New York Western Bean Cutworm Monitoring Program
Progress Report (2010-2016)

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The Pest Problem

Western bean cutworm (*Striacosta albicosta* [Smith]) attacks corn (*Zea mays* L.; including field, sweet and popcorn) and dry beans (*Phaseolus vulgaris* L.), feeding on developing kernels or beans inside husks and pods, respectively. Western bean cutworm (WBC) infestations can cause significant yield losses and may facilitate subsequent colonization by pathogens, furthering damage and impacts. WBC moth, egg mass and larva images are shown below (Fig 1, 2 and 3).


Figure 1. WBC Moth


Figure 2. WBC egg mass


Figure 3. WBC Larva in corn ear

Western bean cutworm (WBC) is native to North America, but has historically been restricted to the Great Plains and westward. Over the past decade, WBC has expanded its range through the Midwest into the northeastern United States and Canada. As WBC has moved eastward, its caterpillars have caused economic damage, particularly in Michigan and Ontario, where growers have reported 8-10% losses in dry beans and 40% losses in field corn. WBC moths were first discovered in Pennsylvania and New York in 2009 and Vermont in 2011. Pheromone trapping was initiated in NY and PA in 2010 and in VT in 2011 in collaboration with scientists from Penn State University and University of Vermont to gain knowledge about WBC populations and better assess their potential risk to corn and dry bean acres in the Northeast. The trapping network has revealed western bean cutworms are becoming more widely distributed and populations are increasing, posing a potential risk to dry beans and the over 3.5 million acres of corn grown in NY, PA, and VT. To date, only non-economic larval infestations have been found in Pennsylvania and Vermont. However, in 2015 some WBC damage was reported to untreated fresh market sweet corn in northern NY (11% losses in Oswego, NY, M. Zuefle pers. com.), WNY field corn (M. Stanyard, WNY CCE Dairy/field crop team, pers. com). In 2016 WBC larval damage was documented in several fields in northern NY including research trials in Jefferson County (Mike Hunter, pers. communication). In 2014 and 2015 trace levels of suspected WBC damage was found in beans at three elevators in New York during cleaning of red kidney beans. The beans were from Cayuga, Livingston and Steuben Counties. Dry bean pods with WBC feeding damage were first seen in one Western NY field in 2015. Only 1 pod with damage was found in a different field in 2016, plus 2 pods were found with damage in an organic *Trichogramma* release trial .Some dry bean producers have begun to apply an insecticide just after the time of peak moth emergence (C. MacNeil, WNY CCE Veg Program).

Monitoring Procedure:

WBC male moths are trapped using a green "universal" bucket trap hung on posts at the edge of corn or dry bean field sites (Fig. 4). Traps contain the WBC pheromone lure that mimics a female scent to attract male moths. In addition, an insecticide strip is placed in the trap to kill the moths once inside. WBC trapping was initiated the second week of June and continued until early September. Traps were checked weekly and number of moths collected recorded. Moth capture data was entered in PestWatch (www.pestwatch.psu.edu) and shared with the local and regional agricultural community through timely newsletters.

Figure 4. Bucket trap used to collect WBC moths

2010-2016 Results

A volunteer-based WBC pheromone trap monitoring network has been in place in NY since 2010. This report summarizes 2016 WBC collection data from several sources including Cornell Cooperative Extension coordinated field corn, sweet corn and dry bean pheromone monitoring networks and data provided by private agricultural consultants and agribusinesses. NY WBC populations have increased annually since 2010 as indicated by the average and maximum range in number of WBC moths captured per location (Table 1). A total of 19, 476 WBC moths were collected in 2016 less than the 20,844 collected in 2015, compared to 11,353 collected in 2014, and more than 3 times the 6,110 WBC moths collected in 2013. Location and relative moth counts for 2016 trap sites are shown in Figure 5. On average, higher WBC counts continue to be captured in northern and western counties with the majority of high trap counts occurring in locations north of the NYS thruway (Interstate 90). Moth wings are covered with fine scales that can rub off over time with use. The relatively undamaged wing condition of many of the WBC moths captured indicate local WBC populations are becoming established in many areas.

