The Future is Coming Fast

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An independent, private agricultural research and information service

I never met a pesticide that I did not like.

I have no preference for conventional over organic or biological products. I just need efficacy, spectrum of control and not cost an arm and a leg.

Biopesticide versus biofertilizer versus biostimulant

Academic Background

- B.S. Biology, Truman State University (MO).
- M.S. in Entomology, University of Missouri.
- Ph.D. in Entomology (pesticide toxicology), UM
- Dissertation was on documenting and preventing the development of insecticide resistance in corn earworm and tobacco budworm.

Work Background - EPA

- Recruited out of graduate school by EPA.
- Office of Pesticide Program, Biological and Economical Analysis Division. Washington, D.C.
- Worked on Section 18s, Section 3 registrations, Integrated Pest Management, GMO issues, organophosphates, carbamates, pyrethroids, lots of things.
- Tremendous experience. In some ways, set up for the rest of my professional life.
- Some the best friends I have ever had were at EPA, and some are still there. (Hello Neil Anderson - we started in BEAD the same week.)
- My Branch Chief, Janet Anderson, started BPPD

My Bronze Medal for work done while at the Agency.

But good things come to an end, and I moved from one Washington to another.

The reason from going from EPA to Washington State – a key plot point for this talk:

- Amendment to FIFRA in 1984
- Amendment to FIFRA in 1988
- Amendment to FIFRA in 1996
- These amendments to FIFRA resulted in the wholesale loss of pesticides for crops, particularly those produced on limited acres.
- Specialty crops – which are the basis of PNW agriculture.
- WSU hired me away from EPA specifically to address the unmet pest management needs for specialty crops of Washington.
- These amendments created a pest management demand that I have spent my entire professional career addressing.
- And is strong reason why there is such a need for BPIA.

Washington State University Era

- Hired to be WSU's pesticide specialist.
- State liaison to IR-4.
- Reviewed all pesticide recommendations made by WSU.
- Pest management research and extension.
- IR-4 field research center, conducted between 20 and 30 GLP projects on a wide array of crops.
- Instrumental in creating the Washington State Commission on Pesticide Registration. (Addie Waxman)
- Took the lead on Section 18s and 24c registrations.
- Biggest area was working on unmet pest management needs caused by the loss of conventional pesticides.

Post WSU – Started my company

- 1998 - formed a private agricultural professional services company that focuses on agricultural research, consulting and association management.
- Agricultural research for ag chem companies, grower organizations, USDA/IR-4, anybody who will write a check.
- Consulting on pesticide and related environmental issues.
- Administers Washington Asparagus Commission, Washington Blueberry Commission and the Washington State Commission on Pesticide Registration.
- 2004 – started farming.
- Primary area of emphasis was fulfilling unmet pest management needs.

We have a 60 acre research farm in the Columbia Basin, a small research station in northwest Washington, and a tree fruit research site near Wenatchee.

"Dear Sister, I received your card some time ago but was to busy to answer it. I am fine and dandy and this fine you the same. This is our harvest crews. I will write back more when I get time soon. From Albert."

My father's side of the family arrived in the U.S. in 1855 and has only farmed.

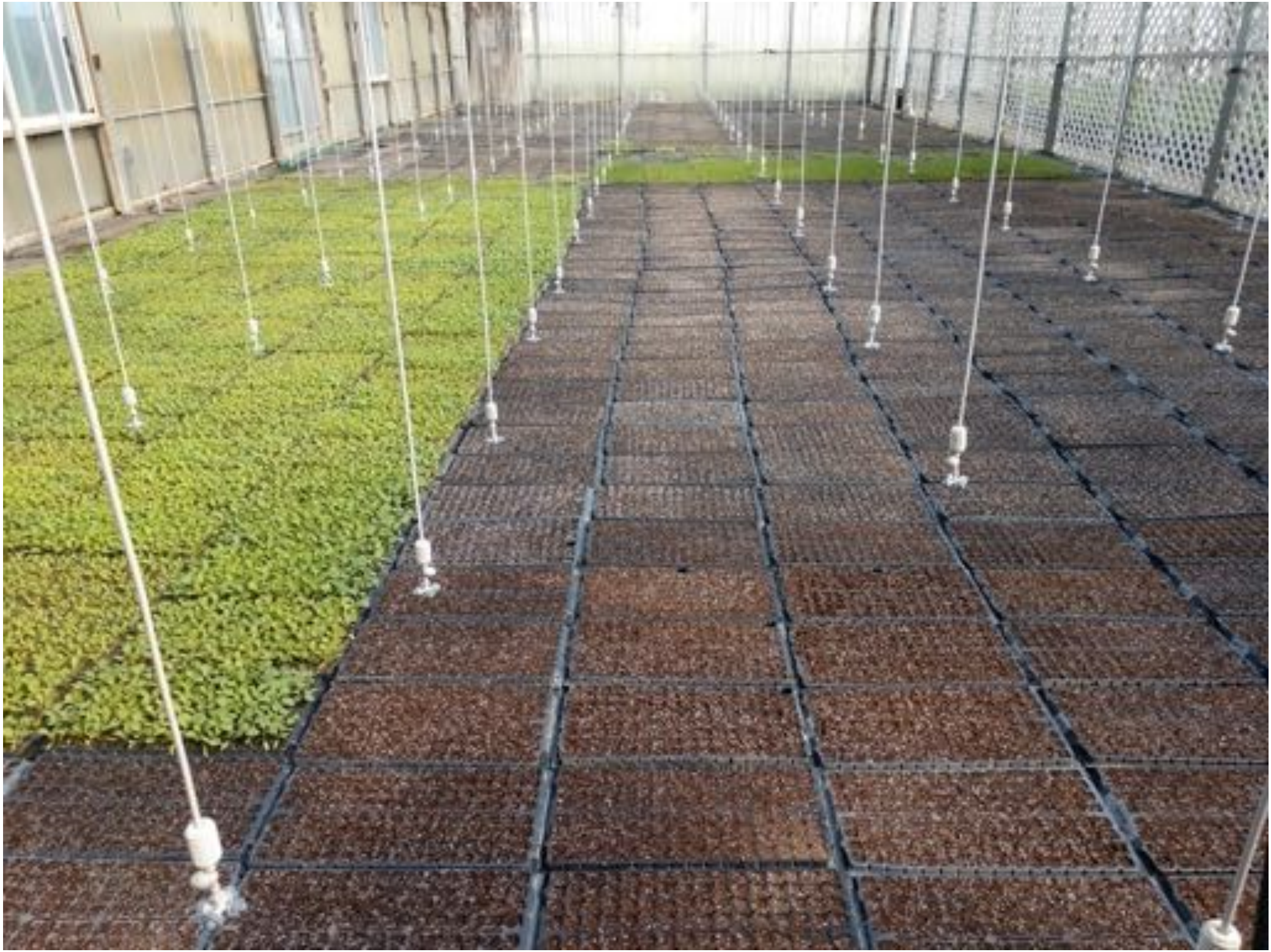
I grew up on a diversified Midwestern farm…….

I grew up with corn, soybeans, alfalfa and Herefords

I ended up in the most diverse temperate agriculture in the world.

Washington (and OR and ID)

- Has the most diverse temperate agriculture in the world.
- How many crops are grown in WA?
- Not sure, nobody knows, but I have list that has 350 different crops and crop groupings.
- The true number has to approach 400.
- Everyone of them has it own set of insect, fungi, viruses, nematodes and other pests.
- The pest problems are overwhelming us.




