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Predicting Cabbage Maggot Flights in New York Using Common Wild Plants

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INTRODUCTION

The cabbage maggot, *Hylemya brassicae* (Wiedemann), is a pest of cruciferous crops in the United States, Europe, and Canada. This insect was introduced into the U.S. from Europe in soil used as ballast in ships. It was first recorded in the United States in the 1830's but undoubtedly had been here some years prior to that date (10). Many cruciferous weeds that serve as hosts of the cabbage maggot were also introduced into this country via seeds in ballast (1,4,10).

In upstate New York there are four flights or broods of this pest each year. The 1st or spring brood is usually the most damaging with peak flights of flies occurring about the middle of May. The 2nd brood of adults peaks atthe beginning of July, the 3rd about the middle of August, and the 4th during the last half of September or early October. The 4th brood is only a partial generation, because part of the 3rd brood overwinters as pupae and emerges as flies the following spring.

Although these broods appear at about the same time each year, there is some variation in date, especially with the 1st and 4th flights. A simple and reliable method of prediction of the flights would be extremely beneficial to growers. Heat unit accumulations have been used to predict maggot emergences (6), but this technique is impractical for growers to use because collecting the proper temperature data is difficult and time consuming. Earlier efforts at prediction attempted to correlate phenological events (notably blooming dates) of plants with certain points in the life cycle of the cabbage maggot. In New York in 1916, Schoene (9) reported that adult flies began to emerge in the spring about the time that the Windsor cherry *(Prunus avium* L.) blossomed. In 1925, Glasgow (8) noted that the blooming of the Reine Claude plum *{Prunus domestica* L.) paralleled first adult emergence and that the European plum *(Prunus* spp.) generally blossomed a few days later and served as a rough guide to indicate when eggs were first being laid. Similar studies have occurred in other states and countries, but few, if any, of them correlate bloom dates with later generations of this pest. Furthermore, most of the indicator plants used were fruit trees which either are not grown here anymore or occur in locations (fence rows, wood lots, etc.) where the maggot is infrequently found.

The purpose of this study was to correlate blooming of wild plants commonly seen near cabbage fields with cabbage maggot flights to provide growers with an accurate prediction tool so that timely applications of insecticides could be used, or planting dates could be adjusted. Also, a description of the life history of this pest is provided.

LIFE HISTORY

The cabbage maggot attacks cruciferous crops and many of the weeds belonging to that family. Its damage is most severe when heavy infestations are followed by periods of hot, dry weather.

Adults.-The adults of this species look similar to the house fly, but are smaller (Fig. 1a,b). The male is about 6 mm (1*1A* in.) long, dark ash gray in color, and is covered with black bristles. The eyes nearly touch in the center of the head. The female is very similar, but lighter in color with the eyes separated (7).

Adults emerge in the spring from overwintering pupae, and after about a week of feeding and mating, the females begin to lay eggs. The adults feed on nectar and pollen from flowers such as dandelions *[Taraxacum officinale* Weber.), white clover *(Trifolium repens* L), marsh marigolds *(Caltha palustris* L), cherries *{Prunus* spp.), and mustard plants *(Brassica* spp.) (2,3).

Eggs.-The eggs are white, elongated, and about 1 mm (1 /25 in.) long. They are laid in cracks in the soil near the plant stem, and depending on temperature (5), they hatch from 2 to 10 days later (7).

Maggots.-The maggots, or larvae, are the damaging stage of this insect. They or the tunnels they make, can easily be seen when the roots of an infested plant are examined (Fig. 1c,d,e). This stage lasts from 19 to 32 days

