The introduction, persistence and impact of seed and soil-borne pathogens on potato crops within a rotation

Jennie Brierley, James Lynott, Louise Sullivan, Cathy Hawes and Alison Lees



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Balruddery rotation & field layout The James Hutton Institute and B \$90,000,322 INCOME. 8040309308 ICO: HIS 341 108 103.50 Potato Winter Barley S BL Balruddery 990 105 107 \$10E 107 124 \$10,000 337 101010-027 1645.200 313:107 Winter OSR HEC 208 12 S С S С **Den South** MBL **Road field** Mid East ----- C 1840 314 324 -------806 PM 128 773 ba 112.22 114 225 A Bahuddery 5 RU -----BOR DISTAN 8HC 305.323 P1 101 101 110 121 Spring Barley Winter wheat **Field Beans** MY S S ----С 214/204 315 324 S BU **Pyľon Kennels** Estate 012-012-02 00Y 108 553 100 COLUMN ENC HILSES NER 252 102 84320 861 122 RU Hall Soils surveyed by J.S. Bell and A.J. Nola Mixed Bottom Land Grei Des of Robubbles GIS work and map preparation by D. Dor IL.

Crop cultivars and sustainable treatment



- 1. Lady Balfour
- 2. Mayan Gold
- 3. Vales Sovereign
- 4. Cabaret
- 5. Maris Piper

Sustainable treatments:-

- Addition of compost
- Reduced inorganic fertilizer
- Reduced herbicide application
- Reduced fungicide/pesticide application







Data collection

On-site meteorological station providing continuous measurements of air temperature, precipitation, wind speed and direction, and solar radiation.

Soil temperature, moisture content, microbial and invertebrate activity, nutrient and water uptake by plants and plant growth are measured alongside nutrient leaching and GHG emissions











Seed inoculum

Disease assessed visually, and symptomless infections identified with real-time PCR.

Post harvest disease assessed visually



	Disease	Pathogen	Real-time PCR assay	
-	Powdery scab	Spongospora subterranea	van de Graaf et al., 2003	
	Black scurf	Rhizoctonia solani AG3	Lees et al., 2002	
	Black dot	Colletotrichum coccodes	Cullen et al., 2002	
Silver scurf		Helminthosporium solani	Cullen et al., 2001	
	Common scab	Pathogenic Streptomyces spp.	M. Tavaria	















Seed- and soil-borne potato pathogens

Soil inoculum

Inoculum levels in soil are determined pre-planting and post-harvest.





Amplification Plot



DNA extraction: Brierley et al. (2009) Applied soil ecology



Black dot





Lees *et al.* (2010) Plant Pathology Brierley *et al.* (2015) Plant Pathology

Powdery scab







No powdery scab





Brierley et al. (2012) Plant Pathology

Silver scurf

No soil inoculum has been detected







Incidence of silver scurf on seed (%)

Common scab







Currently validating an assay for pathogenic streptomyces spp. (Michael Tavaria (Applied Biosystems, Melbourne)





Brierley et al. (2016) Potato Research

Black scurf on tubers



Incidence of blac	k scurf (%) on	seed stoo	cks and pro	geny tubers grown in both conventional and sustainable treatments
	2011		011	
Cultivar	Agronomy	seed	progeny	
Cabaret	Conv.	28	46	
	Sust.		13	
Lady Balfour	Conv.	1	75	
	Sust.		all.	
			est.	
Maris Piper	Conv.	0	.§ 12	
	Sust.		ið 0	
			っ	
Mayan Gold	Conv.	0	0	
	Sust.		0	
Vales sovereign	Conv.	7	2	
	Sust.		5	

Could increased soil organic matter increase disease caused by Rhizoctonia solani AG3 on potato?

In field plots infested with *R. solani* AG3 to which additional OM (barley straw and manure) had been incorporated:

- plant emergence was delayed
- stolon pruning increased
- yield decreased
- black scurf on progeny tubers increased (see figure below)







Soil organic matter (2014)







Refined fungicide spray regimes informed by pathogen detection



and improved weather based forecasting models could be incorporated into the sustainable treatment at the CSC rotation in the near future.





Hydrological assessments with UNESCO Centre at Dundee

Case study and development of a framework for multiple ecosystem services

> IPM and soil borne pathogens

crop quality and human health impacts Strategic Partnership on Food and Drink Science: sustainable management impacts on crop quality <u>EU AMIGA</u> <u>"Assessing and Monitoring</u> Impacts of Genetically modified plants on Agroecosystems"

Winter OSR



Functional relations between biodiversity and ecosystem processes; impact of land use change

Spring beans Winter barley Spring barley

Potato

Winter wheat

EU UPSCALE "Quantifying the benefit of semi-natural

vegetation to crop yield through enhanced pollinator and natural enemy occurrence".

EU PURE

"Pesticide Use-and-risk Reduction in European farming systems with Integrated Pest Management" EU Legume Futures "Legume-supported cropping systems for Europe"

<u>EU BEAST</u> "Bioeffectors for European Agriculture, Soil and Technology"





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