US ISSN 0013-872X
VOL. 112 SEPTEMBER AND OCTOBER, 2001 NO. 4

ENTOMOLOGICAL NEWS

THE AMERICAN ENTOMOLOGICAL SOCIETY

FIRST RECORD OF *HARMONIA AXYRIDIS* (COLEOPTERA: COCCINELLIDAE) IN SOUTH DAKOTA AND NOTES ON ITS ACTIVITY THERE AND IN MINNESOTA[1]

Louis S. Hesler, Robert W. Kieckhefer, David A. Beck[2]

ABSTRACT: The first specimen of the exotic coccinellid, *Harmonia axyridis,* from South Dakota was collected in Brookings County in October 1996. Twenty-eight more specimens of *H. axyridis* were collected in Brookings County through April 2000, but none was found at other collecting sites in the state. Specimens were also collected from Minnesota, but subsequent to previous reports of *H. axyridis* there. All of our specimens were adults of the *succinea* color form. Most were collected outdoors and associated with autumn aggregations. Some *H. axyridis* were active in low numbers at a residence in South Dakota throughout winter 1999-2000. Implications of our findings are discussed regarding the behavior and origin of *H. axyridis* in South Dakota and Minnesota, and its possible impact on resident arthropod communities.

Harmonia axyridis (Pallas) (multicolored Asian lady beetle) is a Palearctic species with established populations in North America. It was released intentionally in several states of the US many times between 1916 and 1985 for biological control of various homopteran pests (Coulson 1982, Gordon 1985, McClure 1987, Hoebeke and Wheeler 1996). The first established population in North America was found in Louisiana in 1988 (Chapin and Brou 1991). Populations of *H. axyridis* were subsequently found in several other states (Chapin and Brou 1991, Lyon 1994, Tedders and Schaefer 1994, Dreistadt et al. 1995, Kidd et al. 1995, Pfannenstiel 1995, LaMana and Miller 1996, Krafsur et al. 1997, Brown and Miller 1998, Colunga-Garcia and Gage 1998) and in eastern provinces of Canada (Coderre et al. 1995, Hoebeke and Wheeler 1996, McCorquodale 1998). Widespread but disjoint distribution of *H. axyridis* in North America indicates establishment at distinct times and locations on the continent. In some cases, *H. axyridis* appears to have established via intentional releases (LaMana and Miller 1996), whereas accidental establishment may explain the appearance of other populations in eastern North America (Day et al. 1994).

Various aspects of the biology of *H. axyridis* in North America are becoming clear with the publication of research results and observations from several states and provinces. Knowledge about North American populations of *H. axyridis* includes information on their behavior and activity, morphology, natural enemies, predation, competition, habitat preferences, and population trends (McClure 1987, Tedders and Shaefer 1994, LaMana and Miller 1996,

[1] Received August 8, 2000. Accepted December 10, 2000.

[2] USDA-ARS, Northern Grain Insects Research Laboratory, 2923 Medary Ave., Brookings, SD 57006.

Nalepa et al. 1996, Brown and Miller 1998, Colunga-Garcia and Gage 1998, Cottrell and Yeargan 1998, LaMana and Miller 1998). We now report the first collections of *H. axyridis* in South Dakota, and recount some observations on its behavior and activity there and in Minnesota.

COLLECTIONS AND OBSERVATIONS

South Dakota. We sampled for coccinellids in eastern South Dakota from October 1996 through April 2000. We collected one *H. axyridis* in 1996, 26 in 1999, and 2 through April 2000 (Table 1). All specimens were adults having orange elytra with varying degrees of black maculation ranging from minute maculae (almost absent) to large, slightly coalescent maculae (*succinea* color form, Komai 1956). Our collections of *H. axyridis* were biased toward maximizing the variation in size, color, and elytral maculation.

All *H. axyridis* were collected in Brookings County (east-central part of the state). Moreover, all but two specimens were collected within a 1-km^2 area about 1 km north of the city of Brookings (T11ON, R50W, sec. 12). Many additional *H. axyridis* adults were observed, but not collected, outdoors in October 1999 at this site. One of us (D.A.B.) observed live *H. axyridis* adults several times within a home in the area north of Brookings from November 1999 through April 2000. One specimen was collected on 29 Apr 2000 inside this residence. The area north of Brookings included our laboratory and about 20 homes with lawns, ornamental plants, and fruit and shade trees. The surrounding landscape consisted primarily of agricultural land devoted to field crops and livestock.

