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Jonas Victor de Macedo,  
*Ministry of Education of Brazil, jonas\_victor\_m@live.com*

Kayla A. Mollet  
*University of Nebraska-Lincoln*

Julie A. Peterson  
*University of Nebraska-Lincoln, julie.peterson@unl.edu*

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FIELD CORN: *Zea mays* L., 'TA566-31,  
Agrisure Viptera 3111'

## Performance of Seed Treatments and in-Furrow at-Plant Insecticides for Protection Against Cry3Bb1-Resistant Western Corn Rootworm, 2015\*

Jonas Victor de Macedo,<sup>1</sup> Kayla A. Mollet,<sup>2</sup> and Julie A. Peterson<sup>2,3</sup>

<sup>1</sup>CAPES Foundation, Ministry of Education of Brazil, Brasília, DF 70.040-020, Phone: +55 65-3259-1549 (jonas\_victor\_m@live.com), <sup>2</sup>University of Nebraska-Lincoln, West Central Research & Extension Center, 402 West State Farm Rd., North Platte, NE 69101, Phone: +1 308-696-6717 (kayla.mollet@unl.edu), Phone: +1 308-696-6704, Fax: +1 308-696-6780 (julie.peterson@unl.edu), and <sup>3</sup>Corresponding author, e-mail: julie.peterson@unl.edu

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Corn (hybrid, maize, sweet) | *Zea mays*

western corn rootworm | *Diabrotica virgifera*

The western corn rootworm is an important pest of corn that can compromise yield by feeding on plant roots during its larval stage. WCRW management has been complicated by the development of resistance in some regions, including Nebraska, to transgenic *Bacillus thuringiensis* (Bt) traits, particularly the protein Cry3Bb1, which confers cross-resistance to mCry3A. A field trial was established to evaluate the efficacy of neonicotinoid seed treatments in combination with in-furrow insecticides on a corn hybrid expressing mCry3A Bt proteins against corn rootworm in an area with a history of rootworm resistance. The trial was conducted in a farmer's field in Keith County near Ogallala, Nebraska, USA (41.116736° N, -101.652410° W), between 8 Jun and 6 Oct 2015. Damage from WCRW to corn expressing Cry3Bb1 proteins was documented in the field during the previous season.

A RCB design with four replications and eight treatments (including an untreated check) was used. Each plot was four rows by 30 ft. The trial was planted on 8 Jun 2015 using a small plot research planter at 32,000 seeds/acre at an approximate depth of 1.4–1.75 inch in 30 inch rows. The hybrid planted was TA566-31 (T.A. Seeds, Jersey Shore, PA, USA) with the Agrisure Viptera 3111 Bt trait package, which expresses mCry3A along with other Bt toxins.

All seed, including the untreated checks (UTCs) were treated with fungicide Maxim<sup>®</sup> Quattro at 0.064 mg ai/seed. The tested insecticides were applied in-furrow, with calculations based on an application volume of 15 gal/acre. The at-plant insecticide treatments were applied on 8 Jun 2015 at rates described in Table 1.

Soil type at the experimental site was Lex loam with low water percolation capacity. The plots received irrigation, fertilization, and

weed management inputs identical to the commercial field surrounding the plots following standard agronomic practices for the region. An aerial application of 2.6 fl oz/acre Mustang<sup>®</sup> Maxx (zeta-cypermethrin) and 1 pt/acre dimethoate insecticide targeting western bean cutworm (*Striacosta albicosta*) was made on 22 Jul 2015. The population of WCRW was measured using eight single-plant emergence cages placed over Cry3Bb1 Bt corn immediately adjacent to the insecticide trial; an average of 47.9 beetles per plant emerged between 7 Jul and 22 Sep 2015.

On 6 Aug 2015, eight plants from the central two rows and interior 22 ft of each plot were randomly chosen and removed along with roots. The roots were washed and rated for damage using the Iowa State 0–3 Node Injury Scale, where a rating of one would indicate one node of root injury due to rootworm feeding. The data were analyzed using PROC MIXED with mean separation using differences of least square means ( $P = 0.05$ ) in SAS.

Mean node-injury ratings for the UTC ranged from 0.00 to 1.30 with a mean of 0.29, indicating low to moderate WCRW pressure. All treatments that included either seed treatment alone or in combination with an at-plant soil insecticide had significantly reduced root damage when compared with the UTC (Table 1). Poncho 0.50 mg ai/seed plus Force 3G at 5 lb/acre had significantly lower root damage when compared with Poncho 0.50 mg ai/seed alone. All other treatments did not result in statistically significant differences in root damage, including seed treatments and at-plant insecticide combinations of low + high vs. high + low rates, respectively. These results indicate that when dealing with Cry3Bb1-resistant populations of WCRW, higher rates of neonicotinoid seed treatment alone or lower rates plus soil-applied insecticides provide adequate root

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**Table 1**

Insecticidal seed treatment		In-furrow insecticide treatment		Mean node injury scale (0–3) <sup>a</sup>
Product (AI)	Rate (mg ai/seed)	Product (AI)	Rate (per acre)	
Untreated check	–	Untreated check	–	0.29 A
Poncho (clothianidin)	1.25	–	–	0.09 BC
Poncho (clothianidin)	0.5	–	–	0.14 B
Poncho (clothianidin)	0.5	Capture LFR (bifenthrin)	16 fl oz	0.10 BC
Poncho (clothianidin)	0.5	Force 3G (tefluthrin)	5 lb	0.03 C
Poncho (clothianidin)	0.5	Aztec (tebupirimphos + cyfluthrin)	3 lb	0.04 BC
Poncho (clothianidin)	0.5	Ampex (clothianidin)	5.12 oz wt (0.16 lb ai)	0.06 BC
Poncho (clothianidin)	1.25	Ampex (clothianidin)	3.3 oz wt (0.103125 lb ai)	0.06 BC

<sup>a</sup>The node injury scale indicates the number of nodes of feeding injury to roots caused by WCRW, with one node of feeding indicated by a score of 1.0.

protection when pest pressure is low to moderate. However, these results are likely to vary if pest pressure is higher. Given that most of the evaluated treatments did not show significant differences in root protection, application cost and need to rotate insecticide mode of

action for resistance management should be important factors in selection of seed treatments and at-plant insecticides for rootworm management.