training sessions were set up accordingly. Indeed, yet in the inception phase of the project, an assessment on participatory methods has been run and Participatory Learning and Action (PLA) approach has been eventually assessed as the best one to ensure the inclusion of multiple perspectives. The main purpose of PLA is to support people within communities to analyze their own situation, rather than have it analyzed by outsiders, and to ensure that any learning is then translated into action (Gosling and Edwards 2003). In addition, a gender-sensitive approach has been applied to the trainings that have been designed considering gender roles and power relations; they have provided equal opportunities to participate in the process by caring to times, venues and use of local languages.

The GITs have been conceived as the first step towards the innovation validation and aim at involving the producers, yet from the inception phase. They are just the first step in a sequence of 6, summed up in **Table 1**. After the GITs, where farmers and processors meet and share their vision and goals for the Food Hubs and exchange information about specific topics, the Food Hubs were created and the innovation tested (first in pre-test, then in pilot phase). The constant iteration between researchers and local actors is a key feature of the project: specifically, the practical trainings focused the single innovations (step 5) are aimed at validating the innovations at adequate scale and planned to trigger feedback loops of control and improvement involving developers and adopters.

Table 1. Activities with farmers and food processors (SMEs) and participatory approach

Step	1	2	3	4	5	6
Task	**T3.3**	**T3.3**	**T3.4**	**T4.1¸T4.5**	**T5.1¸T5.5**	**T5.1¸T5.5**
Activity	Group introductory training	Food Hubs creation	Innovation undertaking	Innovation tests	Individual and group practical training	Innovation pilot and validation

2. FoodLAND practical training: aims and scope

According to the project bottom-up and participatory approaches, following the courses on introductory topics GIT organized in the early project phase (T3.3), and as component creating / strengthening the Food Hubs as local innovation centres, FoodLAND has organized a second set of training activities with food operators based on active learning methods and gender equality principle (Task 5.1-5.9). In this regard, specific mechanisms (being aware of the gender roles and power relations; providing equal opportunities to participate in the process by putting attention to the times, venues, use of local languages, etc.) will be lifted to ensure women's participation. These training packages are aimed at providing the local farmers and food processors with operational instructions on the adoption and management of the validated innovations.

This second set of training activities has been organised – triggering PLA approach – as individual and group practical (demonstration/capacity building) activities to be conducted in parallel to the implementation of the technological research (where relevant) and of the innovation pilots and validation. These technology-centred trainings aim at strengthening the participants' understanding of novel production and post-harvest techniques, innovative tools and systems (e.g., climate smart/precision agriculture, hydroponics, and integrated aquaculture), new technologies for primary and secondary processing, and supply chain management. Thus they aim at fostering knowledge and operational capacity to deploy, manage, and maintain the validated technological innovations – documented by the released guidelines D4.1 ÷ D4.11 (e.g., training pamphlets, user manuals, flow diagrams, and operational recommendations) and practice abstracts D6.5 – validated jointly at appropriate scale.

3. Second training packages on the adoption and management of the tested innovations: an overview

The second training course aimed at consolidating the food operators' knowledge and practical skills to adopt, manage and validate the project innovations and complement the related guidelines. Specifically, the realized training materials provide local farmers and food operators with a set of notions and concrete information on a series of innovative tools and systems as per the following **Table 2**. It is clear that both the contents and formats of the learning packages widely differ across technologies as well as Food Hubs (when the same type of innovation must be validated in different contexts). The diversity that emerges from the proposed solutions reflects the different needs highlighted by farmers and stakeholders as well as the conditions and opportunities characterizing the local communities. Nevertheless, in order to take into due account the existing heterogeneity inside the local communities, the developed learning materials have been let available on the project intranet so as to be used for further training initiatives across the network of Food Hubs.

