Abstract (36th International Carrot Conference, 14-17 August 2013, Madison, WI)

Xanthomonas hortorum pv. carotae causes bacterial blight of carrot. Genetic resistance to bacterial blight is limited in commercial carrot cultivars, and little public research has been carried out on screening for sources of resistance. Furthermore, disease symptoms typically do not develop until pathogen populations reach 10^7 to 10^8 CFU/g dry leaf tissue, complicating evaluations for resistance to X. hortorum pv. carotae infections in the field. Sixty-six plant introduction (PI) lines from the United States Department of Agriculture (USDA) National Plant Germplasm System, two inbred carrot lines from Dr. Philipp Simon’s carrot breeding program at the University of Wisconsin, and 17 proprietary carrot hybrids or open pollinated lines from six vegetable seed companies or breeders were screened for resistance to X. hortorum pv. carotae. Evaluations included percentage of the foliage that developed symptoms six weeks post-inoculation, and population of the pathogen (CFU/g dry leaf tissue) detected on a semi-selective agar medium (XCS) when the foliage was assayed six weeks post-inoculation. Pathogen populations on foliage ranged from 1.38 X 10^7 to 3.28 X 10^11 CFU/g dry leaf tissue for individual plants, with a median of 2.80 X 10^9 CFU/g dry leaf tissue, and a mean ± standard error of 8.36 X 10^1 ± 1.07 X 10^7 CFU/g dry leaf tissue. Severity of symptoms ranged from 0 to 50% of the foliage blighted, with a median of 7% and a mean ± standard error of 8.8 ± 0.38%. Visual symptoms after 6 weeks and CFU/g dry leaf tissue (arc sine transformed) were significantly correlated (Pearson’s correlation coefficient of r = 0.4685 at P<0.0001). Eight PI lines with potential resistance (lowest visual ratings and populations of X. hortorum pv. carotae detected) were selected for a second screening, along with five of the most susceptible PI lines to aid in the study of inheritance of resistance or susceptibility to X. hortorum pv. carotae. The lines that express the most resistance in the second screening will be crossed to inbred carrot lines from Dr. Simon’s program in an effort to incorporate the resistance into a genetic background available for public use. The variation detected among entries in this study suggests it should be possible to develop carrot cultivars with improved resistance to bacterial blight, but resistance is likely to be highly quantitative. Screening a more diverse set of Daucus germplasm may be necessary to identify greater sources of resistance.

Materials and Methods

Seed of carrot Plant Introduction (PI) lines were obtained from the USDA North Central Plant Introduction Station (Ames, IA) as well as two inbred, male sterile carrot lines (Phil Simon, USDA ARS, University of Wisconsin), and 17 proprietary cultivars. PI lines were selected based on preliminary screening for reaction to Xhc by cooperating seed companies.

Plants were grown in a greenhouse at the Washington State University NorthWestern Washington Research and Extension Center, in a randomized layout of 25 plants/rack. Ten weeks after planting, plants were enclosed in clear plastic bags for 24 h to increase relative humidity, the foliage spray-inoculated with Xhc (~10^6 CFU/ml) until runoff (Fig. 2), and enclosed in bags for 72 h. Foliar bacterial blight severity ratings (% of foliage with symptoms) were done for all plants/line 4 and 5 weeks post-inoculation. Five individual plants were then rated/line 6 weeks post-inoculation. After this rating, the population of Xhc on the foliage was quantified by assaying five individual plants/line (2). The foliage of each plant was cut into small pieces, shaken in PO4 buffer for 1 h, and a 10-fold dilution series prepared. An aliquot of each dilution was plated on the semi-selective XCS agar medium (3 replicate aliquots/dilution), the plates incubated at 28°C for 5 days in the dark, and colony counts calculated/g dry weight of the assayed foliage.

Discussion

• This screening demonstrated a wide range in reaction of 66 PIs to Xhc under greenhouse conditions.
• Variation among PIs in foliar ratings and Xhc levels detected suggests it may be possible to select and incorporate greater resistance to bacterial blight into commercial cultivars.
• However, variation in foliar ratings and Xhc populations among plants of individual lines demonstrates how erratic development of bacterial blight can complicate efforts to screen for resistance (3), even with plants inoculated uniformly.

This, combined with the heterogeneous PIs, means multiple screenings are needed to improve confidence in the results.

• Following a second screening, crosses will be made between putative resistant PIs and two inbred, male sterile lines, as well as susceptible PIs and the inbreds, to determine the inheritance of resistance/susceptibility.
• Progeny populations will be developed and screened in field trials to assess if greenhouse results reflect reactions in field conditions.

References


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