

RUTGERS

New Jersey Agricultural
Experiment Station

Managing Sweet Corn Worm Pests with Newer Insecticides and Crop Technologies

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Primary Ear Infesting Insects

European corn borer (stalk too)

Corn earworm – We'll focus on this pest today

Fall armyworm (foliage too)

Secondary Ear Infesting Insects

Sap beetles

Corn leaf aphids (husks)

European corn borer:

Populations trending steeply downward with increased adoption of *B.t.* transgenic field corn in ag areas where other host crops are grown.

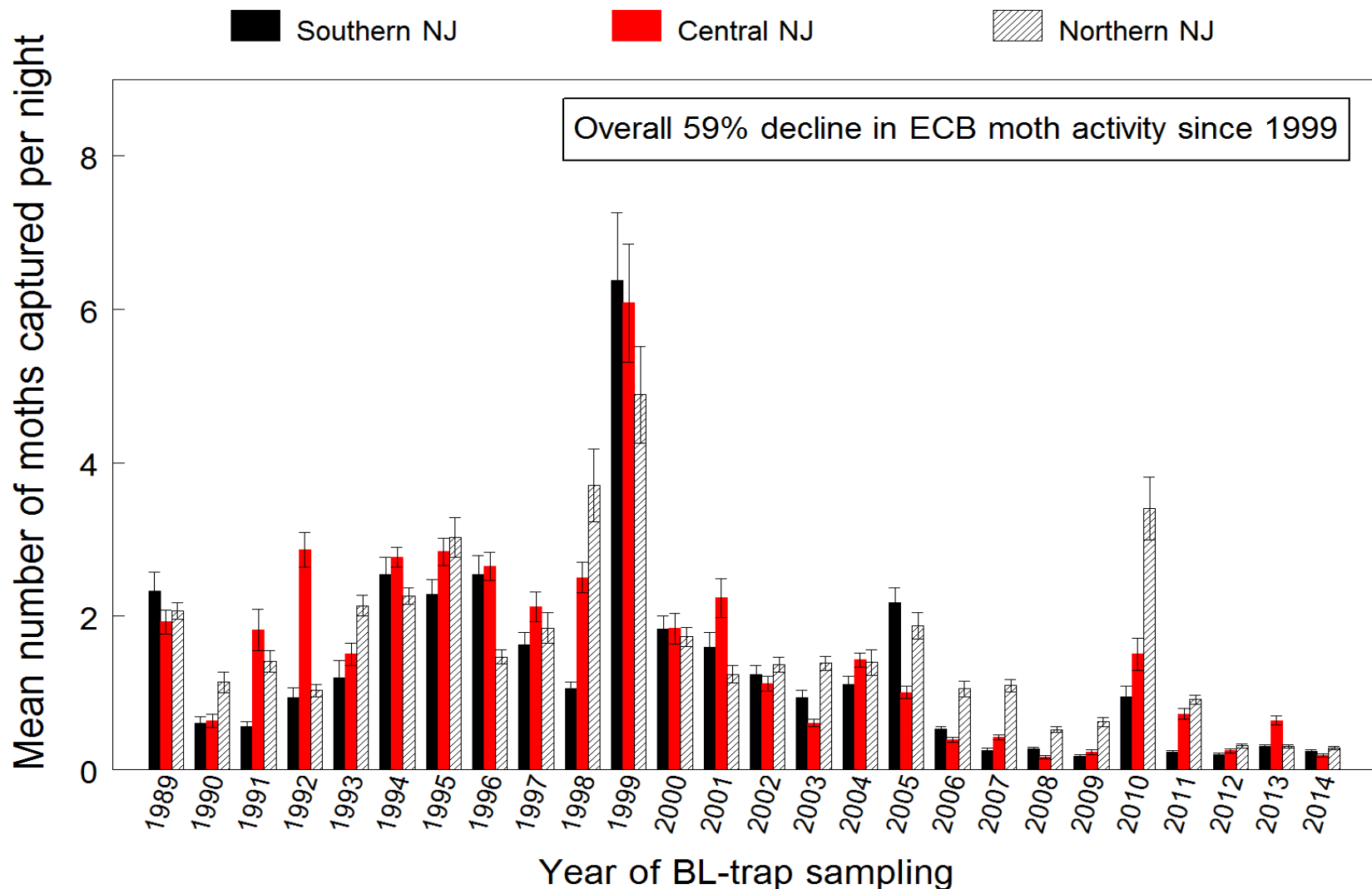
Goal – manage ECB larval population *in plants* prior to ear infestation.

