Combining Scouting and Tolerant Cultivars for the Effective Management of Leaf Blight Diseases of Carrots

Project Leaders: George Abawi and John Ludwig, Dept. of Plant Pathology.
NYSAES, Cornell University, Geneva, NY 14456

Cooperators: Carol MacNeil, Coop. Ext., Ontario CCE, Canandaiqua.
Chuck Bornt, Coop. Ext., Lake Plains Region, Albion.
Gib Scott, Agrilink Foods, Phelps
Nellie Call, Private Consultant, Batavia
Don Sweet, Private Consultant, Batavia
Peter Call, Grower, Batavia
Edward Hansen, Grower, Stanley
Larry Christenson, Grower, Hall
Bob McCarthy, Private Consultant

Assistants: Christine Vogel, Rebecca Gerhart, Scott VanNostrand

Background and Justification:

Leaf blight diseases continue to be a major factor in the production of carrots in New York. *Alternaria dauci* has been considered as the principal pathogen of carrot blight in New York, whereas a low incidence of leaf blight caused by *Cercospora carotae* is also observed annually. Yield losses can be significant if blight development occurs early in the season. In addition, the development of severe blight diseases will result in premature defoliation of carrots, thus reducing the efficiency of harvesting the crop and increasing yield losses. Management of these diseases is based primarily on the use of fungicide applications, usually starting in late June and continuing throughout the long carrot season. Currently, Bravo 720 is the most often used fungicide by carrot growers and is applied at the rate of 2 pts./A and as many as 8 times/season.

The results of extensive trials conducted in 1997 and 1998 in collaborating with carrot growers and Extension Staff demonstrated that the critical threshold level of 25% infected leaves is an appropriate trigger for the first fungicide application. It was also shown that subsequent sprays need to be applied at 10 – 14 days intervals if the scouting reports showed an increase in the severity of leaf blight or a high probability of wet weather conditions is forecast for the coming 2-5 days. In these tests, the grower-managed plots received more than double the number of sprays applied to the IPM plots. In addition, leaf blight severity ratings and carrot yield were about equal in the IPM and the grower-managed plots.

In 1998, it was also observed that the carrot varieties scouted in the IPM trials as well as others grown in New York differed greatly in their reaction to leaf blight. For example, Carson and Fullback appeared as highly tolerant at one location and Carson required no fungicide application at another site. Thus, the leaf blight project conducted in 1999

focussed on assessing the reaction of available and promising varieties of carrots to fungal leaf pathogens in experimental and commercial fields. Twenty slicing and dicing cultivars were evaluated in the experimental field at the Geneva Station. The cultivars Fontana, Nevis, Newport and Napa showed the highest severity of leaf blight development among the 20 varieties included in the test. In contrast, the carrot cultivars Carson, Bolero, Ithaca, Calgary, Fullback, and Neal were the most tolerant to leaf blights. The latter was evident by the low leaf blight severity ratings recorded throughout the season and the relatively low area under the disease progress curve calculated for these varieties. In the commercial field in Genesee county, the incidence (number of leaves infected) and severity of leaf blights were lowest on the cultivar Carson, but were progressively higher on Newport, Eagle and Indiana. The latter differential disease reaction was exhibited, although all the cultivars received the first Bravo application on July 13. At the site #1 trial in Yates county, the most tolerant cultivar was again Carson and the incidence and severity of leaf blights were progressively higher on Kamaron, Nevis, Eagle and Indiana. The first fungicide spray at this site was applied on August 14. Boomer and Carson appeared the most tolerant in the trial at site #2 in Yates county, whereas Indiana, and Bergen were the most susceptible to leaf blights among the 7 varieties evaluated.

The identification of a number of locally adapted and commercially acceptable varieties with tolerance to leaf blight diseases will have a significant impact on grower pest management program and profitability of carrot production. A number of the tolerant varieties identified are already being grown at present or are being evaluated on a small scale by growers and industry personnel. The increased use of the identified tolerant varieties will definitely reduce the number of fungicide applications needed for control of these diseases, thus it will reduce production costs and contribute to environmental health. The effectiveness and impact of the combined use of tolerant varieties and the recommended scouting and forecasting procedure in the management of leaf blight diseases need to be demonstrated in collaboration with carrot growers. The latter will not only greatly reduce the number of fungicide applications needed per growing season, but may well eliminate the fungicide applications especially during a growing season such as that of 1999.

