N O T E

Parasitism by *Diadegma insulare* (Hymenoptera: Ichneumonidae) in Collard in South Carolina[1]

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Diadegma insulare (Cresson) (Hymenoptera: Ichneumonidae) is a major natural enemy of the diamondback moth, *Plutella xylostella* (L.), a global pest of crucifers, its preferred host (Horn 1987, Entomol. Exper. Appl. 43: 300-303). The seasonal abundance of *P. xylostella* and its parasitoids has been reported in several regions of North America (Pimentel 1961, J. Econ. Entomol. 54: 889-892; Oatman and Platner 1969, Hilgardia 40: 1-40; Lasota and Kok 1989, J. Econ. Entomol. 82: 811-818). Densities of *P. xylostella* larvae exceeding the economic threshold and a parasitism rate of over 90% by *D. insulare* in untreated collard plots, compared with a parasitism rate of 45% in esfenvalerate-treated plots and 55% in *Bacillus thuringiensis*-treated plots, were reported in South Carolina (Muckenfuss and Shepard 1994, J. Agric. Entomol. 11: 361-373).

Wildflower nectar sources near or around field crops may increase the effectiveness of *D. insulare.* This parasitoid was reported to make frequent visits to flowers such as yellow rocket [*Barbarea vulgaris* (Brown)], canola (*Brassica napus* L.), wild mustard [*Brassica kaber* (D.C.) Wheeler] and wild carrot (*Daucus carota* L.) (Idris and Grafius 1997, Environ. Entomol. 26: 114-120). Feeding on these plant species prolonged longevity and increased fecundity of the parasitoid. Several studies (e.g., Altieri et al. 1977, PANS 23: 195-205; Horn 1981, Environ. Entomol. 10: 285-289; Horn 1984, J. New York Entomol. Soc. 92: 19-26) have shown that weeds among crops, which provide reservoirs for alternative hosts and nectar sources for adult parasitoids, reduce populations of phytophagous insects on the crop by subjecting them to increased predation and parasitism. The objective of this study was to determine if there was a difference in incidence of parasitism in *P. xylostella* by *D. insulare* in collards bordered by nectar-producing plants compared with fields lacking these plants in the coastal area of South Carolina. We also report seasonal occurrence of *D. insulare* in two geographic regions of South Carolina.

Wildflowers and parasitism. Collards were transplanted on 10 and 11 Novem-

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ber, 31 August, and 12 October 1999 at Coastal Research and Education Center in Charleston, SC, at four sites (Fig. 1). No pesticides were used. Sites 1 (0.58 ha) and 3 (0.38 ha) consisted of "Vates" collards and uncultivated wildflowers. Wildflowers such as crimson clover (*Trifolium incarnatum* L.), cutleaf eveningprimrose (*Oenothera laciniata* Hill), wild radish (*Raphanus raphanistrum* L.), and *Verbena bonariensis* L. were most prevalent. Sites 2 (0.27 ha) and 4 (0.11 ha) consisted of only "Vates" collard. Wildflowers growing in or around fields within 5 m of Sites 2 and 4 were removed by disking.

Each site was divided into four plots. Ten collard plants were visually examined for late second to fourth-instar *P. xylostella* larvae in each plot on 22 March, 27 April, and 12, 16, and 25 of May 2000. Larvae were transported to the laboratory in cartons filled with collard leaves and reared on soybean flour and wheat-based artificial diet (Southland Products Inc., Lake Village, AR) in 30-ml plastic cups. Pupae were reared in 30-ml plastic cups without artificial diet at room temperature in the laboratory. The larvae were checked for mortality, symptoms of disease, and parasitism every 2 d. For all collections, parasitism was computed as follows: the number of emerged adult *D. insulare* divided by the total number of *P. xylostella* larvae and pupae times 100. The SAS general linear model procedure was used to analyze the data ($P = 0.05$) between treatments for parasitism (SAS Institute 1997). The treatments did not have a significant effect on seasonal abundance of parasitism ($t = 0.09$; df = 4; $P = 0.9323$). The mean percentage parasitism by *D. insulare* in collard associated with wildflower was 48.58 ± 7.59 (SEM). The mean percentage parasitism in collard without wildflowers surrounding the field was 49.32 ± 5.63 (SEM). The total number of *P. xylostella* collected season-long was higher in collards associated with weeds. The mean rate of parasitism ranged from 31.5 to 66.6%. In Florida, population densities of *P.*

