

Citations for resistance ratings in the Handy Bt Trait Table

Insect	Bt protein	Crop & Location	For more information
corn earworm (CEW) <i>Helicoverpa zea</i>	Cry1Ab	Sweet corn Maryland	<ul style="list-style-type: none"> Dively et al. 2016. Field-evolved resistance in corn earworm to Cry proteins expressed by transgenic sweet corn. <i>PLoS ONE</i> 11(12)
	Cry1A.105 x Cry2Ab2	Sweet corn Maryland	<ul style="list-style-type: none"> Dively et al. 2016. Field-evolved resistance in corn earworm to Cry proteins expressed by transgenic sweet corn. <i>PLoS ONE</i> 11(12)
	Cry1A.105	Field corn the Carolinas	<ul style="list-style-type: none"> Bilbo, et al. 2019. Susceptibility of Corn Earworm to Cry1A.105 and Cry2Ab2 in North and South Carolina. <i>J. Econ. Entomol.</i>, 1–13 doi: 10.1093/jee/toz062
	Cry2Ab2	Field corn the Carolinas	<ul style="list-style-type: none"> Bilbo, et al. 2019. Susceptibility of Corn Earworm to Cry1A.105 and Cry2Ab2 in North and South Carolina. <i>J. Econ. Entomol.</i> 1–13 doi: 10.1093/jee/toz062
European corn borer (ECB) <i>Ostrinia nubilalis</i>	Cry1F	Field corn Nova Scotia	<ul style="list-style-type: none"> Smith et al. 2019. Practical resistance of <i>Ostrinia nubilalis</i> to Cry1F <i>Bacillus thuringiensis</i> maize discovered in Nova Scotia. <i>Nature Sci Rep</i> 9, Article #18247 doi:10.1038/s41598-019-54263-2
fall armyworm (FAW) <i>Spodoptera frugiperda</i>	Cry1F	Field corn Florida N. Carolina	<ul style="list-style-type: none"> Huang et al. 2014. Cry1F Resistance in fall armyworm <i>Spodoptera frugiperda</i>: Single gene versus pyramided Bt maize. <i>PlosOne</i> 9(11). Li et al. 2016. Frequency of Cry1F non-recessive resistance alleles in North Carolina field populations of <i>Spodoptera frugiperda</i>. <i>PlosOne</i> 11(4).
Northern corn rootworm (NCR) <i>Diabrotica barberi</i>	Cry3Bb1	Field Corn North Dakota	<ul style="list-style-type: none"> Calles-Torrez et al. 2019. Field-evolved resistance of northern and western corn rootworm populations to corn hybrids expressing single and pyramided Cry3Bb1 & Cry34/35Ab1 Bt proteins in North Dakota. <i>J. Econ. Entomol.</i> 112: 10.1093/jee/toz111
	Cry34/35Ab1	Field Corn North Dakota	<ul style="list-style-type: none"> Calles-Torrez et al. 2019. Field-evolved resistance of northern and western corn rootworm populations to corn hybrids expressing single and pyramided Cry3Bb1 & Cry34/35Ab1 Bt proteins in North Dakota. <i>J. Econ. Entomol.</i> 112: 10.1093/jee/toz111
Southwestern corn borer (SWCB) <i>Diatraea grandiosella</i>	Cry1F	Field Corn Arizona New Mexico	<ul style="list-style-type: none"> Arizona Pest Management Center. Posted 1 Feb 2017. Chlorpyrifos use in Arizona and New Mexico. Public comment submitted to EPA, ID Docket EPA-HQ-OPP-2015-0653-0654.
western bean cutworm (WBC) <i>Striacosta albicosta</i>	Cry1F	Field Corn Western corn belt (increased tolerance) Great Lakes region	<ul style="list-style-type: none"> Ostrem et al 2016. Monitoring susceptibility of western bean cutworm field populations to <i>Bacillus thuringiensis</i> Cry1F protein, <i>J. Econ. Entomol.</i> 109(2) 847–853. Smith et al. 2017. Evidence for field-evolved resistance of <i>Striacosta albicosta</i> to Cry1F <i>Bacillus thuringiensis</i> protein and transgenic corn hybrids in Ontario, Canada. <i>J. Econ. Entomol.</i> 110: 2217-2228. Numerous field failures in Great Lakes region in 2016
western corn rootworm (WCR) <i>Diabrotica virgifera virgifera</i>	Cry3Bb1	Field Corn Iowa Minnesota North Dakota	<ul style="list-style-type: none"> Gassmann et al. 2011. Field-Evolved Resistance to Bt maize by western corn rootworm. <i>PLoS ONE</i> 6(7). Gassmann et al. 2012. Western corn rootworm and Bt maize: Challenges of pest resistance in the field. <i>GM Crops & Food: Biotech in Ag and the Food Chain</i> 3(3) 1-10. Gassmann et al. 2012. Field-evolved resistance to Bt maize by western corn rootworm: Predictions from the laboratory and effects in the field. <i>J. Invertebrate Pathology</i> 110:287-293.

western corn rootworm (WCR) continued....			<ul style="list-style-type: none"> • Zukoff et al. 2016. Multiple assays indicate varying levels of cross resistance in Cry3Bb1-selected field populations of the western corn rootworm to mCry3A, eCry3.1Ab & Cry34/35Ab1. JEE 109(3): 1387-1398. • Calles-Torrez et al. 2019. Field-evolved resistance of northern and western corn rootworm populations to corn hybrids expressing single and pyramided Cry3Bb1 & Cry34/35Ab1 Bt proteins in North Dakota. J. Econ. Entomol. in press.
	mCry3A	Field Corn Iowa Minnesota Texas	<ul style="list-style-type: none"> • Gassmann et al. 2014. Field-evolved resistance by western corn rootworm to multiple <i>Bacillus thuringiensis</i> toxins in transgenic maize. PNAS 111(14). 5141–5146. • Zukoff et al. 2016. Multiple assays indicate varying levels of cross resistance in Cry3Bb1-selected field populations of the western corn rootworm to mCry3A, eCry3.1Ab & Cry34/35Ab1. JEE 109(3): 1387-1398. • Field failures in Texas Panhandle. See https://focusonagriculture.blogspot.com/2018/08/texas-panhandle-corn-rootworm-probably.html.
	eCry3.1Ab	Field Corn Iowa Minnesota	<ul style="list-style-type: none"> • Jakka et al.. 2016. Broad-spectrum resistance to <i>Bacillus thuringiensis</i> toxins by western corn rootworm. Nature Scientific Reports 6, 27860; doi: 10.1038/srep27860. • Zukoff et al. 2016. Multiple assays indicate varying levels of cross resistance in Cry3Bb1-selected field populations of the western corn rootworm to mCry3A, eCry3.1Ab & Cry34/35Ab1. JEE 109(3): 1387-1398.
	Cry34/35Ab1	Field Corn Iowa Minnesota	<ul style="list-style-type: none"> • Gassmann et al. 2016. Evidence of resistance to Cry34/35Ab1 corn by western corn rootworm: Root injury in the field and larval survival in plant-based Bioassays. JEE 109(4): 1872–1880 • Zukoff et al. 2016. Multiple assays indicate varying levels of cross resistance in Cry3Bb1-selected field populations of the western corn rootworm to mCry3A, eCry3.1Ab & Cry34/35Ab1. JEE 109(3): 1387-1398.