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PHENOLOGY OF OVIPOSITION OF *DASYNEURA OXYCOCCANA* (DIPTERA: CECIDOMYIIDAE) IN RELATION TO CRANBERRY PLANT GROWTH AND FLOWERING

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ABSTRACT

Eggs of cranberry tipworm, *Dasyneura oxycoccana* (Diptera: Cecidomyiidae) were sampled in a Wisconsin cranberry marsh from 1990 through 1992. Oviposition began in May within one week after the first cranberry shoots elongated more than 5 mm. Oviposition fluctuated in June, then greatly decreased in July, after over 90% of cranberry flowers had opened. Some oviposition continued into August. Tipworm probably has greatly overlapping generations, as no distinct broods could be detected. Consequently, *D. oxycoccana* may be difficult to manage without control methods effective against multiple life stages.

Cranberry tipworm, *Dasyneura oxycoccana* (Johnson), feeds on the youngest leaves of cranberry, *Vaccinium macrocarpon*, at the apex of growing shoots. Larvae rasp the leaves while feeding, and the cranberry plant responds by growing distorted, cupped leaves. Feeding eventually kills the apical meristem of the shoot (Smith 1890).

Tipworm has been suspected of causing reductions in cranberry yield, although the cranberry plant is able to compensate for the damaged tips. Smith (1890) examined infested cranberry branches and could find no damage to the current year's fruit or to the flower buds forming for the next year. After making more observations, Smith (1905) stated that tipworm feeding does not hinder flower bud formation if damage occurs early in vigorous plants. If feeding occurs late enough on weak plants, however, vegetative buds are formed at the expense of flowering buds. Latter publications on the insect (e.g., Franklin 1948) repeated the same viewpoint. However, *D. oxycoccana* apparently has caused severe yield reduction in New Jersey (Eck 1990) and many Wisconsin growers believe that tipworm causes economic losses.

The larval stage of *D. oxycoccana* was observed to last about 10 d, and the pupal stage about 3 days. Therefore, estimating the duration of the life cycle to be about half a month, Smith (1890) believed there were four to five generations per year. However, he reported that most feeding injury occurred in early summer. Franklin (1948) and later authors stated there were two distinguishable broods in early summer, about a month apart. The second brood was believed to be more damaging than the first. There are no published sources that indicate when the broods occur in Wisconsin, and what phenological events could be correlated with the timing of broods.

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Tipworm adults lay tiny, oblong eggs on the innermost leaves of growing cranberry shoots (Franklin 1948). Eggs are not usually laid on dormant buds or branches that have paused in growth (Eck 1990). Oviposition may build and decline along with the abundance of suitable growing tips. The purpose of this study is to determine the phenology of oviposition of cranberry tipworm and relate the time of oviposition to easily-observed events in the cranberry plant.

MATERIALS AND METHODS

Eggs of cranberry tipworm were monitored in 1990–1992 in a commercial cranberry marsh in Warrens, Monroe Co., WI. Within the marsh were beds each about 25 by 75 m, separated by ditches and dikes. The sample bed of 'Searles' was not treated with insecticides during the years monitored. Eight quadrats of foliage (each 0.1 m^2 area) were selected randomly within the bed every 2 or 3 days starting in mid-May until the end of August. A subsample of 50 branch tips was randomly selected from each sample and the terminal buds were examined for eggs under a microscope at 25× magnification. Sometimes fewer than 50 intact tips could be recovered if other insects had been feeding on the foliage. In 1992, larvae were counted in the tips as well.

Phenology of the cranberry plants was monitored on the same bed. Plastic hoops (10 cm inner diameter) were secured over the vines in early spring. Twelve hoops were distributed over a 2 by 3 m area about 3 m from the edge of the bed. Any branches growing within the hoops were considered sample units, and the total sample area was about 0.12 m^2. The cumulative number of shoots over 5 mm in length was counted in the hoops every 2 or 3 days in May and June. Flowering is the most visible event to monitor in summer. It is during the summer also that dormant buds are formed for next year's growth (Eck 1990), potentially reducing the available oviposition sites. We hypothesized that cessation of vegetative growth, and thus of oviposition, would occur sometime during or just after flowering. In the summer, the number of flowers in the hoops that had opened or were past bloom were counted. These numbers could be expressed as a percentage of total inflorescence (% in flower) because the number of cranberry flowers is determined the previous year when primordial buds are formed (Eck 1990). Flower observations were made every week in 1990 and every 2 or 3 days in 1991 and 1992.

RESULTS AND DISCUSSION

In all sample years, *D. oxycoccana* adults began oviposition in May, within a week after the first shoots elongated (Fig. 1). In 1992 there appeared to be three or four surges in oviposition before flowering was complete, but no clear peaks could be distinguished in 1990 and 1991 (Fig. 1). The time when 90% of flowers had bloomed occurred in late June one year and in early July in the other two years (Fig. 1). Each year, the majority of oviposition ended soon after most flowers had opened. Occasionally, some eggs were laid throughout the rest of the summer, but not in great numbers (Fig. 1). In 1992, even though there appeared to be cycles in oviposition, the density of larvae gradually increased, then decreased after mid-June, with no apparent separate broods (Fig. 2).

