

Lettuce Fusarium wilt in the UK

Dr Andrew Taylor

*Warwick Crop Centre, School of Life Sciences,
University of Warwick*



Fusarium oxysporum

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Source: Musarama

- One of the most economically damaging fungal plant pathogens causing vascular wilts and root rots: produce long-lived chlamydospores
- Wide range of plants affected including: onion, leek, tomato, lettuce, pea, bean, potato, brassicas, strawberry, apple, pepper, celery, coriander, spinach, banana, oilpalm, carnation and narcissus
- **Special forms exist that are specific to different hosts**
(*formae speciales* - f. spp.)
- Non-pathogenic *F. oxysporum* are abundant in soils



***Fusarium oxysporum* f. sp. *lactucae* (FOL)**

- Identified in Japan, USA, Taiwan, Iran, Brazil, Korea, Egypt, Argentina, Portugal, Spain, Italy, Netherlands, Belgium, Ireland and England
- At least 4 races exist (races 2 and 3 only found in Asia)
- Race 1 is the most widespread; Race 4 (FOL4) identified in the Netherlands in 2013
- Races are defined by differential resistance / susceptibility to a set of lettuce lines



Internal symptoms

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FOL4 in the UK

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- First symptoms observed in Ireland in 2016
- FOL4 confirmed in Ireland and Lancashire in summer 2017
- **Sites**: 4 sites in County Dublin, 5 sites in Lancashire, 2 sites in Cambridgeshire (2018)
- **Varieties**: Little gem (e.g. Skye / Stonsay) Butterhead (e.g. Allegra, Almay, Amica, Espirando, Temira, Carter)
- FOL4 only confirmed on indoor lettuce



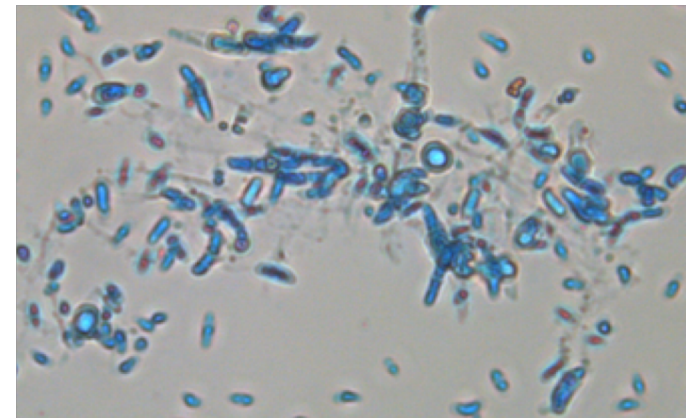
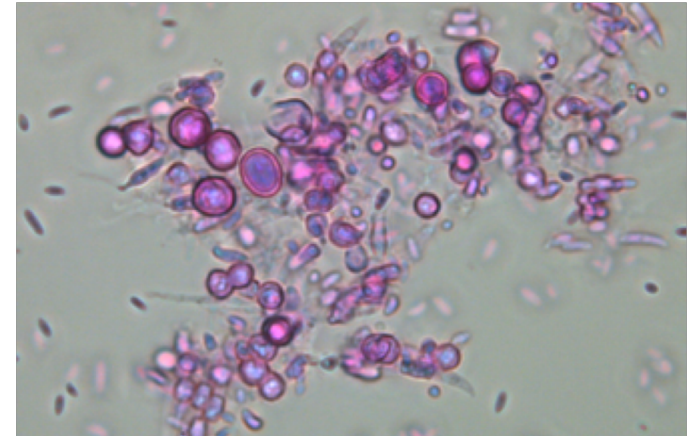
Cambs 14/12/18



Lancs 19/11/18

FOL transmission / survival

- Transmitted in soil via equipment, propagation trays, footwear or possibly on seed (although significance unproven)
- Chlamydospores of *F. oxysporum* can survive in soil for up to 17 years
- Chlamydospores of FOL race 1 can survive in fallow field soil for at least 2.5 years although viability decreased by 86% after 12 months (Crop Protection, **73**: 45-49)



Control of FOL4

- Hygiene (clean boots, equipment / disinfectants / hot water, steam)
- Chemical / biological control (SCEPTREplus)
- Soil disinfestation (steaming / fumigation)
- Resistant cultivars (under development)
- Crop rotation / fallow soil (efficiency?)
- Soil amendments?



