

SPECIES OF ROOT MAGGOTS (DIPTERA: ANTHOMYIIDAE) OF CRUCIFEROUS CROPS IN BRITISH COLUMBIA¹

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Several species of root maggots occur separately or in mixed populations in cruciferous crops in Canada (Matthewman *et al.*, 1950, Brooks 1951, Oughton 1952, and Pond 1956). The composition of these populations varies seasonally and geographically, and, since each species differs in habits, life history, and economic significance it is important to know which ones occur on a crop.

When a primary, phytophagous species attacks a root, the damage frequently attracts phytosaprophagous species and, as decay progresses, additional saprophagous species, predators, and parasites are attracted to the root. A complicated ecological succession is started by the original attack, especially in rutabagas (swede turnips), which have a long growing period and large, fleshy roots.

These facts make analyses of field populations prerequisite to root maggot studies and particularly to control tests.

Root maggots were collected from cruciferous crops in British Columbia from 1948 to 1956. This paper reports data from these collections, with particular reference to *Hylemya* spp. in rutabagas.

Methods

Single and periodic collections were made from various cruciferous crops at many localities throughout British Columbia. For rutabagas, several collections were made from the same fields during the growing season for four years at Courtenay, three years at Victoria, two years at Alberni, and

one year at Tappen and Salmon Arm. The same farms at Courtenay, Victoria and Alberni were used each year. The maggots were generally collected from 30 roots taken at random from portions of the fields not treated with insecticide. The roots were carefully dissected and all maggots found were removed and preserved. The maggots were later identified with Brooks' key (Brooks 1951).

Larvae and puparia for rearing were collected from roots of cruciferous crops at Agassiz, Cloverdale, Kamloops, Kelowna, Ladner, Milner, Tappen and Victoria. The adults were identified by officers of the Entomology Division, Ottawa. Records of adults in the Canadian National Collection of Insects were also obtained.

One hundred and seven collections of maggots were made and identified from cultivated crucifers during the eight years 1949 - 1956 (Table I). Most of these were from rutabagas, but one or more collections were made from each of cabbage, radish, turnip, cauliflower and broccoli. The collections were from all the major agricultural areas in the Province except the Peace River area (Table II).

Species Found

Larvae of four species of *Hylemya* were found: the cabbage maggot, *H. brassicae* (Bouché); the seed-corn maggot, *H. cilicrura* (Rond.); the turnip maggot, *H. floralis* (Fall.); and *H. fugax* (Meig.).

Of 395 flies of the genus *Hylemya* reared from larvae from cabbage, radish, rutabagas, and brussels sprouts from eight localities, 78 per cent were of *brassicae*, 17 per cent were of *cilicrura*, 5 per cent were of *fugax*, and 0.2 per cent were of *planipalpis* (Stein).

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Since larvae of *planipalpis* and *brassicae* cannot be separated satisfactorily by Brooks' key, a few of the larvae reported as of *brassicae* might be of *planipalpis*. Identifications of adults, however, showed that this error was very small. Similarly, a few of the larvae given as of *cilicrura* might be of *liturata* (Meig.) (= *trichodactyla* (Rond.)). No adults of *liturata* were reared from crucifers but the species was reared by Mr. J. H. McLeod, now of the Entomology Laboratory, Belleville, Ontario, from bean roots at Vancouver. It occurs elsewhere in Canada on cultivated crucifers.

The cabbage maggot is the most common and most widely distributed root maggot in British Columbia (Tables I and II). It was the most abundant species throughout the growing seasons (Table III) and constituted 82 per cent of the total *Hylemya* maggots collected. It is the most serious pest of cultivated crucifers in the province. Up to 90 per cent of the plants of untreated early stem brassica crops have been killed by the maggots (Kings *et al.* 1957), and approximately 80 per cent of untreated rutabagas are frequently rendered unmarketable because of maggot damage (King and Forbes 1954).

TABLE I.—Numbers of larvae of various species of *Hylemya* collected from various cruciferous crops in British Columbia, 1949 - 1956.

Crop	Number of collections	<i>brassicae</i>	<i>cilicrura</i>	<i>floralis</i>	<i>fugax</i>	Total
Cabbage	5	804	12	0	3	819
Cauliflower	2	78	1	0	0	79
Broccoli	1	0	1	23	0	24
Radish	4	185	4	0	0	189
Rutabaga	93	3190	761	140	3	4094
Turnip	2	39	0	0	0	39
Total	107	4296	779	163	6	5244
% of grand total	—	81.9	14.9	3.1	0.1	—

The seed-corn maggot is also generally distributed in British Columbia. It formed 2 per cent of the *Hylemya* larvae collected from cabbages and 18.6 per cent of those from rutabagas (Table I). It became increasingly common in rutabagas as the seasons progressed until it constituted about 20 per cent of the total maggots in the roots. The larvae always occurred in association with *brassicae* or *floralis* larvae, or both, so that there was no evidence that they caused primary root damage. In coastal British Columbia during backward spring weather, the seed-corn maggot is often a fairly serious pest on sprouting seeds, especially beans and peas.

