

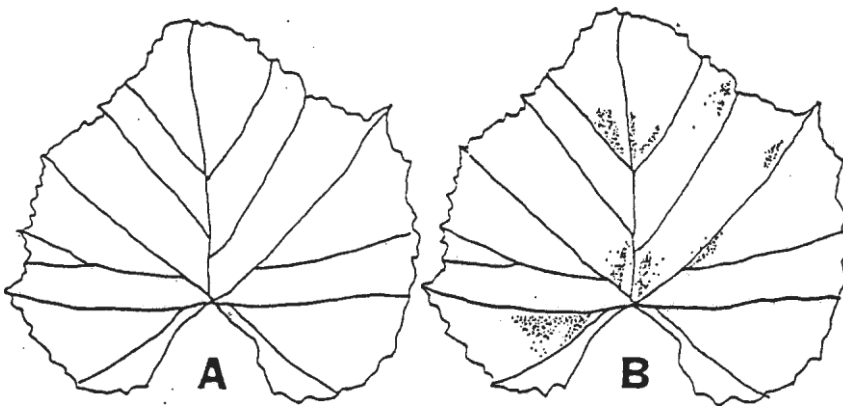
## Marrone Bio Innovations Cooperative Testing 2013

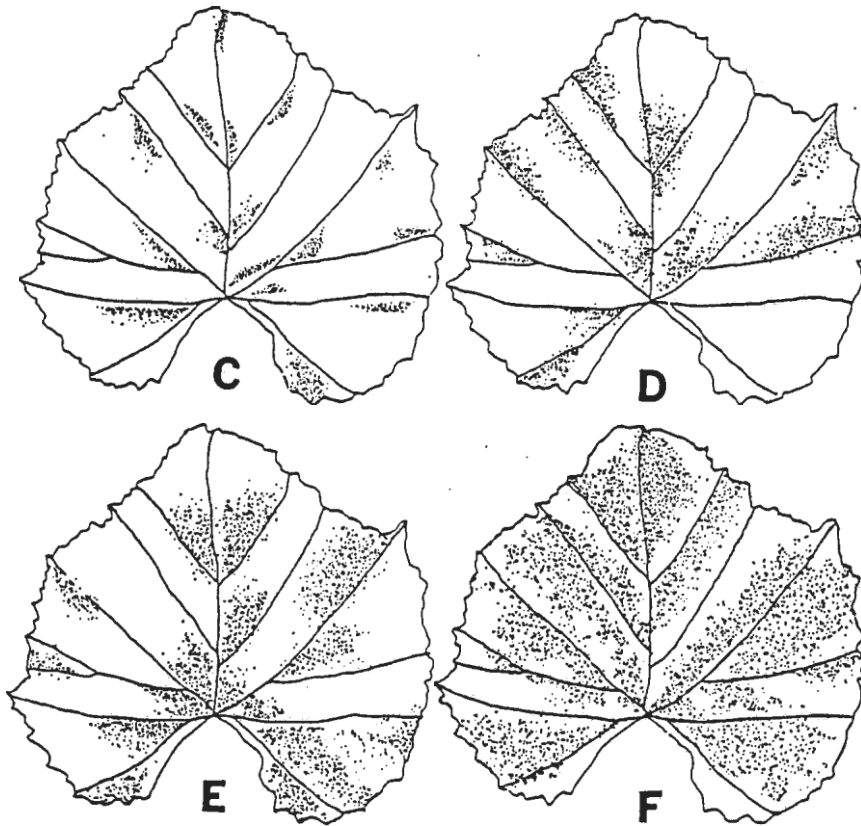
*Dr. Michael Saunders and Jody Timer: Department of Entomology Pennsylvania State University*

The experimental design for this insecticide trial consisted of small-plot treatments each composed of two panels (6 vines) of Concord grapes in a random block design. These treatments were replicated four times, with two panels left between each treatment. Treatments were applied three times to every replication except the untreated check. These treatments were timed in accordance with the grape berry moth predication model (NEWA weather site) and were applied on 7/7/2013, 8/11/2013, and 9/19/2013. All sprays were applied at a pH of 6.0. Insecticides were applied immediately after mixing.

