Strategies for root disease prevention and control – crop husbandry and cultural techniques, testing for root pathogens, crop protection options and control programmes

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WHAT I WILL COVER

- Crop husbandry and cultural techniques
- Testing for root pathogens
- Plant protection product (PPP) options
- The phosphite story
- Control programmes

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CROP HUSBANDRY

- Do not re-use pots
- Thorough clean up between crops
- Disinfection of production beds and equipment
- Weekly disposal of dead or dying plants

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CROP HUSBANDRY

- Production beds should be maintained and renewed every 3-5 years – change of sand, capillary matting etc
- Rotate crops wherever possible
- Avoid overfilling pots
- Where mulch is used, reduce spillage
- Overwatering is the largest problem with root pathogens
- Check irrigation system uniformity, address possible leaks and blockages

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CULTURAL TECHNIQUES

- Crop densities and ventilation
- Reduce stress/overheating in pots – south/north side of pots
- Potting depth and handling of input material
- Flooding and bed unevenness – pot-in-pot or lift on/in crates
- Care of the planting material pre-potting
- Shading of crops post potting – NOT fleecing!
- Control key growing media parameters – EC, pH and temp.

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CULTURAL TECHNIQUES

- Use of binding agents to flush excess salinity
- Frost protection
- Soil dwelling pest control
- Do not irrigate overhead after pruning!
- Use of Calcinit (calcium nitrate) to top up and flush excess potassium sulphate

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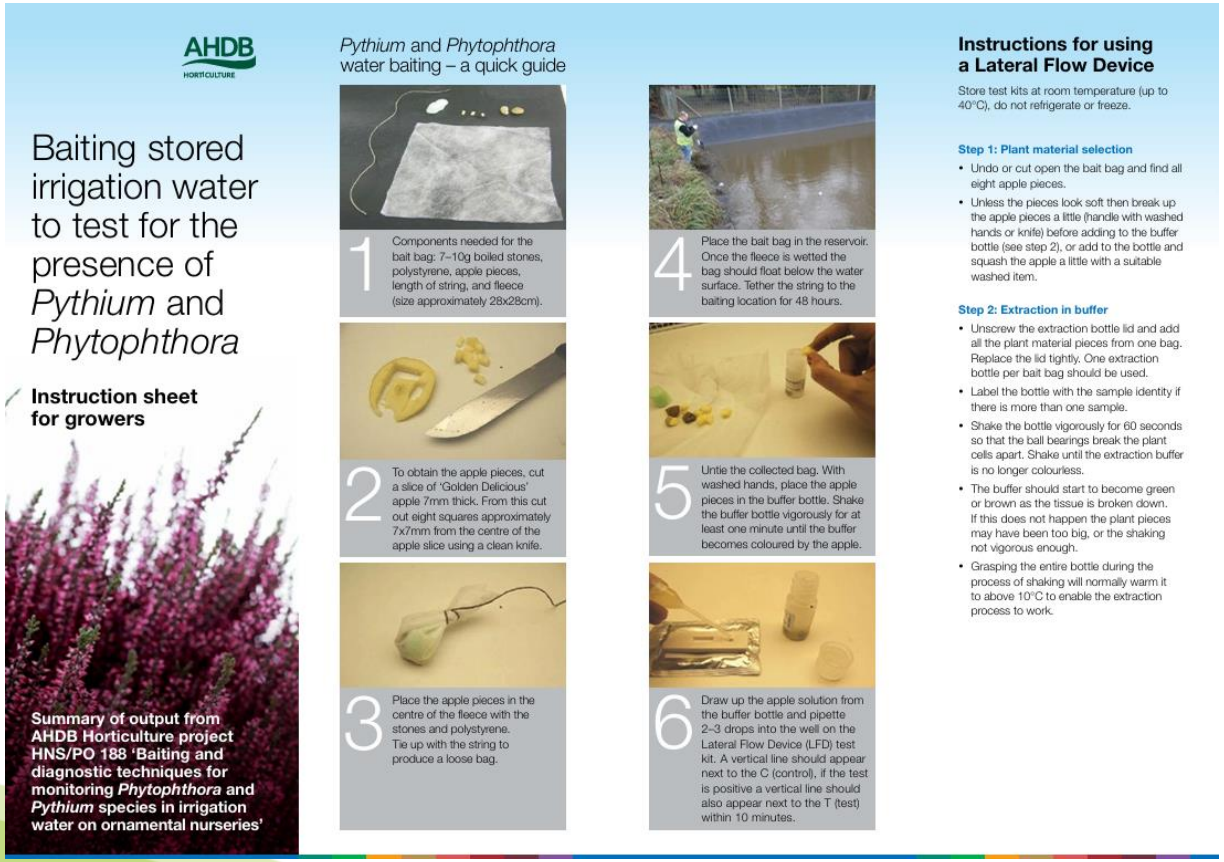
TESTING FOR ROOT PATHOGENS

