The Bug Report!

Aphid Alert II & Colorado Potato Beetle Resistance Trials – 2014

NPPGA & Area II Research Reports 2013

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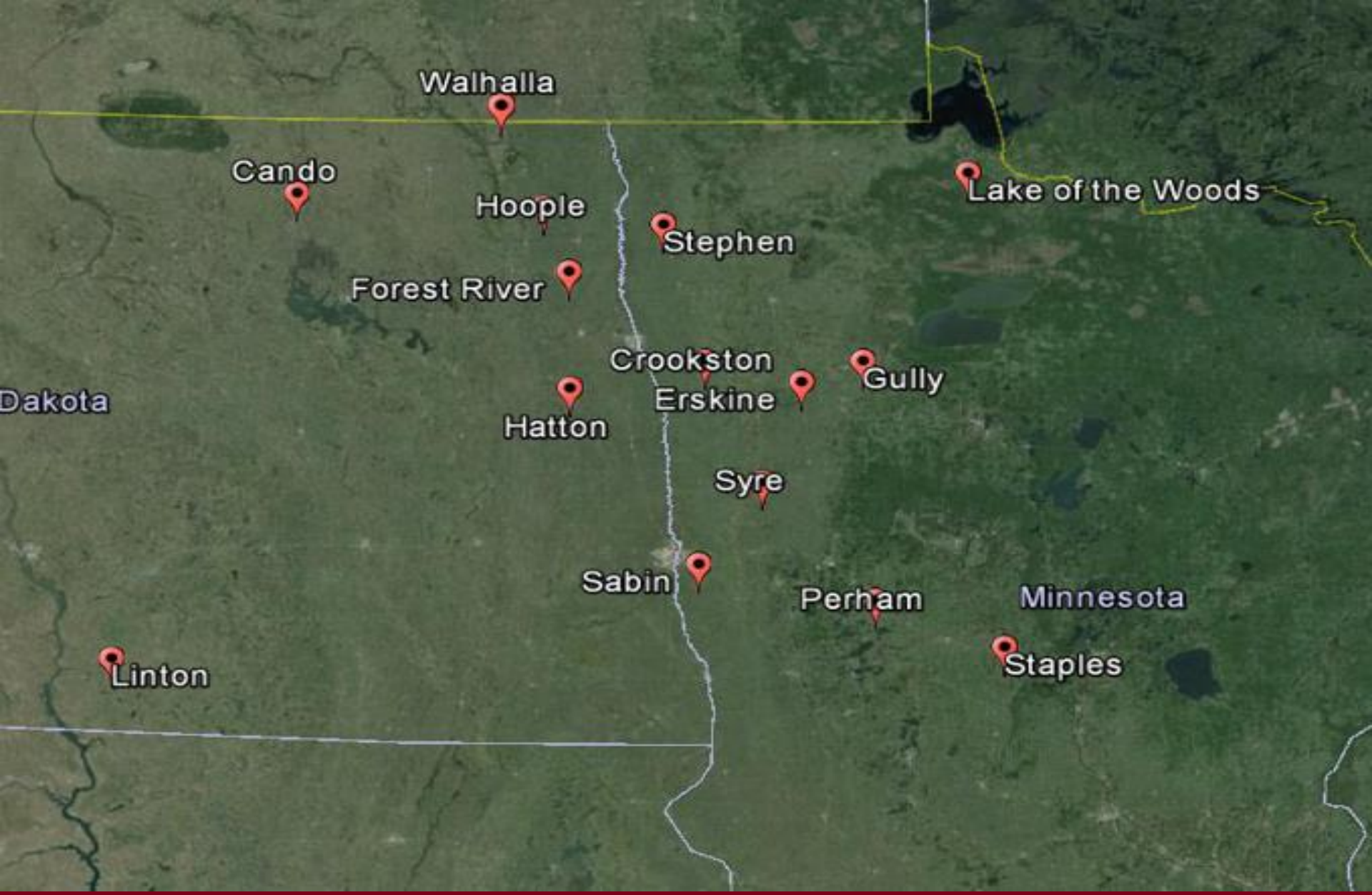
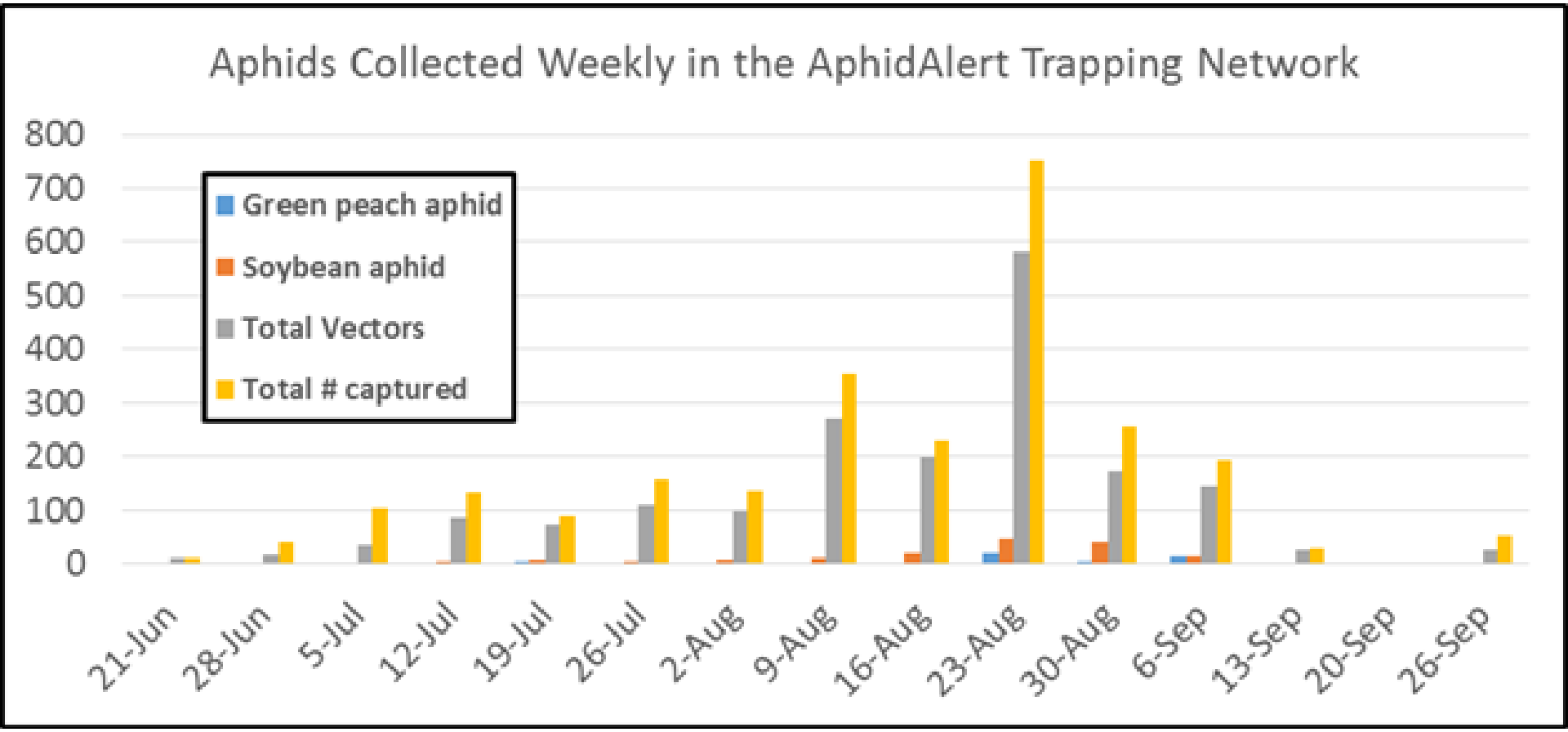
Aphid Alert II

