





MANAGING INSECT PESTS IN NORTHWEST CONIFER SEED ORCHARDS

Where are we now and what does the future hold?

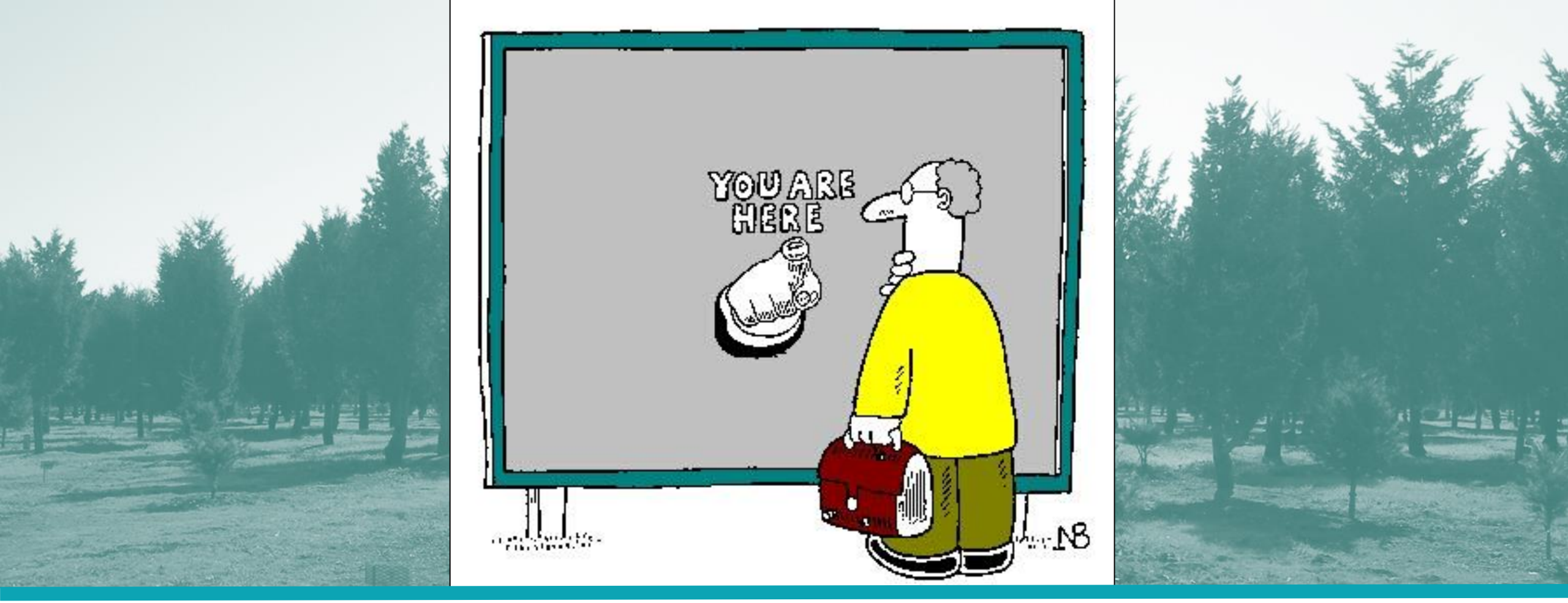
MANAGING INSECT PESTS IN NORTHWEST CONIFER SEED ORCHARDS

Where are we now?

- 2016 NWSOMA Survey results:
  - Pests
  - Suppression
- Insect pest review
- IPM tools