- Testing water for pathogens
- In-house water baiting
- Sorbus International and Agdia



TESTING FOR ROOT PATHOGENS (live tissue)

- Tetrazolium salts
- Sigma-Aldrich (Merck)
- Works on any live plant tissue
- Useful in late winter early spring deliveries

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PPP OPTIONS – BASAL ROTS

Amistar (MAPP18039)	Azoxystrobin 250g/L	11	2 (4)	(360g a.s/ha)	Gantry sprayer must only be used in PPFE. Resistance management important	No adjuvants, do not apply above 30°C or below 10°C
Amylo-X WG (MAPP17978)	*Bacillus amyloliquefaciens subsp. plantarum* strain D747 250g/kg	BM02	6	-	March to October timing for outdoor crops. Respirator use during application	Can leave light brown spray deposits
Luna Privilege (MAPP18393)	Fluopyram 500g/L	7	2	-	Respiratory equipment must be worn during application. SRSU gloves must be worn for 2 weeks in outdoor situations and protective clothing and SRSU gloves for 5 weeks in protected crops. Managers must carry out a thermal comfort checklist	Very persistent and systemic product, some phytotoxicity possible
Nativo 75 WG (MAPP16867)	Tebuconazole + trifloxystrobin 50g/kg + 250g/kg	3 + 11	2	720g/ha/yr	Container-grown crops only. Protective clothing required for 42 days after treatment. Crop height timing restriction. Managers must carry out a thermal comfort checklist	Efficacious product but check restrictions for handling etc.
Serenade ASO (MAPP16139)	*Bacillus subtilis* strain QST 713 1.015kg/L	BM02	6	-	Respirator use during application	
Signum (MAPP11450)	Boscalid + pyraclostrobin 267g/kg + 67g/kg	7 + 11	2	6.0kg/ha/yr		
Switch (MAPP15129)	Cyprodinil + fludioxinil 375g/kg + 250g/kg	9 + 12	3	-	Max concentration of 80g of product in 100L of water	
Taegro (MAPP16139)	*Bacillus amyloliquefaciens* strain FZB24 130g/kg	BM02	10	-	Latest application 1 day before harvest. Respirator use during application	

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PPP OPTIONS - BLACK ROOT ROT

Amistar (MAPP18039)	Azoxystrobin 250g/L	11	2 (4)	(360g a.s/ha)	Gantry sprayer must only be used in PPFE. Resistance management important	No adjuvants, do not apply above 30°C or below 10°C
Fandango (MAPP17318)	Fluoxastrobin + prothioconazole 100g/L + 100g/L	11 + 3	-	2.5L/ha/yr	Forest nursery only, SRSU gloves for 5 weeks, do not enter crops for 3 days. Must not be applied by handheld equipment	Needle blight EAMU, but will give incidental control of other fungal pathogens
Luna Privilege (MAPP18393)	Fluopyram 500g/L	7	2	-	Respiratory equipment must be worn during application. SRSU gloves must be worn for 2 weeks in outdoor situations and protective clothing and SRSU gloves for 5 weeks in protected crops. Managers must carry out a thermal comfort checklist	Very persistent and systemic product, some phytotoxicity possible
Nativo 75 WG (MAPP16867)	Tebuconazole + trifloxystrobin 50g/kg + 250g/kg	3 + 11	2	720g/ha/yr	Container-grown crops only. Protective clothing required for 42 days after treatment. Crop height timing restriction. Managers must carry out a thermal comfort checklist	Efficacious product but check restrictions for handling etc.
Sercadis (MAPP19716)	Fluxapyroxad 300g/L	7	2	600ml/ha/yr	Handling restrictions for SRSU gloves for 5 weeks for outdoor and 11 weeks for protected crops. Protective clothing for use in treated protected crops for 11 weeks. Apply between 1 April and 30 September to outdoor crops. Must not be used on container-grown crops on non-porous surfaces. Managers must carry out a thermal comfort checklist	Latest EAMU covers narcissus crops
Switch (MAPP15129)	Cyprodinil + fludioxinil 375g + 250g/kg	9 + 12	3	-	Max concentration of 80g of product in 100L of water	

