



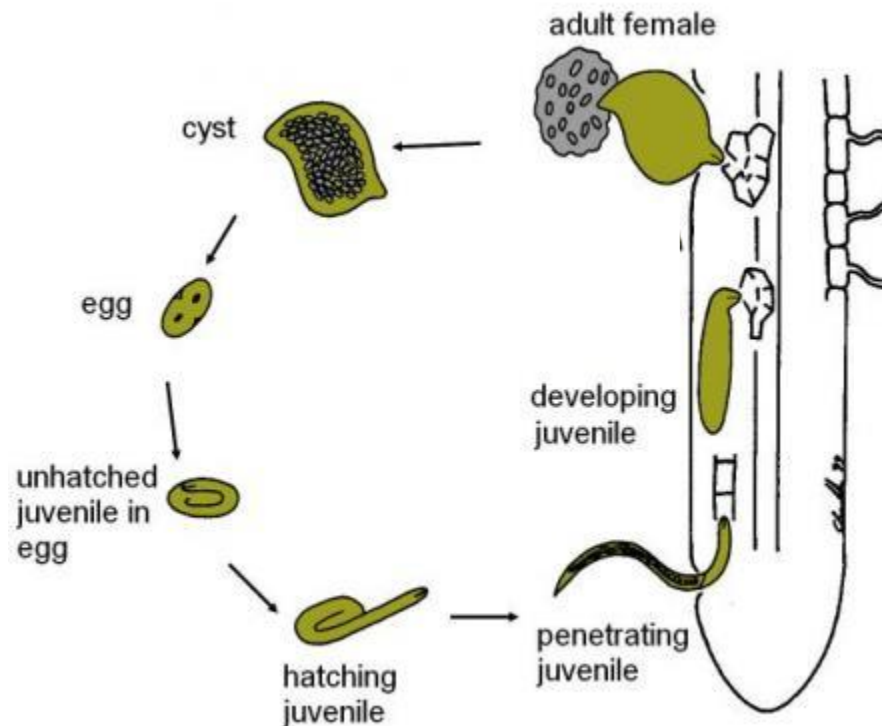
The Search for Nematode Resistance: Mapping the *H2* Gene

Shona Strachan



Impact of *Globodera pallida*

- Potato cyst nematodes (*Globodera rostochiensis* and *G. pallida*) introduced from native South America
- Cause losses in excess of £45 million
- Remain dormant in the soil, as cysts, for many years