Table 1. New York Western Bean Cutworm 2010 – 2016 Collection Data Summary*

	2010	2011	2012	2013	2014	2015	2016
No. Counties	29	37	44	39	41	39	40
No. Traps	54	67	88	89	96	91	101
Avg. No. WBC / Trap	13	23	42	66	117	266	193
Range in Totals	0 - 99	0 - 165	0 - 344	0 – 853	0 – 1019	0 – 1688	0 – 1662
Peak Flight	2-Aug	2-Aug	25-Jul	21-28-Jul	3-Aug	2-Aug	31-Jul

*Data compiled from WBC trap catch information provided by field corn, sweet corn, and dry bean monitoring networks across NY.

Pheromone trap data has documented WBC moth activity, peak flight and has enhanced timing of field monitoring for egg masses and larvae. Timing and intensity of WBC moth flights have varied slightly annually with peak flights occurring between the last week of July and the first

week of August (Figure 6). This consistent timing of moth flight activity is being used to evaluate accuracy of a midwestern US WBC moth degree-day emergence prediction model (Hanson et al) for its application in the northeast.

Monitoring and Management:
WBC moths prefer pre-tassel corn for their egg laying site and egg masses may be found on the upper surface of leaves at or near the tassel whorl. Young WBC larvae may feed on leaf surfaces but quickly move to corn ears where they can be found feeding on silks or kernels. By contrast, in dry beans WBC lay their egg masses on the undersurface of leaves and larvae feed on pods at night and hide in the soil during the day making them very difficult to detect. Midwestern experience suggests crops at risk be monitored closely for WBC activity when accumulated trap catches approach 100 moths or more. Midwestern and Ontario WBC corn monitoring guidelines recommend carefully searching for egg masses on 10 corn plants in a row in 10 areas of the field.

Our NY management guidelines are based on Midwestern states and Ontario recommendations. When possible plant corn early, use short season hybrids to get past pre-tassel stages before peak flight (typically end of July). Bt corn hybrids Vip 3A (Agrisure Viptera) hybrids have been recommended as having efficacy against western bean cutworm. Bt Corn with Cry1F (e.g. Herculex 1, Xtra, Optimum AcreMax1, SmartStax) have shown to have little resistance to WBC.

A WBC degree-day model using 50 F base temperature has been used in the Midwest to predict WBC flights. This model predicts 25% WBC moth emergence at 1319 DD accumulation, 50% at 1422 DD accumulation and 75% at 1536 DD accumulation. Preliminary evaluation of the model suggests this model, though not perfect, has relative utility for use in the NY. An improved WBC degree-day model was recently published (Hanson et al 2015) that could be evaluated to predict WBC flights in NY. In the meantime, local WBC pheromone trap data, if available, provides the best information to time WBC monitoring activities to assess risk and need for control. Prioritize fields for monitoring dependent on plant stage, recalling pre-tassel corn is highly attractive to WBC for egg laying. Follow threshold guidelines: field corn 5% of plants with egg masses; sweet corn – processing 4%, fresh market 1%; and dry beans – 1st signs of pin feeding, watch nearby corn for signs of WBC activity.

Midwestern and Ontario entomologists recommend a foliar insecticide spray if 5% of non-Bt corn or transgenic corn without protection against WBC have WBC egg masses on them. Ontario recommends timing an insecticide foliar spray application for just after egg hatch when small larvae are present at the top of the plant. Egg hatch occurs a day or two after the egg masses turn purple (typically 5-7 days after being freshly laid). (See more at: http://fieldcropnews.com/2013/07/western-bean-cutworm-thresholds-for-high-risk-fields-in-ontario/#sthash.crBkKtBo.dpuf). A summary of Bt trait family products effective against WBC can be found at Handy Bt Trait Table (http://www.msuent.com/assets/pdf/28BtTraitTable2016.pdf). WBC efficacy concerns have been mounting this season against Cry1F Bt containing hybrids (e.g. Herculex 1, Xtra, Optimum AcreMax1, SmartStax). In 2016 https://www.dtnpf.com/agriculture/web/ag/news/crops/article/2016/10/17/companies-push-back-herculex-trait-2 see below. As of this writing Vip 3A (Agrisure Viptera) hybrids will be the only hybrids recommended in 2017 as effective against western bean cutworm. Late season activities - monitor corn for ear molds and need for early harvest.

Thresholds are not currently available for WBC in dry beans. Dry bean fields adjacent to corn fields that have reached WBC threshold should be considered at risk and monitored closely for signs of foliar or pod feeding by WBC larvae. If bean pods are present and fresh signs of pod feeding are easily found, Michigan and Ontario entomologists recommend spray application is necessary.

