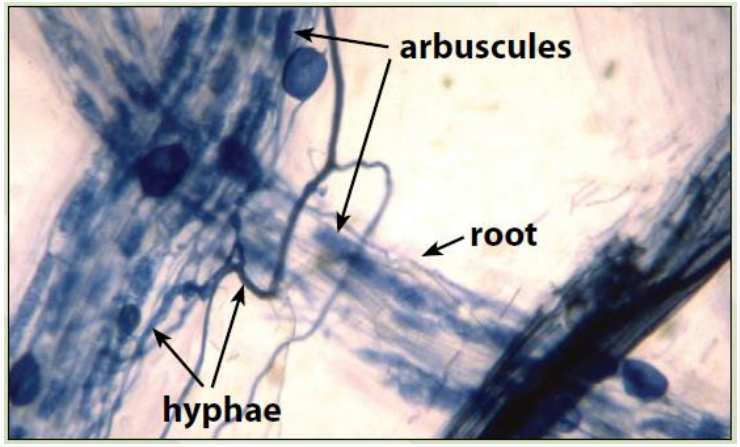
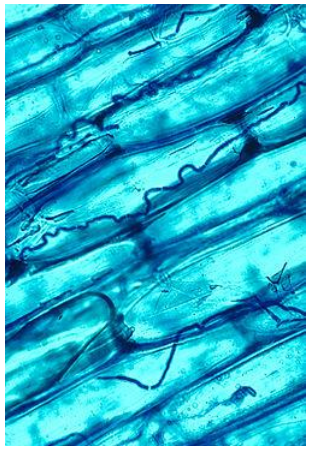
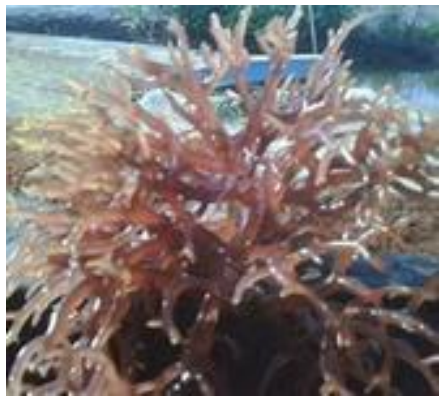


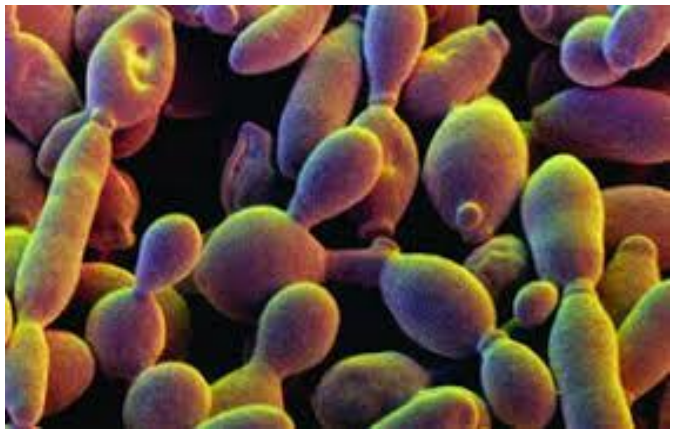


FULVIC ACID

HUMIC ACID

Biostimulants, biofertilsers & biopesticides





2030 Targets for sustainable food production

PESTICIDES

Reduce the overall use and risk of chemical and hazardous pesticides

NUTRIENT LOSSES

Reduce nutrient losses by 50% whilst retaining soil fertility, resulting in 20% less fertilisers

ANTIMICROBIALS

Reduce sales of antimicrobials for farmed animals and aquaculture

ORGANIC FARMING

Increase the percentage of organically farmed land in the EU

Promote use of biological plant protection products

#EUFarm2Fork #EUGreenDeal

#EU BiodiversityStratgey2030

European Commission

There are many different biostimulant/ biofertilser products

Kappaphycus alvarezii,

Ascophyllum nodosum

.

FULVIC ACID HUMIC ACID

Biostimulant global market $5.7 billion by 2026.
Biopesticides Market Worth $10.24 Billion by 2025

There are many different biostimulant/ biofertilser products

Kappaphycus alvarezii,

Ascophyllum nodosum

.

FULVIC ACID HUMIC ACID

Plant Biostimulants are defined by the new EU fertilising products regulation.

A plant biostimulant shall be an EU fertilising a product the function of which is to stimulate plant nutrition processes independently of the product's nutrient content with the sole aim of improving one or more of the following characteristics of the plant or the plant rhizosphere:

(a) nutrient use efficiency;

(b) tolerance to abiotic stress;

(c) quality traits; or

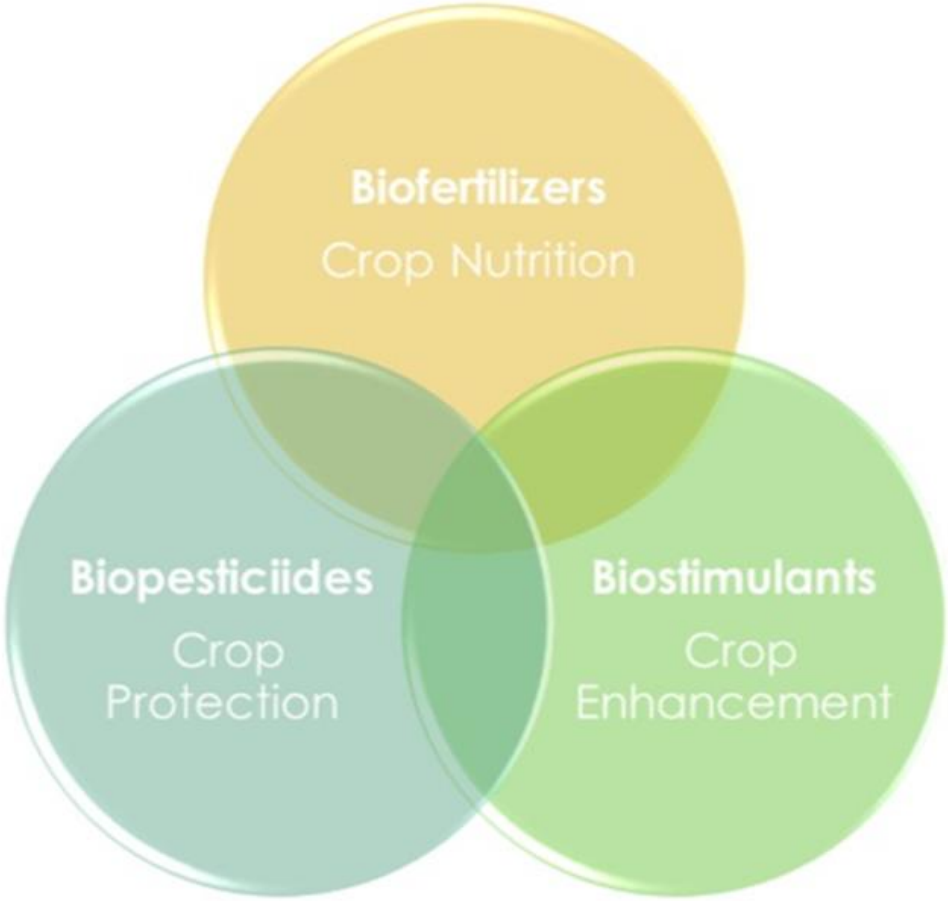
(d) availability of confined nutrients in the soil or rhizosphere

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003

BUT many extracts, proteins and microorganisms are known to have **BOTH biostimulant and plant protection effects!**

For example **chitosan and plant growth promoting bacteria .**

.