Local Organic
Charentais Melons
Smooth light-green striped rind with creamy-yellow, salmon flesh,
superb French gourmet flavor.
$1.79 lb
Grown in Washington/Schreiber and Sons
6327
northwest


AUG 5 2005

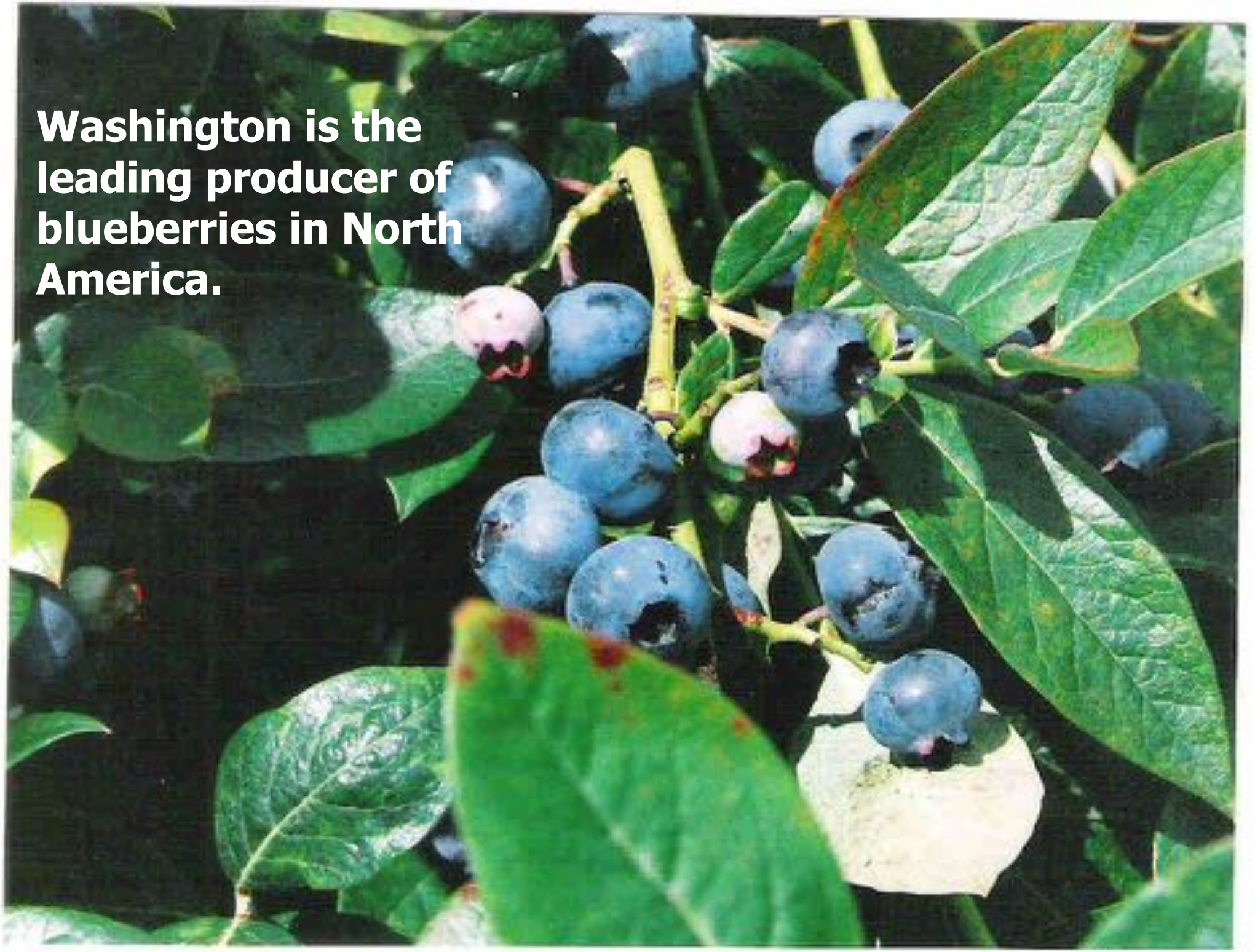

September, 2017


May, 201

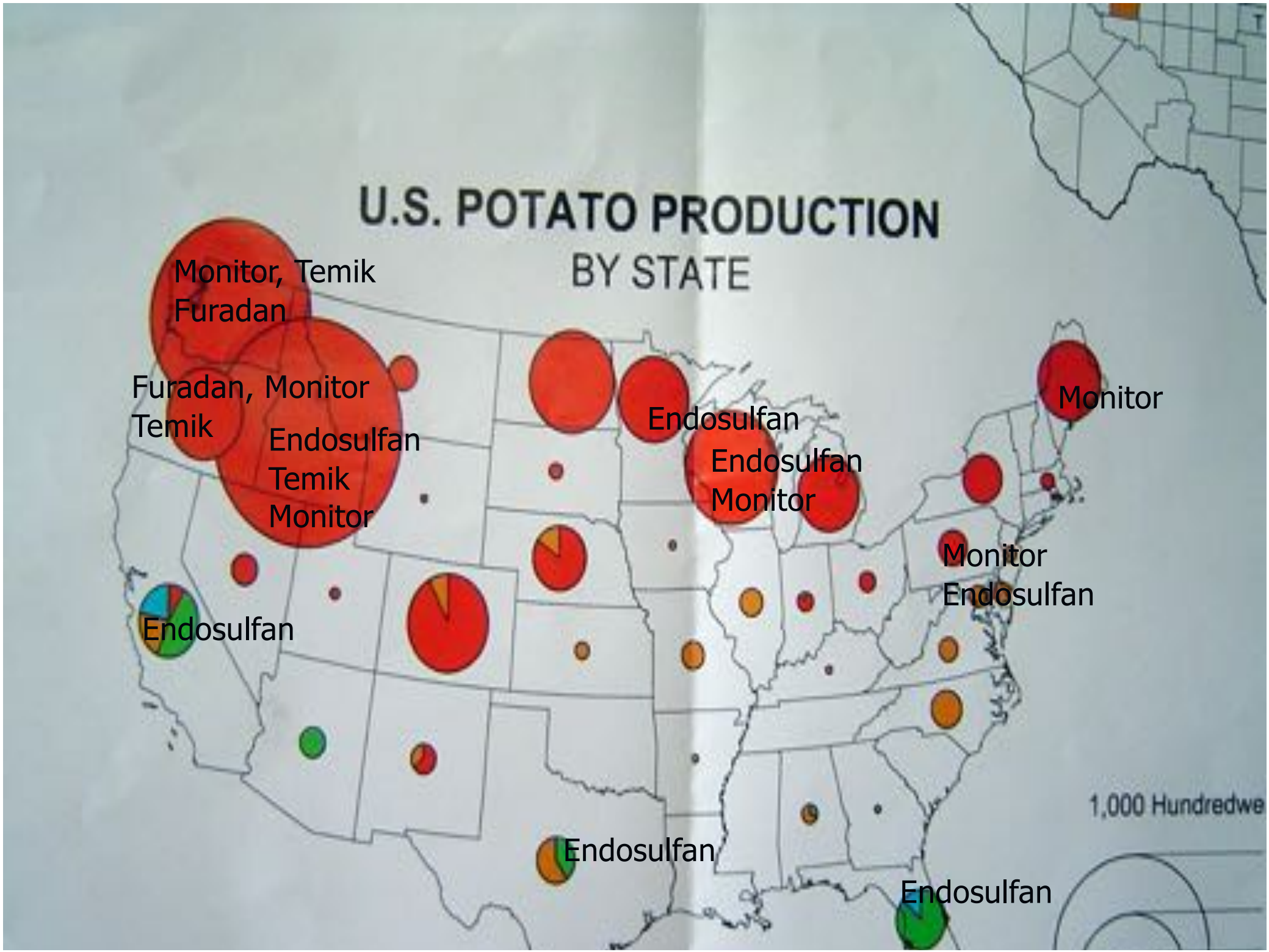

June, 2017


August, 2017

I have come a long way from when I was 12 and riding my pet steer, Ferdinand, in the feed lot next to a field of soybeans.


Washington is the leading producer of blueberries in North America.


Washington has the highest
yielding potatoes in the world.