Infection and the Hypersensitive Response

Susceptible



Resistant





PCN Resistance Genes

G. rostochiensis

G. pallida

H1



1 *R* Gene

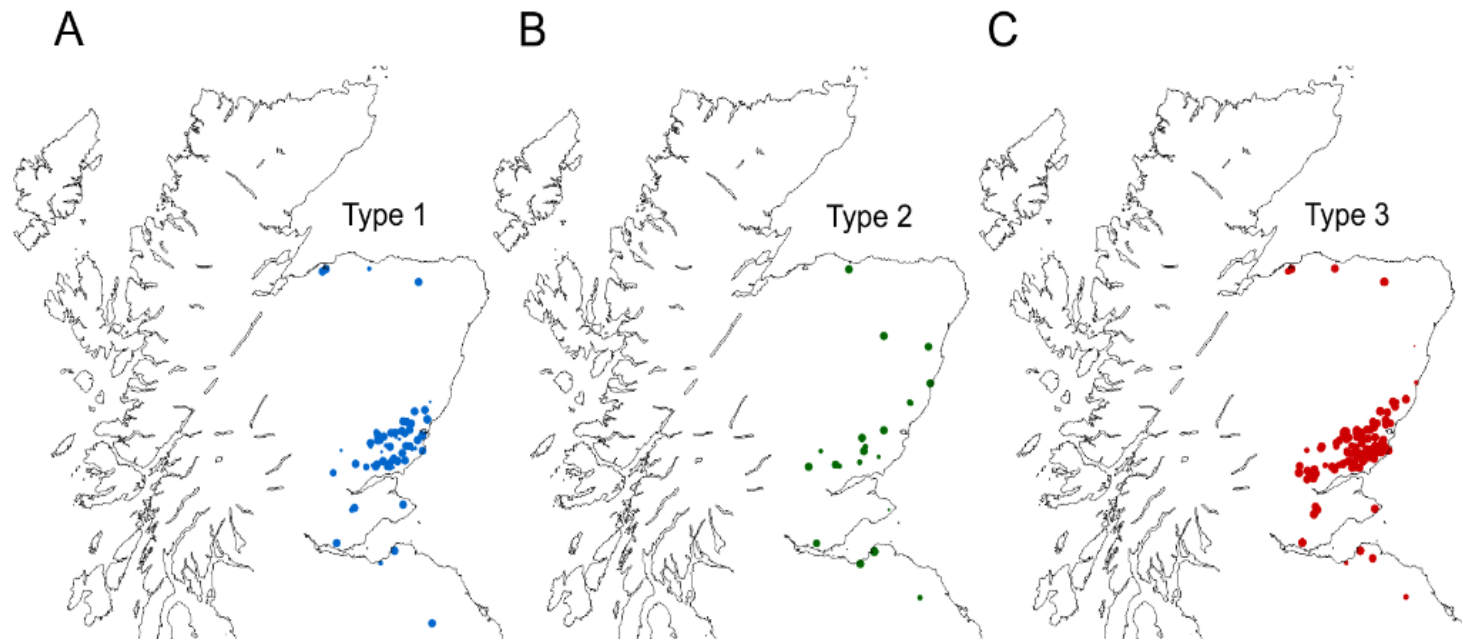


Pa1, Pa2/3



Appearance of *G. pallida* in Scotland

- The *H2* gene controls the Pa1 pathotype of *G. pallida*



Type 2 cytB includes Pa1

Sebastian Eves-van den Akker *et al.* (2015) A metagenetics approach to simultaneously quantify the relative abundance of cyst nematode mitotypes at the level of the county, the field and the individual. (submitted)

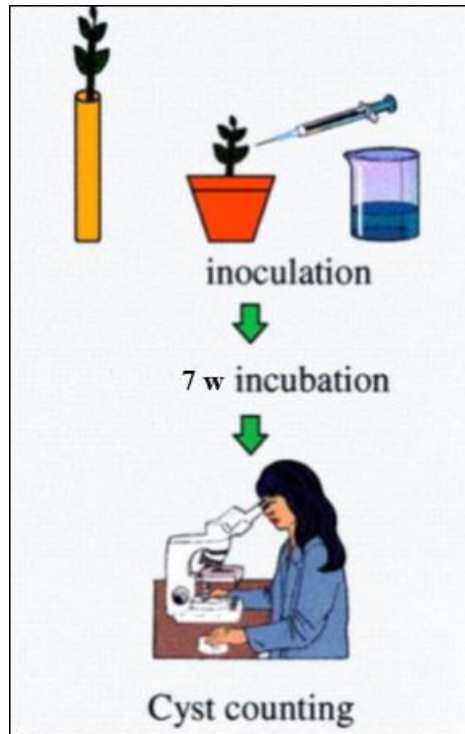


Map the functional *H2* resistance gene(s) using the sequenced potato genome (DM) as a reference