There are a number of factors that can impact the severity of damage from Western Bean Cutworm. These may include the size and survival of over-wintering WBC population; type of Bt gene if a Bt trait hybrid is being used; synchronization between corn silking date and timing of moth flight; use of insecticide sprays for 2 generation European corn borer or other late season ear worms; number of WBC egg masses & survival of young larvae (hot and dry conditions cause mortality); competition/predation/parasitism/diseases including: European corn borer, corn earworm or fall armyworm larvae in the ear or presence of *Trichogramma* egg parasites, nuclear polyhedrosis viruses or entomopathogenic fungi affecting egg or larval stages and environmental factors influencing ear mold development.

Recent observations of note:
Ontario entomologists have reported field corn production areas with above threshold levels of WBC since 2013 and a number of dry bean fields in southwest Ontario had noticeable pod damage in 2015 for the first time. (J. Smith and T. Baute (University Guelph, Ridgetown and OMAFRA). In 2013, heavy populations of WBC in some western Ontario "hotspot" areas were reported causing significant damage SmartStax and Herculex hybrids (Cry1F Bt hybrids). (http://fieldcropnews.com/2014/07/does-spraying-bt-corn-for-western-bean-cutworm-make-sense/). There have been similar reports of high WBC populations challenging Cry1F Bt hybrids in areas of the Midwest. WBC populations were reported causing economic damage in Ontario province in 2014 and 2015. Ontario entomologists suspect more WBC were seen outside its typical range due to later planting dates outside the hot-spot areas that were attractive to female moths looking for pre-tassel corn to lay their eggs. 2014 was the first year Ontario had multiple fields of edible dry beans with easily visible WBC damage (http://fieldcropnews.com/2014/09/scout-for-western-bean-cutworm-and-ear-mould-now/).

In 2014 - 2016, WBC larvae were found feeding in sweet and field corn in northern and western NY. In 2015, WBC damage was reported to untreated fresh market sweet corn in northern NY (11% losses in Oswego, NY, M. Zuefle pers. com.), WNY field corn (M. Stanyard, WNY CCE Dairy/field crop team, pers. com). 2015 was the first year that dry bean pods with WBC feeding damage was seen in the field. Some dry bean producers have begun to apply an insecticide just after the time of peak moth emergence (C. MacNeil, WNY CCE Veg Program).

In 2016 northern NY field corn trials 18 – 21% of Cry1F plants had WBC larval damage (Mike Hunter, CCE of Jefferson County, Watertown, NY, personal communication).

Concerns with WBC control in Cry1F Bt hybrids (excerpted from an article in The Progressive Farmer Magazine (10/5/2016).
In 2016 Dow AgroSciences released a statement to The Progressive Farmer Magazine (DTN) from biology team leader Brad Hopkins confirming that some of their growers have reported

"greater feeding damage than in past years under high-pressure conditions and reduced sensitivity of the pest to Cry1F." Dow and Pioneer representatives acknowledged reports of Cry1F failures against western bean cutworm. Dr. Christine DiFonzo (MSU) and the other entomologists said they were flooded with reports of severe western bean cutworm infestations this summer in Herculex-traited corn in Michigan, Indiana, Ohio and New York. The ear damage has created some serious ear mold and grain quality issues.
https://www.dtnpf.com/agriculture/web/ag/news/crops/article/2016/10/05/herculex-trait-fails-western-bean-4