Twenty clusters were randomly harvested, to assess grape berry moth damage, for each replication approximately two weeks after the treatments were applied. Grape Berry moth damage is more easily discernible two weeks after infestation. Number of damaged berries and number of damaged clusters were reported. In general the grape berry moth damage this season in the Lake Erie region was average. Twenty leaves were sampled twice during the growing season to rate for Japanese beetle and leaf hopper damage. The leaves were divided into ten top and ten bottom samples. Japanese beetle damage is more prevalent on top leaves with leafhopper damage typically occurring farther down in the canopy.

Leafhopper damage was ratted using the rating scale designed by Jubb et al. 1983.





Rating A = no injury = 0:  
Rating B = < 3% injury = 1:  
Rating C = 3% to 6% injury = 2:  
Rating D = 6% to 12% injury = 3:  
Rating E = 12% to 25% injury = 4  
Rating F = 25% to 50% injury = 5  
Higher than 50% injury = 6

Japanese beetle damage was rated on the scale developed by Boucher and Pfeifer:

0% damage = 0  
10% damage = 1  
20% damage = 2  
30% damage = 3  
40% damage = 4  
50% damage = 5  
60% damage = 6  
Greater than 60% damage = 7

This growing season, Japanese beetle damage was below normal for this area, and leafhopper damage was above normal.

**Application equipment:**

Applications were made with a covered boom type (tunnel sprayer). This type of sprayer covers the entire canopy with a boom and a polyvinyl fabric shroud. There are 4 “cone pattern” spray nozzles on each side of the boom. The boom straddles the row with a 5.5 foot span. The nozzles are arranged so that they are the same height as the vineyard canopy, the top nozzles are 6 ft. off of the ground and the bottom nozzles are about 4 ft. high. The nozzles are arranged in a box pattern on each side. The nozzles are 12 inches apart to the side and 12 inches above or below. This pattern is followed on each side of the boom for a total of 8 nozzles.

The applications were made at 100 gal/acre. At 150 psi. at a ground speed of 3 mph. Entire canopy was sprayed. The pump on the sprayer is PTO driven from the tractor.

**Results (statistical differences in red):**

**Grape Berry Moth Damage:**

**Grape Berry Moth** Damage Assessment 7/23 sprayed on 7/7. Number of Cluster’s Damaged - Incidence

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>	<b>% Cluster Damaged</b>
MBI-203@1lb/acre	6.75	9.52(a)	9.5%
MBI-203 @ 2lb/Acre	7.14	5.95(a)	6.2%
MBI-206 @ 1 gal/Acre	4.76	2.38(a)	2.4%
MBI-206 @ 2 gal/Acre	9.82	8.33(a)	8.3%
Dipel @ 1 lb./Acre	4.60	3.57(a)	3.7%
Untreated Check	2.75	2.38(a)	2.5%

*Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test*

**Grape Berry Moth** Damage Assessment 7/23 sprayed on 7/7. Number of Berries Damaged - Severity

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>	<b>% Berries Damaged</b>
MBI-203@1lb/acre	0.26	0.37(a)	.37%
MBI-203 @ 2lb/Acre	0.28	0.23(a)	.22%
MBI-206 @ 1 gal/Acre	0.18	0.09(a)	.09%
MBI-206 @ 2 gal/Acre	0.41	0.33(a)	.30%
Dipel @ 1 lb./Acre	0.15	0.12(a)	.12%
Untreated Check	0.098	0.09(a)	.08%

*Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test*

**Grape Berry Moth** Damage Assessment 8/30 sprayed on 8/11. Number of Cluster’s Damaged - Incidence

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>	<b>% Cluster Damaged</b>
MBI-203@1lb/acre	8.69	14.29(a)(b)	14.3%
MBI-203 @ 2lb/Acre	7.78	23.81(a)(b)	23.8%
<b>MBI-206 @ 1 gal/Acre</b>	<b>4.76</b>	<b>11.91(b)</b>	<b>11.9%</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>12.52</b>	<b>10.71(b)</b>	<b>10.7%</b>

<b>Dipel @ 1 lb./Acre</b>	<b>12.59</b>	<b>11.91(b)</b>	<b>11.9%</b>
Untreated Check	4.56	34.52(a)	34.5%

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Grape Berry Moth Damage Assessment 8/30 sprayed on 8/11. Number of Berries Damaged - Severity**

