



# SECURING SUSTAINABLE PLANT PROTECTION IN DENMARK

ENABLING THE TRANSITION TO  
BIOCONTROL SOLUTIONS

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The project is part of the seven "knowledge gap projects" at the Green Solutions Centre at the University of Copenhagen funded by part of the research reserve funds to strengthen cross-disciplinary capacity building with a focus on nature, climate, environment, and agriculture. The goal is to create a better foundation for integrated, cross-scientific public sector support in the green transition, and the results should serve as a basis for future strategic collaborations with, among others, foundations and stakeholders.

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# Executive summary

Danish agriculture is entering a period of structural transitions. Regulatory withdrawals of plant protection products, including the 2025 ban on PFAS-containing pesticides<sup>1</sup>, combined with increasing environmental and societal pressures, are narrowing the range of available crop protection tools. While reducing reliance on synthetic pesticides is a necessary objective, viable and scalable alternatives must be available to safeguard Danish agricultural productivity and competitiveness.

Biocontrol solutions - including microbial agents and plant-derived compounds - represent a

promising but underutilised component for more sustainable plant protection. Globally expanding yet limited in Denmark, their uptake is constrained not primarily by farmer resistance, but by systemic barriers in regulation, knowledge infrastructure, market conditions, and innovation incentives.

Based on interdisciplinary research conducted through the BioPlantPro project (2025–2026), this white paper identifies **three strategic policy priorities**:

1. **Regulation & Incentives:** Ensure a clear and operational EU definition of biocontrol agents and align regulatory, financial, and user incentives to actively promote environmentally friendly solutions over conventional chemical pesticides.
2. **Knowledge, Acceptance & Capacity:** Establish a coordinated national knowledge function that integrates scientific, regulatory, and practical expertise, strengthens advisory capacity, and supports region-specific learning and implementation.
3. **Research & Innovation System:** Implement long-term, mission-oriented funding instruments that bridge early-stage discovery with field validation, regulatory readiness, and market deployment.

By aligning regulatory reform, knowledge infrastructure, and innovation policy, Denmark can position itself as a leader in enabling a

managed and economically viable transition toward sustainable plant protection.



# Securing sustainable plant protection in Denmark

Across the EU, approximately 290,000–300,000 tonnes of pesticides are sold annually<sup>2</sup>. Denmark is among the most intensively cultivated countries in Europe, with more than 60% of its land used for agriculture. Crop protection remains

essential to maintain yields, food security, and economic stability in key sectors such as potato

production. Yet the environmental and health implications of synthetic pesticide use - including groundwater contamination and persistent substances such as PFAS - are prompting accelerated regulatory action.

Recent withdrawals of PFAS-containing products in Denmark and ongoing reforms of the EU Plant Protection Products framework illustrate the urgency of developing sustainable alternatives. Reducing pesticide use without ensuring access to effective alternatives risks measurable yield losses and reduced competitiveness in key agricultural sectors.

Biocontrol solutions - including microbial agents, plant-derived compounds, and other biologically based plant protection products - represent a promising but underexplored

“ *Biocontrol solutions — including microbial agents, plant-derived compounds, and other biologically based plant protection products — represent a promising but underexplored component of the solution.* ”

component of the solution. Globally, such products account for more than 5% of the pesticide market and are expanding<sup>3</sup>. However, their availability and uptake in Denmark remain limited. This is not primarily due to lack of

farmer interest. Rather, structural barriers in regulation, innovation incentives, market conditions, and

knowledge transfer constrain their development and deployment.

This white paper builds on the interdisciplinary BioPlantPro project (2025–2026), integrating insights from plant biotechnology, law, and social science. Based on stakeholder interviews across the value chain, regulatory analysis, and scientific assessment, the paper identifies key bottlenecks in the current system and proposes actionable policy pathways.

The objective is not to replace chemical pesticides overnight. Instead, the aim is to enable a managed transition toward a more diversified and sustainable plant protection strategy — one that safeguards agricultural productivity while meeting environmental and societal expectations.