4. Second training packages on practical information on the adoption and management of the tested innovations

Precision protection systems

Late blight on potatoes: disease detection and treatment

Late blight on potatoes :
Disease detection and treatment

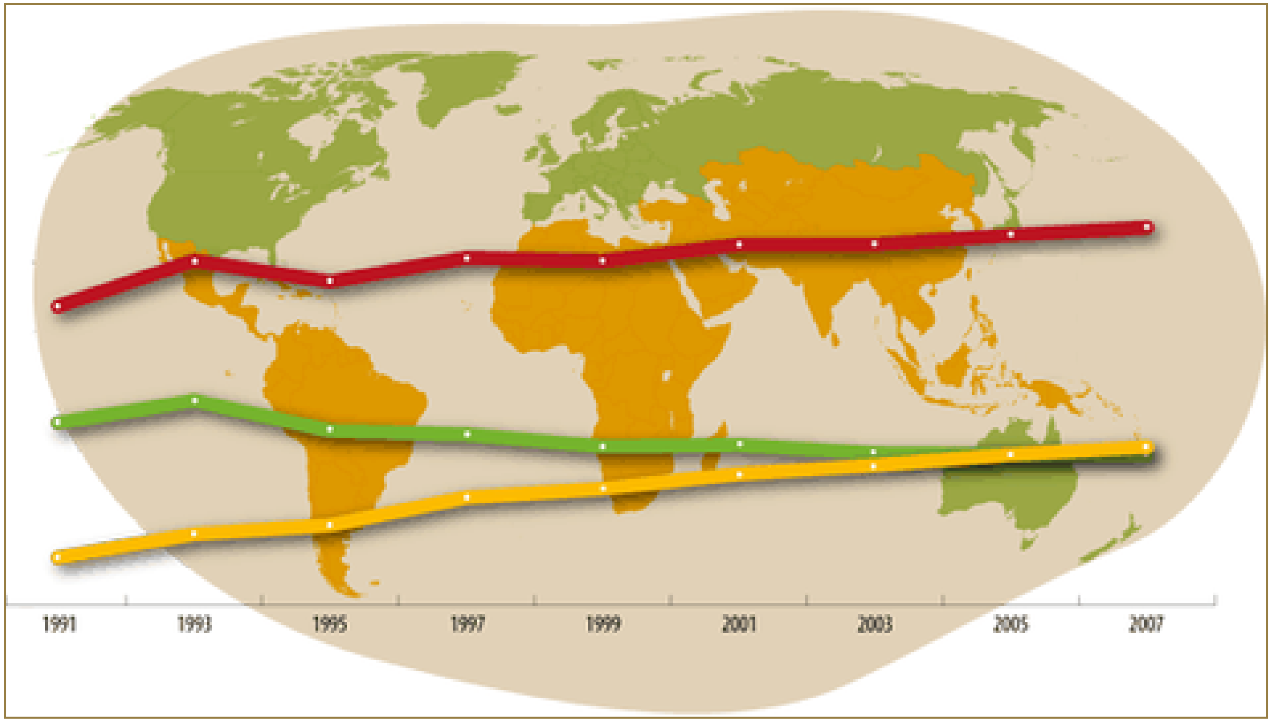
<u>Presented by</u> : Lahlali Rachid
Prof. PhD at the National School of Agriculture in Meknes

Introduction

Potatoes have long been grown in Morocco because of their culinary value to local consumers and the fact that part of the production is exported.

1- The international potato cultivation situation

The potato sector is evolving rapidly. Until the early 90s, most potatoes were grown and consumed in Europe, North America and the countries of the former Soviet Union.



	1991	1993	1995	1997	1999	2001	2003	2005	2007
Country	million tonnes								
developed	183,13	199,31	177,47	174,63	165,93	166,9	160,97	159,97	159,89
in development	84,86	101,95	108,5	128,72	135,15	145,9	152,11	160,01	165,41
WORLD	267,99	301,26	285,97	303,35	301,08	312,9	313,08	319,98	325,3

World potato production, 1991-2007

	Quantité (t)
1. Chine	72 040 000
2. Féd. de Russie	36 784 200
3. Inde	26 280 000
4. Etats-Unis	20 373 267
5. Ukraine	19 102 300
6. Pologne	11 643 769
7. Allemagne	11 604 500
8. Bélarus	8 743 976
9. Pays-Bas	7 200 000
10. France	6 271 000
	Source: FAOSTAT

Main potato producers, 2007

Asia and Europe are the world's two main potato-producing regions, accounting for over 80% of global production in 2007.