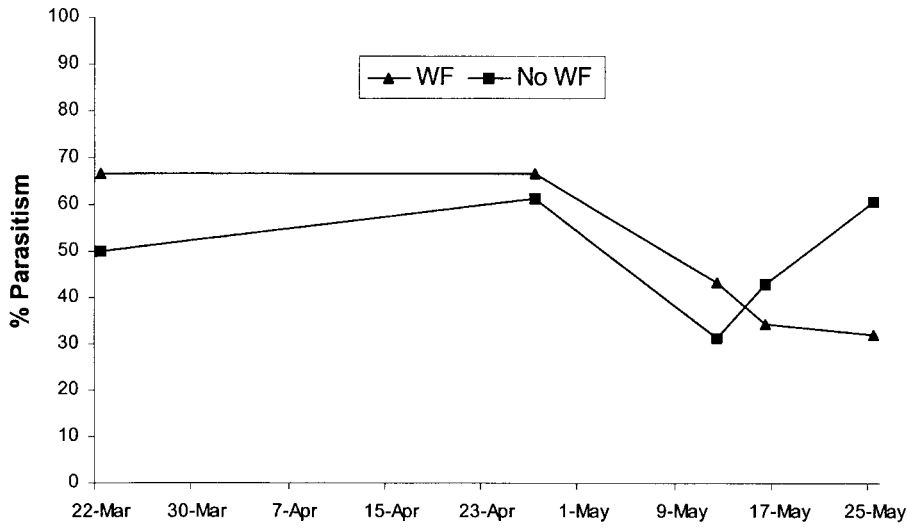

Fig. 1. Percentage parasitism of *Plutella xylostella* by *Diadegma insulare* in collard with and without wildflowers in Charleston, SC, 2000; WF = wild flowers surrounding plots; No WF = no wild flowers surrounding plots.

xylostella and *D. insulare* were higher when collards were associated with cabbage (Mitchell et al. 1997, Florida. Entomol. 80: 54-62). Availability of nectar sources from wildflowers did not appear to enhance the population density of *D. insulare* in collards.

Incidence of parasitism in two regions. A collard field that was not treated with pesticides was selected as a study area at the Clinton Sease Farm in Lexington Co., SC, in 2000. This field (0.61 ha) was adjacent to a squash field and was not bordered by wildflowers. The field was sampled on nine dates in 2000: 9 June, 16 June, 23 June, 30 June, 6 July, 14 July, 20 July, 3 August, and 10 August. Pupae and late second to fourth-instar *P. xylostella* larvae were collected on each sampling date. Ten plants were randomly sampled at each of five sites on each sampling date. Each sampled plant was marked with a flag to avoid sampling the same plant more than once. Larval and pupal *P. xylostella* were monitored on 50 plants each sampling date. They were collected, placed into cylindrical cages (480 ml) with collard leaves and transported to the laboratory where they were reared as described above. They were checked for mortality, symptoms of disease, and parasitism every 2 days. For all collections, parasitism was computed as described previously.

In June 2001, a collard field was selected for sampling at the Clinton Sease Farm in Lexington Co., SC. No pesticides were applied to the collards. The field was bordered on one side by flowering *V. bonariensis* and was divided into four plots. Sample dates were 14 June and 29 June 2001, and 25 plants were sampled per plot. Samples of *P. xylostella* larvae were collected, transported to the laboratory, reared on artificial diet, as described above. Data on rate of parasitism were recorded and computed as described above.

Eight rows (0.61 ha) of collard were planted May 2001 at the Coastal Research and Education Center in Charleston, SC. Each row was approximately 0.9 m wide and 176 m long. Samples of *P. xylostella* larvae and pupae were collected on 12, 18, and 26 June 2001. Flowering wild radish, crimson clover, and cutleaf evening primrose bordered the edge of the field. The field was divided into four plots. In each plot, 10 collard plants were randomly selected and monitored for *P. xylostella*. Sampled plants were flagged to prevent duplicate sampling. Larvae and pupae of *P. xylostella* were transported to the laboratory, handled as described above, and parasitism data were computed as noted above.

Percentage parasitism of *D. insulare* was higher during early June than during subsequently occurring generations through mid-August 2000 at the Clinton Sease Farm in Lexington, SC ($t = 2.37$; df = 7; $P = 0.05$). The mean rate of parasitism during early June was 24.3 ± 3.5% with a total of 135 *P. xylostella* larvae and pupae collected. The mean rate of parasitism for the next generation of *P. xylostella* was 2.4 ± 0.5% with a total of 1,625 *P. xylostella* larvae and pupae. Hymenopteran wasps (n = 28) representing the genus *Cotesia* also were reared from the diamondback moth larvae. In addition, occasional chalcid wasps were detected as parasitoids of *P. xylostella*.

During 2001, percentage parasitism of *P. xylostella* by *D. insulare* also was highest in early to mid-June. In Lexington Co., the rate of parasitism was 29.4% in mid-June. By the end of June, there was very little presence of *P. xylostella* in the field, and no parasitoid was observed. The population of *P. xylostella* was most dense during early June in Charleston, SC, with 24 pupae and 18 larvae per 40 plants. The rate of parasitism at the Charleston site peaked at 45.2% in early June 2001 and dropped to 15.4% by late June. No pupae were observed during subsequent sampling dates in June.

Our study demonstrates the relatively high incidence of *D. insulare* from March through mid-June in South Carolina. These results on seasonal occurrence and parasitism of *P. xylostella* by *D. insulare* in collard in South Carolina suggest potential for utilization of biological control in IPM systems. Further investigations on environmental factors will help determine the potential of *D. insulare* in the biological control of *P. xylostella.*

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