U.S. POTATO PRODUCTION
BY STATE
Monitor, Temik
Furadan
Furadan, Monitor
Temik
Endosulfan
Temik
Monitor
Endosulfan
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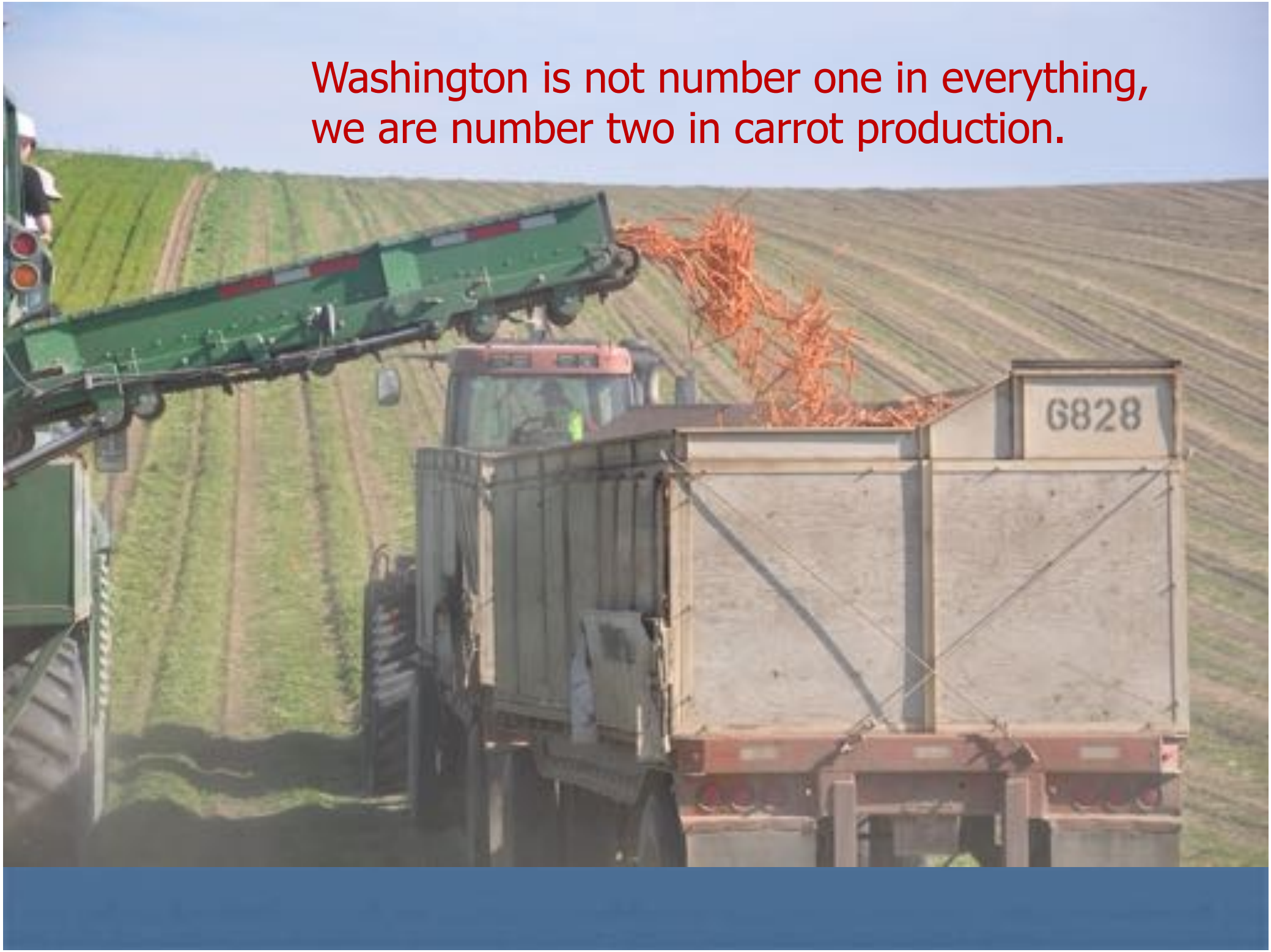
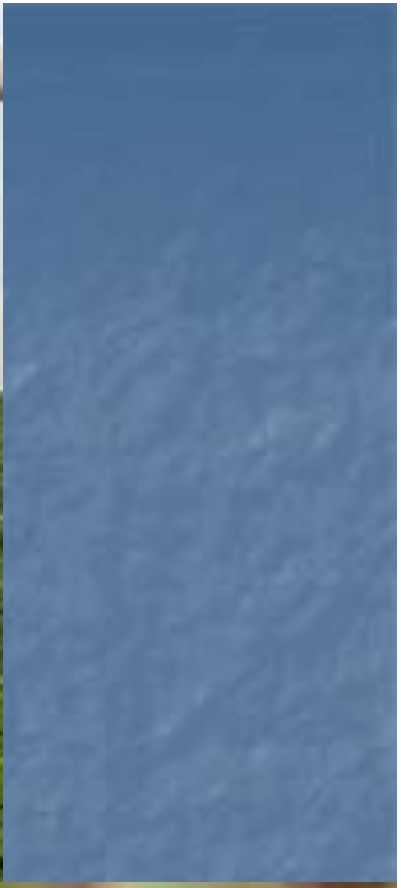
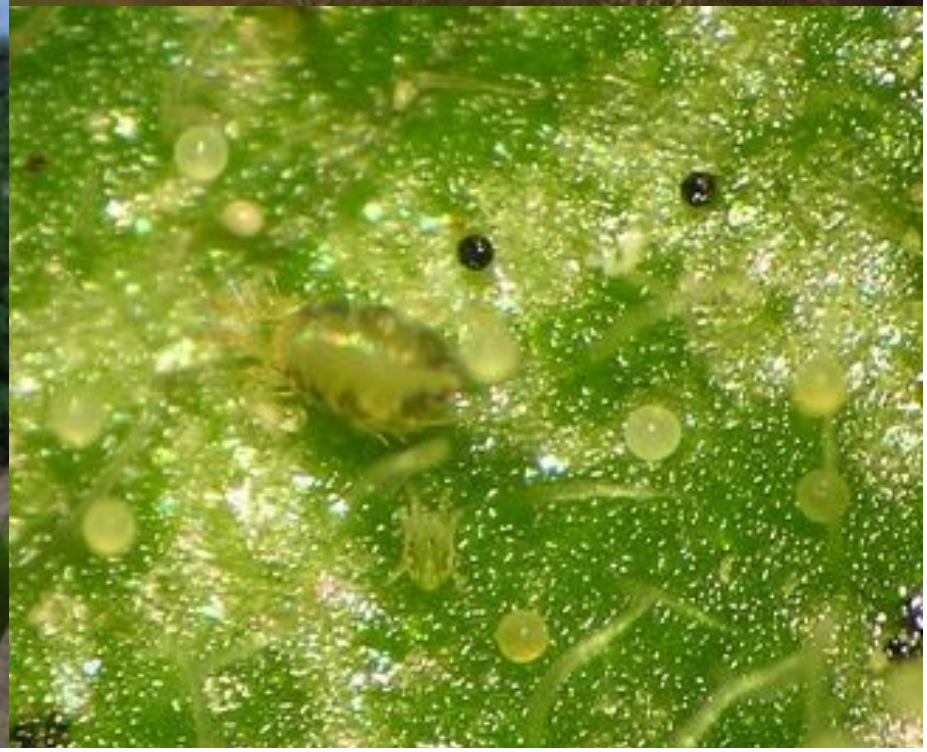
Sweet cherries are just one of
many crops that Washington is
the national leader in production.


Washington is not number one in everything,
we are number two in carrot production.
G828

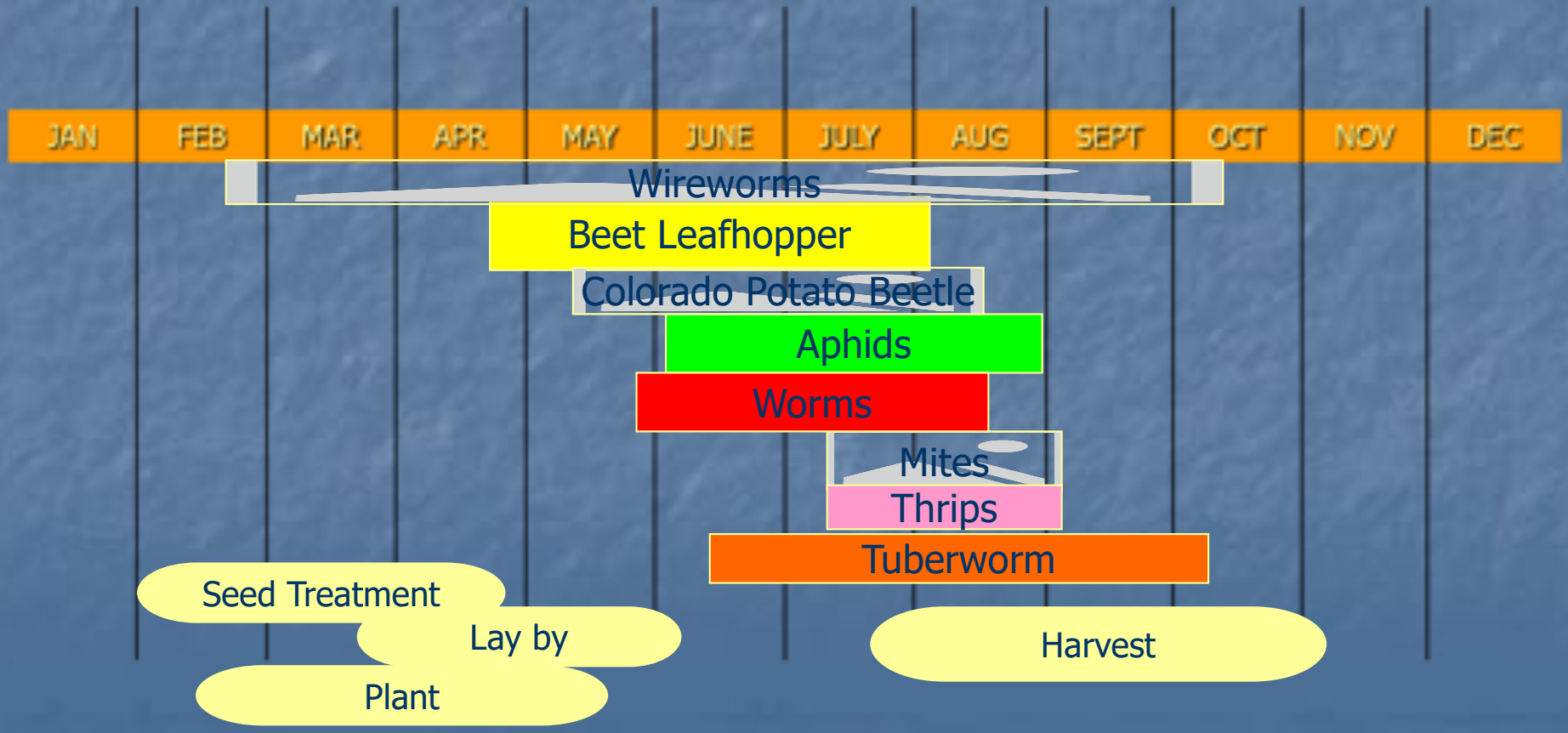
Most Washington wheat is soft white winter and is exported through the Pacific Rim and the rest of the world. Exports are a very big deal in the PNW. A higher percentage of Washington's agriculture is exported than any other state.




