SENSITIVITY OF *XANTHOMONAS CAMPESTRIS* PV. *CAROTAE* TO COPPER PESTICIDES IN CENTRAL OREGON CARROT SEED FIELDS

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Abstract

Bacterial leaf blight of carrot *(Daucus carota* subsp. *sativus),* caused by *Xanthomonas campestris* pv. *carotae,* is a common problem in central Oregon carrot seed fields. Infection by this seedborne pathogen is difficult to prevent and disease management is difficult once established. Because copper-containing products are regularly applied to central Oregon carrot seed fields, the development of copper resistant populations of *X campestris* pv. *carotae* is a possibility. A survey of carrot seed fields was performed in summer 1998. Isolates of the bacterial pathogen were recovered from symptomatic leaf and umbel tissue. Copper resistance of each isolate was tested using a copper amended media technique. No *X campestris* isolates collected in 1998 were resistant to copper. In 1999, we will obtain a larger collection, isolating bacteria from a larger number of fields in central Oregon to broaden the scope of inference of this study.

Introduction

Bacterial leaf blight of carrot *(Daucus carota* subsp. *sativus),* caused by *Xanthomonas campestris* pv. *carotae,* is a common problem wherever carrots are grown, including central Oregon. Symptoms include necrotic leaf spots with irregular yellow halos, brown stem and petiole lesions, blighted umbels, and gummy bacterial exudates on stems and umbels. Infection reduces both carrot yield and seed quality. Once established, this disease is difficult to manage. Yet, disease prevention also is difficult because *X campestris* pv. *carotae* is seedborne and hot water seed treatments may not entirely eradicate the pathogen (Umesh et al, 1998).

Carrot seed has been produced in central Oregon since the 1970s and is regularly the most profitable crop per acre for this region. Planting treated seed to prevent disease may not be effective in seed production fields because new plantings are often adjacent to or very near older plantings. As the pathogen can be disseminated by irrigation water splashes, insects, and carrot refuse, initially healthy seedlings can become infected from nearby fields. The disease has even been observed in isolated plantings suggesting long distance transmission or seedbome inoculum. Copper-containing products are regularly applied each year to reduce disease and increase seed quality. Yet, there is no clear evidence that copper-containing products significantly reduce disease incidence or severity.

A variety of reasons may account for this lack of substantial control of bacterial blight in central Oregon. *X campestris* pv. *carotae* may systemically infect carrot early in the growing season and therefore cannot be eradicated from the field. Chemical protection is difficult because carrot is susceptible to the bacteria throughout its growth and infection can be continuous throughout the growing season. Lastly, the traditional copper-containing products may not be effective.

The ineffectiveness of these products could be due to the development of resistance in strains of the pathogen. Because copper products have traditionally been used in attempts to manage this disease and may be applied many times during the year, copper resistance is a possibility. Copper resistance has been reported in a variety of plant pathogenic bacteria, including *X campestris* pathovars pathogenic to other crops including pepper, tomato and walnut (Adaskaveg, 1985; Ritchie, 1991 Lee, 1993). Therefore, we investigated whether copper resistant strains ofX *campestris* pv. *carotae* exist in central Oregon carrot seed fields.

Materials and Methods

Symptomatic carrot plants were collected from eight fields located near Madras, OR between June and July 1998. Bacteria were isolated from leaf and stem lesions and blighted umbel tissue. Symptomatic tissue was macerated and soaked in sterile distilled water to allow bacteria to be released from the tissue. The water was then streaked onto nutrient agar to encourage bacterial growth. Bacteria resembling *Xanthomonas* colonies were selected for copper resistance screening and stored in distilled water at 4 C. Isolates were identified to genus and species using media based physiological tests. For comparison, a known *X campestris* pv. *carotae* isolate was obtained from Donald Cooksey of the University of California at Riverside.

Copper resistance screening was performed using techniques and agar media designed by Scheck et al (1996) and Anderson et al (1991). Jay Pscheidt of Oregon State University provided *Pseudomonas syringae* pv. *syringae* isolates with known copper sensitivity and resistance levels for the screening media. A known copper resistant strain ofX *campestris* pv. *vesicatoria* was also obtained from D. Cooksey. These three strains were used as copper sensitive and resistant controls in the carrot isolate screening tests.

Bacterial isolates were recovered from frozen storage, suspended in sterile distilled water, and plated onto a media containing CuSO4*H20 at concentrations of 0, 0.16, 0.32, 0.48, 0.64, 0.80, and 0.96 mM. This gradient of copper concentrations was used because bacterial copper resistance is quantitative. Cultures were incubated at 23 C for 72 h. The minimum copper concentration that prevented colony growth was recorded. Isolates that could grow at or above 0.32 mM CuSO4*H2O were considered resistant. Three replicates per isolate were used and each test was performed three times.

Results and Discussion

Of the eight fields from which carrots were collected, *Xanthomonas-like* bacteria was isolated from six locations. Twenty-two isolates were recovered from symptomatic tissue and 10 were characterized as *X campestris.* No isolate grew on media containing more than 0.16 mM CuSa4*H20. Therefore, all *X campestris* isolates were sensitive to copper.

This was a limited field survey and resulted in a small number ofX *campestris* isolates. The results from this limited collection and screening of bacteria from central Oregon carrot fields do not suggest that copper resistant strains exist in the region. But with approximately 3000 acres of carrot seed in central Oregon, more fields should be surveyed to broaden the inference of this study.

In 1999, we will collect symptomatic plants from a larger number of fields. As a copper screening method has now been developed, a large number of isolates can be tested. In addition, laboratory techniques will be modified to increase the recovery of bacteria from plant tissue. By determining whether copper resistant *X campestris* pv. *carotae* populations exist in central Oregon, the most effective disease management strategies, chemical or cultural, can be developed for bacterial leaf blight.

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Acknowledgements

This study was supported by a grant from the Integrated Pest Protection Center. We thank Drs. Donald Cooksey and Jay Pscheidt for providing bacterial isolates. For advice on copper resistance screening techniques, we thank Dr. Larry Moore of Oregon State University.