Resistance/Other Issues: Not significant

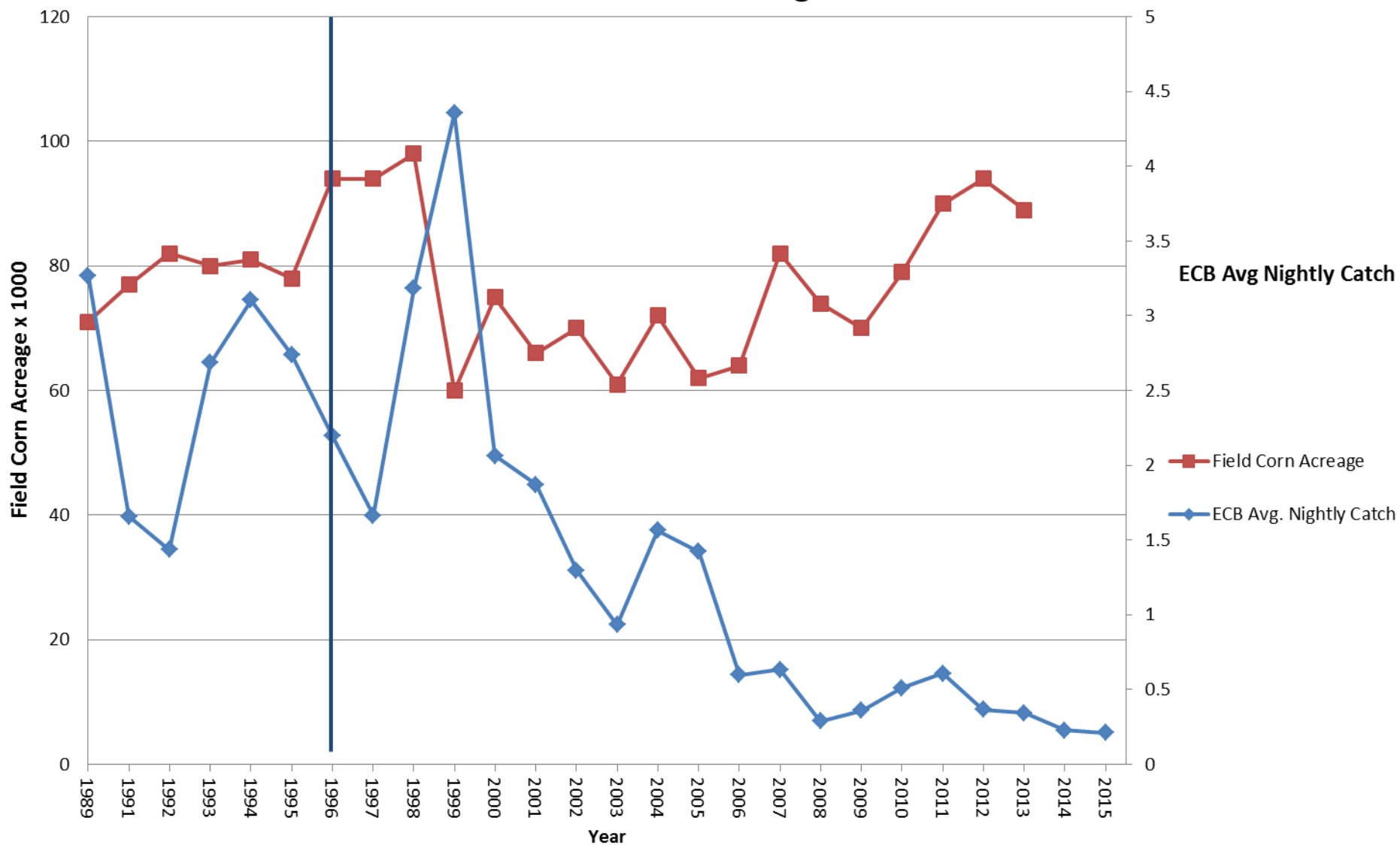
Adoption rates of *B.t.* transgenic field corn in NJ

Year	CRD	Tot. Acres	<i>B.t.</i> Acres	% Adoption
2006	North	35,200	16,815	48%
	Central	16,000	7,127	45%
	South	28,800	9,735	34%
2013	North	37,600	31,800	85%
	Central	17,700	13,700	78%
	South	30,600	22,100	72%