## Denmark’s Shrinking Pesticide Toolbox: Why Action Is Urgent

Regulatory withdrawals are accelerating across Danish agriculture. Over recent years, a growing number of plant protection products have been removed from the market due to environmental and health concerns. Most recently, the national ban on PFAS-containing pesticides in 2025 led to the withdrawal of 33 products, significantly narrowing available treatment options in several crop systems<sup>1</sup>.

At the same time, EU-level reforms of the Plant Protection Products Regulation aim to

reduce environmental impact and accelerate the transition toward safer alternatives. While proposals to reduce overall pesticide use by 50% by 2030 were politically contested and ultimately withdrawn, the underlying policy direction remains clear: future crop protection must become more sustainable, more targeted, and less environmentally burdensome.

This transition is not occurring in isolation. Danish agriculture is among the most productive in Europe, operating under high



*Potatoes account for billions of kroner in annual value and are central to regional economies, particularly in Western Denmark. They are also among the most pesticide-dependent crops.*

yield expectations and tight economic margins. Crop protection remains essential to prevent substantial yield losses. Globally, plant pests and diseases reduce crop yields by an estimated 20–40% annually<sup>4</sup>. Reductions in pesticide availability without effective alternatives therefore carry tangible production risks.

The vulnerability of the Danish potato sector illustrates the structural challenge. Potatoes account for billions of kroner in annual value and are central

to regional economies, particularly in Western Denmark.

They are also among the most pesticide-dependent crops. With PFAS withdrawals and limited remaining active substances, parts of the sector face increasing production risk. In response, industry actors have established coordination initiatives to manage the regulatory transition — a

clear signal that the current trajectory creates uncertainty across the value chain.

The core challenge is therefore not simply reducing pesticide use. It is ensuring that regulatory withdrawal of synthetic products is matched by the timely development, approval, and deployment of viable alternatives. Without such alignment, Denmark risks entering a reactive cycle in which product withdrawals outpace innovation, leaving farmers with fewer

tools while environmental pressures persist.

This situation calls for a strategic

approach that simultaneously safeguards agricultural productivity and accelerates the development of environmentally sustainable plant protection solutions.

*“ Globally, plant pests and diseases reduce crop yields by an estimated 20–40% annually. Reductions in pesticide availability without effective alternatives therefore carry tangible production risks.*

# Why biocontrol is not scaling in Denmark

Biocontrol solutions are frequently presented as a natural alternative to conventional chemical pesticides. Yet despite growing political interest and farmer awareness, their availability and uptake in Denmark remain limited.

The constraint is not technological potential alone. Rather, limited scaling results from interacting structural barriers across regulation, market dynamics, knowledge systems, and innovation incentives.

## Regulatory design does not fully reflect the nature of biocontrol

The current EU regulatory framework does not contain a clearly defined and operational category for biocontrol agents. While distinctions are made between chemical substances and micro-organisms, and provisions exist for “low-risk” substances, the framework was historically designed around synthetic active substances.

As a result, developers of biocontrol agents often face approval procedures, data requirements, and timelines that do not fully reflect the biological characteristics of these products. Field trials and risk assessments are frequently structured according to standards developed for conventional pesticides. This can lead to requirements that are not proportionate to biological risk profiles, while important ecological interactions may still be insufficiently addressed.

Stakeholders consistently describe lengthy and costly approval processes — often spanning

7–10 years — as a major barrier, particularly for small and medium-sized enterprises. For a relatively small market such as Denmark, this significantly reduces commercial incentives to introduce new products.

The December 2025 proposals by the European Commission to amend the current Plant Protection Product regulation<sup>5</sup> acknowledge that the absence of a dedicated biocontrol category has been a limitation of the current regulatory framework, but in their current wording they risk perpetuating existing misalignments by introducing a definition of a biocontrol agent that lacks clarity. Moreover, the proposals suggest granting unlimited approval without re-examination for specific active substances and unlimited renewal of already approved substances, which will largely benefit incumbent traditional chemical products, taking away incentives to innovate into new biological products.