SCEPTREplus: control of FOL4

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- A range of chemical and biological products tested against FOL4 using glasshouse pot assay
- Plants raised in peat blocks and transplanted into infested compost (high dose)
- Symptoms scored twice weekly for 6 weeks
- Remaining plants bisected to score internal browning



Products and application

Product	Active	Application
Amistar	Azoxystrobin	T1
Amylo X	<i>Bacillus amyloliquefaciens</i>	T0+T1+T2
Basamid	Dazomet	1 application
AHDB9895		1 application
Luna Sensation	Fluopyram + Trifloxystrobin	T1
AHDB9896		T1+T2
Prestop	<i>Gliocladium catenulatum</i>	T0+T1+T2
Previcur Energy	Propamocarb + Fosetyl Al	T1
Signum	Boscalid + pyraclostrobin	T1
Switch	Cyprodinil + Fludioxonil	T1
T34	<i>Trichoderma asperellum</i>	T0+T1+T2
Triatum P	<i>Trichoderma harzianum</i>	T0+T1
Agrichem flowable Thiram	Thiram	T1

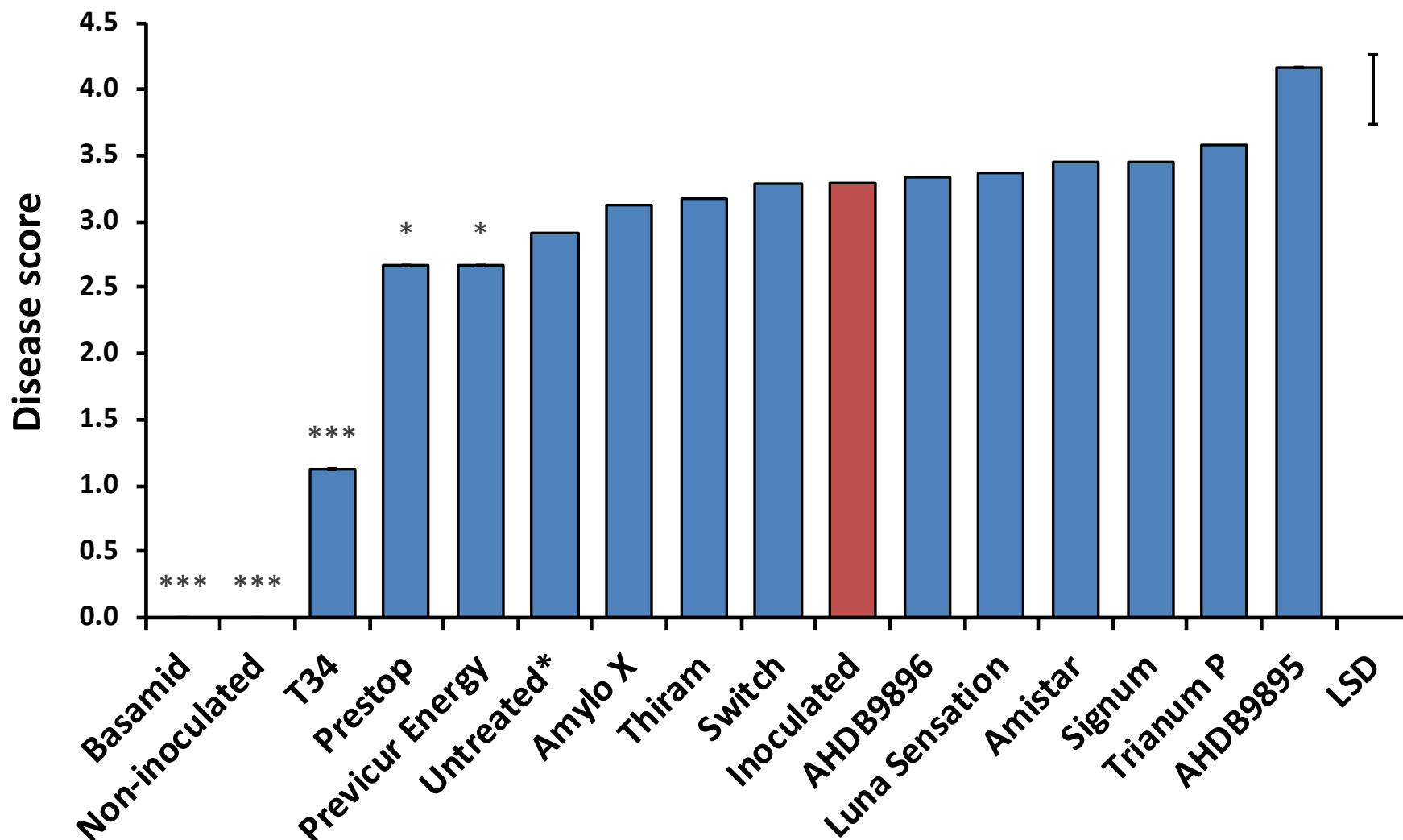
T0 – applied to peat blocks at sowing

T1 – applied at transplanting

T2 – applied 1 week after transplanting

Effect of treatments on FOL4

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Symptoms at 32 days

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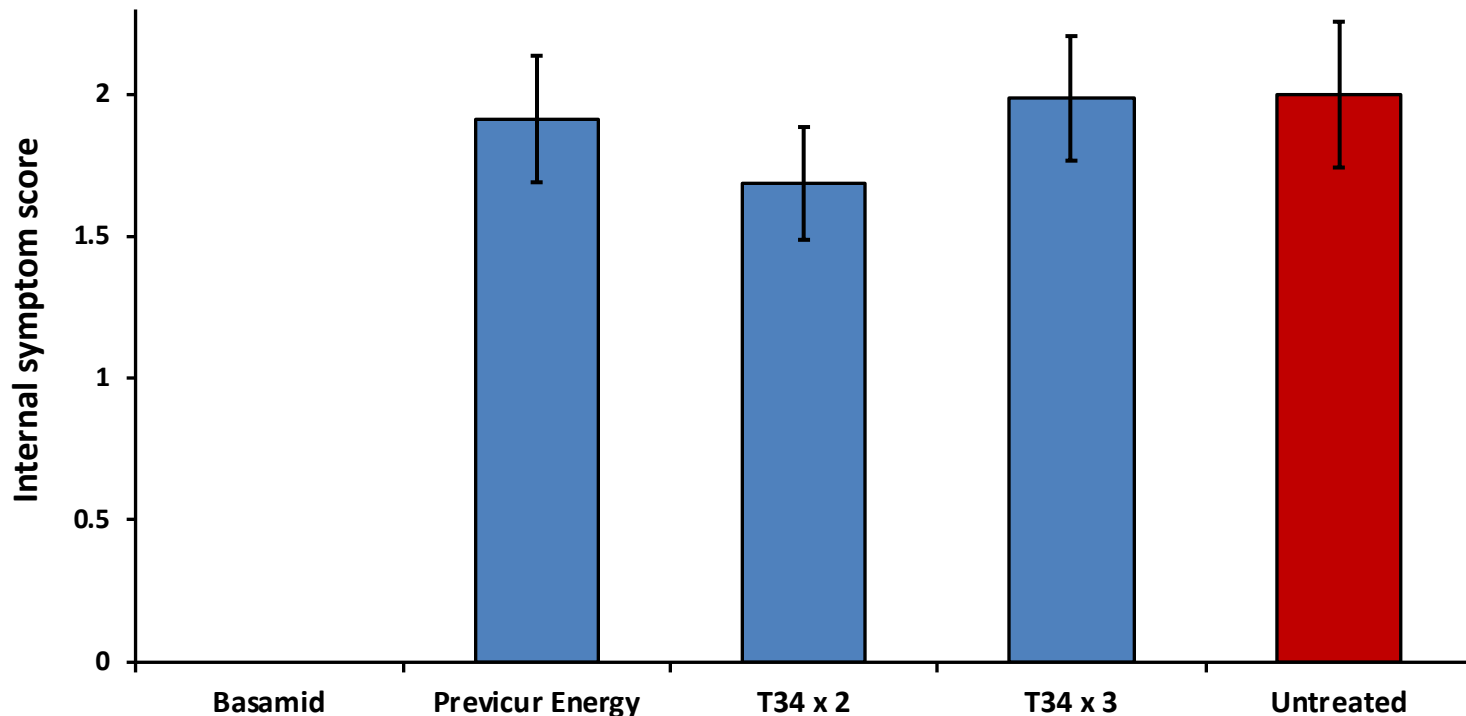