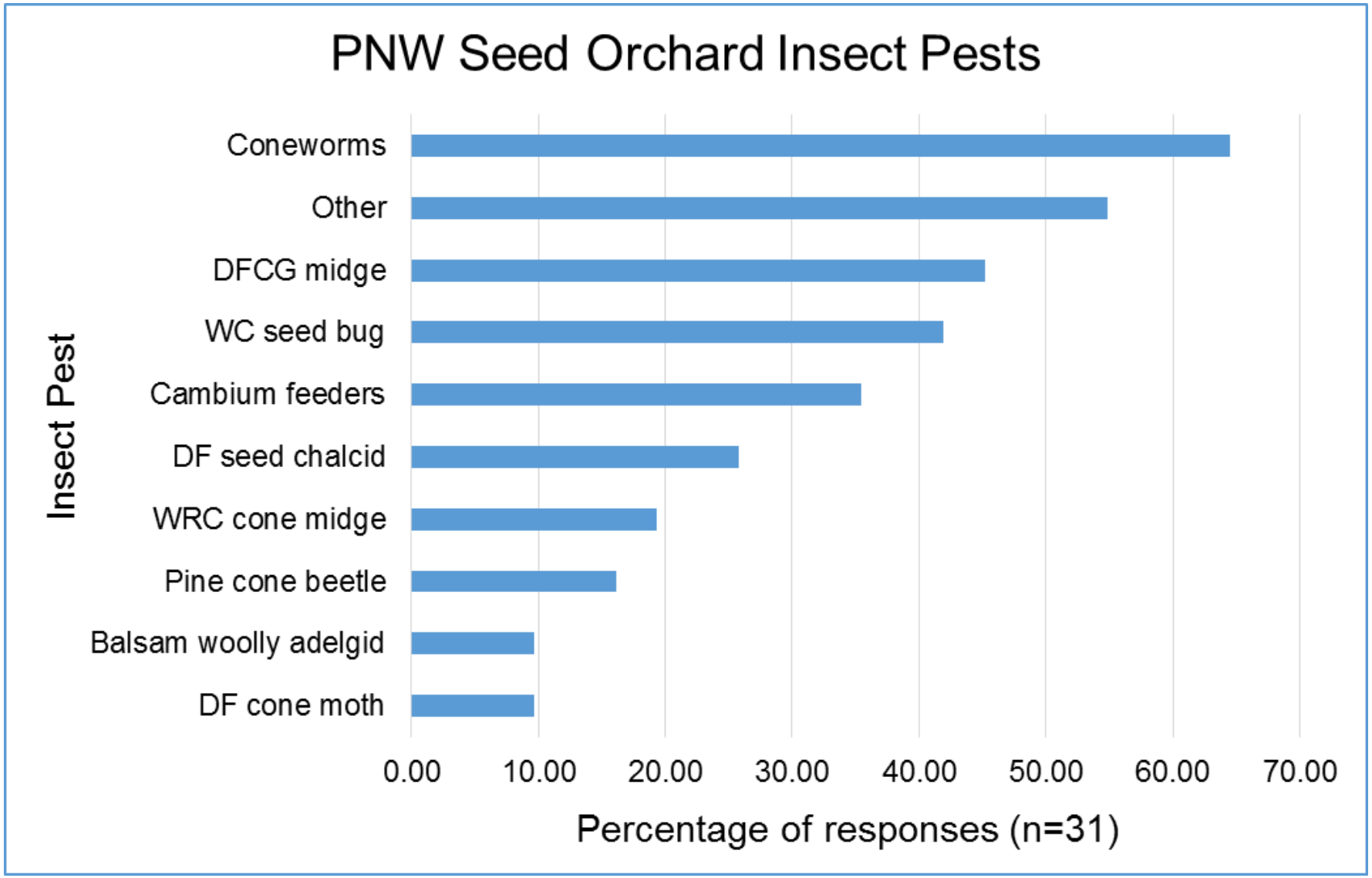
What does the future hold?

- Potential climate change impacts
- 2016 NWSOMA Survey results:
  - Concerns



WHERE ARE WE NOW?

