Accepted for publication 17 April 2006. Published 7 June 2006.

Influence of Berry Injury on Infestations of the Multicolored Asian Lady Beetle in Wine Grapes

Tederson L. Galvan, Eric C. Burkness, and **William D. Hutchison,**
Department of Entomology, University of Minnesota, St. Paul 55108

Corresponding author: Tederson L. Galvan. galva008@umn.edu

Galvan, T. L., Burkness, E. C., and Hutchison, W. D. 2006. Influence of berry injury on infestations of the multicolored Asian lady beetle in wine grapes. Online. Plant Health Progress doi:10.1094/PHP-2006-0607-01-BR.

The multicolored Asian lady beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae), has become an economically significant, contaminant pest in the wine making process throughout the eastern U.S. and in Ontario, Canada (1,5). *Harmonia axyridis* adults tend to aggregate (Fig. 1) on grape clusters near harvest, and subsequently, may be incorporated with the grapes during wine processing. Once crushed, the beetles release their foul smelling hemolymph that can taint the flavor and aroma of the resulting wine (1,5).

Fig. 1. Aggregation of *Harmonia axyridis* adults on clusters of 'Leon Millot'.

The pest status and biology of *H. axyridis* in grapes has not been fully determined. For example, the timing of beetle infestation and its interaction with grape injury are unclear. Two previous laboratory studies (2,3) had divergent conclusions regarding the ability of *H. axyridis* to cause primary injury on grape berries. Even though Kovach (3) stated that *H. axyridis* "can injure fruit," studies in Minnesota indicate that previous injury to grape berries is necessary for sustained feeding by *H. axyridis* adults. For example, Koch et al. (2) showed that *H. axyridis* did not cause primary injury to grape berries, based on a laboratory study over 2 years using 3 grape varieties and 100 *H. axyridis* (i.e., twice as many beetles as Kovach used). In addition, *H. axyridis* was not found in clusters in vineyards, with a low proportion (e.g., 0.12) of clusters with injured berries, even though beetles were caught on yellow sticky cards (T. L. Galvan, *unpublished data*). While Kovach (3) states that *H. axyridis* "can injure fruit," he does not provide a definition of "the injury." In addition, only 3 out of 50 *H. axyridis* were found feeding on non-injured berries in his laboratory study. In this article, we present results showing the influence of freshly injured berries (Fig. 2) on *H. axyridis* infestations in wine grapes (Fig. 3), and how this relationship affects the management of *H. axyridis*.

Fig. 2. Freshly injured berries of ‘Leon Millot.’

Fig. 3. *Harmonia axyridis* adult feeding on freshly injured berry.

In 2004 and 2005, we sampled an established vineyard of ‘Leon Millot’ near Hastings, MN, from mid August to mid September. In 2004, 40 grape clusters were sampled on 31 August, 2, 7, 10, 13, 17, and 23 September. In 2005, 60 grape clusters were sampled on 9, 16, 23, 26, 29, and 31 August; 120 grape clusters were sampled on 2 and 9 September. On each date, randomly selected clusters were sampled using visual, whole-cluster inspection from randomly selected vines in a 1-ha vineyard. For each cluster, data were recorded for the presence or absence of at least one *H. axyridis* adult and/or one freshly injured berry. Freshly injured berries were defined as an opening in the berry skin that exposes the pulp. Causes of injury to berries were primarily splitting, followed by birds or insects. Splitting is caused by a sudden increase of absorption and/or adsorption of water, atmospheric humidity, or temperature (4). Varieties with a tight cluster structure, such as ‘Leon Millot,’ as observed in our sampling, normally have high rates of splitting. Mean proportion of clusters infested with *H. axyridis* and mean proportion of clusters with freshly injured berries, on each sample date, were transformed by arcsine square root. Linear regressions of transformed proportions were performed for each year (PROC REG, 2003; SAS Institute Inc., Cary, NC). In addition, we compared the proportions of *H. axyridis* found in clusters with injured berries and in clusters with intact berries. Mean proportions of *H. axyridis*, on each sample date, were transformed by arcsine square root, and t-tests of transformed proportions were performed for each sample date (PROC TTEST; SAS).