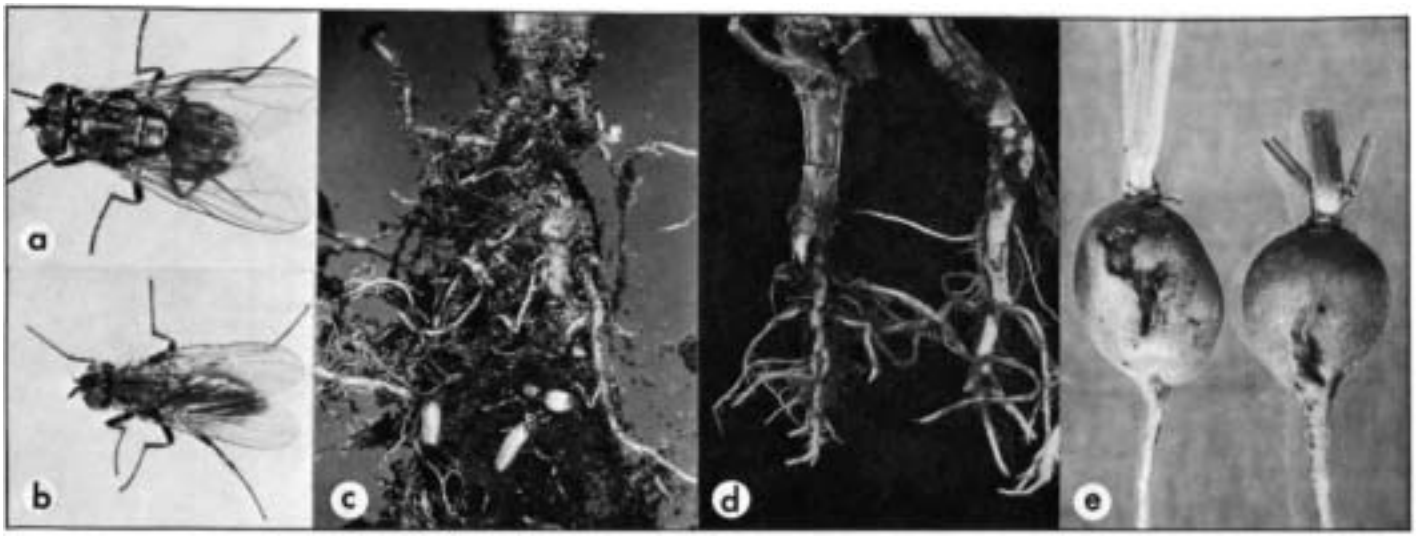

Figure 1 .—(a) House fly; (b) adult cabbage maggot; (c) cabbage maggot larvae infesting cabbage root; (d) maggot feeding tunnels on cabbage root; and (e) maggot feeding tunnels on radish root.

depending on soil temperatures. When fully grown the larvae leave the roots to pupate in the soil (7). Roots which are heavily damaged by larval feeding are frequently invaded by soft rot pathogens.

Pupae.-The pupae are present in the soil near the host plant and are found up to a depth of 22 cm (8-1*12* in.). The puparium (pupal covering) is reddish brown in color and is about 5-6 mm (1 /5-1 /3 in.) long. An adult fly may emerge from the pupa in about 2 weeks, or the insect may overwinter in this stage and emerge the following spring (7).

