

# Resistance testing for *Pectobacterium* and *Dickeya*

Ian Toth



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# Control of blackleg disease

- Blackleg and soft rot diseases are caused by *Pectobacterium* and *Dickeya* spp. and are currently controlled by:
  - Crop inspection at different stages of seed production (those that are infected are heavily removed from the seed production chain)
  - Good storage temperature and ventilation that prevent disease development in store (but have little effect on disease development once back in the field)
  - Deployment of cultivars with disease resistance
  - Czajkowski *et al.* 2011 *Plant Pathol.* 60, 999



# Disease resistance

- Few potato cultivars show resistance / tolerance to blackleg and soft rot.
- Some cultivars show partial resistance.
- Attempts to breed cultivars of *Solanum tuberosum* with increased resistance have been only partially successful, perhaps due to a narrow range of genetic diversity being used in parental material.



Finlay Dale

# Discovering resistance in the Commonwealth Potato Collection (CPC)

- 1500 accessions of ca. 80 wild and cultivated potato species.



K.K. Balls. Expedition to Mexico 1938. Field Notes.

201. Solanum sp. above Los Pescados, Ofrre de Perote, Veracruz. 25.6.1938. 11,500 ft.  
Native name. "Papas Simarona"  
Rosettes of leaves flattened to surface of ground. Single tubers to each plant, rarely 1" diam. Not yet flowering. Growing in wood usually rather flattened. Open patches not far from tracksides of Pinus and Abies religiosa, open patches not far from tracksides

202a. Solanum sp. Los Pescados, Ofrre de Perote, Veracruz. 25.6.1938. 10,500 ft.  
Plants with much the same appearance as the previous but possibly more advanced. Rosettes of leaves to 6" across, still flattened though not so much so. Not yet in flower. Tubers to 1" across, usually rather flattened. Growing among the roots of trees and among scrub, in forests of Pinus species. Partial shade.

Hacienda de San Juan de Los Molinos, Ferote, Vera Cruz. June 2-1938. Dr. R.N. Salaman

202b. Solanum sp. Tixtlan, Tlaxcala, Mex. 26.6.1938. 7, 300 ft. Native name "Papas Simarona"  
Upright stems to 6" tall, dark, purplish-green, hairy tubers to 1 1/2" across, globose. Old walls, sandy soil. (Old Tlaxcala Plateau)

K.K. Balls. Expedition to Mexico 1938. FIELD NOTES.

Packet No 5. S. stoloniferum.

20404. Solanum sp. Extrajerarla, Tetlanochan, (San Francisco) Mt. Malinche, Tlaxcala. 21.6.1938. 9,500 ft.  
Flowers pale mauve to 1" diam, with darker markings on reverse corolla. Stems slender, upright, to 12" tall. Usually a single stem to each plant, unbranched to inflorescence. Leaves gray at slightly hairy. Growing on banks between cultivation, and among scrub, in very sandy soil. Tubers often very deep and rarely as much as 1 1/2" across. Pale yellow in colour.

All the wild potatoes of this region are called Papas Simarona the natives do not seem to distinguish between species, if there are more than one here. One man told me these potatoes were poison, but he was not corroborated by his companions!

Solanum sp. Mt. Malinche. 21.6.1938. 9,000 ft.  
Flowers pale mauve to 1" diam, with darker markings and orange yellow anthers. Leaves making a flattened rosette on surface of the ground, bright green, and heavily hairy. Growing in deep, vegetable humus, among rotting leaves and branches of Pinus and Abies, in dense, moist shade. (Leaf rosettes to 12" across). In narrow barrens well up into the mountain slopes. This seems to be in a very limited area.

Solanum sp. Mt. Malinche Tlaxcala. 22.6.1938. 10,000 ft. Native name. Papas Simarona.  
Flowers pale mauve with deeper markings and bright yellow anthers. Leaves making a flattened rosette on ground surface, to 6" across. The tubers here were all of a slightly dark colouring, though not red, and this may be due to the rotting pine-needles in which, entirely they are growing. In deep shade of young and rather dense Pine woods.

P.S. I have herbarium material of all the Potato species which have collected wild in this country, and shall be forwarding to Dr. Hudson when the collection is complete, but in the meantime the value of the small lot to make a parcel worth while. I hope that this material may be helpful. Most of it has been sent in duplicate with my complete collection to the Herbarium at New in case it might be useful for reference before I am able to send the complete collection of Potato specimens to you.