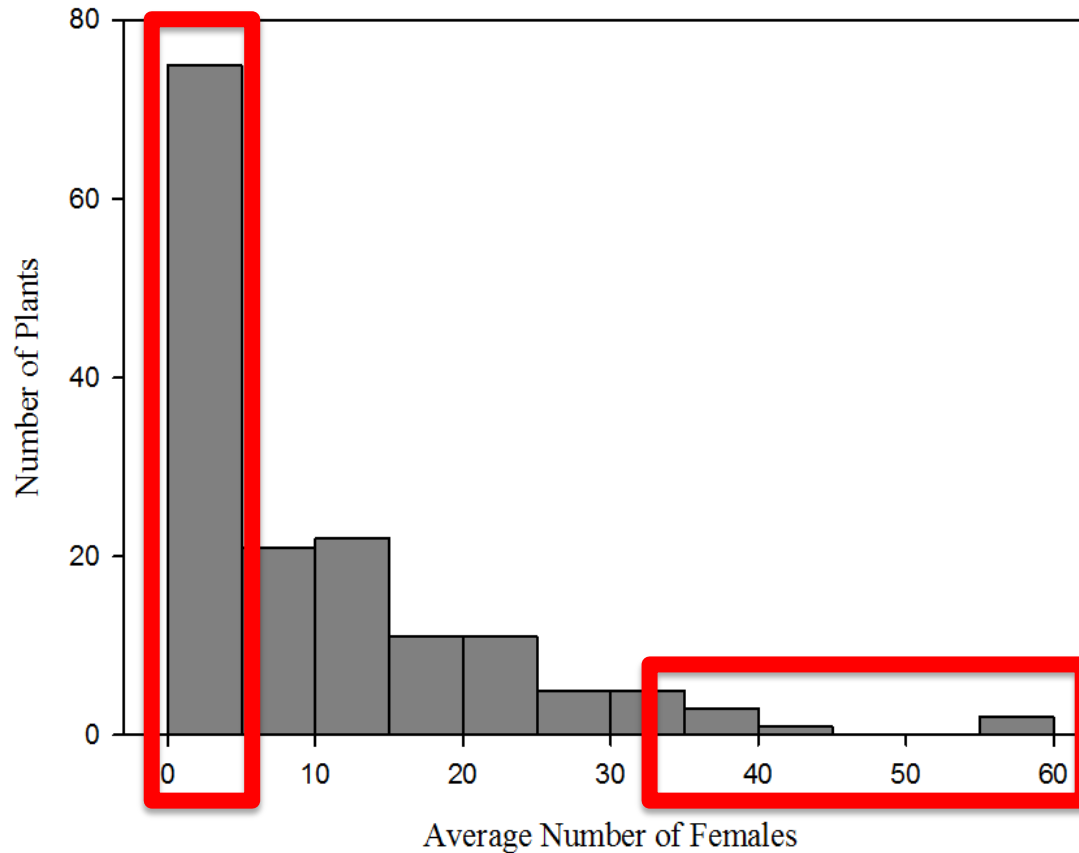
Phenotyping the resistance in a segregating progeny

- 192 progeny plants from Picasso x P55/7
- Summer 2014 = clonal propagation via cuttings
- Spring 2015 = tuber grown plants





Phenotypic evaluation suggests a near 1:1 ratio of segregation

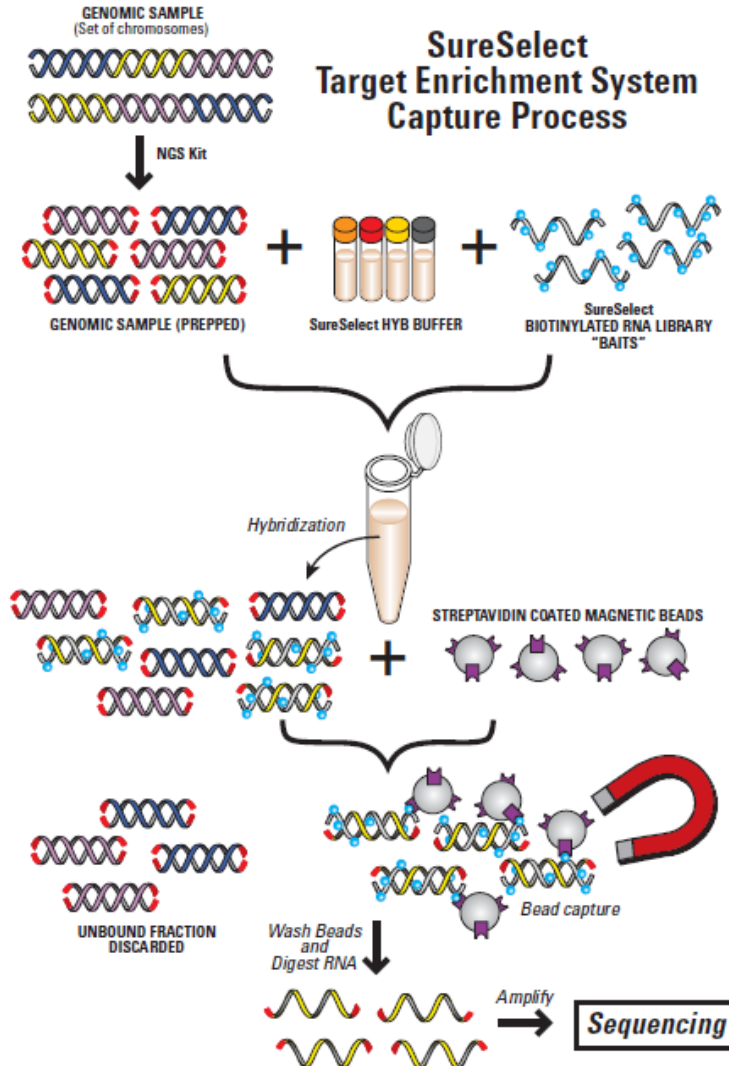


Picasso [SSSS] X P55/7 [RSSS]



