2024 Potato Academy

Understanding the Relationship Between Pest and Beneficial Arthropods in Potato Fields

Tim Waters and Alan Schreiber

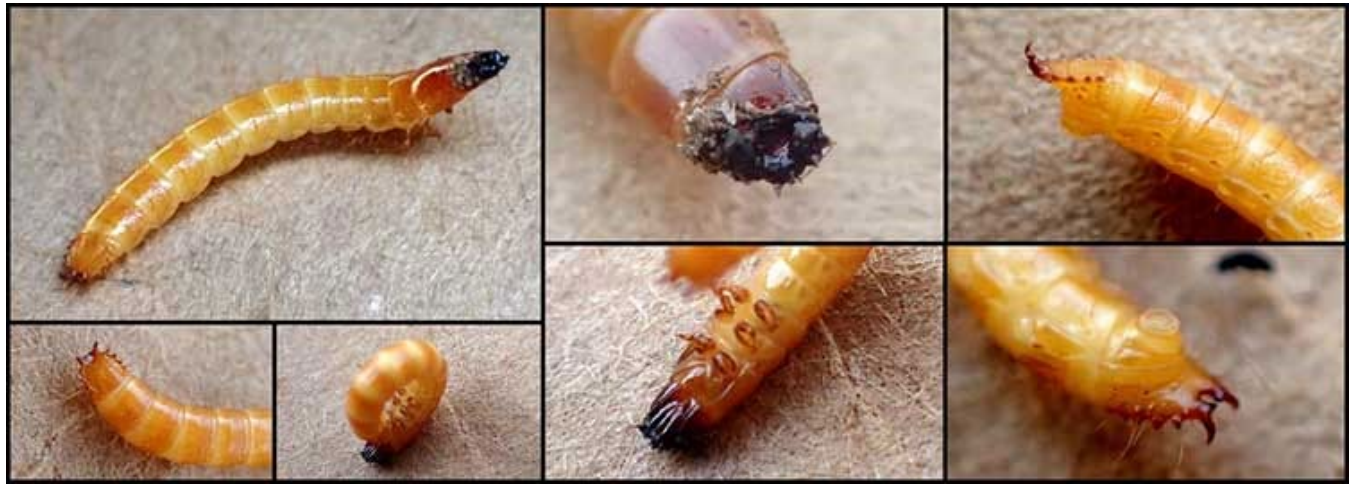
Basic-principles

-
- Understanding The Relationship Between Pest and Beneficial Insects in Potato Fields
- Identifying and enumerating beneficials versus pests versus incidentals
- Insecticide types from broad to selective levels of control
- How a secondary pest flare occurs for aphids, mites, thrips and psyllids

Pest Arthropods

Wireworm (Elateridae)

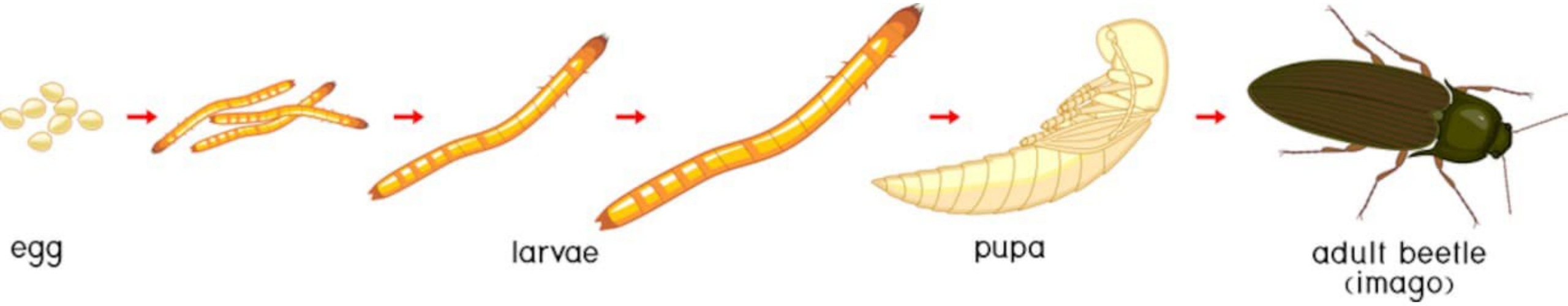
Click Beetle



https://www.flickr.com/photos/bugldy99/32856026170/

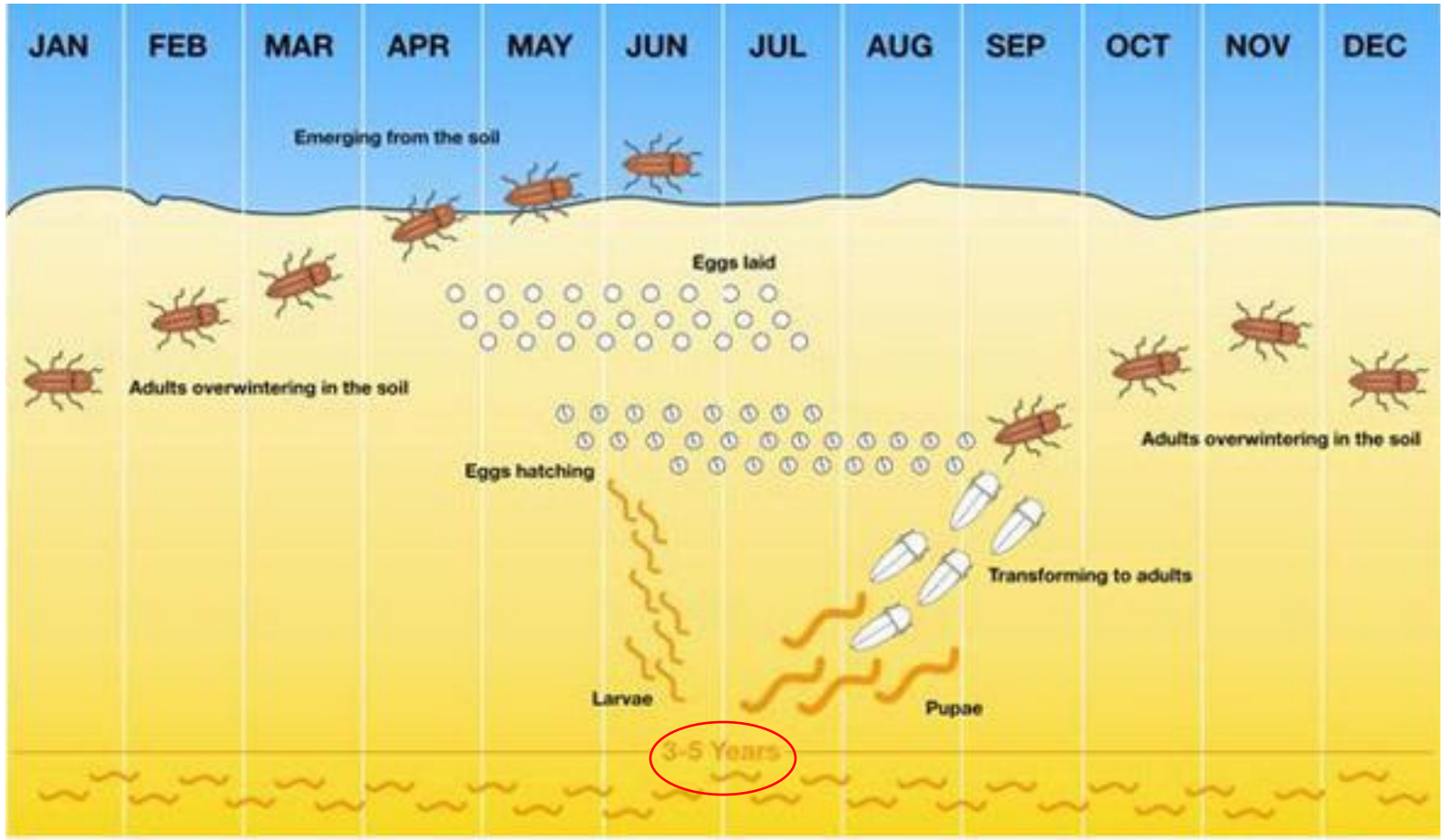
[Credit: ©entomart]

