

## Holocyclic, seasonal activity, morphometry and natural enemies of willow aphid, *Cavariella aegopodii* (Scopoli) (Homoptera: Aphididae) in the Indian region

D GHOSH, P K MEDDA and S CHAKRABARTI

Biosystematics Research Unit, Department of Zoology, University of Kalyani, Kalyani 741 235, India

MS received 8 July 1985; revised 16 December 1985

**Abstract.** The aphid, *Cavariella aegopodii* is a holocyclic species, alternating between willow and plants of the family Umbelliferae. Its biology and natural enemies are discussed. Morphometry of different morphs are also provided here.

**Keywords.** Aphid; *Cavariella aegopodii*; morphometry; biology; natural enemies.

### 1. Introduction

*Cavariella aegopodii*, a cosmopolitan and polyphagous aphid, is a serious pest of carrot (*Daucus carota*) in Australia and France where it transmits 'carrot motley dwarf virus' (Eastop 1966; Brunel and Rabasse 1977). In India, however, this aphid has never been reported on carrot which otherwise harbours two different aphids, viz., *Hyadaphis coriandri* and *Myzus persicae* (Raychaudhuri 1983). In fact, carrot is not usually cultivated in the mountainous areas where the aphid occurs on willow. Hilly people, however, cultivate wild carrot (*Chaerophyllum villosum*) which is so far resistant to aphid infestation.

*C. aegopodii*, essentially a holocyclic species, leads a heteroecious life on willow and plants of the family Umbelliferae (in New Zealand: Cottier 1935; Middle East: Bodenheimer and Swirski 1957; Australia: Eastop 1966; Poland: Szelegiewicz 1968; North America: Stroyan 1969; Japan: Higuchi and Miyazaki 1969; Scotland: Stroyan 1976). The present study has been conducted in Garhwal range of western Himalaya at Joshimath (ca. 1900 m) to obtain an account of the biology and natural enemies of this aphid.

In this paper, morphometric measurements of the different available morphs, seasonal and sexual activities, host-association and natural enemies of this aphid have been discussed.

### 2. Materials and methods

At Joshimath (Field station in Garhwal range of western Himalaya), several willows (*Salix tetrasperma*) were selected for study. Condition of the plants and occurrence and activity of the aphid (*C. aegopodii*) were observed in natural condition from time to time during the period September, 1982 to April, 1985. Aphid samples from these plants

were collected as and when required and studied. The aphids on the secondary host plants were observed in a bed of Umbelliferae.

### 3. Observations and discussion

#### 3.1 *Host association and seasonal activities*

3.1.1 *On primary host:* In the area of the present study, 3 species of willows, viz., *Salix tetrasperma*, *S. elegans* and *S. babylonica* are found to occur. This aphid infests the first one, which is wild and distributed on the hill slopes and used as fodder and fuel by hilly people. Besides, the bark of *S. tetrasperma* is used for tanning and also said to be febrifuge (medicinal value) (Watt 1972).

On this plant, this aphid occurs in 2 phases, viz: (i) autumn and winter phase and (ii) spring phase.

3.1.2 *Autumn and winter phase:* Alatae from the secondary hosts immigrate to willows towards October and November (8–28th October in 1982 and 1983; 10th November in 1984). They parthenogenetically produce nymphs which develop into oviparae. They live both on dorsal and ventral surface of leaves. When oviparous colonies are well-established, the alate males make their appearance on the primary hosts (23rd November in 1982 and 2nd December in 1984). It should be mentioned that these males are developed on the secondary hosts only. The ovipara usually remains settled on a particular site of leaf and waits for the mating partner. After the encounter, male approaches towards the back of the female, moves its antennae for a few seconds, slowly mounts over the back of the female. The female raises its caudal portion. Male bends down its abdomen and inserts the aedeagus inside the genital aperture of the female. Mating lasts for about 3–4 min. At the end, male moves sidewise, retracts the aedeagus and moves away. Female remains passive throughout the mating period. A female having eggs in the abdomen is also found to mate for the second time. It appears that it is the male which has the habit of multiple copulation, initiates the second copulation. The male usually dies after 6–7 days of mating.

A fertilised ovipara after 8–10 days of mating starts laying eggs at the buds. The number of eggs produced by a female is 3–4, which are laid during a period of 1–2 days. Each egg is elongatedly oval and orange-yellowish when fresh, but becomes darker afterwards, measuring about 0.6–0.7 mm in length and 0.2–0.3 mm in maximum width. Sometimes 2 females are observed to stay in an oviposition site and thus upto 6 eggs are found in a bud. Ovipara dies after 5–6 days of egg-laying. Eggs are left at this stage for overwintering. All these phenomena are completed before the middle of December (10th December in 1982 and 8th December in 1983), when the leaves of the willow trees gradually turn yellowish. This follows shedding of leaves and the plants remain bare till the end of February.