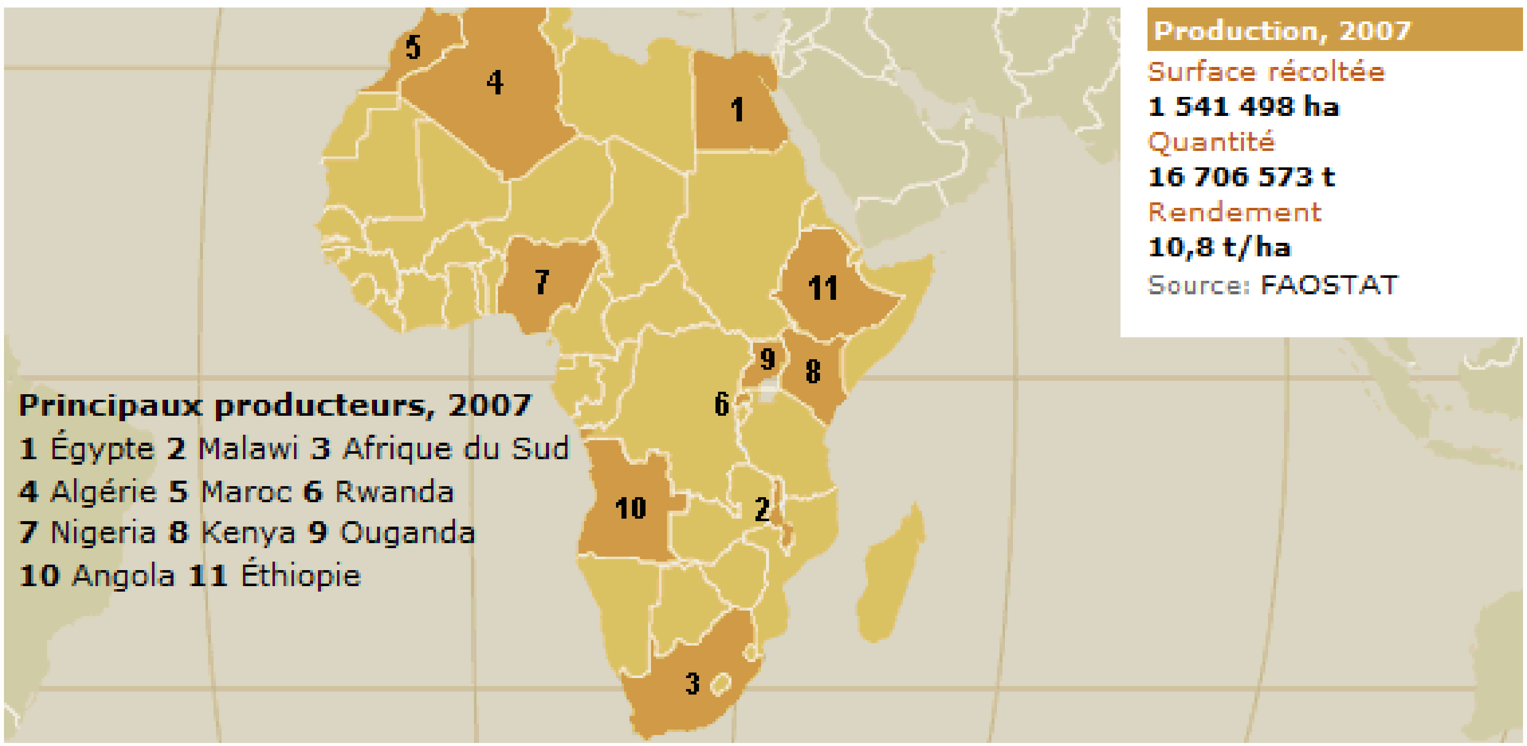
	Area harvested hectares	Quantity tonnes	Yield tonnes/hectare
Africa	1 541 498	16 706 573	10,8
Asia and Oceania	8 732 961	137 343 664	15,7
Europe	7 473 628	130 223 960	17,4
Latin America	963 766	15 682 943	16,3
North America	615 878	25 345 305	41,2
WORLD	19 327 731	325 302 445	16,8

(Source: FAOSTAT)

2-The national potato cultivation situation

The potato arrived late in Africa, around the turn of the 20th century.