Procedures:

Twenty-one slicing and dicing carrot varieties were planted on May 31 at the NYSAES Vegetable Research Farm. Individual plots of each variety consisted of four rows, 10 ft long and replicated 5 times in a randomized complete block design. Spreader rows of the susceptible cultivar ‘Eagle’ were planted between the tested varieties and also around the plot area in order to increase disease pressure and uniformity. All cultural practices employed were according to commercial production recommendations. As needed, the plots were irrigated and sprayed with the insecticide ‘Asana’, to control the leafhoppers and their transmission of Aster Yellows. However, no fungicide application was made throughout the season. All plots were scouted by examining 25 leaves from 5 sites to record the incidence of leaf blight diseases. About half the varieties included in the test were at the leaf blight threshold level (25% infected leaves) on August 8. Thus, only the

severity of leaf blights was recorded afterwords using a scale of 1 (no lesions, healthy) to 9 (>50% of leaves affected). Ratings of 2, 3, 4, 5, 6, 7, and 8 refer to 1 lesion –1%, 2-5%, 6-10%, 11-21%, 21-30%, 31-40%, and 41-50% of leaves affected, respectively.

Three carrot fields of collaborating growers were also selected to demonstrate the combined impact of scouting and the use of a tolerant cultivar in the management of leaf blight diseases. In each field, the cultivar Carson and a susceptible cultivar selected by the cooperating grower (Eagle, Bergen, and Canada at site #1, #2, and #3, respectively) were planted in large strips across the fields, each several widths of the grower's sprayer boom. Both varieties were in each field scouted weekly for the incidence and severity of leaf blight diseases as mentioned above. The weekly scouting data was collected using a "V' or "W" sampling design. A minimum of 50 leaves (50 plants early in the season) were examined from 10 sites (5/site) along the sampling pattern throughout the growing season. The initial fungicide application to each cultivar was applied when the critical threshold level of 25% infected leaves was reached. Additional fungicide sprays were applied based on the observed changes in disease severity, forecast of rainfall or dew periods (>30% probability), and allowing 10 – 14 days between sprays. The severity of leaf blight diseases on other carrot varieties grown in three additional fields were also made in late September. These varieties received the same number of fungicide sprays that were made according to the grower's disease management strategy.

Results and Conclusions:

The unusual wet and rather cool weather conditions, specially the low night temperature, that prevailed during the growing season greatly affected the etiology and development of leaf blight diseases. In contrast to previous years, *Cercospora carotae* was the predominate pathogen causing leaf blight during the 2000 growing season in New York. Alternaria-leaf blight appeared late and was only light in incidence and severity. It is known that the development of Alternaria-leaf blight is favored by warm night temperatures.

The replicated leaf blight variety trial was planted rather late (on May 31), due to prolonged wet soil conditions of the selected experimental field. Leaf blight development was slow and disease incidence and severity remained low during June and July. However, leaf blight incidence was above the critical threshold level (25% infected leaves) on 9 of the 21 varieties included in the test on August 8 (Figure 1). Disease severity increased on all the varieties from an average of 3.7 on August 18 to 6.2 on October 7. At the end of the season, severity of Cercospora-leaf blight development on the varieties included in the test varied significantly and ranged from moderate to very severe (Table 1). Bergen, Bristol, Neal, Bolero, Eagle, and Fullback were among the most tolerant varieties to Cercospora-leaf blight, whereas Napa, Fontana, Canada, Goliath, Calgary and Ithaca were among the most susceptible to this disease (Figure 2). Results of previous variety evaluation in New York suggested that Carson, Bolero, Ithaca, Calgary, fullback and Neal were among the most tolerant to Alternaria-leaf blight, whereas Fontana, Nevis, Newport, Napa, Kamaran, Goliath, Bergen and Eagle were among the most susceptible. Not surprisingly, the reaction of a number of the carrot

varieties to the two pathogens (*Cercospora* and *Alternaria*) of leaf blight diseases differed greatly. For example, Carson was the most tolerant to Alternaria-leaf blight, but was among the varieties exhibiting moderate to severe susceptible reaction to *Cercospora*, with an average disease severity of 6.2 on October 7. In contrast, Bergen, Eagle, and Ithaca were among the most tolerant varieties against *Cercospora*, but were among the most susceptible to Alternaria in previous tests (1997-1999). Interestingly, Bolero, Neal, and Fullback exhibited a tolerant reaction to both leaf blight diseases caused by *Cercospora* and *Alternaria*.