The two remaining specimens were collected from two other sites in Brookings County. One was brought to us for identification after it was collected on a yellow sticky trap that had been deployed from 31 Aug to 6 Sep, 1999, in a maize field just north of Aurora (about 5 km east of Brookings, Brookings Co.; T11ON, R49W, sec. 34). No other *H. axyridis* were found on an additional 3621 traps that were deployed among that maize field and several others within a 41-sq.-km area between 7 July and 7 September, 1999. The sticky traps were deployed to capture *Diabrotica* spp. (Coleoptera: Chrysomelidae, corn rootworm beetles; Karr and Tollefson 1987). However, they also routinely captured various non-target insects, including individuals of the eight or so coccinellid taxa commonly found in South Dakota maize fields (Elliott et al. 1996). The remaining specimen of *H. axyridis* was collected on March 7, 2000, as the beetle flew about 1 m above a lawn on the campus of South Dakota State University in Brookings.

Between October 1996 and April 2000, we sampled for coccinellids at several other times and locations in eastern South Dakota. For instance, we sampled for adult coccinellids by enumerating species and numbers seen while walking parallel to rows within wheat or barley fields, similar to a method

described by Elliott et al. 1991. This type of sampling occurred roughly weekly during May and June 1998 in both a wheat field in Clay County (about 160 km south of Brookings) and a barley field about 2 km north of Brookings. Our efforts also included several avocational collecting trips throughout eastern South Dakota during the summer and autumn months of 1996 through 1999. We found various species of coccinellids, but not *H. axyridis*, at these other locations.

Minnesota. Our sampling for coccinellids in Minnesota was limited to October 1998 and November 1999. In October 1998, 18 *H. axyridis* adults were collected outdoors at Rochester (Olmsted County), and, in November 1999, a single adult was collected indoors at Chanhassen (Carver County) (Table 1). Many additional *H. axyridis* adults were present at the Rochester site. Specimens from Rochester were collected with bias toward maximizing variation in size, color, and elytral maculation. Like those from South Dakota, *H. axyridis* from Minnesota also had the *succinea* color form. Voucher specimens from both states are housed at the Northern Grain Insects Research Laboratory, Brookings.

DISCUSSION

Our collections of *H. axyridis* in South Dakota are the first specimens reported from there. *Harmonia axyridis*, however, had been found previously in Minnesota (Kimball 1998). The origin of *H. axyridis* in South Dakota and Minnesota is unknown, but we have not found records that *H. axyridis* have ever been intentionally released in either state (Coulson 1982, Gordon 1985, McClure 1987). *Harmonia axyridis* may have arrived in South Dakota and Minnesota by geographic range expansion from adjacent states, by accidental introduction(s) (Day et al. 1994), or by both means. Populations of *H. axyridis* in North America are capable of rapid geographic range expansion (Tedders and Schaefer 1994, Kidd et al. 1995, LaMana and Miller 1996, Wheeler and Stoops 1996, Colunga-Garcia and Gage 1998, McCorquodale 1998), as indicated by the radiation of this species during the last decade across much of the eastern half of North America (Tedders and Schaefer 1994, Hoebeke and Wheeler 1996) and west coast of the U.S. (Dreistadt et al. 1995, LaMana and Miller 1996). Alternatively, major air and shipping ports in Minnesota could have allowed for the accidental introduction of *H. axyridis*, as the first collections of many adventive coccinellids in North America are associated with major ports (Day et al. 1994).

Our specimens of *H. axyridis* from South Dakota and Minnesota are variants of the *succinea* color form, and specimens from both states were similar in the range of elytral color form variation. The *succinea* color form predominates in *H. axyridis* populations of North America (Tedders and Schaefer 1994, Coderre et al. 1995, LaMana and Miller 1996, Nalepa et al. 1996).

We collected specimens of *H. axyridis* both outdoors and indoors. Most (45 of 48) specimens were collected outdoors, where they were active on plants, sun-warmed surfaces of buildings, or in flight. We observed and collected many *H. axyridis* as they aggregated in autumn. Similarly, in Oregon, LaMana and Miller (1996) found *H. axyridis* aggregating outdoors in autumn on buildings, outcroppings of rocks, and other conspicuous features of the landscape. In North Carolina and Virginia, Nalepa et al. (1996, 2000) collected *H. axyridis* from buildings in both urban and agricultural areas.

