



The Bug Report!

***Aphid Alert II & Colorado Potato Beetle
Resistance Trials – 2014
NPPGA & Area II Research Reports 2013***

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Aphid Alert II

- Re-establishment of suction trap network run 1998-2003 in MN, ND, MB
- Grower cooperators tend trap through summer, sending in weekly catch which we identify



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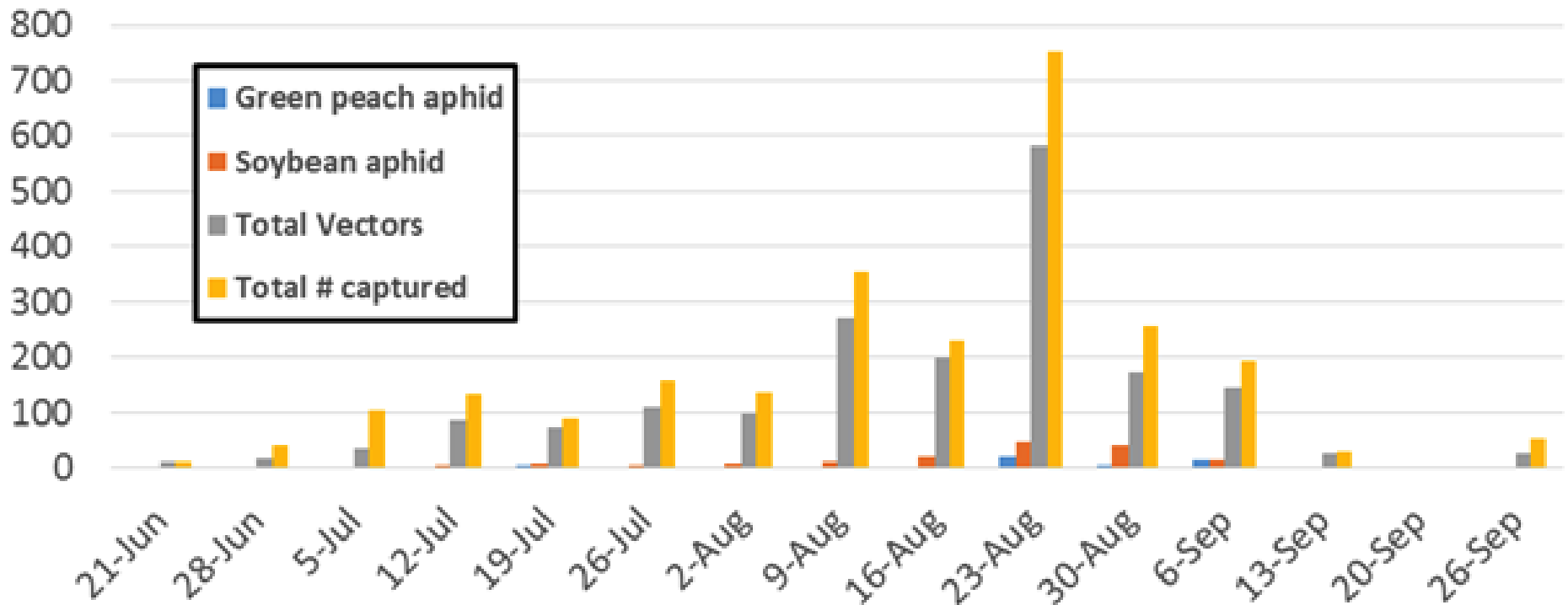


