

HEMP: *Cannabis sativa* Lamarck, ‘Sweeten’

Evaluation of Biological Insecticides to Manage Corn Earworm in CBD Hemp, 2020

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Hemp fibre | *Cannabis sativa* ssp. *indica*

Bollworm/corn earworm (CEW)/tomato fruitworm | *Helicoverpa zea* (Boddie)

The objective of this experiment was to assess the efficacy of several biological insecticide products for management of CEW on cannabidiol (CBD) hemp in Virginia. A field experiment was conducted with ‘Sweeten’ hemp transplanted into raised soil beds on 2 Jul 2020 at the Virginia Tech Southern Piedmont Agricultural Research and Education Center in Blackstone, VA. The experiment had 17 treatments: Agree WG (*Bacillus thuringiensis* var. *aizawai*), Crymax (*Bacillus thuringiensis* var. *kurstaki*), Entrust SC (spinosad), Gemstar LC (polyhedral occlusion bodies of the nuclear polyhedrosis virus of *Helicoverpa zea*), Gemstar LC + BoteGHA ES (polyhedral occlusion bodies of the nuclear polyhedrosis virus of *Helicoverpa zea* + *Beauveria bassiana* strain GHA), Spear-Lep (GS-omega/kappa-Hxtx-Hv1a), Spear-Lep + Leprotec (GS-omega/kappa-Hxtx-Hv1a + *Bacillus thuringiensis* var. *kurstaki*), Heligen A (polyhedral occlusion bodies of *Helicoverpa zea*; applied on 2 Sep 2020 ONLY), Heligen AB (polyhedral occlusion bodies of *Helicoverpa zea*; applied on 2 and 8 Sep 2020 ONLY), Heligen ABC (polyhedral occlusion bodies of *Helicoverpa zea* applied on 2, 8, and 15 Sep 2020), XenTari DF (*Bacillus thuringiensis* var. *aizawai*), Heligen + XenTari DF (polyhedral occlusion bodies of *Helicoverpa zea* + *Bacillus thuringiensis* var. *aizawai*), PyGanic EC (pyrethrins), PyGanic EC + Exponent (pyrethrins + piperonyl butoxide), DiPel DF (*Bacillus thuringiensis* var. *kurstaki*), Coragen (chlorantraniliprole), and an untreated check arranged in an RCB design with four replicates. Individual plots were comprised of five plants. Approximately 1 wk after flowering, hemp plants

were sprayed with insecticides in the field using a 3-nozzle boom equipped with D3 spray tips powered by a CO₂ back sprayer at 40 psi. All treatments were applied three times: 2, 8, and 15 Sep 2020. On 8, 15, and 23 Sep, the number of CEW, virus-infected CEW, and presence of bud rot was counted on 10 buds per plot (Table 1). Data were analyzed using ANOVA procedures and means were separated using Tukey’s HSD at the 0.05 level of significance.

On 8 Sep (7 DAT1), there was no treatment effect on number of CEW per 10 buds per plot (Table 1). On 15 Sep (7 DAT2), Gemstar LC + BoteGHA ES, Heligen ABC, and Coragen treatments had significantly fewer CEW than PyGanic EC and PyGanic EC + Exponent. Gemstar LC had significantly fewer CEW than PyGanic EC + Exponent. On 23 Sep (8 DAT3), Entrust SC had significantly fewer CEW than Crymax and the untreated check. PyGanic EC and PyGanic EC + Exponent had significantly more cumulative CEW than Entrust SC, Gemstar LC + BoteGHA ES, Heligen ABC, and Coragen. PyGanic EC + Exponent had significantly more cumulative CEW than Heligen + XenTari DF. Gemstar + BoteGHA resulted in the fewest cumulative CEW per plot; this treatment was not significantly different from Entrust SC, Heligen ABC, or Coragen. There was a significant treatment effect on proportion bud rot at harvest. Entrust SC had a significantly lower incidence of bud rot than all treatments except the untreated check, Gemstar LC + BoteGHA ES, Spear-Lep, Heligen A, Heligen AB, and Coragen. No signs of phytotoxicity were observed from any treatments.¹

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Table 1.

Treatment	Rate/acre	Number of CEW per 10 buds			Cumulative CEW days	Proportion bud rot 23 Sep ^a
		8 Sep	15 Sep	23 Sep		
Untreated control	—	2.3	3.5abc	3.8a	62.9abc	0.4abcde
Agree WG	16.0 oz	1.5	3.8abc	2.3ab	53.8abc	0.6abc
Crymax	16.0 oz	1.8	3.8abc	3.5a	60.4abc	0.5abcd
Entrust SC	5.0 fl oz	0.8	1.5abc	0.0b	23.0c	0.1e
Gemstar LC	5.0 fl oz	1.3	1.0bc	2.3ab	31.5abc	0.8a
Gemstar LC + BoteGHA ES	5.0 fl oz	0.0	0.5c	0.5ab	12.7c	0.2cde
	16.0 fl oz					
Spear-Lep	32.0 fl oz	2.3	2.5abc	1.5ab	46.3abc	0.5abcde
Spear-Lep + Leprotec	32.0 fl oz	3.3	3.5abc	1.8ab	61.3abc	0.6abc
	16.0 fl oz					
9. Heligen A	2.4 fl oz	1.0	2.3abc	0.5ab	32.3abc	0.3bcde
Heligen AB	2.4 fl oz	1.0	1.5abc	2.3ab	33.7abc	0.4abcde
Heligen ABC	2.4 fl oz	1.5	0.5c	1.3ab	25.4c	0.6abc
XenTari DF	16.0 oz	2.3	3.0abc	1.8ab	51.0abc	0.5abcd
Heligen + XenTari DF	2.4 fl oz	1.3	1.5abc	0.5ab	28.3bc	0.5abcd
	16.0 oz					
PyGanic EC	15.6 fl oz	3.3	6.0ab	2.8ab	84.0ab	0.5abcd
PyGanic EC + Exponent	15.6 fl oz	3.3	6.3a	3.3ab	87.9a	0.6ab
	23.0 fl oz					
DiPel DF	16.0 oz	2.3	2.5abc	2.8ab	51.3abc	0.5abcd
Coragen	3.5 fl oz	1.0	0.5c	0.8ab	20.2c	0.1de
P-value from ANOVA		NS	0.0015	0.0025	0.0001	<0.0001

Means followed by the same letter within a column are not significantly different ($P > 0.05$).

^aArcsine-transformed proportion data were used for analysis, but untransformed sample means are presented.