In 2004, regression analysis showed a strong relationship ($R^2 = 0.98$) between the proportion of *H. axyridis* infested clusters and clusters with freshly injured berries (Fig. 4 A). However, in 2005, the relationship ($R^2 = 0.45$) was not as strong (Fig. 4 B). The range of proportion of clusters with freshly injured berries did not differ between 2004 (0.10 to 0.82) and 2005 (0.05 to 0.90). However, the range of the proportion of *H. axyridis* infested clusters in 2004 (0.05 to 0.65) was greater than in 2005 (0.0 to 0.28). In addition, at harvest, we also observed a higher mean density of *H. axyridis* per cluster in 2004 (2.12) than in 2005 (0.14). The poor relationship between *H. axyridis* infestation and injured berries in 2005 can be explained by the lower density and infestation of *H. axyridis*. The lower density in 2005 was due to a lower overall *H. axyridis* density in the vineyard (T. L. Galvan, *unpublished data*), and/or an earlier harvest. In 2005, harvest was 2 weeks earlier than in 2004 which may have minimized the subsequent buildup of *H. axyridis* populations in the vineyard. Even though the relationship in ‘Leon Millot’ was not as significant in 2005 as in 2004, we did observe the influence of freshly injured berries on *H. axyridis* infestations in other grape varieties such as ‘Frontenac’ and ‘Marechal Foch’ (T. L. Galvan, *unpublished data*). Results from the t-tests for each sample date corroborated with the results from the regression analysis. Proportions of *H. axyridis* were greater in clusters with injured berries than in clusters with intact berries in all 13 sample dates that had *H. axyridis*. However, sample dates where beetle counts were significantly different ($P < 0.05$), often included the late-season observations near harvest (7, 17, and 23 September 2004, 29 and 31 August, and 2 September 2005).