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PPP OPTIONS – FUSARIUM SPP.

Amistar (MAPP18039)	Azoxystrobin 250g/L	11	2 (4)	(360g a.s/ha)	Gantry sprayer must only be used in PPFE. Resistance management important	No adjuvants, do not apply above 30°C or below 10°C
Amylo-X WG (MAPP17978)	*Bacillus amyloliquefaciens subsp. plantarum* strain D747 250g/kg	BM02	6	-	March to October timing for outdoor crops. Respirator use during application	Can leave light brown spray deposits
Fandango (MAPP17318)	Fluoxastrobin + prothioconazole 100g/L + 100g/L	11 + 3	-	2.5L/ha/yr	Forest nursery only, SRSU gloves for 5 weeks, do not enter crops for 3 days. Must not be applied by handheld equipment	Needle blight EAMU, but will give incidental control of other fungal pathogens
Prestop (MAPP19458)	*Gliocladium catenulatum* strain J1446 320g/kg	NC	-	-	Min interval between applications of 7 days. Respiratory equipment must be worn during application. Max concentration of 500g/100L must not be exceeded. Growing media incorporation rate 500g product/m3	
Serenade ASO (MAPP16139)	*Bacillus subtilis* strain QST 713 1.015kg/L	BM02	6	-	Respirator use during application	
Signum (MAPP11450)	Boscalid + pyraclostrobin 267g/kg + 67g/kg		2	6.0kg/ha/yr		
Switch (MAPP15129)	Cyprodinil + fludioxinil 375g/kg + 250g/kg	9 + 12	3	-	Max concentration of 80g of product in 100L of water	
T34 Biocontrol (MAPP17290)	*Trichoderma sperellum* strain T34 120g/kg	BM02	1 (2)	-	Respirator use during application, max 10g/L in use concentration. Various application methods	Storage requirement of 4°C, light powder formulation very hydrophobic
Trianum P (MAPP16741)	*Trichoderma harzianum* Rifai strain T-22 10g/kg	BM02	2 (4)	-	Respirator use during application, apply above 10°C, min 4 weeks interval in cultivation and 14 days in propagation	

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PPP OPTIONS – PYTHIUM AND PHYTOPHTHORA SPP.

Paraat (MAPP15445)	Dimethomorph 500g/kg	40	2	-	Min 600L/ha water volume	
Prestop (MAPP19458)	*Gliocladium catenulatum* strain J1446 320g/kg	NC	-	-	Min interval between applications of 3 weeks for protected and 7 days for outdoor crops. Respiratory equipment must be worn during application. Max concentration of 500g/100L must not be exceeded	
Previcur Energy (MAPP15367)	Fosetyl-aluminium + propamocarb hydrochloride 310g/L + 530g/L	33 + 28	2	-	Latest application 21 days before harvest. Drench only treatment	
Promess (MAPP16008)	Propamocarb-hydrochloride 722g/L	28	3 (1)	-	Various application methods available including drenches and media incorporation	
Subdue (MAPP20776)	Metalaxyl-M 465.2g/L	4	1	-	Container-grown crops only. Apply at a concentration of 6.25 ml product per 100 litres of water for outdoor crops and 12.5ml product per 100 litres of water for protected crops. Drench volume should correspond to 10% pot volume. Managers must carry out a thermal comfort checklist. No handling restriction for 2 weeks after treatment. Workwear and SRSU gloves for handling crops from 2 weeks to 3 weeks in protected situations	Serious resistance issues, must not be used on its own. Various application methods and rates
T34 Biocontrol (MAPP17290)	*Trichoderma sperellum* strain T34 120g/kg	BM02	1 (2)	-	Respirator use during application, max 10g/L in use concentration. Various application methods	Storage requirement of 4°C, light powder formulation, very hydrophobic
Trianum P (MAPP16741)	*Trichoderma harzianum* Rifai strain T-22 10g/kg	BM02	2 (4)	-	Respirator use during application, apply above 10°C, min 4 weeks interval in cultivation and 14 days in propagation	