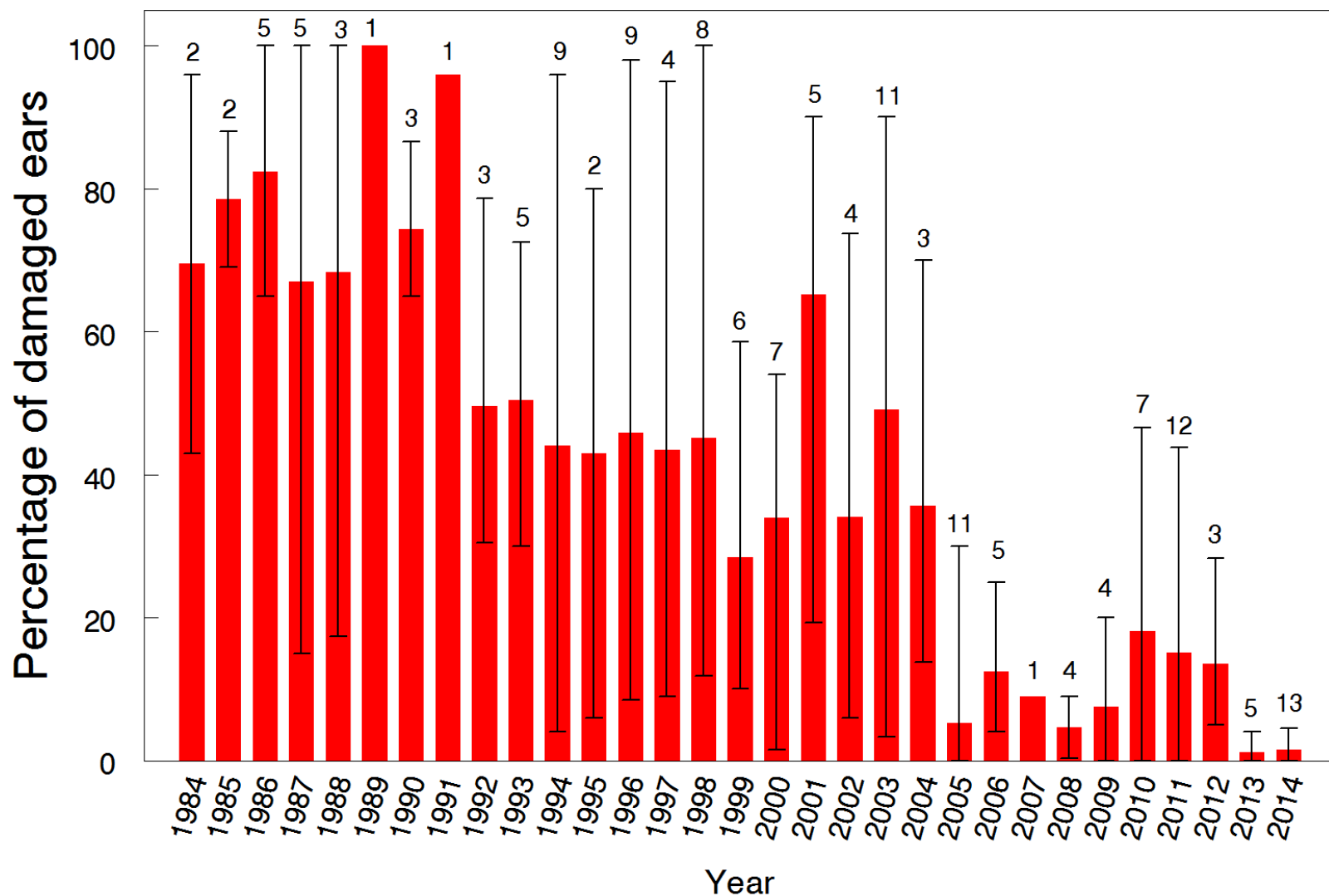
Declining ECB light trap catches



Adult ECB catch v. Field Corn Acreage in NJ



ECB damage trend in untreated sweet corn ears



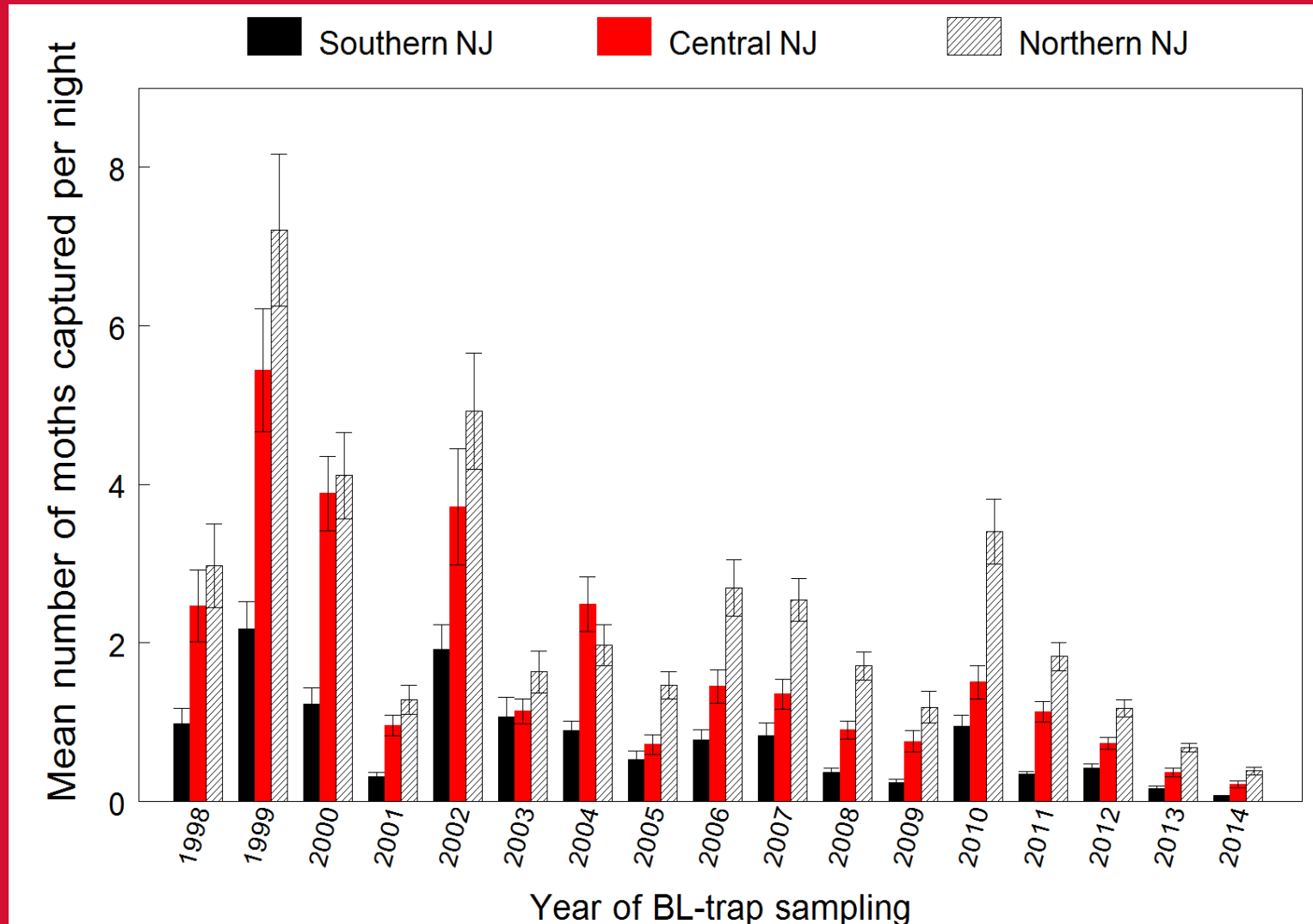
Corn earworm:

Populations also trending generally downward, but subject to uncertainty due to occasional overwintering success and late season migrations.

Goal – manage CEW larvae on silks between egg hatch and ear infestation.