Genotyping via GenSeq

- R
- S



y and P55/7
ogeny and Picasso

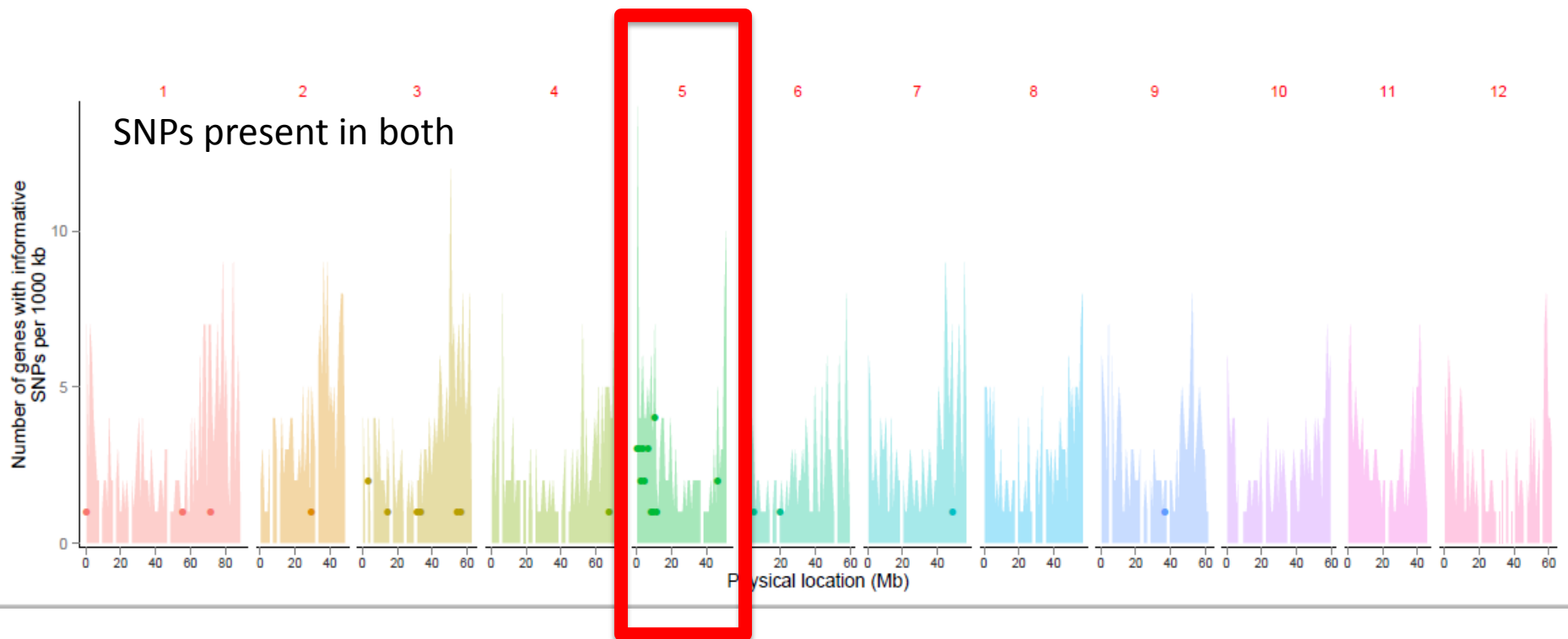
nt

→ MiSeq Sequencing

Extr



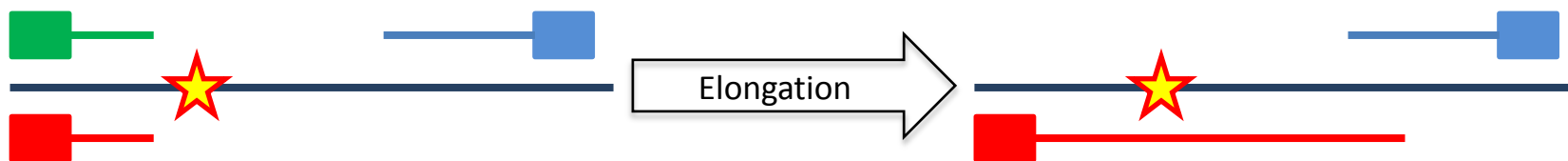
Graphical distribution of informative SNPs on 12 chromosomes



