

BELL PEPPER: *Capsicum annuum* “Aristotle”**Efficacy of organic Insecticides for Control of BMSB on Pepper in Virginia, 2014\*****J. Adam Morehead,<sup>1</sup> John D. Aigner, Jr., James M. Wilson, Louis B. Nottingham, Anthony DiMeglio, and Thomas P. Kuhar**

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Pepper | *Capsicum annuum*brown marmorated stink bug | *Halyomorpha halys*

Sabadilla; cevadilla; (Z)-(S)-3-(but-2-enyl)-2-methyl-4-oxocyclopent-2-enyl (1R,3R)-2,2-dimethyl-3-(2-methylprop-1-enyl)-cyclopropanecarboxylate + (Z)-(S)-3-(but-2-enyl)-2-methyl-4-oxocyclopent-2-enyl (E)-(1R,3R)-3-(2-methoxycarbonylprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(pent-2-enyl)cyclopent-2-enyl (1R,3R)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(pent-2-enyl)cyclopent-2-enyl (E)-(1R,3R)-3-(2-methoxycarbonylprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(penta-2,4-dienyl)cyclopent-2-enyl (1R,3R)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(penta-2,4-dienyl)cyclopent-2-enyl (E)-(1R,3R)-3-(2-methoxycarbonylprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate; (2R,3aS,5aR,5bS,9S,13S,14R,16aS,16bR)-2-(6-deoxy-2,3,4-tri-O-methyl- $\alpha$ -L-mannopyranosyloxy)-13-(4-dimethylamino-2,3,4,6-tetra-deoxy- $\beta$ -D-erythro-pyranosyloxy)-9-ethyl-2,3,3a,5a,5b,6,7,9,10,11,12,13,14,15,16a,16b-hexadecahydro-14-methyl-1H-as-indaceno[3,2-d]oxacyclododecine-7,15-dione and 50–5% (2S,3aR,5aS,5bS,9S,13S,14R,16aS,16bS)-2-(6-deoxy-2,3,4-tri-O-methyl- $\alpha$ -L-mannopyranosyloxy)-13-(4-dimethylamino-2,3,4,6-tetra-deoxy- $\beta$ -D-erythro-pyranosyloxy)-9-ethyl-2,3,3a,5a,5b,6,7,9,10,11,12,13,14,15,16a,16b-hexadecahydro-4,14-dimethyl-1H-as-indaceno[3,2-d]oxacyclododecine-7,15-dione; dimethyl; (2aR,3S,4S,4aR,5S,7aS,8S,10R,10aS,10bR)-10-acetoxy-3,5-dihydroxy-4-[(1aR,2S,3aS,6aS,7S,7aS)-6a-hydroxy-7a-methyl-3a,6a,7,7a-tetrahydro-2,7-methanofuro[2,3-b]oxireno[e]oxepin-1a(2H)-yl]-4-methyl-8-[[{(2E)-2-methylbut-2-enyl]oxy]octahydro-1H-naphtho[1,8a-c:4,5-b'c']difuran-5,10a(8H)-dicarboxylate + (Z)-(S)-3-(but-2-enyl)-2-methyl-4-oxocyclopent-2-enyl (1R,3R)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate + (Z)-(S)-3-(but-2-enyl)-2-methyl-4-oxocyclopent-2-enyl (E)-(1R,3R)-3-(2-methoxycarbonylprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(pent-2-enyl)cyclopent-2-enyl (1R,3R)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(pent-2-enyl)cyclopent-2-enyl (E)-(1R,3R)-3-(2-methoxycarbonylprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(penta-2,4-dienyl)cyclopent-2-enyl (1R,3R)-2,2-dimethyl-3-(2-methylprop-1-enyl)cyclopropanecarboxylate + (Z)-(S)-2-methyl-4-oxo-3-(penta-2,4-dienyl)cyclopent-2-enyl (E)-(1R,3R)-3-(2-methoxycarbonylprop-1-enyl)-2,2-dimethylcyclopropanecarboxylate; (2aR,3S,4S,4aR,5S,7aS,8S,10R,10aS,10bR)-10-acetoxy-3,5-dihydroxy-4-[(1aR,2S,3aS,6aS,7S,7aS)-6a-hydroxy-7a-methyl-3a,6a,7,7a-tetrahydro-2,7-methanofuro[2,3-b]oxireno[e]oxepin-1a(2H)-yl]-4-methyl-8-[[{(2E)-2-methylbut-2-enyl]oxy]octahydro-1H-naphtho[1,8a-c:4,5-b'c']difuran-5,10a(8H)-dicarboxylate; 49% Potassium salts of fatty acids; 47% Potassium salts of fatty Acids + (2R,3aS,5aR,5bS,9S,13S,14R,16aS,16bR)-2-(6-deoxy-2,3,4-tri-O-methyl- $\alpha$ -L-mannopyranosyloxy)-13-(4-dimethylamino-2,3,4,6-tetra-deoxy- $\beta$ -D-erythro-pyranosyloxy)-9-ethyl-2,3,3a,5a,5b,6,7,9,10,11,12,13,14,15,16a,16b-hexadecahydro-14-methyl-1H-as-indaceno[3,2-d]oxacyclododecine-7,15-dione and 50–5% (2S,3aR,5aS,5bS,9S,13S,14R,16aS,16bS)-2-(6-deoxy-2,3,4-tri-O-methyl- $\alpha$ -L-mannopyranosyloxy)-13-(4-dimethylamino-2,3,4,6-tetra-deoxy- $\beta$ -D-erythro-pyranosyloxy)-9-ethyl-2,3,3a,5a,5b,6,7,9,10,11,12,13,14,15,16a,16b-hexadecahydro-4,14-dimethyl-1H-as-indaceno[3,2-d]oxacyclododecine-7,15-dione

