Screening potato breeding clones and varieties for resistance to three potato cyst nematode species

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Two species of potato cyst nematodes, *Globodera rostochiensis,* and *G. pallida*, are found in the United States. Potato is also a host for a newly described *Globodera* species, *G. ellingtonae*. All three *Globodera* spp. were used in this study to evaluate resistance in 22 potato breeding clones and varieties. Each clone was replicated four to five times using similar methodologies conducted in two replicated experiments with each nematode species. Three entries had high resistance to all three cyst nematodes. Seven entries had resistance to *G. ellingtonae* and *G. rostochiensis.* There was close alignment with resistance to *G. ellingtonae* and *G. rostochiensis*, suggesting that the significant effort to incorporate resistance to *G. rostochiensis* may provide twice the benefit.

INTRODUCTION

Potato cyst nematodes (PCN) (*Globodera* spp.) are of worldwide regulatory concern, and are some of the most economically important pests of potato, causing significant yield loss if not controlled. Very few effective control measures exist for minimizing their impact, but host resistance provides an excellent tool for control of these pests. Development of resistance to one or more species of potato cyst nematode would provide host resistance, but currently, there are no commercially acceptable potato varieties in the U.S. with resistance to PCN for use by growers in the Northwest.

In 2006, pale cyst nematode (*Globodera pallida*) was detected in Idaho, USA and golden nematode (*Globodera rostochiensis*) was detected in Quebec, Canada. A third nematode, *G. ellingtonae,* was detected in Oregon and Idaho in 2008. Prior to that *G. pallida* had not been detected in USA, and *G. rostochiensis* was only known in New York, Newfoundland and British Columbia in North America.

Two of these nematodes (*G. pallida* and *G. rostochiensis*) are under quarantine by regulatory agencies in each country. Although potato is a host for *G. ellingtonae*, it is not currently listed as a quarantine pest. Without a quarantine policy for *G. pallida or G. rostochiensis,* many importing countries may refuse to accept potatoes from the USA or Canada even from non-infested areas.

This study combined the research efforts of three nematology labs with the potato breeding program at Aberdeen, Idaho to effectively screen existing varieties and advanced breeding lines for resistance to all three *Globodera* species.

This work is part of a larger effort involving 17 scientists from USA, Canada, UK, and France. This team has partnered together a grant called **GLOBAL** to find effective solutions to the potato cyst nematode problems. Further information on their efforts can be found at **globodera.org**.

Table 1. Comparison of resistance ratings[1] across three potato cyst nematode species.

	Breeding line/variety	*Globodera pallida*	*Globodera rostochiensis*	*Globodera ellingtonae*	Average score	Resistance vs. Désirée
1	Moonlight	6	9	9	8	Resistant
2	Eden	5	9	9	8	Resistant
3	NY 121	6	8	9	8	Resistant
4	Sante	6	5	9	7	Partial Res.
5	Albatros	2	8	9	6	Partial Res.
6	Avondale	2	8	9	6	Partial Res.
7	Nicola	1	9	9	6	Partial Res.
8	Banba	1	8	9	6	Partial Res.
9	Karaka	5	4	9	6	Partial Res.
10	Slaney	2	6	9	6	Partial Res.
11	A08636-7PCN	4	6	3	4	Susceptible
12	A03882-10YN	3	4	4	4	Susceptible
13	A08636-8PCN	2	6	3	4	Susceptible
14	V-15-71	2	6	3	4	Susceptible
15	A03873-3	2	2	6	3	Susceptible
16	A08640-2	3	3	3	3	Susceptible
17	A08640-8	3	2	4	3	Susceptible
18	A061008-4	4	1	3	3	Susceptible
19	A07934-7	2	2	4	3	Susceptible
20	A06968-4	3	1	3	2	Susceptible
21	A08636-11PCN	1	4	2	2	Susceptible
22	A06689-2	1	2	3	2	Susceptible
ck1	Désirée	2	2	2	2	Susceptible
ck2	Russet Burbank	1	1	2	1	Susceptible
	Average	2.9	4.8	5.6		

[1]European Plant Protection Organization, % susceptibility compared to susceptible control. 1-9 scale; 9=<1%, 8=1.1-3%, 7=3.1-5%, 6=5.1-10%, 5=1-1-15%, 4=15.1-25%, 3=25.1-50%, 2=50.1-100, 1=>100%.

Table 2. Host status of a set of *Solanum* differentials for *Globodera* spp. found in the United States.

Differential[1]	*G. pallida*	*G. rostochiensis* Ro1	*G. rostochiensis* Ro2	*G. ellingtonae*
65.346/19 (S. vernei)	-	+	+/-[2]	-
62.33.3 (S. vernei)	+/-	+	+	+
D47/11 (S. andigina)	+/-	+	+/-	+
P55/7 (S. multidissectum)	-	+/-	-	-
12764ab1 (S. andigina)	+/-	+	+	+
Desiree	-	-	-	-

+ = RS > 8 (resistant); +/- = RS 5-7 (partially resistant); and, - = RS < 4 (susceptible).

RESULTS & DISCUSSION

Table 1. Moonlight, Eden, and NY121 showed the best resistance against all three *Globodera* species. Seven other entries had resistance against two species. Resistance to *G. ellingtonae* is similar to *G. rostochiensis* suggesting common sources of resistance. These results can be used by breeders to direct efforts to develop potato cyst nematode resistant varieties for the US industry.

Table 2. Differential potato lines developed for characterizing resistance/susceptible responses to different *Globodera* species and different populations were evaluated. As mentioned above, response to *G. ellingtonae* resembles the response to *G. rostochiensis* Ro2. These results closely correspond to previously observed responses with European nematode populations.

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