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PPP OPTIONS - OTHERS

- **LALSTOP K61** – relatively new on the market, early indications don't show much of a different efficacy to other bio-fungicides
- **BIOSTIMULANTS**
  - **Plant stress relief options and many others – Zonda, Kelpak, Megafol, Quantis and many others**
  - **Frost protection – ProAct, CropAid, Intracell and many others**
  - **Enhanced root development – HortiPhyte, HortiBoost, VidiParva and many others**

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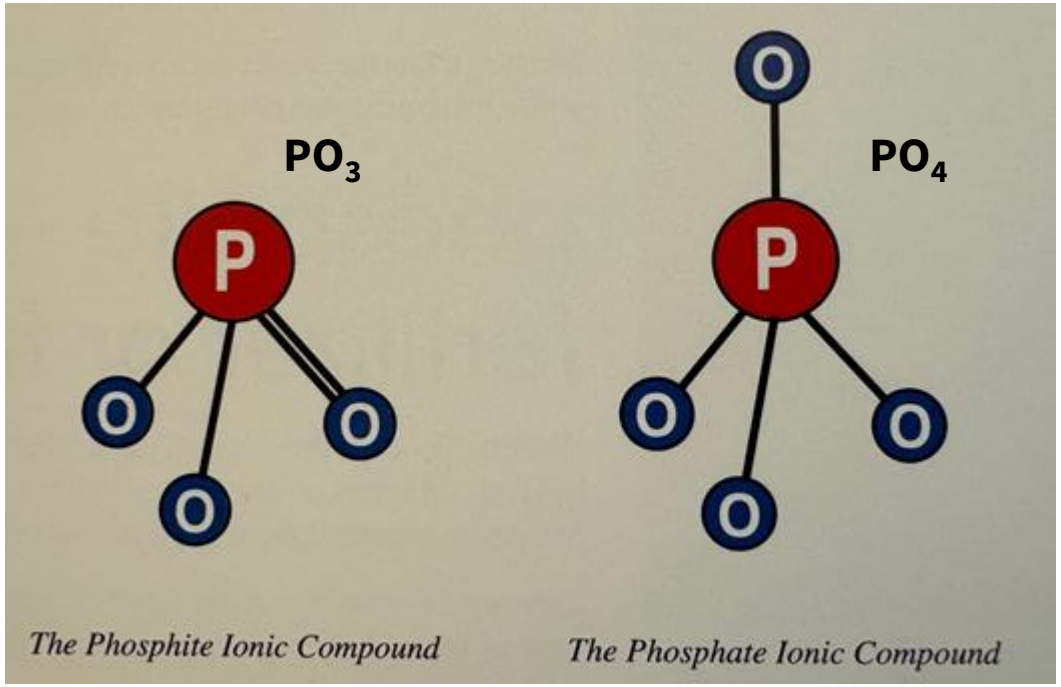
THE PHOSPHITE STORY

- Fertiliser or a fungicide?
- Developed in the 1980s in Australia
- Registered in 1991 in Australia
- Both fertiliser and as fungicide solo or in co-form
- Challenges with registration and traceability in fresh produce
- In EU arrived in early 2000s
- UK one of the last countries to register fosetyl-aluminium (Aliette)
- PO_3 – liquid
- PO_4 – solid



