AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
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TITLE: Breeding for Resistance to Columbia Root Knot Nematode: Identification of New Sources of Resistance

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SUMMARY:

Columbia root knot nematode (CRKN*; Meloidogyne chitwoo*di) is the single most important nematode problem in the Columbia basin of Oregon and Washington. CRKN damage is economically critical as the infestation causes blemishes and pimple-like galls on tubers, rendering them unmarketable for fresh market and reducing quality when processed into chips and fries (Brown et al. 2014). Currently, growers rely heavily on fumigants to control CRKN. However, restrictions and outright bans of effective fumigants have increased cost and lowered effectiveness of fumigant application. Crop rotation is viewed as alternate method to control CRKN, but the persistence of this pathogen in the soil and its broad host range (Mojtahedi et al. 1988) often makes crop rotation an impractical approach. Large-scale contract farming can also limit crop rotation options. Because of environmental concerns over the use of harmful soil fumigants and the high cost incurred in its applications, host genetic resistance (resistant cultivars) is viewed as the most desirable, economical and long-term means of controlling CRKN. We aim at introgressing resistance for CRKN for long-term sustainable potato production.

OBJECTIVES:

1. Identify Sources of Resistance to CRKN
2. Introgress CRKN Resistance into Elite Potato Germplasm

PROCEDURES:

This project will be divided into three primary segments: an initial screening for resistance sources from wild potato germplasm, a replicated evaluation of sources identified in the initial screening using multiple isolates of CRKN, and the early introgression of resistance sources into elite *S. tuberosum* germplasm.

Isolates Used

MC1: An isolate representative of race 1, the most common CRKN race in the United States.

MCRoza: An isolate of race 1 that overcame root resistance introgressed from *S. bulbocastanum.*
MC27: An isolate representative of race 2, a race that has a different host profile than race 1, and has become more common with increased use of alfalfa in rotations.
CAMC2: An isolate of race 2 that can infect the wild clone SB22, the source of CRKN resistance introgressed from *S. bulbocastanum*.

Initial Screening for resistance to CRKN

True potato seeds from 46 plant introductions (PIs) were ordered from the NSRP-6, Potato Genebank, Sturgeon Bay, Wisconsin. PI's include: *S. iopetalum*, *S. bulbocastanum*, *S. hougasii*, *S. boliviense, S. guerreroense, S. brevicaule*, *S. stenophyllidium*, *S. stoloniferum*, and *S. andreanum*. These species were selected based on diversity, presence of resistance in the past CRKN resistance screening studies, and the ease of introgression into tetraploid potato germplasm.

For screening, 20 seedlings from each PI will be planted in 1" pots. After 28 days, ten seedlings from each PI will be transplanted into 4" pots, and inoculated with 5,000 eggs of the "Roza" pathotype of race 1 of CRKN, applied directly to the root system with a pipette. Ten seedlings of "Rutgers" tomato will be used as susceptible checks. Fifty-five days after inoculation, eggs will be extracted from the potato seedlings, and counted with a compound microscope.

Preliminary resistance screening for CRKN will be conducted in multiple sets.. Cuttings of each potato seedling will be made so that they can be clonally propagated in the event that the initial screening suggests potential source of resistance. Individual genotypes will not be replicated at this stage as a) plants would need to be clonally produced before the nematode resistance screening, which would limit our ability to screen a large, diverse panel and b) each PI is replicated, allowing for limited statistical inferences.

Based on the initial screening, putative resistant clones will be propagated from stem cuttings for replicated resistance screening.

Replicated Evaluation of CRKN Resistance Sources

We will evaluate each potential source of CRKN resistance against four isolates of CRKN (MC1, MCRoza, MC27, and CAMC2), replicated twice. Inoculation and quantification procedures will be similar to the unreplicated screening as explained previously. This evaluation will serve to verify that the selected accessions are resistant to MCRoza, and to evaluate each source of resistance against various pathotypes of CRKN.

Early Introgression into Elite Germplasm

Promising clones with potential resistance to CRKN will be introgressed into elite *S. tuberosum* germplasm, and will be maintained in tissue culture indefinitely for future research. Most species screened in this study will cross directly with elite potato clones. Several *S. tuberosum* clones will be used as parents to maximize the likelihood of successful crosses.

SIGNIFICANT ACCOMPLISHMENTS TO DATE:

1. We have completed the initial evaluation of a wide panel of wild potato accessions and identified approximately 30 clones from 6 wild potato species with potential resistance to Roza pathotype of CRKN.

2. In conducting the replicated evaluation of these clones, we have hit several setbacks, most likely due to greenhouse temperatures outside of those required by CRKN. However, from the data we have gathered, we have narrowed our efforts down to 18 clones from 3 wild potato species for which we are very confident that novel resistance to Race 1 of CRKN. Full replicated results from this phase of the experiment are expected this spring.

BENEFITS & IMPACT:
Once the breadth of resistance present in each of the clones we have identified is better understood, they will extremely valuable in the development of potato clones with durable resistance to CRKN.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM: No additional funding was received

FUTURE FUNDING POSSIBILITIES: We applied for USDA-AFRI grant based on our initial screening results. The proposal was not funded but the reviewers asked us to provide more screening results and suggested us to apply once we have confirmed source of resistance to CRKN.