The University Of Sheffield. Institute for Sustainable Food.

European Research Council
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# ChemPrime: Durable crop protection against pests and diseases through priming of plant immunity.

**SUMMARY:** Treatment of plants with chemical priming agents increases their resistance against plant pests and diseases. This long-lasting protection is based on a form o f immunological memory, which enables plants to mount a faster and stronger immune response against future attack by pests and diseases. Researchers at the University of Sheffield have optimised this technology to minimise effects on crop yield and have devised ways of implementing it for integrated crop protection strategies.

## OBJECTIVE.

ChemPrime was funded by a proof-of-concept grant from the European Research Council (ERC). Its main objective was to identify pathways for commercialisation of priming chemicals as a viable crop protection technology.

## BACKGROUND.

A large proportion of global crop yield is lost to plant diseases every year. While pesticides help to reduce these losses, there are growing environmental concerns about their use as well as plants developing resistance lowering efficacy.

It is possible to increase disease resistance in plants by priming the plant immune system to enable them to display a faster and stronger defence reaction to pests and diseases. Thus far, chemical priming agents have not reached their full economic potential due to undesirable effects on plant growth and yield. We have shown through previous ERC-funded research (at the University of Sheffield) mechanisms by which selected β-amino acid chemicals can induce broad-spectrum resistance with minimal side-effects on plant growth [1],[2],[3],[4].

**Figure 1.**
Defence intensity of primed and unprimed plants

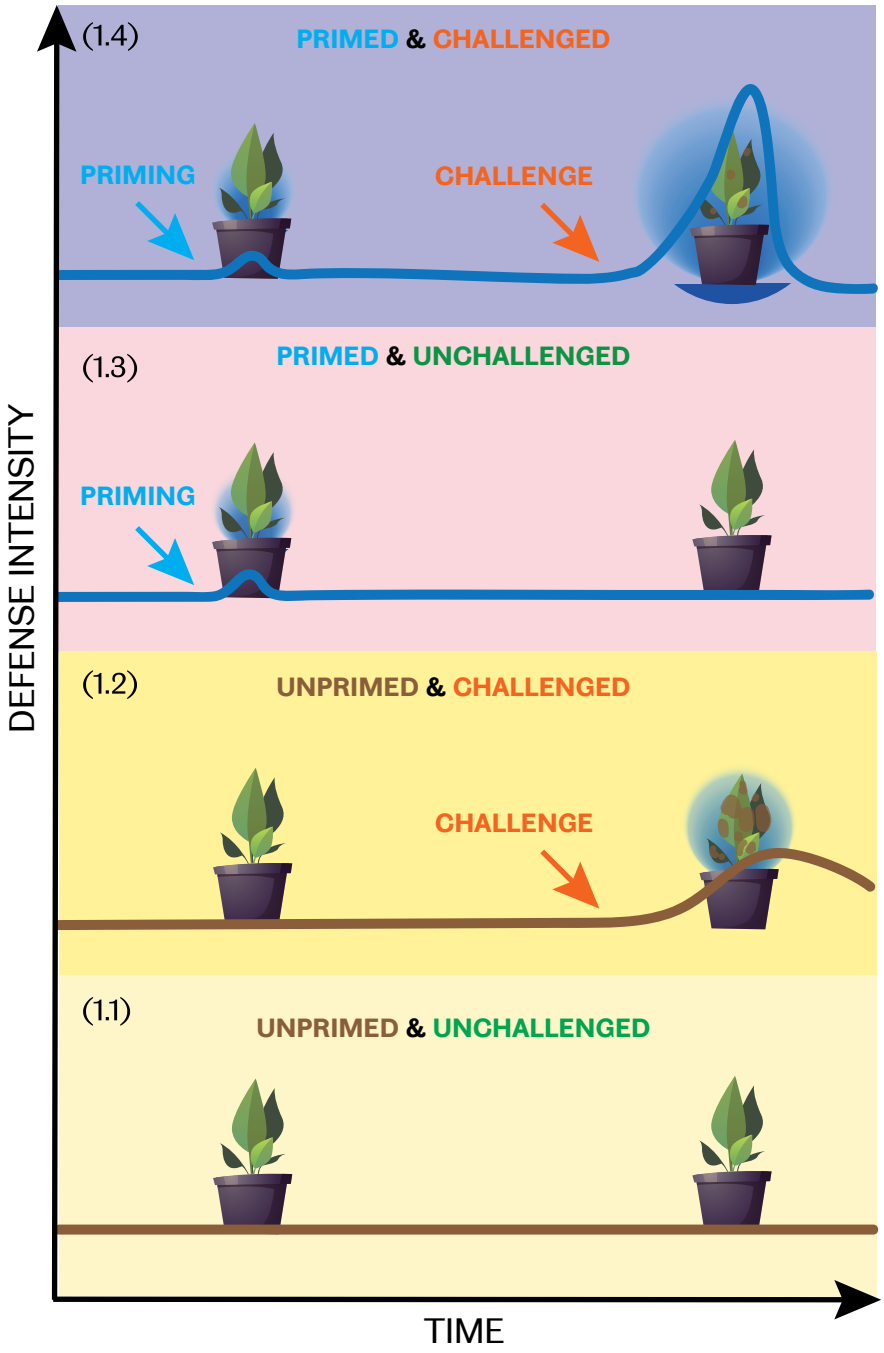


Figure 1. Plants treated with priming agents show a faster and/or stronger immune response upon future attacks by pests or diseases in comparison to unprimed plants.

