A 13-YEAR SURVEY OF THE APHIDOPHAGOUS COCCINELLIDAE IN MAIZE FIELDS IN EASTERN SOUTH DAKOTA

R.W. KIECKHEFER and N.C. ELLIOTT[1]

USDA, ARS, NPA, Northern Grain Insects Research Laboratory, Rural Route #3, Brookings, SD, USA 57006.

Cŏccinellids are a conspicuous group of aphidophagous predators in maize, *Zea mays* L., in the Northern Great Plains of the United States. Numerous studies have been conducted on the ecology of coccinellids in maize in North America (Ewert and Chiang 1966*a*, 1966*b*; Smith 1971; Foott 1973; Wright and Laing 1980; Corderre and Tourneur 1986; Corderre *et al.* 1987). However, there have been few long-term surveys of coccinellids in maize. Foott (1973) reported on the abundance of coccinellid species inhabiting maize in eastern Canada over a 4-year period; no surveys of this type have been reported for the Northern Great Plains. We sampled coccinellids in maize fields at three sites in eastern South Dakota for 13 consecutive years to determine the species inhabiting the crop and levels of variation in their abundances among sites and years.

One field at each of the following three sites in eastern South Dakota was sampled for coccinellids each year from 1973 through 1985: about 14 km from the town of Dry Lake; about 10 km from Brookings; and about 6 km from Clear Lake. Distances among sites ranged from approximately 50 to 80 km. Coccinnellid populations were sampled by collecting in a hand-held, mouth suction aspirator all adult and larval coccinellids seen in a thorough inspection of plants for 15 min within a field row selected at random. Four such samples were taken from a field on each sampling occasion (total 1 h). Coccinellids were anesthetized in the aspirator, transferred to containers, and identified to species in the laboratory. Species identifications were made (using a dissecting microscope when necessary) by comparison with known specimens. Each site was sampled at intervals of approximately 1 week starting when maize in the fields was nearing the end of vegetative growth (usually mid-July) and continuing until maize had dried (usually mid-September). A median of eight 1-h samples was taken from each field each year. Sampling was done in the early afternoon on sunny days, after the ambient temperature had reached at least 15°C, wind velocity was under 24 km/h, and foliage was dry. For each coccinellid species, the number of individuals collected per 15 min (abundance) was averaged on yearly and 13-year bases for each site and across sites.

Seven species of coccinellids commonly occurred in maize in eastern South Dakota: *Hippodamia convergens* Guerin-Meneville; *H. tredecimpunctata tibialis* (Say); *H. parenthesis* (Say); *Coleomegilla maculata* (DeGeer); *Coccinella transversoguttata* Faldermann; *Cycloneda munda* (Say); and *Adalia bipunctata* (L.). Species other than these seven were occasionally observed but no more than 10 individuals of any of these species were collected during the 13 years.

Averaged over years, there were no large differences in species abundances among sites relative to their standard errors (Table 1). Except for *H. tredecimpunctata* and *C. maculata* which changed positions at Dry Lake, and *H. parenthesis* and *C. munda* which exchanged positions at Brookings, rankings of species abundances were identical at all sites.

Abundances of coccinellids varied annually over the course of the study. Abundance of *H. tredecimpunctata* varied least among years, in a proportional sense, from 1.07 to 15.94 individuals per 15 min, or about 15-fold (Table 2). *Hippodamia parenthesis, C. munda, C. transversoguttata,* and *A. bipunctata* were virtually absent from the crop in 1 or more years. Averaged over sites, *H. convergens* was the dominant coccinellid in maize, accounting for a low of 11% of all coccinellids in 1985 to a high of 78% in 1976,

[1]Current address: USDA, ARS, SPA, Plant and Water Conservation Laboratory, PO Box 1029, Stillwater, OK 74076.