- 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



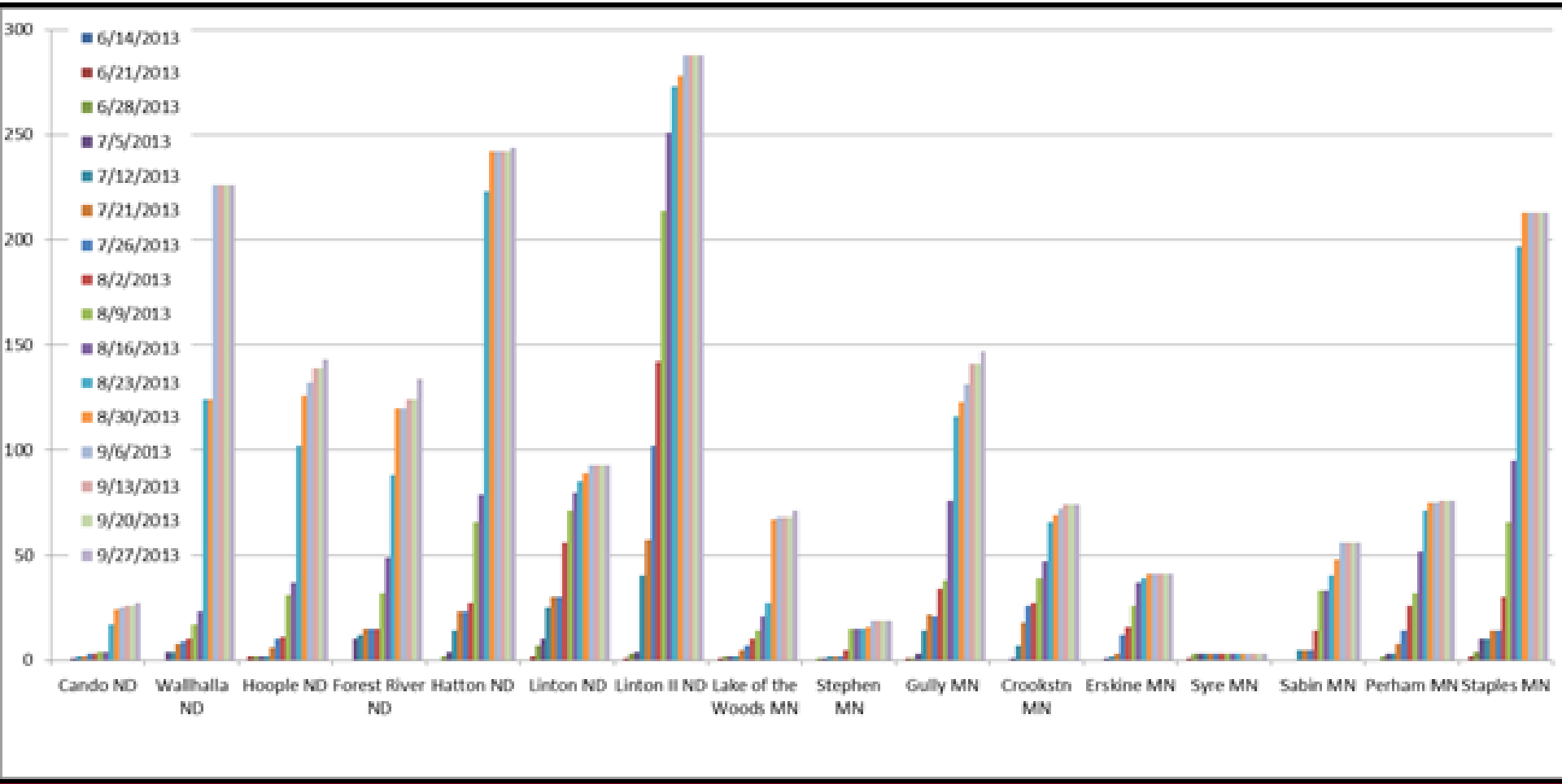
Low GPA / SBA


Aphids Collected Weekly in the AphidAlert Trapping Network
800
700
600
500
400
300
200
100
0
Green peach aphid
Soybean aphid
Total Vectors
Total # captured
21-Jun
28-Jun
5-Jul
12-Jul
19-Jul
26-Jul
2-Aug
9-Aug
16-Aug
23-Aug
30-Aug
6-Sep
13-Sep
20-Sep
26-Sep

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	Gully MN	Crookstn 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	[illegible]															
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

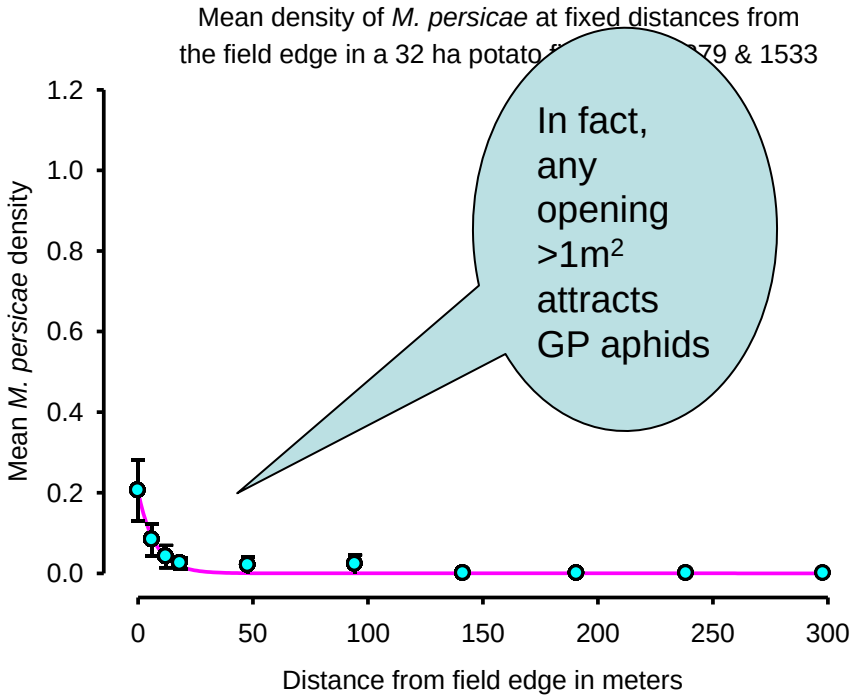
- Easy to implement
- Expanded to include any open area in the field (alleys, variety separation,etc)