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>	<b>% Berries Damaged</b>
<b>MBI-203@1lb/acre</b>	<b>0.72</b>	<b>0.81(b)(c)</b>	<b>0.75%</b>
MBI-203 @ 2lb/Acre	0.46	1.66(a)(b)	1.7%
<b>MBI-206 @ 1 gal/Acre</b>	<b>0.35</b>	<b>0.608(c)</b>	<b>0.59%</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>0.75</b>	<b>0.531(c)</b>	<b>0.52%</b>
<b>Dipel @ 1 lb./Acre</b>	<b>0.50</b>	<b>0.495(c)</b>	<b>0.49%</b>
Untreated Check	0.59	2.35(a)	2.34%

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Grape Berry Moth Damage Assessment 8/30. Number of Cluster's Damaged - Incidence**

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>	<b>% Cluster Damaged</b>
MBI-203@1lb/acre	21.12	50.0(a)(b)	50%
<b>MBI-203 @ 2lb/Acre</b>	<b>13.68</b>	<b>46.43(b)</b>	<b>46.4%</b>
<b>MBI-206 @ 1 gal/Acre</b>	<b>13.11</b>	<b>46.43(b)</b>	<b>46.4%</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>17.60</b>	<b>35.71(b)</b>	<b>35.7%</b>
<b>Dipel @ 1 lb./Acre</b>	<b>20.20</b>	<b>47.62(b)</b>	<b>47.6%</b>
Untreated Check	7.14	75.0(a)	75%

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Grape Berry Moth Damage Assessment 8/30. Number of Berries Damaged - Severity**

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>	<b>% Berries Damaged</b>
<b>MBI-203@1lb/acre</b>	<b>3.12</b>	<b>5.82(b)</b>	<b>6.14%</b>
MBI-203 @ 2lb/Acre	2.80	7.04(a)(b)	7.02%
MBI-206 @ 1 gal/Acre	2.77	6.67(a)(b)	6.85%
<b>MBI-206 @ 2 gal/Acre</b>	<b>2.54</b>	<b>5.71(b)</b>	<b>5.71%</b>
Dipel @ 1 lb./Acre	4.01	7.09(a)(b)	7.14%
Untreated Check	2.67	13.75(a)	13.9%

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

### Leafhopper Damage:

#### Leafhopper Damage Assessment 8/9. Top Leaf Damage- Incidence -Number of Leaves Damaged

Treatment	Std. Dev.	Mean
MBI-203@ 1lb/acre	33.49	12.5(a)(b)
<b>MBI-203 @ 2lb/Acre</b>	<b>26.67</b>	<b>7.5(b)</b>
MBI-206 @ 1 gal/Acre	30.38	10(a)(b)
<b>MBI-206 @ 2 gal/Acre</b>	<b>26.67</b>	<b>7.5(b)</b>
Dipel @ 1 lb./Acre	40.51	20.0(a)(b)
Untreated Check	42.29	22.5(a)

#### Leafhopper Damage Assessment 8/9. Bottom Leaf Damage -Incidence-Number of Leaves Damaged

Treatment	Std. Dev.	Mean
MBI-203@ 1lb/acre	49.03	37.5(a)(b)
<b>MBI-203 @ 2lb/Acre</b>	<b>33.49</b>	<b>12.5(c)</b>
MBI-206 @ 1 gal/Acre	40.51	20.0(b)(c)
MBI-206 @ 2 gal/Acre	40.51	20.0(b)(c)
Dipel @ 1 lb./Acre	50.38	45.0(a)
Untreated Check	48.30	35.0(a)(b)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

#### Leafhopper Damage Assessment 8/9. Top Leaf - Severity - Amount of Leaf Damage

Treatment	Std. Dev.	Mean
MBI-203@ 1lb/acre	1.00	0.38(a)
MBI-203 @ 2lb/Acre	0.80	0.23(a)
MBI-206 @ 1 gal/Acre	1.22	0.38(a)
MBI-206 @ 2 gal/Acre	0.80	0.23(a)
Dipel @ 1 lb./Acre	1.44	0.68(a)
Untreated Check	1.27	0.68(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