DAMAGE TO CROPS

Most of the damage caused by the maggot is restricted

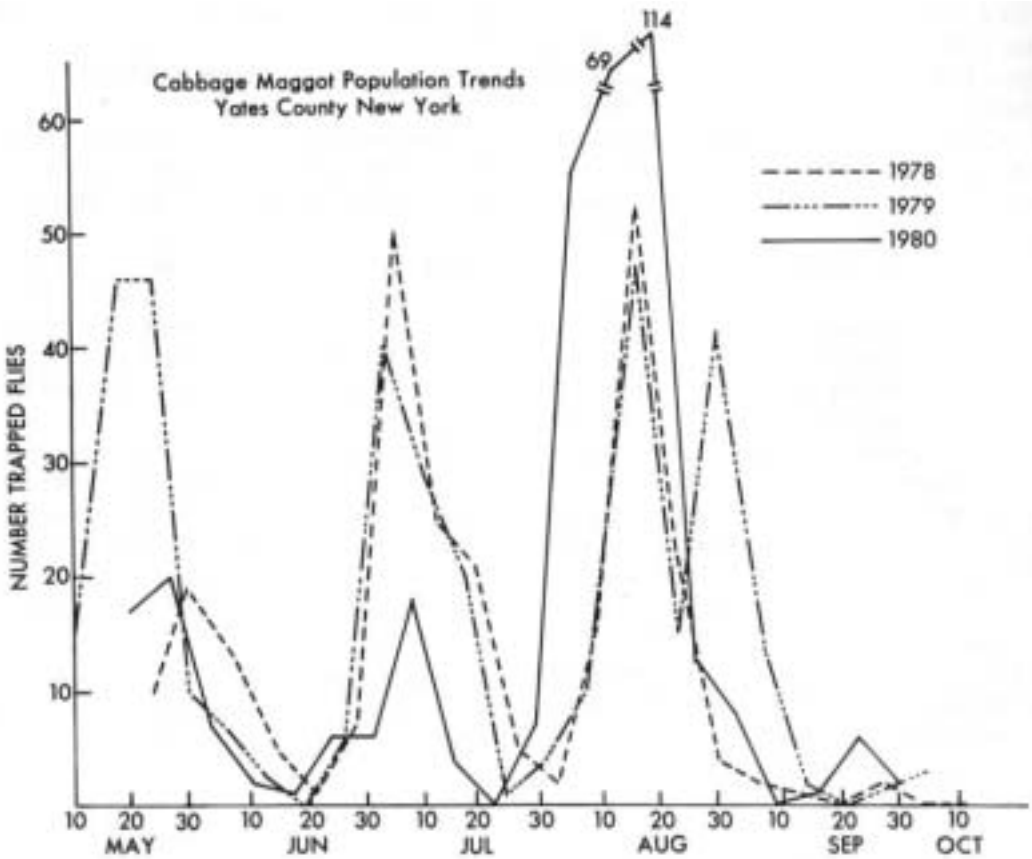

Figure 2.—Population trends of cabbage maggot adults collected in field traps in Yates County, NY.

to the roots of the plants (Fig. 1 d,e). In crops such as cabbage, where the above-ground portion of the plant is marketed, maggot damage may result in formation of a .smaller head, wilting, or sometimes death of the plant. If cabbage or related crops have well established root systems and moisture is available, some damage can be tolerated before yield loss occurs. In cruciferous root crops such as radish and turnip, where underground portions are marketed, very light maggot injury may reduce or destroy the salability of the crop (Fig. 1e).

If large numbers of maggots occur late in the season, they will occasionally infest above-ground portions of their hosts. Larvae from 3rd and 4th broods will invade the buttons of Brussels sprouts as they are forming on the stalks, because female flies may lay eggs there. Mature cabbage heads are sometimes invaded when the ground is saturated from heavy rains, driving the larvae out of the soil.

POPULATION TRENDS IN NEW YORK

Figure 2 presents population trends of the adults for 1978, 1979, and 1980 on one farm in Yates County, New York. These patterns were determined by fly catches from cone-shaped traps fashioned from window screen. They illustrate typical flight patterns for this part of the state. Three complete broods and a partial 4th are evident.

The spring brood occurs about the time that locally grown transplants are still in the seedbed and early direct seeded cabbage is beginning to emerge. Young plants are particularly susceptible to injury, because their root systems are not well developed. The 2nd brood threatens transplants in later plantings and even established fields if the season is dry. Brussels sprouts are just forming by the end of the 3rd brood flights and are thus susceptible to injury by larvae from both the late 3rd and 4th broods.

CORRELATION OF FLIGHTS WITH COMMON WILD PLANTS

During 1978, dates of 1 st and peak bloom were recorded for 13 species of wild plants which are commonly seen in uncultivated ground such as ditch banks and at the edges of fields. These dates were compared with emergence peaks of cabbage maggot flies from 18 farms to determine which plants bloomed during the flight periods of the various broods. In 1979 and 1980, dates of 1st and peak bloom for selected plants (chosen primarily from those observed in 1978) were recorded. These dates were compared with trap counts from eight farms. Figure 3 presents blooming sequences of five plants which are closely correlated with the four flight periods of the cabbage maggot in upstate New York. When using bloom sequences for predicting cabbage maggot activity, care must be taken to note the earliest full or peak bloom which occurs, since "full bloom" for many wild plants will continue for several weeks.