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Low GPA / SBA

Aphids Collected Weekly in the AphidAlert Trapping Network

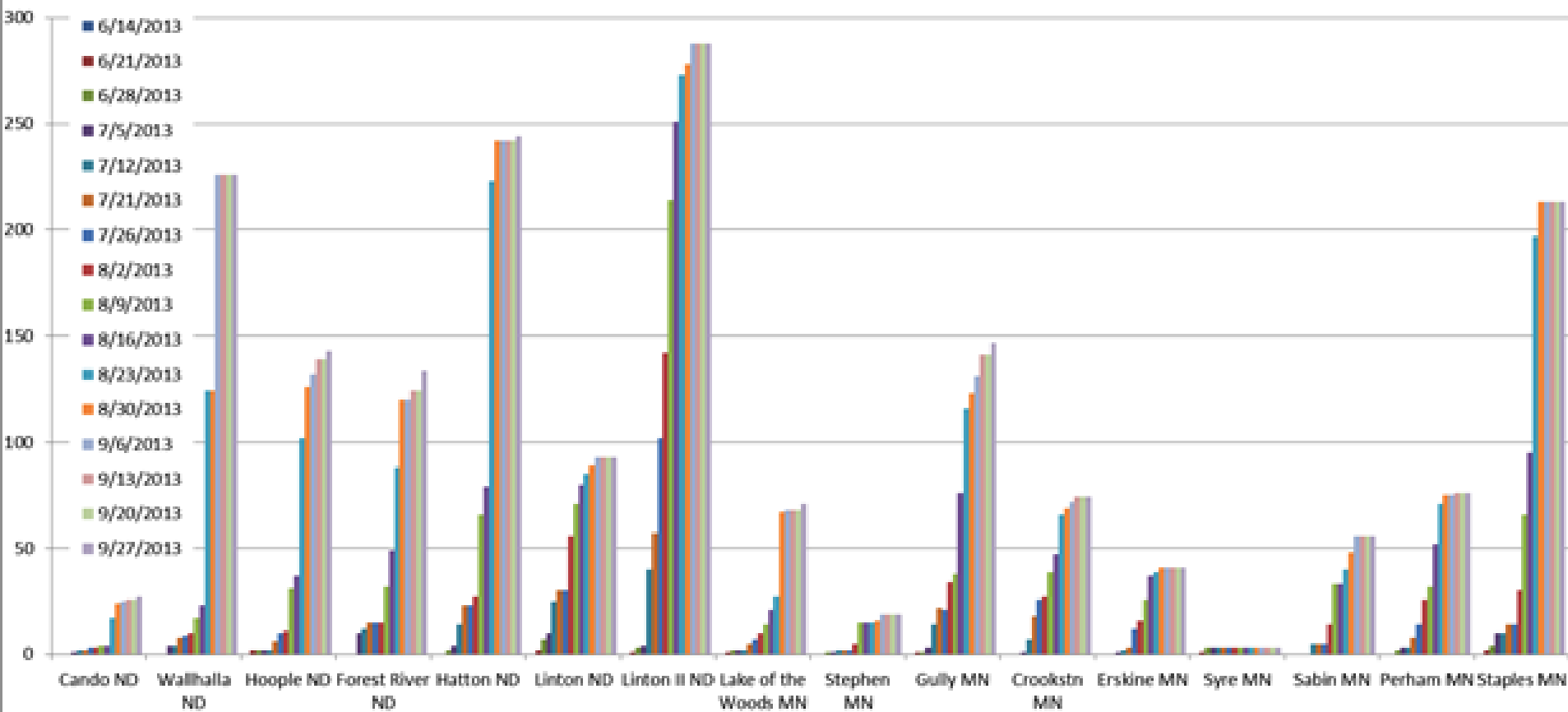


Aphid Species Captured - Entire Season (aphids/trap)

	Cando ND	Wallhalla ND	Hoople ND	Forest River ND	Hatton ND	Linton ND	Linton II ND	Lake of the Woods MN	Stephen MN	Crookstn Gully MN	Erskine MN	Syre MN	Sabin MN	Perham MN	Staples MN	
Green peach aphid	0	8	1	3	1	0	4	0	0	0	1	0	0	0	1	1
Soybean aphid	0	5	1	6	9	2	10	2	1	2	21	0	0	0	5	23
Bird cherry oat aphid	2	13	14	11	6	10	31	1	0	23	5	5	0	6	2	27
Corn leaf aphid	0	9	0	0	1	6	10	3	0	2	0	2	0	0	1	2
English grain aphid	0	22	13	16	7	27	100	4	3	6	17	14	0	15	21	28
Green bug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potato aphid	0	1	0	20	3	4	11	1	0	13	1	5	0	0	4	2
Sunflower aphid	0	14	0	1	2	2	8	0	2	1	3	3	0	0	1	18
Thistle aphid	1	1	0	1	2	0	9	0	0	5	1	0	0	0	0	0
Turnip aphid	0	0	0	1	0	1	2	0	0	6	0	0	1	0	1	3
Cotton/melon aphid	0	14	1	7	3	6	24	5	0	6	4	1	0	2	9	51
Pea aphid	0	3	1	3	0	8	11	2	5	3	2	1	0	3	0	2
Cowpea aphid	0	2	5	6	21	8	18	7	4	5	1	1	2	2	4	15
black bean aphid	1	3	1	13	16	6	9	1	0	3	4	5	0	7	2	3
Buckthorn aphid	0	29	0	0	6	0	3	1	0	1	6	2	0	5	1	38
Non-vectored species	2	50	20	51	37	28	99	16	6	32	19	17	1	14	5	21
No ID'd	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0
Total # captured	6	174	57	120	146	108	250	42	24	108	85	56	4	54	57	224
Total Vectors	4	124	37	88	79	80	251	27	15	76	66	39	3	40	52	213



Cumulative weekly catch



PVY

- Non-persistent virus
 - Aphid acquires virus in seconds
 - Can then transmit in seconds
 - Some species may remain infectious but most clean mouthparts on the first uninfected plant but can quickly re-acquire from another infected plant
 - Because transmission time is so short, can't be adequately controlled with traditional insecticides
 - Vectored principally by winged aphids moving plant to plant



Tactics developed over past 20 yrs...