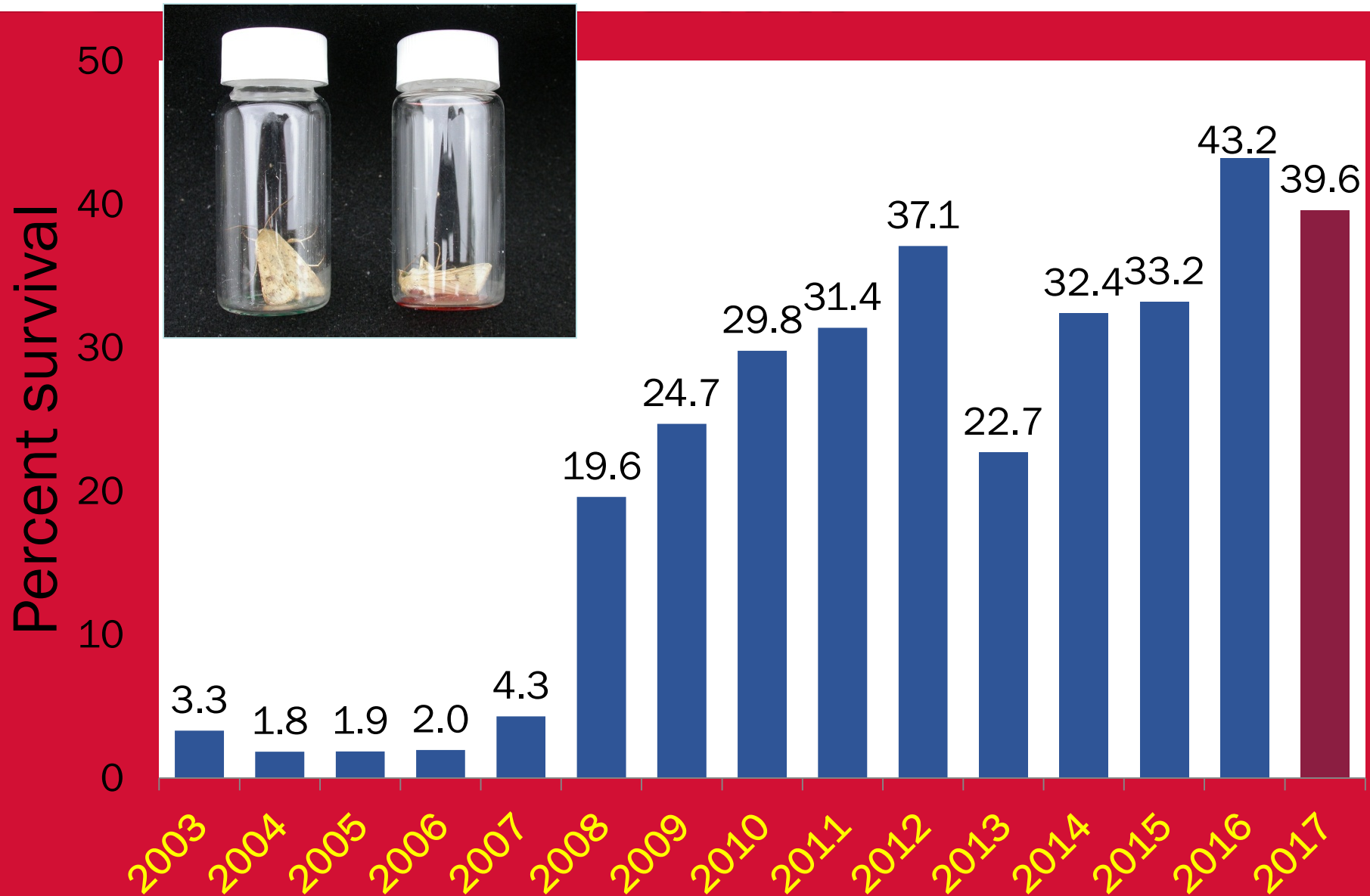
Resistance/Other Issues: Documented but variable resistance to pyrethroids and *B.t.* toxins. Insecticide applications **can** flare aphid populations.

Declining CEW light trap catches in NJ



Annual *H. zea* moth survival (5 μ g cypermethrin) in Suffolk, VA, 2003-2017.

Data: Ames Herbert, VaTech

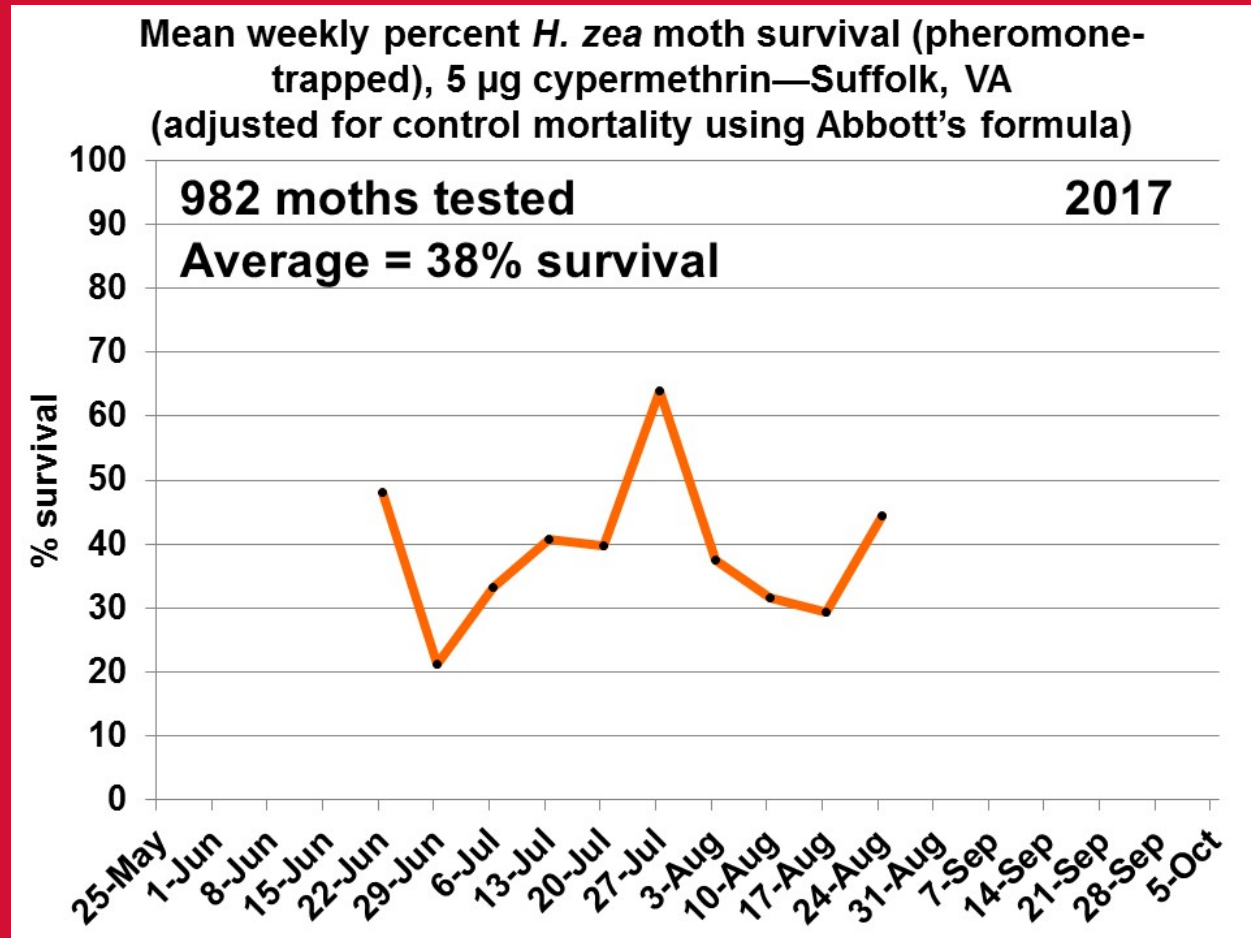


CEW individuals show fluctuating levels of resistance within a single season

Reminder:

Very difficult to predict when and how significant pyrethroid resistance will be in any given year!!

