BRIEF ARTICLES

AN EARLY WILT AND RUSTY ROOT PROBLEM IN CARROTS AT THE BRADFORD MARSH

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The Bradford Marsh is an area of approximately 8,000 acres of muck soil located about 50 miles north of Toronto. This area represents an important sector of the vegetable producing industry in Ontario. About 2,000 acres of this land is used for carrots and any threat to this crop is of considerable importance to the growers.

Historically, this probelm was first brought to the attention of government and university personnel in 1.962 when it occurred on two separate farms and was serious enough to cause some concern. Several persons were consulted but no one could identify the condition. The problem recurred in 1965, this time on several farms and with more extensive damage. Again, no one was able to identify the condition or suggest measures for control. Another outbreak occurred in 1968 causing extensive damage on a number of farms. During the years between these outbreaks the disease was comparatively mild and attracted little attention. The 1968 outbreak was undoubtedly serious enough to warrant an organized programme of study directed towards providing some of the answers.

Briefly, the problem can be described as follows: The first symptoms are noticed when the carrota; are about **4** to *6* inches tall. The tops wilt during the day and recover at night. After several days of this intermittent wilting the older leaves begin to show signs of necrosis at the margins and the affected areas in the field become quite conspicuous because of leaf discoloration and reduced growth. Examination of the roots reveals various degrees of decay on the tap root, especially at the point of origin of branch roots, and also on the branch roots themselves. Affected roots tend to become distinctively rusty-red in color in the vicinity of the nectrotic areas which appear flaky in texture. As the disease progresses and the amount of decay increases, plants begin to die, resulting in a reduced stand. However, if conditions for growth are good, the plants recover from these early symptoms and continue to grow and develop into a reasonably healthy-looking stand above ground. Below ground the situation is somewhat different. The carrots formed are short and stubby, the lower portion of the root having failed to expand. Other carrots are forked and knobby. Many of these misshapen carrots produce excessive fibrous branch roots which hold the soil during harvesting operations. The "rusty root" symptom is evident on these fibrous roots throughout the growing season. In 1968 this condition was so bad that several acreages were disced-under at harvest time because the carrots were considered non-marketable.

In a few instances, growers had reseeded the carrots where the initial stand was badly affected. These reseeded areas resulted in stands that were sufficiently disease-free to be economically harvested. This suggests the possibility that temperature and moisture may be involved in the problem. There is also some indication of difference in varietal susceptibility but the evidence is insufficient for a recommendation at the present time.

Although several persons have attempted to diagnose the problem, its cause has not yet been established. **A** reliable diagnosis with appropriate recommendations for control will undoubtedly require a substantial programme of careful research. An effort is being made to establish such a programme.

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EFFECTIVE RANGE OF BASIDIOSPORES OF GYMNOSPORANGIUM'

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References to effective basidiospore dissemination of Gymnosporangium are often understandably vague (Palmiter 1953, Bernaux 1956), but MacLachlan (1935) has made a definite estimate of a range as great as 7 or 8 miles. Recent field evidence has led to the conclusion that basidiospores may be effectively disseminated for even greater distances.

In the fall of 1968, roestelia of Gymnosporangium globosum Farl. were very abundant on leaves of Crateagus crus-galli L. and C. ?submollis Sarg. along edges of pasture and mixed wood near Maberly, Lanark Co., Ontario. The rust was first observed at this site on September 9, when aecia were slightly past maturity, many of them having lost half their spore mass. The infection was so heavy that the alternate host was assumed to be

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nearby even though the area is at the northern limit of Juniperus virginiana L. [red cedar] (Fox and Soper 1953). However the J. virginiana was not close by and was not found even within a mile of the site. Further search revealed rare andwidely scattered Juniperus 5 miles southwest that were healthy or exhibited very rare rust galls, and, many acres of red cedar trees some 15 miles south at Westport, Leeds Co., Ont. Galls were abundant in the latter area and telia have been collected from them in previous years; it seemed probable that these stands were the source of the inoculum for the rust outbreak at Maberly.

In eastern Ontario telia become evident in the first half of May and have gelatinized by the end of May or the first week of June. If climatological data should indicate a northerly spore dispersal. pattern at this period, there would be strong evidence in favor of Westport as the site of origin for the basidiospore inoculum on the Crataegus near Maberly.

Weather data for May and June were obtained from the Canada Department of Transport for the Kingston–Trenton area, and the following summary has been extracted:

WINDS: In May, winds prevailed form the southwest at 10 mph and continued through June. This wind direction was almost continuous from May 7 to 19. For the remainder of the month, the southwest winds were interrupted every other day by northerly and easterly wind flows. During June 1 to 8, winds were continuously from the southwest and south-southwest at 7 to 15 mph.

TEMPERATURE: Mean temperature for May was 52.8°F (11.5°C) with a mean maximum and mean minimum of 62.0°F (16.7°C) and 43.6°F (6.5°C). The days are described as partly cloudy to cloudy and overcast with only 10 clear days during the month. June 1 to 4, the mean maximum and mean minimum were 65.4°F (18.5°C) and 52.8°F (11.5°C), withmostly cloudy and overcast skies.

PRECIPITATION: Total rainfall in May was 5.03 inches (12.78 cm) recorded over 20 days. Slight rain was recorded for May 2–6, and southwesterly winds began on May 7 and continued through May 19. During this period, May 9, 11, 12, and 16–22 were rainy, as were May 28–31 and June 1–3.

Natural basidiospore dissemination takes place during and immediately following periods of precipitation (MacLachlan 1935). According to data summarized above, spore discharge would have occurred mainly between May 5 and May 23 and between May 29 and June 5. Basidiospores would have been directed towards Maberly during May 7–19 by southwesterly winds that continued at least every other day until June 8. Roestelia of G. globosum require 80–90 days to mature from time of inoculation (Parmelee 1965), hence the estimated dates for maturity at Maberly would be chiefly between August 7 and 23, and as late as September 3. The aecia that were collected on Crataegus on September 9 were estimated to be a week to 10 days past prime condition which is taken as fully elongated and just prior to rupturing. They had probably reached full maturity by the end of August, a date which fits adequately within the predicted periods.

The cool moist conditions in May and early June favored abundant basidiospore discharge, and the accompanying southweeterly winds secured northward spore dispersal toward Maberly. The time required for aecial development, added to the estimated period of spore dispersal, agrees with the date of aecial maturity at Maberly. Thus field evidence strongly supported by climatological data is the basis for concluding that Crataegus spp. near Maberly, Ontario, were infected by aerial inoculum originating some 15 miles away. Basidiospores of other species of Gymnosporangium may have a similar range of effective spread.

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