Table 1. Average (± SE) over 13 years of the number of coccinellids collected per 15 min (abundance) from maize fields at three sites in eastern South Dakota. Data from which averages were calculated are annual averages for each site

Species	Site		
	Clear Lake	Dry Lake	Brookings
H. convergens	9.55 ± 2.54	10.77 ± 2.21	9.03 ± 2.62
H. tredecimpunctata	6.93 ± 2.21	6.23 ± 1.34	7.89 ± 2.95
C. maculata	3.79 ± 1.46	6.42 ± 2.59	4.41 ± 1.86
C. transversoguttata	0.32 ± 0.11	0.39 ± 0.20	0.12 ± 0.07
H. parenthesis	0.10 ± 0.03	0.05 ± 0.01	0.05 ± 0.04
C. munda	0.06 ± 0.02	0.04 ± 0.02	0.07 ± 0.02
A. bipunctata	0.04 ± 0.02	0.03 ± 0.02	0.04 ± 0.02

Table 2. Average number of coccinellids collected in 15 min (abundance) and relative abundance of coccinellids in maize fields in eastern South Dakota averaged over three sites and 13 years (1973–1985)

Species	Abundance*	Relative abundance*
H. convergens	9.78(1.30–24.40)	0.44(0.11–0.78)
H. tredecimpunctata	7.02(1.07–15.94)	0.32(0.12–0.59
C. maculata	4.87(0.37–18.40)	0.22(0.02–0.72)
C. transversoguttata	0.28(0.00–1.10)	0.01(0.00–0.03)
H. parenthesis	0.07(0.00–0.23)	0.00(0.00–0.01)
C. munda	0.06(0.00–0.16)	0.00(0.00–0.01)
A. bipunctata	0.04(0.00–0.12)	0.00(0.00–0.01)

*Range of annual averages over three sites in parentheses.

and averaging 44% of all coccinellids collected in maize over the 13 years (Table 2). On average, *H. tredecimpunctata* was the second most abundant coccinellid and *C. maculata* was third.

Our data reveal high levels of year-to-year variability in abundances of all aphidophagous coccinellids inhabiting maize fields in eastern South Dakota, but demonstrate a marked degree of similarity in abundances of all species among geographically separated sites. These observations have bearing on methods for field evaluation of the impact of the exotic coccinellid *Coccinella septempunctata* L., which recently established in the region (Obrycki *et al.* 1987; Flanders and Nelson 1988), on native coccinellids. To achieve reliable information on change in species characteristic abundances that might result from altered interspecies relationships, studies may need to be conducted at only a few sites within a region, but may need to be several years in duration.

We thank Sandy Hubbard for word processing and editing this manuscript. Tim Kring, Gerry Michels, and Jim Webster gave useful critiques of a preliminary version of the manuscript.

Corderre, D., and J.C. Tourneur. 1986. Vertical distribution of aphids and aphidophagous insects on maize. *In* Hodek, I. (Ed.), Ecology of Aphidophaga. Academia Press, Prague.

Corderre, D., L. Provencher, and J. Tourneur. 1987. Oviposition and niche partitioning in aphidophagous insects on maize. *Can. Ent.* **119**: 195–203.

Ewert, M.A., and H.C. Chiang. 1966*a*. Effects of some environmental factors on the distribution of three species of Coccinellidae in their microhabitat. *In* Hodek, I. (Ed.), Ecology of Aphidophagous Insects. Academia Press, Prague.

——— 1966*b*. Dispersal of three species of Coccinellids in cornfields. *Can. Ent.* **98**: 999–1003.

Flanders, R.V., and D.J. Nelson. 1988. Aphid biological control project: Fiscal year 1988 report. USDA, APHIS Report. 38 pp.

Foott, W.H. 1973. Observations on coccinellids in corn fields in Essex County, Ontario. *Proc. ent. Soc. Ont.* **104**: 16–21.

Obrycki, J.J., W.C. Baily, C.R. Steltenow, B. Puttler, and C.E. Carlson. 1987. Recovery of the seven-spotted lady beetle, *Coccinella septempunctata* (Coleoptera: Coccinellidae), in Iowa and Missouri. *J. Kansas ent. Soc.* **60**: 584–588.

Smith, B.C. 1971. Effects of various factors on the local distribution and density of coccinellid adults on corn (Coleoptera: Coccinellidae). *Can. Ent.* **103**: 1115–1120.

Wright, E.J., and J.E. Laing. 1980. Numerical response of coccinellids to aphids in corn in southern Ontario. *Can. Ent.* **112**: 977–988.

(Date received: 6 April 1989; date accepted: 16 January 1990)