From a EU regulation point of view….**Regulation (EC) No 1107/2009, fall under plant protection products.**

A revision of the PPP framework is due at the end of 2021 to enable PPPs containing biological active substances to be marketed

Table 2. A summary of the evidence for positive biostimulant effects on plant nutrition, growth and stress tolerance for any plant species, based on information summarised in AHDB Review No. RR89

		Promote plant nutrition?			Improve plant growth and yield?			Promote biotic stress tolerance?	
Group	**Product type**	**Nitrogen**	**Phosphorus**	**Other nutrients**	**Hormonal**	**Growth**	**Yield**	**Pathogen**	**Pest**
Non-microbial	Seaweed extracts	Low	Low	Low	Moderate	Moderate	Moderate	Low	Low
	Humic substances	Moderate	Low	Low	Low	Moderate	Moderate	No	No
	Phosphite and other inorganic salts	No	No	No	Low	Moderate	Moderate	Moderate	No
	Chitin and chitosan derivatives	No	No	No	Low	Moderate	Moderate	Good	Low
	Anti-transpirants	No	No	No	Good	No	Moderate	No	No
	Protein hydrolysates and free amino acids	Low	No	Low	No	Low	Low	No	No
Microbial	Plant growth promoting bacteria	Moderate	Moderate	Low	Low	Good	Good	Moderate	Low
	Non-pathogenic fungi	Low	Low	Low	Low	Moderate	Moderate	Moderate	No
	Arbuscular mycorrhizal fungi	Low	Moderate	Low	No	Moderate	Moderate	Low	Low

Good evidence base (including multiple field-based experiments on cereals or oilseed rape)

Moderate evidence base (good number of experiments, including some field-based experiments on cereals or oilseed rape)

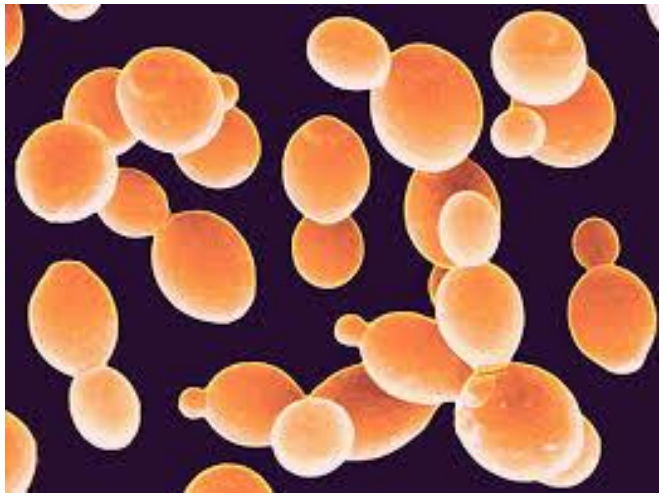
Low evidence base (principally laboratory-based experiments with little or no data on cereals or oilseed rape)

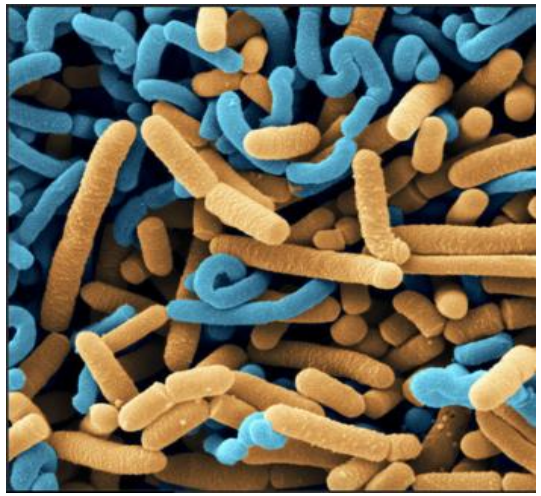
No evidence base (not enough evidence available)

How does it work – what is the mode of action ?