All images created by Katie Baker

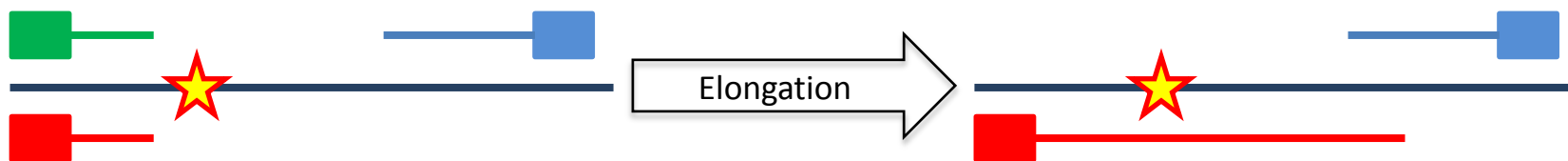


KASP Marker Analysis





KASP Marker Analysis





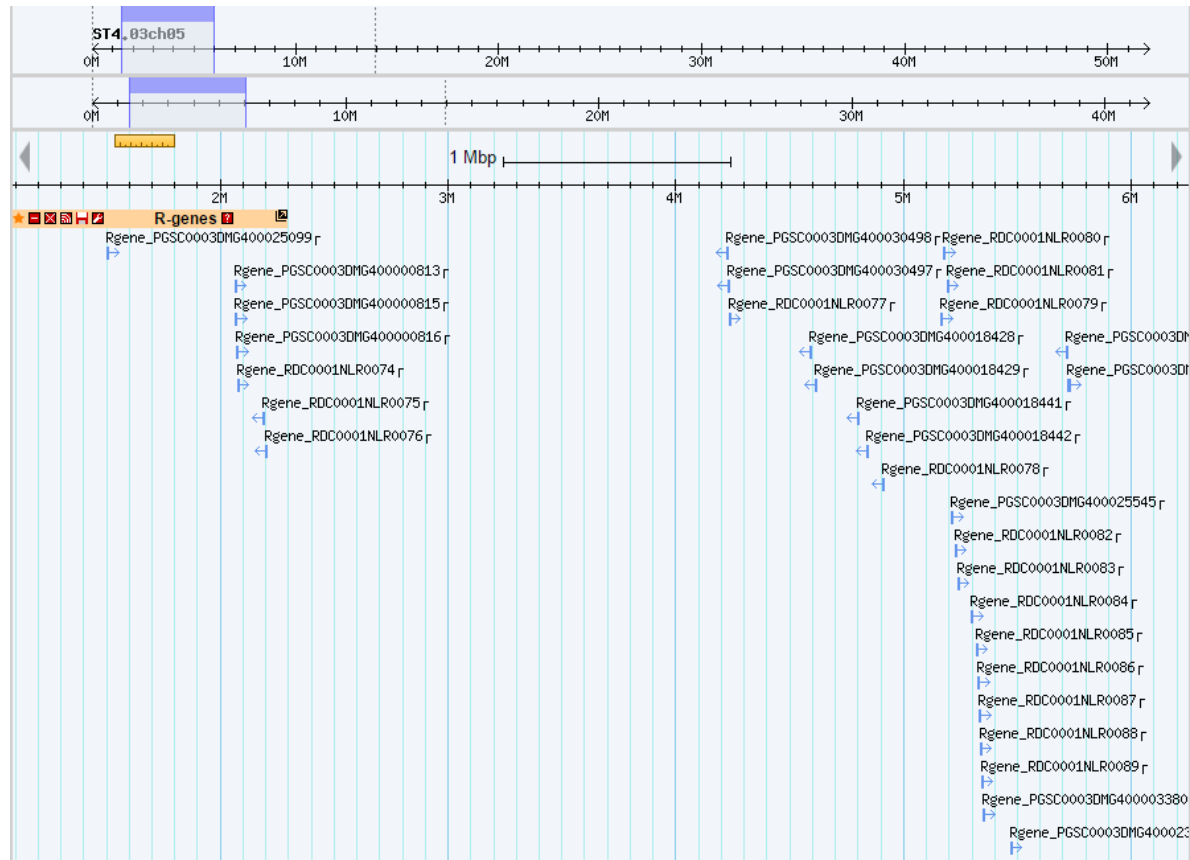
Allele specific KASP Markers and graphical genotyping delimits a 4.7Mb interval

