MASONAPHIS MAXIMA (MASON) (HOMOPTERA: APHIDIDAE), AN APHID ON THIMBLEBERRY WITH AN UNUSUAL LIFE HISTORY[1]

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ABSTRACT

A two-year study of **Masonaphis maxima** (Mason) on thimbleberry, **Rubus parviflorus** Nutt., revealed an unusual life history. The eggs hatched in late March or early April, and the fundatrices matured and reproduced a month later. Males and females were produced in late May or in June and egg-laying had started by July. This early egg-laying coincided with the cessation of production of new growth by the host plant. Additional description of the fundatrix is included.

Introduction

Three species of aphids occur commonly on thimbleberry, *Rubus parviflorus* Nutt., around Vancouver, B.C. These are *Amphorophora parviflori* Hill, *Masonaphis (Oestlundia) maxima* (Mason), and *Masonaphis (Oestlundia) davidsoni* (Mason). They are easily separable by the following key:

1. Clavate cornicles with a few slight striations just below the flange but not reticulated.....*A. parviflori* Hill
   Clavate cornicles distinctly reticulated 2
2. Apterous viviparous female..... 3
   Alate viviparous female..... 4
3. 6-14 sensoria on third antennal segment.....*M. maxima* (Mason)
   20-23 sensoria on third antennal segment..... *M. davidsoni* (Mason)
4. Fore wings each with conspicuous dark spot at the tip.....*M. maxima* (Mason)
   Fore wings without dark spot.....*M. davidsoni* (Mason)

M. maxima is by far the commonest and most numerous of the three. All are vectors of thimbleberry ring spot virus (Stace-Smith, 1958). MacGillivray (1958) has added to the published descriptions of *M. maxima* and *M. davidsoni*. Hill (1958) described *A. parviflori*. The present paper presents additional description of the fundatrix of *M. maxima* and biological data on this species.

Description of the Fundatrix

Since MacGillivray's (1958) description is based on a single specimen, we add the following description:

Similar to apterous viviparous female but with shorter antennae. Body 2.69-4.70 mm long. Antennae 0.6-0.8 of the length of body; third segment with 1-4 secondary sensoria; unguis considerably shorter than third segment and 2.7-3.3 times as long as the base of sixth segment. Cornicles only slightly swollen, maximum diameter 1.1-1.2 times the smallest, and reticulated on distal 0.06-0.11 of their length.

[1] Contribution No. 135, Research Station, Research Branch, Canada Department of Agriculture, Vancouver, B.C.

Lengths in mm and number of secondary sensoria:

					Antennal segments				Sensoria
No.	Body	Ant.	Corn.	Cauda	III	IV	V	VI	on III
1	4.33	2.88	0.99	.20	.61	.43	.46	.18+.52	2, 1
2	4.67	3.11	1.07	?	.69	.46	.49	.20+.59	3, 4
3	4.70	2.94	1.00	.29	.65	.43	.47	.20+.54	2, 1
4	4.70	3.13	1.14	.35	.76	.48	.50	.19+.53	3, 3
5	2.69	2.36	1.05	.34	.63	.48	.42	.14+.46	3, 4
6	3.88	2.49	0.98	.35	.65	.49	.46	.18+.50	3, 4

(1-6, from **Rubus parviflorus**, Vancouver, B.C.; 1-2, April 12, 1966; 3-6, April 26, 1967.)

Biology

M. maxima is a large non-economic aphid living on the undersides of young leaves and growing terminal shoots of thimbleberry, *Rubus parviflorus* Nutt. Thimbleberry is a native shrub of the forest understory, particularly common along partially shaded edges of clearings.

The following life history data were gathered from extensive, naturally occurring plots of thimbleberry on the campus of the University of British Columbia. Frequent observations were made until first instar fundatrices were found on the plants. Plots were sampled at least weekly thereafter. A number of colonies were reared on thimbleberry in pots in a screenhouse and greenhouse.

The entire life cycle occurs on thimbleberry. The eggs hatched during the period March 22-31 in 1966 and April 1-10 in 1967 and fundatrices were mature and reproducing a month later. Progeny of the fundatrices were mostly apterous; only 10-15 per cent were alate. Some male nymphs were produced in the third generation starting as early as May 17. Male nymphs were easily distinguished by their bright red color. The first mature males were noted on May 31 in 1966 and on June 13 in 1967. Mature oviparae were found at about the same time. Egg laying had commenced by early July. The last aphids were found on August 9 in 1966 and on July 18 in 1967. Thus there are only 3 or 4 parthenogenetic generations each year. Maximum density of 525 aphids per cane was reached by July 12 in 1966 and the numbers decreased very rapidly thereafter. Maximum density of 252 aphids per cane was reached by June 20 in 1967.

Eggs were found on buds, leaves, and stipules of stems 2-3 inches long arising from the crown. These parts remain green throughout the winter. Few eggs were found on stems and leaves well above the ground. Some eggs were found on dead leaf litter close to thimbleberry crowns. In the screenhouse, large numbers of eggs were laid on the clay pots containing the thimbleberry plants; very few were laid on the plants themselves. The eggs are dark green when laid and turn black and shiny in 3-7 days depending on the temperature. They are ellipsoid, 1.55-1.69 mm in length and 0.78-0.85 mm in width.

