Economic Thresholds / Action Thresholds in Potato Insect Pest Management

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9:15 AM-45 Minutes

Objective

- To examine whether it is adjusting economic thresholds / action thresholds could change **insecticide use**, **improve insect pest management**, and **reduce pest management costs**, without negatively impacting potato yield and quality.

Partners

- WSU
- ADG
- Funded by WSPC
- Potatoes Processors (3)
- Growers (30+)
- Crop Advisors

Methods

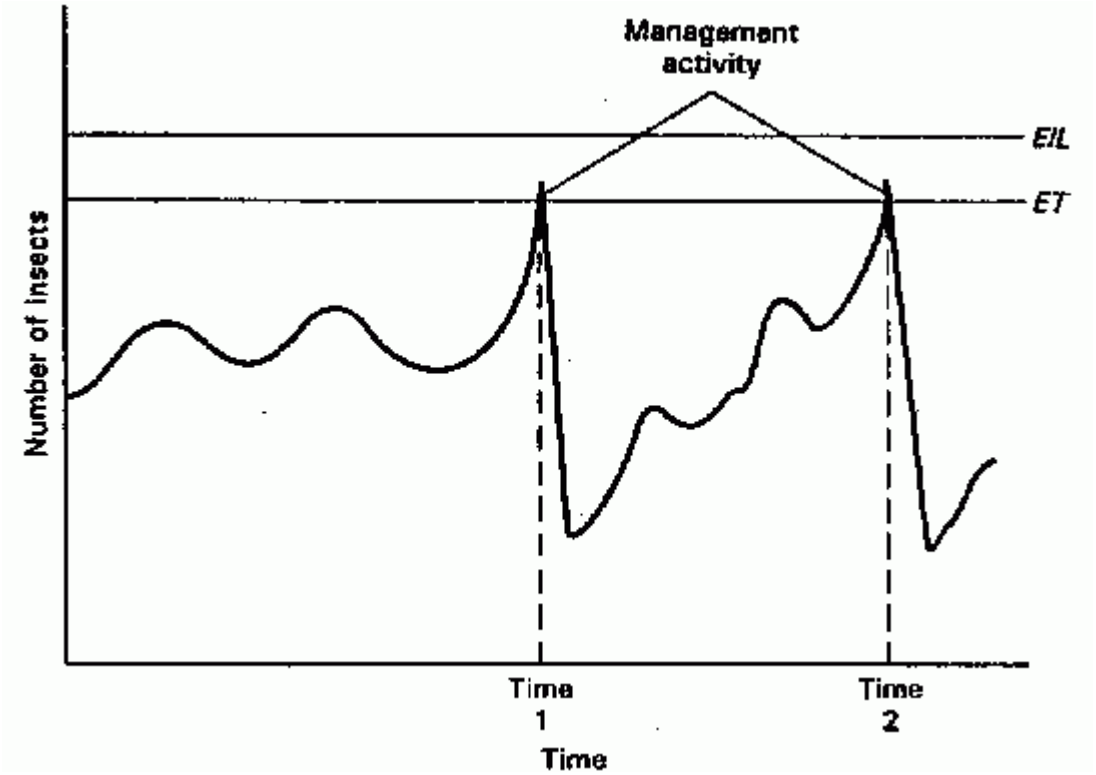
- Paired fields with similar production excluding insect management after planting
  - One field grower standard IPM,
  - One field enhanced IPM
- Limit variables – about 75% of fields were CW
- Fields sampled weekly, data reported back to producers, insecticide options discussed when thresholds met (E-IPM)
- Many interactions between Waters/Schreiber and with growers particularly as pest numbers neared thresholds.

Regions for our project

- North region was north of Highway 26
- Central region was Highway 26 to Pasco
- South region was south of Pasco – Benton and Walla Walla

Economic threshold

The economic threshold (ET) differs from the EIL in that it is a practical or operational rule, rather than a theoretical one. Stern et al. defined the ET as "the population density at which control action should be initiated to prevent an increasing pest population (injury) from reaching the economic injury level." Although measured in insect density, the ET is actually a time to take action.



We do not have economic thresholds for any insect pest of potatoes in the PNW.

