

Clemson University IPM Progress Report 2000-2002

The Role of Nectar-Producing Plants in Enhancing Parasitism of the Diamondback Moth, *Plutella xylostella*, by the Parasitoid, *Diadegma insulare*, in Collards

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Objective 1:

Determine the longevity and fecundity of *Diadegma insulare* when adult parasitoids are fed on naturally occurring nectar-producing plants and on other food sources high in carbohydrates.

Procedures:

Kale and cabbage seeds were obtained from Park Seed Company (Greenwood South Carolina 29467) and planted in the greenhouse at the Clemson University Coastal Research and Education Center (REC), Charleston, SC in mid-November. Transplants were set 18 inches apart in 8 rows approximately 300 feet long. The plot consisted of 3 rows of ornamental cabbage ('Cabbage Color Up Mix'), 4 rows of ornamental kale (2 rows 'Nagoya Mix' and 2 rows 'Friszy White'), and 1 row of 'Vates' edible kale (*Brassica oleracea* var. *alboglabra*).

Longevity studies with *D. insulare* were conducted in a 1- acre field. Pupae of the parasitoid were received bi-weekly from a colony maintained on diamondback moth and collard at the University of Florida by Dr. Gary Leibe. Larvae of the diamondback moth were obtained from a laboratory colony at the USDA-ARS, Charleston, SC. Flowers of 'Vates' edible kale were tested along with two types of ornamental kale ('Nagoya Mix' and 'Friszy White') at Coastal REC. Flowers of white clover (*Trifolium repens*), red clover (*T. pratense*), tansy (*Tanacetum vulgare*), and uncultivated wild radish (*Raphanus raphanistrum*) were also examined. Treatments included floral nectar, floral nectar and water, water, and 15% honey solution. *D. insulare* females were introduced to cages placed on flower stems in the field, or into cages with stems from which the flowers had been clipped. Mortality was checked every 24 hours for five days in the field. Surviving parasitoids were transported to the laboratory for fecundity tests.

For fecundity studies, each female parasitoid was placed in an ice-cream cylinder cage (480 ml); the cage enclosed a young collard bouquet (3-4 leaf stage) with 50 late 2nd instar larvae. There was one cage per treatment. Female parasitoids were allowed to oviposit for 24 hours in a growth chamber at 26 degrees Celsius. Growth chamber conditions allowed for 16 hours of daylight and 8 hours of darkness. After 24 hours, parasitoids were removed and placed on 10% honey. Larvae were removed and placed into 30 ml cups containing multi-species artificial diet. Cups containing larvae (5 per cup) and diet were placed into the growth chamber at 26 degrees Celsius. Percent parasitism was recorded for each treatment.

Results:

Treatments had a significant effect on longevity (using ANOVA, $F = 8.63$; $df = 10, 46$; $P > 0.0001$). *D. insulare* lived longest on the 'Vates' kale, 'Vates' kale and water, 'Nagoya Mix' kale and 15% honey treatments, averaging 3.5 to 4 days (Figure 1). On wild radish, red clover, red clover and water, frizzy white kale, white clover, tansy, and water, *D. insulare* did not live as long, averaging 1.5 to 2 days, as compared with the other treatments. Adding water to cages containing 'Vates' kale and red clover did not enhance longevity.

Treatments did not have a significant effect on the rate of parasitism (using ANOVA, $F = 0.46$; $df = 7, 19$; $P < 0.84$). *D. insulare* feeding on the flowers of the 'Nagoya Mix' kale yielded the highest rate of parasitism, averaging 28% (Figure 2). *D. insulare*, which fed on water and 'Frizzy White' kale, yielded the lowest rate of parasitism, averaging 3%. Parasitism was similar among *D. insulare*, which fed on flowers of wild radish, red clover, 'Vates' kale or 15% honey, averaging 18% to 20%. Adding water to 'Vates' kale did not enhance parasitism.

Objectives 2 and 3:

Determine the seasonal abundance of parasitism of diamondback moth (DBM) in collards in relation to the species composition and phenology of nectar-producing plants. Determine parasitism of DBM larvae by *Diadegma insulare* in fields bordered by nectar-producing plants compared with fields without these plants.

Procedures:

A collard field (0.34 acres) was not treated with pesticides and was sampled for diamondback moth larvae at Coastal REC. Sampling dates were June 12, 2001, June 18, 2001 and June 26, 2001. Wild radish, crimson clover (*T. incarnatum*), and cutleaf evening primrose (*Oenothera laciniata*) bordered the edge of the field. Some wildflowers serve as nectar sources for *D. insulare*, particularly those with wide or shallow corollas, where *D. insulare* can easily reach the nectar. Corolla lengths of flowers (Table 1) were determined from the

literature (Radford et al. 1968, Manual of the Vascular Flora of the Carolinas). The field was divided into four quadrants. Ten collard plants were randomly selected and sampled per quadrant. Larvae of diamondback moth were transported to the laboratory to be reared on artificial diet. Pupae were placed into 30 ml cups without artificial diet. They were checked for mortality, symptoms of disease, and parasitism. Parasitism was computed by dividing the number of emerged *D. insulare* parasitoids by the total number of diamondback larvae and pupae collected from the field.