E10 - Bolivia - San Benito - the village helped

3 *Rybinii* *phureja*.


EPC 979. Recd 6 Oct 39.

Balls' no: B7475

*Solanum* sp. Specimen obtained in market Pasto. Dept Nariño, Colombia. 9.3.39.  
Cultivated at Los Pitireros, S. of Pasto and also in Obunuco, Caocita, in warm climates.  
Native name: "Chaucha negra". *purple in existing stock*  
Plants to 80cm. tall. *flowers white*. The tubers grow to 30cm. long. Very good eating quality, selected seed sown in August to harvest end of December (worth 8 pesos a carga). Dry, floury. Plants resistant to "Iagota" (*Phytophthora*). Tubers oval, with point at heel, to 7.5 x 4.5 x 3.5. Skin black-purple, very even coloured. Eyes small, narrow, deep with strong marked, overhanging, straight brows and slight bulge above. Flesh deep yellow.

3 tubers w. dark purple, many sprouts.

1967 flld. section - 2 May 7



# *Solanum phureja*



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# Disease resistant varieties

- Crosses between *S. tuberosum* (tetraploid) and *S. phureja* (diploid) display relatively high resistance but tuber yields are reduced.
- There is a lack of resistant tetraploid parental germplasm available to breeders world-wide.
- Of the 245 cultivars in the 'British Potato Variety Database' only 17 show moderate to high resistance, 5 of which include *S. phureja* material.

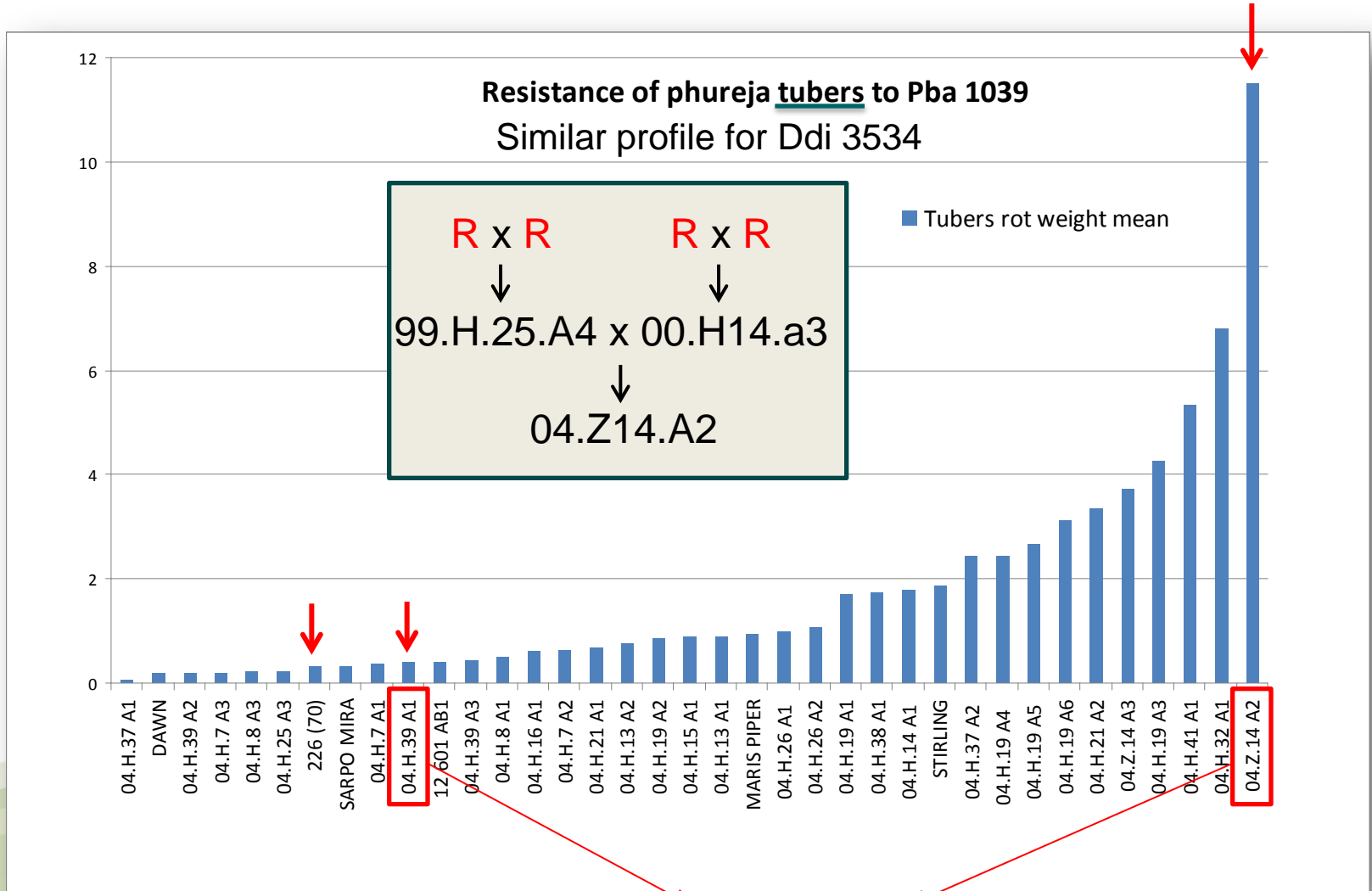
Resistance to Damage, Pests and Diseases	Low	.	.	.	.	.	.	.	High
Dry rot ( <i>Fusarium coeruleum</i> )	.	.	.	.	5	.	.	.	.
Dry rot ( <i>Fusarium sulphureum</i> )	1	.	.	.	.	.	.	.	.
Late blight on foliage ( <i>Phytophthora infestans</i> )	.	.	.	4	.	.	.	.	.
Late blight on tubers ( <i>Phytophthora infestans</i> )	.	.	.	.	.	.	7	.	.
Powdery scab ( <i>Spongospora subterranea</i> )	.	.	.	.	.	.	7	.	.
<b>Blackleg ( <i>Pectobacterium atrosepticum</i> )</b>	.	.	.	.	.	.	.	8	.
Common scab ( <i>Streptomyces scabiei</i> )	.	.	3	.	.	.	.	.	.
Potato Cyst Nematode ( <i>Globodera pallida</i> Pa 2/3, 1 )	.	2	.	.	.	.	.	.	.
Potato Cyst Nematode ( <i>Globodera rostochiensis</i> Ro1 )	1	.	.	.	.	.	.	.	.
Potato Leafroll Virus	.	.	.	.	5	.	.	.	.
Potato Virus Yo	.	2	.	.	.	.	.	.	.
Bruising	.	.	.	.	.	.	.	.	9
Splitting	.	.	.	.	.	6	.	.	.