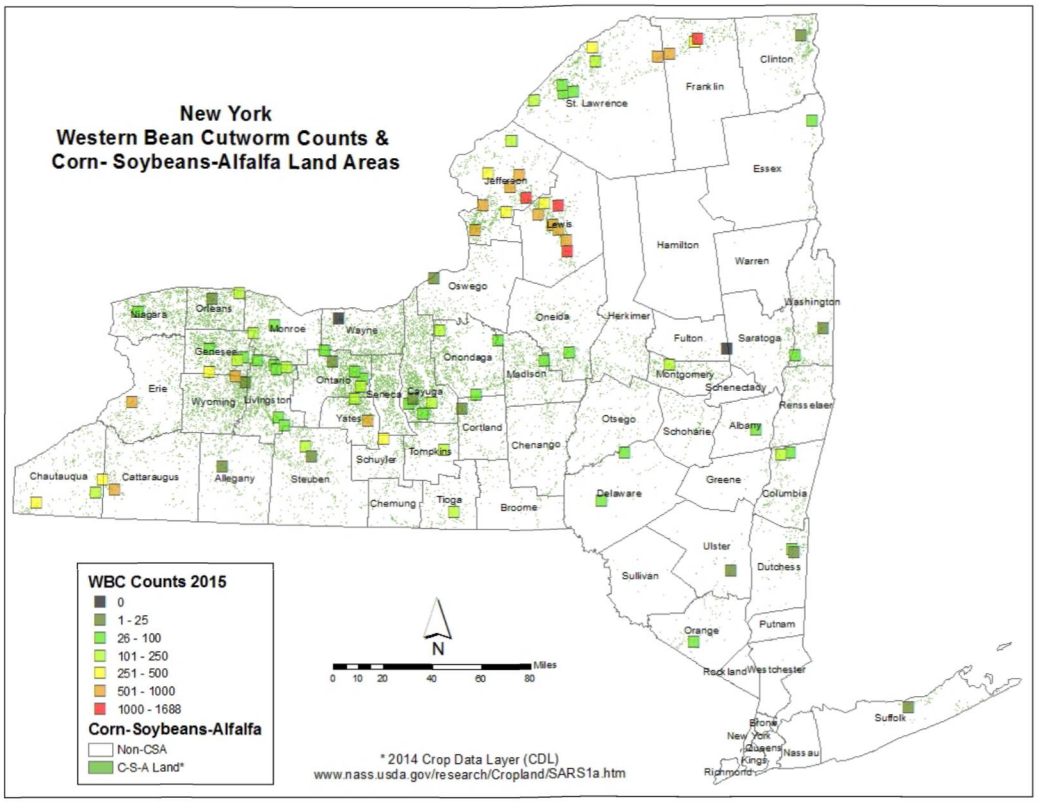
An open letter to the Seed Industry regarding the efficacy of Cry1F Bt against western bean cutworm was developed by several university entomology researchers and published in October 2016 (http://blogs.cornell.edu/ccefieldcropnews/2016/10/04/an-open-letter-to-the-seed-industry-regarding-the-efficacy-of-cry1f-bt-against-western-bean-cutworm-october-2016/). The letter in part states: "As extension educators and specialists, we can no longer refer to Cry1F as providing WBC control. In fact the opposite is true, and our extension recommendations (including the Handy Bt Trait Table) will be changing to classify Cry1F hybrids for WBC the same as non-Bt, Cry1Ab, or double/ triple pro hybrids, all of which provide no control. In other words, we believe that Cry1F fields must be scouted for egg masses and sprayed with foliar insecticides if needed, the same as a non-Bt corn. Western bean cutworm is now the PRIMARY Lepidopteran ear pest in many parts of the Great Lakes region.".

From the company response: "For now, both Dow and Pioneer are adjusting their descriptions of Cry1F in their product use guides for the trait. This summer, Pioneer downgraded Cry1F's rating for WBC from "very good" to "moderate" for the 2017 season.

"I would categorize 'moderate' as meaning moderate levels of plant protection and that Cry1F may provide plant damage suppression rather than control" under low to moderate insect pressure, Pioneer's strategy lead for insect resistance management, Clint Pilcher, told DTN. "This is a pest you need to scout for; you need to get out and monitor for it, and our field materials have been updated to reflect that."