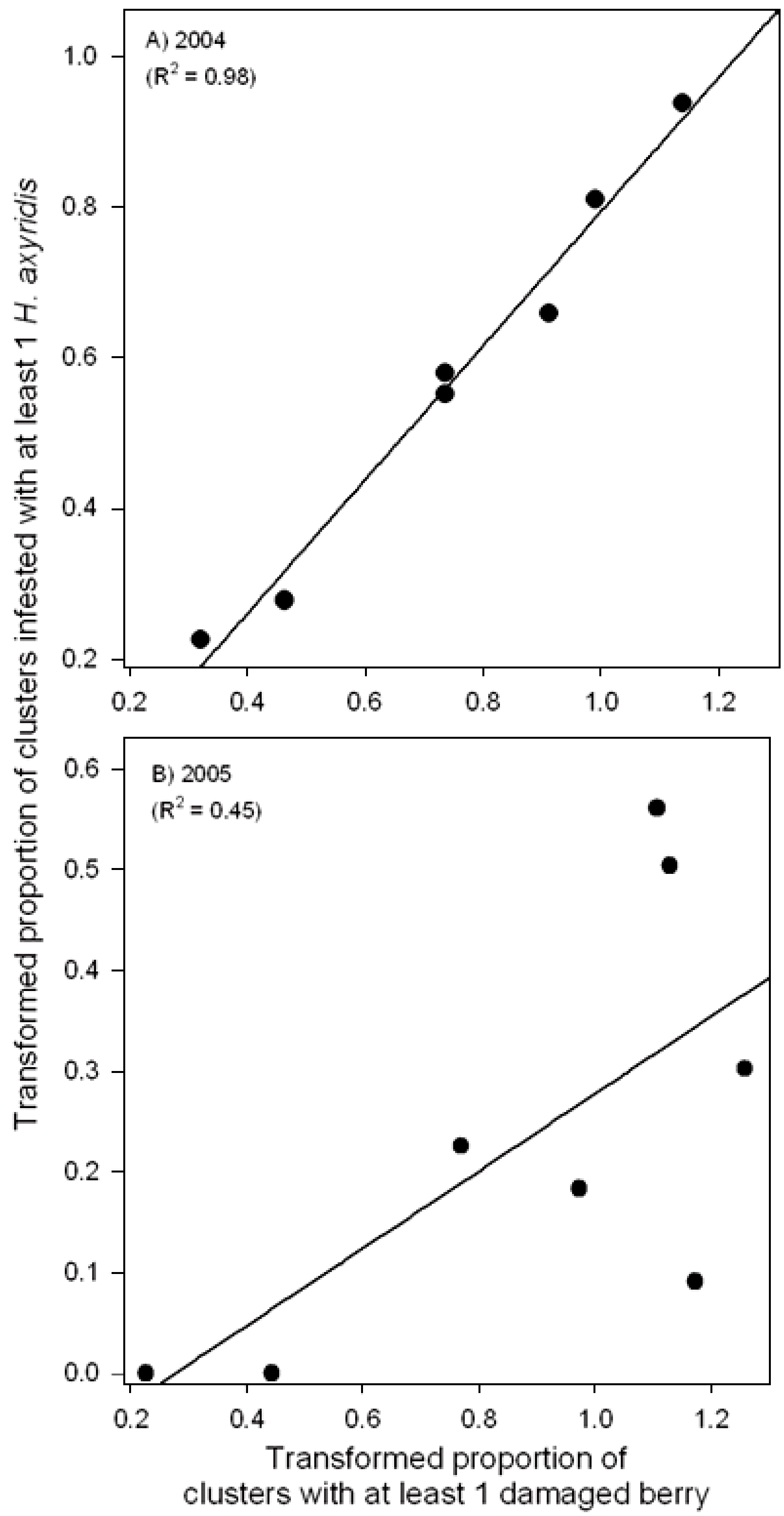

Fig. 4. Linear relationship between the proportion of clusters infested with at least one *Harmonia axyridis* adults, and the proportion of clusters with at least one injured berry. Solid lines represent the predicted models: y = -0.0969 + x 0.8909 (F = 267.74 and P = <.0001) (A); y = -0.1627 + x 0.3839 (F = 5.04 and P = 0.0659) (B). Proportions were transformed by arcsine square root.

The relationship between berry injury and *H. axyridis* infestation has two important implications for the management of *H. axyridis* in wine grapes. The first relates to the information that growers should obtain to make decisions about *H. axyridis* management. Since infestations are dependent on berry injury, and because *H. axyridis* does not cause initial berry injury (2), the presence of *H. axyridis* in the vineyard does not necessarily indicate the presence of this insect in grape clusters. Therefore, growers should closely monitor the incidence of berry injury in addition to infestations of *H. axyridis* in clusters to make management decisions. The second implication deals with the reduction of berry splitting. Growers can reduce berry injury caused by splitting by selecting varieties with resistance or tolerance to splitting, use of irrigation to avoid long periods of drought, and to avoid injuring berries when pruning or spraying (4).

Literature Cited

1. Galvan, T. L., Burkness, E. C., and Hutchison, W. D. 2006. Wine grapes in the Midwest: reducing the risk of the multicolored Asian lady beetle. Public. 08232. Univ. of Minn. Ext. Serv., St. Paul.
2. Koch, R. L., Burkness, E. C., Wold-Burkness, S. J., and Hutchison, W. D. 2004. Phytophagous preferences of the multicolored Asian lady beetle (Coleoptera: Coccinellidae) to autumn ripening fruit. J. Econ. Entomol. 97:539-544.
3. Kovach, J. 2004. Impact of multicolored Asian lady beetles as a pest of fruit and people. Am. Entomol. 50:159-161.
4. Opara, L. U., Studman, C. J., and Banks, N. H. 1997. Fruit skin splitting and cracking. Hort. Rev. 19:217-262.
5. Pickering, G. J., Lin, Y., and Ker, K. 2006. Origin and remediation of Asian lady beetle (*Harmonia axyridis*) taint in wine. In Crops: Growth, Quality and Biotechnology. III. Quality Management of Food Crops for Processing Technology. R. Dris, ed. WFL Publisher, Helsinki, Finland.