JUL 30 2004



Phenology of Insect Pests of Columbia Basin Potatoes




KEEP REFRIGERATED. GARDER AU FROID
WINTER CREEK
MEDIUM / MOYENNE

Ethyl parathion (a case study for specialty crops)

- Ethyl parathion was one of my products at EPA. It was an old highly acutely toxic organophosphate registered on 70+ crops.
- I determined the benefits of the product for the benefit risk calculation made during its reregistration.
- I was responsible for registrations on specialty crops. For some of the crops for which we had no data, I was clueless on what the crop even was and had no way to figure out who even to talk to about it (e.g. currants).
- During the process, registrations were dropped for all the specialty crops because we had no data. No data = no benefits. Registrations were kept on a dozen or so crops for which we had data, all of which were large acre crops.

During the first week on my job at WSU I got a call from a currant grower.

He said "Someone at EPA cancelled ethyl parathion and it was the only thing we had to control the currant cane borer, can you help me?"

The loss of conventional pesticide registrations created a pest management crisis.

Ground zero for this situation has been the Pacific Northwest (and plenty of other locales).

This is still an unfolding crisis.

Cancellation of all chlorpyrifos tolerances; the pending loss of diazinon are the latest examples of this.

Tolerance Revocations: Chlorpyrifos
Posted by the Environmental Protection Agency on Aug 29, 2021

Summary

On April 29, 2021, the United States Court of Appeals for the Ninth Circuit ordered EPA to issue a final rule concerning the chlorpyrifos tolerances by August 20, 2021. Based on the currently available data and taking into consideration the currently registered uses for chlorpyrifos, EPA is unable to conclude that the risk from aggregate exposure from the use of chlorpyrifos meets the safety standard of the Federal Food, Drug, and Cosmetic Act (FFDCA). Accordingly, EPA is revoking all tolerances for chlorpyrifos.

Dates

This final rule is effective October 29, 2021. The tolerances for all commodities expire on February 28, 2022.

The loss of chlorpyrifos is a really big deal for us.

One of the critical value of chlorpyrifos is its ability to control soil pests.

- Onion maggot
- Seed corn maggot
- Cabbage maggot
- Corn rootworm
- Soil leps. such as cutworms
- Mint root borer
- Garden symphylan

Chlorpyrifos is registered on a wide range of crops

- Sweet corn, asparagus, dry beans, green beans, all of the beans, broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, collars, kale, kohlrabi, mustard greens, green peas, radish, turnip, grapes, cranberry, Christmas trees, among others.
- And on all of the corresponding seed crops.
- In the PNW it is used on corn at plant, foliar worm control, soil insect pests, aphids and some more obscure pests.
- One of its advantages is its ability to control mixed assemblages of pests.

24cs for chlorpyrifos in Washington

- All 24cs held by Corteva for Lorsban Advanced
- WA 090002 grapes for mealybug, cutworms
- WA 090004 trees for pulp, several insect species
- WA 090010 grasses grown for seed, several insect species
- WA 090011 carrots grown for seed for lygus, cutworms – important for Lygus pre bloom.
- WA 090012 Christmas trees, for several insect species.

The conventional products that we are losing will not be fully replaced by conventional synthetic products.

- The rate of new synthetic product registrations is not keeping up with the loss of products.
- New conventional products are narrower in spectra of control.
- The difference has to be made up with biologicals.
- Lots of biologicals.
- It will take several different biologicals to serve as replacements just for chlorpyrifos.
- The need for biologicals is increasing.
- Hundreds of biological products are needed to replace the loss of conventional synthetic pesticides.
- Biofertilizers and biostimulants are part of this.

Export markets (need biologic products)

- If you want to export to the EU, you almost have to be organic or rely on biologicals due to their highly restrictive maximum residue limits.
- Let's take hops for example… 40% of the U.S. hop production is exported to the EU. Last year the EU started enforcing a 0.5 ppm MRL for chlorate (byproduct of use of chlorine).
- All hops are irrigated by drip, growers use chlorine dioxide to keep lines clean, but research we conducted in 2021 showed standard line cleaners caused chlorate residues in hops above the MRL.
- The industry needs a biological drip line cleaner.
- Export commodities increasingly need biologicals.

The loss of organophosphate insecticides is most impactful on specialty crops

- The 2022 Washington Legislature provided research funds to develop alternatives to OPs:

Sec. 603
$500,000 of the general fund—state appropriation for fiscal year 2023 is provided solely for the Washington state commission on pesticide registration to fund research to develop alternatives for growers currently using organophosphate pesticides.

- Much of this research will involve looking at biologicals.

Initial OP alternative funded projects funded by the WSCPR

- Identifying alternatives to organophosphates for control of seedcorn maggot and wireworm in vegetable cropsX
- Symphylan control in vegetable seed crops
- Asparagus chlorpyrifos replacement projectX
- Mealybug management without chlorpyrifos or imidacloprid
- Oak leaf volatiles for pest suppression and disease management
- Insecticide alternatives to chlorpyrifos for mint root borer control on mint
- Alternatives to organophosphates on alfalfa grown for forage and seed
- Organophosphate alternatives for X-disease vectoring leafhoppersX
- Diazinon replacement for Lepidopterous pests of raspberry and blueberry
- Evaluation of B. bassiana as an alternative to the organophosphate dichlorvos for bed bug control

For me the emblematic specialty crop pest is the European asparagus aphid

- Introduced pest.
- Obligate feeder on asparagus.
- Toxic spit
- If not controlled, it will kill the plant.
- Action threshold is one aphid in field.
- The inability to control this pest was why there was virtually no organic asparagus in the U.S.
- Loss of disulfoton.

European Asparagus Aphid

This is a production ending pest.
The industry has been in an emergency situation for controlling the aphid, with 9 years of a Section 18 for lambda cyhalothrin (Warrior). They now rely exclusively on sulfloxaflor (Transform).

The Washington Asparagus Commission wanted an organic means to control European asparagus aphid.

Seven applications, every seven days, four replications, heavy pressure, counts for 49 days.

Trt No.	Treatment Name	Total aphids per plant	
8	Ecozin	261.0	a
5	OXIDATE	215.5	ab
7	NEEMIX	211.3	ab
4	Saf-T-Side	203.4	abc
1	UNTREATED CHECK	186.0	abc
3	SUCRASHIELD	176.0	abc
2	PESTOUT	128.3	bcd
6	AZA-DIRECT	121.5	bcd
11	Pyganic/Ecozin	92.5	cd
9	Pyganic/Aza-Direct	64.3	d
10	Pyganic/Neemix	59.5	d

Table1. Asparagus aphid insecticide trial, ranked by total number of aphids.