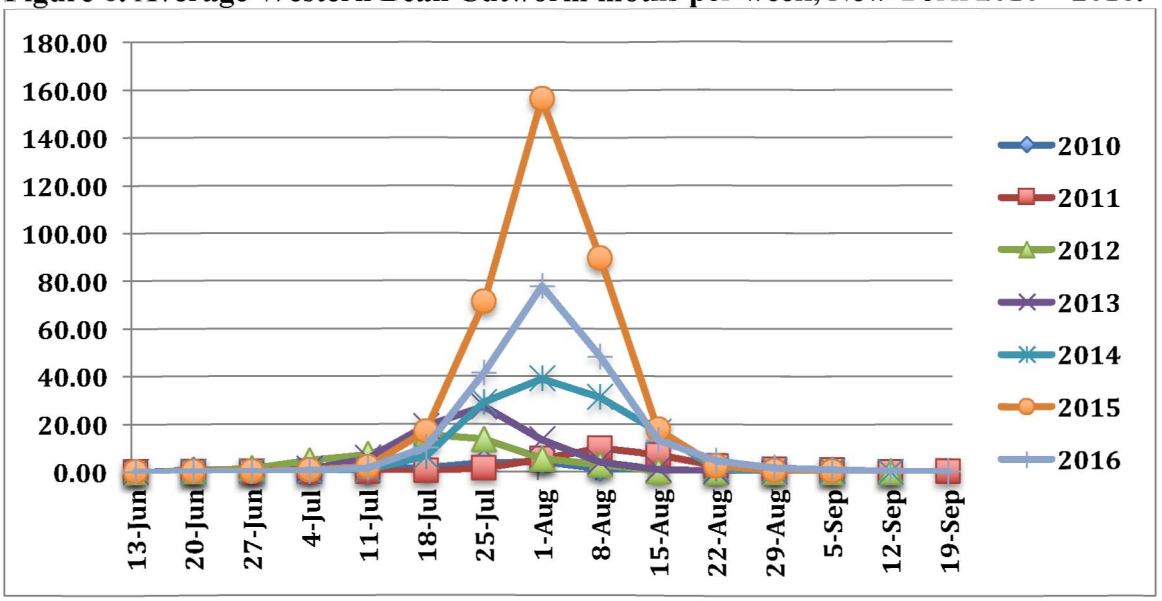
More information on Seed Company response to the entomologist's letter can be seen at:
https://www.dtnpf.com/agriculture/web/ag/news/crops/article/2016/10/17/companies-push-back-herculex-trait-2

Figure 5. Western Bean Cutworm trap location and accumulated moth capture for 2016.



Pheromone trapping 2010 – 2016 documented WBC moth activity. This information is being related to a growing degree model to help fine-tune crop monitoring activities. The peak WBC flight in 2016 was recorded the week of July 31/August 1 (Figure 6).

Figure 6. Average Western Bean Cutworm moths per week, New York 2010 – 2016.

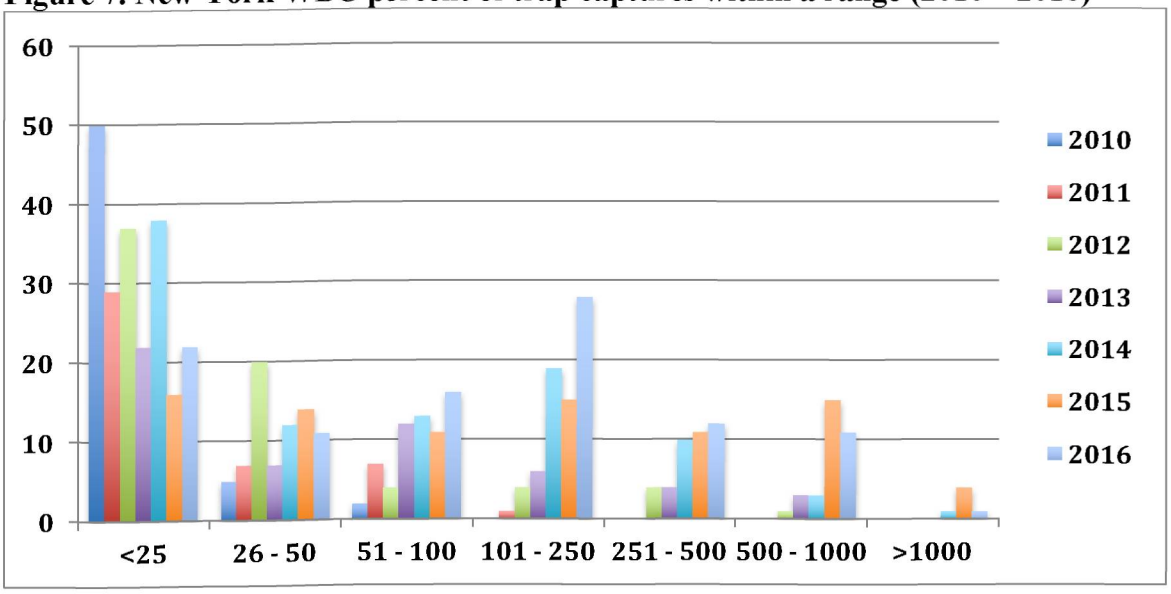


The range of accumulated WBC moths captured per trap in New York by year (2010 – 2016) are shown in figure 7. In 2010, the majority of accumulated trap catches in NY were less than 25 per

trap. WBC trap catches have increased every year since. WBC "hotspots" occurred in northern and western NY locations monitored in 2015 and 2016. Statewide, 10 sites caught less than 10 WBC moths, while 49% of traps caught more than 100 moths per trap. The highest WBC trap count in 2016, 1662 WBC moths were collected in a Franklin county location slightly less than last years highest trap count of 1688 WBC moths collected from a Jefferson county location. Accumulated New York WBC trap catch data by 2016 location are shown in Table 2.