- Pest of numerous crops including cereals, grasses, potato and other vegetables
- Most serious problems coming out of pasture or crops where they were not treated
- Have resurged as a problem with the discontinued use of organochlorine insecticides

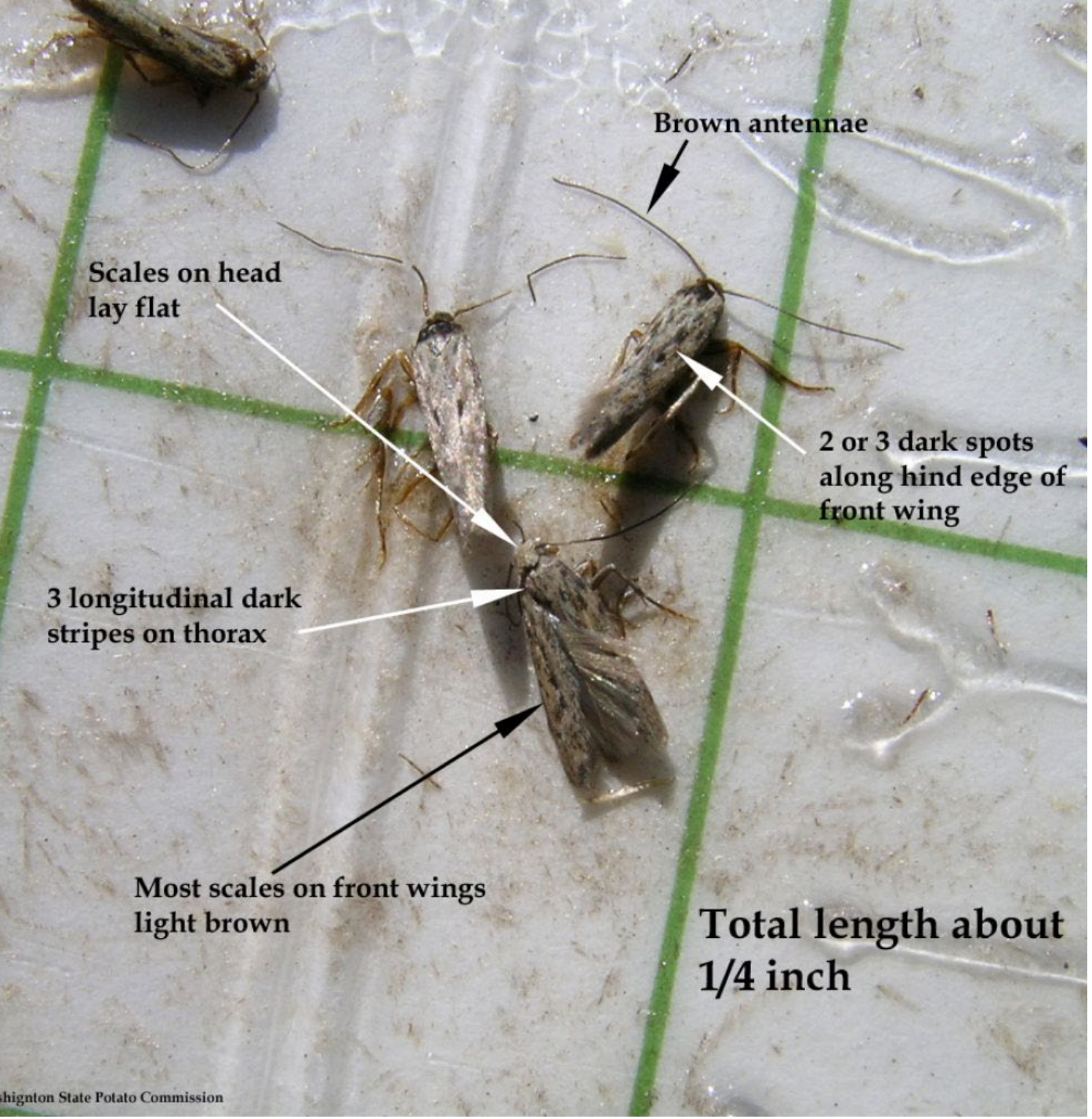


Life cycle

- Long life stages (years instead of days)
- In soil and move extensively in soil profile making control difficult.
- Some life stages do not feed
- Larvae move up in soil profile in spring, down in summer and back up in fall. Can be spring or fall issue in carrot
- One species stays up during hot soil now!!

