

Foreword

The intensification of our agriculture has led to a considerable increase in agricultural and food production, both in terms of quantity and quality making it possible to ensure an affordable food to all. But it has also generated negative impacts that are now well-documented. Chemical pesticides are at the very heart of this tension. Given their impact on biodiversity and health, gradually phasing out chemical pesticide use has become a major challenge, in France, in Europe and in many countries across the world. With this in mind, since the Grenelle de l'Environnement political meetings in 2007, the French governments have committed agricultural stakeholders to a thorough change in order to move towards more productive, agroecological agriculture that provides more respect for the environment and human health. In line with the European directive on the use and impact of plant protection products compatible with sustainable development, this commitment has been translated at the French scale into the “Écophyto” plan.

The transition of agriculture towards more sustainability while ensuring a decent income for producers and a high level of production concerns all citizens and must be endorsed by all socio-economic stakeholders. It also requires special efforts in research and innovation because the transformation of production methods must be based on scientific knowledge that offers farmers new solutions for all situations of crop protection.

To support the Écophyto plan's initiatives, the French government launched in 2020 a Priority Research Programme (known in French as a PPR) to accelerate research and the acquisition of fundamental knowledge, exploring all the horizons that can be employed for a progressive phase-out of pesticides. With a budget of €30 million and a duration of six years, the PPR was created to mobilise researchers in all relevant disciplines. An appropriate framework for the exploration of scientific fronts has been defined: the ultimate goal is to be able to produce crops with no chemical pesticides at all. As this book demonstrates, the choice of an ambitious target for the potential complete elimination of pesticides enables us to explore scientific avenues that will lead to breakthrough innovations, mobilizing systemic approaches and multiple levers that are not only biotechnical, but also organizational and societal, ultimately enabling a significant reduction in the use of pesticides. The prospect of low-pesticide agriculture, reaffirmed by the President of the French Republic at the World Biodiversity Summit in Marseille in October 2021, is in line with Europe's Green Deal ambition to reduce pesticide use and impact by 50% by 2030, i.e. in a very short space of time. The need for research and innovation is therefore considerable.

The PPR “Growing and Protecting Crops Differently”, scientifically coordinated by INRAE, is currently funding 10 ambitious projects providing structure for scientific communities. These projects bring together numerous research units from France's universities and national research organisations. The approaches are mainly interdisciplinary, and their content combines fundamental research with studies on the practical application of innovative methods. For example, fundamental approaches

concern our understanding of the biological mechanisms involved in crop health and the prophylactic measures needed to achieve this objective. Applied approaches are conducted in partnership with agricultural stakeholders and concern the deployment of new crop protection methods and the technical and organisational innovations required. The size and duration of these projects will encourage the long-term structuring of scientific communities on highly promising topics such as understanding plant microbiota and its influence on plant health, epidemiological monitoring methods for prophylaxis, the co-design of cropping systems, the creation of resistant varieties, species and variety mixtures, the diversification of cover crops, the spatial organisation of crops in the landscape and new biocontrol methods, alongside public policies and collective organisation.

In addition to the research projects, the programme overall management involves initiatives to maximise the impact of this research. Original approaches for impact analysis are being developed throughout the programme and its various projects. A foresight study has been conducted to figure out what pesticide-free European agriculture would look like in 2050, leading to three contrasting scenarios where biological breakthroughs are required, where the transition pathways have been documented, scenarios being illustrated through four case studies across Europe. At the same time, symposia and events involving both national and international scientific communities and agricultural stakeholders are being organised. These events provide an opportunity to share the progress of the projects, as well as their achievements, facilitating the transfer of knowledge and solutions to farmers and society at large.

All this knowledge and possibly disruptive innovations are becoming available at the very moment when, in France, a new ambitious plan is being implemented. Named Parsada, its ambition is to provide alternatives to 75 molecules that are at threat in the coming 5 years for re-approval. As they are massively used in the French cropping systems, it is compulsory to re-design cropping systems where crop protection has to be ensured. The achievements of the PPR are of utmost importance to reach these new goals.

This ambitiously titled book was coordinated by the researchers who scientifically defined and presently manage the programme. It illustrates the programme design approach through an initial review of the issues involved in phasing out pesticides, the knowledge already available and promising avenues of research that could make it possible to grow and protect crops differently without the use of chemical pesticides.

The “Growing and Protecting Crops Differently” programme demonstrates the originality of the scientific dynamics introduced. Advances in our knowledge will produce the information needed and innovations required to avoid the need for pesticides. This approach was conceived from the outset on an international and, particularly, European scale, as illustrated by the European Research Alliance “Towards a Chemical Pesticide-Free Agriculture” supported by France, Germany and presently a total of 37 research organisations from 21 European countries. This European Alliance is the cradle for emergence of ambitious projects and initiatives to foster production of knowledge, co-design of innovation and support to public policies. The ambition of both the French programme and the European Alliance is

to contribute to European strategies for agroecological transition, food security and the restoration of agricultural environment.

I am convinced that those involved in research and education, as well as all the professionals concerned by the changes to be implemented in agriculture, will find in this book resources to fuel their reflections, decisions and actions. I hope that this collective effort will enable our societies to make the ambitious and essential transition to sustainable and competitive agricultural production methods that will guarantee affordable and healthy food for all, and a safe environment for future generations.

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