There has been a trend of more WBC moths being captured per location each year as seen in Table 1 and Figure 7. While actual accumulated trap counts ranged from 0 to 1662, the statewide average WBC moth catch per location this year was 193 shown in Table 1 and Figure 8.

Figure 7. New York WBC percent of trap captures within a range (2010 – 2016)



	<25	26 - 50	51 - 100	101 - 250	251 - 500	500 - 1000	>1000	Total Traps
2010	50	5	2					57
2011	29	7	7	1				44
2012	37	20	4	4	4	1		70
2013	22	7	12	6	4	3		54
2014	38	12	13	19	10	3	1	96
2015	16	14	11	15	11	15	4	86
2016	22	11	16	28	12	11	1	101

Figure 8. Average Number WBC Moths Per Trap By County Compared to NY State Average in 2016.

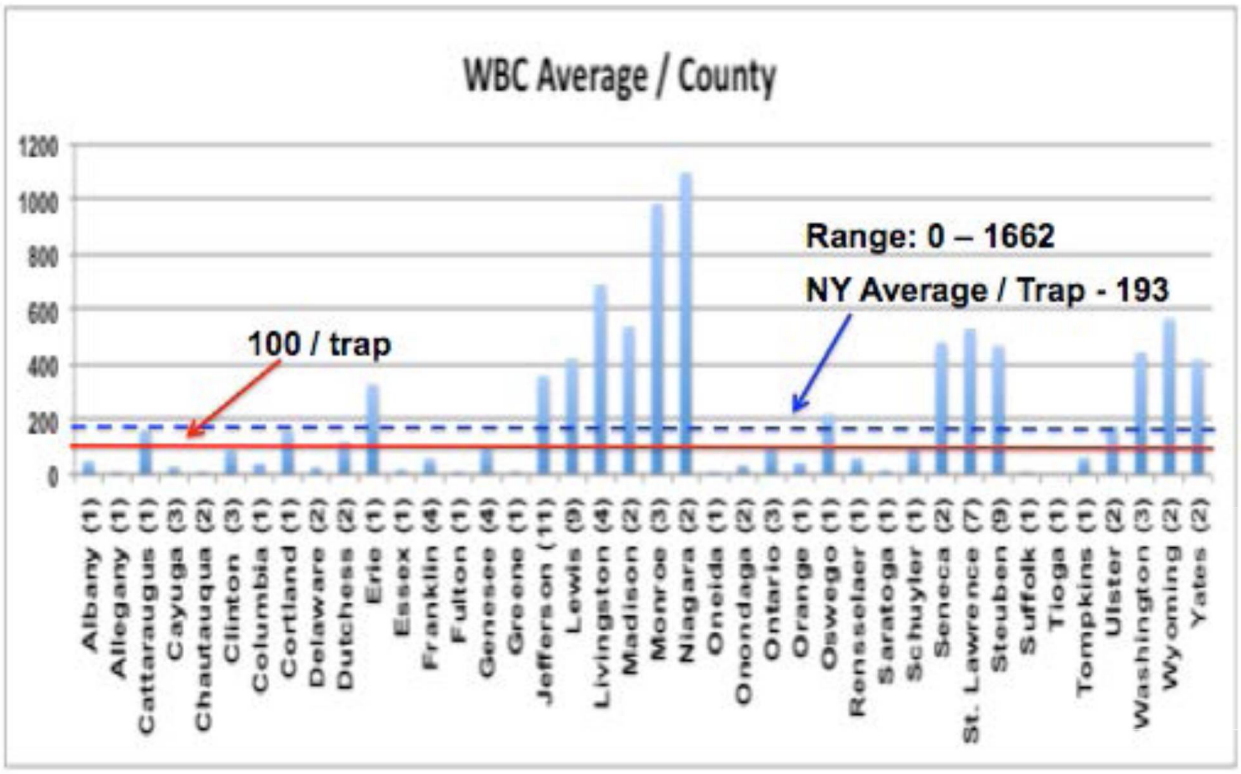


Table 2. 2016 NY Western Bean Trap network accumulated catch total by location*.