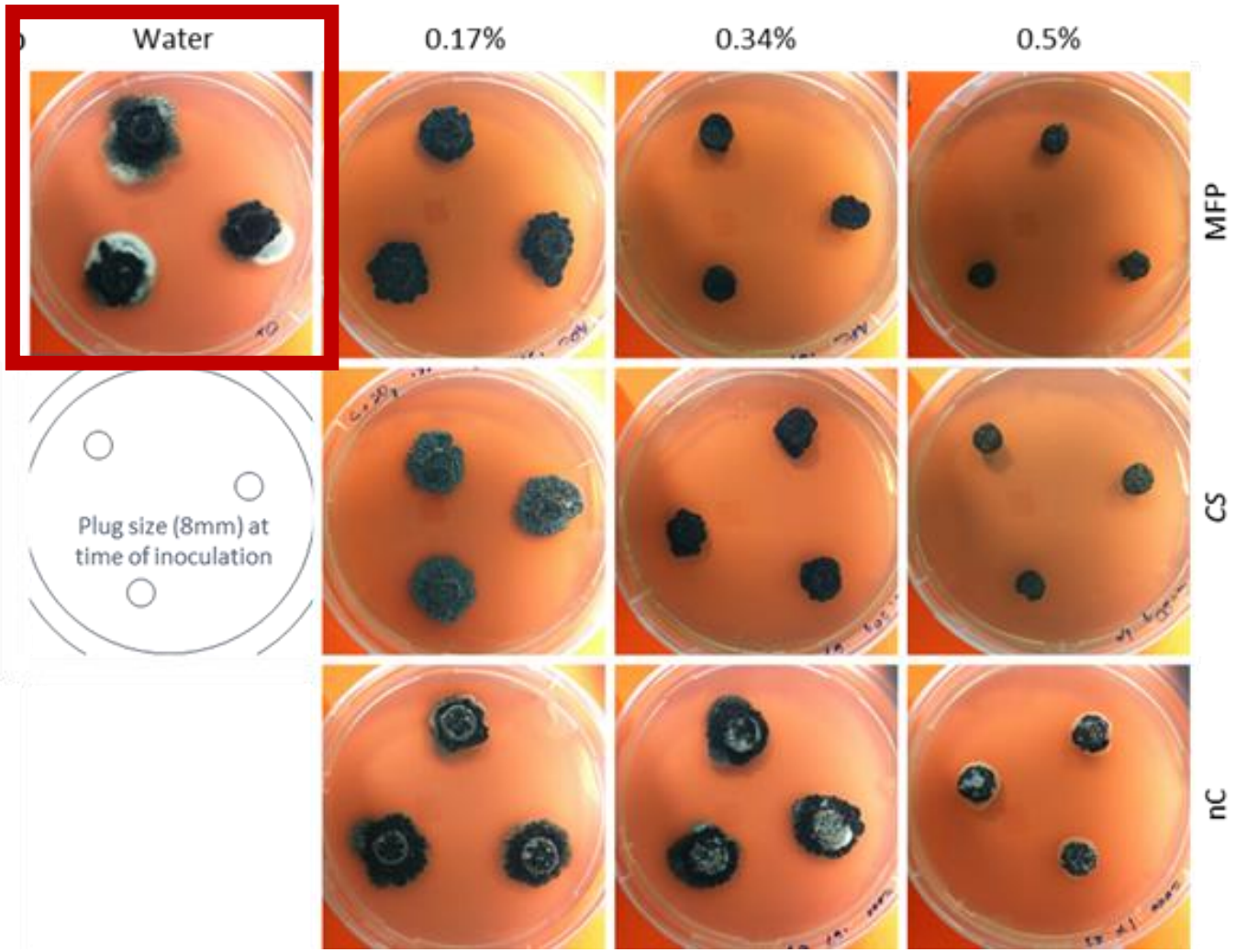
Microbial Fermentation Product

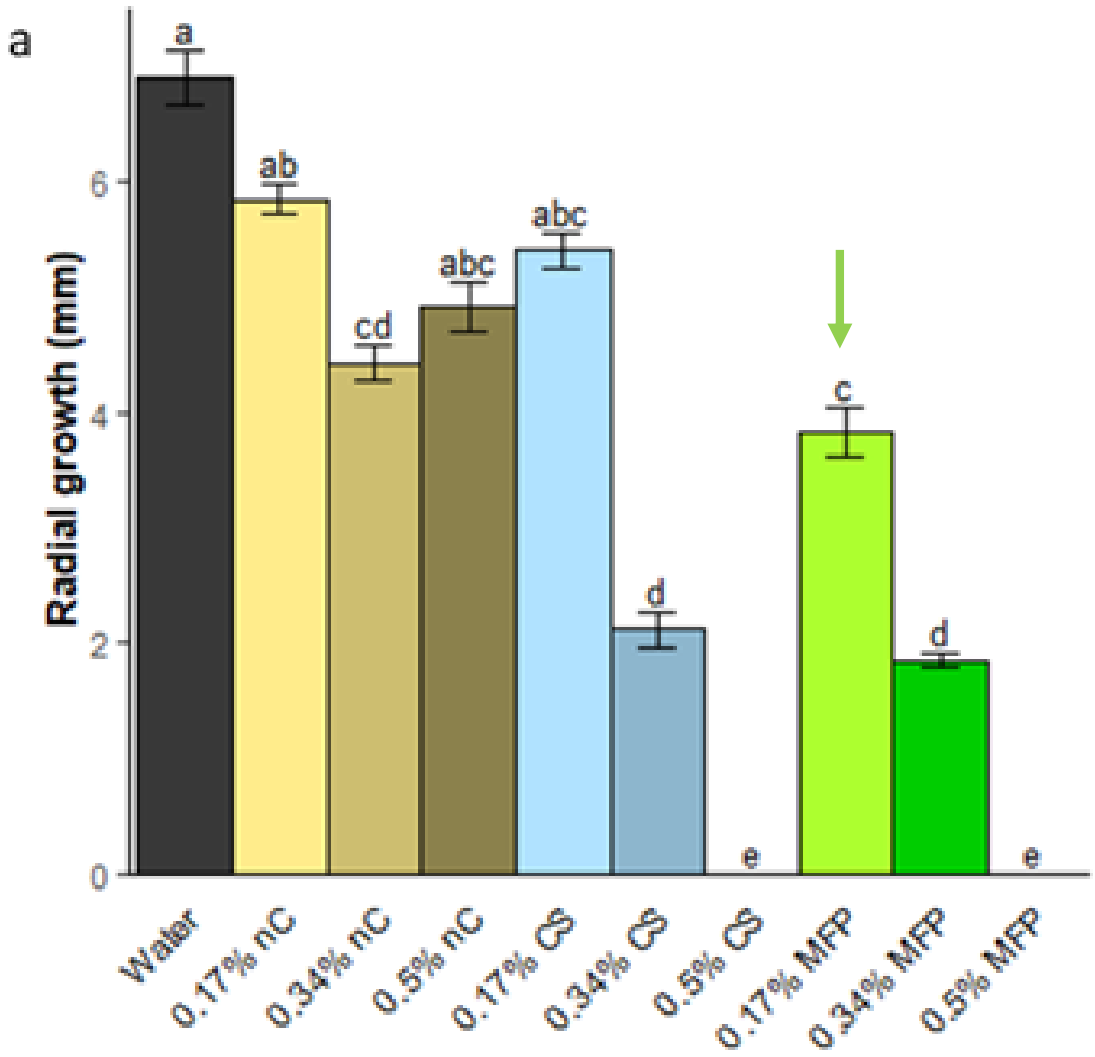
MFP consists of a proprietary blend of novel bacterial fermentation media, yeast cell wall and copper (Alltech Crop Science, KY, USA)





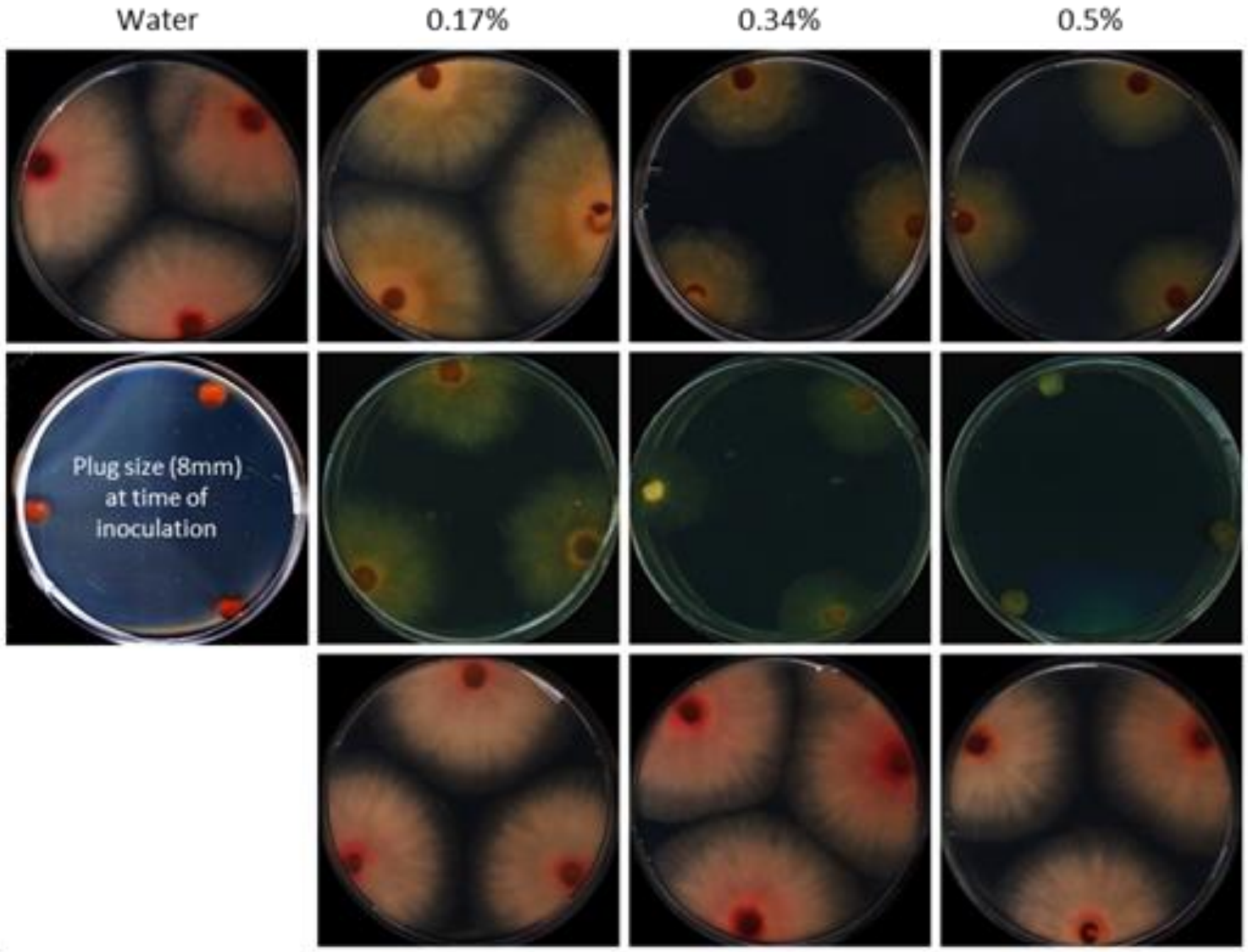
Fungal (Septoria) growth is inhibited by Microbial Fermentation Mix

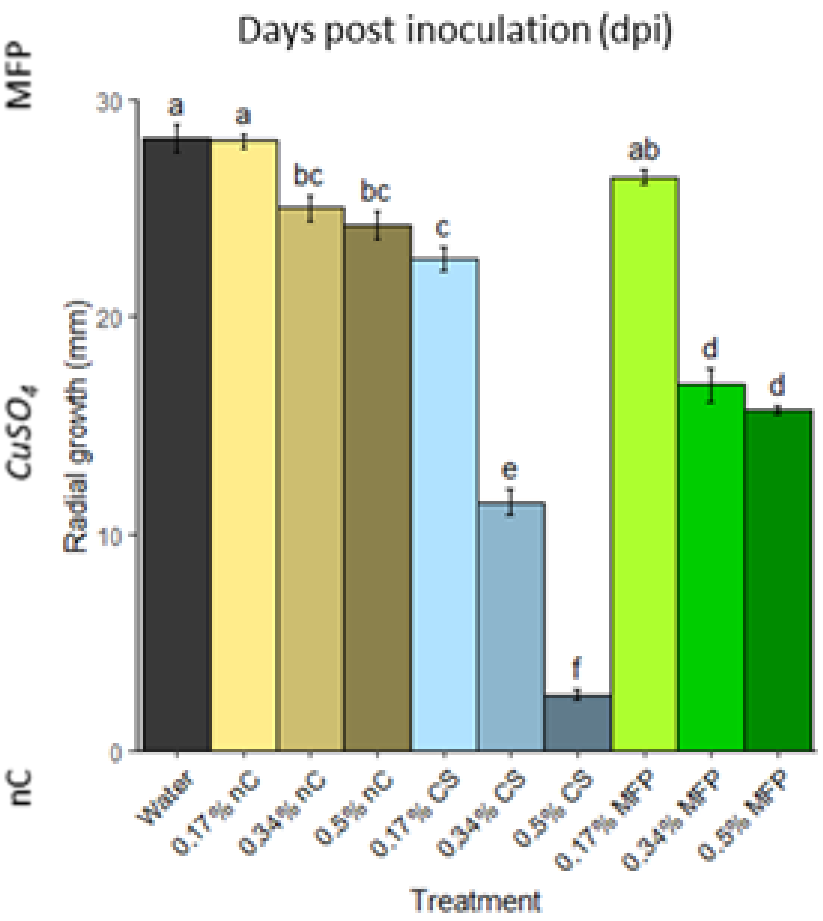




Twamley, T., Gaffney M. & Feechan A. Unpublished.