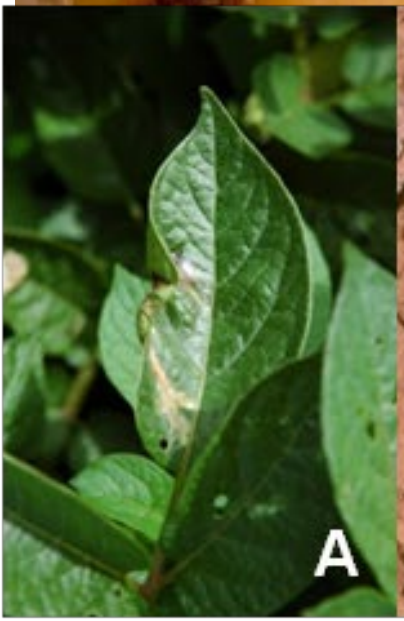



A
B
C
D


Brown antennae
Scales on head lay flat
2 or 3 dark spots along hind edge of front wing
3 longitudinal dark stripes on thorax
Most scales on front wings light brown
Total length about 1/4 inch
shignton State Potato Commission


State Potato Commission

Gelechiidae
Phthorimaea operculella
2 mm


A

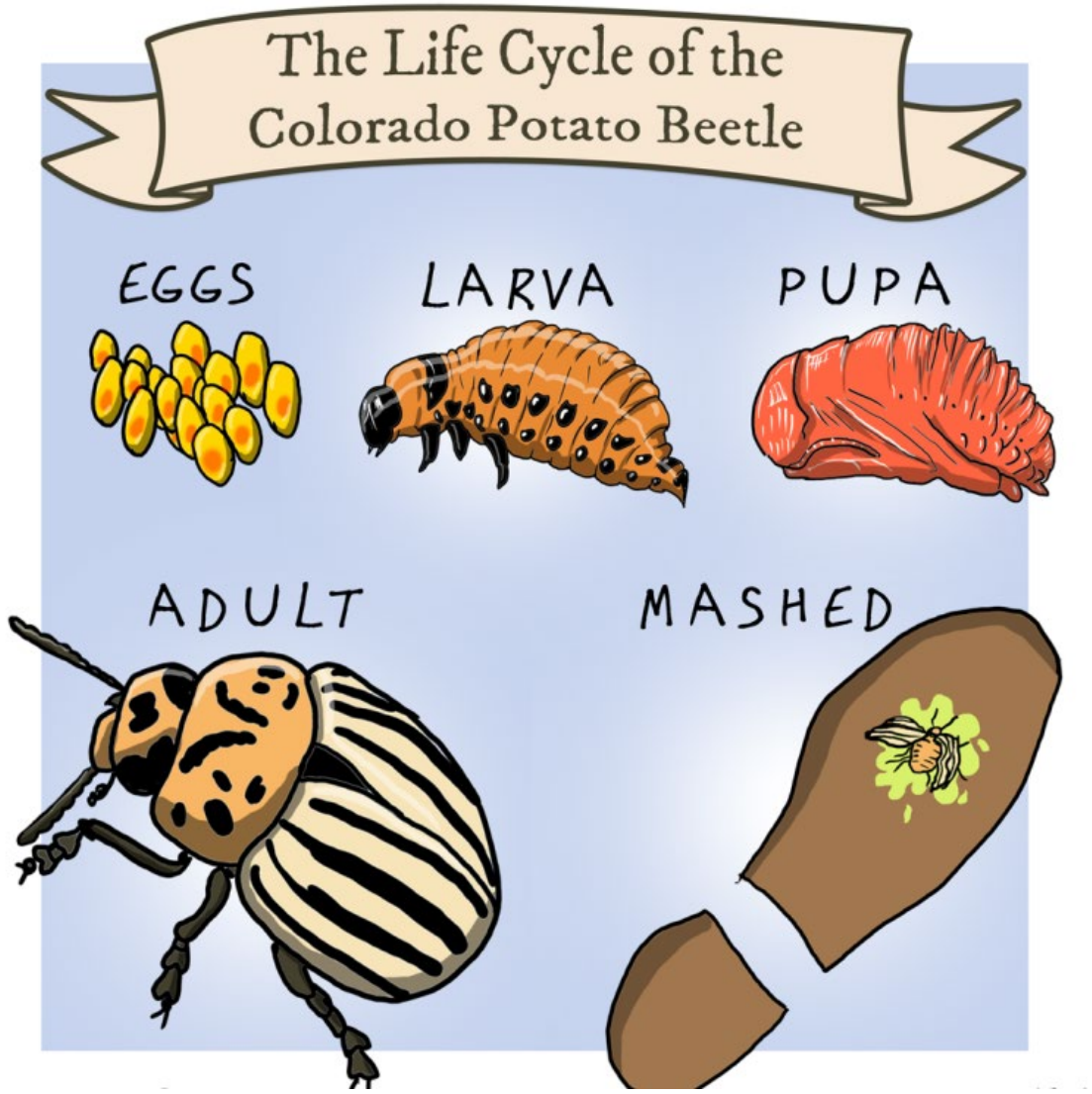

B


C


D

Potato Beetle Biology

- Complete metamorphosis
- Multiple generations per season
- Overwintering diapause triggered by short days, cold temps, and reduced food quality
- Adults burrow into soil and diapause for 3 to 24 months
- Emerge in the spring, coinciding very well with emergence of potato and nightshades



Damage by CPB

- Old larvae (the last or 4th larval instar) are reported to be responsible for as much as **75 percent** of feeding damage.
- Potatoes can usually tolerate up to 30 percent defoliation when they are in the vegetative stage.
- They are much more sensitive when tubers are beginning to bulk and can only tolerate about **10 percent** defoliation.
- Tuber bulking begins soon after flowering, making this time critical for beetle management.

Sub-economic Pests Complications

- Vectoring plant pathogens
  - Potato Psyllid, found in potatoes in the PNW for ever. Without the bacteria in the population, they are always sub-economic.
  - Introduction of the liberbacter in the population turns subeconomic pest into a key pest.
  - Total re-organization of Potato insect IPM Programs