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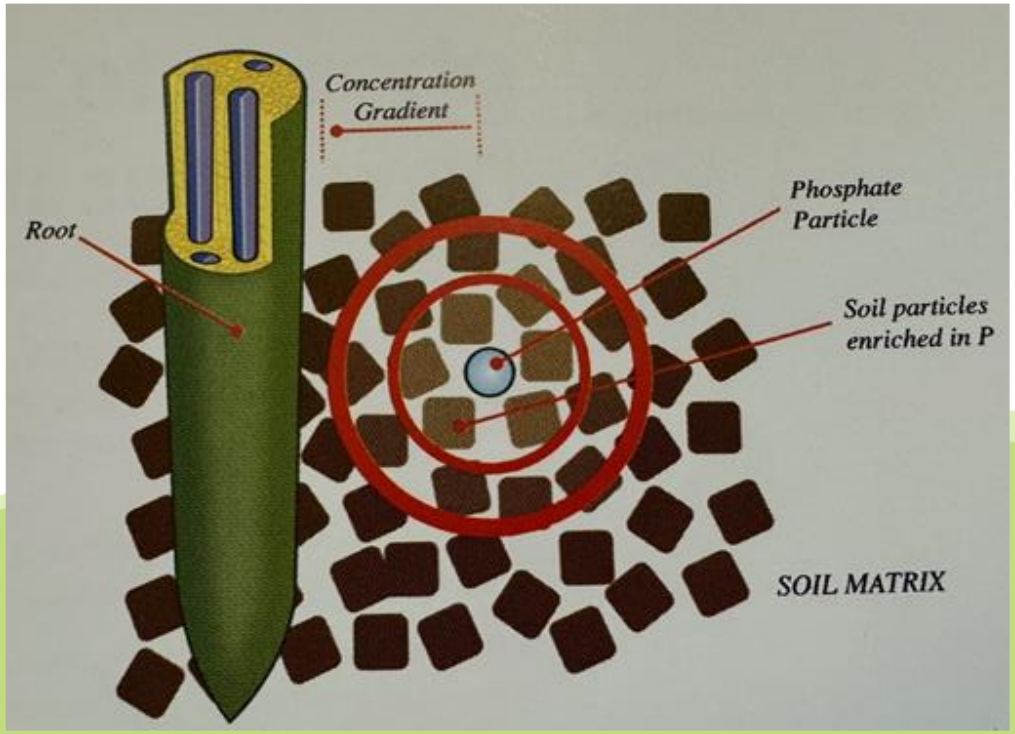
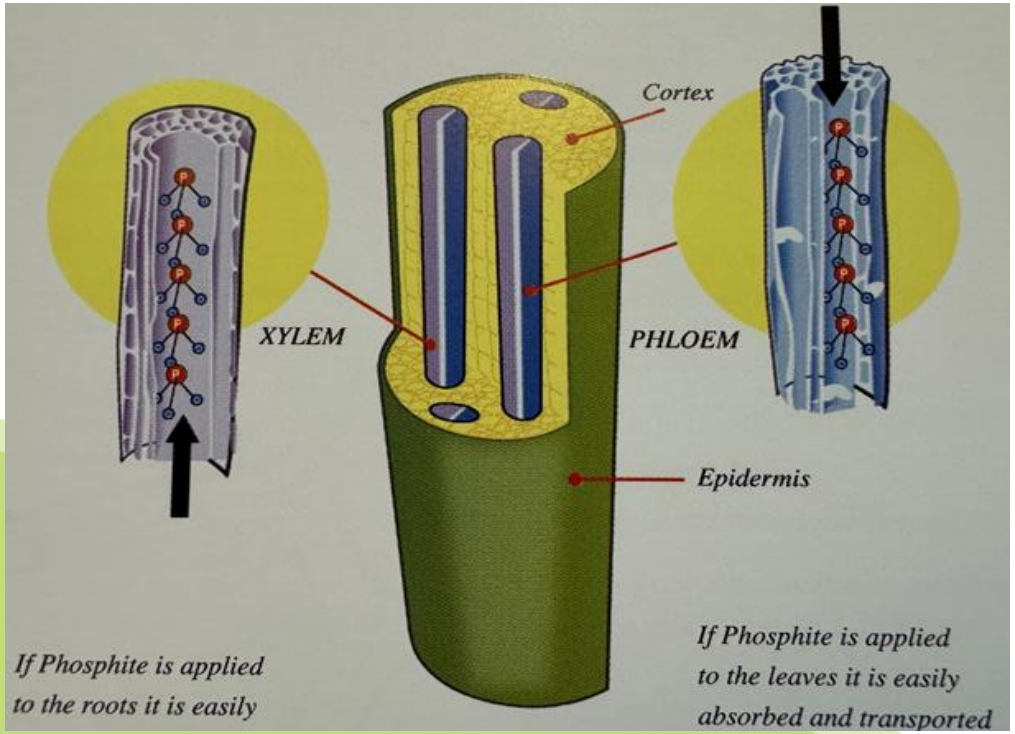
THE PHOSPHITE STORY