FOL4 quarantine polytunnel



Winter polytunnel trial

- Only Basamid provided any level of control



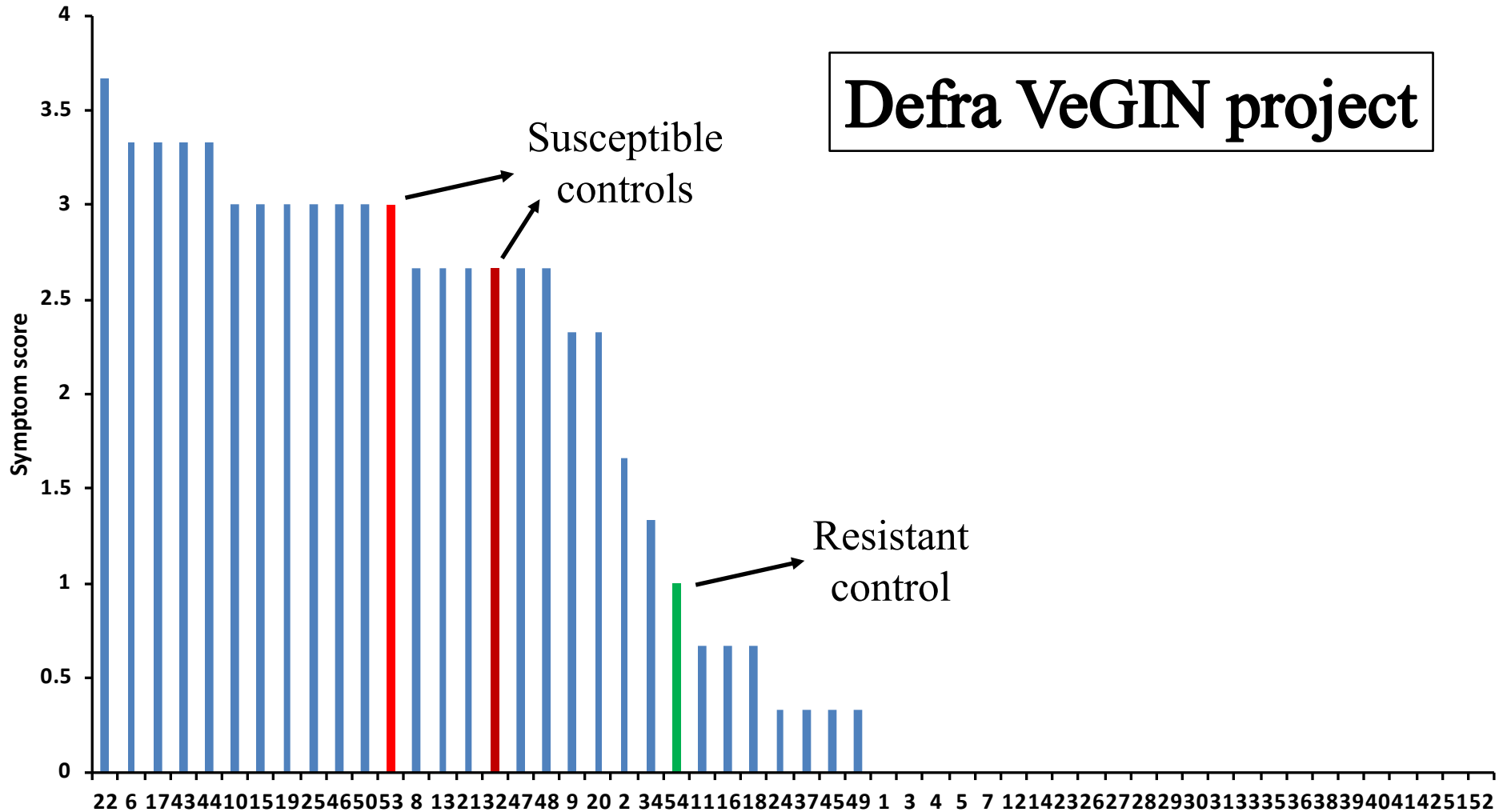
Resistance screening

- 52 lines from VeGIN lettuce diversity set screened for resistance to FOL4
- Plants raised in peat blocks before transplanting into infested compost
- Temperature controlled glasshouse (25°C day, 18°C night)
- Wilting scored twice weekly
- Plants cut longitudinally after 40 days

Resistance screening

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Defra VeGIN project



FV PE 458 Lettuce: biology and management of Fusarium wilt