Rating Date				Aug-20-2019	Aug-27-2019	Sep-3-2019	Sep-10-2019	Sep-17-2019	
SE Group No.				1	2	3	4	5	7
Rating Type				Aphid count	Aphid count	Aphid count	Aphid count	Aphid count	Total count
Rating Unit				Number	Number	Number	Number	Number	Number
Number of Subsamples				2	2	2	2	2	2
Days After First/Last Applic.				0 0	7 7	14 7	21 7	28 7	
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code	1	2	3	4	5	6
1	Untreated				5.1a	6.1a	5.9a	5.4a	6.3a	23.6 a
10	Venerate XL	4	qt/a	ABCD	6.6a	3.1bc	2.9b	2.1b	1.4bc	9.5 b
8	Aza-Direct	1.5	pt/a	ABCD	6.9a	3.4b	2.5bcd	1.8b-e	1.1bc	8.8 bc
8	Pyganic 1.4EC	1	qt/a	ABCD						
5	Aza-Direct	2	pt/a	ABCD	6.3a	2.6bcd	2.8bc	2bc	1.3bc	8.6 bc
6	Pyganic 1.4EC	2	qt/a	ABCD	4.9a	2.3cd	2.3bcd	1.9bcd	1.5b	7.9 bcd
12	Cinnerate	30	fl oz/a	ABCD	5.8a	3.0bcd	2.3bcd	1.6c-f	0.9bc	7.8 b-e
9	Grandevo	3	lb/a	ABCD	6.5 a	2.8 bcd	2.1 cd	1.6 c-f	0.9 bc	7.4 cde
11	Veratran D	10	lb/a	ABCD	5.3a	3.0bcd	2.3bcd	1.4efg	0.6c	7.3 cde
4	Transform	1.5	oz/a	A	7.8 a	2.4 cd	2.1 cd	1.5 def	0.6 c	6.6 de
2	Warrior II	1.92	fl oz/a	A	5.1a	2.1d	2.0d	1.4efg	0.6c	6.1 de
3	Sivanto 200SL	10.5	fl oz/a	A	5.5a	2.1d	1.9d	1.3fg	0.8bc	6.0 e
7	Aza-Direct	2	pt/a	ABCD	4.8a	2.3cd	1.9d	1.0g	0.9bc	6.0 e
7	Pyganic 1.4EC	2	qt/a	ABCD						

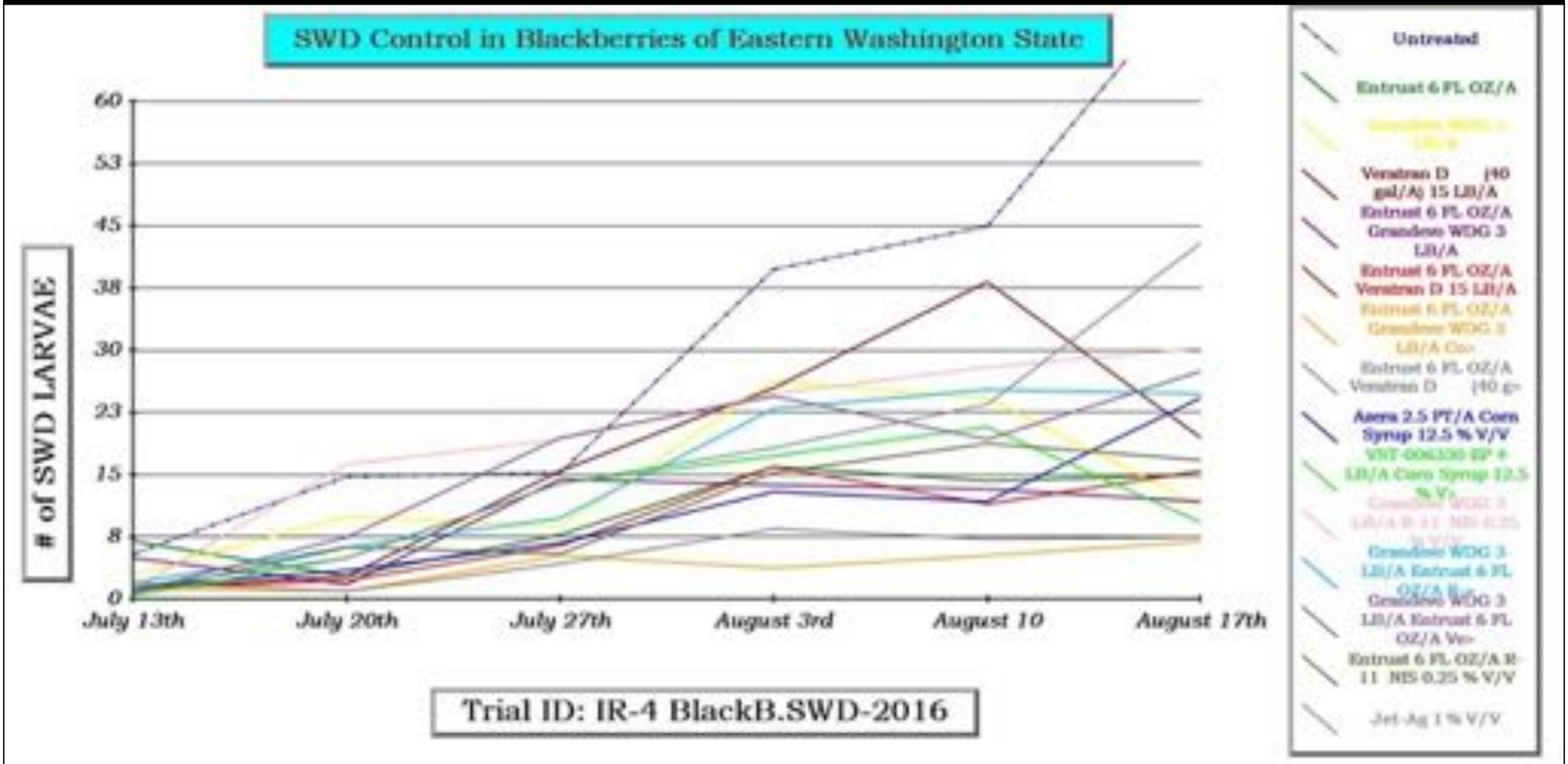
Partially as a result of the ability to control EAA organically, Washington is the primary supplier of organic asparagus in the U.S.

Production of organic asparagus in Washington is increasing by 25% a year.

Application of Pyganic + AzaDirect
Eggplant – August 24, 2015

A more critical pest has been spotted wing Drosophila in small fruit.

This has been a devastating pest for berry growers, particularly for those growing organically.


SWD Control in Blackberries of Eastern Washington State
# of SWD LARVAE
60
53
45
38
30
23
15
8
0
July 13th
July 20th
July 27th
August 3rd
August 10
August 17th
Trial ID: IR-4 BlackB.SWD-2016
Untreated
Entrust 6 FL OZ/A
Venatran D
Entrust 6 FL OZ/A
Grandevo WDG 3 LB/A
Entrust 6 FL OZ/A
Venatran D 15 LB/A
Aerra 2.5 PT/A Corn Syrup 12.5 % V/V
Jet Ag 1 % V/V

2016 Organic SWD Trial Results in Blackberry

ranked by total SWD over the trial

Total SWD over the trial

Trt No.	Treatment Name	Rate	Rate Unit	SWD / 20 Total	
7	Entrust r/w Grandevo + CS	6	fl oz/a	23.5	j
8	Entrust r/w Veratran + CS	6	fl oz/a	30.5	ij
19	Delegate	4.5	oz wt/a	31.3	ij
6	Entrust r/w Veratran	6	fl oz/a	53.0	hij
5	Entrust + Grandevo	6	fl oz/a	60.0	g-j
9	Azera + corn syrup	2.5	pt/a	60.8	g-j
2	Entrust	6	fl oz/a	62.8	g-j
24	Entrust	6	fl oz/a	63.3	g-j
10	Experimental V + corn syrup	4	lb/a	66.8	f-j
18	Experimental D	11.4	fl oz/a	77.5	e-I
20	Malathion 8 Aquamul	20	fl oz/a	80.8	e-h
3	Grandevo WDG	3	lb/a	83.5	e-h
13	DeBug Turbo r/w Entrust	64	oz/a	89.3	d-h
22	Grandevo WDG r/w Entrust (2)	3	lb/a	91.0	d-h
23	Grandevo (3) r/w Ent (2) r/w Ven (1)	3	lb/a	99.3	c-h
4	Veratran D	15	lb/a	103	c-g
25	Jet-Ag	1	% v/v	105.3	b-g
14	Experimental D	1.43	fl oz/a	106.5	b-g
11	DeBug Turbo	64	oz/a	112.8	b-f
21	Grandevo WDG	3	lb/a	119.8	b-e
17	Experimental D	8.5	fl oz/a	120.3	b-e
16	Experimental D	5.7	fl oz/a	137.0	bcd
15	Experimental D	2.84	fl oz/a	140.5	bc
12	DeBug Turbo	104	oz/a	152.5	ab
1	Untreated			196.0	a

The majority of organic blueberries in the U.S. now use the aforementioned program, rotating Grandevo/Venerate/Jet Ag (PAA) with Entrust.