- Often locked up in soil and only small amounts available
- PO_3 – easily absorbed by all plant parts and mobile within the plant
- **Since phosphorus takes part in the bioenergetic plant processes, it triggers Induced Systemic Resistance (ISR) process easily**





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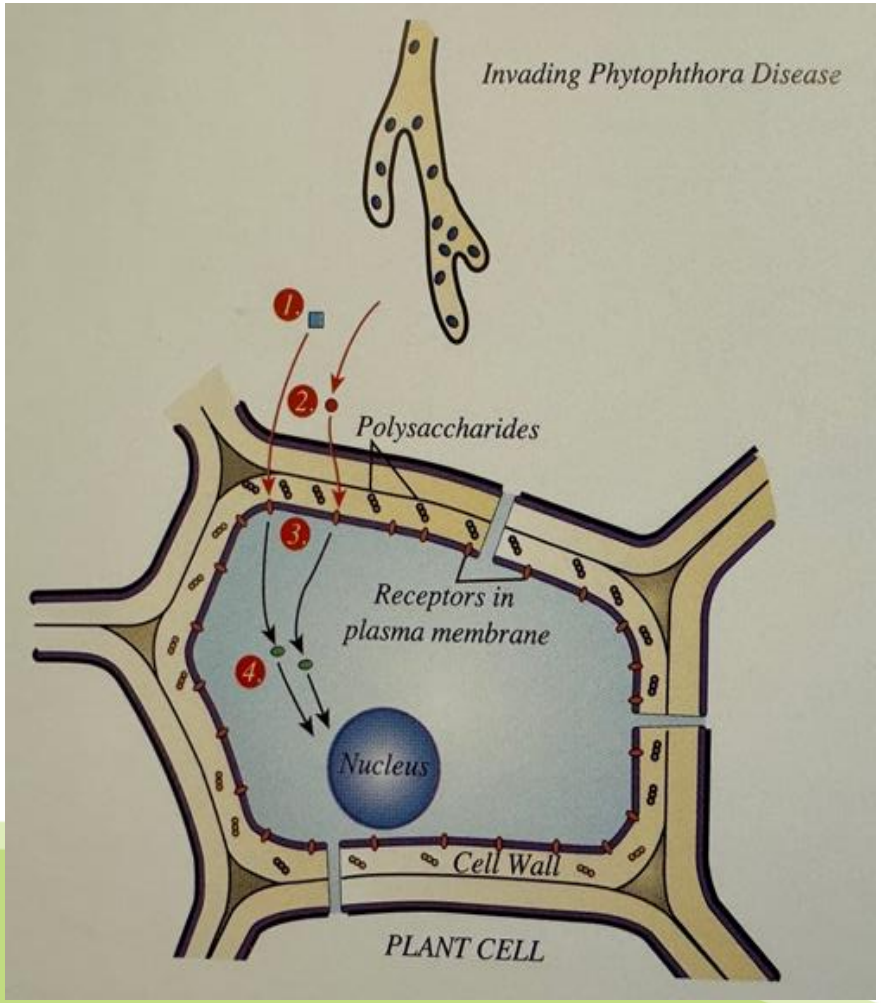
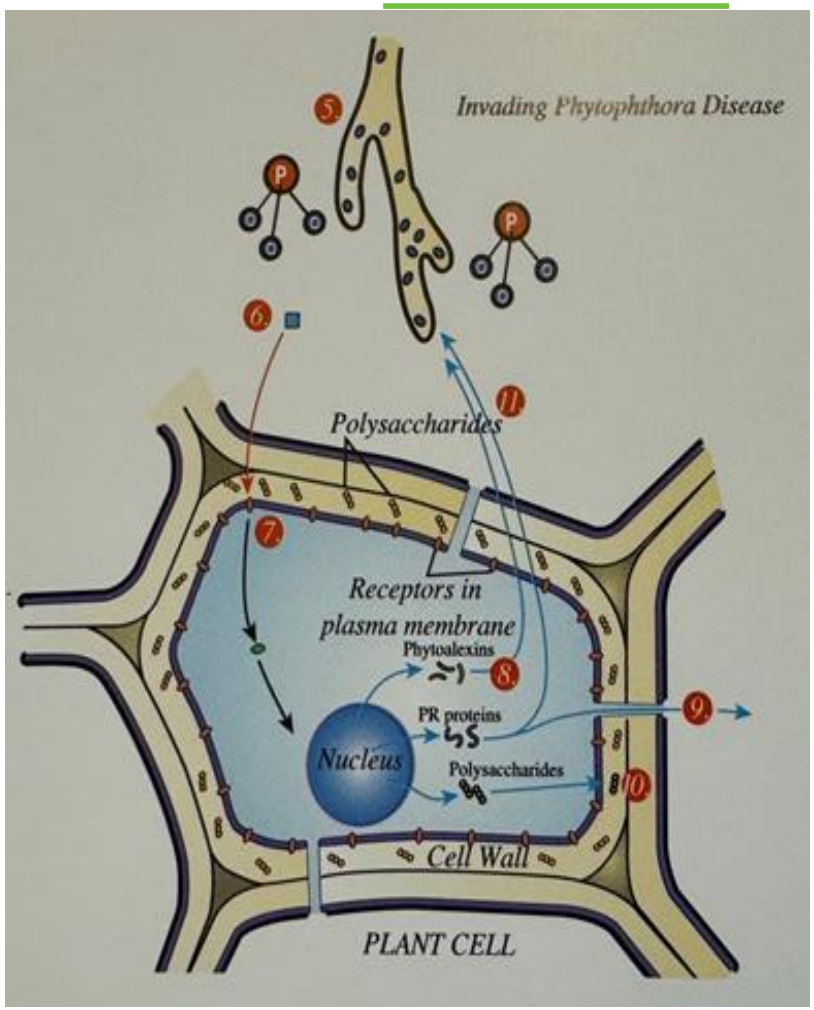
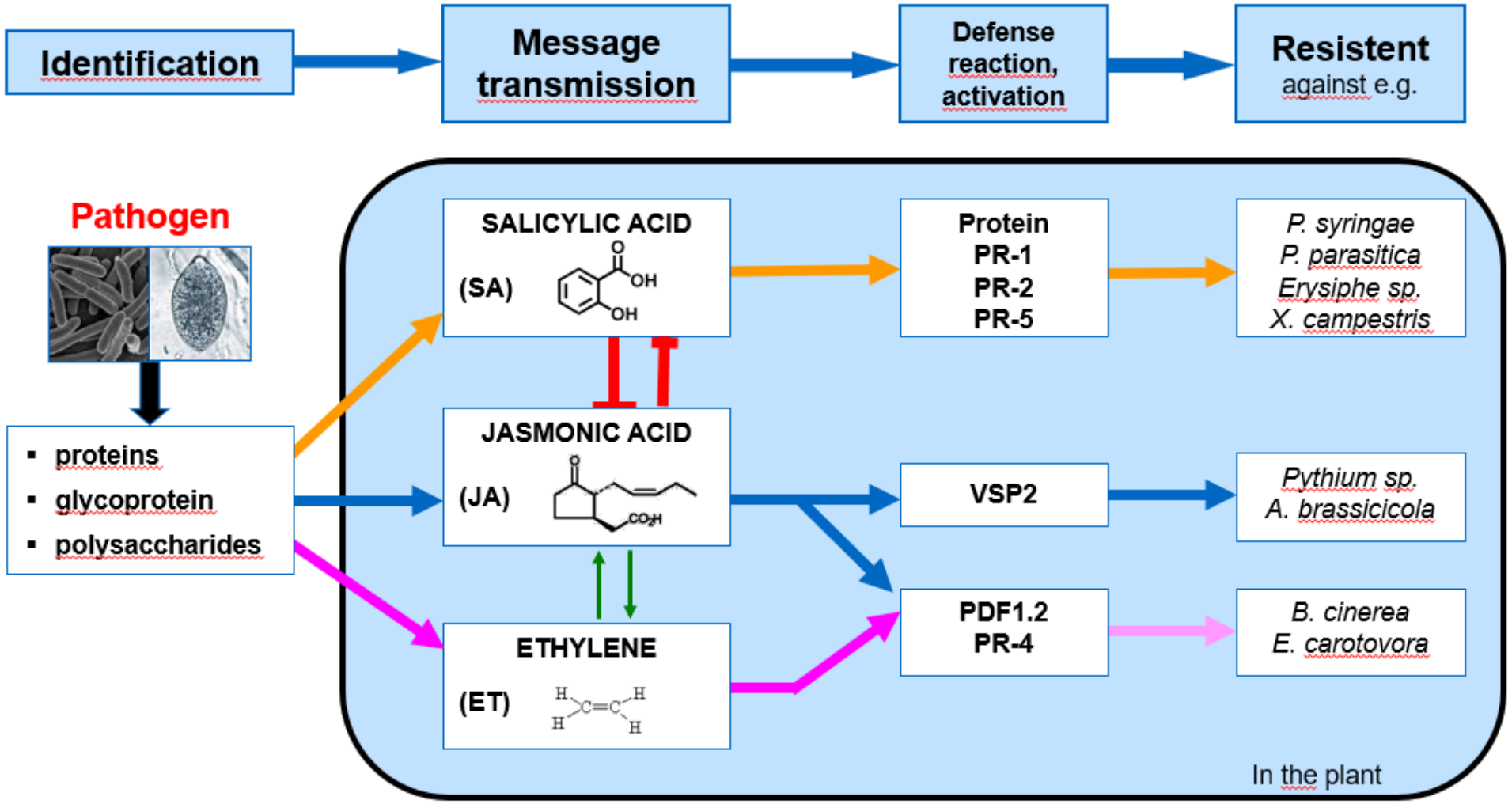
HOW DOES PHOSPHITE WORK