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AHDB
HORTICULTURE

AIMS

- 1) Develop tools for molecular detection and quantification of FOL4
- 2) Determine the effect of temperature and inoculum level on FOL4 disease development and the impact of non-hosts / fallow on FOL4 survival.
- 3) Test hygiene measures to eliminate FOL4 inoculum



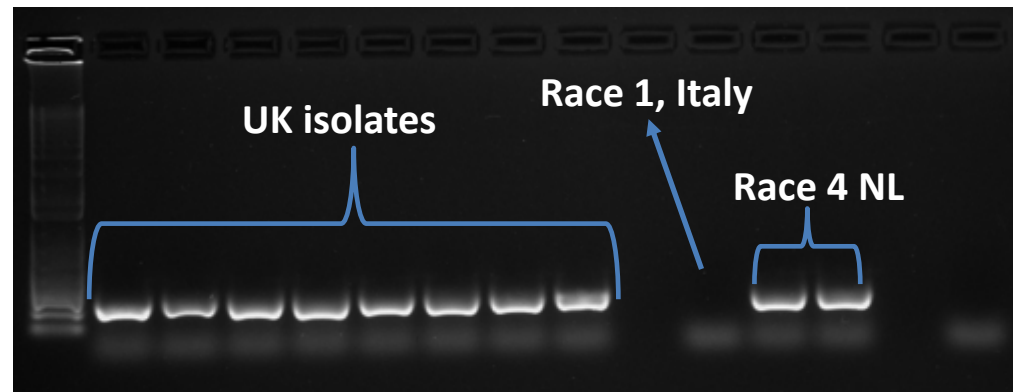
Current molecular detection of FOL4

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- Pathogen isolated from inside infected tap root
- DNA extracted and published PCR used to test for FOL4
- qPCR assay under development