Occasional Pests

- Beet leafhopper
- Wireworms
- Aphids
- Stink bugs

DEVELOPMENTAL BIOLOGY

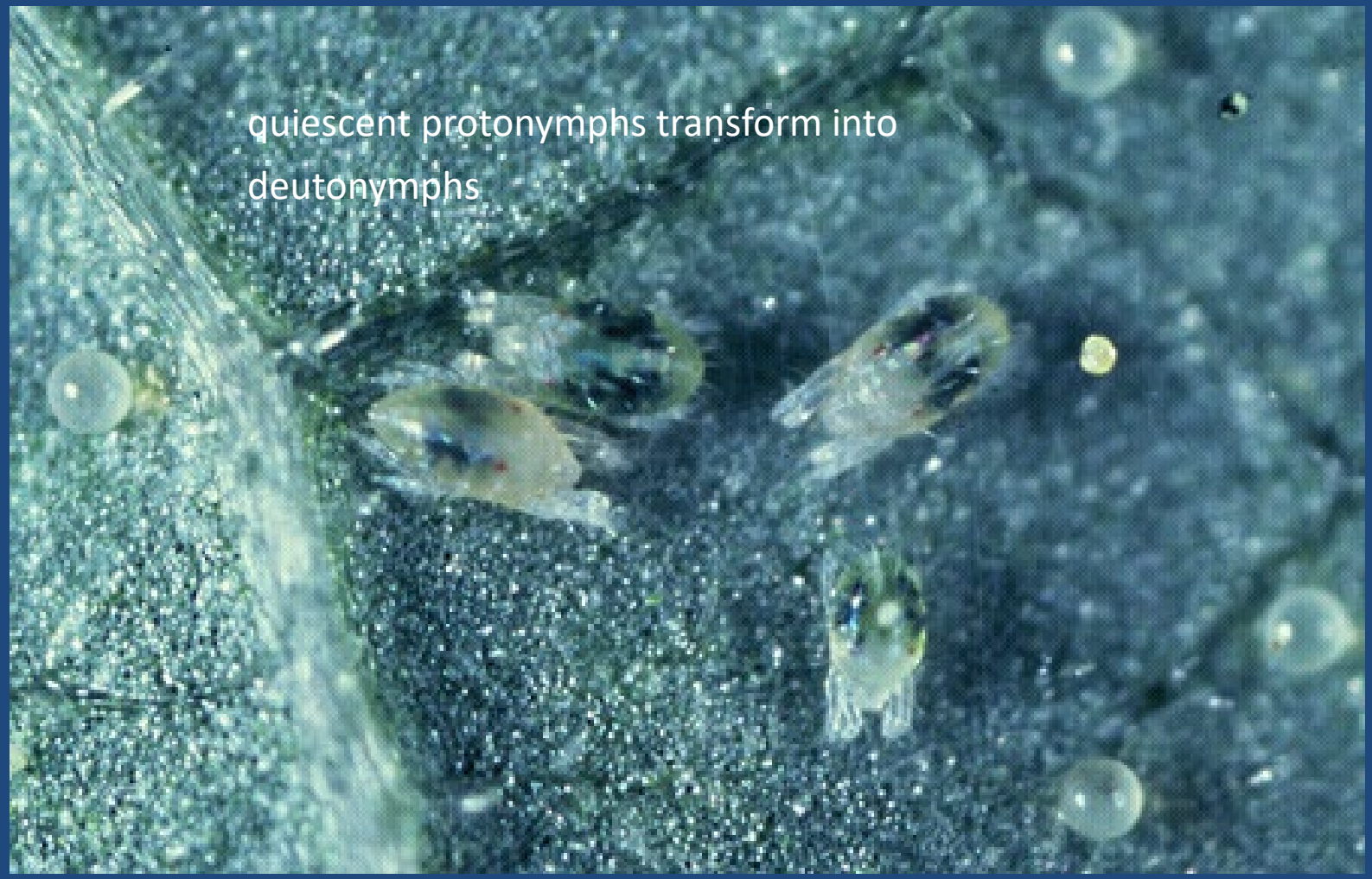
Stages include:

egg, larva, protonymph, deutonymph, and adult.

Eggs (lower portion) and male (upper portion) of the twospotted spider mite.

DEVELOPMENTAL BIOLOGY

DEVELOPMENTAL BIOLOGY



DEVELOPMENTAL BIOLOGY

Aphids

- 15 Species worldwide that feed on potatoes, none of which are host specific
- Two species are of economic concern
  - <Green Peach Aphid (*Myzus persicae*)
  - Potato Aphid (*Microsipium euphoribiae*)>

Green Peach Aphid (*Myzus persicae*)

- Extremely wide host range (40 plant families)
- Overwinters as eggs on *Prunus* spp. (Heteroecious-host plant alteration)
- Can reproduce sexually, or parthenogentically
- 1.2-2.3 mm
- Body color variable
- Thrives in warmer conditions
- Vector of PLRV or (net necrosis) which actually improves fitness of GPA
- Vector of PVY (most successful) which increases growth rate of GPA

Potato Aphid (*Microsipium euphoribiae*)

- Wide host range (20 plant families)
- Primary host is *Rosa* spp.
- Origin is N. America
- 2-4 mm
- Body color variable
- More common in cooler weather or cooler seasons
- Usually Anholocyclic (parthenogenesis)
  - Except OW as egg
- Vector of PLRV or (net necrosis)
- Vector of PVY

Aphid or Lygus?

- Slow
- Cornicles
- Filter chamber
- Live birth
- Many species
- Colonies

- Fast
- No cornicles
- 5 black spots on back
- Mostly *L. hesperus*
- Loners

PLRV-Luteovirus

- For transmission to occur, it must first move to gut, and back out through salivary system
- Upward rolling of affected leaflets.
- Stunting
- Tuber necrosis
- Can impact yield and quality
- RB is highly impacted
- Neonics and control by seed producers has significantly reduced this in WA potatoes

PVY-Potyvirus

- Mosaic
- Stunting
- Tuber necrosis (some strains and some cultivars)
- Symptomology varies drastically by strain and cv.
- Yield and Quality Reduction
- Huge problem in seed production
- Some cultivars are asymptomatic (Dark Red Norland, Kennebeck)
- Difficult to reduce with insecticides since transmission is so rapid

Beneficial Arthropods

Aphid Control

- Parasitic Wasps
- Hoover Flies
- Ground Beetles
- Ladybird beetles
- Lacewings
- Big-eyed bugs

Trade Name Foliar Prod.	IRAC Group	Col. Potato Beetle	Beet Leafhopper	Lepidoptera	Psyllid	Aphids	Thrips	Mites	Lygus
Lannate	1a		x	x		x	x		x
Sevin	1a	X	X	x					x
Malathion	1b		X			x			
Dimethoate	1b		X			X			x
Pyrethroids	3	x	x	x	~~x~~				x
Neonics	4a	x	x		x	x			
Thiameth.	4a	x	x		x	x			
Imidacloprid	4a	x	x		x	x			
Clothianidin	4a	x	x		x	x			
Sivanto	4d	X	X		X	X			X
Transform	4c		x		x	x			X
Blackhawk	5	X		X	X (n)		x		
Radiant	5	x		x	x (n)		x		
Agri-Mek	6	x			x		x	x	
Fulfill	9b				x	x			
Beleaf	29				x	x			X
Rimon	15	x		x	x (e,n)				X
Torac	21a	x	x		x	x	x		
Avaunt	22	X		x					
Movento	23				x (e,n)	x	x		
Oberon	23				x (e,n)			x	
Exirel	28	x		x	x	x	x		
Coragen	28	X		x					

