Integrating Rogueing, Stylet oils, Insecticides and Induced Resistance for PVY Management

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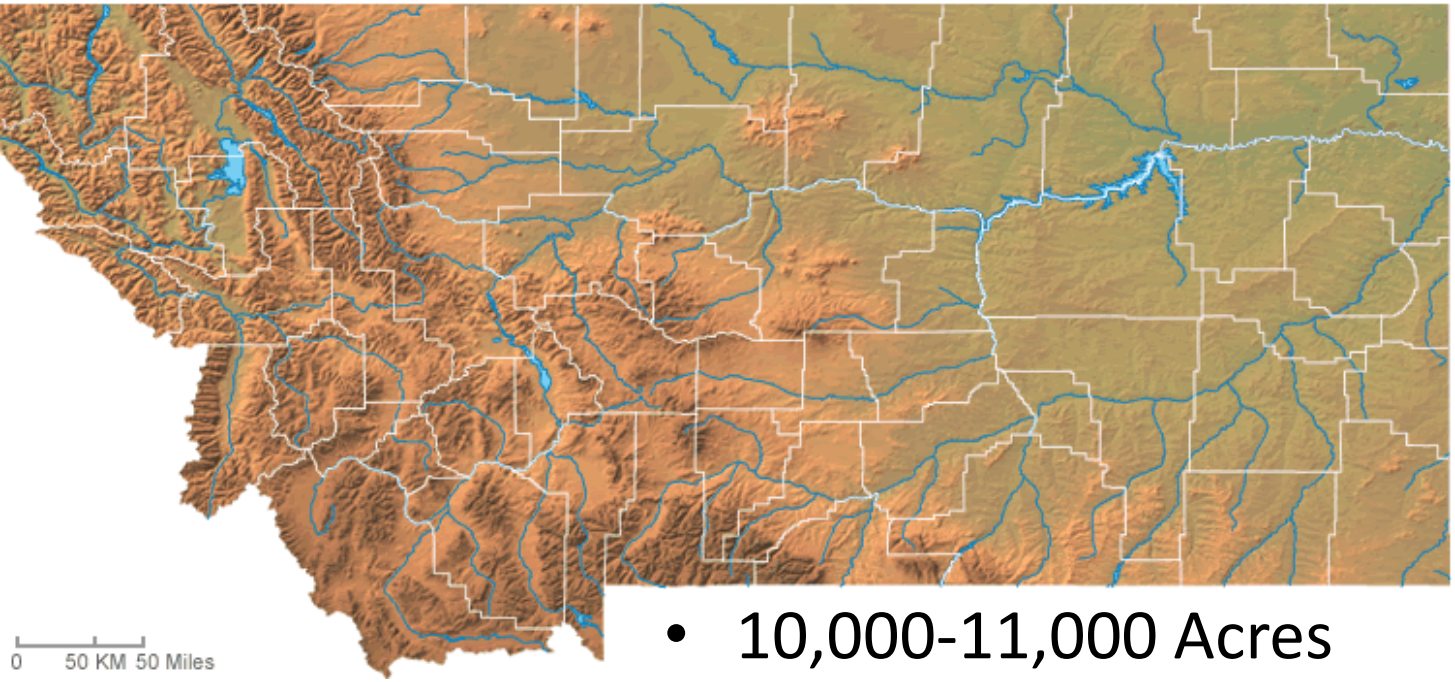
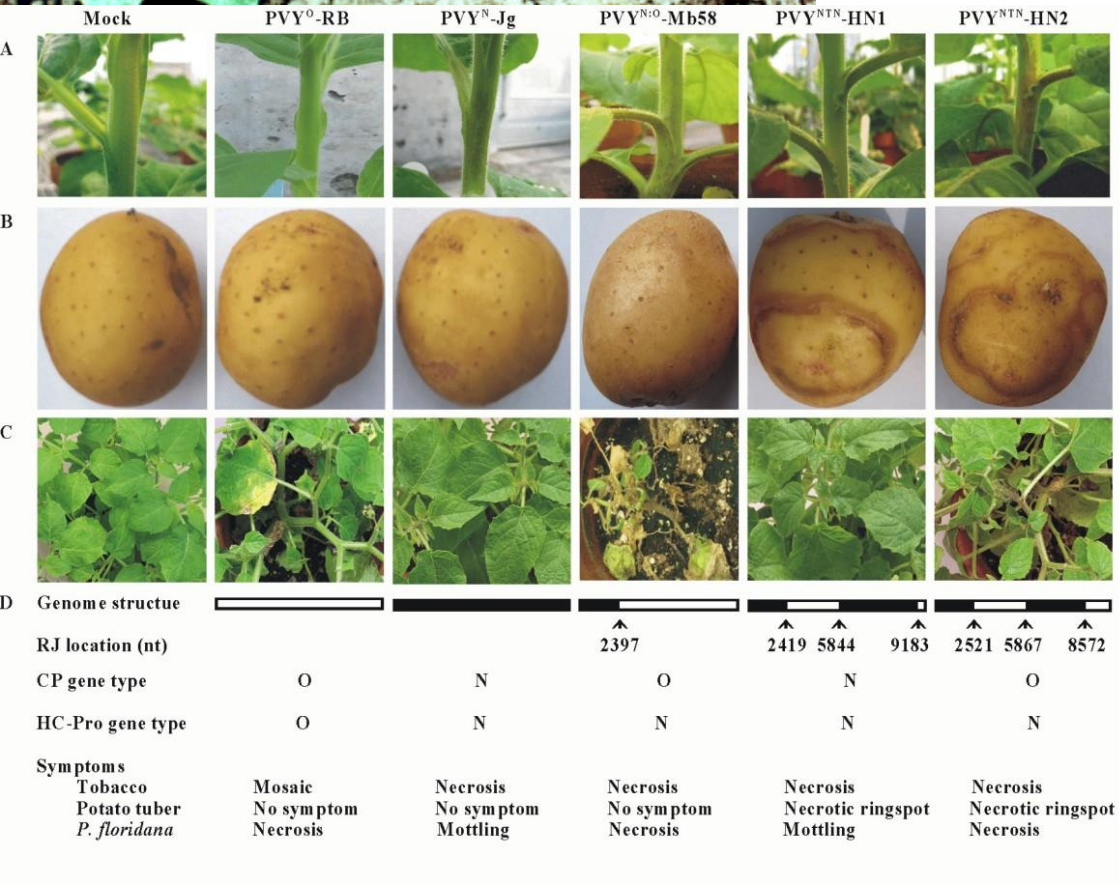
Montana Seed Potato Industry