We collected other specimens indoors as they crawled on potted plants or around windows or doorways. In autumn, *H. axyridis* adults can be active in large numbers inside homes, other buildings, and among the hives of domesticated honey bees, making this beetle species a nuisance pest (Tedders and Schaefer 1994, Kidd et al. 1995, Caron 1996, Knodel and Hoebeke 1996, Kimball 1998, Nalepa et al. 2000).

During the winter, *H. axyridis* adults enter diapause (Sakurai et al. 1988), and individuals can overwinter outdoors in North America (McClure 1987). However, we observed indoor activity of *H. axyridis* through the winter. Coccinellids may become active without breaking reproductive diapause during warm periods in winter (Anderson and Richards 1977). Nalepa et al. (2000) have suggested that coccinellid activity may be relatively continuous throughout the winter in heated buildings.

During spring and summer, *H. axyridis* utilizes a wide range of environments, including annual and perennial crop fields and arboreal habitats (Tedders and Schaefer 1994, Coderre et al. 1995, LaMana and Miller 1996, Brown and Miller 1998, Colunga-Garcia and Gage 1998, Cottrell and Yeargan 1998, LaMana and Miller 1998). Individuals prey on a wide range of Homoptera and other arthropods (Tedders and Schaefer 1994, Coderre et al. 1995, Dreistadt et al. 1995, LaMana and Miller 1996, Brown and Miller 1998, Cottrell and Yeargan 1998, LaMana and Miller 1998). The presence of *H. axyridis* in apple orchards in West Virginia improves biological control of *Aphis spiraecola* Patch (Homoptera: Aphididae) (Brown and Miller 1998). Both South Dakota and Minnesota contain a variety of major vegetation types, including some arboreal habitats and many grassland and field crop habitats (Johnson and Larson 1999). As *H. axyridis* was not released for control of any particular arthropod pest in these two states, it will be important to determine its impact on different prey species within the various habitats.

Harmonia axyridis may also impact resident coccinellids in South Dakota and Minnesota. Another exotic coccinellid, *Coccinella septempunctata* L., is associated with reduced abundance of two native coccinellids, *Adalia bipunctata* (L.) and *C. transversoguttata richardsoni* Brown, in South Dakota (Elliott et al. 1996). In West Virginia (Brown and Miller 1998) and in Michigan (Colunga-Garcia and Gage 1998), *H. axyridis* has been associated with population declines of other coccinellid species, including *C. septempunctata.*

It is difficult to predict the eventual effect of an introduced polyphagous predator like *H. axyridis* on biological control of arthropods and on populations of other coccinellids (Elliott et al. 1996). This underscores the need for monitoring in ecosystems in which an exotic predator has been introduced. The recent advent of *H. axyridis* in South Dakota and Minnesota provides opportunities to monitor expansion of its geographic range and to assess its impact upon arthropod communities. Results of such studies can improve our understanding of the merits and limitations of exotic predators within the ecological landscape.

Table 1. Collection data for *Harmonia axyridis* collected in South Dakota and Minnesota.

Collection date	Nearest town	Description of collection site	Number collected
South Dakota, Brookings County			
25 Oct. 1996	Brookings	Outdoors, south-facing walls of garden shed	1
6 Sep. 1999	Aurora	Outdoors, maize field, yellow sticky trap	1
18 Sep. 1999	Brookings	Outdoors, *Zinnia* sp. flowers	1
8 Oct. 1999	Brookings	Outdoors, south-facing walls of garden shed	6
9 Oct. 1999	Brookings	Outdoors, south-facing walls of garden shed	2
10 Oct. 1999	Brookings	Outdoors, south-facing walls of garden shed	3
14 Oct. 1999	Brookings	Outdoors, south-facing walls of garden shed	7
22 Oct. 1999	Brookings	Outdoors, flower bed	1
24 Oct. 1999	Brookings	Indoors, near window of house	1
25 Oct. 1999	Brookings	Outdoors, south-facing walls of garden shed	3
26 Oct. 1999	Brookings	Outdoors, in flight over lawn	1
7 Mar. 2000	Brookings	Outdoors, in flight over lawn, South Dakota State University campus	1
29 Apr. 2000	Brookings	Indoors, above doorway of house	1
Minnesota, Olmsted County, Visitor Center, Quarry Hill Nature Reserve			
24 Oct. 1998	Rochester	Outdoors, south-facing walls of visitor center	8
26 Oct. 1998	Rochester	Outdoors, south-facing walls of visitor center	3
28 Oct. 1998	Rochester	Outdoors, south-facing walls of visitor center	7
Minnesota, Carver County			
25 Nov. 1999	Chanhassen	Indoors, window of house	1