Action Threshold

- Management guidelines for a particular insect pest include a population density, usually referred to as the "*action threshold*," that is used to determine if a control tactic is justified. As long as the pest density remains below this threshold no action is needed, but if the insect population density exceeds this level, a control action is recommended. How high or low this level is depends on how much damage can be tolerated, which in turn varies depending on the situation; for example, in the case of psyllids infected with the causal agent of zebra chip, there is no level of infection that we could reasonably tolerate. In agriculture we can determine the value of the product that we are trying to produce, and can set an *action threshold* based on this value

Table 1. Potential examples of action thresholds and insecticides used for the potatoes managed according to conventional practices and enhanced IPM practices.

Insect Pest	Standard Practice		Enhanced IPM	
	Action Threshold	*Insecticides*	*Action Threshold*	*Insecticides*
Colorado Potato Beetle	At detection	Pyrethroid insecticide	5% defoliation	Coragen, Rimon, Aza-Direct, Blackhawk
Green Peach Aphid	One aphid per plant	Vydate, Actara	5 aphids per plant	Beleaf, Fulfill
Thrips	5 per plant	Lannate, Torac Dimethoate, Mustang Max	20 per plant	Radiant, Blackhawk, Beleaf
Lygus	5 per 15 sweeps	Mustang Max, Vydate, Lannate	30 per 15 sweeps	Rimon, Transform
Potato Psyllid	Detection of eggs, larvae or adults	Lannate, Vydate, Torac, pyrethroids	1 psyllid per leaf or detection of LSO in population	Beleaf, Fulfill, Transform, Sivanto, Movento, etc.
Worms	First sign of defoliation	Pyrethroid insecticides	5 to 10% defoliation	Coragen, Rimon, Blackhawk
Beet Leafhopper	First detection in sticky cards	Pyrethroid or neonic insecticides	Detection by sweep net or detection of BLTVA in populations	Transform
Mites	At detection	Grower choice	At detection	Grower choice

PLRV have been effectively removed from the PNW potato system, presumably due to widespread use of neonicotinoid insecticides, particularly in the seed industry.

We think it is time to allow a higher level of aphids as long as PLRV is not present in the PNW.

The action threshold for CPB is quite different from first generation to second generation.

You can withstand significantly more CPB feeding on second generation than you can on the first generation.

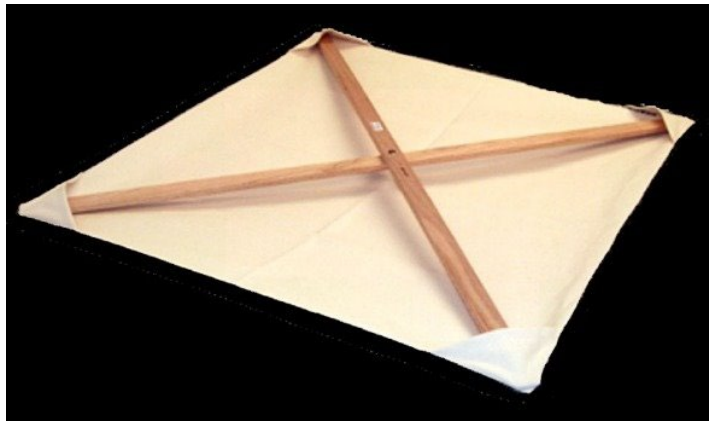
Closer to harvest the more mites you can tolerate.