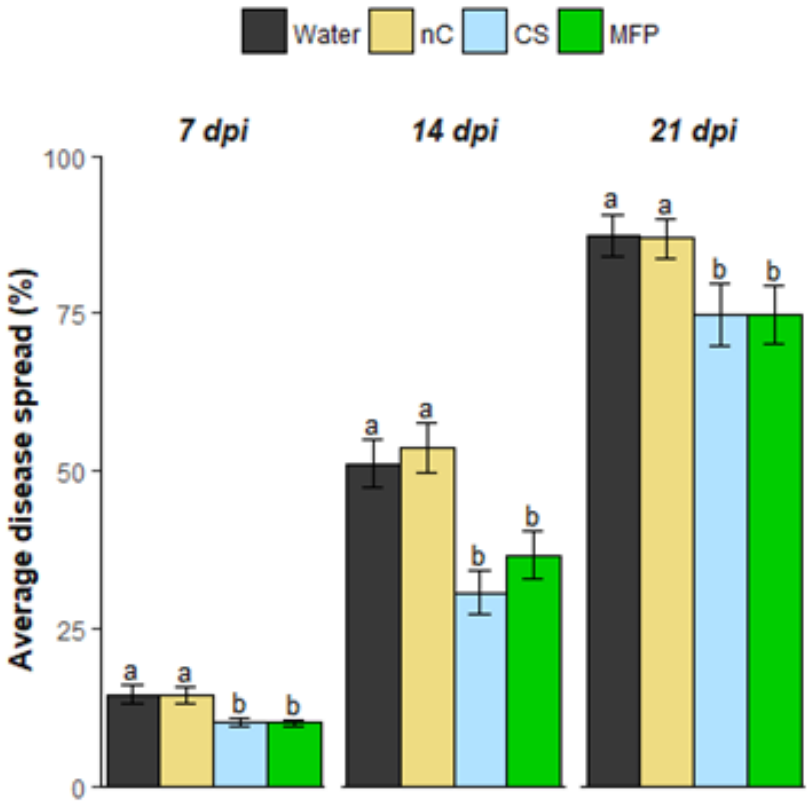
Fungal (Fusarium) growth is inhibited by Microbial Fermentation Mix

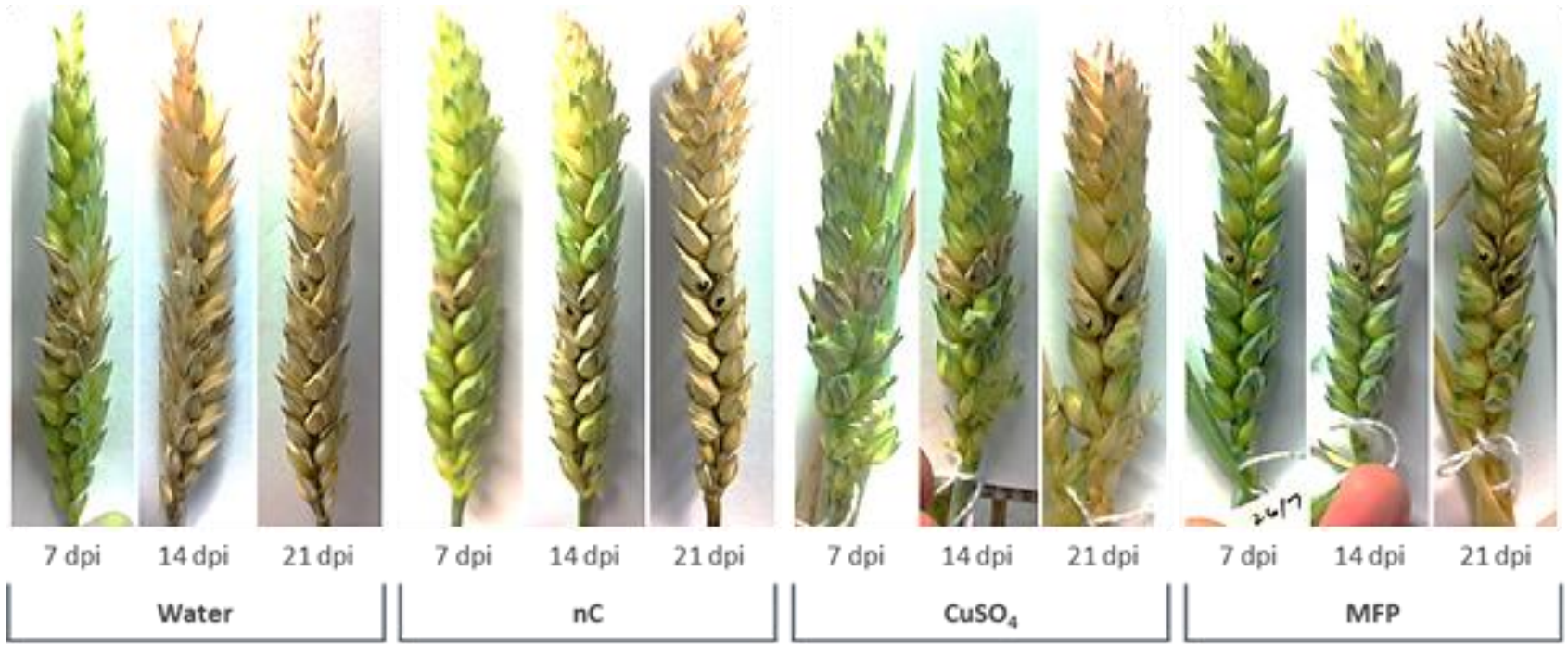




Twamley, T., Gaffney M. & Feechan A. Unpublished.

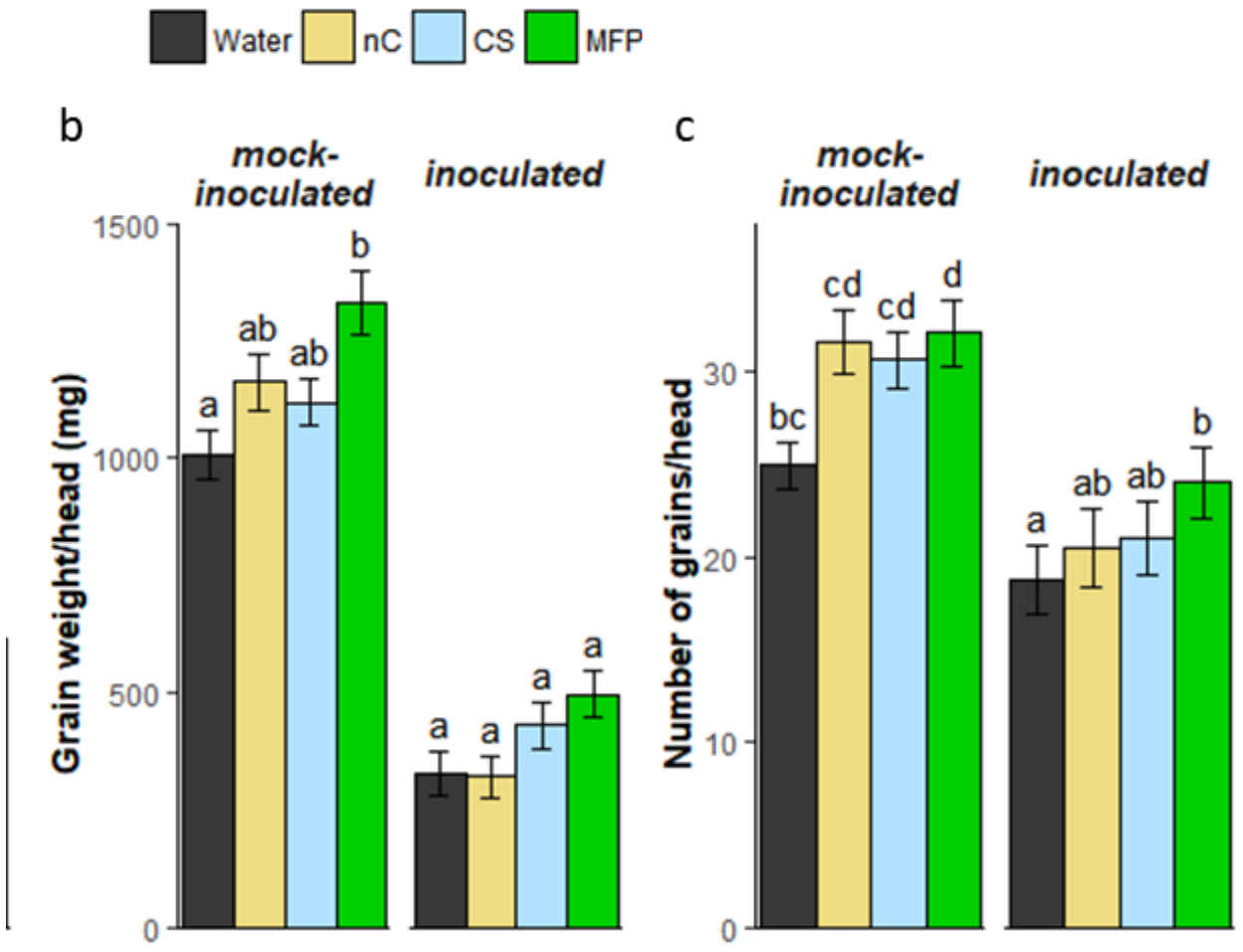
Disease (Fusarium) is inhibited by Microbial Fermentation Mix





