

Carrot cyst nematode population growth in the Holland Marsh, Ontario, Canada

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Introduction

The carrot cyst nematode (CCN), *Heterodera carotae* (Jones), is a carrot yield-robbing nematode commonly found in the high organic matter (muck) soils of the Holland Marsh, Ontario, Canada, and also found in organic soils in Michigan State, U.S.A. (Fig. 2 & 3). The nematode parasitizes carrot and wild carrot roots causing the carrots to become forked, stunted or smaller in size. To date, CCN has not been identified in any mineral soils in Ontario. The nematode has been found in 90% of fields sampled in the Holland Marsh, but not in any muck soils in other regions of the province.

Methods

Between 2016 to 2021, commercial fields of carrots and onions were assessed for the presence of CCN in the Marsh and the population change over seasons was tracked. A two-year carrot and onion rotation is common in the Holland Marsh. Fields were soil sampled in the Fall in an X pattern by collecting 20 cm soil cores. Two fields following a continuous carrot and onion rotation were also sampled annually from 2016 to 2021 to track CCN population changes. Juveniles and males were extracted using a modified Baermann pan method and female cysts were extracted using the Fenwick method (Fig. 1).

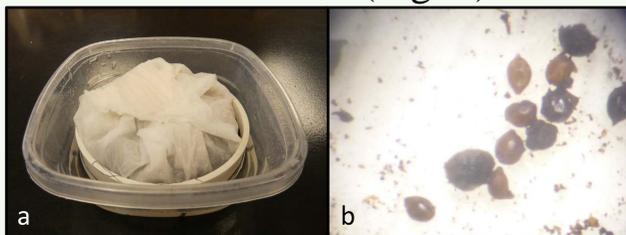


Figure 1. a) Baermann pan used for CCN juvenile extraction and b) females extracted from the Fenwick method.



Figure 2. a) CCN female with egg sac; b) CCN juvenile; and c) unmarketable carrots after CCN parasitism.

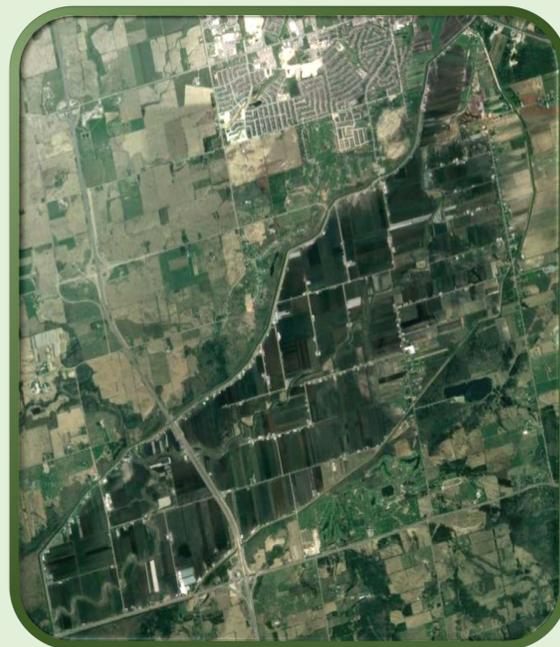


Figure 3. Map of the Holland Marsh, Ontario, Canada.

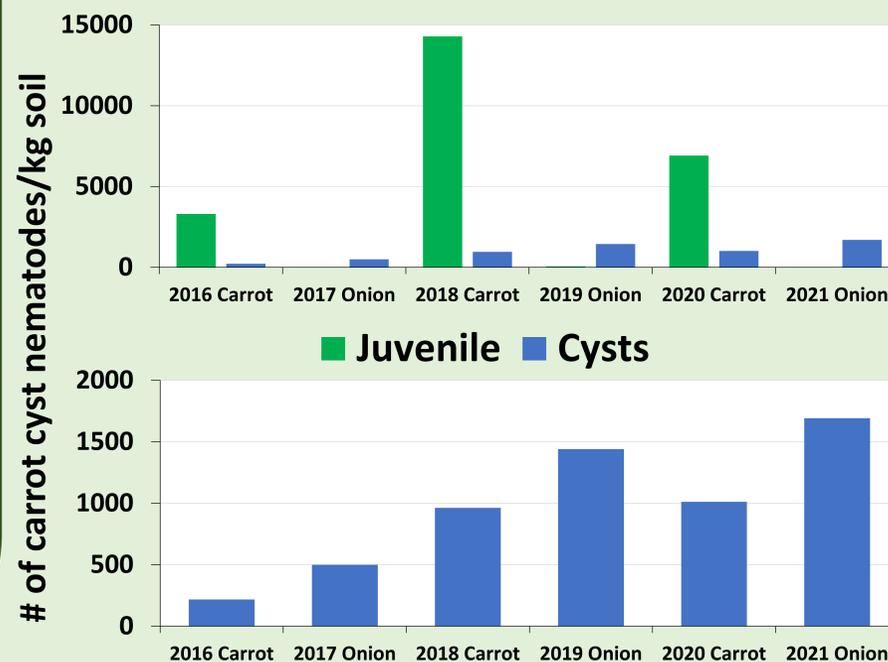


Figure 4. CCN population change in two fields following a continuous carrot-onion rotation in the Holland Marsh from 2016 to 2021.

Results

In 2018, the number of cysts in carrot fields ranged from 0 to 6420/kg soil. The number of juveniles was always higher than the number of cysts, and there were low numbers of male CCN (Fig. 4). In most years, onion fields were also sampled that had carrots the previous year. The number of cysts in fields with CCN generally increased each year, even in an onion crop that followed a carrot crop. The same trend was found from the two fields that were sampled annually from 2016 to 2021 on a continuous carrot-onion



Figure 5. CCN female cysts developed on secondary carrot roots.

Conclusions

The increase in cysts from carrots to onions is likely due to a maturation process of cysts on fine carrot roots in the fall which cannot be recovered at the time of sampling (Fig. 5). Cysts have been found to contain an average of 63 eggs. These eggs can remain viable for many years, which allows populations to build each year. Very few juvenile and male CCN were recovered after an onion or any non-carrot crop. Future research focused on the development, efficacy and registration of nematicides is necessary to manage the growing populations of CCN in the Holland Marsh.