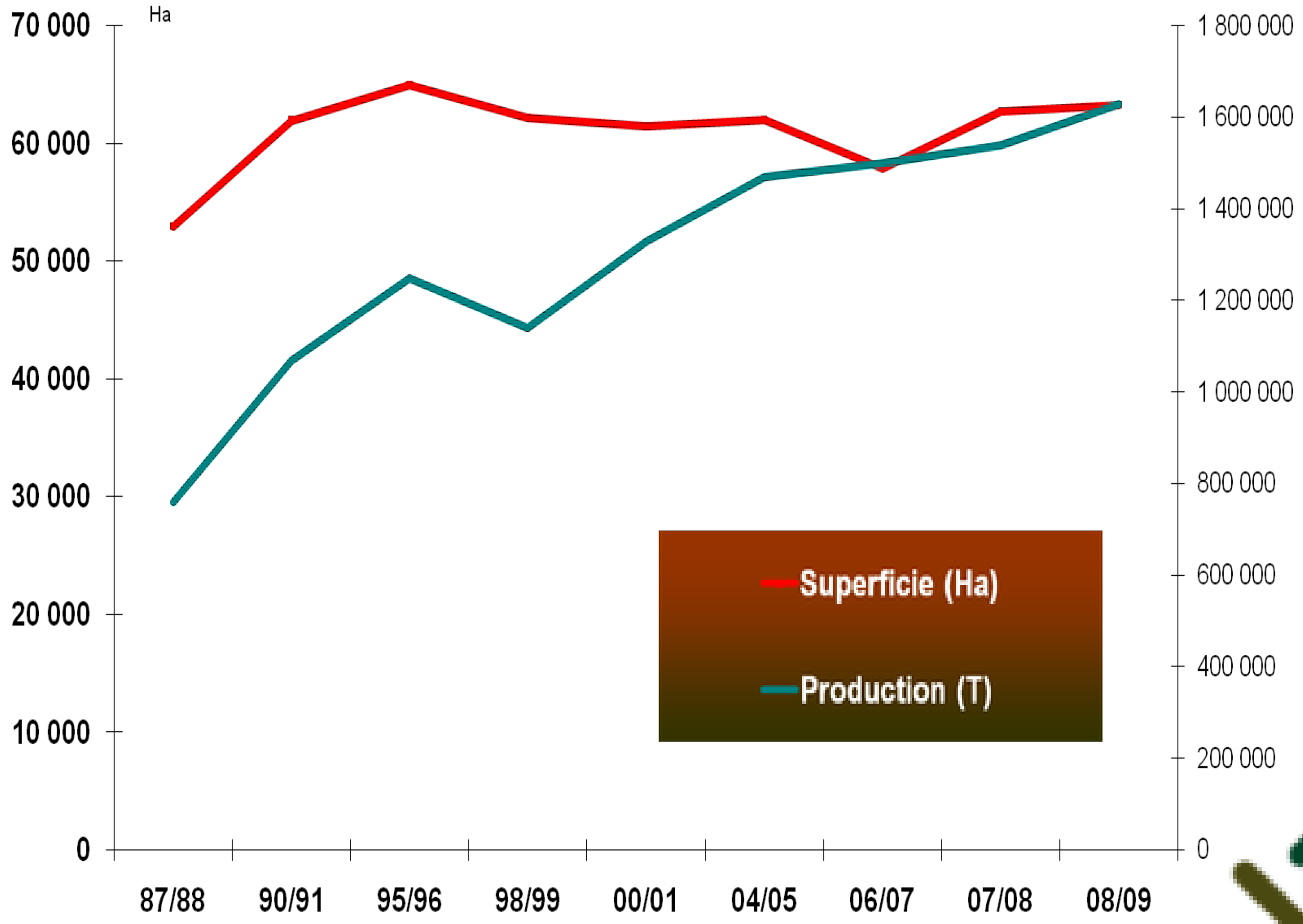
Production has risen steadily in recent years, from 2 million tonnes in 1960 to a record 16.7 million tonnes in 2007.



1- ***area and production***

Species	Average area 2004-2022	%	Average production 2004-2022	%
Potato	61 000	23,2	1 480 000	22,1
Onion	29 000	11,1	765 000	11,4
Tomato	20 000	7,6	1 178 000	17,6
Melon Watermelon	40 000	15,3	1 253 000	18,7
Green legumes	39 000	14,9	396 000	5,9
Carrots Turnips	18 000	6,9	400 000	5,9
Other	56 000	21,3	1 233 000	18,4
Total	263 000	100	6 705 000	100