# The project

This project is to investigate and identify the source(s) of resistance in *S. phureja* to allow it to be fully exploited in developing new resistant (tetraploid) cultivars



# Resistance to multiple strains and species



07.H.128

Tested in 2013

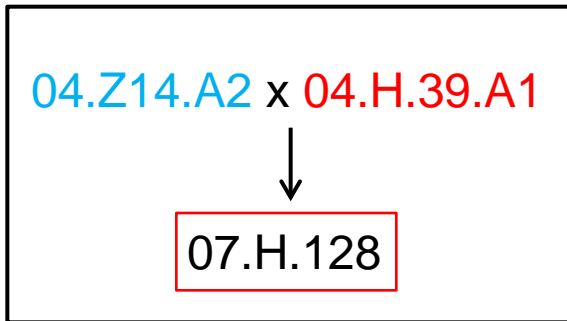


# Populations to test

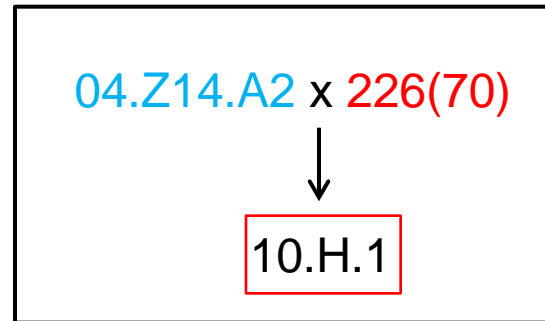


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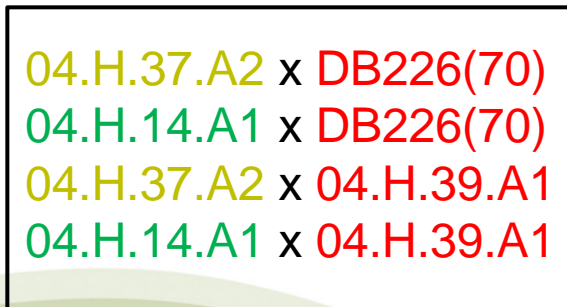
Testing  
2013