Organic blueberry production is increasing at a rate that exceeds that of conventional blueberries. (Washington produces more organic blueberries than the rest of the U.S. combined.)

Seduce – Ant, Earwig and Cutworm Bait

- .07% spinosad bait (same active ingredient as Entrust).
- 20 to 44 lbs. per acre.
- Almost every crop on the label (around 200).
- Soil applied granule insecticidal bait that has an attractant.
- Effective up to four weeks.
- Vegetables – scatter the bait around plants by hand

I use Seduce on my farm.

- We use it at transplant for wireworm control in watermelons; allows plants to get to a size that are not bothered by wireworms.
- Downside is that it has short residual.
- I have wireworm problems near harvest in cantaloupes and the residual is not long enough to provide protection.
- This product works, but in a narrow range of situations.
- Can be used on a wider array of pests than is what is on the label (2ee of FIFRA allows this.)
- We recently established that it can provide some protection against wireworm (but it is not a long residual solution.)

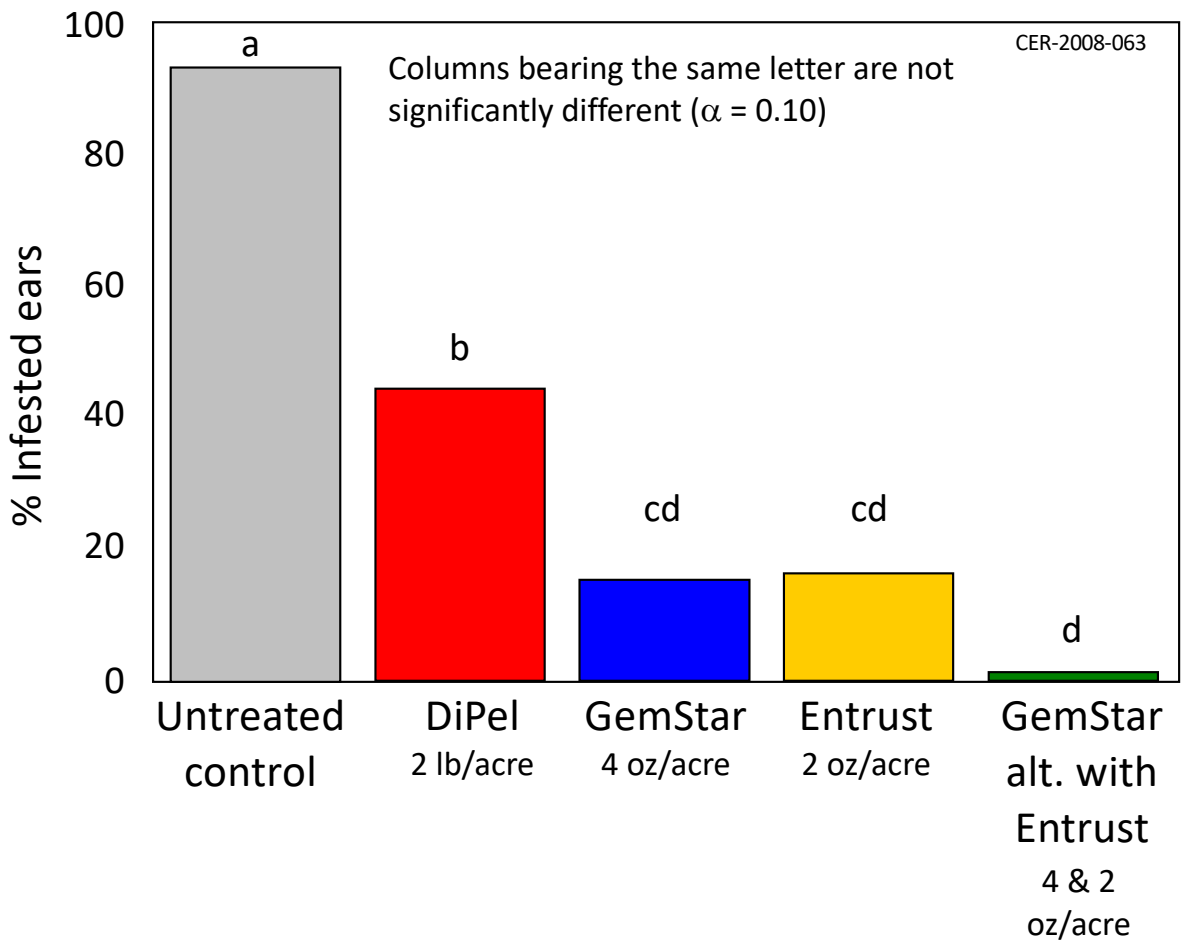
Gemstar (Certis)

- Registered on sweet corn, tomatoes, peppers, leafy and other vegetables. (surprisingly cheap.)
- 4 to 10 oz/acre, air, ground and overhead sprinker, 4 day REI, 0 day PHI.
- Microencapsulated virus that attack only three species of worm pests, most important for WA is corn earworm.
- Has to be ingested, by first and second instar larvae; no adult activity (a weak point, but also true for other organic insecticides.)
- Works better when applied with 5 lbs of sugar/molasses.
- 2 month shelf life, less if exposed to above 90 degrees F.
- The product should be used more than it is.

GemStar vs. corn earworm in organic sweet corn (2008)

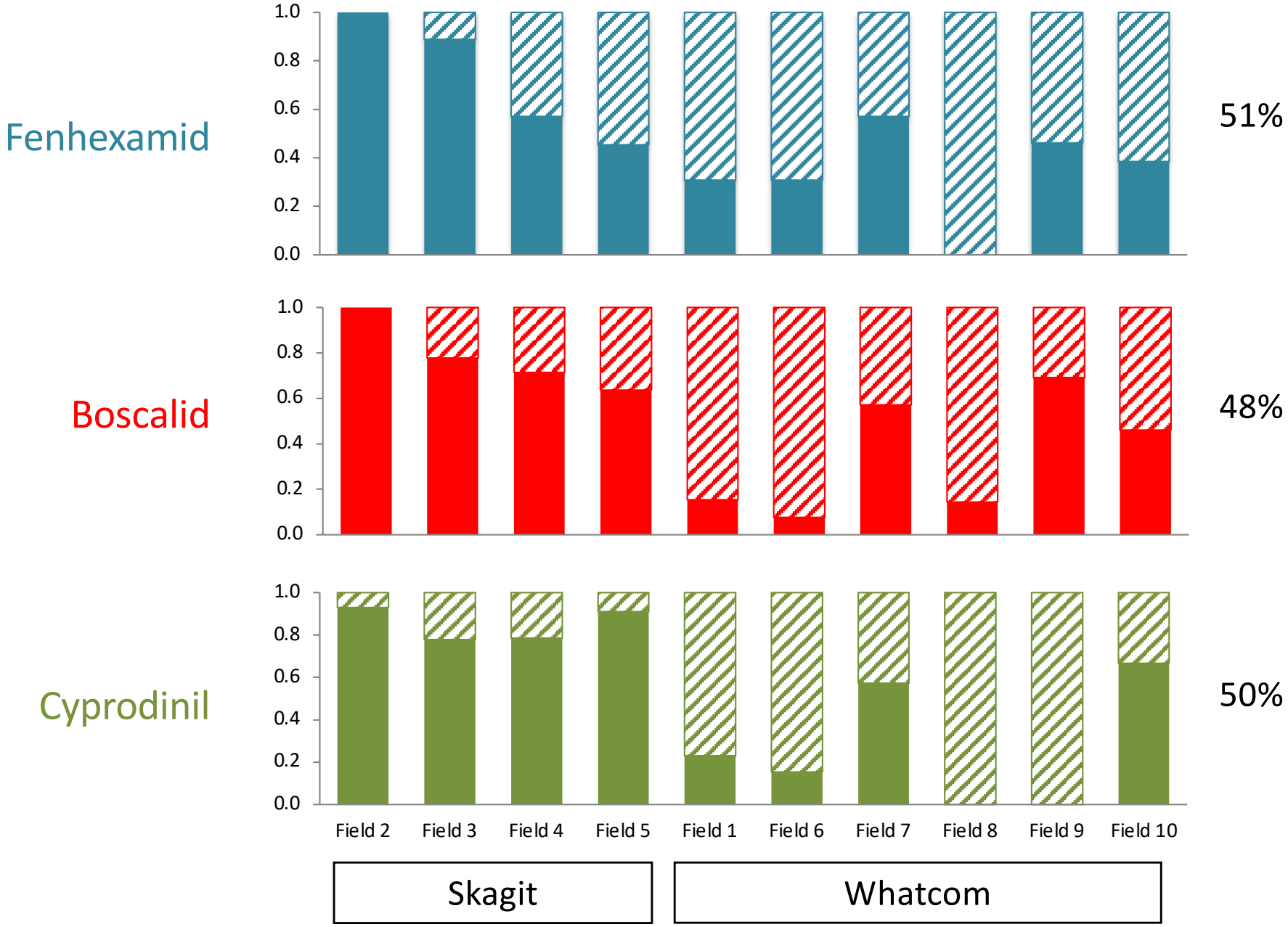
Investigator: Dr. Alan Schreiber, Agric. Development Group