ACKNOWLEDGMENTS

We thank Robert D. Gordon for identifying specimens of *H. axyridis*. Debra Hartman furnished the specimen of *H. axyridis* collected near Aurora and information about its collection. Norman C. Elliott, B. Wade French, J. Bruce Helbig, Lauren A. Hesler, and Paul J. Johnson graciously reviewed drafts of this manuscript.

LITERATURE CITED

Anderson, J.M.E., and A. M. Richards. 1977. First records of reproductive diapause and aggregation in Australian Coccinellidae (Coleoptera). Proc. Linn. Soc. New S. Wales 102: 13-17.

Brown, M. W., and S. S. Miller. 1998. Coccinellidae (Coleoptera) in apple orchards of eastern West Virginia and the impact of invasion by *Harmonia axyridis*. Entomol. News 109: 136-142.

Caron, D. M. 1996. Multicolored Asian lady beetles a "new" honey bee pest. Am. Bee J. 136: 728-729.

Chapin, J. B., and V. A. Brou. 1991. *Harmonia axyridis* (Pallas), the third species of the genus to be found in the United States (Coleoptera: Coccinellidae). Proc. Entomol. Soc. Wash. 93: 630-635.

Coderre, D., É. Lucas, and I. Gagné. 1995. The occurrence of *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in Canada. Can. Entomol. 127: 609-611.

Colunga-Garcia, M., and S. H. Gage. 1998. Arrival, establishment, and habitat use of the multicolored Asian lady beetle (Coleoptera: Coccinellidae) in a Michigan landscape. Environ. Entomol. 27: 1574-1580.

Cottrell, T. E., and K. V. Yeargan. 1998. Intraguild predation between an introduced lady beetle, *Harmonia axyridis* (Coleoptera: Coccinellidae), and a native lady beetle, *Coleomegilla maculata* (Coleoptera: Coccinellidae). J. Kans. Entomol. Soc. 71: 159-163.

Coulson, J. R. 1982. Releases of beneficial organisms in the United States and its territories—1982. US Dept. Agric. Misc. Pub. 1505.

Day, W. H., D. R. Prokrym, D. R. Ellis, and R. J. Chianese. 1994. The known distribution of the predator *Propylea quatuordecimpunctata* (Coleoptera: Coccinellidae) in the United States, and thoughts on the origin of this species and five other exotic lady beetles in eastern North America. Entomol. News 105: 244-256.

Dreistadt, S. H., K. S. Hagen, and L. G. Bezark. 1995. *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), first western United States record for this Asiatic lady beetle. Pan-Pac. Entomol. 71: 135-136.

Elliott, N. C., R. W. Kieckhefer, and W. C. Kauffman. 1991. Estimating adult coccinellid populations in wheat fields by removal, sweepnet, and visual count sampling. Can. Entomol. 123: 13-22.

Elliott, N., R. Kieckhefer, and W. Kauffman. 1996. Effects of an invading coccinellid on native coccinellids in an agricultural landscape. Oecologia 105: 537-544.

Gordon, R. D. 1985. The Coleoptera (Coccinellidae) of America north of Mexico. J. N.Y. Entomol. Soc. 93: 1-912.

Hoebeke, E. R., and A. G. Wheeler. 1996. Adventive lady beetles (Coleoptera: Coccinellidae) in the Canadian maritime provinces, with new eastern U.S. records of *Harmonia quadripunctata*. Entomol. News 107: 281-290.

Johnson, J. R., and G. E. Larson. 1999. Grassland plants of South Dakota and the northern Great Plains. S. D. Agric. Exp. Stn., B566 (rev.).

Karr, L. L., and J. J. Tollefson. 1987. Durability of the Pherocon AM trap for adult western and northern corn rootworm (Coleoptera: Chrysomelidae) sampling. Environ. Entomol. 80: 891-896.