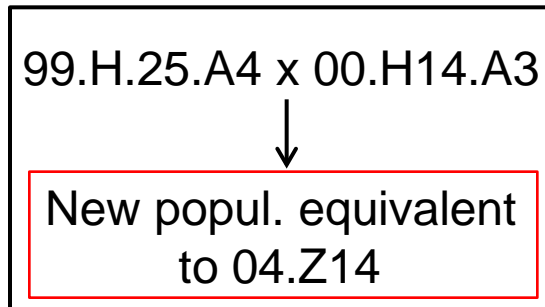
Testing 2014



Crossed  
2013

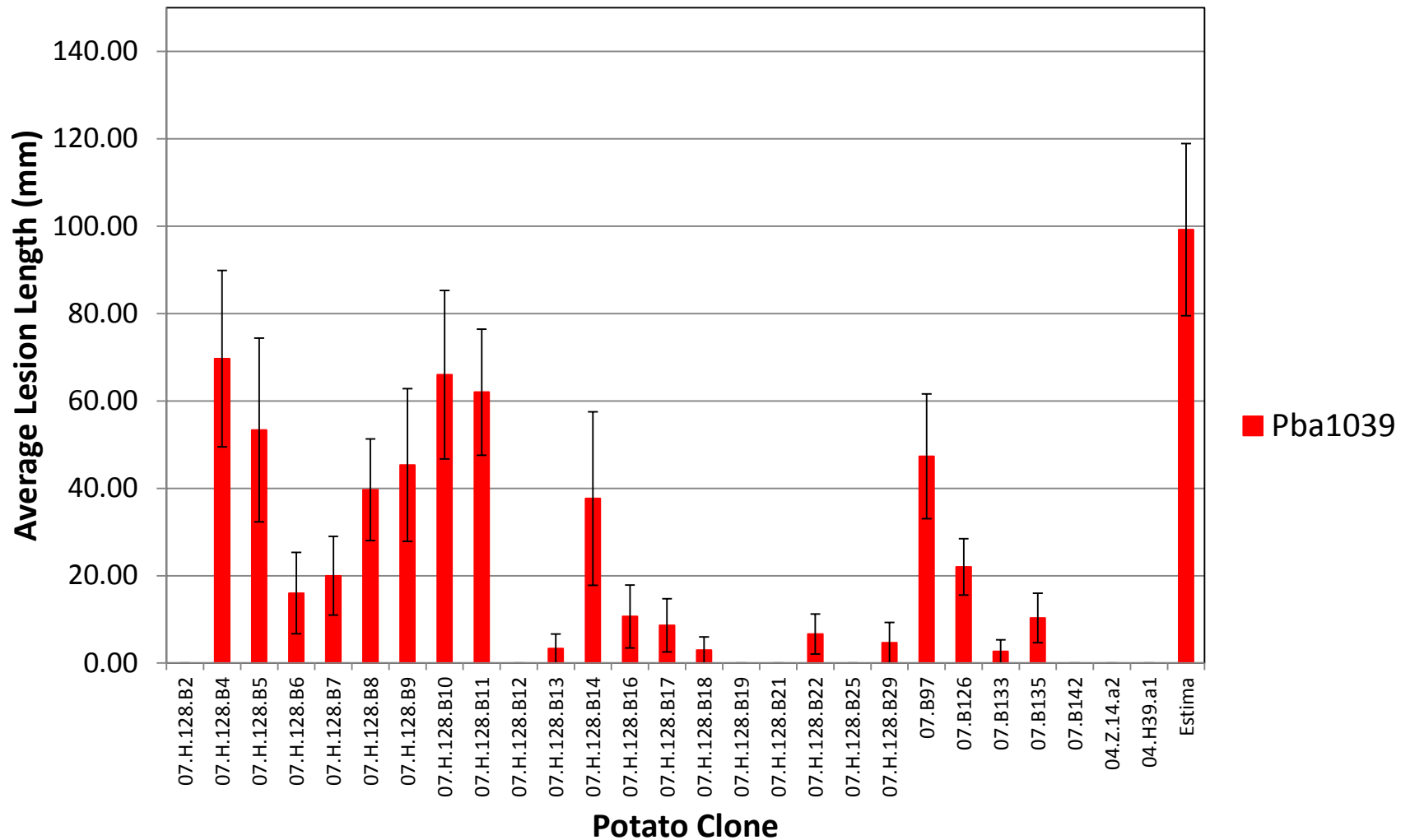


200 true seed  
planted 2013

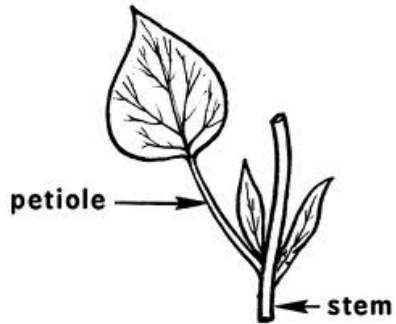