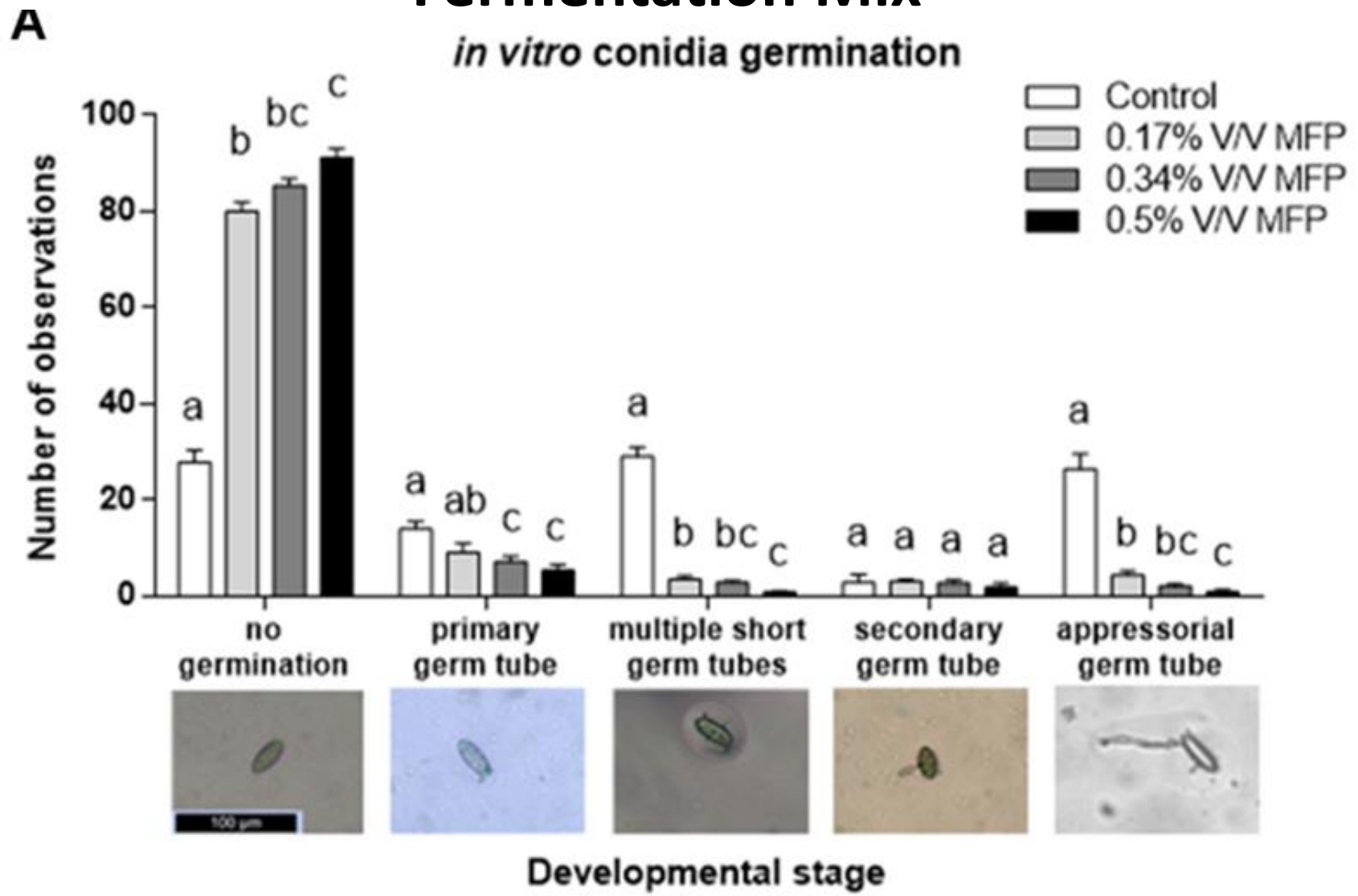
Twamley, T., Gaffney M. & Feechan A. Unpublished.

Yield is improved by Microbial Fermentation Mix



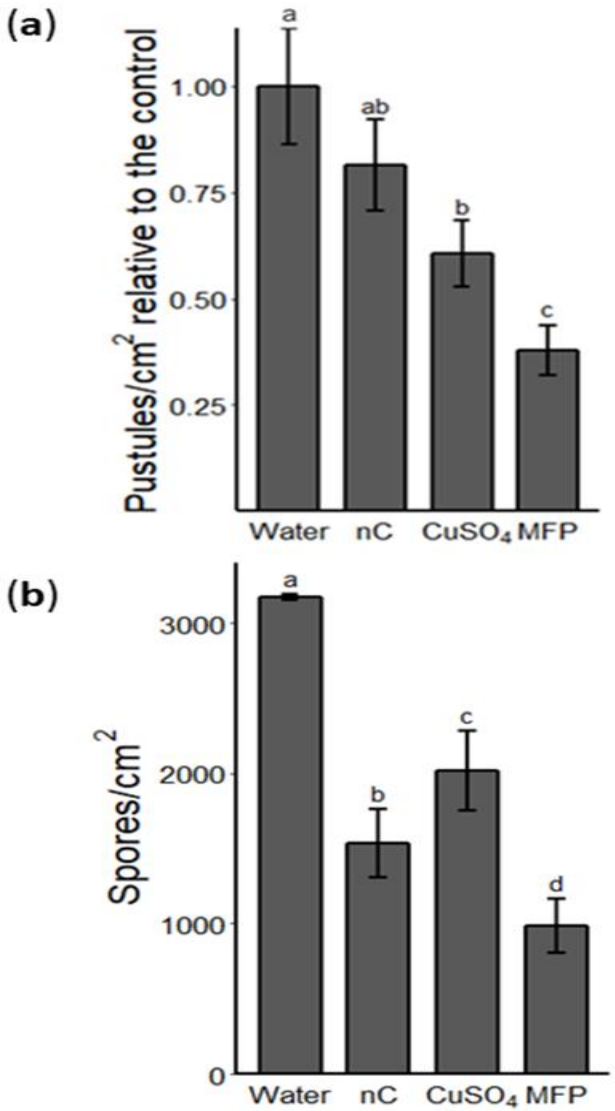
Twamley, T., Gaffney M. & Feechan A. Unpublished.