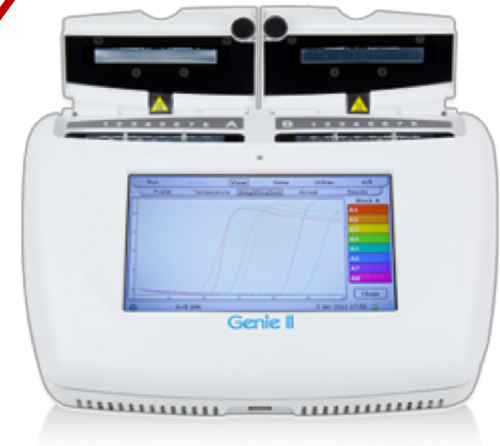
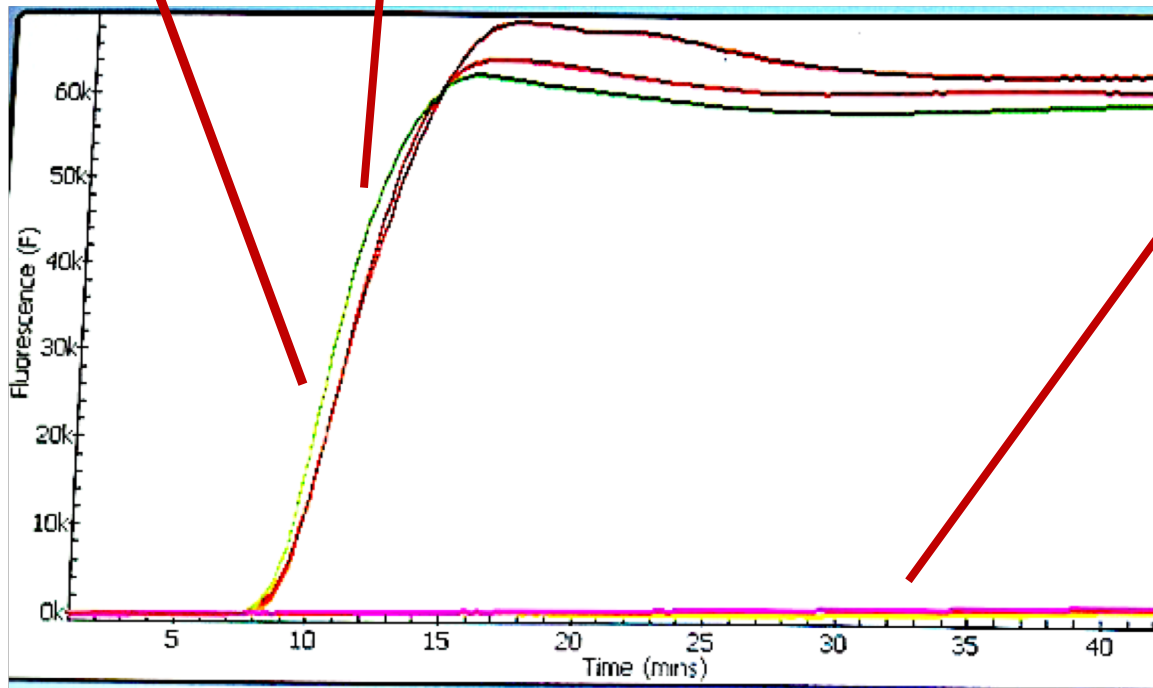