- Steps to lower inoculum
- Vector control
 - Timed insecticide
 - Crop oils
 - Border crops
 - Targeted border applications





Hey! I seem to be attracted to that edge!

Aphids attracted to edge of field when colonizing
- Probably function of contrast in reflected light



Crop oils – refined mineral oils

- E.g. Aphoil, JMS Stylet Oil, etc.
- Mineral oils reduce PVY transmission efficiency by 73% in trials
- Oil treatment of the source plant or both the source and test plant proved even more effective in reducing virus transmission efficiency.
 - Maybe inhibitory amount of oil particles are carried over on aphid mouthparts during subsequent feeding events
- Exact mode of action unknown but appears to be a complex contact-based action.
 - Complete & uniform coverage of the leaf surface with oil is essential with 5-7 day re-application to cover new growth (so timing is necessary)
 - Aphoil 2%-4% v/v, JMS Stylet Oil 0.75%-1.5% v/v in 30-60g/ac



Border crops

The attraction of canopy and adjacent bare soil has been used in an effective control tactic. Planting non-PVY host plants (small grains such as rye, or soybeans) as border crops around small seed lots serves 2 purposes:

- Eliminates comparative difference between bare soil and green canopy
- Provides a ‘clean’ plant on which aphids that are arriving infective can clean off virus from their mouthparts



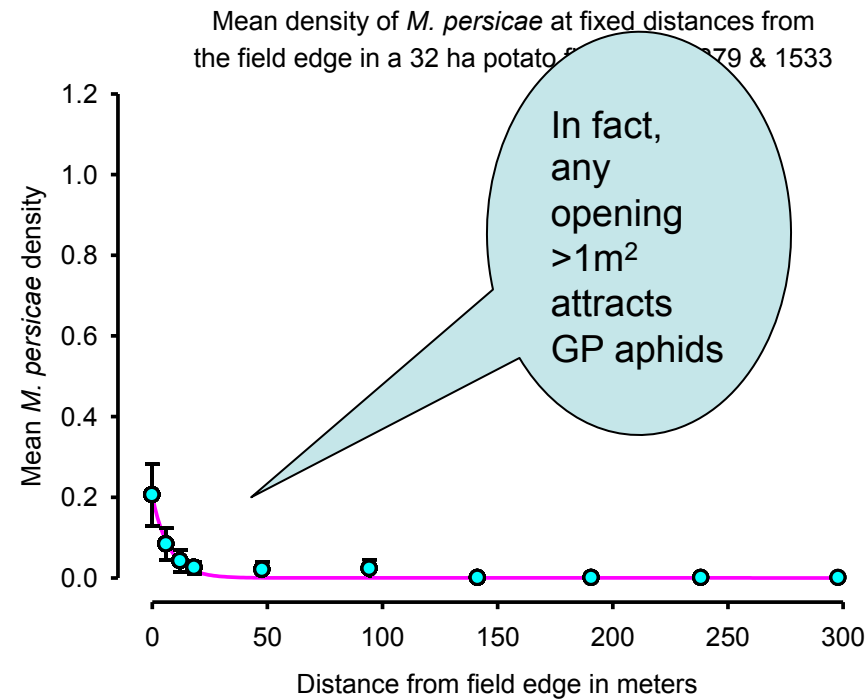
Border crop

- Easy to implement
- Expanded to include any open area in the field (alleys, variety separation, etc)



Aphid colonization

- Green peach aphid and other vectors tend to first colonize the field edge (next to bare soil) and settle for 7-10 days prior to dispersing across the field
- Provides opportunity for targeted border applications to control aphid vectors
 - Practice used by a number of seed producers



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What's old is new again – a lot of the same techniques still have merit...

There are three key IPM principals for managing PVY -

1) Reduce the level of initial PVY inoculum in the crop. *incidence* in the disease epidemic, in other words, *fewer infected plants* occurs because the start of the epidemic is delayed by slowing or eliminating the appearance of the first PVY-infected plants in the field.