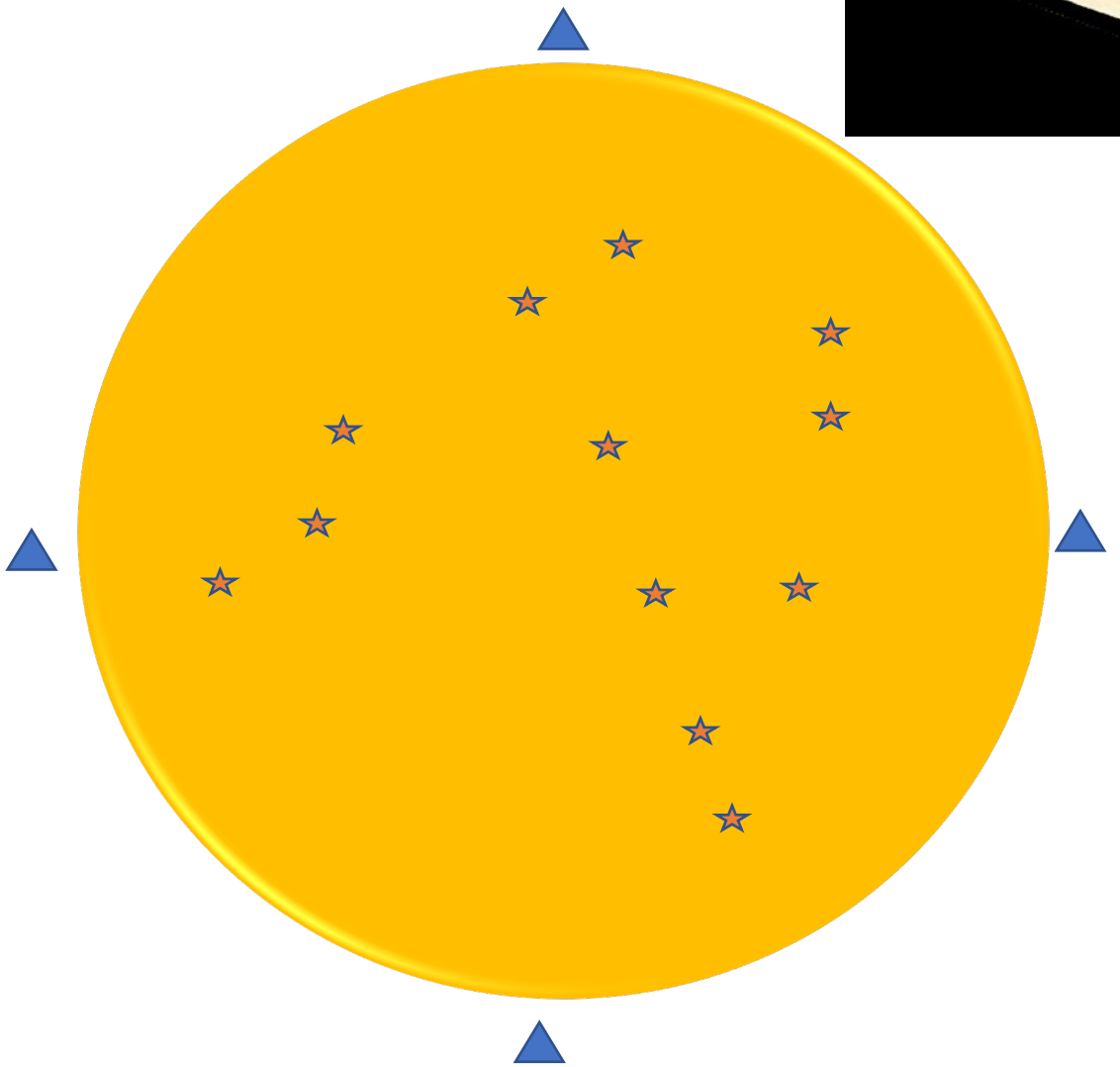
Methods

- 2019 – 11 pairs of fields
  - Central, South
  - 2,372 acres
  - 2 scouts
- 2020 -- 18 pairs of fields
  - North, Central, South
  - 4,000 acres
  - 4 scouts
- 2021 -- 17 pairs of fields
  - North, Central, South
  - 3,600 acres
  - 4 scouts

Methods

- Beating sheet samples
  - Exterior and interior
- Leaf samples
- In furrow view





Results-Arthropods – Over Three Years

- More pest insects in **South Columbia Basin-** especially aphids, Lygus, thrips and worms
- CPB is becoming more problematic, particularly from Basin City south.
- Overall pest populations fluctuated year to year with different pests being more of a problem each year, except for CPB which was the most treated for insect pest each year.
- (A note, we had fields in 2021 that had volunteer potatoes from four years ago.)

Results- Arthropods – Year One

- When comparing the eleven enhanced IPM fields to the eleven grower standard IPM fields there were some noticeable differences in insect populations.
- There were more small CPB larvae (3%), lygus nymphs (19%), lygus adults (11%), loopers (72%), and cutworms (135%) in the enhanced IPM fields as compared to the grower standard IPM fields.
- Recognizing that the enhanced IPM fields were intentionally managed at higher thresholds it is not surprising that some pest populations were higher in the enhanced IPM fields.