The turnip maggot was collected from rutabagas at Courtenay, Prince George and Smithers and from broccoli at Prince George. Records of the adults include one as far north as Atlin. It is significant that in Alaska the turnip maggot is the most important and widely distributed root maggot whereas the cabbage maggot has not been recorded (Washburn 1953, p. 3). In British Columbia it was taken only during August and September (Table III). At Courtenay, where periodic collections were made from rutabagas, *floralis* occurred on the roots during August and early September each year, sometimes being more abundant than *brassicae*. In north-central British Columbia *floralis*

TABLE II.—Localities in which larvae and adults of six species of *Hylemya* were found in British Columbia.

Species	Localities
<i>brassicae</i> (Bouché)	Larvae: Agassiz, Alberni, Armstrong, Barnhartvale, Cloverdale, Comox, Courtenay, Cranbrook, Creston, Grand Forks, Honeymoon Bay, Kamloops, Kelowna, Lavington, Ladner, Milner, Penticton, Quesnel, Smithers, Sullivan Station, Salmon Arm, Tappen, Thrums, Vancouver, Victoria. Adults: Agassiz, Armstrong, Cloverdale, Cultus Lake, Duncan, Essondale, Hazelton, Kamloops, Kelowna, Ladner, Milner, Pacific, Port Hammond, Robson, Saanich, Sicamous, Tappen, Vancouver, Vernon, Victoria.
<i>cilicrura</i> (Rond.)	Larvae: Alberni, Cloverdale, Comox, Courtenay, Grand Forks, Honeymoon Bay, Kamloops, Kelowna, Ladner, Prince George, Quesnel, Salmon Arm, Sullivan Station, Tappen, Victoria. Adults: Agassiz, Cloverdale, Cultus Lake, Hedley, Kelowna, Keremeos, Ladner, Milner, Naramata, Nicola, Oliver, Robson, Salmon Arm, Summerland, Tappen, Vancouver, Vernon, Victoria.
<i>floralis</i> (Fall.)	Larvae: Courtenay Prince George, Smithers. Adults: Armstrong, Atlin, Invermere.
<i>fugax</i> (Meig.)	Larvae: Armstrong, Quesnel, Victoria. Adults: Agassiz, Kamloops, Robson, Cultus Lake.
<i>planipalpis</i> (Stein)	Adults: Milner, Victoria.
<i>liturata</i> (Meig.)	Adult: Vancouver.

caused severe damage to rutabagas and broccoli in August, 1954.

The maggot *H. fugax* constituted only 0.1 per cent of the *Hylemya* larvae collected. It occurred in cabbage at Quesnel and in rutabagas at Armstrong and Victoria. Adults were reared from maggots from brussels sprouts at Agassiz and from radish at Kamloops.

A single fly of *H. planipalpis* was reared from a maggot collected from rutabaga at Milner in 1950. An adult of this species was taken at Victoria on July 2, 1918, by Mr. W. Downes, formerly of the Fruit Insect Laboratory, Victoria, British Columbia. It is a major pest of radish in the Prairie Provinces (Brooks 1951).

TABLE III.—Numbers of *Hylemya* larvae collected from cruciferous crops in British Columbia, by months, 1949 - 1956.

Species	June	July	August	September	October	November
<i>brassicae</i> (Bouché)	806	422	873	784	1331	80
<i>cilicrura</i> (Rond.)	16	42	262	195	263	1
<i>floralis</i> (Fall.)			138	25		
<i>fugax</i> (Meig.)					6	
Total	822	464	1273	1004	1600	81

Other maggots collected in small numbers from roots of rutabagas included: *Dolichopus* sp., *Fannia canicularis* (L.), *Lonchaea vaginalis* Fall., *Muscina assimilis* (Fall.), *Oscinella* sp. (coxendix group), *Eumerus strigatus* (Fall.), *Sciara* sp., and a phorid. The maggots *Fannia canicularis* and *Muscina assimilis* were very common on roots of cabbages infected with clubroot that had begun to decay.

Adults of *Coenosia tigrina* (Fall.), a dipterous predator first reported in Canada from Quebec (Perron and Lafrance 1952), were reared from immature stages from rutabagas at Tappan, B.C., in 1950.

Summary

Root maggots collected during 8 years from cruciferous crops in British Columbia were mostly the cabbage maggot, *Hylemya brassicae* (Bouché). The seed-corn maggot, *H. cilicrura* (Rond.) occurred frequently and the turnip maggot, *H. floralis* (Fall.) was found only during August and September at Courtenay, Prince George and Smithers. *H. fugax* (Meig.) was collected in small numbers. A single adult of *H. planipalpis* (Stein) was reared from a maggot collected from rutabaga at Milner. *H. liturata* (Meig.) was not found in crucifers, but did occur in bean roots at Vancouver. *H. brassicae* and *H. floralis* caused primary root damage. On rutabagas, *H. cilicrura* occurred only in association with *brassicae* or *floralis*, or both.

Acknowledgments

The authors are grateful to Mr. A. R. Brooks, Entomology Laboratory, Saskatoon, Sask., for identifying the maggots of the initial collections; to Mr. M. D. Noble, entomology Laboratory, Vancouver, B.C., for his help in collecting maggots; and to the various officers of the Entomology Laboratories at Agassiz, Kamloops, Vancouver and Victoria for their collections of maggots.

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