Better to include other chemistries in protection plan.



Data: Ames Herbert, VaTech

Insecticide Control of Corn Earworm

- ☐ Pyrethroids no longer provide enough ear protection.
- ☐ Necessary to switch or rotate to alternative products.
- ☐ Mixtures of Lannate plus a pyrethroid can help to circumvent the resistance problem and improve control of sap beetles and fall armyworms.
- ☐ Rotations and mixtures with different active ingredients, such as Coragen, Radiant, Blackhawk, Entrust, as well as premix products (i.e. Besiege, and Consero).
- ☐ Rotating pyrethroids with other insecticides in different mode-of-action classes helps to delay further resistance development (applied to the overwintering regions).

A little terminology, going forward:

IRAC group 28 = diamide insecticides
= Coragen, Besiege (component)

Besiege used to be called *Voliam Express

IRAC group 5 = spinosyn insecticides
= Radiant, Entrust, Blackhawk

Evaluation of insecticides rotated every other spray with Warrior II™ ZT (1.92 fl oz/A), Eastern Shore of VA, 2014
(7 sprays: Aug 4, 6, 8, 11, 13, 15, and 18)

Treatment	Rate / acre	% marketable* ears	% clean ears	No. larvae/25 ears
Untreated Control		83 a	12	28.0 a
Coragen 1.67SC	5 fl. oz (high)	97 bc	79	1.8 c
Besiege	10 fl. oz (high)	99 c	96	0.3 c
Blackhawk 36WG	3.2 oz (high)	89 ab	58	12.3 b

* Harvest August 19

Chlorantraniliprole (Coragen, Besiege component).....how does it work?

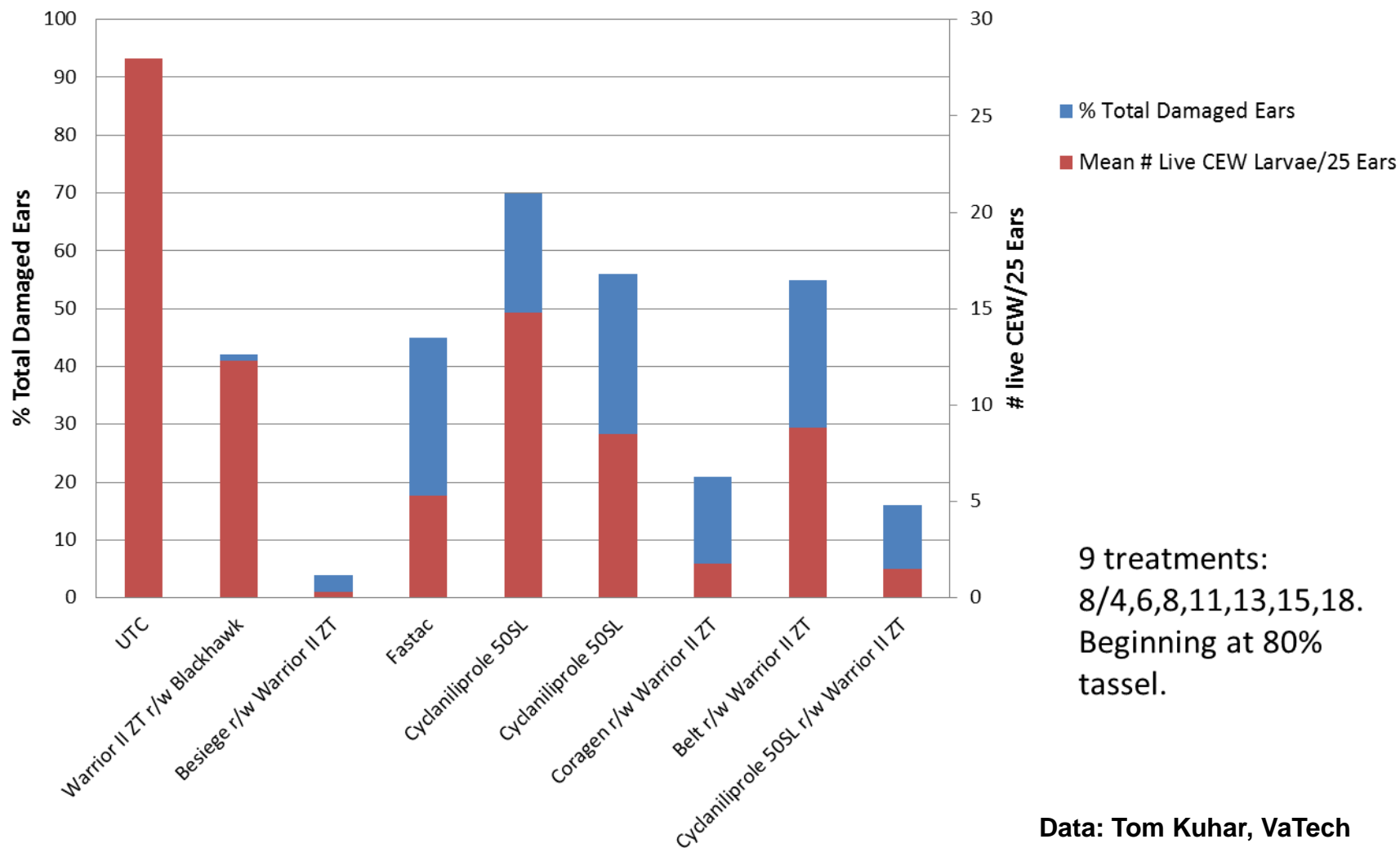
**....stimulates the release and depletion of intracellular calcium stores
....from muscle cells, causing impaired muscle regulation, paralysis and
ultimately death of sensitive species. (Cordova *et al.* 2006).**

When sprayed, Coragen 20 SC is systemic locally (translaminar activity); the active ingredient penetrates the cuticle/epidermis and gets into the mesophyll cells. Norwegian Sci. Comm. on Food Safety April 2010.