#### Leafhopper Damage Assessment 8/9. Bottom Leaf - Severity -Amount of Leaf Damage

Treatment	Std. Dev.	Mean
MBI-203@ 1lb/acre	3.80	1.90(a)(b)
MBI-203 @ 2lb/Acre	1.00	0.38(c)
MBI-206 @ 1 gal/Acre	1.44	0.68(c)
MBI-206 @ 2 gal/Acre	2.16	0.93(b)(c)
Dipel @ 1 lb./Acre	3.04	2.38(a)
Untreated Check	2.03	1.35(a)(b)(c)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Leafhopper** Damage Assessment 9/16. Top Leaf Damage-Incidence -Number of Leaves Damaged

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
<b>MBI-203@1lb/acre</b>	<b>38.48</b>	<b>17.5(b)(c)</b>
<b>MBI-203 @ 2lb/Acre</b>	<b>15.81</b>	<b>2.5(c)</b>
<b>MBI-206 @ 1 gal/Acre</b>	<b>26.67</b>	<b>7.5(c)</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>38.48</b>	<b>17.5(b)(c)</b>
<b>Dipel @ 1 lb./Acre</b>	<b>45.22</b>	<b>27.5(b)</b>
Untreated Check	50.64	50.0(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Leafhopper** Damage Assessment 9/16. Bottom Leaf Damage- Incidence- Number of Leaves Damaged

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
MBI-203@1lb/acre	47.43	67.5(b)(a)
<b>MBI-203 @ 2lb/Acre</b>	<b>50.38</b>	<b>45.0(c)(d)</b>
<b>MBI-206 @ 1 gal/Acre</b>	<b>50.57</b>	<b>47.5(b)(c)</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>43.85</b>	<b>25.0(d)</b>
Dipel @ 1 lb./Acre	43.85	75(a)
Untreated Check	38.48	82.5(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Leafhopper** Damage Assessment 9/16. Top Leaf Damage- Severity- Amount of Leaf Damage

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
<b>MBI-203@1lb/acre</b>	<b>1.15</b>	<b>0.53(b)(c)</b>
<b>MBI-203 @ 2lb/Acre</b>	<b>0.47</b>	<b>0.08(c)</b>
<b>MBI-206 @ 1 gal/Acre</b>	<b>0.80</b>	<b>0.23(c)</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>1.15</b>	<b>0.53(b)(c)</b>
<b>Dipel @ 1 lb./Acre</b>	<b>1.55</b>	<b>0.90(b)</b>
Untreated Check	2.80	2.43(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Leafhopper** Damage Assessment 9/16. Bottom Leaf Damage-Severity - Amount of Leaf Damage.

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
<b>MBI-203@1lb/acre</b>	<b>6.33</b>	<b>5.43(b)</b>
<b>MBI-203 @ 2lb/Acre</b>	<b>2.93</b>	<b>2.23(c)</b>
<b>MBI-206 @ 1 gal/Acre</b>	<b>3.07</b>	<b>2.53(c)</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>2.78</b>	<b>1.40(c)</b>
<b>Dipel @ 1 lb./Acre</b>	<b>4.94</b>	<b>5.58(b)</b>
Untreated Check	6.37	7.65(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

### Japanese Beetle Damage:

Japanese Beetle Damage Assessment 8/9. Top Leaf Damage- Incidence -Number of Leaves Damaged

Treatment	Std. Dev.	Mean
<b>MBI-203@1lb/acre</b>	<b>49.03</b>	<b>37.50(b)</b>
<b>MBI-203 @ 2lb/Acre</b>	<b>49.61</b>	<b>40.0(b)</b>
<b>MBI-206 @ 1 gal/Acre</b>	<b>47.43</b>	<b>32.5(b)</b>
MBI-206 @ 2 gal/Acre	50.06	42.5(a)(b)
Dipel @ 1 lb./Acre	50.57	52.5(a)(b)
Untreated Check	49.03	62.5(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

Japanese Beetle Damage Assessment 8/9. Bottom Leaf Damage- Incidence- Number of Leaves Damaged

Treatment	Std. Dev.	Mean
<b>MBI-203@1lb/acre</b>	<b>36.16</b>	<b>15(b)</b>
MBI-203 @ 2lb/Acre	43.85	25(a)(b)
<b>MBI-206 @ 1 gal/Acre</b>	<b>42.29</b>	<b>22.5(b)</b>
<b>MBI-206 @ 2 gal/Acre</b>	<b>33.49</b>	<b>12.5(b)</b>
<b>Dipel @ 1 lb./Acre</b>	<b>30.38</b>	<b>10(b)</b>
Untreated Check	50.06	42.5(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