## 07.H128 Clone Resistance to *Pba* 1039 and *Dsol* 2222



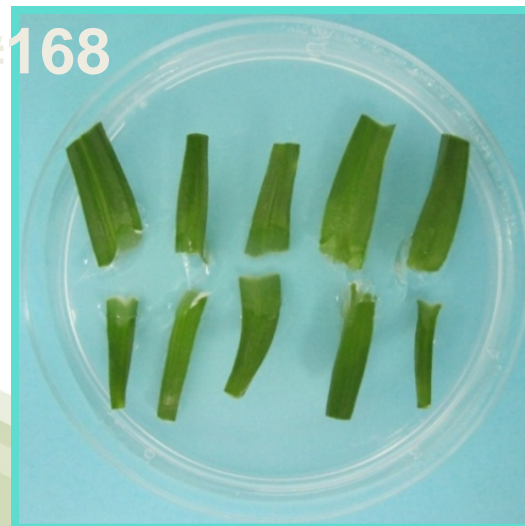
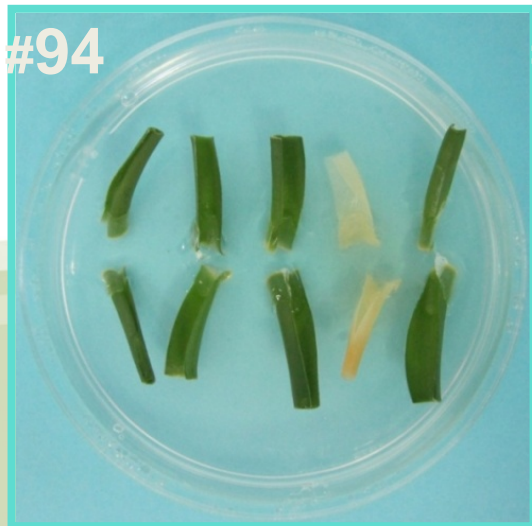
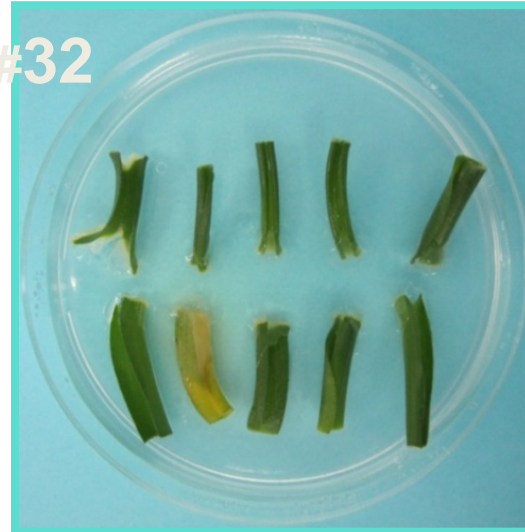
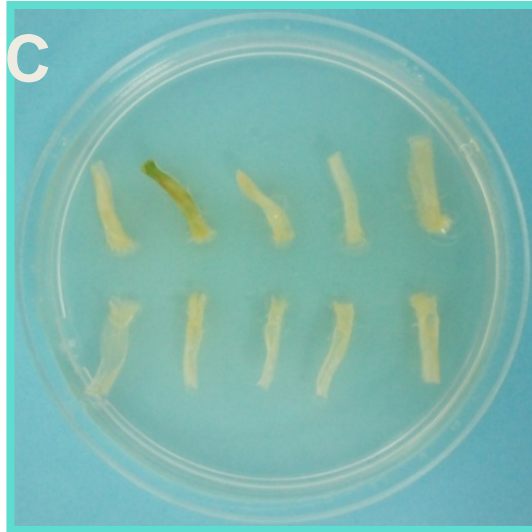
# Development of a new test