....chlorantraniliprole could penetrate in rice leaves and is transported for a short distance, moving to the stem or the leaf sheath of the treated leaves. ...it (chlorantraniliprole) could not be transported between leaves. (Chen, *et al.* 2015. Journal of Agricultural Science; Vol. 7, No. 12)

This means that you likely get some worm control through ingestion of tissue indirectly exposed to Coragen (ie. lower leaf surface when chemical contacted upper surface), but not through ingestion of unexposed tissue (ie. silks that emerged since last spray).

CEW Control, 2014 - Painter, VA



Laboratory bioassay: Field collected CEW larvae (7/27/17) from sorghum heads, Painter, VA. Sorghum heads dipped in field-rate insecticide concentrations.

Trt	Rate/A (20 gal/A water)	% dead CEW 24 h	% dead CEW 48 h	% sick CEW 24 h	% sick CEW 48 h	% total dead+sick 24 h	% total dead+sick 48 h
Besiege	10 fl oz	80.0	100.0	20.0	0.0	100.0	100.0
Exp.	-	40.0	70.0	60.0	30.0	100.0	100.0
Prevathon	14 fl oz	50.0	90.0	50.0	10.0	100.0	100.0
Warrior II	1.92 fl oz	40.0	70.0	40.0	20.0	80.0	90.0
UTC		0.0	0.0	0.0	0.0	0.0	0.0

This study demonstrates a level of field resistance to λ -cyhalothrin (Warrior), that is overcome with the addition of chlorantraniliprole (Besiege). Chlorantraniliprole alone (Prevathon) also effective but somewhat slower acting.

Data from Tom Kuhar - VaTech

Considerations for CEW management in the Mid-Atlantic Region

Standard pyrethroids – lambda cyhalothrin (Warrior, etc.), bifenthrin (Sniper, etc.) can still work **BUT** subject to variability in population resistance during the course of a season. Control is unpredictable. Issues with aphid control if used exclusively.

Lannate - still good on CEW. Aphid control is variable to our south. Still good here, but spray interval and other rotation products influence control.

CEW Considerations cont'd

Diamide products – (Coragen) generally very good. Very safe for beneficial insects, so they conserve aphid enemies.

Diamide/pyrethroid combo (Besiege) is very good on CEW, but use disrupts beneficials and thus can cause aphid problems.

Spinosyn products – generally very good. Radiant has less variability in some trials than Blackhawk. Contact toxicity to bees and parasitic wasps.

Fall Armyworm

Populations highly variable in NJ, both in timing of arrival and in intensity. 2017 was a moderate year.

Goal- Prevent unacceptable injury to immature corn plants, **AND** prevent FAW larvae from entering ears. Control on immature plants is based on scouting results. Expect that CEW silk spray schedule will prevent ear damage from FAW.

Resistance/other issues- **Significant** resistance to pyrethroid insecticides.

Realistic control of FAW must include:

Diamide products: Coragen (alone or in combination with pyrethroid (Besiege)).

Spynosyn based products: Radiant, Entrust, Blackhawk alone or in combination with g-cyhalothrin (Consero).

Lannate: Still providing good control in NJ. High spray volume offers best control.

Avaunt: Good control, but not for use after pre-tassel

Next - CEW resistance to transgenic sweet corn!

2017 sites and harvest dates for *B.t.* sentinel sweet corn plots :