From: peipotato.org

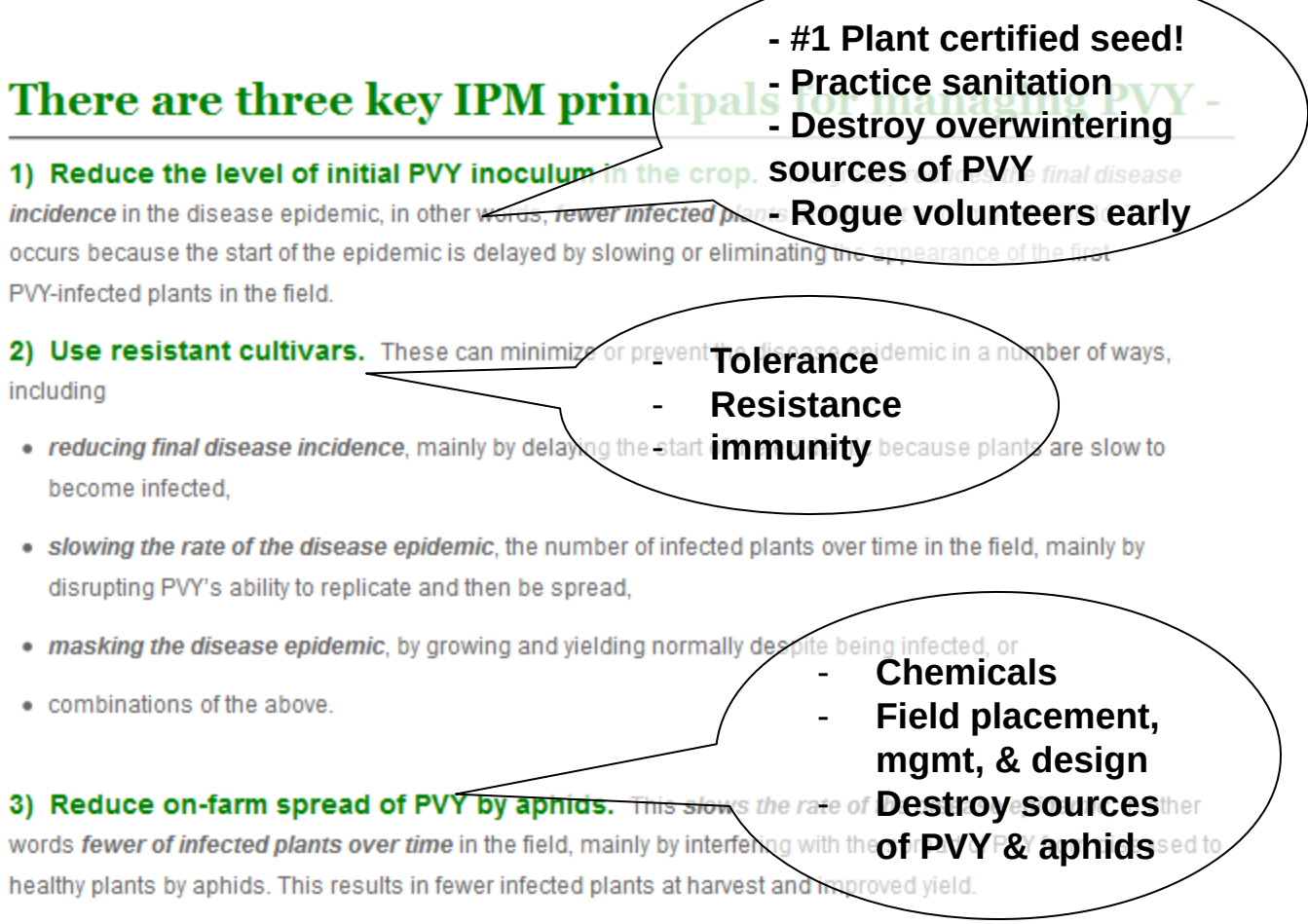
From: A. Charkowski: (http://ofrf.org)