County	Town	WBC Total
Albany	Feura Bush	49
Allegany	Belfast	9
Cattaraugus	Randolph	162
Cayuga	Aurora	63
Cayuga	King Ferry	1
Cayuga	Sherwood	18
Chautauqua	Kennedy	53
Chautauqua	S. Dayton	199
Clinton	Chazy	36
Clinton	Peru	16
Clinton	Plattsburg	220
Columbia	Valatie	40
Cortland	Preble	157
Delaware	Davenport	36
Delaware	Walton	27
Dutchess	Amenia	15
Dutchess	Amenia/Millbrook	27
Erie	Eden	326
Essex	Willsboro	18
Franklin	Chateaugay	313
Franklin	Dickinson Center	756
Franklin	Malone	1662
Franklin	Moira	525
Fulton	Amsterdam	4
Genesee	Avon	64
Genesee	Batavia	95
Genesee	Pavilion	144
Genesee	Stafford	193
Greene	Athens	13
Jefferson	Calcium	392
Jefferson	Chaumont	140
Jefferson	Clayton	815
Jefferson	Ellisburg	524
Jefferson	Hounsfield	947
Jefferson	Pamelia	489
Jefferson	Philadelphia	563
Jefferson	Plessis	146
Jefferson	Rodman	200
Jefferson	Rutland	554

County	Town	WBC Total
Livingston	S Caledonia	161
Livingston	SW Caledonia	135
Madison	Kirkville	11
Madison	Munnsville	68
Monroe	Hamlin	268
Monroe	Spencerport	653
Monroe	Spencerport	7
Niagara	Barker	421
Niagara	Ransomville	68
Oneida	Vernon Center	1
Onondaga	Baldwinsville	119
Onondaga	Tully	77
Ontario	Farmington	2
Ontario	Geneva	148
Ontario	Seneca Castle	64
Orange	Florida	44
Oswego	Oswego	218
Rensselaer	Kinderhook	60
Saratoga	Clifton Park	16
Schuyler	Burdett	102
Seneca	Auburn	0
Seneca	Seneca Falls	78
St. Lawrence	Chase Mills	58
St. Lawrence	Edwards	137
St. Lawrence	Hammond	137
St. Lawrence	Huevelton	89
St. Lawrence	Madrid	499
St. Lawrence	N. Lawrence	645
St. Lawrence	S. Colton	141
Steuben	Avoca	168
Steuben	Avoca	14
Steuben	Cohocton (Flat)	14
Steuben	Cohocton (Hill)	26
Steuben	Dansville	78
Steuben	Howard (Flat)	19
Steuben	Howard (Hill)	72
Steuben	N. Cohcoton	148
Steuben	Wayland	42
Suffolk	Riverhead	4

Jefferson	Watertown	575	Tioga	Owego	0
Lewis	Croghan	255	Tompkins	Varna	61
Lewis	Croghan	210	Ulster	Stone Ridge	0
Lewis	Denmark	318	Ulster	Accord	15
Lewis	Harrisburg	236	Washington	Greenwich	48
Lewis	Lowville	298	Washington	Greenwich	129
Lewis	Lowville	169	Washington	Salem	38
Lewis	Martinsburg	647	Wyoming	Wyoming	195
Lewis	New Bremen	144	Wyoming	Wyoming	464
Lewis	Turin	190	Yates	Bellona	63
Livingston	Avon	18	Yates	Penn Yan	116
Livingston	Groveland	264	Field Corn	Sweet Corn	Dry Beans

*101 WBC traps, 19, 476 total moths captured.

2017

The weekly WBC pheromone trap survey is expected to continue in the summer of 2017. WBC trap catches are expected to increase, but if so *by how much* and *under what conditions*? Field monitoring for WBC in 2017 is highly recommended - *especially* in areas that had high trap counts in 2015 and 2016 and fields with sandy soil types that would allow easier burrowing and may affect overwintering survival. WBC trap count updates will be provided during the field season at NYS IPM Weekly Pest Report: http://blogs.cornell.edu/ipmwpr/#, the NY Sweet Corn Pheromone Trap Network: http://sweetcorn.nysipm.cornell.edu/, and the Penn State "Pest Watch" – regional map of WBC trap catches over time: *www.pestwatch.psu.edu/*.