In June 2001, a collard plot without any pesticide applications was identified for sampling at the Clinton Sease Farm in Lexington County, South Carolina. This field was bordered on one side by *Verbena bonariensis* and was divided into four quadrants. Sample dates were June 14, 2001 and June 29, 2001. Twenty-five plants were sampled per quadrant. Samples of diamondback moth larvae were collected, transported to the laboratory, and placed on artificial diet. Pupae were placed into 30 ml cups without artificial diet. Larvae and pupae were checked for mortality, symptoms of disease, and parasitism.

Results and Discussion:

The rate of parasitism in Charleston County at Coastal REC was 45% in early June. In mid-June, parasitism decreased to 19% but ultimately peaked at 66% in late June. Parasitism was computed out of a total of 84 diamondback moth larvae and pupae. In Lexington County the rate of parasitism was 29% in mid June. By the end of June, there was very little presence of diamondback moths in the field and rate of parasitism was 0%. Despite the low numbers of diamondback moths in Lexington County, the rates of parasitism for June 2001 and June 2000 were similar. In mid June of 2000, parasitism was approximately 21% and decreased to 0% parasitism in late June.

Figure 1
Effect of Floral Nectar on Longevity
of *D. insulare*

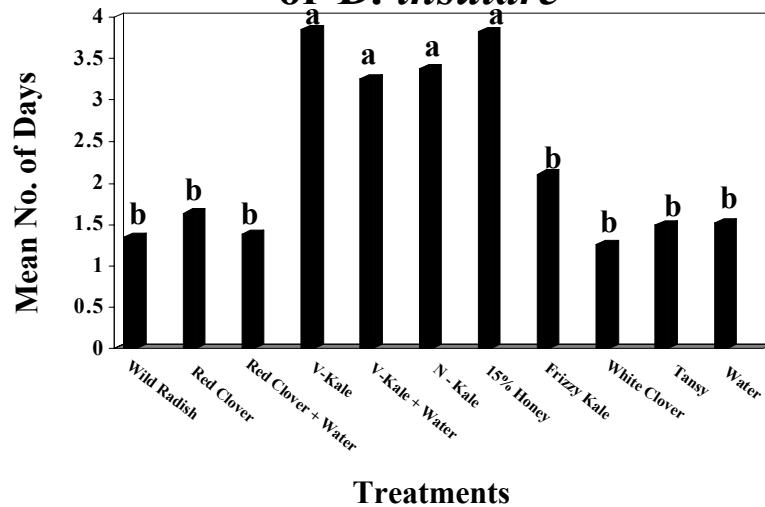


Figure 2 - Incidence of Parasitism by *D. insulare* in the Laboratory

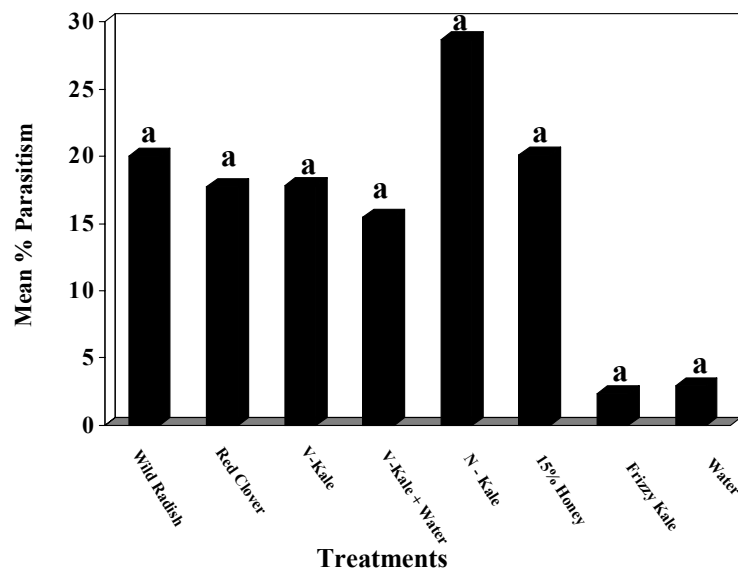


Table 1

Common Name of Flower	Scientific Name	Corolla Length
Kale	<i>Brassica oleracea</i> var. <i>alboglabra</i>	1.2 cm - 2.5 cm
Red Clover	<i>Trifolium pratense</i>	1.2 cm - 1.8 cm
Crimson Clover	<i>Trifolium incarnatum</i>	0.8 cm - 1.2 cm
White Clover	<i>Trifolium repens</i>	0.6 cm - 1.2 cm
Wild Radish	<i>Raphanus</i> <i>raphanistrum</i>	1.5 cm - 2.0 cm
Cutleaf Evening Primrose	<i>Oenothera laciniata</i>	0.8 cm - 2.5 cm
Verbena	<i>Verbena bonariensis</i>	0.2 cm - 0.3 cm