	81	6	7	★ 8	17	40	45	47	55	57	65	★ 72	★ 93	100	★ 104	131	135	★ 168	
ST04_03ch05_141633	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	100 0 0 0 0
ST04_03ch05_143782	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0 0 0 0 0
ST04_03ch03_143853	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0 0 0 0 0
ST04_03ch05_300075	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0 0 0 0 0
ST04_03ch05_44910	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0 0 0 0 0
ST04_03ch05_47376	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0 0 - 0
ST04_03ch05_60792	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0 0 0 1
ST04_03ch05_10615	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 1 0 0 1
ST04_03ch05_11253	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0 1 0 0 1
	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	
	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1	
	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1	



Chromosome V

- *H2* gene probably within one of two resistance (*R*) gene clusters



Re-phenotype recombinant progeny plants

- Repeat KASP assays for all progeny plants

[illegible]

Recombinants	2014	2016
72	26	31
73	10.67	37
176	14	38
93	22.33	73
107	0.33	10
109	0.67	1

Progeny	2014	2016
87	0	2
91	0	4
15	0.67	4
110	0	6
47	38	74
65	24.67	16



Next Steps

- Repeat using 1000 progeny plants
 - decrease the area of genome to target
 - increases confidence



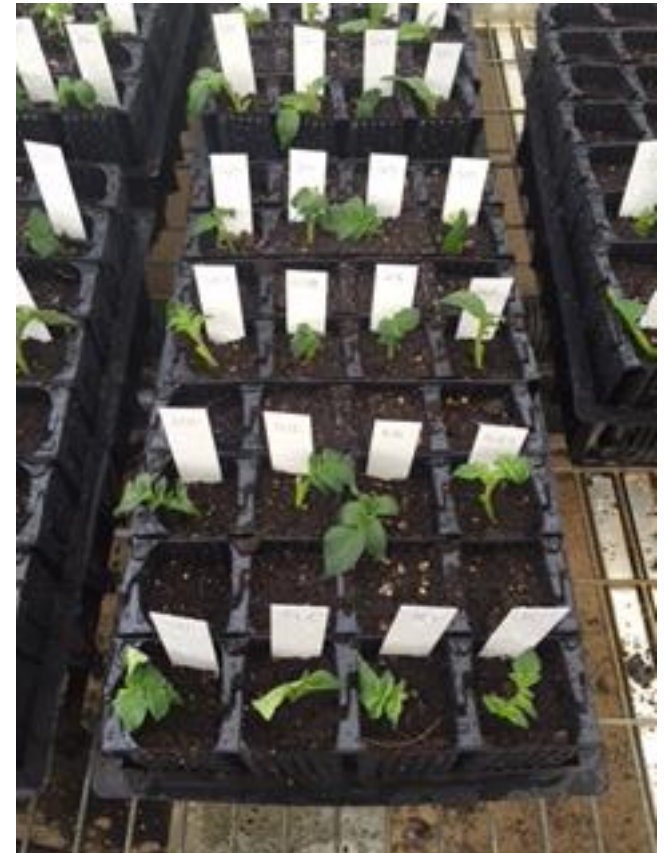
[illegible][illegible]

