

**Deployment of Nutrient-Rich Nematode Resistant Carrots to Benefit Growers,
Consumers, and the Environment
2011 Progress**

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Outputs

Carrot populations developed from parents representing several sources of resistance were displayed in field trials during USDA – UC Desert Research and Extension Center (DREC) carrot field day March 1, 2011 (attended by about 50 carrot industry reps and local news media), the annual USDA – UW field day August 26, 2011 (~20 carrot industry and university students), and USDA – UC Kearney Agr Center Field Day Sept. 15, 2011 (~20 carrot growers and industry reps, and local news media). USDA experimental hybrids including nematode resistant parents had high horticultural quality (appearance and flavor) based on performance evaluated by attendees, and USDA experimental nematode resistant germplasm including resistant parents had high levels of nematode resistance where nematode resistance to two species of root-knot nematode was evaluated. A press release on the USDA – UC DREC trial attracted media attention in the local newspaper. The USDA – UC Kearney trial attracted coverage by the industry trade journal, Carrot Country, which resulted in the major story including cover photo for the Fall, 2011 issue. Progress in nematode screening and seed production of resistant selections was discussed at the California Fresh Carrot Advisory Board Meeting March 15, 2011 in Bakersfield to ~30 carrot growers, shippers, and seed companies representing ~70% of the U.S. production and most of the U.S. growing area with warm climate nematode attack; and the 35th Intl. Carrot Conf. November 30 in South Africa to ~140 carrot growers, processors, and seed companies. Detailed results of the nematode resistance and agronomic screenings were reported in the annual report of the California Fresh Carrot Advisory Board which is distributed industry-wide. Nematode resistant carrots were featured at 1) the Farm Smart Program at UC DREC in January and March, 2011 (>8000 “learners” annually), and the University of Wisconsin Horticultural Field Days in September, 2011 (>200 participants). Carrots were provided, described to the public and samples made available for tasting. A lecture on carrots that included several images of nematode resistant carrots and this project, was presented at “Wednesday Night at the Lab”, a UW public science education program with ~80 attendees from the public, videostreaming at WHA, the Wisconsin Public Television network, and broadcast 4x. A web site (<http://www.ars.usda.gov/pandp/docs.htm?docid=19858>) is developed to target carrot growers and inform the public about carrots and the role nematode resistance will have for the U.S. crop. Regular interactions with industry provides stakeholder input. Reports, photos of carrots & trial results are posted. Collaborative trials in organic production sites are in place. Regular communications have been established with our advisory team, carrot grower and seed company representatives on

our industry stakeholder team, as well as with other carrot growers and seed companies. Large-scale seed lots (up to 4kg) of advanced nematode resistant carrot lines were developed with seed industry partners for evaluation under grower production field conditions as part of the resistant carrot implementation process.

Outcomes/Impacts

Carrots are an important source of nutrients for the U.S. diet and have \$550 million farm gate value to U.S. growers, but root-knot nematodes (*Meloidogyne* spp.) threaten approximately 3/4 of U.S. carrot crop. Nematode infection causes forking and galling disfigurement to carrot taproots resulting in cosmetic injury and economic loss. New sources of genetic resistance to the two most important root-knot species affecting carrot production, *M. javanica* and *M. incognita*, have been identified in several unrelated germplasm sources from local carrot populations of diverse geographic origins including Brazil, Europe, Syria, China, and Australia. These sources of nematode resistance vary widely in nutritional value and flavor. This project moves nematode resistant carrots to mainstream production and improves nutritional value of typical orange, nematode resistant carrots. The inheritance and genetic map location of resistance genes is being determined, and molecular markers are being developed to facilitate incorporation of resistance genes by indirect selection. Carrot types with unusual purple and yellow color that occur in resistant germplasm will also be available for large-scale and niche market growers. Progress has been made in achieving the goals of this project according to our proposed plan of work. This year preliminary provision of seed samples of selected resistant inbreds has been made to vegetable seed companies with carrot breeding programs to provide us with information about both field performance of inbreds and experimental hybrids produced by industry, and also seed production capability of this elite germplasm. This also allows initial incorporation of selected resistance genes into industry germplasm, making deployment possible through this vital industry conduit of our public sector-developed elite germplasm. Industry feed-back from five seed companies has been received and positive progress has been noted by them, in terms of ability to generate crosses incorporating both nematode resistance and horticultural field and consumer quality, and in terms of seed production capacity of selected materials. Nutritional quality evaluations have been made based upon carotenoid and anthocyanin pigment levels and types, and promising nutritional value is equivalent to or surpasses average carotene content of major current U.S. carrot cultivars, with typical anthocyanin and lutein content compared to several purple and yellow carrots grown in the U.S. Flavor evaluations indicated flavor comparable to standard U.S. carrots, with exceptional juicy texture noted in some selections..

Publications:

Simon, P.W., and Roberts, P.A. 2011 Deployment of Nutrient-Rich Nematode Resistant. 35th Int'l. Carrot Conference Meeting Abstracts, p. 3.

Participants and Training

Included co-PIs P.W. Simon and P. A. Roberts, J. Nunez, University of California Cooperative Extension, scientists and students with the USDA, ARS at the University of Wisconsin – Madison, and with the University of California-Riverside, carrot seed industry and producers. The California Fresh Carrot Advisory Board was also involved in undertaking this work. Professional development and training included presenting information to carrot growers groups at meetings and at field days on carrot nematode resistance evaluation trials and carrot hybrid germplasm evaluation trials. Participants from the general public were in attendance in lectures (Wisconsin and South Africa) and field days (California and Wisconsin) described in “Outputs”.

Target Audience

Included carrot seed producers, crop production industry, small-scale and organic specialty crop growers and support industry, vegetable researchers, plant geneticists, and consumers. A web site was developed to inform carrot industry, researchers, and consumers about project progress, and oral and poster presentations were made at crop production, national horticulture, plant breeding, and genomics meetings.