The blooming of yellow rocket *(Barbarea vulgaris* R. Br.) (Fig. 4) accurately indicated emergence in the spring.

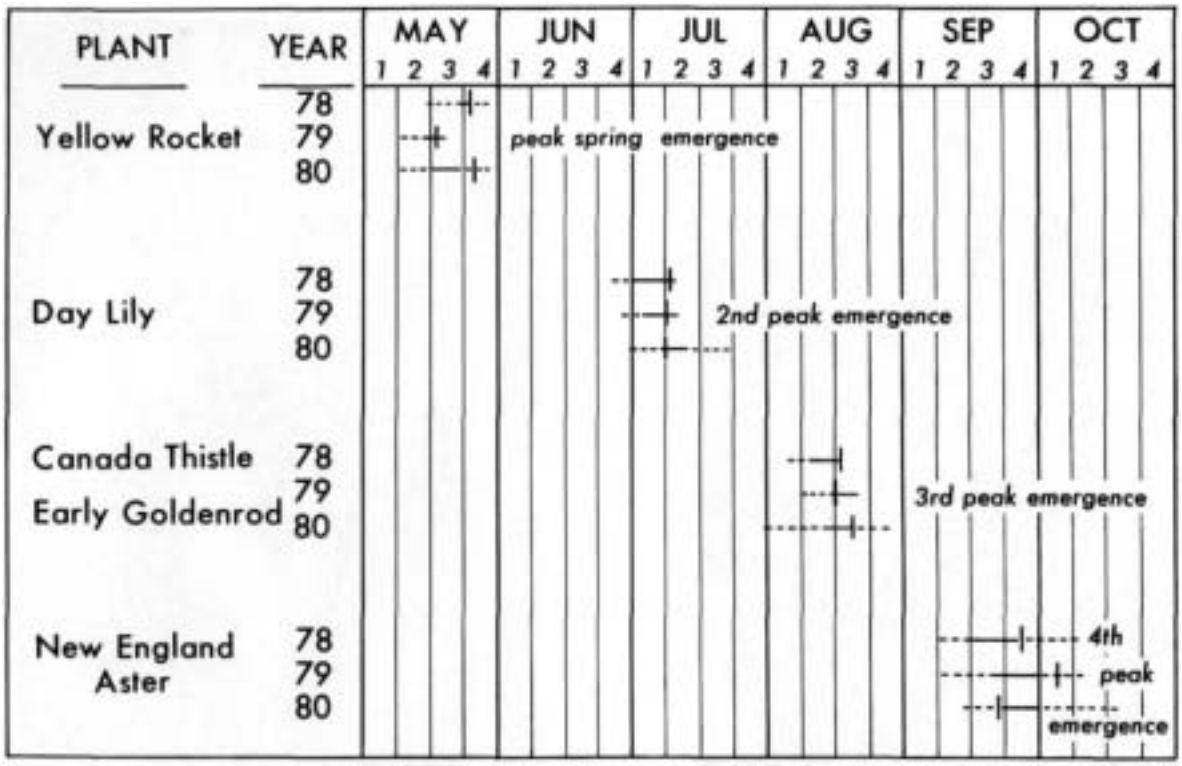

Figure 3.—Correlation of cabbage maggot flights with common wild plants for 3 years. Symbol ----------1--- indicates first bloom, full bloom (solid line), declining bloom; vertical line indicates peak flight of maggot adults.

Figure 4.—Yellow Rocket (Winter Cress)—Barbarea vulgaris. *From* Common Wild Flowers of New York State *by Patricia*

Ellison, John M. Kingsbury, and Peter A. Hyypio. Cornell Ext. Bull. 990.