- 10,000-11,000 Acres
- ~14.4% of seed potatoes for US crop
- Market- Columbia Basin- WA/OR, ID, N
- Yields ~320 CWT/A
- ~$40 million

Objectives

- Compare and contrast the roles of:
  - Rogueing-based on ELISA testing
  - No gap insecticide-Neonicotinoid at planting-60 days post plant- Anti-feeding insecticides @14 day intervals (4-5 applications) till vine kill.
  - Mineral oil @ 4 day intervals from emergence to vine kill
  - BmJ (Certis USA) induced resistance @14 day interval
- FOR reduction in PVY infection



PVY

-Currently most important virus in Potato Seed Certification Programs

-In some states 50%+ of lots fail certification

-Stylet-borne by both potato colonizing and non-colonizing aphids

-New strains- PVY$^{N:O}$ PVY^{NT} PVY^{NTN}, PVY^{N-Wi} now dominate

BmJ Induced Resistance: A tool in Managing Virus Diseases

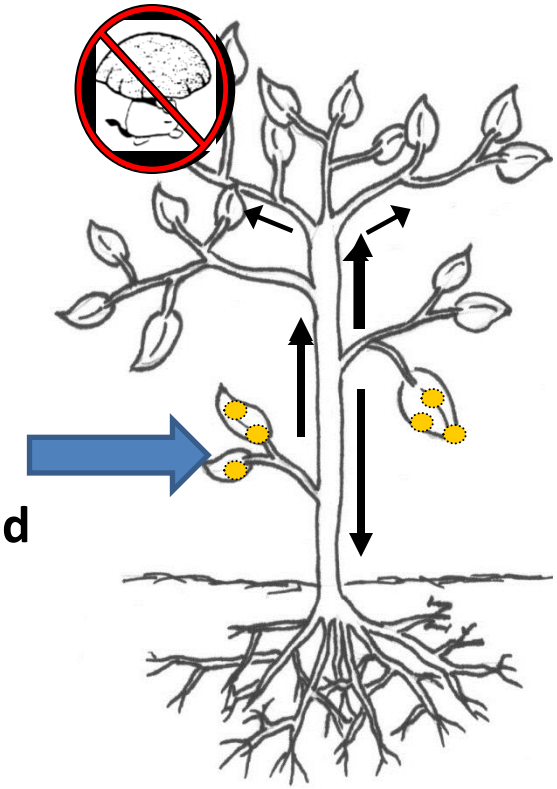
BmJ is washed cell preparation on Bacillus mycoides isolate J that induces plant resistance by activation of NPR1 gene and ethylene signaling pathway.

originally isolated from sugar beet phyllosphere

Will be marketed by Certis USA-
USA and Canadian label expected September 2016

BmJ Induced Resistance

Challenged-3-5 after induction



Induced

- Expressed by
  - Oxidative burst-ROX
  - Activation of npr1 gene
  - Induction of ethylene signaling
  - elevated levels of Pr-proteins and defense compounds (**PR-Proteins (e.g. Chitinases, Beta Glucanases, peroxidases**)
  - "primed" i.e. plant can react fast to pathogen attack

- Soft resistance, i.e. some disease will occur
- **Virus- reduced infection and reduced virus titer in infected plants-TMV, CMV, PVY, some Gemini-NOT PVX**
- **Reduced feeding by aphid vector**

PVY Greenhouse

Treatment	% PVY infection Mechanical Inoculation -3 trial ave.	% PVY infection Aphid transmission 3 trial ave.
Dead BmJ +PVY	58.3 a	40.0 a
Dead BmJ	0 c	0
Live BmJ induction 5 days before inoculation with PVY + BmJ @ 14, 28, and 42 days post inoculation	26.6 b	0

Myzus persicae-does not like to feed on BmJ treated plants
Generally (0-1 short tasting probe followed by no feeding-data not shown)

Table 4. Effects of induction of resistance by water, BmJ and Actigard on green peach aphid feeding period on potato leaves 5-7 days after induction- 30 minute observation.