Wireworm	Lygus	Mites	Thrips	Aphid	Psyllid	Leps	BLH	CPB		
										o
	x					x	x	x	Zeta cypermethrin/bifenthrin	Hero
	x					x	x	x	ZETA-CYPERMETHRIN	MUSTANG MAXX
	x					x	x	x	BIFENTHRIN	BRIGADE 2EC
	x					x	x	x	ESFENVALERATE	ASANA XL
	x					x	x	x	BETA-CYFLUTHRIN	BAYTHROID XL [148
	x					x	x	x	LAMBDA-CYHALOTHRIN	WARRIOR II W/ZEON
	x					x	x	x	PERMETHRIN	PERMETHRIN [136
			x	x	x		x	x	TOLFENPYRAD	TORAC
x									FIPRONIL	REGENT 4SC
	x					x	x	x	CARBARYL (CARBAMATE)	SEVIN BRAND XLR
			x		x	x		x	SPINOSAD	BLACKHAWK NATURALYTE
		x	x		x			x	ABAMECTIN (AVERMECTIN B1)	AGRI-MEK SC
	x				x	x		x	SPINETORAM	DELEGATE WG
				x	x		x	x	IMIDACLOPRID	ADMIRE PRO
				x	x		x	x	THIAMETHOXAM	ACTARA
			x			x		x	OXAMYL (CARBAMATE)	VYDATE C-LV
	x			x			x		DIMETHOATE (ORGANOPHOSPHATE)	DIMETHOATE 400 EC
									PHOSMET (ORGANOPHOSPHATE)	IMIDAN 70-W AG
			x	x	x	x		x	CYANTRANILIPROLE	DuPONT EXIREL [172
			x	x	x				SPIROTETRAMAT	MOVENTO [169
						x		x	CHLORANTRANILIPROLE	CORAGEN
	x				x	x		x	NOVALURON	RIMON 0.83 EC
		x			x				SPIROMESIFEN	OBERON 2SC
						x		x	INDOXACARB	AVAUNT EVO
		x							PROPARGITE	COMITE II
		x							BIFENAZATE	ACRAMITE -4SC
		x							HEXYTHIAZOX	ONAGER OPTEK
	x			x	x				FLONICAMID	Carbine
	x			x	x		x	x	FLUPYRADIFURONE	SIVANTO PRIME
				x	x				PYMETROZINE	FULFILL [198
	x			x	x		x		SULFOXAFLOR	TRANSFORM WG

Potato Psyllid Consortium 2015

CHECK

BELEAF 2.8 FL OZ/A

BRIGADE 6.4 FL OZ/A

a b a a a a a b a a a a a

NUMBER COUINS

6
4.8
3.6
2.4
1.2
0

6-1-2015 6-8-2015 6-15-2015 6-22-2015 6-29-2015 7-6-2015 7-13-2015 7-20-2015 7-27-2015 8-3-2015 8-10-2015 8-17-2015 9-3-2015

Trial ID:

Potato Psyllid Consortium 2015

missing

a a a a a b a

NUMBER COUINS

5
4
3
2
1
0

CHECK

BELEAF 2.8 FL OZ/A

BRIGADE 6.4 FL OZ/A

6-22-2015 6-29-2015 7-6-2015 7-13-2015 7-20-2015 7-27-2015 8-17-2015 8-25-2015 9-3-2015 9-8-

Trial ID:

Neonicotinoid Conundrum

Beneficial including bee safety discussion

Discussion Points

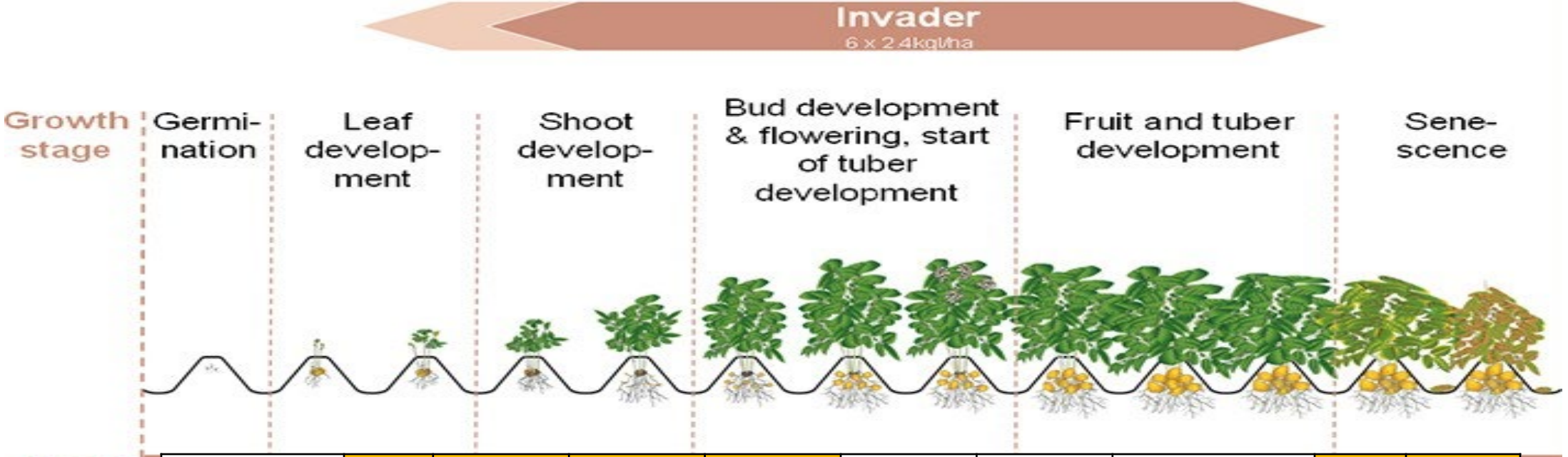
- Name your top 2 insect threats in potatoes you manage
- How do you scout for the top insect threats, what method do you use?
- Where is the most effective location to scout in your field?
- How often do you scout for insects in each field?
- What drives your decision on which insecticide to use?
- What is the most common beneficial insect in your potato fields?

Advanced-principles

- Understanding Threshold Based Insect Management
- Economic or treatment/action thresholds
- Columbia Basin Action Thresholds for Potato Insects
- Large versus small chewing insects (Beetle and worms) have no idea what this means
- Value of spraying versus or not

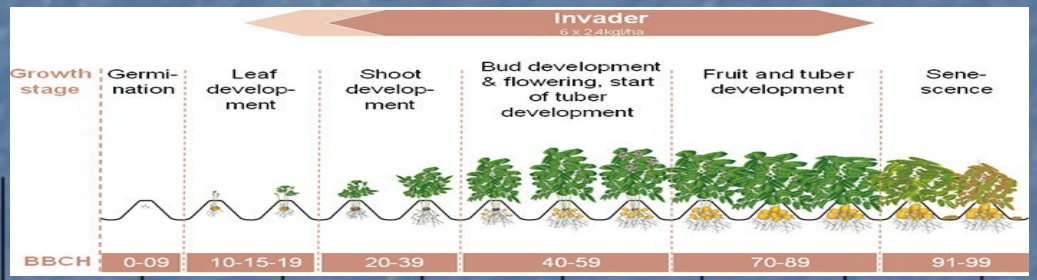
Key pests have changed over time…

- Focus initially on Wireworm, CPB, Aphids
- beet leafhopper
- two-spotted spidermite
- potato tuberworm moth
- potato psyllids
- Lygus? thrips?