SURVEY: DAMAGING INSECTS



SURVEY: DAMAGING INSECTS

Other (one or two responses)

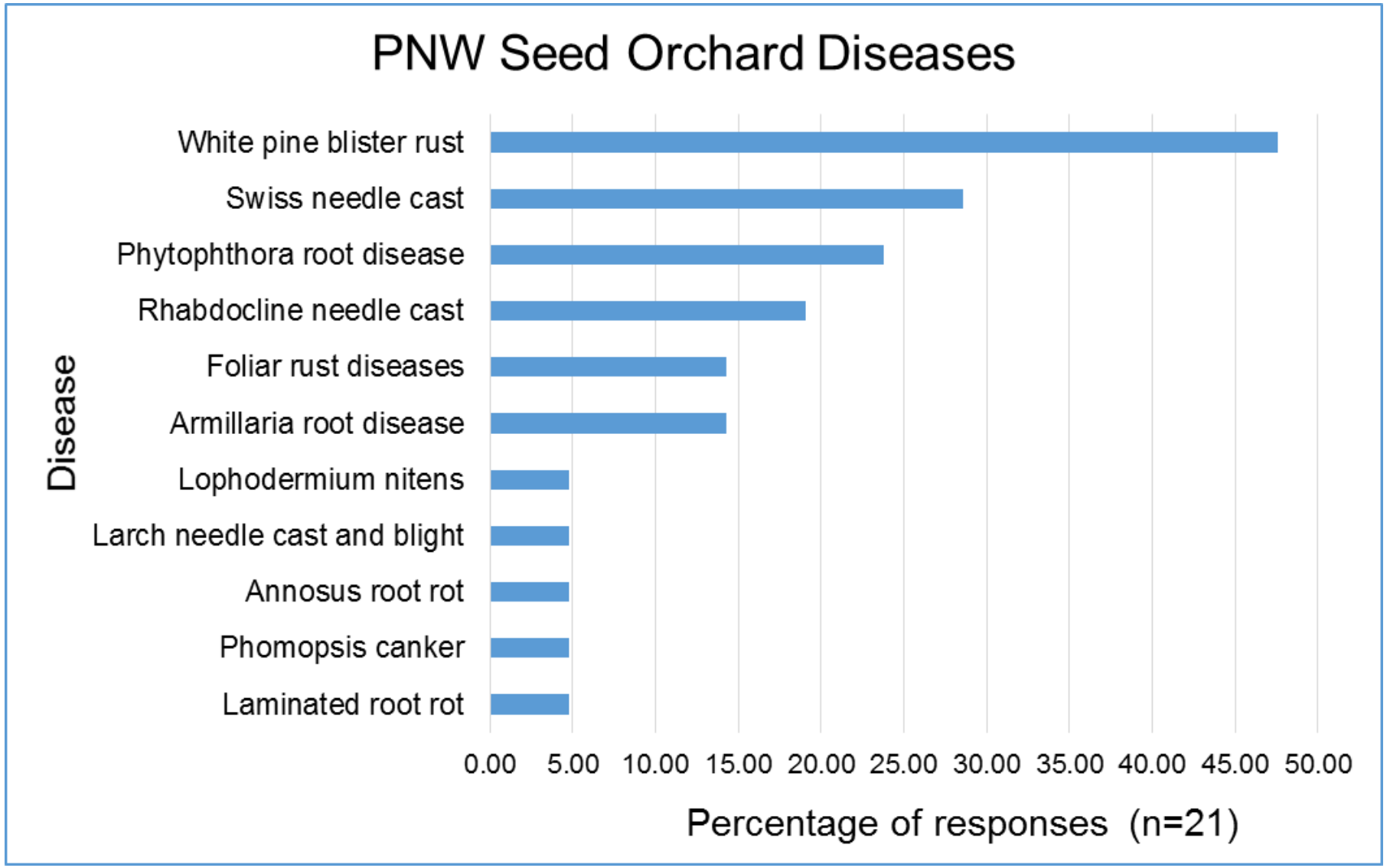
Cone and Seed

- *Cydia* sp. (pine seedworm)
- Larch cone adelgid
- Noble fir cone and seed insects
- Port-Orford-cedar cone gall midge
- *Strobilomyia* spp. in larch
- Unknown seed midge in larch