2) Use resistant cultivars. These can minimize or prevent the disease epidemic in a number of ways, including

- *reducing final disease incidence*, mainly by delaying the start because plants are slow to become infected,
- *slowing the rate of the disease epidemic*, the number of infected plants over time in the field, mainly by disrupting PVY's ability to replicate and then be spread,
- *masking the disease epidemic*, by growing and yielding normally despite being infected, or
- combinations of the above.

3) Reduce on-farm spread of PVY by aphids. This slows the rate of *infection* in other words *fewer of infected plants over time* in the field, mainly by interfering with the PVY passed to healthy plants by aphids. This results in fewer infected plants at harvest and improved yield.

- #1 Plant certified seed!
- Practice sanitation
- Destroy overwintering sources of PVY
- Rogue volunteers early

- Tolerance
- Resistance
- immunity

- Chemicals
- Field placement, mgmt, & design
- Destroy sources of PVY & aphids

- From potatovirus.com – a U.S. federally funded effort to stem the nationwide PVY epidemic



What works, what might not...

- Crop borders but it's important to remember these don't help with within field movement of existing inoculum
- Crop oils – time application prior to arrival of aphids (or first colonizers *at very latest!* So timing very important)
- Border treatments (originally only recommended for PLRV but adapted by some for PVY) may work but be less effective years when **lots** of soybean aphid in the mix, SBA spends so little time at the edge



Insecticides: limit spread of PVY

- Systemics, like Admire Pro and Movento (Spirotetramet, Bayer) have both been shown to limit PVY transmission
- Fulfill (Pymetrozine, Syngenta Crop Protection), Beleaf[®] (Flonicamid) –anti-feedant properties and stop probing
- Still must know when aphids colonizing fields
 - Monitoring of not only potato fields but knowledge of what local soybean aphid populations are doing





Aphid Alert II – can provide info on what aphids are flying, when and where.

Check out:

aphidalert.blogspot.com



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Poster Child for Insecticide Resistance



Adults overwinter in:

1. Shelter belts
2. Previous year's potato fields

Colonize fields:

1. Field edges near overwintering sites
2. Rarely fly into first fields first of season
3. Fields located > 1 mi from last year – colonized late

Determining adult age:

1. Overwintering adults, hind wings (membranous) are reddish
2. Newly emerged adults (F_1), hind wings are clear



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**A week late = 50%
yield loss**



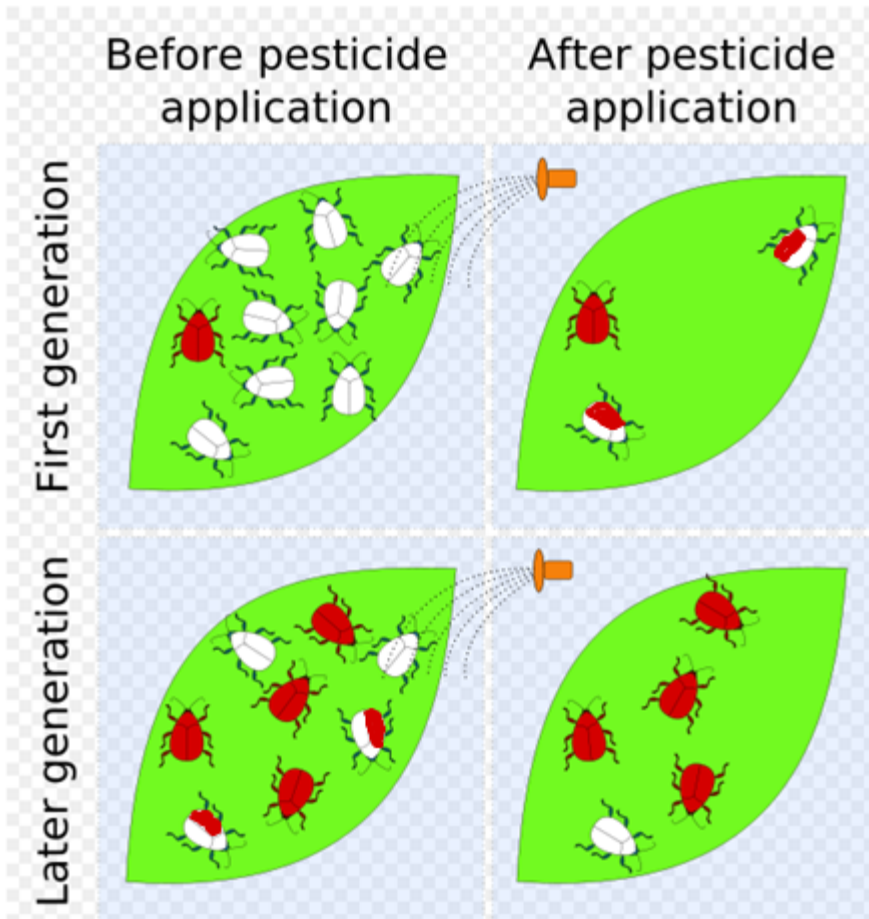
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- Insecticide resistance has long been a consideration in potato production
- Becoming even more important
 - Colorado potato beetle still developing resistance to everything we throw at it
 - New disease vectors (i.e. potato psyllids) strong candidates for developing insecticide resistance
 - Old disease vectors (aphids!) also have characteristics making them candidates for developing resistance (i.e. aphid vectors of PVY)
- CPB an ideal model for the system