## Misaligned expectations and performance uncertainty

Biocontrol agents are often evaluated against the performance expectations of conventional chemical pesticides. However, biological products operate through different mechanisms and frequently require adjusted application strategies, timing, and integration into broader crop management systems.

Interviews reveal that efficacy is highly context-dependent, influenced by environmental conditions, formulation, and application technology. Current regulatory trial designs

prioritise standardised data admissibility over practical learning about optimal field use, creating a gap between regulatory approval and advisory capacity.

As a result, advisors lack context-specific guidance, farmers perceive higher yield risk, and developers struggle to generate both admissible and practically useful field knowledge. This reinforces caution across the value chain, even where interest in biocontrol solutions is high.

## Fragmented knowledge and innovation risk

The development and deployment of a biocontrol product involves multiple actors - researchers, start-ups, agrochemical companies, regulators, advisors, and farmers - over a period that can extend beyond a decade. Knowledge requires repeated transfers and is not always retained or integrated.

Start-ups may lack regulatory expertise. Regulatory authorities may face capacity

constraints in assessing novel biological mechanisms. Practical application knowledge may be lost when products

change ownership. Advisory systems may not be sufficiently equipped to translate scientific findings into farm-level recommendations. The outcome is uncertainty rather than resistance.

At the same time, biocontrol products are often crop- and region-specific. For international developers, the Danish market alone may not justify adaptation and approval costs. Smaller companies face funding gaps between early-

stage development and regulatory approval - the so-called "valleys of death" - as private investment timelines rarely align with regulatory timelines. Without targeted incentives, promising solutions risk stalling before reaching the field.

Taken together, these factors explain why biocontrol solutions remain underrepresented in Denmark's plant protection toolbox

despite broad stakeholder interest and clear political intent. The challenge is systemic rather than behavioural:

the current system does not yet sufficiently align regulation, knowledge infrastructure, and innovation incentives to enable a coherent transition toward environmentally sustainable plant protection.

The following sections outline three strategic policy pillars that can support this alignment.

*“ The challenge is systemic rather than behavioural: the current system does not yet sufficiently align regulation, knowledge infrastructure, and innovation incentives to enable a coherent transition toward environmentally sustainable plant protection. ”*



Potato plants attacked by potato late blight. Photo: Johan Jönsson

# Recommendations

## Recommendation 1 – Regulation & incentives

### Enabling a coherent biocontrol framework

The ongoing revision of the EU Plant Protection Products framework creates a critical opportunity. While the Commission's proposal to introduce a category of "biocontrol substances" is a positive step, regulatory differentiation alone will not drive transition. Clear definitions must be combined with aligned innovation and user incentives.

#### **Establish a clear and operational definition**

A robust statutory definition of biocontrol agents is essential to provide legal certainty and investment predictability. Current proposals leave key elements open to interpretation, particularly regarding substances of biological origin and synthetic equivalents.

Denmark should support:

- A precise EU-level definition of biocontrol agents.
- Risk assessment criteria proportionate to biological characteristics and environmental impact.
- Clear differentiation from conventional chemical active substances.

Clarity at EU level will reduce ambiguity and uneven implementation across Member States.

#### **Align innovation incentives with environmental objectives**

The current framework applies largely uniform regulatory data protection periods and fee structures regardless of environmental profile. This does not sufficiently reward environmentally safer solutions.

Denmark should advocate for:

- Differentiated regulatory data protection linked to environmental risk profiles.
- Reduced approval and authorisation fees for biocontrol agents at EU and national level.
- Financial instruments lowering entry barriers for SMEs developing biological solutions.

Incentives must actively steer innovation toward environmentally preferable alternatives.

#### **Reduce adoption risk through targeted user incentives**

Product availability alone does not ensure uptake. Farmers operate under economic constraints, and perceived yield risk limits adoption.

Denmark could explore:

- Targeted tax or subsidy mechanisms linked to biocontrol use.
- Integration of biocontrol uptake into sustainability and water-quality schemes.
- Temporary risk-sharing mechanisms for early adopters.