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Table 1

Treatment/formulation	Rate – amt product/acre	% of harvested fruit with stink bug damage	
		29 Aug.	17 Sept.
Untreated check	—	10.0	18.8 a
Veratran D	8.5 oz	7.5	1.3 b
Pyganic Crop Protection EC5.0 II	17 fl oz	5.0	2.5 b
Blackhawk Naturalyte Insect Control	0.07 oz	6.3	5.0 b
Azera Insecticide	56 fl oz	15.0	0.0 b
Aza-Direct Botanical Insecticide	56 fl oz	13.8	3.8 b
M-Pede	86 fl oz	15.0	2.5 b
Neudorff 1138	86 fl oz	17.5	1.3 b
Venerate Bioinsecticide	215 oz	26.3	3.8 b

All data were analyzed using analysis of variance (ANOVA). Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different ( $P > 0.05$ ).

The invasive BMSB has become a major pest of pepper in Virginia, particularly on organic vegetable farms. The objective of this experiment was to assess the efficacy of biologically derived insecticides for the control of BMSB in peppers. The experiment consisted of nine treatments arranged in an RCB design with four replicates. Bell peppers were transplanted on raised beds covered with black polyethylene mulch on 10 June 2014 at the Virginia Tech Kentland Research Farm near Blacksburg. Plots were 1 row in width and 20 ft (6.1 m) in length with no guard rows on each side. Rows were planted on a 6 ft row center (1.8 m) with 11 inches (0.3 m) between plants. All foliar treatments were applied on 19, 25 August, and 3 and 9 September with a 3-nozzle boom equipped with 45 cores and D3 spray tips and powered by a CO<sub>2</sub> backpack sprayer at 40 psi delivering 38 gpa. Veratran-D required a special preparation of placing the seeds in a mesh bag into the

proper volume of water for field application and syringing the aqueous portion after >2 h of seeping. All plots were maintained according to standard organic practices.

On 29 August and 17 September, market-sized fruit were harvested in each plot, and the percent fruit damaged by stink bugs was recorded. Proportion damage data were analyzed using analysis of variance and were arcsine square root transformed prior to analysis. Means were separated using Fisher's protected LSD at the 0.05 level of significance.

BMSB pest pressure was low to moderate with 10% and 18% fruit damage on 29 August and 17 September, respectively (Table 1). There was no significant treatment effect on 29 August, but there was on 17 September, when all insecticide treatments had significantly less stink bug damage than the untreated check.