1. Recognition of pathogen
2. Pathogen masks recognition with suppressors
3. Recognition fails by host cell
4. **Weak signal = delay in defence response**
5. Pathogen affected by phosphite
6. Suppressors under or not produced
7. Recognition of pathogen by host
8. Triggered phytoalexin production
9. Signalling to other cells
10. Polysaccharides strengthen the cell
11. Disease is limited or controlled





PHOSPHITE MECHANISM



- **Previcur Energy**
- **Frutogard**

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CONTROL PROGRAMMES – CURRENT

Week 1	Week 2	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 12
Potting	Root growth	Vegetative growth extension			Bud formation			Start of flowering	
T-34 incorporated	**Subdue + HortiPhyte**		**Promess + HortiPhyte**			**Paraat + HortiPhyte**			

- Growing media incorporation of T-34 as standard for susceptible crops
- Subdue + phosphite as standard treatment
- All others have varying degrees of implementation in programmes

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CONTROL PROGRAMMES – FUTURE 1

Week 1	Week 2	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 12
Potting	Root growth	Vegetative growth extension			Bud formation			Start of flowering	
T-34 incorporated	**LalStop K61 + HortiBoost**		**Previcur Energy + HortiBoost**		**Frutogard X2**			**Promess + HortiPhyte**	

- Possibly Lalstop/Prestop likely to become more widely used
- Previcur Energy is likely to become more of a mainstay
- Frutogard is newly registered but rarely used
- Promess remains a propagation/young plant option

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CONTROL PROGRAMMES – FUTURE 2

Week 1	Week 2	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 12
Potting	Root growth	Vegetative growth extension			Bud formation			Start of flowering	
T-34 incorporated	**Vidi Parva + HortiBoost**	**Vidi Parva**	**Previcur Energy + HortiBoost**		**Frutogard X2**			**Promess + HortiPhyte**	

- Mixture of reliance on biostimulants and currently approved products
- Most likely we will see use of elicitors and fertilisers applied as foliar or liquid feeds
- Handling restrictions and possible MRL implementations will play a key role

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SUMMARY

- Most likely cultural/crop husbandry measures will be vital
- Attention to good nutrition is likely to increase
- Supplemented by biostimulants and remaining active substances
- Future restrictions on PPPs inevitable
- New active substances likely to be more difficult to approve for high volume sprays

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