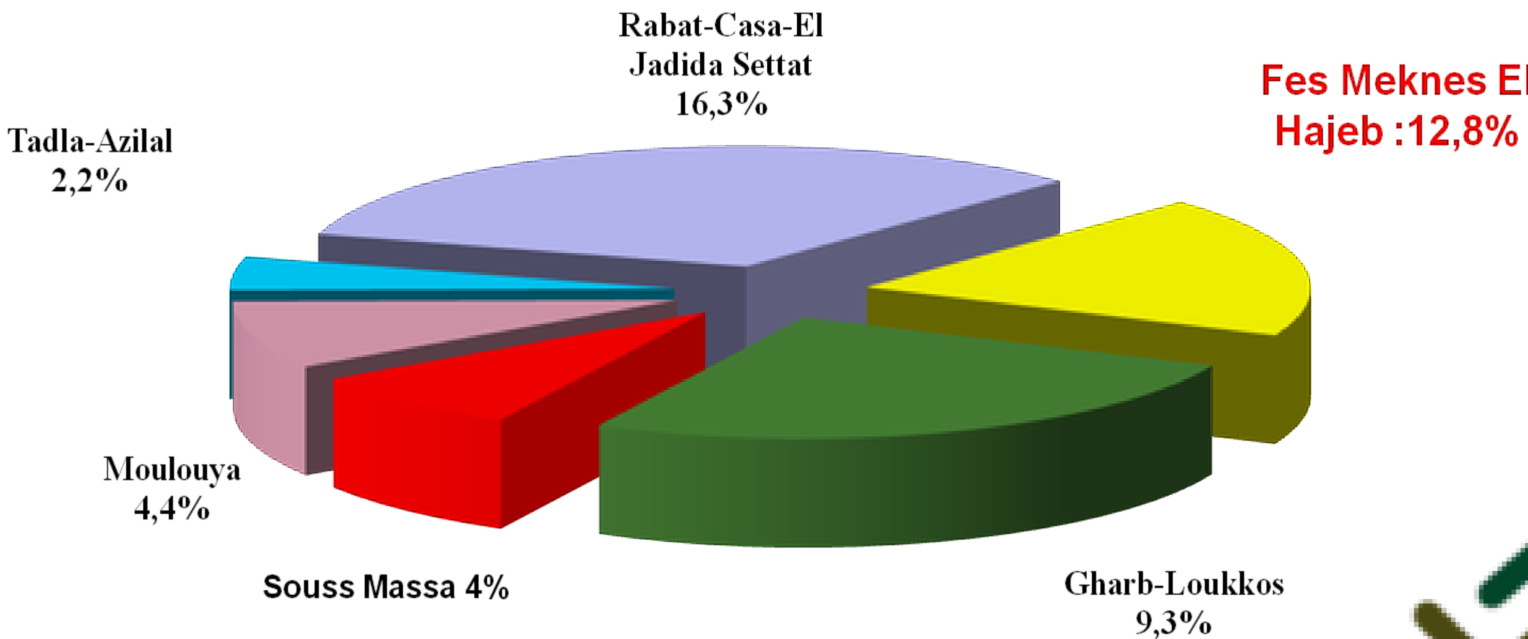
CHANGE IN AREA AND PRODUCTION OF POTATOES



this speculation has grown rapidly thanks to:

- development of irrigated areas
- massive importation of selected seeds

2- *Distribution of potato cultivation.*



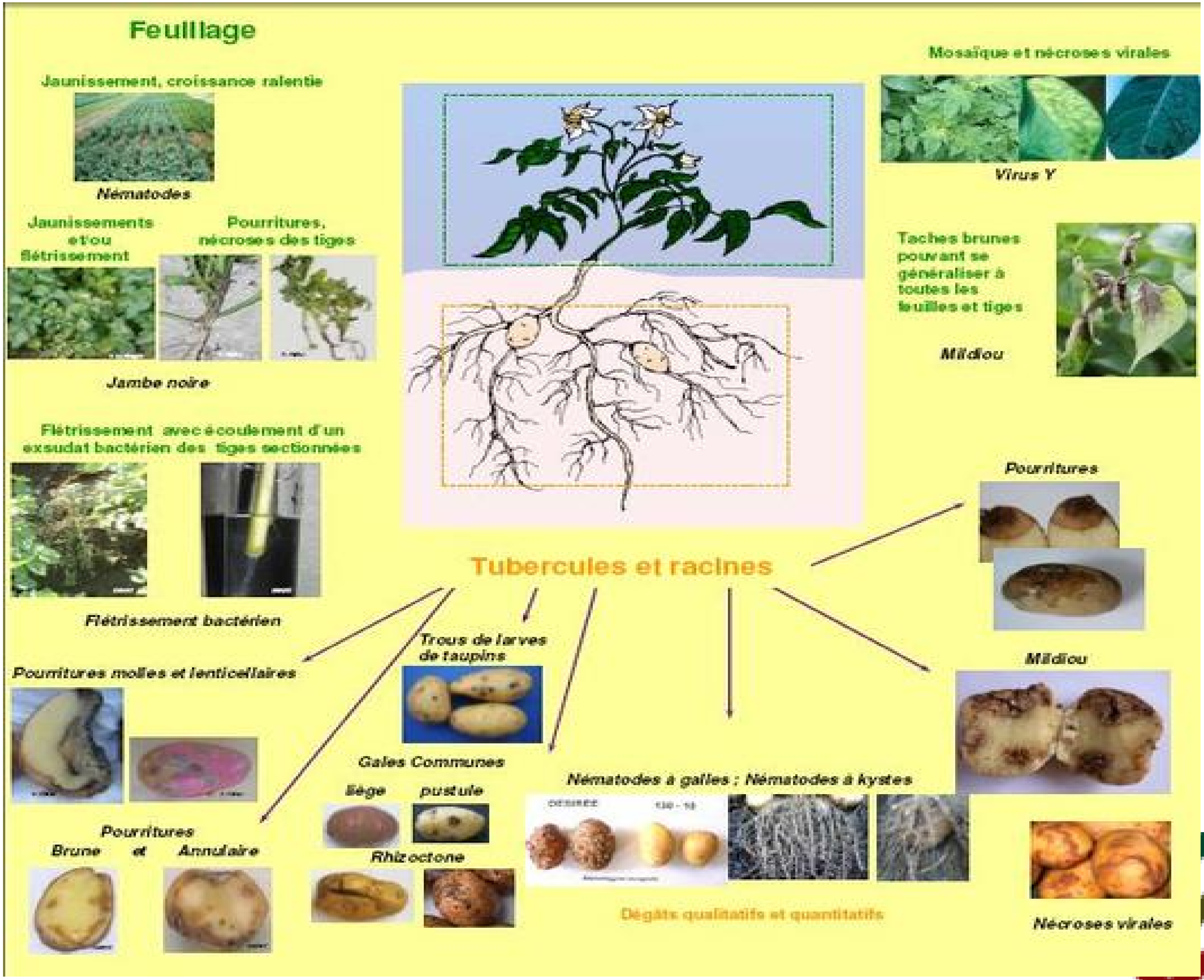
REGIONAL DISTRIBUTION OF POTATO AREA

PRODUCTION SPREAD PRACTICALLY OVER THE WHOLE YEAR

3- Difficulties in the sector

Average potato yields at national level remain low, at between 10 and 15 T/Ha for early crops and between 15 and 20 T/Ha for seasonal crops.

- **Crop management**
- **Plant health**
- **Plant quality**
- **Low diversity**

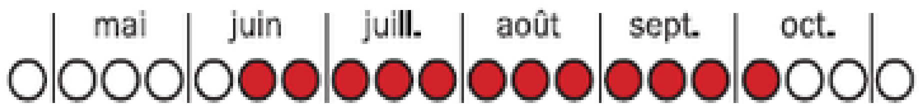


Feuillage
Jaunissement, croissance ralentie
Nématodes
Jaunissements et/ou flétrissement
Pourritures, nécroses des tiges
Jambe noire
Flétrissement avec écoulement d'un exsudat bactérien des tiges sectionnées
Flétrissement bactérien
Mosaïque et nécroses virales
Virus Y
Taches brunes pouvant se généraliser à toutes les feuilles et tiges
Mildiou
Tubercules et racines
Pourritures
Mildiou
Trous de larves de taupins
Pourritures molles et lenticellaires
Gales Communes
liège
pustule
Rhizoctone
Pourritures
Brune et Annulaire
Nématodes à galles ; Nématodes à kystes
DESIREE
Dégâts qualitatifs et quantitatifs
Nécroses virales

FOLIAR DISEASES OF THE POTATO

I-Downy mildew caused by Phytophthora infestans

This disease was responsible for the deaths of at least one and a half million people in Ireland between 1845 and 1851, and drove around a million more to emigrate to the American continent.