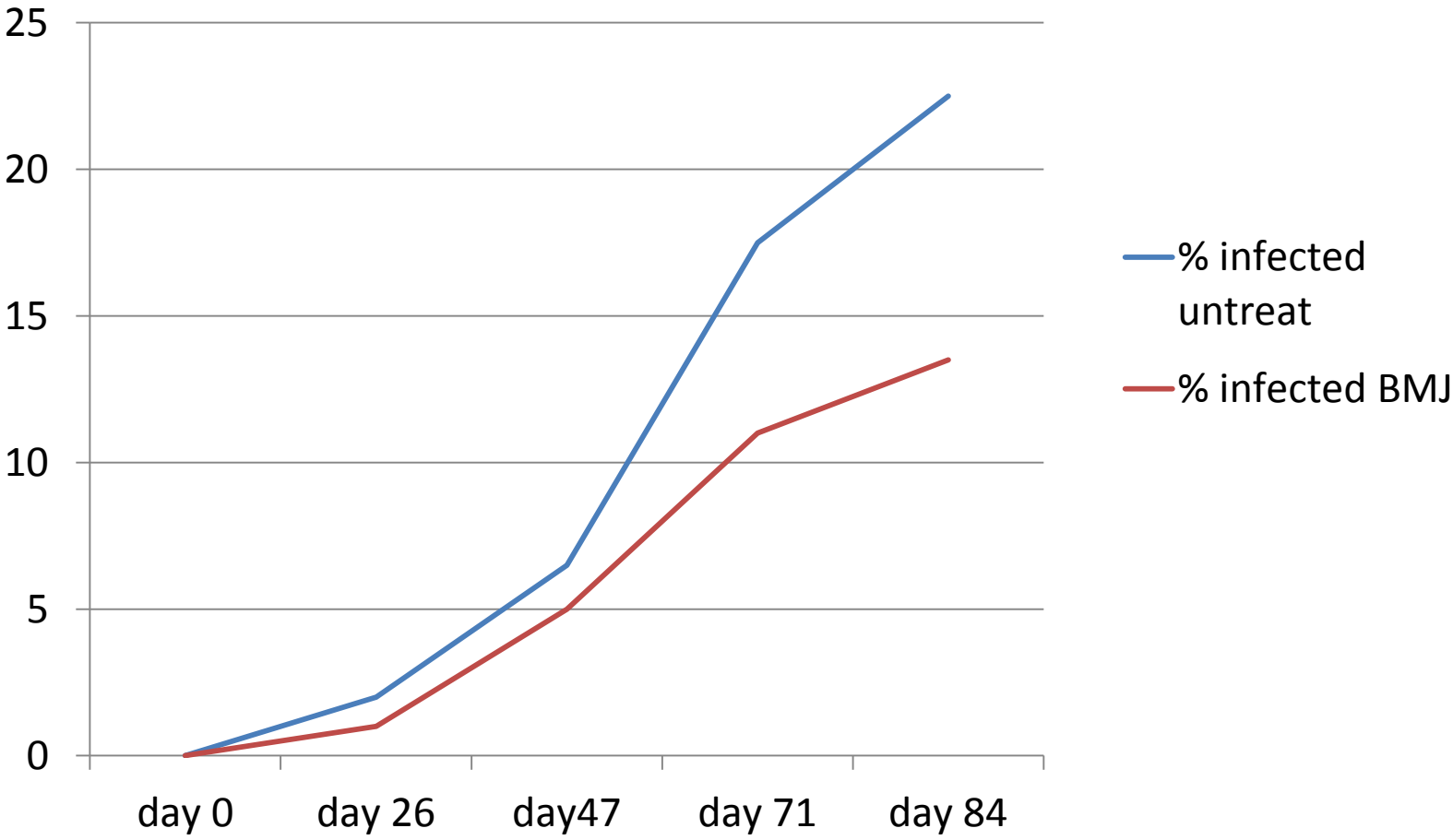
Source plant	Induction treatment		
	Water	BmJ	Actigard
PVY (-)	22 minutes Range 15-30 minute	<2 seconds Range 0-6 seconds	<6 seconds Range 0-15 seconds
PVY (+)	20 minutes Range 15-30 minutes	<2 seconds Range 0-5 seconds	<6 seconds Range 0-17 seconds

Aphids feeding on BmJ or Actigard induced plants typically probed once then rarely fed again during the 30 minute observation period, whereas aphids feeding on water induced plants would feed for long periods of time 15-30 minute range and then would typically feed again if initial time was less than 30 minutes. No virus transmission was noted in any treatment even the water treatment.

Hermiston, OR- PVY Plots-work cooperative with Phil Hamm and Nina Zidack 2009-2014.

Hermiston, OR- Integrated PVY Management Plots, Norkotah borders-Treatments 2 rows 50 plants Norkotah separated by red variety-All plants tested by ELISA 3-4 times plus winter test of one tuber per hill

Figure 1. 2009 Percent infection of Russet Norkotah potatoes at different times planted at Hermiston, OR. either induced with BmJ at emergence then every 14 days compared to non- induced potatoes. Data are statistically different at day 71 and day 84 @P<0.05.