# Results.

The first part of ChemPrime (indicated in green) involved a combination of basic and translational research to fill the knowledge gap necessary for adoption of priming agents by commercial stakeholders. This research operated across technology readiness levels (TRLs) 2-4 and has led to the discovery of new plant regulatory genes of chemical immune priming and related trade-offs to plant growth, which can be exploited as breeding targets. This WP also delivered translational knowledge about the dose-dependent effectiveness and duration of (combinations of) priming chemicals in crops and further optimised methods of delivery of the chemicals to minimise formation of chemical residues in food products.

The second part of ChemPrime (indicated in red) focused on exploring market opportunities, involving various engagement activities with stakeholders to facilitate development of the technology across TRLs 5-9. This resulted in a map of different application pathways and corresponding adoption barriers. In addition, we have generated contacts with industry stakeholders and established a new partnership with chemists to develop a cost efficient bulk synthesis of priming-inducing β-amino acids.

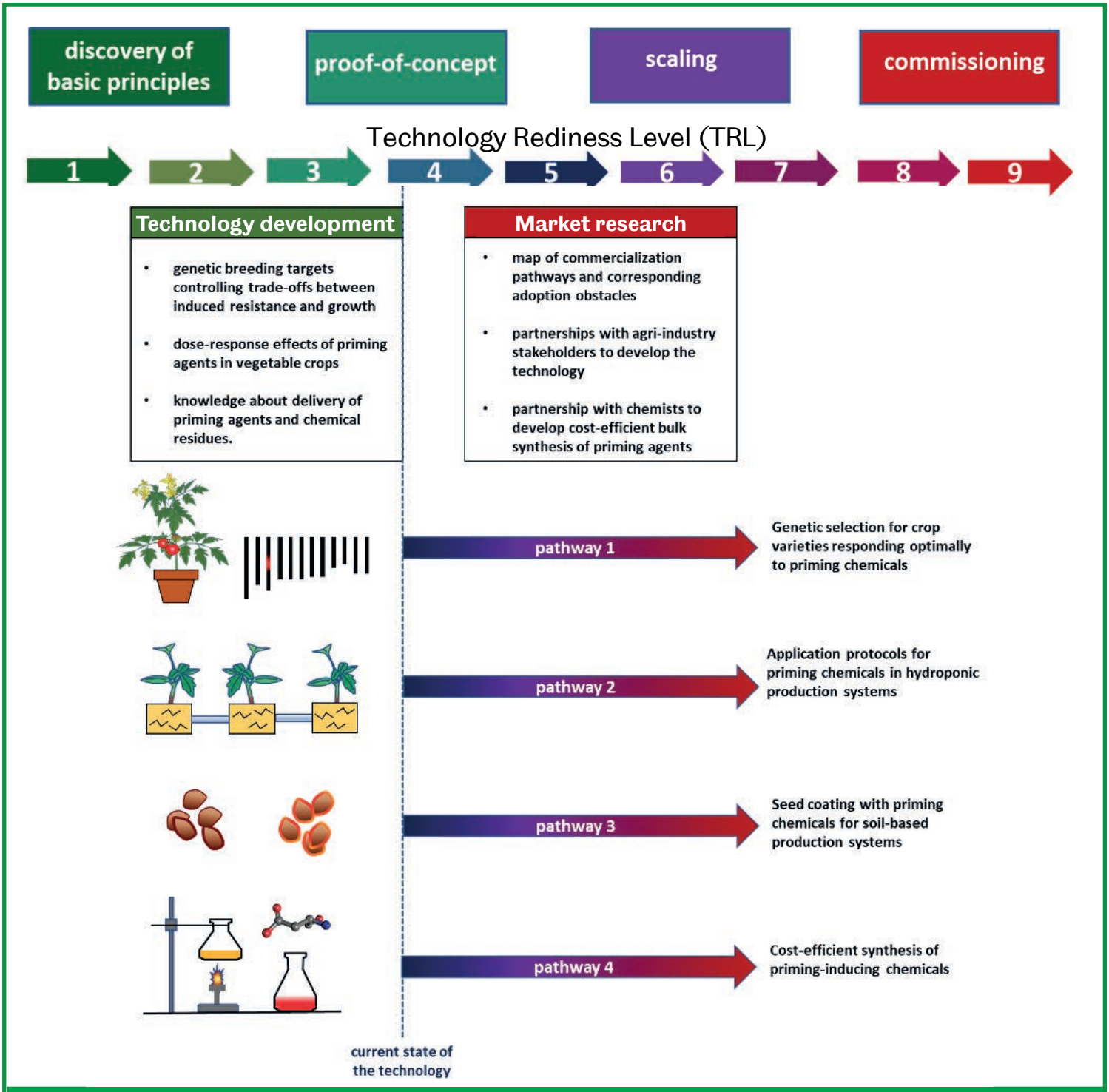


Figure 2: Main deliverables of the ChemPrime project have accelerated the technology readiness levels (TRLs). Shown are the four commercialisation pathways to facilitate adoption of priming chemicals in crop protection strategies.

# What's next?

The ChemPrime project was completed on 31st October 2020. We have identified the need for practical and integrable methods, as well as the importance of thorough cost and benefits analyses across production systems.

We continue to co-design our next steps with our research colleagues, industry partners and end-users, towards the development of a viable product for integration in sustainable crop protection.

If you would like to know more about the results, or you are interested in further development of plant priming in your crop protection strategy, please contact us.

## CONTACTS.


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## REFERENCES.


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[2] Luna E, G. BE, J. S, Ton J. 2016. Optimizing chemically induced resistance in tomato against Botrytis cinerea. Plant Disease 100: 704-710.

[3] Buswell W, Schwarzenbacher RE, Luna E, Sellwood M, Chen B, Flors V, Pétriacq P, Ton J. 2018. Chemical priming of immunity without costs to plant growth. New Phytologist 218: 1205-1216.

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