Results-Arthropods – Year One

- Enhanced IPM fields had 40% more thrips than the grower IPM fields and slightly more psyllid nymphs, although psyllid numbers were low in all locations.
- The enhanced IPM fields had 20% fewer aphids and 70% fewer mites than the grower IPM fields.
- Again, this is to be expected, assuming we were managing the enhanced IPM fields correctly.

Results – Arthropods – Year Two

- There were 36.6 times as many wingless aphids south region than in the north and central regions combined.
  - Most of the aphids in the south were from three fields that reached astoundingly large numbers.
  - The number of aphids per plant was so high that field scouts stopped counting when aphid numbers surpassed 200 per sample
- The 14 south fields had 6.5 times as many Lygus as northern 22 fields.
- The average numbers of thrips per field in the south, central, and northern regions were 212, 61, and 80, respectively.
  - Curiously, thrips numbers seem to be higher in the north Basin than in Central Basin, counter to the trend with all other insect pests.
- An average of 41 worms (loopers) were collected per field in the south as compared to 3.7 per field in the north and central regions.

Results – Arthropods Year 1 versus Year 2

- Based on two years of data from this project, the level of insect pest pressure in the south growing region is substantially higher than the central and northern potato growing regions of Washington's Columbia Basin.
- The south region had more Colorado potato beetle (CPB) eggs, large larvae and adults, wingless and winged aphids, Lygus, thrips, worms, and stink bugs than the north and central regions.
- There is black hole for CPB in the east Central Basin where CPB does not exist at any level – all three years.
- We expect that year three data will be similar to year one and year two.

Results-Interior vs. Exterior samples

Sample Location	CPB					aphid			Lygus			thrips
	eggs	small	large	adult		wingless	winged		adult	nymph		
Exterior	36.3	256.0	96.8	105.8		184.0	58.0		180.3	57.8		554.3
Interior	2.6	32.0	20.0	15.3		1815.8	83.1		288.8	96.5		67.8

These results indicate that scouting for CPB and thrips is more effective on the edge of the field but scouting for aphids and Lygus is probably best on the interior of the field

Results- Insecticide Applications – Year One

- Almost all fields had at plant or layby neonicotinoid insecticides, and many had Vydate programs – for nematodes; not included in analysis
- Average number of insecticide applications was 3.5; the range was zero to 8 applications.
- The enhanced IPM fields had an average of **2.5** insecticide applications and the grower IPM fields had an average of **4.5** insecticide applications.
- In the Central Basin the enhanced IPM fields had an average of **2.0** applications while the grower IPM fields had an average of **2.3** applications.
- In the South Basin the enhanced IPM fields had an average of **3.2** applications while the grower IPM fields had an average of **7** applications.

Results- Insecticide Applications – Year Two

- Average of 3 applications per field
- GSTD IPM Fields had **60** insecticide applications
- Enhanced-IPM fields had **43** insecticide applications
- Insecticides used across the 2020 program were Agri-Mek (11), Lannate (9), Beleaf (8), Asana (7), Dimethoate (6), Belay (6), Coragen (6), Mustang Maxx (6), Fulfill (5), Radiant (5), Oberon (5), Rimon (4), Cinnerate (4), Lambda cyhalothrin (4), Cyfluthrin (4), Transform (3), Comite (2), Leverage (2), Athena (2), Avaunt (1) and Blackhawk (1).
- Of the 21 insecticidal products used in the program in 2020, 14 modes of action are represented which is a diverse array of products and modes of action.
- The diversity of insecticides is a very good sign for the industry.
- The number of pyrethroid insecticides applied is concerning.