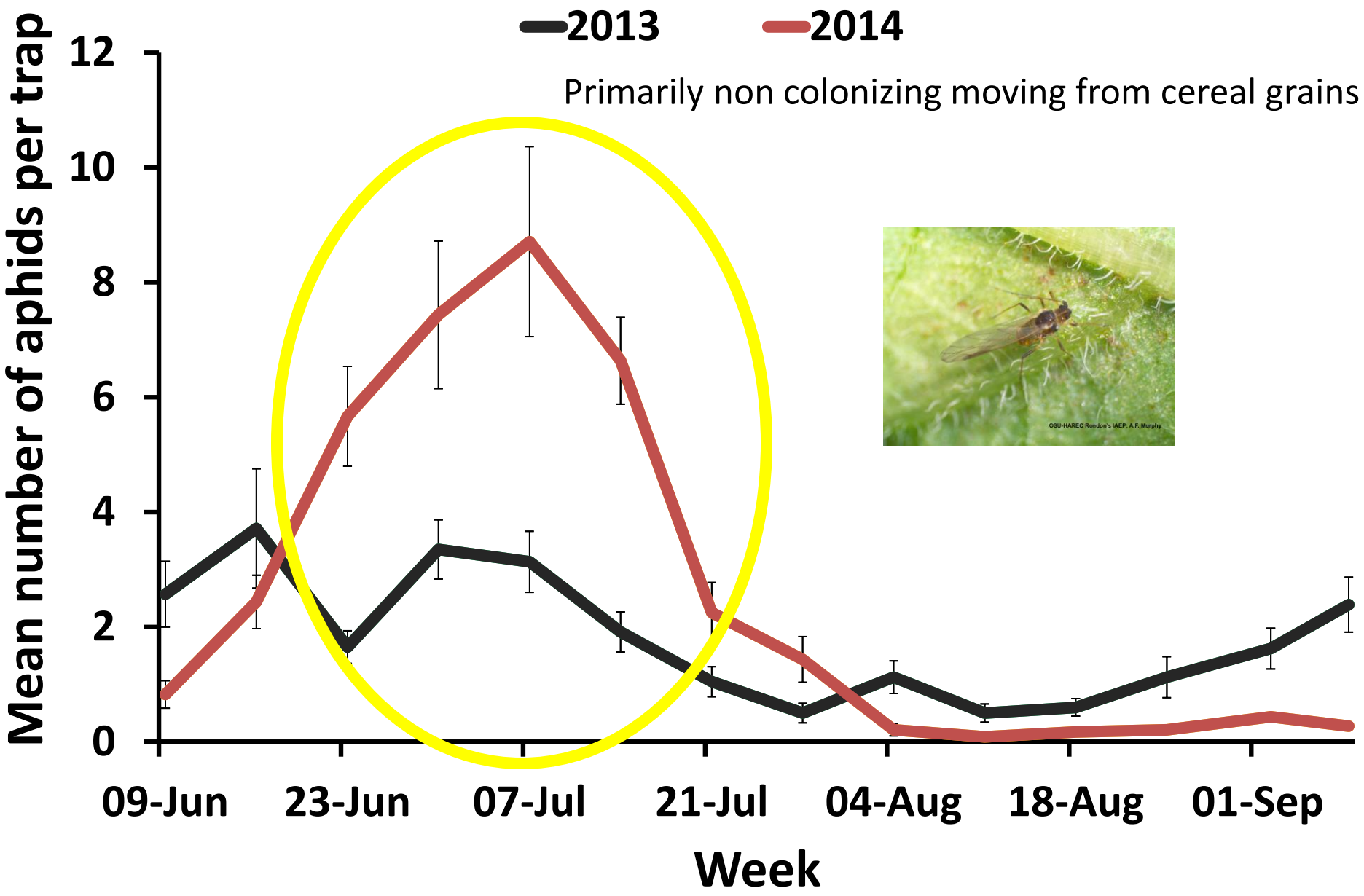


2010 -2011 Hermiston PVY Trials

Treatment	% PVY total including winter test Ave/ (2010-2011)
Untreated	10.2 a (10-10.4)
BmJ WP 2.0 oz/A-14 day emergence to harvest **non-rogued**	4.8 bc (3.5-6.1)
No gap Insecticide-non rogued	11.1 a (10.7-11.5)
BmJ WP 2.0 oz/A 14 days emergence to harvest- **rogue out** infected plants- mid June & mid July, early & mid August	3.1 c (1.5-4.7)
No- Gap insecticide +BmJ WP 2.0 oz/A 14 days emergence to vine kill rogue out infected plants	4.6 bc (3.0-6.3)
No-Gap insecticide-rogue out infected plants.	6.1 b (4.5-7.6)

#	Hermiston 2012/2013 /2014Treatments Non- Rogued	% PVY infection August 1, 2012	2013 Winter test	2014 Winter test
1	UTC	17.5 a	10.9 ab	65 a
2	BmJ Microbial Fungicide @ 2 oz /A applied @ a 12 day interval from emergence till vine kill	11.5 b	13.0 a	58 abc
3	Stylet oil at 4% applied every 4 days from emergence till vine-kill	4.5 c	5.9 cd	45 bcd
4	BmJ, Stylet oil- rates and timing as above Applied separately in 2013/2014	7 bc	7.1 bcd	48 abcd
5	No- gap insecticide	22 a	11.6 ab	61 a
6	BmJ, No-gap insecticide	15 ab	6.4 cd	47 abcd
7	Stylet oil, No-gap insecticide	7.5 bc	3.2 d	40 d
8	BmJ, Stylet oil, No-gap insecticide	8.0 bc	7.8 bcd	50 abcd
	Flsd 0.05	3.8	5.6	8.8

Columbia Basin: Aphids landing in potatoes



PVY Management

- 1.Control volunteer potatoes and weed hosts like nightshade- source of virus.
- 2.Use border crops- aphid cleaning station. Aphids like to land on field edges.
  - Major non colonizing aphid flights come from grain fields as they ripen.
- 3. Start with low infection seed.