3.1.3 *Spring phase:* With the onset of spring towards the middle of February, the overwintered eggs hatch into greyish nymphal fundatrices, when the leaves are yet to appear. As a result, the nymphal fundatrices feed on stem-branches and later migrate to sprouting leaves to grow into adult forms which we have missed to collect. They parthenogenetically give rise to nymphal colony of apterous fundatrigeniae, which take

11–12 days for attaining adulthood and lay about 22–28 nymphs during a period of about 14 days with 0–3 nymphs per day. About 3–4 such generations occur on willow, where the alates begin to appear in the 3rd or 4th generations. These alates emigrate to the secondary host during the middle of April (19th April in 1984).

#### 3.1.4 On secondary host

As mentioned earlier, plants belonging to the family Umbelliferae constitute the major secondary hosts of this species. Cottier (1953), Eastop (1966), Miyazaki (1971) and Knowlton (1983) reported a number of umbellifer crops and weeds besides a few other hosts from different parts of the world. In India, this aphid has been collected from the following hosts: *Heracleum soshoweri* (Raychaudhuri 1980), *Heracleum* sp. (Chakrabarti *et al* 1972), *Pimpinella diversifolia* (Chowdhuri *et al* 1969; Raychaudhuri 1980) and *Sanicula europea* (Raychaudhuri 1980).

The reports of a few other hosts of the family Euphorbiaceae, Polygonaceae, Zingiberaceae (Basu *et al* 1972, 1973; Raychaudhuri *et al* 1980) may be of doubtful occurrence.

In Garhwal range of western Himalaya, from April onwards, alate viviparae (greyish in colour) from the primary host plants begin to emigrate and appear on *Pimpinella diversifolia* where they settle on the apical stem or on the inflorescence stalks. These alatae give rise to parthenogenetic viviparous females. Several overlapping generations appear throughout the summer till early autumn. Morphs produced on this plant are apterae and occasionally alatae for migration or to avoid overcrowding. These are dull green in colour matching with the site of infestation. Again, with the onset of autumn (24th October in 1983), alate production in the colony becomes prevalent for immigration to primary host plants. However, it is known that this species can overwinter in Auckland in the viviparous forms on carrot foliage (Cottier 1953).

### 3.2 Morphometry

Measurements of different available morphs of the species indicate that apterae born on secondary host have smaller body in comparison to those on primary host. Alatae produced earlier on secondary host to avoid overcrowding differ from those produced for immigrating to primary host in autumn having smaller body and lesser number of rhinaria (20–28 against 33–36) on the antennal segment III. Again, these immigrating alatae are similar to those born on primary host in spring except for having larger number of rhinaria (33–36 against 16–19) on antennal segment III. The details of morphometry have been provided in table 1.

### 3.3 Natural enemies

Insects belonging to Coleoptera and Diptera comprise the predatory complex of this aphid at least in western Himalaya and also in India, because this report indicates the first finding of natural enemies of this aphid from India. Aphidophagous coccinellid beetles have never been observed to reproduce on this aphid. In spring, these beetles, rather migrate from their breeding sites, somewhere in the herbages and crops, for

Table 1. Morphometric measurements (in mm) of different morphs.

Morphs	Body length	Antennal length	Urs	Ht2	Siphunculi	Cauda	Secondary rhinaria on antennal segments				
							III	IV	V	VI	
Primary host:											
Apterae	1.97-1.98	0.77-0.79	0.11-0.12	0.11-0.12	0.34-0.37	0.16-0.17	0	0	0	0	
Alatae	2.10-2.16	1.12-1.18	0.10-0.11	0.10-0.11	0.31-0.33	0.14-0.15	16-19	0	0	0	
Alate males	1.86-1.87	1.22-1.26	0.11-0.12	0.10-0.11	0.24-0.25	0.10-0.12	40-44	7-12	5-6	3	
Oviparae	2.14-2.26	0.69-0.77	0.12-0.13	0.10-0.11	0.31-0.37	0.14-0.16	0	0	0	0	
Secondary host:											
Apterae	1.24-1.34	0.52-0.58	0.08	0.08	0.23-0.29	0.11-0.12	0	0	0	0	
Alatae	1.76-2.12	1.10-1.21	0.10-0.11	0.10-0.11	0.30-0.32	0.14-0.15	20-36	0	0	0	

Apterae, Apterous viviparous females; Alatae, Alate viviparous females; Oviparae, Apterous oviparous females; Urs, Ultimate rostral segment; Ht2, Second segment of hind tarsus.

exploitation to all available food sources. The coccinellids include *Coccinella septempunctata*, *Oenopia kirby* and *O. sauzeti* on primary host and *Menochilus sexmaculatus* and *O. sauzeti* on secondary host. *Metasyrphus confrater* is the only syrphid species collected from willow.