Riverhead, NY – 9/11/17

Geneva, NY – 9/27/17

Pittstown, NJ – 8/28/17

Upper Deerfield, NJ – 9/7/17

Cottageville, WV – 9/7/17

Upper Marlboro, MD – 9/13,28/17

Wye River, MD – 9/6/17

Beltsville, MD – 7/14, 8/18,30, 9/26/17

Sudlersville, MD – 8/31/17

Georgetown, DE – 9/12/17

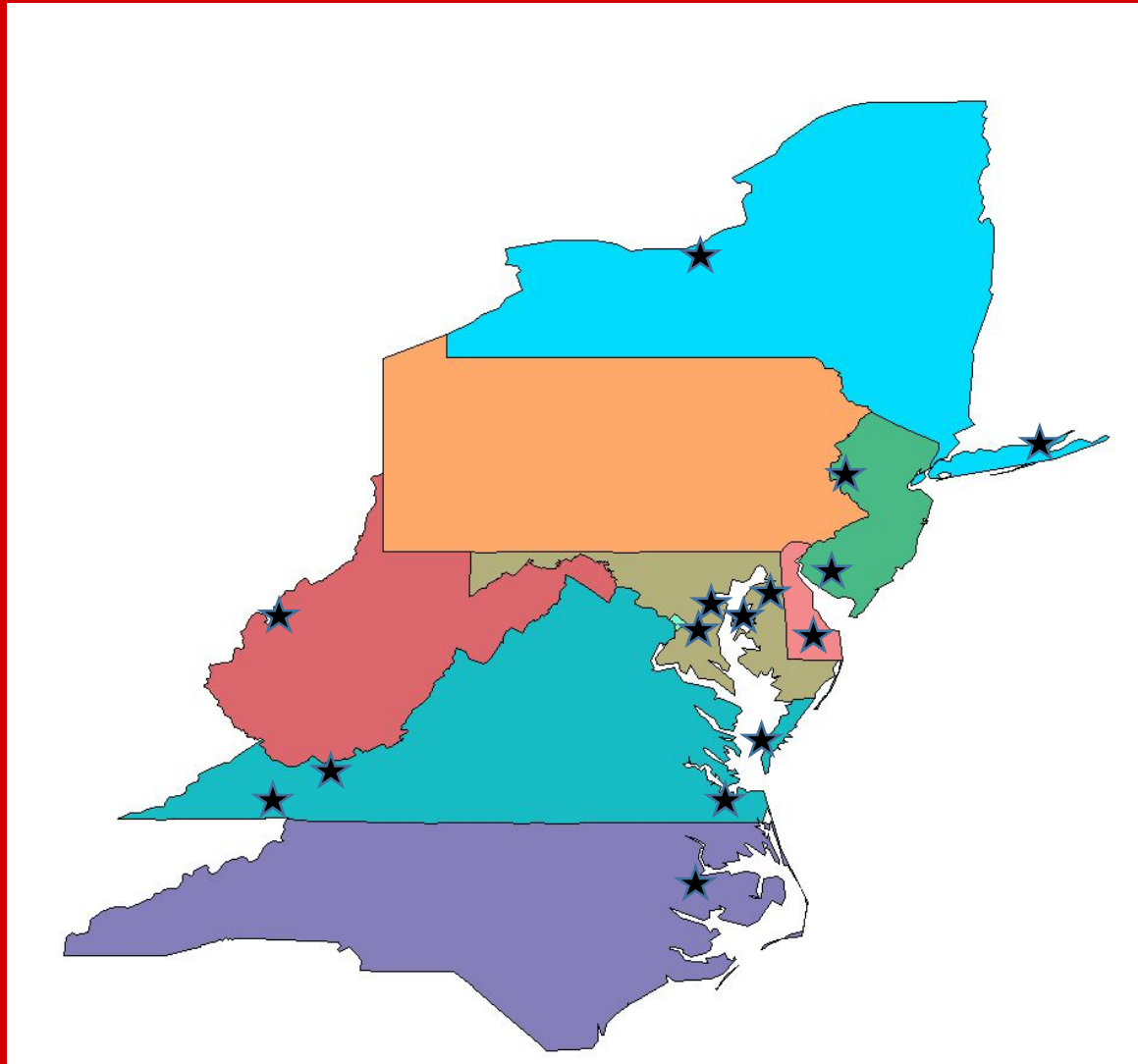
Abingdon, VA – 8/24/17

Suffolk, VA – 9/5/17

Whitethorne, VA – 9/5/17

Painter, VA – 9/5/17

Plymouth, NC – 7/18/17



B.t. and stacked B.t. hybrids used in study:

Syngenta Seeds:

Attribute hybrids (expressing Cry1Ab, event Bt11)

‘BC0805’ (non-B.t. analog – ‘Providence’)

Attribute II hybrids (expressing Cry1Ab and Vip3A, event MIR162)

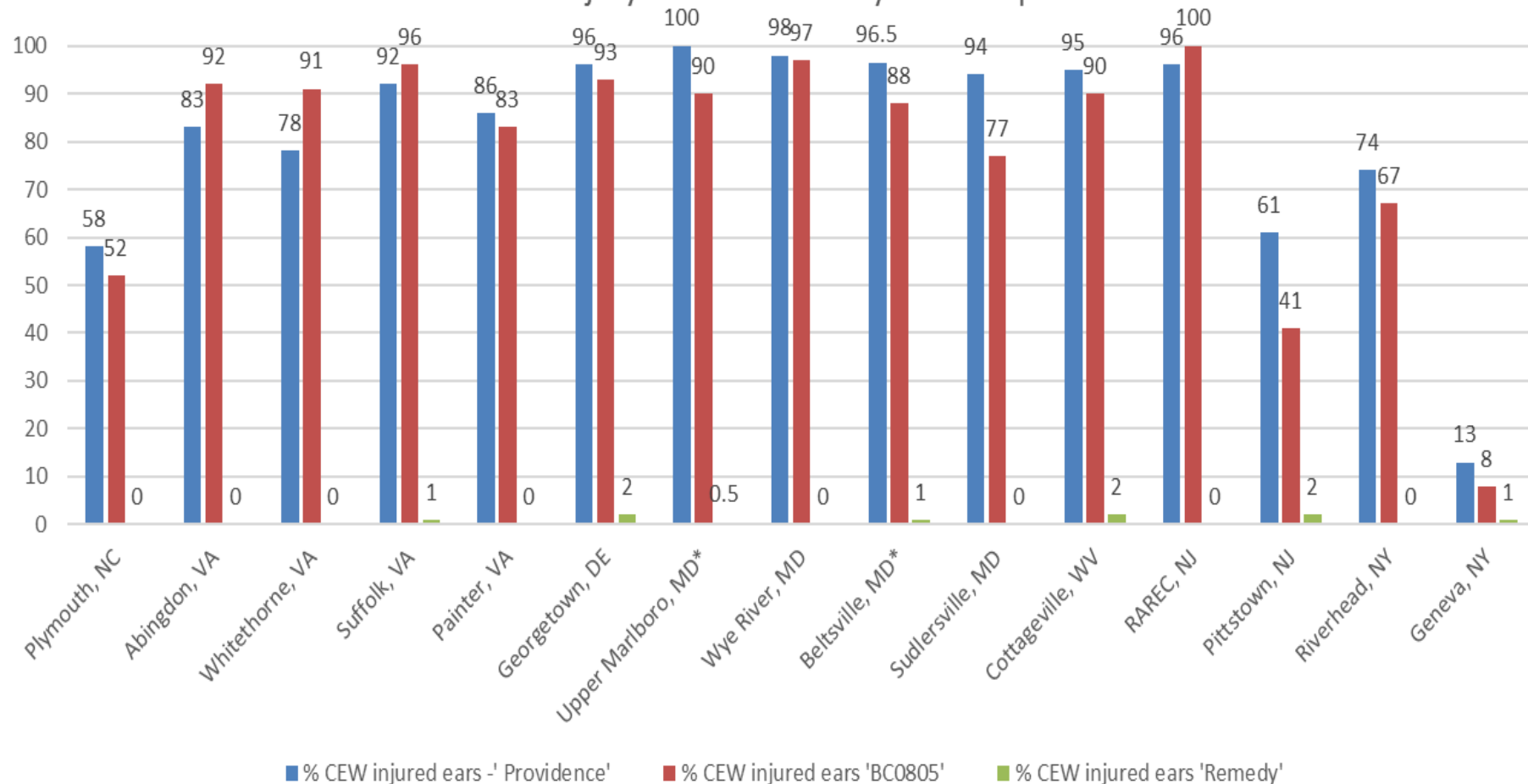
‘Remedy’ (non-B.t. analog – ‘Providence’)

Seminis Seeds (Monsanto):

Performance Series hybrids (expressing the Cry1A.105 and Cry2Ab2, event MON89034)

‘Obsession II’ (non-B.t. analog – ‘Obsession I’)