- Root cuttings
- Vacuum infiltration of whole seedling
- Increased humidity
- Forceps damage to leaf
- Petiole test (vd Wolf)



# Leaf segment assay



95/49/

99/2/32

99/2/28

95/36/1

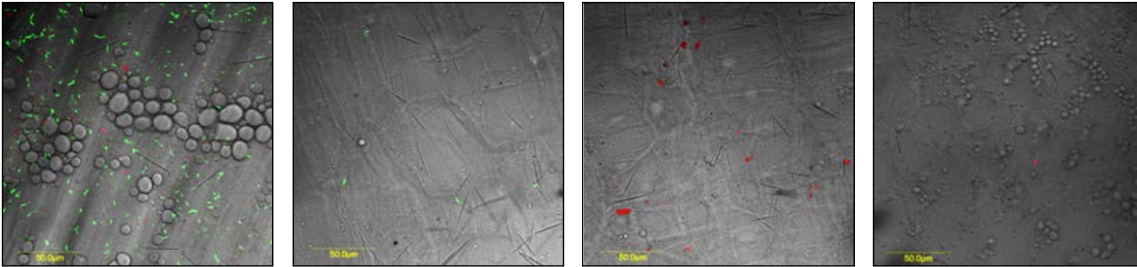


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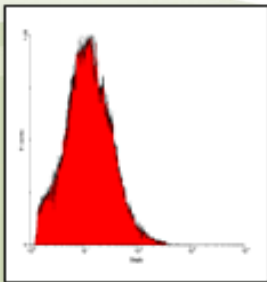
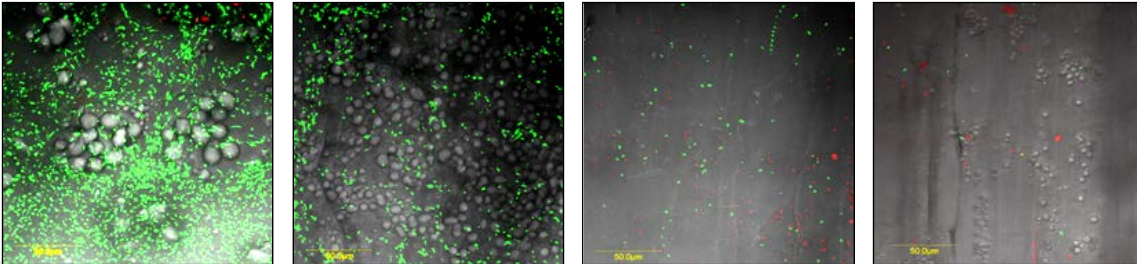
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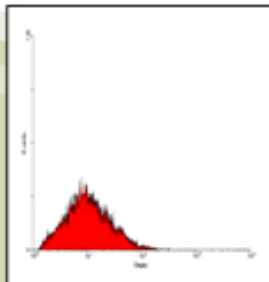
2 dpi



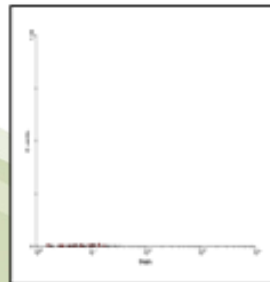
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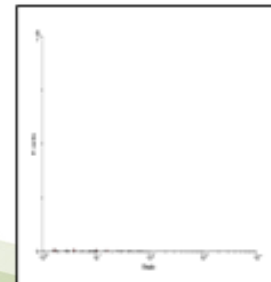
$1.2 \times 10^9 / 1g$



$2.1 \times 10^8 / 1g$



$2.6 \times 10^6 / 1g$



$1.2 \times 10^6 / 1g$



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# Future work

- Develop a high throughput glasshouse method.
- Test bacterial growth and strain movement (using GFP) to ensure that both parental material and resulting progeny are resistant rather than tolerant.
- Test resistant material against other strains and species.



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# Acknowledgements

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Riaghaltas na h-Alba