Figure 5.—Day L/7y—Hemerocallis fulva. *From* Common Wild Flowers of New York State *by Patricia Ellison, John M. Kingsbury, and Peter A. Hyypio. Cornell Ext. Bull. 990.*

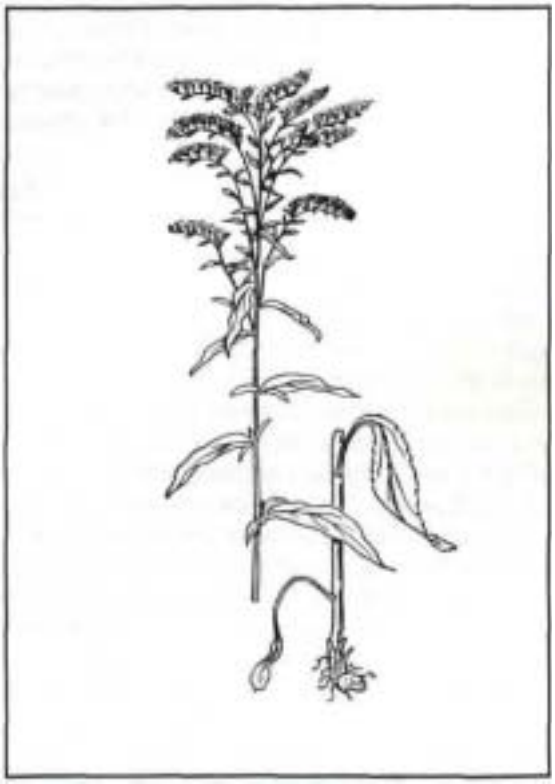

Figure 6.—Early Goldenrod—Solidago juncea. *From* The Flower- Finder *by George L. Walton, M.D., J. B. Lippincott Co. and Harper & Row, Publishers, Inc., Philadelphia, PA. 1916.*

Figure 7.—New England Aster—Aster novae-angliae. *From* Common Wild Flowers of New York State *by Patricia Ellison, John M. Kingsbury, and Peter A. Hyypio. Cornell Ext. Bull. 990.*

Earliest flies of the season appeared at the same time as the 1 st blossoms of this plant. A short time later when the plants first reached full bloom, peak flights occurred. Yellow rocket can serve as a host for larval feeding, and its blossoms supply a good source of nectar and pollen for the flies, thus providing a ready host plant in the absence of commercial cruciferous crops.

Day lily *(Hemerocallis fulva* L.) (Fig. 5) indicated emergence of the 2nd brood. Day lilies which are commonly seen on ditch banks should be observed for blooming at mid-day, because the blossoms close in the evening and remain that way until mid-morning the following day.

Canada thistle *[Cirsium arvense* (L.) Scop.] bloomed at the same time that the 3rd brood emerged. However, this plant is easy to overlook because the flowers are relatively small and not very showy. Also, it is not abundant in all areas, and it can easily be confused with bull thistle (C. *vulgare* L.) If Canada thistle is uncommon in a particular locality, early goldenrod *(Silidago juncea* Ait.) (Fig. 6) is another species which may be used to predict emergence of the 3rd brood. It is usually more widespread in this area, and it is easily observed. Early goldenrod is very similar to the later goldenrod species *{Solidago* spp.) that bloom all through September, but early goldenrod is the first of this group to bloom, so it is relatively easy to recognize.

In New York a partial 4th brood occurs in late September or early October. The blooming of New England aster *(Aster novae-angliae* L.) (Fig. 7), although not as precise an indicator as the other flowers, signals the approximate time when these adults are emerging. New England asters continue to bloom throughout most of October, and low numbers of adult cabbage maggots may also be present during most of the month if weather permits. The peak bloom and the peak emergence, however, usually occur during the period indicated.

CONCLUSIONS

Observation of blooming dates of the common wildflowers discussed above should alert commercial growers and home gardeners to forthcoming maggot infestations. Chemical treatments could be properly timed or planting dates could be adjusted to avoid periods of heavy infestations.

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