- 4.Use planting time “Neonic”- this will control colonizing aphids ~60-65 days- one of major reasons we no longer see Potato Leaf Roll Virus! Start “soft, antifeeding” insecticides ~60 post plant then continue at recommended intervals till all vines are dead. This will retain aphid predators and parasites.
- 5. Rogue-30-60+ % control -but must be able to see. Many new strains are relatively symptomless in some varieties. In MT ~50% is now PVY Wilga

PVY Management Tools

- 6. **Mineral Crop Oils- most effective over 4 years with no gap insecticide program**
  - Use 4 day application during rapid growth then weekly is fine
  - 20-40 ft oil borders on G2-G3 successfully
  - Use at 1-3% with emulsifier (0.75-1.25%)-start at emergence
  - Many products-JMS Stylet oil, Aphoil, Glacial spray fluid, Sunco 7E, Ultra-Fine, Organic leaf oil, etc
  - Chemical characteristics
    - SUS (Saybolt Universal Seconds) 60-150
    - VGC (Viscosity Gravity Constant) 0.79-0.819
    - Boiling range 370-420 C
    - Molecular weight 340-380 daltons
    - Unsulfonated residues (USR) 95-100
    - Paraffin-pour point-<0 C
- Has provided 25-70% control
  - Reduce virus acquisition, persistence on stylet (<2 minutes compared to 2 hrs), transmission

PVY Management Tools

- 6. Seed Producers should use early vine kill-still a lot of other green plants in landscape to attract aphids.
  - most infection occurs late season.
- 7. Induced resistance with BmJ is effective but not as good as mineral stylet oils with no gap insecticide. BmJ cannot be combined with oil-it dies and must be alive to induce resistance-apply separately. BmJ used for early blight, late blight or Sclerotinia white mold will give added virus benefit.
  - BmJ (CERTIS USA) label expected September 2016.

Thank You & Happy Trails