The aphids were heavily preyed upon by syrphid larvae, primarily *Metasyrphus fumipennis* Thomson, *Scaeva pyrastri* (L.), *Syrphus ribesii* (L.), *S. opinator* O.S., and *S. torvus* O.S. (det. J. R. Vockeroth), starting with the fundatrices. During April and early May each year, adult cantharids (*Podabrus* sp.), preyed upon the aphids. At least two species of predacious cecidomyiids were prominent in the colonies from late June onwards. No coccinellid eggs, larvae, or adults were found in the two years of sampling. Parasitism reached 15 per cent. The primary parasites were: *Aphidius rubifolii* Mackauer and a *Praon* sp. (det. M. J. P. Mackauer).

In the greenhouse or screenhouse where predators and parasites were excluded and where the more catastrophic meteorological agents were eliminated, *M. maxima* attained densities sufficient to defoliate and kill thimbleberry plants. In the field, on the other hand, no infestation observed in three seasons of observations was severe enough to cause visible damage to the host.

Dispersal of alates was mainly to new growth on plants within the immediate area. Yellow pan water traps and yellow sticky boards near the observation plots caught only two alate *M. maxima*. Isolated plots of thimbleberry which did not have fundatrices in the spring received few immigrant alates from other plots and populations on them remained low. Apterae dispersed themselves by falling to new growth of new plants arising from the stolons beneath the old plants and from the crown.

Body size of both apterous and alate viviparae varied with the time of collection. Measurement of the lengths of the body, antennal seg-

ments, cornicles, and cauda generally showed the shortest lengths in aphids collected during April, the greatest in those collected during May, and intermediate values in those collected during June.

Field, greenhouse, and screenhouse observations showed that the aphids would not settle or feed on fully mature leaves or stems; they fell from the plants and died whenever there was no succulent growing tissue available.

Discussion

The reduction in the number of parthenogenetic summer generations with very early production of sexuales and eggs on the primary overwintering host is unusual in aphids. In a temperate climate such as at Vancouver, aphids typically migrate in the spring from primary woody overwintering hosts to secondary herbaceous summer hosts (heteroecy), or sometimes spend their entire life cycle on a single host. In either case 10 or more parthenogenetic generations may be produced between April and November , and sexuales, if present, occur in September, October, and November.

Abbreviated life cycles such as that of *M. maxima* have been reported for only a few other aphids. For *Dysaphis devecta* (Walker), on apple, Hille Ris Lambers (1945) and Stroyan (1963) report a short life cycle of three parthenogenetic generations with production of sexuales in June or July. For *Brachycaudus rociadae* (Cockerell), on larkspur, Hottes and Frison (1931), report oviparae in Illinois on May 13 and state that as a result, this aphid passes the larger part of the year in the egg stage. Other authors, however, report sexuales of this species on the same host in Colorado on October 3 (Gillette and Palmer, 1932). For *Kakimia essigi* (Gillette and Palmer), on columbine, Hottes and Frison (1931) mention early production of sexuales and eggs (p. 133), but also describe sexual forms collected at Urbana on October 15 (p. 337). Similarly Palmer (1952) reports sexuales of this species from October 3 to November 29. For *Aphis farinosa* Gmelin, Hille Ris Lambers (1945) reports overwintering eggs in June and July. Robinson (1968) has just reported the presence of oviparae of *Kakimia canadensis* Robinson in early summer in British Columbia and Idaho.

Hottes and Frison (1931) suggest that early production of sexuales and early oviposition is a response to progressive unsuitability of the host and is a substitute for heteroecy and that in the case of *B. rociadae* it is an adaptation to the short period of growth of the host. In a recent review Kennedy and Stroyan (1959) point out that the period of maximum favourability of the sap of any plant is short and that the production of both alate viviparae and sexuales in aphids is a result of this. Alates are able to exploit a fresh host and sexuales produce resistant overwintering eggs. In the case of *M. maxima,* the production of sexuales and eggs certainly coincides with the cessation of production of new growth by the host plant and there is ample evidence that the aphid cannot live on fully mature leaves. Other aphids react to unfavourable host plant condition in other ways. The sycamore aphid, *Drepanosiphum platanoides* (Schr.), shows a density dependent reduction in its reproductive rate (Dixon, 1963 and 1966), and several *Periphyllus* spp. on maple aestivate as peculiar first instar sexuparae called dimorphs (Essig and Abernathy, 1952).

The habit noted with this aphid of laying appreciable numbers of eggs on debris on the ground near its host plant would also seem to be unusual. Aphid eggs are usually laid on or near dormant buds, or on the bark on limbs or canes.

Other instances have been documented of seasonal variation in the body size of aphids. In Israel, Bodenheimer and Swirski (1957), report three species of aphids as being at their largest about March and smallest between August and October.

Bodenheimer and Swirski regard body size as an expression of growth conditions for the aphids and tend to attribute the variation they noted to the nutritive status or physiological condition of the host plant. Other evidence would support this view (Kennedy and Stroyan, 1959; Dixon, 1963 and 1966). For *M. maxima* a combined effect of host plant condition and temperature is indicated. In April the thimbleberry is succulent and favourable for maximum growth, but the temperature is less than optimum; in May both the host plant condition and temperature are favourable; in June the host plant is less succulent and higher temperatures are somewhat less favourable.

Because of its short life-cycle, its complement of predators and parasites, its relationships with the host plant, and its relatively easily determined age-distribution, *M. maxima* has been chosen for further studies of the biotic and abiotic factors influencing aphid population dynamics.

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