Powdery mildew germination is inhibited by Microbial Fermentation Mix



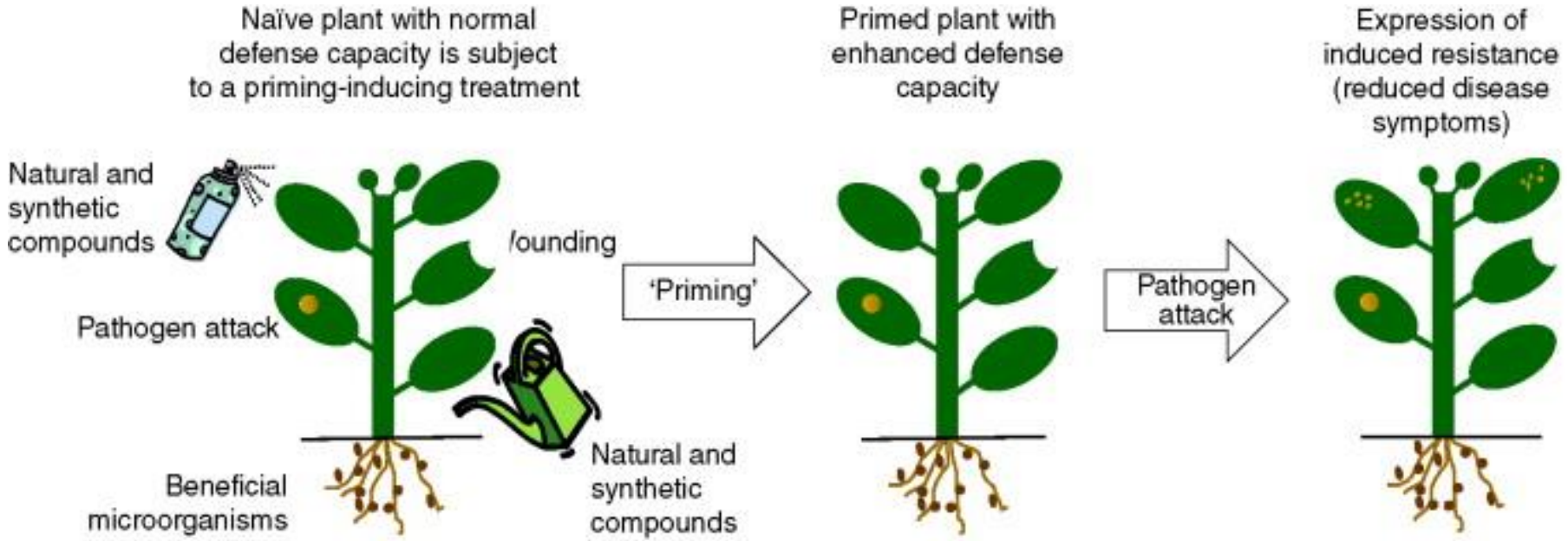
Twamley, T., Gaffney, M. and Feechan, A., 2019. A microbial fermentation mixture primes for resistance against powdery mildew in wheat. *Frontiers in plant science*, *10*, p.1241.

Powdery Mildew is reduced by Microbial Fermentation Mix



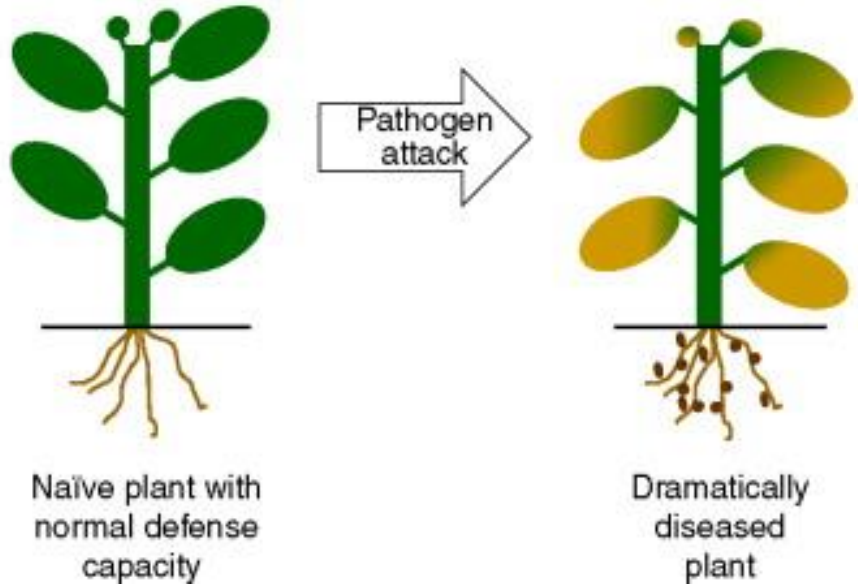
Twamley, T., Gaffney, M. and Feechan, A., 2019. A microbial fermentation mixture primes for resistance against powdery mildew in wheat. *Frontiers in plant science*, *10*, p.1241.