Development of resistance



http://en.wikipedia.org/wiki/Pesticide_resistance

- Same concept with resistance. Resistant genes (R) and susceptible genes (S). Original R gene frequencies rare (10^{-3} to 10^{-6}).
- At the outset, most individuals are SS (susceptible), some RS (partially resistant), very, very few (probably none!) are RR (fully resistant)
- Spray insecticide, kill off SS; RS left to reproduce
- Spray again, SS selected out again, RS (fewer) and RR left to reproduce. Now, some of the mating couples will be RS x RR – Mendel says... $\frac{1}{2}$ RR, $\frac{1}{2}$ RS
- Continues with increasing % of population being RR



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Detecting resistance

- Sampling larvae and adults and exposing them to varying rates of insecticide
 - Current project with samples of adults beetles
- Drop trials
 - Deliver 1 μ mixed formulation to 10 adult beetles each, varying concentrations (1X through 100X field rate)
 - Beetles in petrie plates
 - Replicated 4 times
 - Check CPB 24H, & 7d after
 - Mortality assessed & LD₅₀ calc.

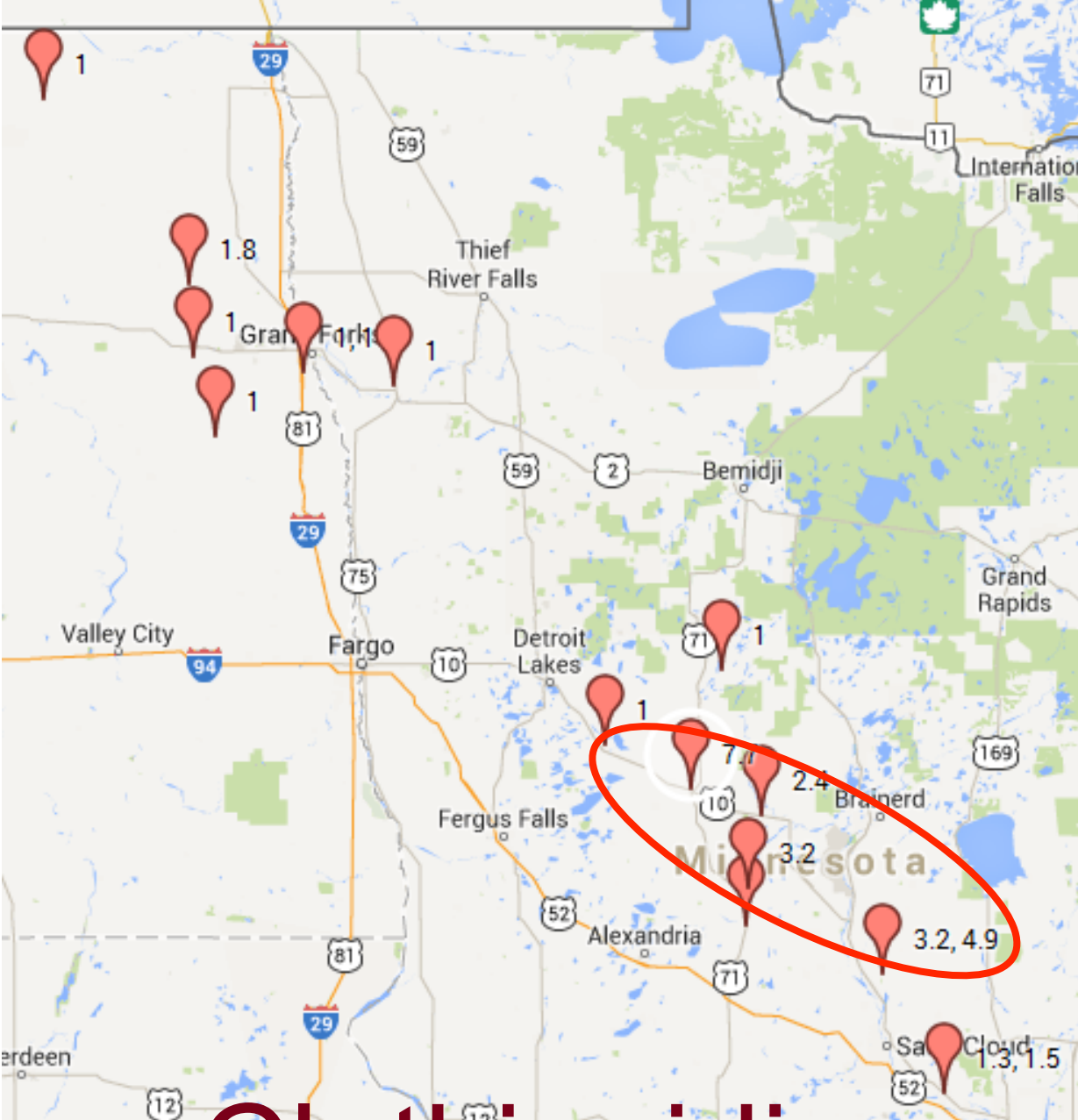


Resistance ratios

2011	Imidacloprid (Admire)	Thiomethoxam (Cruiser)	Clothianidin (Belay)
Becker	4	1.3	<i>NT</i>
Long Prairie	3.5	2.4	<i>NT</i>
Perham	8	2.5	<i>NT</i>
Crookston	1	1	
2012	Imidacloprid (Admire)	Thiomethoxam (Cruiser)	Clothianidin (Belay)
Becker	4.1	1.9	1
Browerville2	10.5	1.7	3.2
Browerville1	1.4	1	1
Hubbard	1	1	1
Hatton	1.6	1	1
Rice	1.5	<i>NT</i>	3.2
Perham	5.5	1.9	1
wadena	4.5	1.4	7.7
Grand Forks	3.8	1	1
Forest River	2.5	1.1	1.1

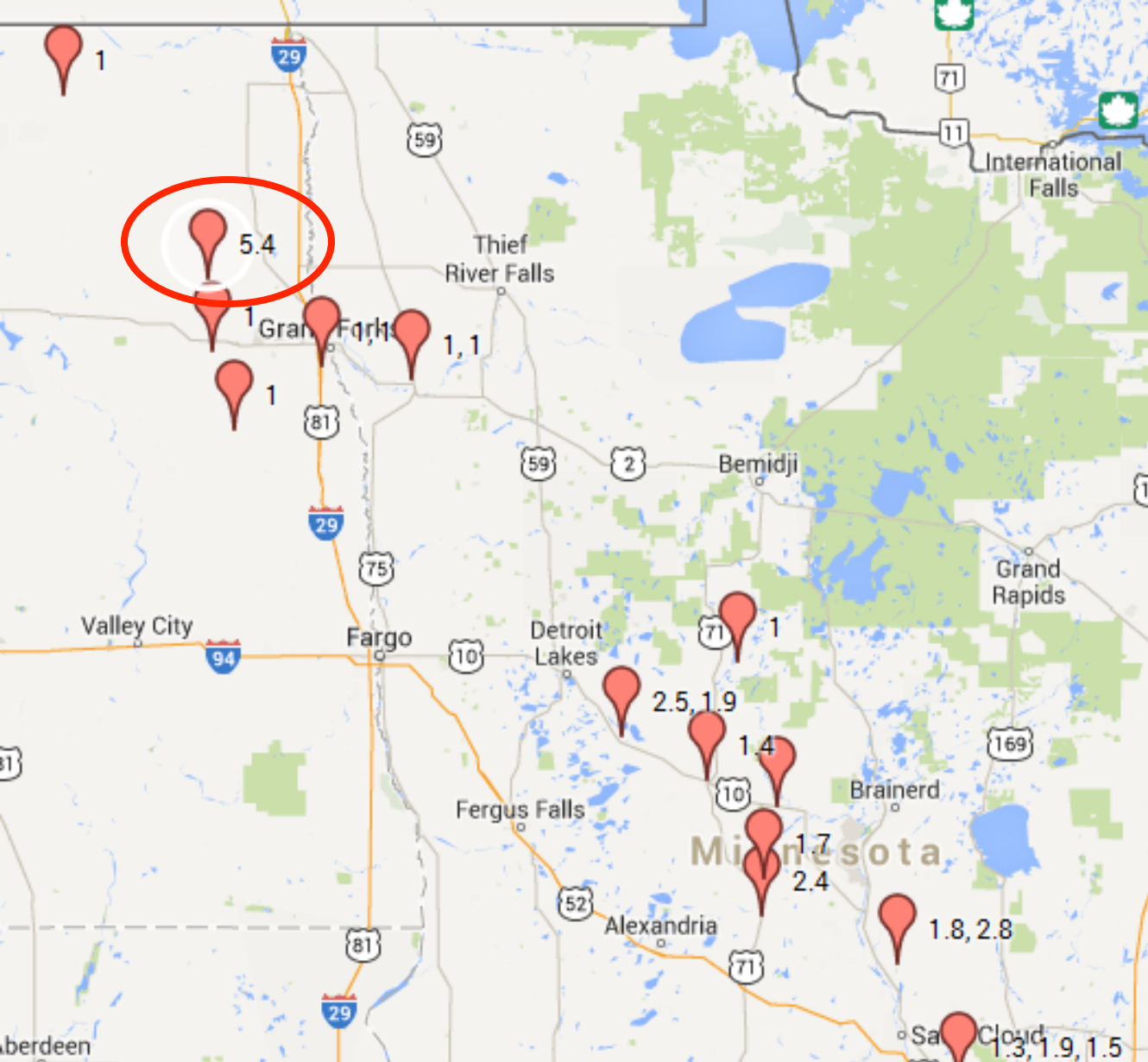
2013	Imidacloprid (Admire)	Thiomethoxam (Cruiser)	Clothianidin (Belay)
Becker	3.9	1.5	1.3
Rice2	4.8	2.8	4.9
Rice1	<i>NT</i>	1.8	1.9
Staples	1.7	<i>NT</i>	2.4
Crookston	1	1	1
Forest River	2	<i>NT</i>	<i>NT</i>
Langdon	1.1	1	1
Larimore	3.5	1	1
Inkster	1	5.4	1.8
Grand Forks	4.1	1	1