Kidd, K. A., C. A. Nalepa, E. R. Day, and M. G. Waldvogel. 1995. Distribution of *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) in North Carolina and Virginia. Proc. Entomol. Soc. Wash. 97: 729-731.

Kimball, J. 1998. Lots of ladybugs. FYI section, 28 Oct. 1998, Minneapolis-St. Paul Star-Tribune.

Knodel, J. J. and E. R. Hoebeke. 1996. Multicolored Asian ladybeetle, *Harmonia axyridis* (Pallas) Coleoptera: Coccinellidae. Cornell Coop. Ext., Misc. Pest Management Fact Sheet, page 101.00.

Komai, T. 1956. Genetics of ladybeetles. Adv. Genet. 8: 155-188.

Krafsur, E. S., T. J. Kring, J. C. Miller, P. Nariboli, J. J. Obrycki, J. R. Ruberson, P. W. Schaefer. 1997. Gene flow in the exotic colonizing ladybeetle *Harmonia axyridis* in North America. Biological Control 8:207-214.

LaMana, M., and J. C. Miller. 1996. Field observations on *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae) in Oregon. Biol. Control 6: 232-237.

LaMana, M., and J. C. Miller. 1998. Temperature-dependent development in an Oregon population of *Harmonia axyridis* (Coleoptera: Coccinellidae). Environ. Entomol. 27: 1001-1005.

Lyon, W. F. 1994. Multicolored Asian lady beetle. Ohio State Univ. Ext. Fact Sheet HYG-2158-94, 2 pp.

McClure, M. S. 1987. Potential of the Asian predator, *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae), to control *Matsucoccus resinosae* Bean and Godwin (Homoptera: Margarodidae) in the United States. Environ. Entomol. 16: 224-230.

McCorquodale, D. B. 1998. Adventive lady beetles (Coleoptera: Coccinellidae) in eastern Nova Scotia, Canada. Entomol. News 109: 15-20.

Nalepa, C.A., K. A. Kidd, and K. R. Ahlstrom. 1996. Biology of *Harmonia axyridis* (Coleoptera: Coccinellidae) in winter aggregations. Ann. Entomol. Soc. Am. 89: 681-685.

Nalepa, C.A., K. A. Kidd, and D. I. Hopkins. 2000. The multicolored Asian ladybeetle (Coleoptera: Coccinellidae): orientation to aggregation sites. J. Entomol. Sci. 35: 150-157.

Pfannenstiel, R. S. 1995. Patterns of habitat use by generalist predators in agricultural ecosystems. Ph.D. Dissertation. Univ. Kentucky, Lexington.

Sakurai, H., S. Takeda, and T. Kawai. 1988. Diapause regulation in the lady beetle *H. axyridis*. In: Niemczyk, E. and A.F.G. Dixon (eds.), Ecology and effectiveness of Aphidophaga, SPB Academic, The Hague. pp. 67-70.

Tedders, W. L., and P. W. Schaefer. 1994. Release and establishment of *Harmonia axyridis* (Coleoptera: Coccinellidae) in the southeastern United States. Entomol. News 105: 228-243.

Wheeler, A. G., Jr., and C. A. Stoops. 1996. Status and spread of the Palearctic lady beetles *Hippodamia variegata* and *Propylea quatuordecimpunctata* (Coleoptera: Coccinellidae) in Pennsylvania, 1993-1995. Entomol. News 107: 291-298.

BOOKS RECEIVED AND BRIEFLY NOTED

HANDBOOK OF VEGETABLE PESTS. John L. Capinera. 2001. Academic Press. $8^1/_2$ x 11 format. 729 pp. Hard. $150.00.

This volume provides a comprehensive survey of all garden and farm pests likely to be encountered in North America. This Handbook provides thorough identification guides, descriptions of past life histories, and pest management recommendations. The text is illustrated with hundreds of line drawings as well as color plates for ease in identification.

THE TRIUMPH OF SOCIOBIOLOGY. John Alcock. 2001. Oxford University Press. 256 pp. Hard. $27.50.

In this objective approach to the sociobiology debate, the author shows how sociobiologists study behavior in all species. He confronts the principal scientific and ideological objections with a compelling analysis of case histories that involve topics as sexual jealousy, beauty, gender differences, parent-offspring relations, and rape and, in so doing, shows that sociobiology provides the most satisfactory scientific analysis of social behavior available today.