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



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



- 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

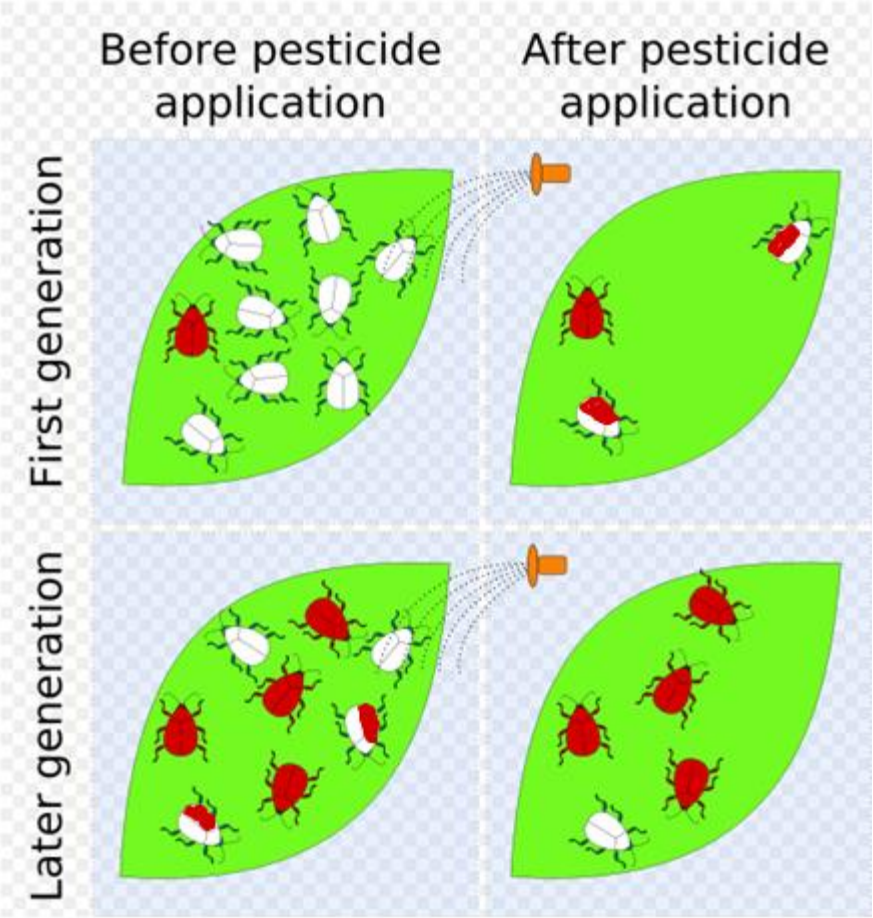
Determining adult age:

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

A week late = 50% yield loss

- 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… ½ RR, ½ RS
- Continues with increasing % of population being RR

Detecting resistance

- Sampling larvae and adults and exposing them to varying rates of insecticide
  - Current project with samples of adults beetles
- Drop trials
  - Deliver 1µ 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 & LD_{50} calc.