Generally considered: **susceptible** = 0X-3X, **minor** = 3X-5X, **low** = 5X to 10X, **medium** = 10X-40X, **high** = 40X-160X, **extremely high** >160X). Shen JL and Wu YD, *Insecticide Resistance in Cotton Bollworm and its Management* (in Chinese). China Agricultural Press, Beijing, China, pp. 259–280 (1995).



Central MN, no reports Red River Valley

Clothianidin



Red River Valley, some sites of concern in Central MN but tested populations still susceptible

Thiomethoxam

Managing insecticide resistance

- Reduce selection pressure – rotate modes of action
- Don't follow at-plant application with a foliar of the same moa
 - E.g. if you've used Admire Pro as a seed treatment with a foliar of Actara, Leverage, Provado or any other of the same season (including edge sprays...)
 - Examine label for moa group
- Same with foliar applications (e.g. *Spinetoram* (& others))
 - *Anthranilic Diamides* (*Spinetoram*, *Chlorantraniliprole* & *Coragen* ai= rynaxypyr, MOA group 28)
 - *Chitinase Inhibitors* (interferes with formation of exoskeleton)
 - *Spinetoram*, *Chlorantraniliprole*, *Spinetoram*, MOA grp 5)
 - *Secondary muscle contraction, tremors, prostration, eventual paralysis (caution with bees)*
 - *Benzoxazinoides* (*Rimon*, ai=novaluron, MOA grp 15)
 - *Growth regulator, needs good timing (target 1st & 2nd instar larvae)*

Look for the MOA group on the label!





PROTM ADP PROTECTANT

Net Contents:

1 GAL. 12 OZ. (140 FL. OZ.)

For uses in pest management and of plant health.

ACTIVE INGREDIENT:

Imidacloprid, 1-[(6-Chloro-3-pyridinyl)methyl] N-nitro-2-imidazolidinimine
OTHER INGREDIENTS:

EPA Reg. No. 264-827

Contains 4.6 pounds of active ingredient per gallon or 550 grams AI/liter.