Results of leaf blight incidence and severity developed on Carson and Eagle (Field 1), Carson and Bergen (Field 2), and Carson and Canada (Field 3) are presented in Figures 3 – 8). Carson was selected as the tolerant varieties; whereas Eagle, Canada, and Bergen as the susceptible varieties based on the previous 3-year data obtained under severe pressure of Alternaria-leaf blight. As shown above, the reaction of these same varieties to Cercospora-leaf blight turned out to be different. Nevertheless, disease monitoring and timing of the first fungicide spray was equally effective. In field 1, leaf blight incidence developed faster on Eagle than Carson (Figure 3). The critical threshold level of 25% infected leaves on Eagle and Carson was reached on July 19 and August 1, respectively. However, disease severity on both varieties was about equal (Figure 6). The collaborating grower made a total of 6 and 7 Bravo applications to Eagle and Carson, respectively. The tops on Carson was better than that on Eagle, thus it was harvested later (mid-November) and resulting in the extra spray received. The yield of Carson and Eagle in this field averaged 26.5 and 24 tons/acre, respectively. In field 2, Bergen and Carson reached the critical threshold incidence on July 12 and July 19, respectively (Figure 4). However, severity of leaf blight development throughout the season was lower on Bergen than Carson (Figure 7). The collaborative monitoring and scheduling of needed fungicide sprays resulted in the application of 6 Bravo's sprays on both varieties. In field 3, the critical disease threshold level on Canada and Carson was reached on July 19 and August 8, respectively (Figure 5). Severity of leaf blight development throughout the season was lower on Carson than Canada (Figure 8). The first spray to both varieties was applied on August 11, due to excessive rainfall on August 1. Canada and Carson were sprayed 4 and 5 times, respectively due to the delayed harvesting of Carson. Leaf blight severity was also assessed on carrot varieties grown in other commercial fields in the same carrot production area. In one field on September 20, leaf blight severity on Goliath, Eagle and Moehren was 5.3, 6.0, and 6.9, respectively. In another field September 19, leaf blight severity on Bergen and Berlander was 3.5 and 8.2, respectively.

These results again demonstrated the effectiveness and practical use of the 25% infected leaves as the trigger for the first fungicide application. It was encouraging that the earliest first spray was applied in Field 2 on July 17, whereas Field 2 and field 3 received the first spray on July 19 and August 11, respectively. The latter is significant since unusually wet weather conditions that are favorable to leaf blight development occurred earlier than normal during this growing season. Thus, monitoring the critical threshold level of leaf blight diseases to time the first application contribute greatly to reducing the number of fungicide applications, even during weather conditions that favor disease development. Unfortunately, all sections of the selected fields were sprayed according to the scouting

program, thus it is not possible to accurately determine the saving in the fungicide used and the economics of disease control. Also, the epidemic development of Cercospora-leaf blight rather than the usual Alternaria-leaf blight in 2000 made it difficult to accurately assess the impact of combining the scouting program with the use of tolerant varieties in the control of these diseases. However, a knowledge was gained on the reaction of the carrot varieties to the Cercospora-leaf blight pathogen. Actually, three varieties (Bolero, Neal and Fullback) have exhibited tolerant reaction to the two fungal pathogens of leaf blight diseases. In 2000, Bergen (which is tolerant to *Cercospora*, but susceptible to *Alternaria*) was sprayed only 4 times, whereas Carson (Tolerant to *Alternaria*, but moderately susceptible to *Cercospora*) was sprayed 6 or 7 times, depending of the location.

Future Needs:

1. In-depth characterization of the reaction of carrot varieties of interest in New York to both *Alternaria dauci* and *Cercospora carotae* under controlled conditions.

2. Demonstration of the cost-benefit of using tolerant varieties in the management of leaf blight diseases and profitability of carrot production in New York.