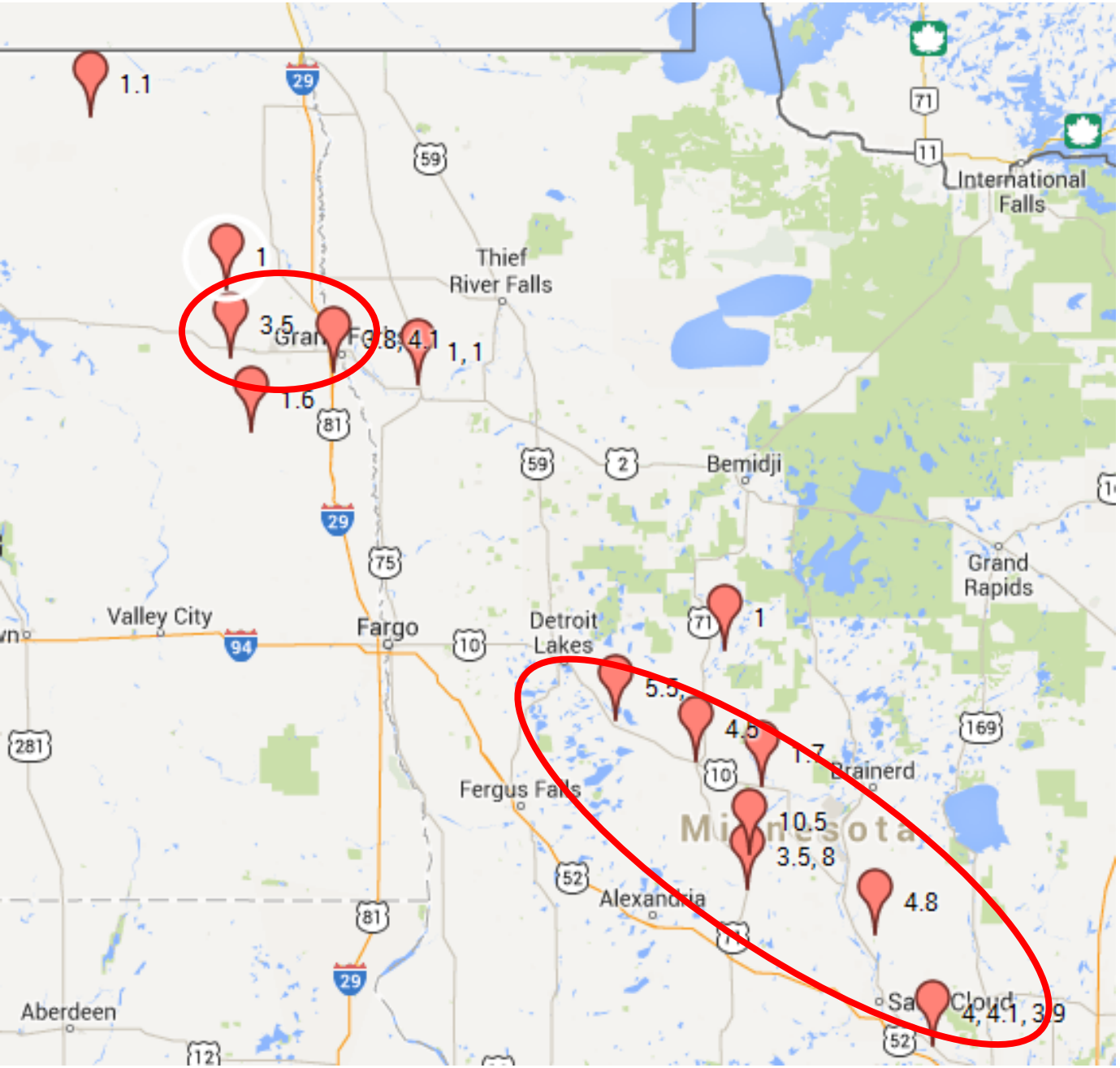
Resistance ratios

2011	Imidacloprid (Admire)	Thiomethoxam (Cruiser)	Clothianidin (Belay)
Becker	**4**	1.3	*NT*
Long Prairie	**3.5**	2.4	*NT*
Perham	**8**	2.5	*NT*
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	*NT*	**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