SHAKE WELL BEFORE USING

**STOP - Read the label before use
KEEP OUT OF REACH**

For **MEDICAL** And **TRANSPORTATION** Emergencies
ONLY Call 24 Hours A Day 1-800-334-7577
For **PRODUCT USE** Information Call
1-866-99BAYER (1-866-992-2937)

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GROUP 4A INSECTICIDE

Don't follow a mode of action number with the same number – use a different moa number



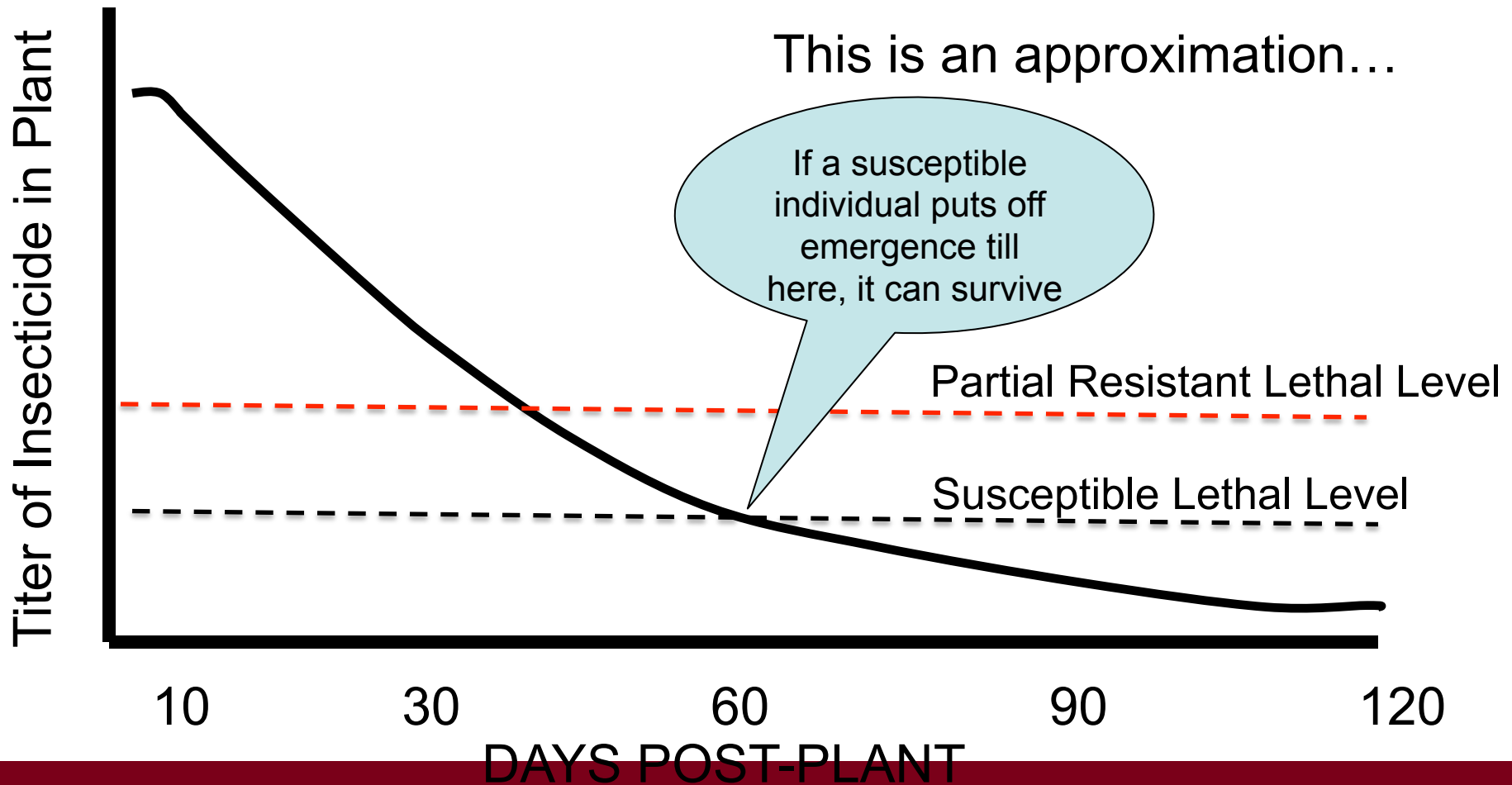
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IRM Tactics

- Reduce selection pressure – foliar thresholds
- Regardless of seed treatment, season long suppression no longer expected
- Remember thresholds for CPB damage
 - Emergence to bloom - 20% defoliation
 - Bloom to 50% leaf yellow – 30% defoliation



Neonicitinoid seed treatments





Special note – behavioral resistance

- First reported in WI
 - CPB adults have protracted diapause (overwintering), emerge later when titer of insecticide lower in the plant
 - Seems to have been observed in MN with overwintering adults being collected well into the summer





Our sincere thanks to the cooperators on *Aphid Alert II* and all those who sent us Colorado Potato Beetles to test and to the Northern Plains Potato Growers and Area II Potato Growers Associations for funding these projects.



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