

# Feeding and Developmental Rates of the Mexican Bean Beetle<sup>1</sup> on Soybeans<sup>2</sup>

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## ABSTRACT

J. Econ. Entomol. 72: 835-836 (1979)

In the laboratory, development times of larvae of *Epilachna varivestis* Mulsant, when feeding on soybean variety 'York', were 5.3, 4.0, 4.8, 7.9, and 7.3 days at 20°C for the 1st, 2nd, 3rd, 4th instars and pupa, respectively (slightly shorter durations were obtained at 26°C). Soybean leaflet surface area consumed was 0.6, 1.7, 5.8, and 26.9 cm<sup>2</sup> at 20°C, and 0.6, 1.8, 7.6, and 21.4 cm<sup>2</sup> at 26°C for the 4 larval stages. Adult consumption of foliage was 2.7 and 3.4 cm<sup>2</sup> at 20°C and 3.7 and 3.8 cm<sup>2</sup> at 26°C for male and female, respectively. Dry weight consumption also was recorded for larvae and adults.

Two essential components of pest management programs are host consumption by the pest and developmental rate of the pest. Economic injury levels have been proposed by using the feeding rates of lepidopteran pests of soybeans (Kogan 1976, Stone and Pedigo 1972, Thomas et al. 1974) and the bean leaf beetle, *Cerotoma trifurcata* (Forster) (Kogan 1976). Waddill et al. (1976) presented a computer simulation model for the Mexican bean beetle (MBB), *Epilachna varivestis* Mulsant, on soybeans but this model did not incorporate feeding rates. With more information on the feeding and developmental rates of this important pest, management and computer simulations can be improved. Reported here are the consumption and development rates of MBB larvae and adults when reared in the laboratory on field grown soybeans.

## Methods and Materials

### Foliage Consumption and Larval Development

Both larvae and adults were reared at 20°±2°C and 26°±2°C, with RH near saturation, and 15:9 (L:D) photoperiod. These temperatures were chosen to approximate the mean of the average min and the average daily temperature (20.4°C) from June to Sept. during 1972-73, and the mean of the average max and the average daily temperature (25.8°C) from June to Sept. during 1972-73, at Suffolk, VA, where this study was done. MBB egg masses collected in the field were held under the aforementioned conditions. Upon hatching, a larva was placed on a field grown 'York' variety soybean leaflet. The leaflet and larvae were placed in a 9-cm petri dish lined with Whatman No. 1 filter paper discs moistened with distilled water. Each petri dish was checked every 24 h. After each molt, or if the leaflet was nearly consumed, the leaflet was removed, labeled, placed in a freezer and the larva was given a fresh leaflet until the adult stage. Some field collected adults also were observed.

### Measurement of Foliage Consumption

The leaf surface area consumed was determined by using a transparent grid, a 0.3×0.3-m sheet of Plexiglas<sup>®</sup>, and a light source. The leaflet was placed on the Plexiglas and the transparent grid was placed over the

leaflet before being placed over the light source. Each square on the grid was equal to 0.0161 cm<sup>2</sup>. Wherever a square in the grid overlaid an area that was eaten that square was counted. The total surface area consumed per leaflet was found by multiplying 0.0161 cm<sup>2</sup> by the number of squares counted per leaflet.

To find the dry weight consumed, a disc of the leaflet was removed from each leaflet with a 1.26 cm<sup>2</sup> cork borer, dried, and weighed. The dry weight consumed was obtained by multiplying the surface area consumed (cm<sup>2</sup>) by the leaflet disc dry weight (g/1.26 cm<sup>2</sup>).

## Results and Discussion

Total larval development was 6.6 days longer at 20° than at 26°C (Table 1). Bernhardt and Shepard (1978) reported developmental times of 23.0 and 30.6 days at 27° and 22°C, respectively, when reared on 'Coker 136' soybeans. These are comparable with our findings of 22.7 and 29.3 days at 26° and 20°C, respectively. Barney and Rock (1975) reared MBB on greenhouse grown lima beans, *Phaseolus lunatus* L., and on a broad range of greenhouse grown, MBB resistant soybean varieties at a rearing temperature of 27°C. Total larval developmental times ranged from 12.9 on lima beans to 21.4 days when reared on a MBB-resistant soybean variety. Kogan (1972) reported larval developmental times of 14-19 days when reared on greenhouse grown soybeans at the same temperature. The lower rates reported in these 2 publications may have been due to the use of greenhouse grown soybean leaflets.