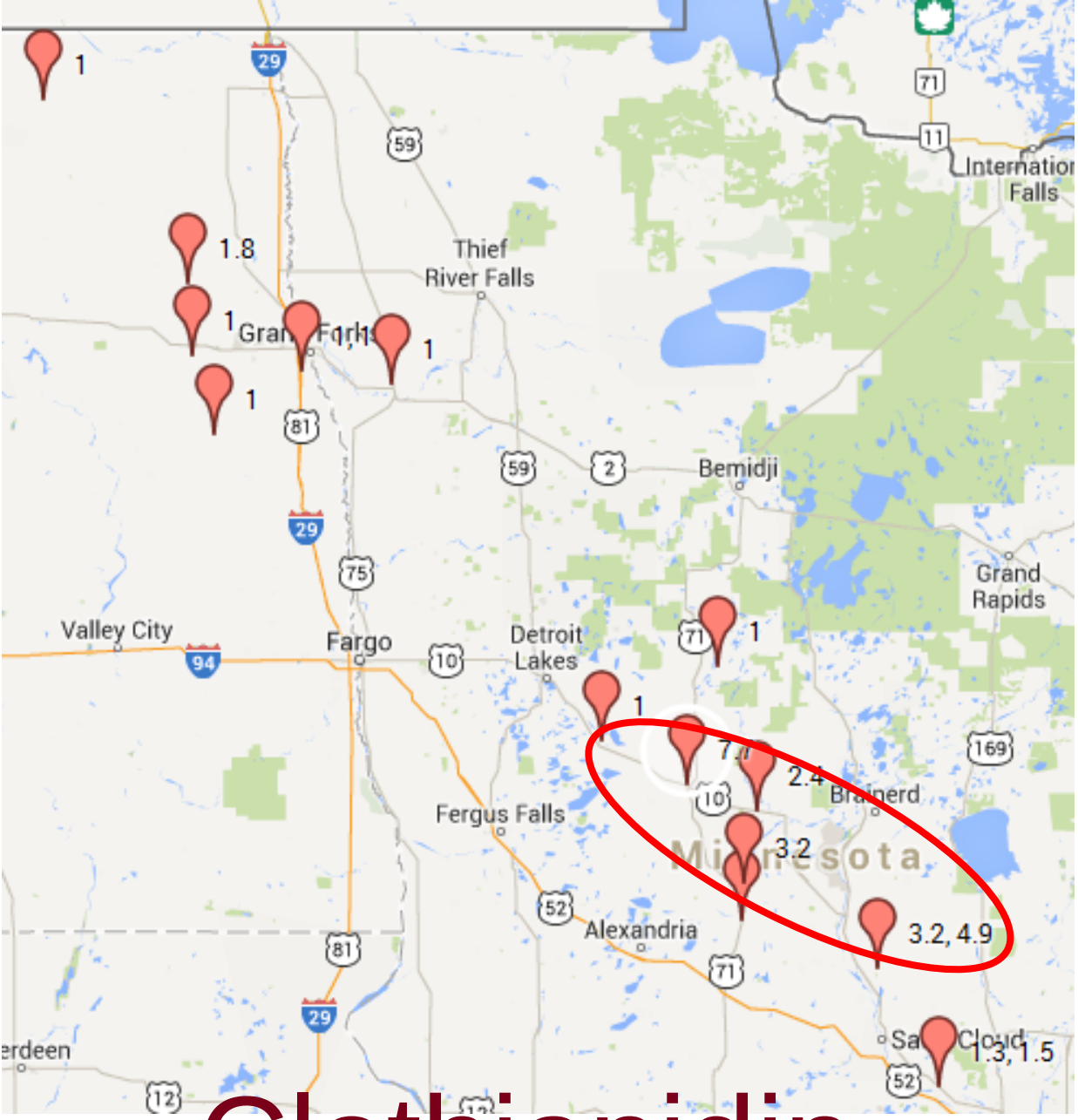
2013	Imidacloprid (Admire)	Thiomethoxam (Cruiser)	Clothianidin (Belay)
Becker	**3.9**	1.5	1.3
Rice2	**4.8**	2.8	**4.9**
Rice1	*NT*	1.8	1.9
Staples	1.7	NT	2.4
Crookston	1	1	1
Forest River	2	*NT*	*NT*
Langdon	1.1	1	1
Larimore	**3.5**	1	1
Inkster	1	**5.4**	1.8
Grand Forks	**4.1**	1	1