Location: Eltopia, WA



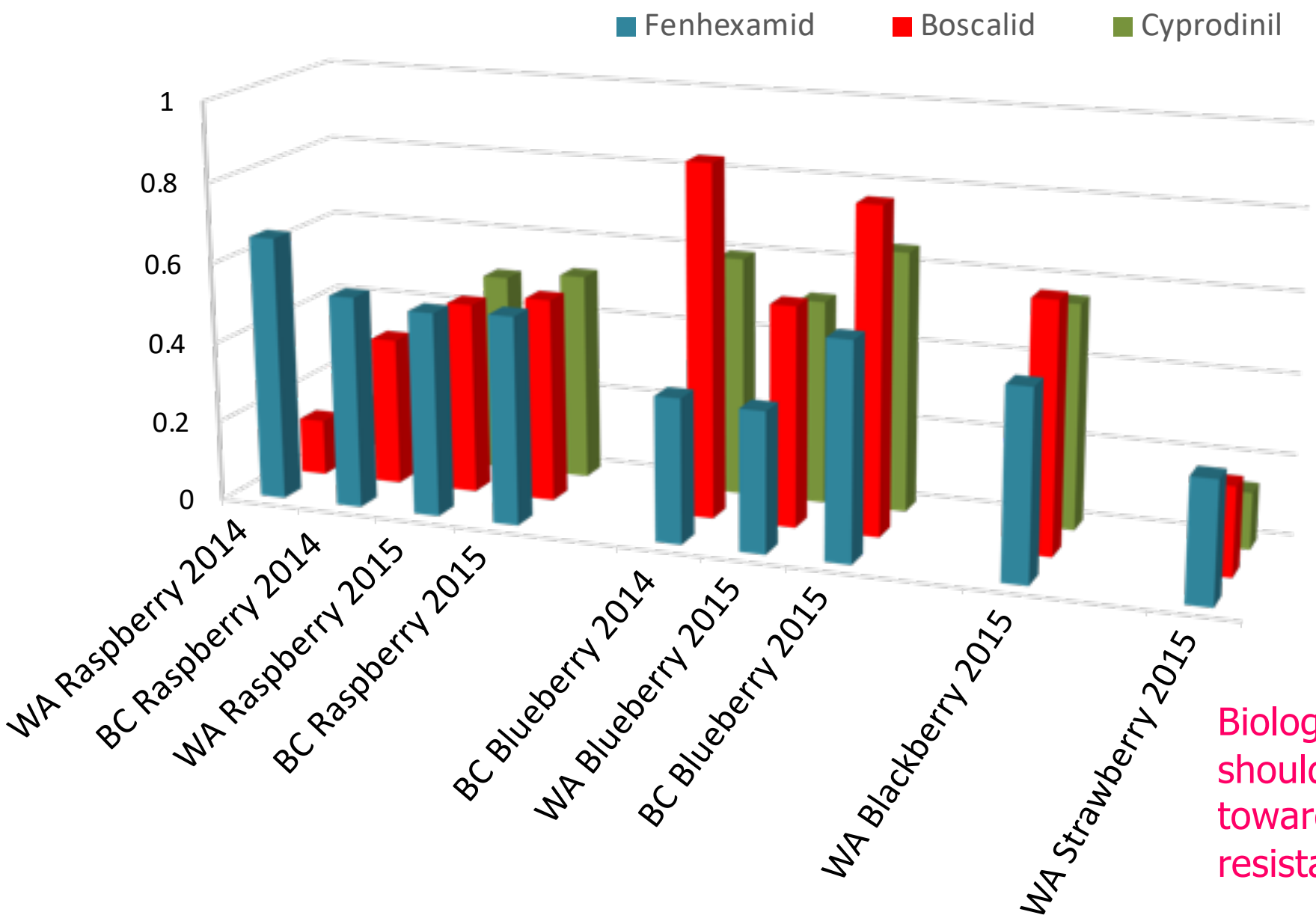
- Randomized complete block design with 4 reps (each 12 x 20 ft.)
- Application via overhead sprinkler chemigation in 0.1" of water.
- Single treatments were applied 5 times, every 5 days.
- Alternating treatment: Gemstar or Entrust applied every 6 days (i.e 12 days between each of 4 applications of the same product)

Botrytis Fungicide Resistance
WA Raspberry 2015



Frequencies of Fungicide Resistance
PNW *Botrytis* Populations 2014-15

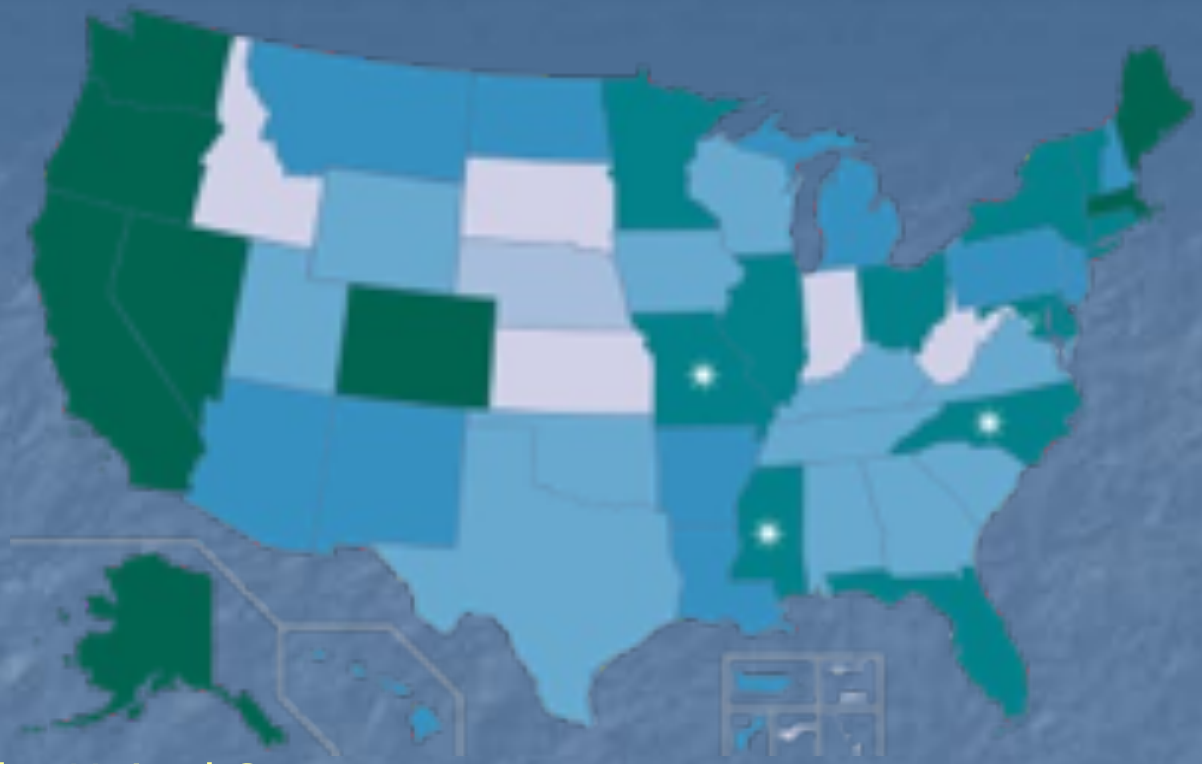
Add in iprodione



Biologics should race towards resistance.