Regarding parasites, though Takada and Rishi (1980) reported *Ephedrus minor* as the aphidiid parasite of *Cavariella* spp. from *Salix*, no such collection was made in the present work both on primary and secondary hosts. However, in France, Rabasse and Brunel (1977) collected *Aphidius salicis* as the primary parasite of *C. aegopodii* on carrot besides *Ephedrus salicicola* and *Trioxys (Binodoxys) heraclei*. Narayanan *et al* (1962) in their world catalogue of aphidiine parasite, mentioned *Ephedrus plagiater* as the only aphidiid parasite of *C. aegopodii*.

### Acknowledgements

The authors are thankful to the Department of Science and Technology, New Delhi, for financing the work and to Mr A K Mandal of this laboratory for his help during field study.

### References

- Basu R C, Ghosh A K and Raychaudhuri D N 1972 A new species of *Eutrichosiphum* and notes on other new records of aphids (Insecta: Homoptera) from NEFA (Arunachal); *Sci. Cult.* **38** 494–495
- Basu R C, Ghosh A K and Raychaudhuri D N 1973 Studies on the aphids (Homoptera: Aphididae) from eastern India XVIII. Five new species and thirty new records from Assam; *Proc. zool. Soc. Calcutta* **26** 89–101
- Bodenheimer F S and Swirski F 1957 *The Aphidoidea of the Middle East* (Jerusalem: Weizmann) pp. 1–378
- Brunel E and Rabasse J M 1977 *Cavariella aegopodii* Scop. (Hom., Aphididae) en culture de carotte dans l'Ouest de la France. I. Biologie et evolution des populations; *Ann. Zool. Ecol. Anim.* **9** 469–480
- Chakrabarti S, Ghosh A K and Raychaudhuri D N 1972 A new genus, a new species and further records of aphids (Homoptera: Aphididae) from the Kumaon hills, northwest Himalaya, India; *Orient. Insects* **6** 387–400
- Chowdhuri A N, Basu R C and Raychaudhuri D N 1969 A new species of *Cavariella* Dal Guercio and other newly recorded aphids (Homoptera: Aphididae) from Simla, Himachal Pradesh; *Sci. Cult.* **35** 334
- Cottier W 1935 Aphids affecting cultivated plants. (1) The carrot, parsnip and willow aphid; *N. Z. J. Agric.* **50** 230–231
- Cottier W 1953 Aphids of *New Zealand*; *N. Z. Dep. Sci. Ind. Res. Bull.* **106** 1–382
- Eastop V F 1966 A taxonomic study of Australian Aphidoidea (Homoptera); *Aus. J. Zool.* **14** 399–592
- Higuchi H and Miyazaki M 1969 A tentative catalogue of host plants of Aphidoidea in Japan; *Insecta Matsumurana Suppl.* **5** 1–66
- Knowlton G F 1983 Aphids of Utah; Utah State University; *Res. Bull.* **509** 1–155
- Miyazaki M 1971 A revision of the tribe Macrosiphini of Japan (Homoptera: Aphididae, Aphidinae); *Insecta Matsumurana* **34** 1–247
- Narayanan E S, Subba Rao B R, Sharma A K and Starý P 1962 Revision of 'A catalogue of the known species of the world belonging to the subfamily Aphidiinae' (Hymenoptera: Braconidae); *Beitr. Entomol.* **12** 662–721
- Rabasse J M and Brunel E 1977 *Cavariella aegopodii* Scop. (Hom., Aphididae) en culture de carotte dans l'Ouest de la France. II. Regulation naturelle par Aphidiides (Hym.) et Entomophthorales, *Ann. Zool. Ecol. Anim.* **9** 481–496
- Raychaudhuri D N 1980 *Aphids of northeast India and Bhutan* (Calcutta: The Zoological Society) pp. 1–521
- Raychaudhuri D N 1983 *Food-plant catalogue of Indian Aphididae* (Aphidological Society) pp. 1–188
- Raychaudhuri D N, Ghosh L K and Das S K 1980 Studies on the aphids (Homoptera: Aphididae) from

- northwest India I; *Insecta Matsumurana* **20** 1–42
- Stroyan H L G 1969 Notes on some species of *Cavariella* Del Guercio, 1911 (Homoptera: Aphidoidea); *Proc. R. ent. Soc. London* **B38** 7–19
- Stroyan H L G 1976 A supplement to the Scottish aphid fauna; *Glasgow Nat.* **19** 235–258
- Szelegiewicz H 1968 Mszyce. Aphidodea; *Kat. Fauny Pol.* **21** 1–316
- Takada H and Rishi N D 1980 Records of fifteen species of Aphidiidae (Hymenoptera) from Kashmir, India, with description of three new species; *Kontyu* **48** 234–240
- Watt G 1972 *A dictionary of the economic products of India* (Delhi: Cosmo. Publ.) **6** 1–687