DNA



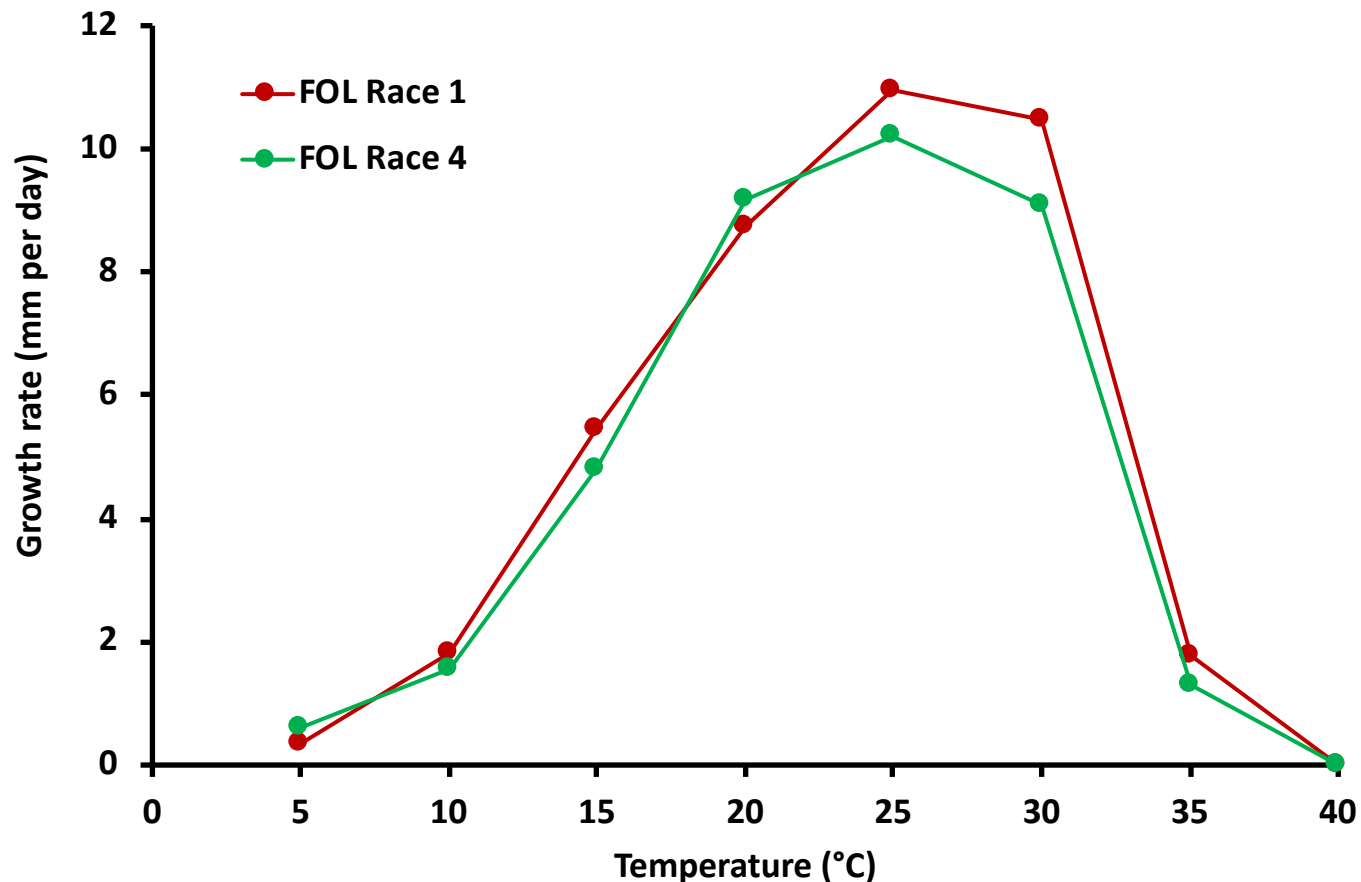
Current FOL LAMP assay

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Ortega *et al.*, 2018. Plant Pathology, **67**: 1462-1473

Effect of temperature on FOL4 growth on agar



Summary

- Lettuce Fusarium wilt is a serious threat to UK protected lettuce production
- Control is challenging and hygiene practices need to be rigorous
- Data from SCEPTREplus showed that Basamid and T34 can provide some control
- Development of resistant cultivars would be greatly beneficial and initial results are promising
- As part of a new AHDB project we are beginning to understand the biology of FOL4 and develop molecular tools for detection

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