Summary:

Western Bean cutworm populations are widespread across New York and have continued to increase annually. On average, relatively higher WBC counts have been observed in northern and western NY counties. The relatively undamaged wing condition of most moths captured indicates WBC populations are becoming locally established, while others continue to be migrants from other sources. To date there have been few reports from New York of economic damage caused by WBC to corn (sweet or field) or dry beans. However, increased incidence of WBC activity in some fields has been documented. In 2016 WBC larvae reportedly damaged organic sweet corn ears in areas with higher moth catches, such as in Erie County (3% damage) and in the St. Lawrence Valley this year *(Abby Seaman, NYS IPM Program)*. A 2016 WBC vs Corn Hybrid trial in Jefferson county documented Vip3A and Duracade field corn hybrids had 0% damage, while the VT Triple PRO hybrid had 18.0%, the CRY1F hybrid had 18.75% damage (Mike Hunter, personal communication).WBC pheromone trap monitoring efforts are planned for summer 2017

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Dewing, DeLisa Drum, Harry Fefee, Jennifer Fimbel, Aaron Gabriel, Jeffrey Gardner, Don Gasiewicz, John Gibbons, Ethan Grundberg, Mike Hunter, Amy Ivy, Joe Lawrence, Laura McDermott, **Carol MacNeil**, Sam Meigs, Stephanie Melancher, Sandy Menasha, Jeff Miller, Anne Mills, Eric Nixon, Kitty O'Neil, Teresa Rusinek, Erik Kocho-Schellenberg, Abby Seaman, Paul Stackowski, Mike Stanyard, Dan Steward, Crystal Stewart, **Ken Wise**, Glenn Yousey, **Marion Zuefle**, WNYCMA.

Literature Cited:

MacNeil, C., J. Gibbons and K. Waldron. 2016. 2016 REPORT: The Magnitude and Distribution of Western Bean Cutworm, and the Risk to Dry Beans. Summary *Report to New York State Dry Bean Industry Committee*

Hanson, A.A., R. D. Moon, R. J. Wright, T. E. Hunt and W. D. Hutchinson. 2015. Degree-Day Prediction Models for the Flight Phenology of Western Bean Cutworm (Lepidoptera: Noctuidae) Assessed with the Concordance Correlation Coefficient. J Econ. Entomol. 108(4): 1728-1738.

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For more information on WBC catches and distribution, please visit:
NYS IPM:

- Weekly Field Crop Pest Report: http://blogs.cornell.edu/ipmwpr/#
- Sweet Corn Pheromone Trap Network: http://sweetcorn.nysipm.cornell.edu/

Eastern NY Sweet Corn Monitoring Program: http://blogs.cornell.edu/jentsch/sweet-corn/

Pestwatch: Sweetcorn *IPM Visualization Tool*: www.pestwatch.psu.edu/sweetcorn/tool/tool.html

Penn State Field Crop News: http://extension.psu.edu/plants/crops/news

	6/12/16	6/19/16	6/26/16	7/3/16	7/10/16	7/17/16	7/24/16	7/31/16	8/7/16
Traps Reporting	**34**	**50**	**59**	**82**	**93**	**97**	**100**	**98**	**98**
WBC Total	**1**	**1**	**1**	**31**	**155**	**982**	**4155**	**7627**	**4720**
Avg WBC / Trap	**0.0**	**0.0**	**0.0**	**0.4**	**1.7**	**10.1**	**41.6**	**77.8**	**48.2**
"0" WBC	**33**	**49**	**58**	**64**	**55**	**24**	**10**	**7**	**12**
> 0 WBC	**1**	**1**	**1**	**18**	**38**	**73**	**90**	**91**	**86**
% Traps Catching	**2.9%**	**2.0%**	**1.7%**	**22.0%**	**40.9%**	**75.3%**	**90.0%**	**92.9%**	**87.8%**

	8/14/16	**8/21/16**	**8/28/16**	**9/4/16**	**9/11/16**	**9/18/16**	**End of Season Total**
Traps Reporting	**87**	**88**	**85**	**54**	**17**	**12**	**101**
WBC Total	**1156**	**411**	**162**	**60**	**10**	**4**	**19,476**
Avg WBC / Trap	**13.3**	**4.7**	**1.9**	**1.1**	**0.6**	**0.3**	**192.8**
"0" WBC	**18**	**34**	**51**	**32**	**12**	**11**	**3**
> 0 WBC	**69**	**54**	**34**	**22**	**5**	**1**	**98**
% Traps Catching	**79.3%**	**61.4%**	**40.0%**	**40.7%**	**29.4%**	**8.3%**	**97.0%**

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