A- Symptoms and damage

Downy mildew symptoms can be observed on all potato organs

- young shoots (primary foci)
- leaves and **petioles** (at all stages of the **epidemic**),
- terminal bunches and stems (especially during early attacks, but also during the **epidemic**)
- tubers.

Young shoots under attack

are spindly and covered with a whitish down (fruiting bodies of the parasite)

On leaves

Discoloured, oily-looking spots

These spots rapidly turn brown and are surrounded by a yellow border on the upper surface of the leaf blades.
On the underside, the fructifications of the parasite can be seen around the edge of the necrotic area in very humid conditions.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terminal florets

- browning and slight curling of the apical leaves
- gradual drying of leaflets

On stems

- purplish-brown necrosis
- The stem often remains rigid, but breaks easily

On tubers

irregular, bluish-grey, purplish or brown surface patches

In sections, rusty or brownish mottled areas can be seen.

This leads to dry rot which does not develop during storage.

C- Control methods

Cultural and sanitary control

These consist of eliminating piles of waste (sorting gaps) and planting tubers with healthy seed.

It is also very important to avoid contamination of the daughter tubers by early and total removal of all dead tubers.

genetic control

The mildew resistance selection programme is based on the introduction of monogenic resistance from the wild species.

Breeders are currently focusing on non-specific resistances to races of the parasite, the main effect of which is to reduce the rate of spread of the disease.

Chemical control

Contact products

dithiocarbamates (manebe, and especially mancozebe),
phthalimides (captafol) ;
phthalonitriles (chlorothalonil) ;
organostanes (fentine-acetate;) ;
copper salts

Penetrating active ingredients

cymoxanil

Systemic active ingredients

phenylamides (metalaxyl, benalaxyl),
carbamates (propamocarb)

2-Other disease: Alternaria solani

Experiments show that infection by *Alternaria solani* causes a 22% drop in yield in spring crops and a 7% drop in autumn crops (not to be confused with Mildew).

A- Symptoms and damage

The clearest symptoms are brownish-black spots with concentric black circles,

Infection of the tuber is only possible if it is wounded, with the spores penetrating through these wounds.

During storage, the fungus can develop and cause significant losses.


C

b-2 Development factors

high temperature (25-30°C),

a period of dew allows medium to heavy infection in a single night.

Conidial induction and sporulation require alternating wet (night) and dry, sunny periods over a period of 36 hours.

The survival of mycelium and spores is greatly affected by hot, dry conditions.

This disease is closely linked to leaf and plant senescence.

The application of nitrogen, by prolonging plant growth and thus delaying senescence, significantly reduces the level of disease.

C- Control methods

During vegetation, all factors that accelerate senescence should be avoided

Applications of chlorothalonil or mancozeb during the second half of the growing season.

Harvest applications of sodium hypochlorite, chlorine or captafol are effective on seed tubers.

The benefits of early detection of late blight in potatoes using drones

- **The problem:** Late blight can destroy the crop if it is not detected early.
- **The solution:** A drone flies over the field, takes special images and detects signs of the disease before they are visible.

Innovation proposed by FoodLAND:

- Using **artificial intelligence (AI)** to analyse plants.
- Results displayed directly on a **mobile application**.

How does the system work?

1. **Flight of the drone**: It flies over your field automatically (15-20 minutes).
2. **Image analysis**: The multi-spectral images are analysed using AI.
3. **Results on your phone**: A colour map shows healthy and diseased areas.

Direct benefits for the farmer:

- Detect the disease **before it spreads**.
- **Reduce pesticide use** by only treating affected areas.
- **Save money and protect your crop**.

Screenshots of the mobile application for precision irrigation and early blight detection notification

Beneficiaries and proposed technical support

- **Intended for:**
    - **Medium-sized or large** potato farms
    - **Small farmers** organized into cooperatives or farmer groups..

What we offer :

- **Training** in the use of the application
- **Field tests** with the support of ENAM and its partners.

Conclusion

Increasing potato production while protecting growers, consumers and the environment requires a holistic approach to crop protection that encompasses a range of strategies

- **Measures to encourage natural predators of pests,**
- **Selection of disease-resistant varieties,**
- **Certified seed potatoes,**
- **Crop rotation,**
- **Organic composting to improve soil quality.**
- **Improved methods of detection and early treatment of diseases, in particular through the use of precision farming technologies.**

Thank you for your attention