Together, these measures would shift the regulatory framework from neutral gatekeeper to transition enabler, accelerating responsible deployment while maintaining competitiveness.

## Recommendation 2 – Knowledge, acceptance & capacity

### Building coordinated knowledge infrastructure

Regulatory reform and financial incentives are insufficient without coordinated knowledge systems. BioPlantPro demonstrates that fragmented expertise and misaligned expectations across the value chain constrain uptake more than lack of interest.

#### **Establish a national biocontrol coordination function**

Biocontrol innovation spans discovery, regulatory approval, advisory translation, and farm application. Knowledge is generated at each stage but not consistently integrated.

Denmark should establish a coordination function that:

- Identifies critical knowledge gaps.
- Integrates scientific, regulatory, and experiential expertise.
- Facilitates structured dialogue across the value chain.
- Provides authoritative, Denmark-specific guidance.

This can build on existing advisory and innovation platforms rather than creating parallel structures.

#### **Strengthen advisory capacity and field-based learning**

Biocontrol efficacy is context-dependent, yet regulatory trials prioritise admissible data over practical learning. Advisory services often lack validated, region-specific guidance.

Denmark should support:

- Demonstration projects and field trials designed for both regulatory compliance and practical optimisation.
- Targeted advisory training in biological mechanisms and application strategies.
- Coordinated dissemination of validated best practices.

Stronger advisory capacity reduces perceived yield risk and builds confidence.

#### **Align regulatory practice with field realities**

Current regulatory frameworks are rooted in conventional pesticide models. Greater dialogue and flexibility are needed to assess biologically distinct mechanisms without compromising safety standards.

Denmark should promote:

- Structured exchange between regulators and practitioners.
- Capacity building within authorities for biological risk assessment.
- Adaptive approaches allowing appropriate validation under Danish conditions.

Successful adoption depends on institutional alignment rather than behavioural change.

## Recommendation 3 – Research & innovation system

### From Discovery to Deployment

Biocontrol transition requires research systems designed for implementation. Promising solutions often stall because innovation pipelines do not bridge early-stage discovery with field validation and regulatory readiness.

#### **Establish long-term, mission-oriented funding**

Short-term and discipline-specific programmes fragment innovation pathways.

Denmark should implement funding instruments that:

- Support sustained, mission-oriented programmes on sustainable plant protection.
- Ensure continuity from discovery to deployment.
- Integrate scientific, regulatory, and societal dimensions from project inception.

#### **Bridge development and approval gaps**

Private investment timelines rarely align with regulatory timelines, creating “valleys of death” during validation and documentation phases.

Denmark should consider:

- Public co-investment or risk-sharing mechanisms for SMEs.
- Dedicated support for semi-field and field trial capacity.
- Funding schemes supporting both regulatory-ready data and practical optimisation.

#### **Incentivise integrated transition partnerships**

Sustainable plant protection is inherently cross-sectoral. Funding and governance structures must reflect this.

Denmark should strengthen partnerships connecting:

- Universities and research institutions
- Regulatory expertise
- Advisory services and farmer organisations
- Developers and value-chain actors

Such partnerships should be incentivised to deliver validated solutions and implementation-ready knowledge.

A research system designed for transition will complement regulatory reform and knowledge infrastructure, ensuring that environmentally sound solutions reach practical use within realistic timeframes.

# Conclusion: A Direction for Sustainable Plant Protection in Denmark

Denmark's plant protection system is evolving under regulatory and environmental pressure. The question is not whether change will occur, but how it will be managed.

Biocontrol solutions offer a pathway to gradually reduce reliance on high-risk synthetic pesticides while safeguarding productivity. Achieving this requires coordinated action across regulation, knowledge infrastructure, and innovation systems.

By aligning EU engagement with national instruments and strengthening interdisciplinary capacity, Denmark can secure a resilient, environmentally responsible, and economically viable plant protection strategy.

The transition is not abrupt replacement, but deliberate diversification. With clear direction and coordinated policy, Denmark can move confidently toward a more sustainable plant protection toolbox.

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