Priming stimulates the plant's own defence mechanisms



- **Induced by biobased elicitors e.g. chitin.**

- **In a primed state, plants respond faster to biotic and abiotic stresses.**



Priming stimulates the plant's own defence mechanisms

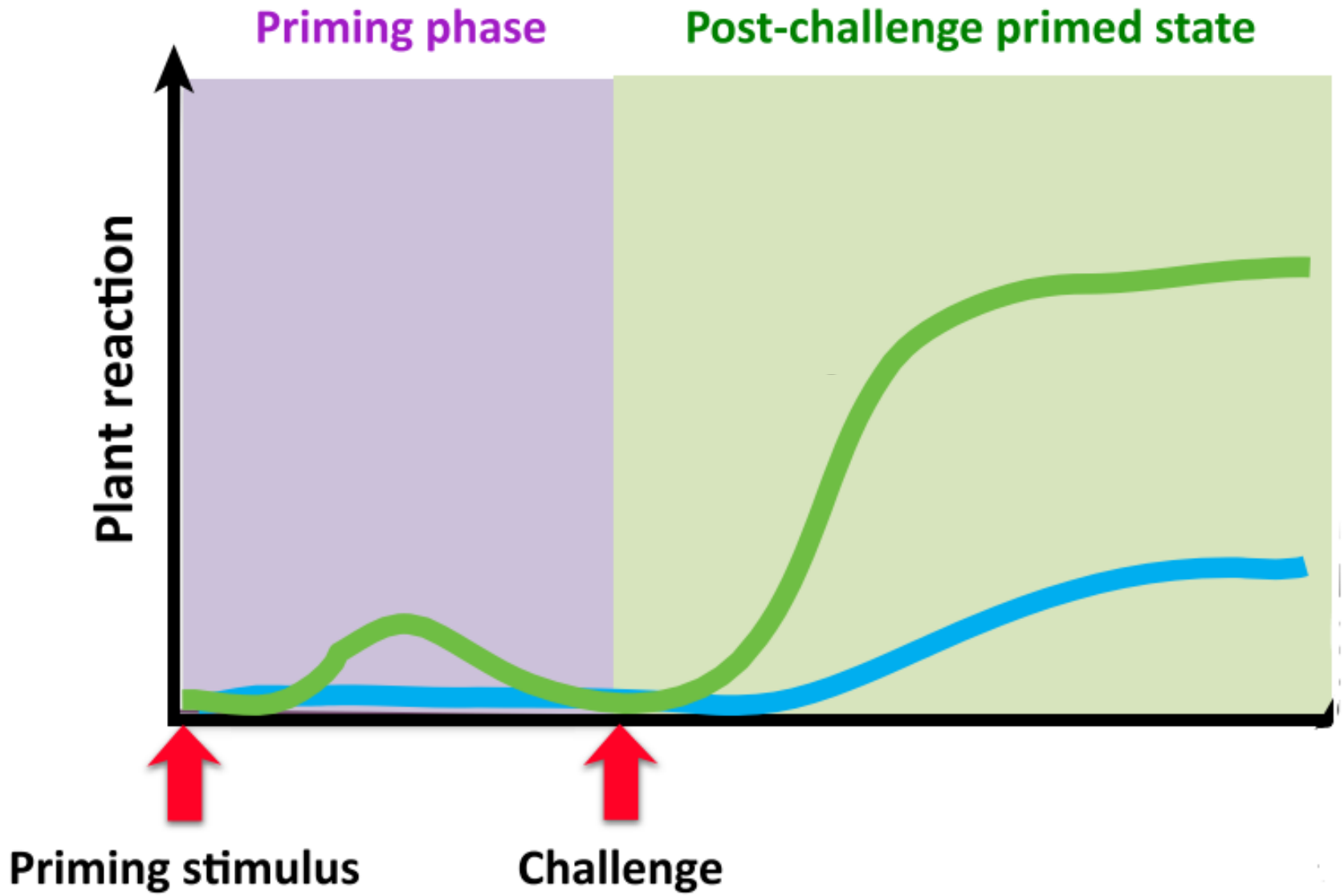
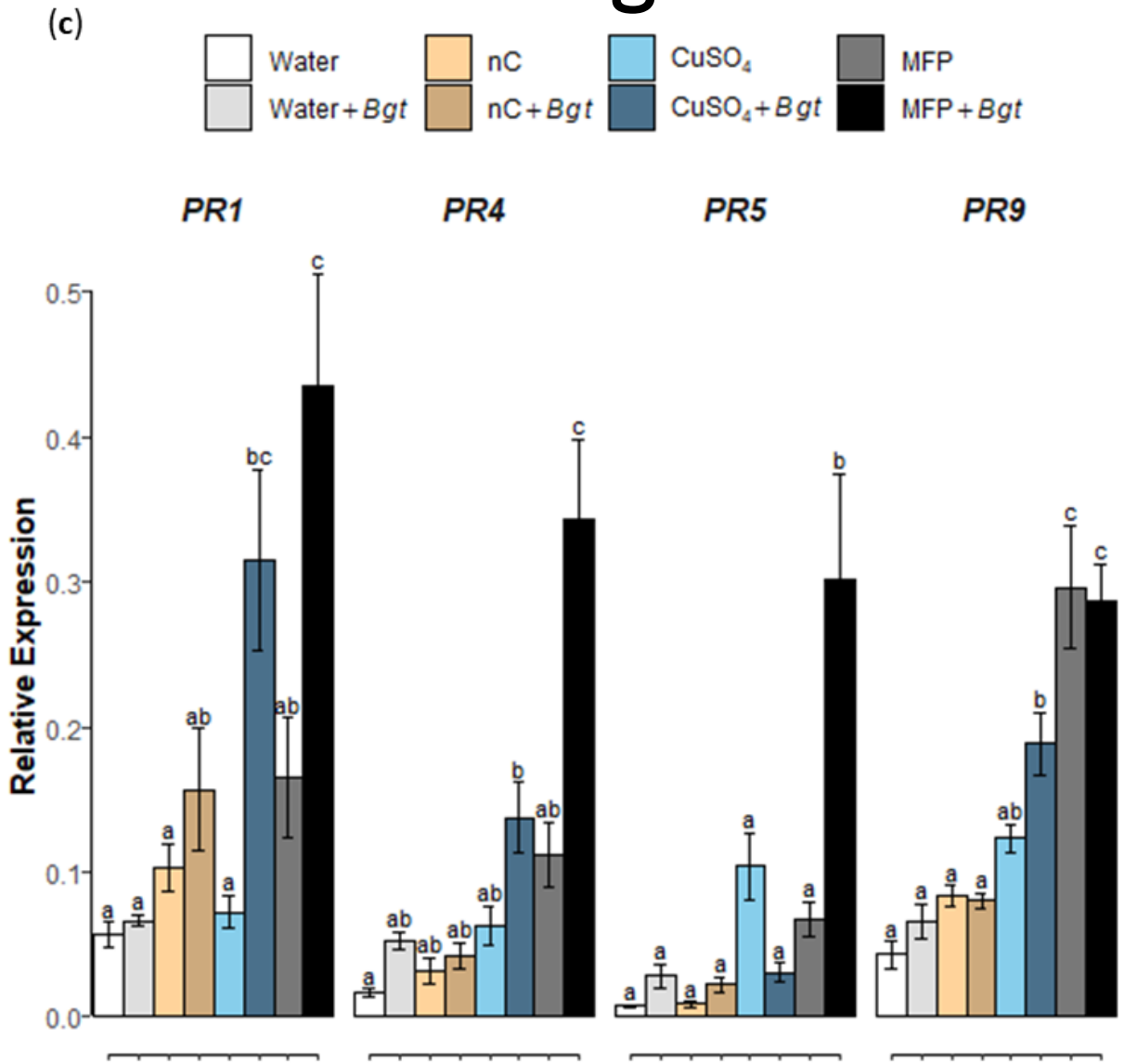


Image adapted from: Balmer, A., Pastor, V., Gamir, J., Flors, V. and Mauch-Mani, B. (2015). *Trends in Plant Science*, 20(7), pp.443-452.

Microbial Fermentation Mix induces Primes Plant Defence genes



Twamley, T., Gaffney, M. and Feechan, A., 2019. A microbial fermentation mixture primes for resistance against powdery mildew in wheat. *Frontiers in plant science*, *10*, p.1241.

Biostimulants, biofertilsers & biopesticides

There are many different “biological” products

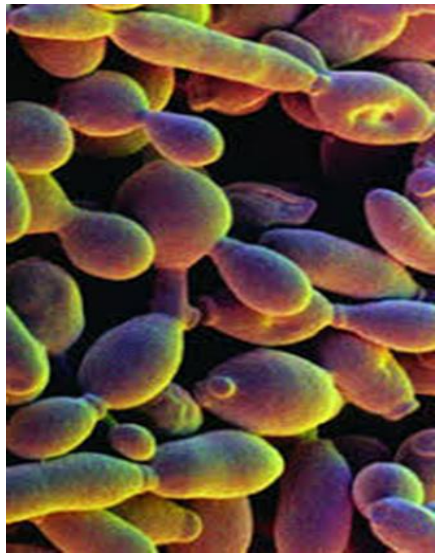
Many bioproducts are likely to have overlapping functions

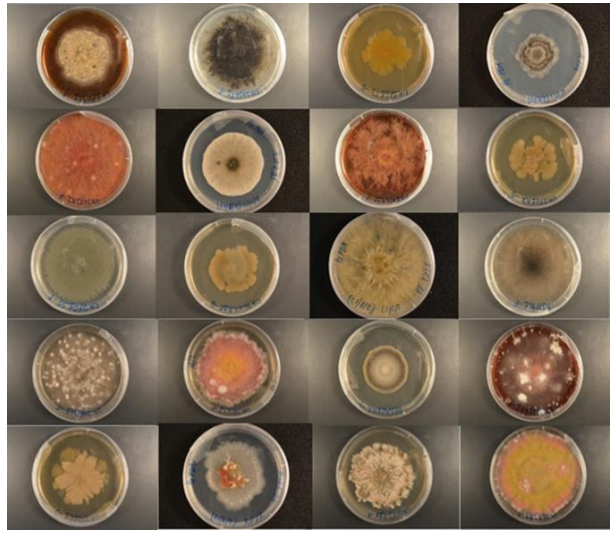
Mixed products may work together

Mixed Microbial Fermentation Product tested here has a directly antifungal /curative action and primes plant defence.

There is a lot of work to do !

Biostimulants and Biopesticides for Crop Production BioCrop





NUI Galway
OÉ Gaillimh

eagasc
Agriculture and Food Development Authority

UCD DUBLIN
University College Dublin
Ireland's Global University

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Universidad de Sevilla

NIAB

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

Brandon Bioscience

eseed™

Shot hole disease of cherry laurel

Teagasc
Agriculture and Food Development Authority

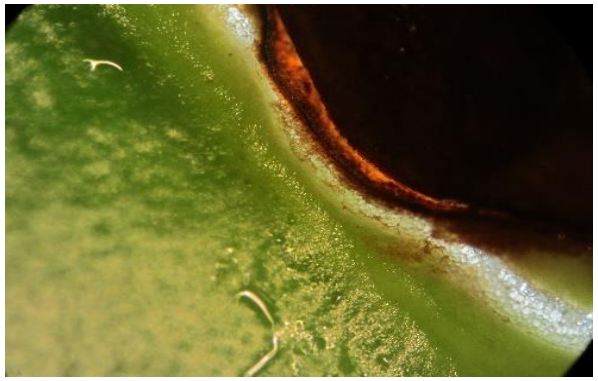
New Leaves

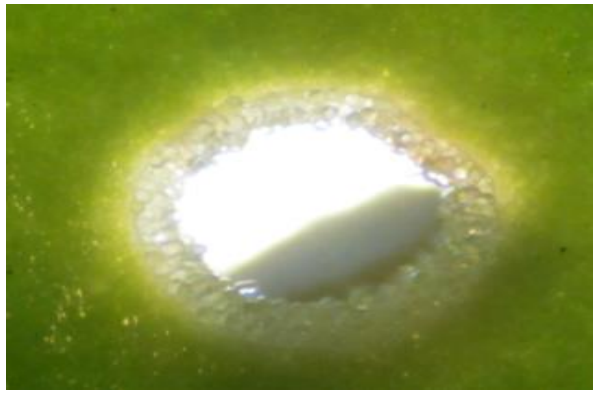
Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