Wireworm									
CPB									
Aphid									
Leafhopper									
Psyllid									
Loopers									
Mites									
Thrips									
Lygus									
Tuberworm									

Phenology of Insect Pests of Columbia Basin Potatoes



JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC

Wireworms

Beet Leafhopper (2002)

Colorado Potato Beetle

Aphids

Worms (1995)

Mites

Thrips (1995)

Tuberworm (2005)

Psyllids (2011)

Seed Treatment

Lay by

Plant

Harvest

What is IPM

- *Integrated Pest Management (IPM) is a sustainable, science-based, decision-making process that combines biological, cultural, physical and chemical tools to identify, manage and reduce risk from pests and pest management tools and strategies in a way that minimizes overall economic, health and environmental risks.*
- **Integrated Pest Management**, or IPM, is an approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops, harming animals, infesting buildings or otherwise interfering with our livelihood or enjoyment of life. IPM means responding to pest problems with the **most effective, least-risk option.**

How do IPM programs work?

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-tiered approach.

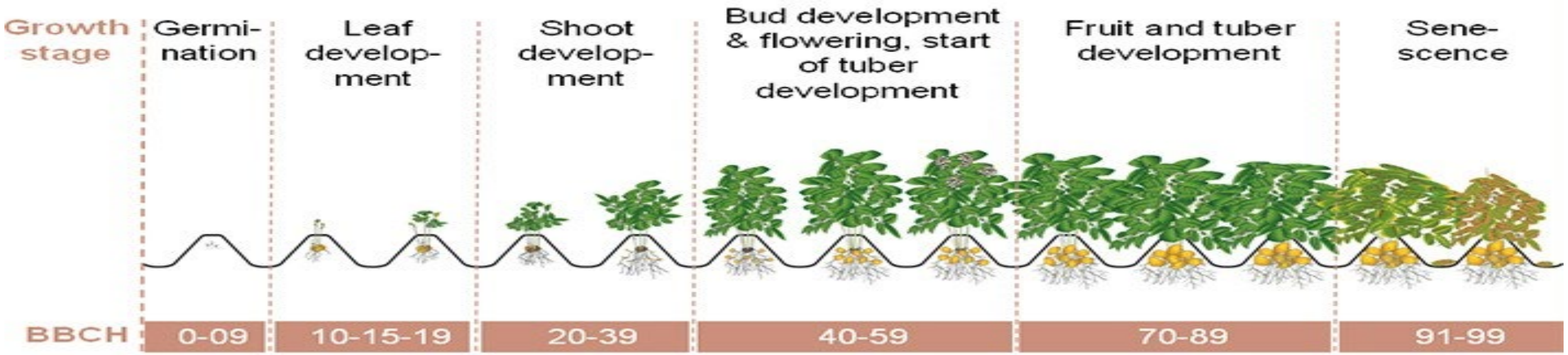
- **Set Action Thresholds**
- **Monitor and Identify Pests**
- **Prevention**
- **Control**

Set Action Thresholds

- Before taking any pest control action, IPM first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. The level at which pests will become an economic threat is critical to guide future pest control decisions.

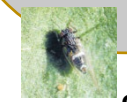
Monitor and Identify Pests

- Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed.



Wireworm									
CPB									
Aphid									
Leafhopper									
Psyllid									
Loopers									
Mites									
Thrips									
Lygus									
Tuberworm									

Early Potato=
Everything



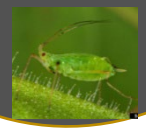
Pheromone
Trap

Wind

Sticky Trap
(height)

Sticky Trap

Alfalfa=
Everything



Sticky Trap

Stressed
areas, weeds
such as
watergrass

Corn

What to look for:
Stressed Plants
Holes
Frass
Beneficial Insect
Weeds
Movement

Sticky Trap

Onion

Prevention

- As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to prevent pests from becoming a threat. In an agricultural crop, this may mean using cultural methods, such **as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock**. These control methods can be very effective and cost-efficient.

Control

- Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk.

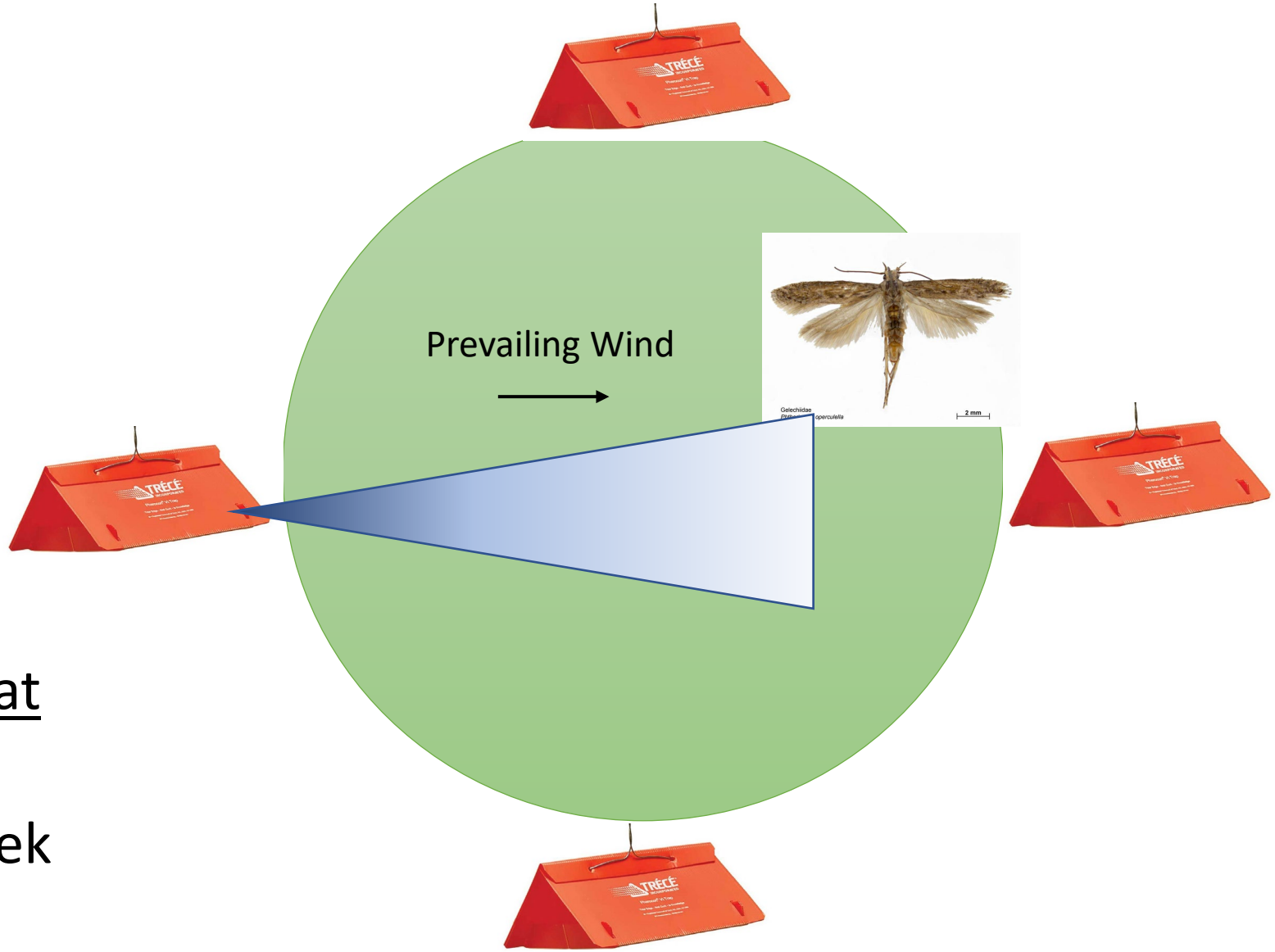
Control

- Effective, less *risky* pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding.
- If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.