After flowering, the cranberry plant begins to produce the vegetative and flowering buds for the following year (Eck 1990). Oviposition decreases after flowering probably because of the decrease in available growing shoots. As the plants produce some growing shoots in August, perhaps to compensate

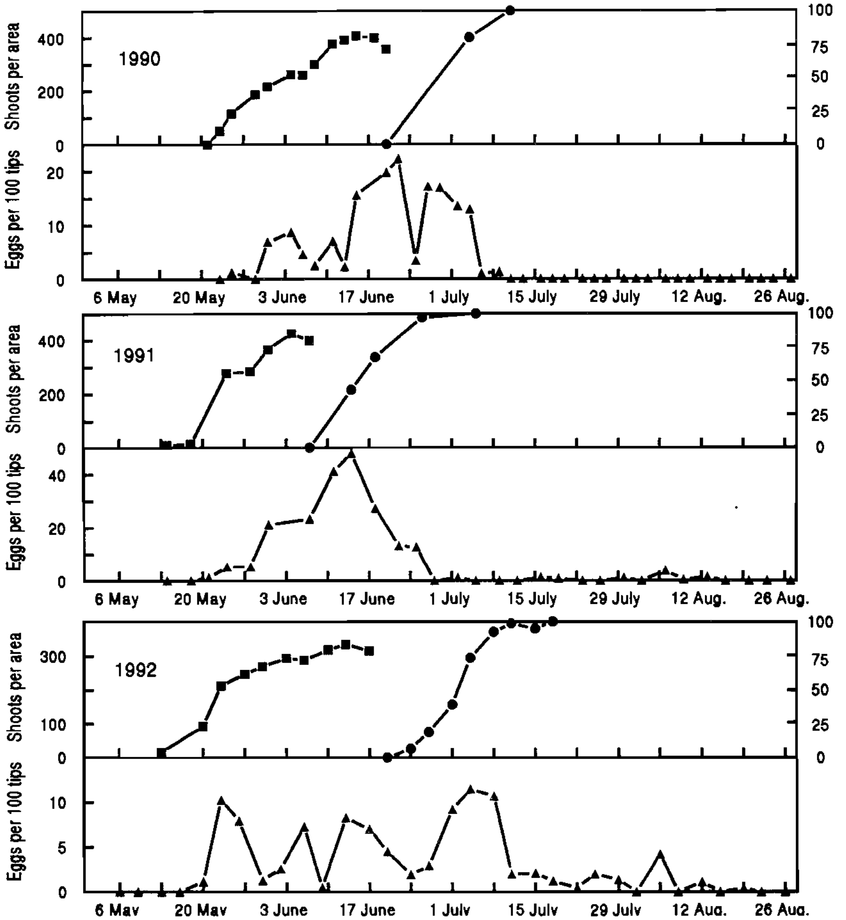

Figure 1. (upper graphs) (■) The number of cranberry shoots 5 mm or longer counted within a 0.12 m^2 area, and (●) the percentage of inflorescence opened or past bloom. (lower graphs) The density of *Dasyneura oxycoccana* eggs counted on up to 400 shoot tips per sample date. Data from three years are presented in paired graphs.

for those damaged in June or July, a few females are able to find these and lay eggs on them (Fig. 1).

Scouting for tipworm can be greatly improved by concentrating observations between the time of new growth in the spring and the end of flowering. Eggs can be deposited at any time during this interval. Although it is likely that more than one generation was produced during this time period, we were unable to discern distinct broods. Lack of distinct generations makes the

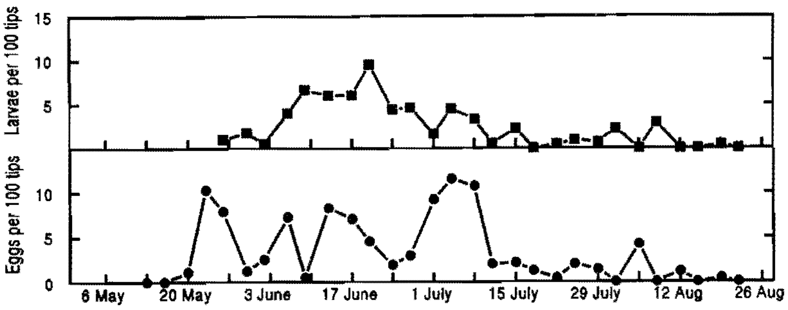

Figure 2. The density of *Dasyneura oxycoccana* larvae (upper graph) and eggs (lower graph) counted in up to 400 cranberry shoot tips per sample date. Data are from 1992.

phenology of the insect difficult to predict and makes the insect a challenge to manage with stage-specific control agents.

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