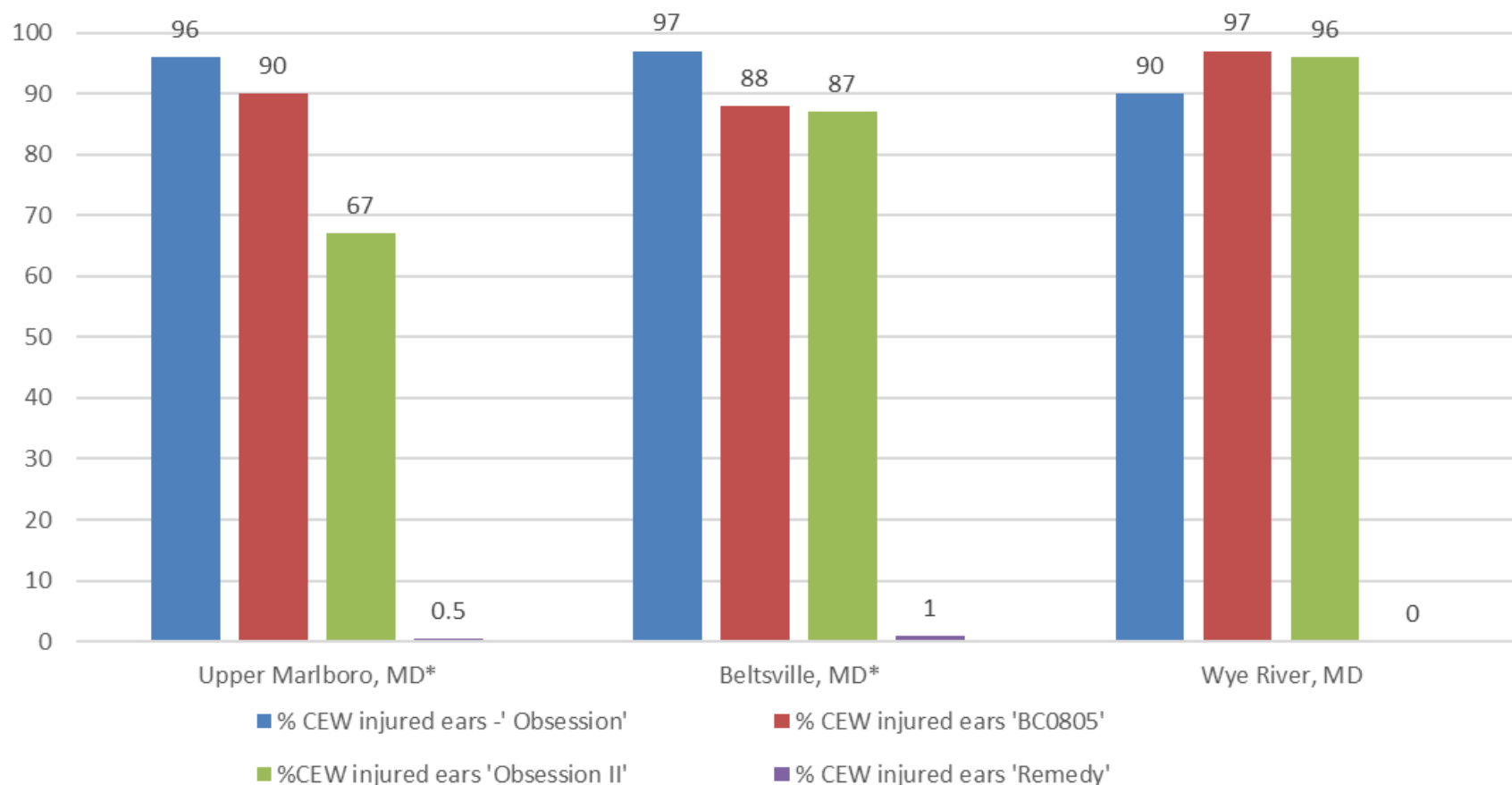
Relative CEW injury in non-B.t. vs Cry1Ab vs Vip 3A isolines



All sites included Providence and Attribute I and II isolines.

*** = average of more than one trial.**

Relative CEW injury in non-Bt vs Cry 1A vs Cry1A/2Ab vs Vip 3A varieties



A Performance Series Hybrid was also included at several of the MD sites. * = average of more than one trial.

Considerations when using *B.t.* transgenic hybrids

Attribute Series – Syngenta (*Providence, Avalon, etc.*)

Attribute II – Syngenta (*Remedy, Milky Way, others*)

Performance Series– Seminis (*Obsession II, Temptation II, Passion II, 9010SA*)

None will control aphids, sap beetles or BMSB.

Excellent control of ECB. Poor to very good control of CEW, dependent on type. Performance Series and Attribute II offer good of FAW control.

It is critical to know the population pressure of CEW and FAW. **Continued.....**



- ❑ Larvae have a better chance to survive in the ear, because not all kernels express *Bt* protein (75% in Attribute I and Performance, 93.5% in Attribute II).
- ❑ More damage is likely to occur under high insect pressure and in hybrids lacking good tip cover. More moths = more larvae = more opportunity.
- ❑ Some surviving larvae become sick and do not develop or feed normally; but can be present in the ears. Resistant individuals have reduced reproductive ability, but are very tolerant of Cry toxins. Vip3a toxin still strong for CEW.
- ❑ For late plantings, two or more insecticide sprays may be needed in Attribute I and Performance Series corn to prevent ear damage from exceeding fresh market standards.

Final Thoughts

B.t. If you choose to plant corn with Cry1A, you will not have ECB issues at any stage. However, you may have to manage FAW in the whorl, and will have to treat for CEW during the silk period much as you would with non-Bt corn.

If you choose to plant corn with Cry1A and Cry2Ab2 toxins (also herbicide resistant), you will not need to manage worm pests prior to silking, but you will need to treat for CEW during the silk period. Some reduction in silk sprays may be achieved, but timing becomes extremely critical.

If you choose to plant corn that includes the Vip3A trait, you will not need to manage worm pests **AS OF THIS SEASON!**

Non - B.t. Consistent CEW and FAW control should include diamide insecticides (the combo product Besiege is often among best), or spinosyns like Radiant. Lannate works well. Do not rely exclusively on pyrethroids.

If you want to reduce sprays - Follow IPM trap recommendations!

Questions??