UCD DUBLIN

Leighton Smith

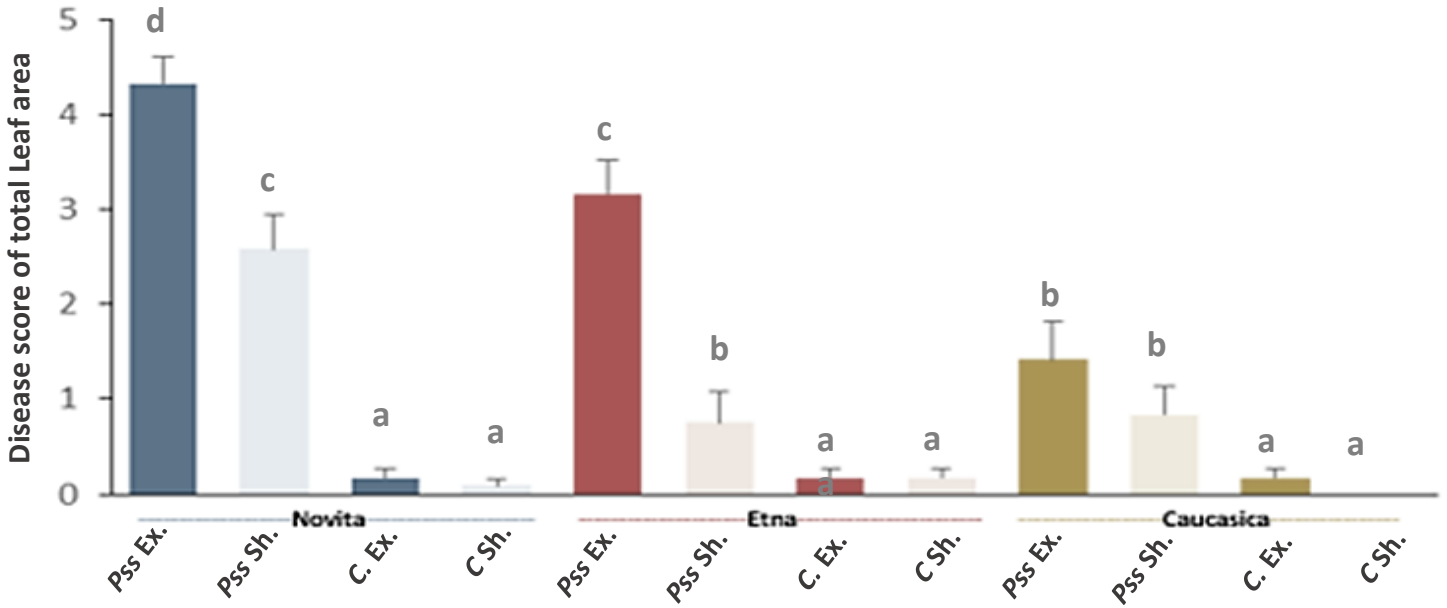
Leaves displaying Shot hole Symptoms





Exposed vs shaded

Exposed sites promote shot hole symptoms in cv. Novita and Etna



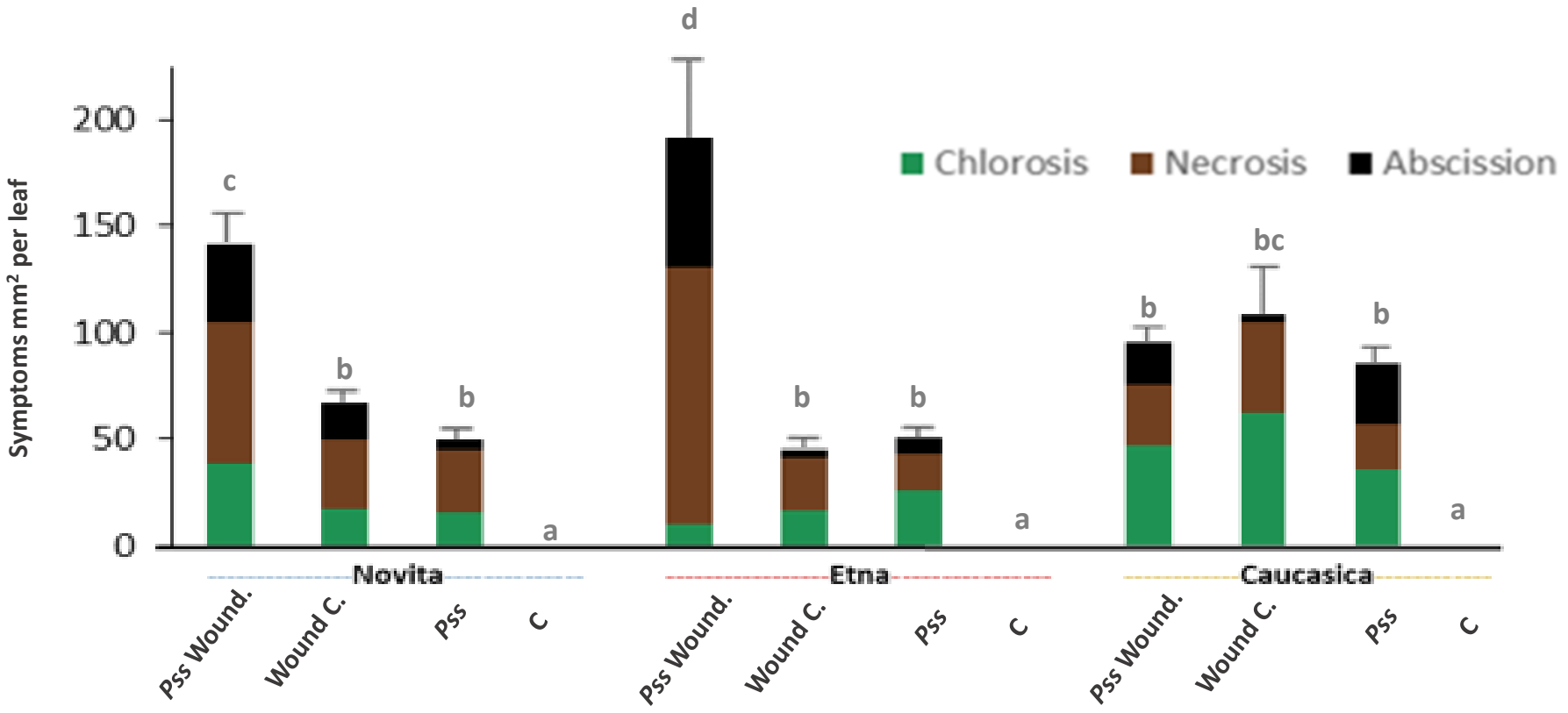
Exposed

Shaded

Different cultivars of Cherry Laurel, *P. laurocerasus* at 14 dpi when inoculated with *Pss*. Mean leaf score. Three cultivars 'Caucasica', 'Novita' & 'Etna'. 24 plants (per rep). Exposed (n=12) or shaded (n=12). Two leaves per plant inoculated with Pss 7562 (n=2) or sterile H_2O (n=2) Tukey HSD P≤0.05. Three independent repetitions completed. Inoculation 5 X 10^6 cell/ml (Young J, 1991). The p-value <0.05. Error bars - SE.

Smith L., Grogan H. and Feechan, A., Unpublished

Wounding promotes shot hole symptoms



Impact of wounding on disease severity at 28 dpi when wounded & inoculated with Pss 7562. Three cultivars 'Caucasica', 'Novita' & 'Etna'. 24 *Prunus laurocerasus* plants (per rep). Two independent repetitions were completed. Four plants per cultivar (n=4) received two wounds to three leaves & inoculated with Pss (n=2) or ultrapure sterile H2O (n=2). Four plants remained non-wounded plants per cultivar (n=4) & received inoculation with Pss (n=2) or ultrapure sterile H2O (n=2) to three leaves.). Tukey HSD $P \leq 0.05$. Data presented is the mean of two independent experiments. Inoculation 5 X 106 cell/ml (Young J, 1991). $p < 0.05$. SE= standard error.

Smith L., Grogan H.. and Feechan, A., Unpublished

Thank you

Dr Mark Gaffney,

Dr. Helen Grogan
Brian McGuiness
Danielle Boland

Feechan group