Key Pests

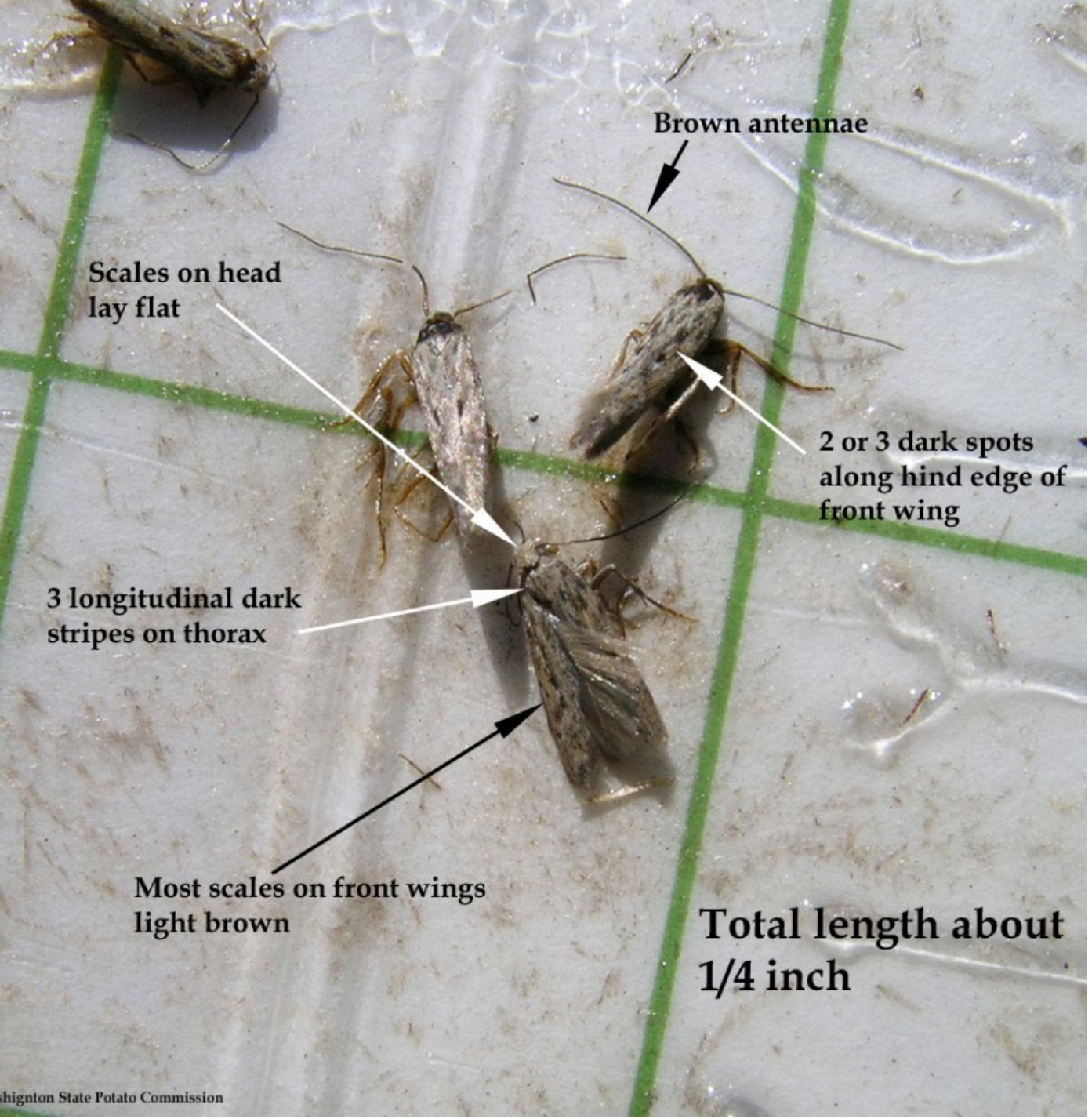
- Those in which Insect IPM programs focus on
- Can be crop type specific, regionally specific, time specific market specific
- Colorado potato beetle
- Potato Psyllid
- Potato Tubermoth

Potato Tuber Moth Scouting & Thresholds



Thresholds:

- 8-10 moths/trap/day <u>at susceptible stage</u>
- 56-70 moths/trap/week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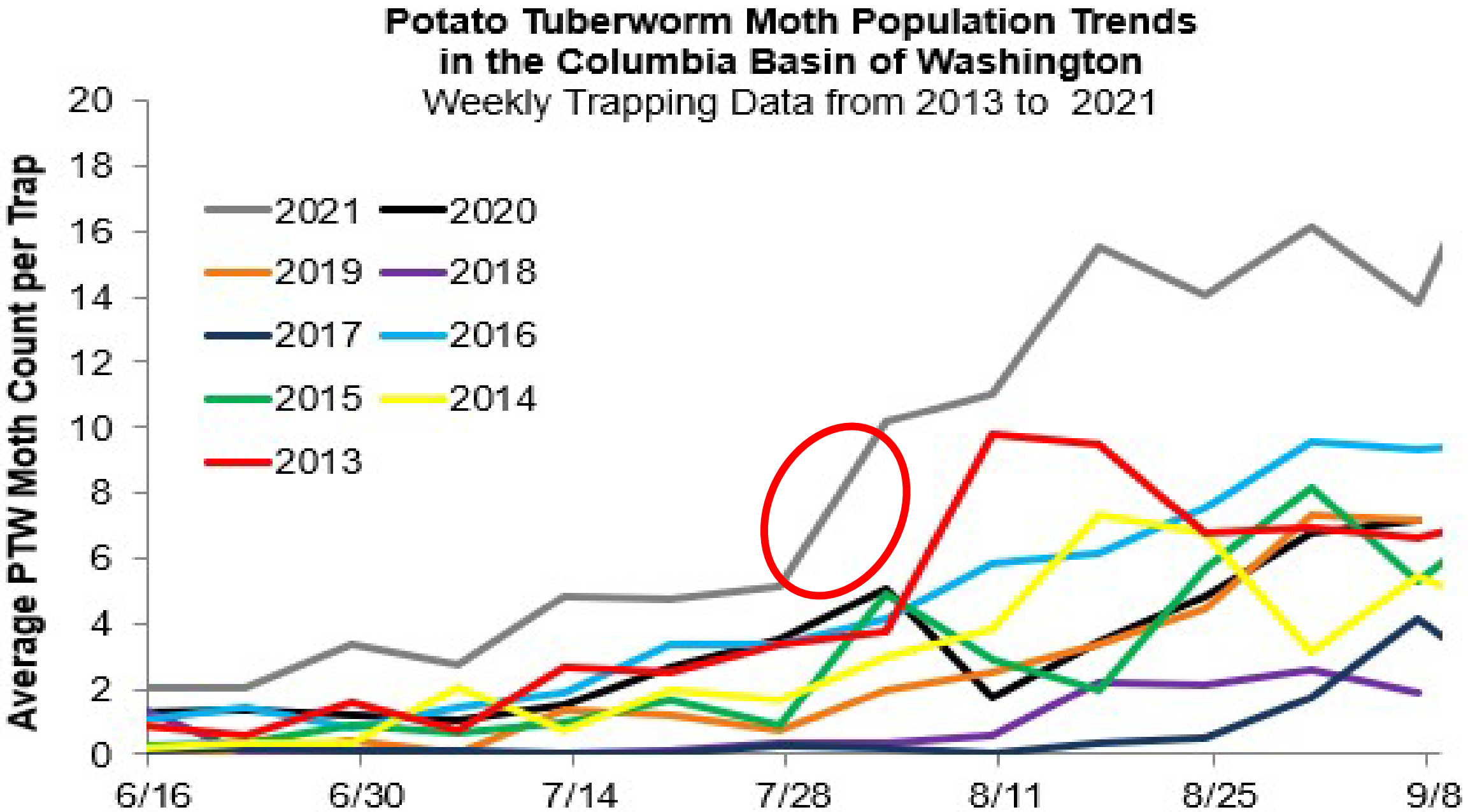


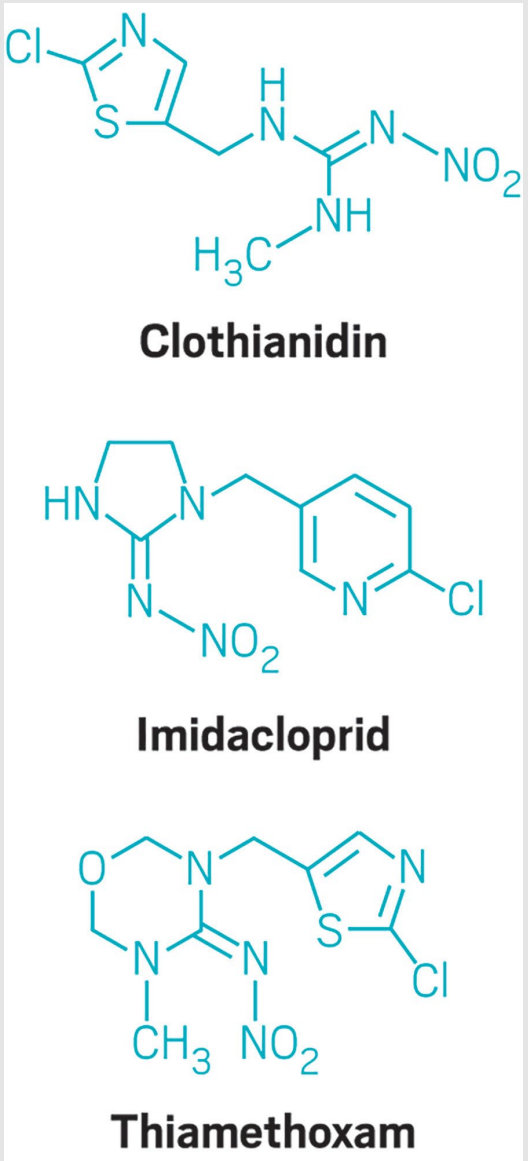
Courtesy: C. Wohleb WSU 2021

Potato Tuber Moth Control

- Elimination of cull piles and volunteers. Eliminate cull piles and volunteer potatoes to reduce overwintering stages, which are a source of next year's populations
- Soil moisture at and after vine kill. Keeping the soil moist via overhead irrigation prevents soil cracking. This is especially important later in the season when vines are beginning to die. In research at Oregon State University, applying 0.1 inch of water daily through a center pivot irrigation system from the time of vine kill until harvest decreased PTW tuber damage and did not increase fungal or bacterial diseases. The daily irrigation probably closed soil cracks, reducing tuberworm access.
- Length of time between desiccation and harvest. Field observations support the premise that PTW prefer green foliage to tubers for egg laying and feeding. When foliage starts to decline, tuber infestation increases. Adults move into the soil via soil cracks to find shelter from the light and to lay eggs on tubers, while larvae do so to find food. Thus, the length of time between desiccation and harvest is crucial. **The longer dead vines and undug tubers remain in the field, the greater the likelihood of tuber infestation.**
- Rolling or covering hills. Tubers that are exposed or close to the surface are at high risk for PTW damage. Do everything possible to maintain more than 2 inches of soil over the tubers during the season. Covering hills with 1 to 2 inches of soil immediately after vine kill significantly reduces tuber infestation
- Research at Oregon State University found that rolling of potato hills in sandy soil caused soil to slough off the hill, resulting in increased PTW damage. Thus, rolling is not recommended in areas with sandy soils.
- https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw594.pdf

Potato Tuber Moth Control

- Pesticide timing. Timing of insecticide application to reduce tuber damage is an important question. In 2005, trials in the Columbia Basin tested three insecticides (Asana, ~~Monitor 4~~, and Lannate LV), applied at different intervals (from 1 to 4 weeks) before vine kill. All insecticide treatments significantly reduced tuber damage. There was no advantage to beginning control efforts earlier
- Biology and Management of the Potato Tuberworm in the Pacific Northwest, PNW 594 (Oregon State University Extension Service)
- **Pay attention to PHI**
- **Dead vines=Risk of damage by PTW**
  - Coragen or Vantacor
  - **Pyrethroids**
  - Avaunt
  - Lannate
  - Rimon
  - Radiant/Blackhawk



The Importance of Neonicotinoid Insecticides and How to Produce Potatoes in the Northwest Without Them

Tim Waters, WSU

Alan Schreiber, ADG

Washington-Oregon Potato Conference

Thursday January 26, 2023

1:25 PM-25 Minutes