Table 2 presents surface area and dry weight consumed by each growth stage. The amount of foliage consumed expressed as surface area follows the same trends as the dry weight consumed since surface area is a function of the dry weight. Total larval consumption of soybean foliage was greater at 20° than at 26°C. Although the 1st-3rd instars ate less at the lower temperature compared to the higher temperature, the 4th instar consumed significantly more at 20°C causing total larval consumption to be greater at this temperature. The 4th instar was responsible for 76 and 68% of the total food consumed at 20° and 26°C, respectively. Barney and Rock (1975) reported larval consumption of 45.5 and 103.9 mg on lima beans and a highly resistant soybean variety, respectively. Total larval consumption in our study of 87.4 and 97.4 mg at 26° and 20°C, respectively, falls within this range. Kogan (1972) found that foliage consumption at 27°C ranged from 51.3 to 86.3 mg. Adult consump-

<sup>1</sup> Coleoptera: Coccinellidae.

<sup>2</sup> Received for publication Apr. 16, 1979.

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tion in our study, 3.7 and 3.8 cm<sup>2</sup>/day (Table 2) at 26°C, showed no difference between the sexes, but at 20°C males consumed (2.7 cm<sup>2</sup>/day) 11% less ( $P < 0.05$ ) than females (3.4 cm<sup>2</sup>/day).

**Table 1.**—Mean number of days for development of Mexican bean beetle larvae at 2 constant temperatures.

Stadia	20°C		26°C	
	N	Mean ± SD	N	Mean ± SD
1st*	58	5.3±0.7	52	4.0±0.8
2nd*	50	4.0±0.7	49	2.8±0.7
3rd*	46	4.8±1.9	46	4.4±1.4
4th*	44	7.9±1.7	32	5.9±1.6
Pupa*	37	7.3±0.8	21	5.6±1.4

\* Temperature caused a significant difference in duration of stadia by the Student's *t*-test ( $P < 0.05$ ).

**Table 2.**—Dry weight and surface area consumption of soybean leaflets by the Mexican bean beetle under 2 constant rearing temperatures (adult consumption expressed as mg or cm<sup>2</sup> per 24 h).

Growth stage	Dry wt (mg)				Surface area (cm <sup>2</sup> )			
	20°C		26°C		20°C		26°C	
	N	Mean ±SD	N	Mean ±SD	N	Mean ±SD	N	Mean ±SD
Larva								
1st	58	1.6± 0.6	52	1.8± 0.9	58	0.6±0.3	52	0.6±0.4
2nd	50	4.9± 3.0	49	5.1± 2.9	50	1.7±1.0	49	1.8±1.3
3rd*	46	17.3± 6.2	46	21.4± 7.5	46	5.8±2.3	46	7.6±3.5
4th*	44	73.6±16.1	32	59.1±25.7	44	26.9±6.1	32	21.4±9.0
Adult								
Male*	15 <sup>a</sup>	8.4±1.7	12 <sup>b</sup>	10.1±2.2	15	2.7±0.5	12	3.7±0.9
Female	21 <sup>c</sup>	9.8±3.3	11 <sup>d</sup>	11.1±2.3	21	3.4±1.1	11	3.8±0.9

\* Temperature caused a significant difference in foliage consumption (Student's *t*-test  $P < 0.05$ ).

<sup>a</sup> The 15 males at 20°C fed for a mean of 15.0 days.

<sup>b</sup> The 12 males at 26°C fed for a mean of 8.6 days.

<sup>c</sup> The 21 females at 20°C fed for a mean of 15.5 days.

<sup>d</sup> The 11 females at 26°C fed for a mean of 15.3 days.

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