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Note

Pollen and Nectar Feeding by *Chilocorus kuwanae* (Silvestri) (Coleoptera: Coccinellidae)

Predaceous coccinellids are known to have a wide variety of accepted food. Even explicitly carnivorous lady beetles will supplement their diet with pollen and nectar from flowers and extrafloral nectaries (Hagen. 1962. Annual Review of Entomology 7: 289–326; Hodek. 1973. Biology of Coccinellidae. Junk, The Hague). There has, however, been relatively little work on the dietary habits of coccinellids that prey on scales of the family Diaspididae (Drea and Gordon. 1990. *In* The Armoured Scale Insects, Their Biology, Natural Enemies and Control. Vol. B. Elsevier, Amsterdam, pp. 19–40). This is a report on observations of adults of the imported diaspidid predator *Chilocorus kuwanae* (Silvestri) feeding on nectar and pollen of the host plant (*Euonymus* sp.) of one of its prey, the euonymus scale, *Unaspis euonymi* (Comstock) (Homoptera: Diaspididae).

Between April and September 1990, the Korean strain of *C. kuwanae* was released (n = 764) at a commercial location in Raleigh, N.C.; the site consisted of a low hedge (approx. 1 m) comprised of 8 bushes of *Euonymus japonicus aureo-variegatus* ("Gold Spot") severely infested with euonymus scale. On the morning of 4 June 1991, adult *C. kuwanae* (n = 27 by casual count) were observed on the flowers of these shrubs. The observed adults were the first generation of the year (matured from eggs produced by overwintering adults). Pupae and adults were the most abundant stages of *C. kuwanae* at the site, although a few late-instar larvae were also present. The bushes were largely free of live scale at the time of the observation.

On 6 June 1991 more detailed behavioral observations were conducted at the same site. We noted that adult *C. kuwanae* on flowers had their mouthparts in contact with the base of the ovary (Fig. 1). Because ants and honeybees were also observed in a similar position on the flowers, it is presumed that all these insects were feeding on floral nectar; floral nectaries in the family Celastraceae occur between the stamens and the ovary (Esau. 1965. Plant Anatomy. John Wiley & Sons, N.Y.). Adult *C. kuwanae* were observed similarly oriented on flowerheads of *Euonymus kiautschovicus* ("Manhattan") at a second site in Raleigh on 9 July 1991.

Eleven adults (6 males, 5 females) were collected from the flowerheads (6 June 1991) and brought back to the laboratory where they were dissected and their stomach contents inspected with phase contrast at 40×. All insects were positive for the presence of pollen in the gut. The prolate-spheroidal shape and the surface pattern of the pollen observed in the gut contents were consistent with that of published pictures of euonymus pollen (Lewis et al. 1983. Airborne and Allergenic Pollen of North America. The Johns Hopkins University Press, Baltimore), and with euonymus pollen collected from anthers and observed with a phase contrast microscope. Although thrips (*Frankliniella triticae* (Fitch)) were present on flowerheads at the site, no insect parts were obvious in the gut contents of the dissected coccinellids.

The reported observation of pollen and nectar feeding in *C. kuwanae* indicates that, when prey is scarce, this predator can supplement its diet with food of plant origin. Although nectar may be a source of energy for adults, it is probably nutritionally insufficient for egg or fat production (Hagen 1962). Pollen, however, is rich in protein (Levin and Haydak. 1958. Proceedings of the 10th International Congress of Ento-

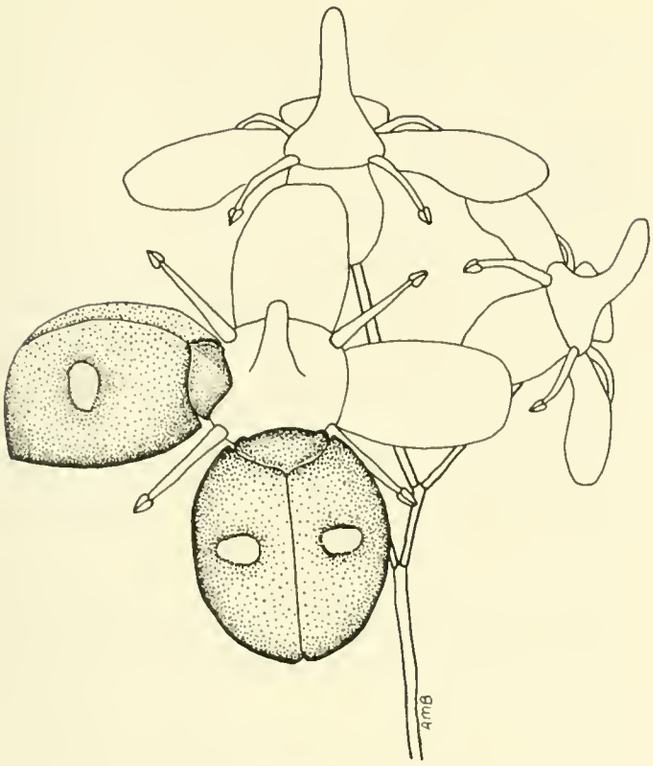

Fig. 1. Adults of *Chilocorus kuwanae* feeding at floral nectaries of *Euonymus* sp. Drawn from a photograph.

mology 4: 1079–1084), and may support oögenesis in the females. Unfortunately, we did not note the condition of ovaries in dissected females; the observed nectivory probably occurred during the pre-oviposition period of the newly emerged adults.

There is currently an extensive program for the release and distribution of *C. kuwanae* in the United States (Drea and Carlson. 1987. Proceedings of the Entomological Society of Washington 89: 821–824; Hendrickson et al. 1991. Proceedings of the Entomological Society of Washington 93: 197–200). These lady beetles can be reared in large numbers on scale infested bushes in outdoor insectaries, or on scale reared on squash in the laboratory (Tanaka and Kobayashi. 1970. Proceedings. Association for Plant Protection of Kyushu 16: 56–59; J. J. Drea, pers. comm.). Because of the need to synchronize the supply of scales to the needs of the beetles, however, periods of food shortage are a common problem in rearing these insects for biocontrol programs.

C. kuwanae has a wide host range within the Diaspididae and maintains itself on rotational prey over the course of the year (Kato. 1968. Kontyu 36: 29–38). Because of the reported observations, and because the ability to maintain a species of coccinellid on artificial diet may be related to broadness of host range (Hussein and Hagen. 1991. Entomologia Experimentalis et Applicata 59: 197–199), it may be possible to formulate a non-scale diet for laboratory maintenance or mass rearing of *C. kuwanae.* Artificial diet was a valuable alternative to natural prey for maintaining *C. nigritus* (Fabr.) adults. Artificial diets were, however, suboptimal for larval development and the maintenance of adults in *C. bipustulatus* L. and *C. infernalis* Muls. (Hattingh. 1989. 7th International Congress of the Entomological Society of South Africa, pp. 15–16).

We thank David L. Stephan (Entomology Department, North Carolina State University) for identifying the thrips, and John W. Scott (Plant Protection, North Carolina Department of Agriculture) for identifying the plants.

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