Results- Insecticide Applications

	Foliar Insecticides		Vydate	
Region	GSTD	IPM	GSTD	IPM
North	19	17	21	17
Central	16	11	0	0
South	25	15	15	10
Total	60	43	36	27

- 29% reduction in insecticide applications across the program
- North had an 11% reduction
- Central region had a 32% reduction
- Southern region had a 50% reduction

Results-Costs of Insect Control Year One

- Based on average retail cost of insecticide, and application (surfactants and other additives not included) (Does not include seed treatment or Vydate)

Location	Grower	IPM $/A	GSTD $/A
South	1	71	146.5
North	2	32.5	32.5
North	3	80	115
South	4	139.5	187
North	5	25	56
South	6	123.5	199.5
North	7	50	28
South	8	10.5	124
North	9	153	153.5
North	10	9	9
	Sum	**694**	**1051**
	Average $/A	**69.4**	**105.1**

Average South Basin Insecticide costs
$164.25 grower IPM versus $ 86.13 for enhanced IPM.
Average North Insecticide costs $65.67 for grower IPM versus enhanced IPM $58.25.

Results-Costs of Insect Control Year Two

- Based on average retail cost of insecticide, and application (surfactants and other additives not included) (Does not include seed treatment or Vydate)
- Average costs per acre
  - North-$75
  - Central-$125 (fewer fields and major CPB outbreak)
  - South-$69
- Average cost per acre by tactic (almost same as year 1)
  - GSTD IPM-$104
  - E-IPM-$63
- Average cost per acre by tactic and region
  - North
    - GSTD-$84
    - E-IPM-$70
  - Central
    - GSTD-$145
    - E-IPM-$106
  - South
    - GSTD-$92
    - E-IPM-$47

Results-Yield and Quality Year 1

	Paid Tons/Acre	% Usable	% Bruise Free	Culls%	Spec Grav	% > 6 oz	#1 > 6%	DarkEnds%	IntDisc%	SerNem%	IBS%	Net_necro%
Grower Standard	37.86	88.85	59.44	7.17	1.08509	74.68	71.37	0.05	0.34	0.00	0.03	0.02133
IPM	38.08	87.23	60.69	10.28	1.08506	73.55	68.98	0.13	1.60	0.00	0.07	0.00963

Results-Yield and Quality-Year 2

Insect Management	Yield (Ton/A)	Usable (%)	Bruise Free (%)	Specific Gravity	Culls (%)	Process Culls (%)
Enhanced IPM (IPM)	38.6	89.1	49.4	1.083	5.6	5.3
Grower Standard (GSTD)	41.8	88.8	52.3	1.085	6.9	4.2

Summary

- The objective of this program was to determine if applying IPM tactics such as using action thresholds, not spraying insecticides preventatively or in a calendar fashion, use of selective insecticides and intensive scouting could substitute for the use of insecticide applications.
- It appears that in some cases this is possible. For this to happen there must be significant pest pressure.

Summary

- Four paired fields had no foliar insecticides applied to either the IPM field or the grower standard field indicating that when given the absence of pest pressure, growers do not apply insecticides and there is no opportunity for reduction of insecticides.
- However, for most fields with heavy pest pressure it was typical to reduce insecticide use by two to three applications.
- In the most extreme example, the grower's standard field had 8 insecticide applications while the enhanced IPM field had 3.
- The results suggest that providing growers with supplemental scouting support and additional pest management expertise can result in managing potato insect pests with reduced insecticide use without any detectable reductions in yield or quality.

Summary

- Pest pressure generally increased from north to south, but this is not a uniform or always true statement.
- Using enhanced IPM did not significantly change yield or yield quality
- There is strong interest from growers/production managers/crop advisors for more and better pest management information.
- Our overwhelming obstacle in this project was these industry members are quite busy and often do not have enough time to deal with complicated pest management issues but were generally very receptive to receiving our information as evidence in significant changes made based on our input.

A word about neonictinoid insecticides

- Admire Pro, Belay, Cruiser, Platinum and Actara.
- These are the most important group of insecticides to the potato industry.
- They are under threat due a variety of reasons but most prominent of these is its threat to pollinators, particularly honey bees.
- End users of potatoes (e.g. Wal Mart) and other businesses have talked about prohibiting use of this class of insecticides.
- For the record, there are no honey bees, no pollinators present in potato fields.

Discussion Points

- How do you determine when to control a potato insect pest?
- When do you control Colorado potato beetle?
- When do you control green peach aphid?
- Do you incorporate counts of beneficial insects in insect pest management decisions?
- Name the non chemical control methods you use to control insect pests in potatoes?