	Piscaso	P567	S29	S30	S31	S32	S33	S34	S35	S36	S37	S38	S39	S40	S41	S42	S43	S44	S45	S46	S47	S48	S49	S50	S51	S52	S53	S54	S55	S56	S57	S58	S59	S60	S61	S62	S63	S64	S65	S66	S67	S68	S69	S70	S71	S72	S73	S74	S75	S76	S77	S78	S79	S80	S81	S82	S83	S84	S85	S86	S87	S88	S89	S90	S91	S92	S93	S94	S95	S96	S97	S98	S99	S100	S101	S102	S103	S104	S105	S106	S107	S108	S109	S110	S111	S112	S113	S114	S115	S116	S117	S118	S119	S120	S121	S122	S123	S124	S125	S126	S127	S128	S129	S130	S131	S132	S133	S134	S135	S136	S137	S138	S139	S140	S141	S142	S143	S144	S145	S146	S147	S148	S149	S150	S151	S152	S153	S154	S155	S156	S157	S158	S159	S160	S161	S162	S163	S164	S165	S166	S167	S168	S169	S170	S171	S172	S173	S174	S175	S176	S177	S178	S179	S180	S181	S182	S183	S184	S185	S186	S187	S188	S189	S190	S191	S192	S193	S194	S195	S196	S197	S198	S199	S200	S201	S202	S203	S204	S205	S206	S207	S208	S209	S210	S211	S212	S213	S214	S215	S216	S217	S218	S219	S220	S221	S222	S223	S224	S225	S226	S227	S228	S229	S230	S231	S232	S233	S234	S235	S236	S237	S238	S239	S240	S241	S242	S243	S244	S245	S246	S247	S248	S249	S250	S251	S252	S253	S254	S255	S256	S257	S258	S259	S260	S261	S262	S263	S264	S265	S266	S267	S268	S269	S270	S271	S272	S273	S274	S275	S276	S277	S278	S279	S280	S281	S282	S283	S284	S285	S286	S287	S288	S289	S290	S291	S292	S293	S294	S295	S296	S297	S298	S299	S300	S301	S302	S303	S304	S305	S306	S307	S308	S309	S310	S311	S312	S313	S314	S315	S316	S317	S318	S319	S320	S321	S322	S323	S324	S325	S326	S327	S328	S329	S330	S331	S332	S333	S334	S335	S336	S337	S338	S339	S340	S341	S342	S343	S344	S345	S346	S347	S348	S349	S350	S351	S352	S353	S354	S355	S356	S357	S358	S359	S360	S361	S362	S363	S364	S365	S366	S367	S368	S369	S370	S371	S372	S373	S374	S375	S376	S377	S378	S379	S380	S381	S382	S383	S384	S385	S386	S387	S388	S389	S390	S391	S392	S393	S394	S395	S396	S397	S398	S399	S400	S401	S402	S403	S404	S405	S406	S407	S408	S409	S410	S411	S412	S413	S414	S415	S416	S417	S418	S419	S420	S421	S422	S423	S424	S425	S426	S427	S428	S429	S430	S431	S432	S433	S434	S435	S436	S437	S438	S439	S440	S441	S442	S443	S444	S445	S446	S447	S448	S449	S450	S451	S452	S453	S454	S455	S456	S457	S458	S459	S460	S461	S462	S463	S464	S465	S466	S467	S468	S469	S470	S471	S472	S473	S474	S475	S476	S477	S478	S479	S480	S481	S482	S483	S484	S485	S486	S487	S488	S489	S490	S491	S492	S493	S494	S495	S496	S497	S498	S499	S500	S501	S502	S503	S504	S505	S506	S507	S508	S509	S510	S511	S512	S513	S514	S515	S516	S517	S518	S519	S520	S521	S522	S523	S524	S525	S526	S527	S528	S529	S530	S531	S532	S533	S534	S535	S536	S537	S538	S539	S540	S541	S542	S543	S544	S545	S546	S547	S548	S549	S550	S551	S552	S553	S554	S555	S556	S557	S558	S559	S560	S561	S562	S563	S564	S565	S566	S567	S568	S569	S570	S571	S572	S573	S574	S575	S576	S577	S578	S579	S580	S581	S582	S583	S584	S585	S586	S587	S588	S589	S590	S591	S592	S593	S594	S595	S596	S597	S598	S599	S600	S601	S602	S603	S604	S605	S606	S607	S608	S609	S610	S611	S612	S613	S614	S615	S616	S617	S618	S619	S620	S621	S622	S623	S624	S625	S626	S627	S628	S629	S630	S631	S632	S633	S634	S635	S636	S637	S638	S639	S640	S641	S642	S643	S644	S645	S646	S647	S648	S649	S650	S651	S652	S653	S654	S655	S656
ST04_03ch05_1438531	0	1	-	1	0	1	1	1	0	0	-	0	-	0	-	1	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0													