Japanese Beetle Damage Assessment 8/9. Top Leaf - Severity - Amount of Leaf Damage

Treatment	Std. Dev.	Mean
<b>MBI-203@1lb/acre</b>	<b>8.15</b>	<b>5.50(b)(c)</b>
<b>MBI-203 @ 2lb/Acre</b>	<b>7.16</b>	<b>5.00(c)</b>
<b>MBI-206 @ 1 gal/Acre</b>	<b>5.86</b>	<b>3.75(c)</b>
MBI-206 @ 2 gal/Acre	7.47	5.75(a)(b)(c)
Dipel @ 1 lb./Acre	9.92	8.75(a)(b)
<b>Untreated Check</b>	<b>9.44</b>	<b>9.25(a)</b>

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

Japanese Beetle Damage Assessment 8/9. Bottom Leaf – Severity- Amount of Leaf Damage

Treatment	Std. Dev.	Mean
<b>MBI-203@1lb/acre</b>	<b>5.16</b>	<b>2.0(b)</b>
MBI-203 @ 2lb/Acre	5.64	3.0(a)(b)
MBI-206 @ 1 gal/Acre	5.54	2.75(a)(b)
<b>MBI-206 @ 2 gal/Acre</b>	<b>3.35</b>	<b>1.25(b)</b>
Dipel @ 1 lb./Acre	3.04	1.0(b)
<b>Untreated Check</b>	<b>5.52</b>	<b>4.5(a)</b>

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Japanese Beetle** Damage Assessment 9/16. Top Leaf Damage- Incidence -Number of Leaves Damaged

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
MBI-203@1lb/acre	50.06	57.5(a)(b)
<b>MBI-203 @ 2lb/Acre</b>	<b>50.64</b>	<b>50.0(b)</b>
MBI-206 @ 1 gal/Acre	50.57	52.50(a)(b)
MBI-206 @ 2 gal/Acre	50.38	55.0(a)(b)
Dipel @ 1 lb./Acre	49.03	62.5(a)(b)
Untreated Check	45.22	72.5(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Japanese Beetle** Damage Assessment 9/16. Bottom Leaf Damage- Incidence- Number of Leaves Damaged

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
<b>MBI-203@1lb/acre</b>	<b>26.67</b>	<b>7.5(b)</b>
<b>MBI-203 @ 2lb/Acre</b>	<b>33.49</b>	<b>12.5(b)</b>
MBI-206 @ 1 gal/Acre	40.51	20.0(a)(b)
<b>MBI-206 @ 2 gal/Acre</b>	<b>30.38</b>	<b>10(b)</b>
Dipel @ 1 lb./Acre	42.29	22.5(a)(b)
Untreated Check	46.41	30(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Japanese Beetle** Damage Assessment 9/16. Top Leaf Damage- Severity -Amount of Leaf Damage

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
<b>MBI-203@1lb/acre</b>	<b>7.76</b>	<b>7.50(b)</b>
<b>MBI-203 @ 2lb/Acre</b>	<b>9.31</b>	<b>8.25(b)</b>
MBI-206 @ 1 gal/Acre	10.86	10(a)(b)
MBI-206 @ 2 gal/Acre	10.74	9.75(a)(b)
Dipel @ 1 lb./Acre	10.25	10.25(a)(b)
Untreated Check	10.95	13.25(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

**Japanese Beetle** Damage Assessment 9/16. Bottom Leaf Damage- Severity - Amount of Leaf Damage.

<b>Treatment</b>	<b>Std. Dev.</b>	<b>Mean</b>
<b>MBI-203@1lb/acre</b>	<b>4.63</b>	<b>1.25(b)</b>
MBI-203 @ 2lb/Acre	4.27	1.50(a)(b)
MBI-206 @ 1 gal/Acre	4.05	2.0(a)(b)
<b>MBI-206 @ 2 gal/Acre</b>	<b>3.04</b>	<b>1.0(b)</b>
Dipel @ 1 lb./Acre	4.94	2.5(a)(b)
Untreated Check	5.26	3.25(a)

Means followed by the same letter in columns are not significantly different by Turkey Studentized Range test

In this trial, all of the treatments showed more efficacy than the untreated check against grape berry moth. MBI-206 EP was the most efficacious treatment.