There is a very large and significant crop in the U.S. (probably top 20 in $$) that relies almost exclusively on biopesticides.

Marijuana



Cannabis laws in the United States

- Jurisdiction with legalized cannabis.
- Jurisdiction with both medical and decriminalization laws.2 Marked states have only legal non-psychoactive medical cannabis.
- Jurisdiction with legal psychoactive medical cannabis.
- Jurisdiction with legal non-psychoactive medical cannabis.
- Jurisdiction with decriminalized cannabis possession laws.
- Jurisdiction with cannabis prohibition.

Cannabis remains a Schedule I substance under federal law.
Some cities and Indian Reservations have legalization policies separate from their surrounding states. Cannabis is illegal in all Federal enclaves.


AGRICULTURE - A Cornerstone of Washington's Economy
Why Cannabis needs consistency of agricultural designation across the state
KEY ECONOMIC FACTS ON WASHINGTON AGRICULTURE
38,353 total farms
2.9% Cannabis
(1104 licensed as of Dec 2016*)
183,800 agricultural jobs
12.6% Cannabis
(22,900 est.)
TAX COLLECTED
Sales Tax $30.1 mil
Excise Tax $229 mil
TOP 10 CROPS
ACREAGE UTILIZED FOR TOP 10 PRODUCTS
Apples 140,000 acres
Cannabis 413 acres
Wheat 2.235 million acres
Potatoes 170,000 acres
Hay 845,000 acres
Cherries 37,200 acres
Grapes 70,000 acres
Pears 20,000 acres
Hops 32,150 acres
Blueberries 17,000 acres
Whatcom
San Juan
Island
Skagit
Okanogan
Ferry
Stevens
Pend Oreille
Clallam
Jefferson
Snohomish
Chelan
Douglas
Lincoln
Spokane
King
Mason
Grays Harbor
Kittitas
Grant
Adams
Whitman
Thurston
Pierce
Pacific
Lewis
Yakima
Franklin
Garfield
Columbia
Walla Walla
Asotin
Cowlitz
Skamania
Benton
Klickitat
Clark
Tier I
Tier II
Tier III
Top 10 Cannabis producing counties in GREEN

Washington Cannabis Pests

- Two-spotted spider mite
- Hemp russet mite and a broad mite
- Aphids, root and foliar
- Fungus gnats
- Thrips
- Whitefly
- Leafminer
- Other pests, such as worms
- Powdery mildew
- Botrytis (bud rot)
- Pythium (marijuana root rot)
- More pest species will come
- Abiotic problems that confound figuring out what pest problem you might have.

The cannabis industry has the most advanced biological pest management program in the country.

- Without university research support.
- Without university extension support.
- Without university pesticide application training
- Without help from the USDA.
- Without help from IR-4.
- They did it on their own, without agricultural degrees.
- *If a bunch of pot heads can develop a successful biological pest management program, then other crops should be able to.*

The Future is Going Biological

The Future is Coming!

My clients – then and now*, not counting grower groups

1998 - 2006

- Arvesta
- BASF
- Bayer
- Cerexagri
- Dow
- DuPont
- Gowan
- FMC
- ISK
- Novartis
- Rhone Poulenc
- Valent
- Zeneca

2022

- Acadian
- Agbiome
- AgriAuthority
- Attune
- BASF
- Bayer*
- BioAgro
- Biogro
- ChO2
- Corteva*
- DPH
- Gowan*
- Greenlight BioS?
- ISK BioSciences
- Kemin
- MBI
- Miller
- Montys
- Sipcam
- SymAgro
- Syngenta*
- Telios
- Valent
- Vestaron*
- Vive
- Westbridge
- Wilbur Ellis*
- Certis
- Ecophage

The Future of Potato Nematode Control

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An independent, private agricultural research and information service

Standard Nematicides

- Telone – Industry standard. Very effective, broad spectrum, it is the ticket for nematode control. Expensive, EPA forced lower rates, limited availability. If you have access to it, it is the most effective nematode control option.
- Vydate – Very commonly used. Effective. Has some efficacy against other pests. It is carbamate and is often used for the "carbamate kick" greening effect. It is highly acutely toxic. It is a carbamate. Under regulatory pressure. EPA wants to curtail and restrict its use.
- Mocap. Nematicide, wireworm material. Effective, but little used. Most acutely toxic insecticide in the marketplace.
- These potato nematicides workhorses have been here for 50 or so years. Effective. Consistent. Reliable.

Anyone familiar with the federal regulatory environment has to be concerned with future availability of these three products.

The three products have issues and limitations and having additional nematicides will bring value to the potato industry.

2021 Nematode Trial

- Funded by Northwest Potato Research Consortium (Idaho, Oregon, Washington Potato Commissions and registrants
- Six replications, nematode counts were collected in advance for all plots, plots were distributed uniformly across all treatments.
- Pressure was very heavy, 46% of tubers were infested in untreated check.
- Population was mostly Columbia root-knot, some northern root knot and lesion nematodes.
- Applications were either in furrow at plant or chemigation at 0.5 acre inches of water.


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9,000 tubers
peeled

None of the new products are replacements for Telone or Vydate

- Nimitz, Salibro and other nematicides will require a program approach, particularly in moderate and heavy pressure situations.
- These products will usually require multiple applications of more than one active ingredient.
- For the most part companies with a new product will recommend its product to be applied at plant.
- There may be efficacy with a follow up application, but the best efficacy is associated with a planting time treatment.
- In many cases the companies with new nematicides prefer their product to be applied with a Vydate program.

Comparison of 29 Potato Nematode Control Programs

Trt No	Treatment Program	Timing of Applicat.	% Nematode Infection	Specific Gravity
1	Untreated Check		46 a	1.07238 fg
3	VYDATE / Averland FC	ABCF / DE	42 ab	1.07258 fg
27	MeloCon LC (newly registered) (low)	AIJKL	36 abcd	1.07478 bcdefg
8	Experimental 1	A	35 abcd	1.07380 defg
7	Experimental 1	A	34 abcde	1.07605 abcdef
26	MeloCon LC (newly registered)	A	33 abcde	1.07360 efg
16	Velum Prime+Nimitz / Vydate	A / BCEF	31 abcdef	1.07393 defg
21	MeloCon	M	30 abcdef	1.07835 abcd
2	AVERLAND FC / Vydate	ADE /BCF	30 abcdef	1.07468 bcdefg
28	CX10272	AIJKL	27 abcdefg	1.07577 abcdef
22	Majestene	ABCEF	27 abcdefg	1.07570 abcdef
19	Salibro	A	27 abcdefg	1.07452 cdefg
4	Experimental 4 / Vydate	A / BCDEF	24 bcdefg	1.07745 abcde
14	Experimental 2 / Vydate	A / BCEF	24 bcdefg	1.07657 abcdef
9	Experimental 1	A / H	24 bcdefg	1.07500 bcdefg
17	Salibro / Vydate CLV	A / BCEF	24 bcdefg	1.07278 fg
15	Nimitz / Vydate CLV	A / BCEF	20 cdefg	1.07515 abcdefg
23	MeloCon LC (newly registered)	A	19 cdefg	1.07837 abcd
11	Majestene / Vydate	A / BCEF	19 cdefg	1.07642 abcedf
5	VYDATE /Experimental 1	ABCEF / H	19 cdefg	1.07518 abcdg
10	Experimental 1	A C EFG	19 cdefg	1.07350 efg
25	MeloCon LC (newly registered)	A / IJKL	18 cdefg	1.07962 a
13	MBI 306/ Vydate CLV	A / BCEF	17 defg	1.07610 abcdef
18	Salibro / Vydate CLV	A / BCEF	17 defg	1.07377 defg
24	MeloCon LC (newly registered)	AIJKL	15 efg	1.07577 abcdef
20	abamectin	BH	11 fg	1.07872 abc
12	MBI 306 / Vydate	ABCEF	10 g	1.07507 abcdefg
29	CX10272 / CX10272 (Living Microbial)	AIJKL	8 g	1.07925 ab

Ranked by efficacy

You forgot to mention specific gravities.

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Ranked by efficacy

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The Future is Coming Fast

For biologicals….