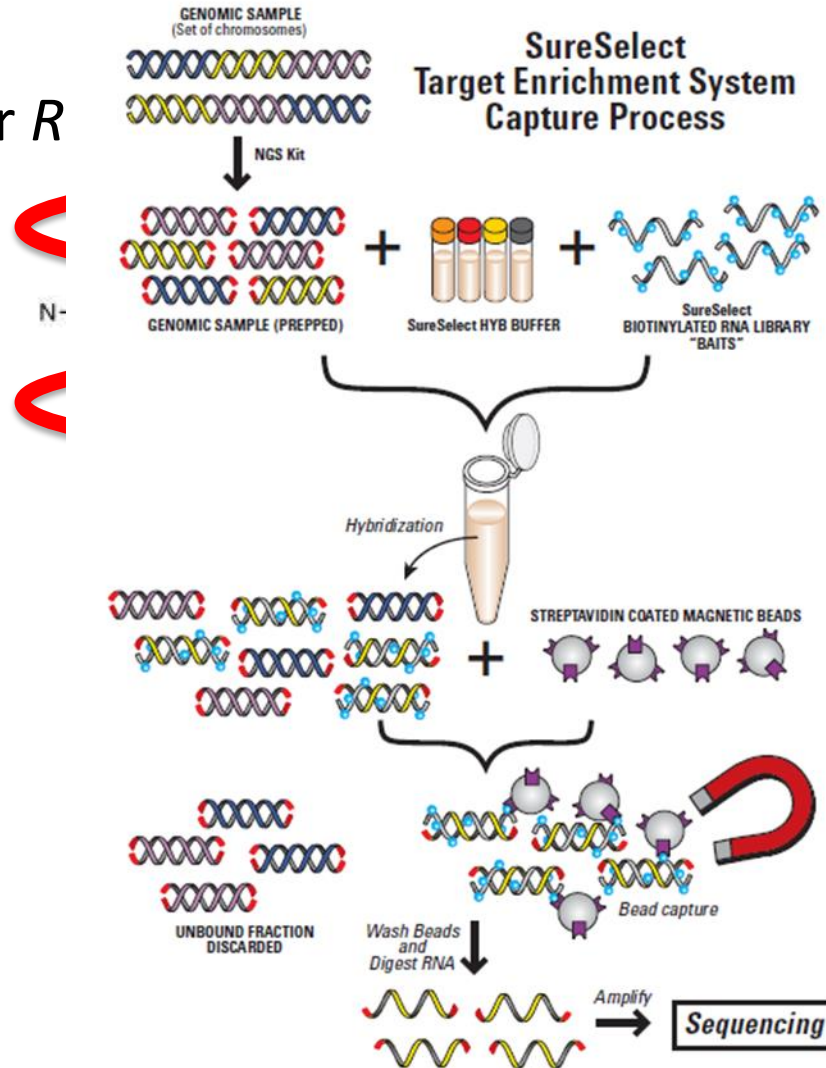
Phenotypically test recombinant progeny

- Do not know how these plants react when infected with Pa1 cysts
- Repeat screening process as in 2014
 - 4 clonal propagates of each plant
 - 80 propagates of 'control' plants



What happens next?

- Enrich for R





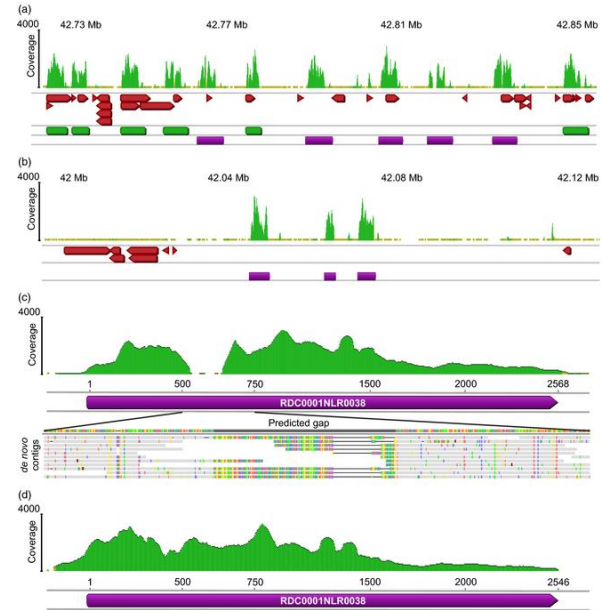
What happens next?



The James
Hutton
Institute



+



Jupe *et al* 2013, The Plant Journal



H2



Acknowledgments

Lab of Nematology

- Vivian Blok
- John Jones
- Sophie Mantelin
- Jamie Orr
- Kyriakos Varypatakis
- James Price
- Ulrike Gartner
- Anne Holt
- Ailsa Smith

Special Thanks

- Ingo Hein
- Katie Baker
- Glenn Bryan
- Miles Armstrong
- Karen McLean
- Gaynor McKenzie



University of
St Andrews