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).



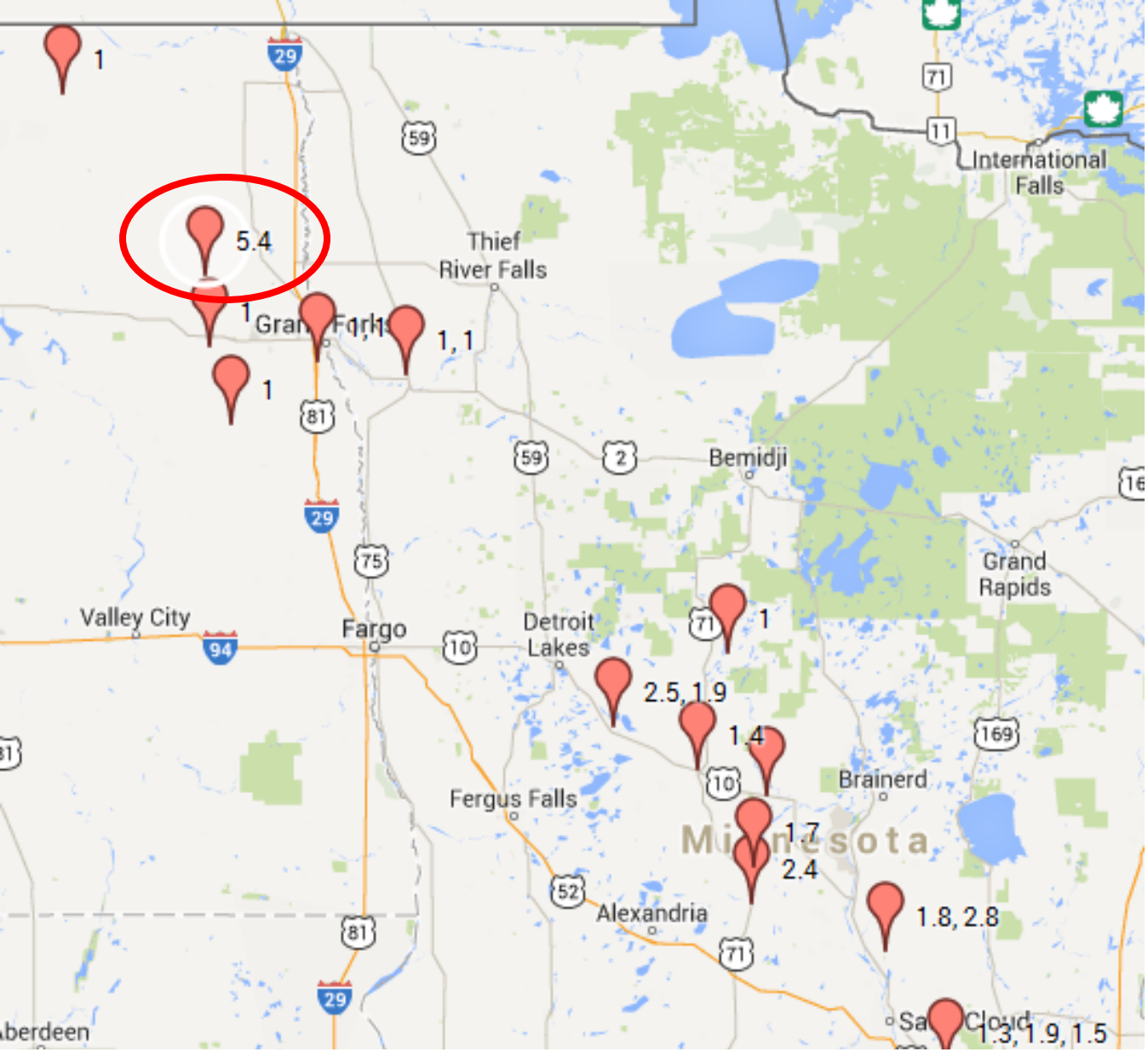
Central MN & Red River Valley

Imidacloprid



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

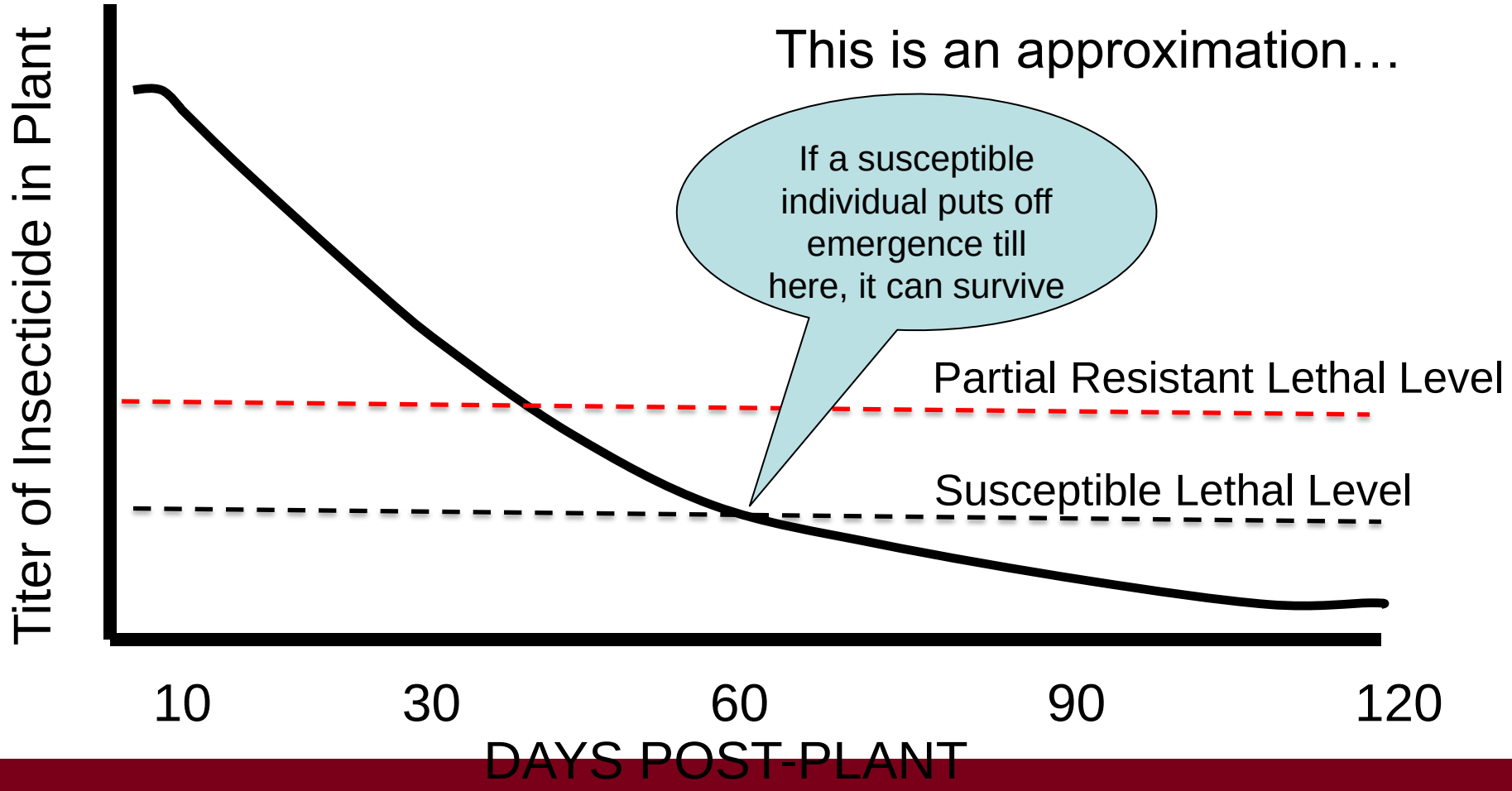
- Reduce selection pressure – rotate modes of action
- Don't follow at-plant application with a foliar of the same moa
  - E.g. if you've used Admire Pro as a seed treatment DO NOT follow with a foliar of Actara, Leverage, Provado or any other foliar Neonicotinyl in the same season (including edge sprays…)
  - Examine label for moa group
- Same with foliars – e.g. alternative moa's (& others)
  - *Anthranilic Diamides (Cyazypyr* ai= Cyantraniliprole *& Coragen* ai= rynaxypyr, MOA grp 28)
  - *Spinosyn Products (Spinosad, Spinetoram,* MOA grp 5)
  - *Benzolureas (Rimon, ai=novaluron*, MOA grp 15)

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

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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