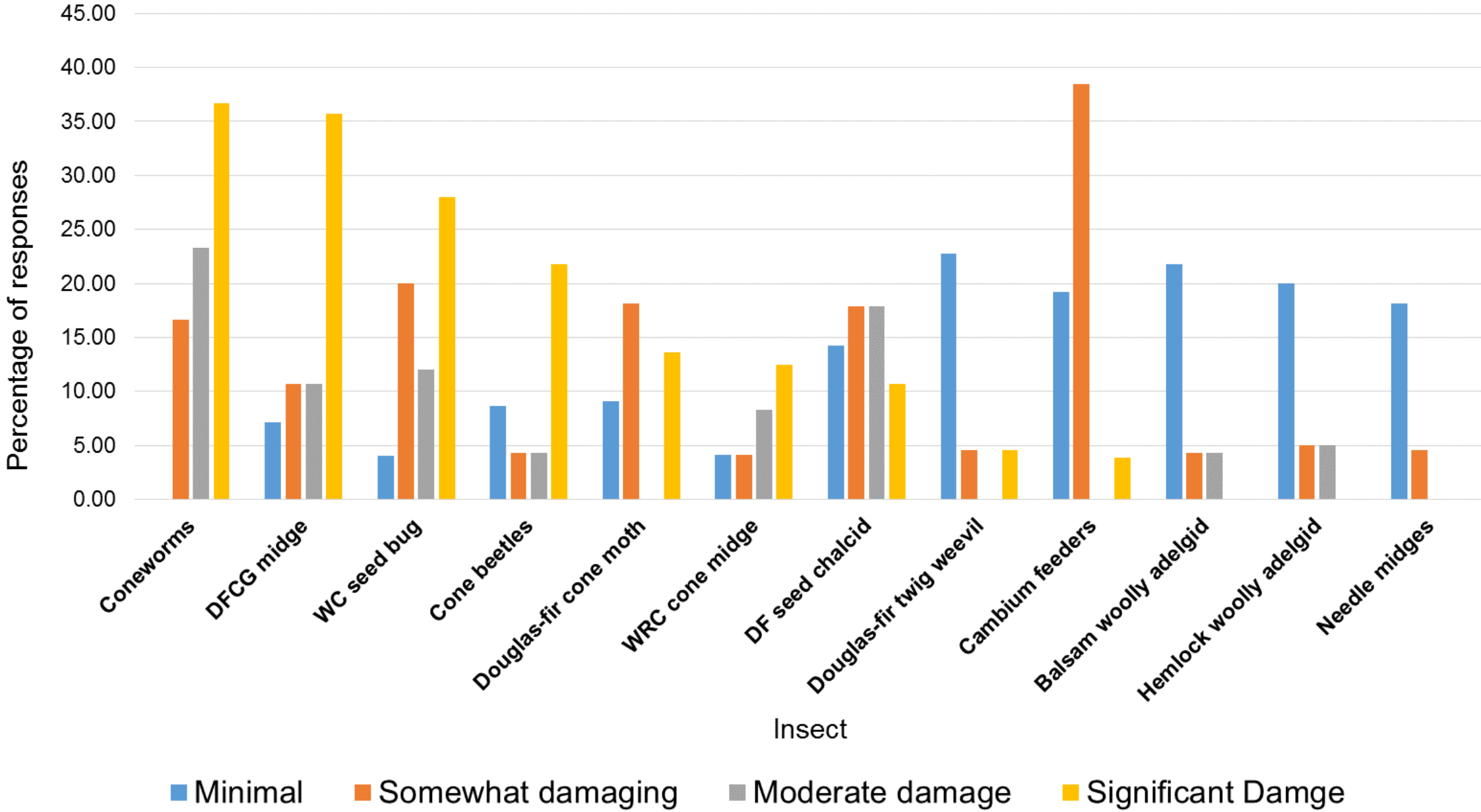
Tree

- Bark beetles in ponderosa pine
- Douglas-fir budmoth
- DF twig weevil
- European pine shoot moth
- Hemlock woolly adelgid
- Pine leaf adelgid
- Spruce gall adelgids
- Ten-lined June beetle
- Western cedar bark beetle
- Western spruce budworm

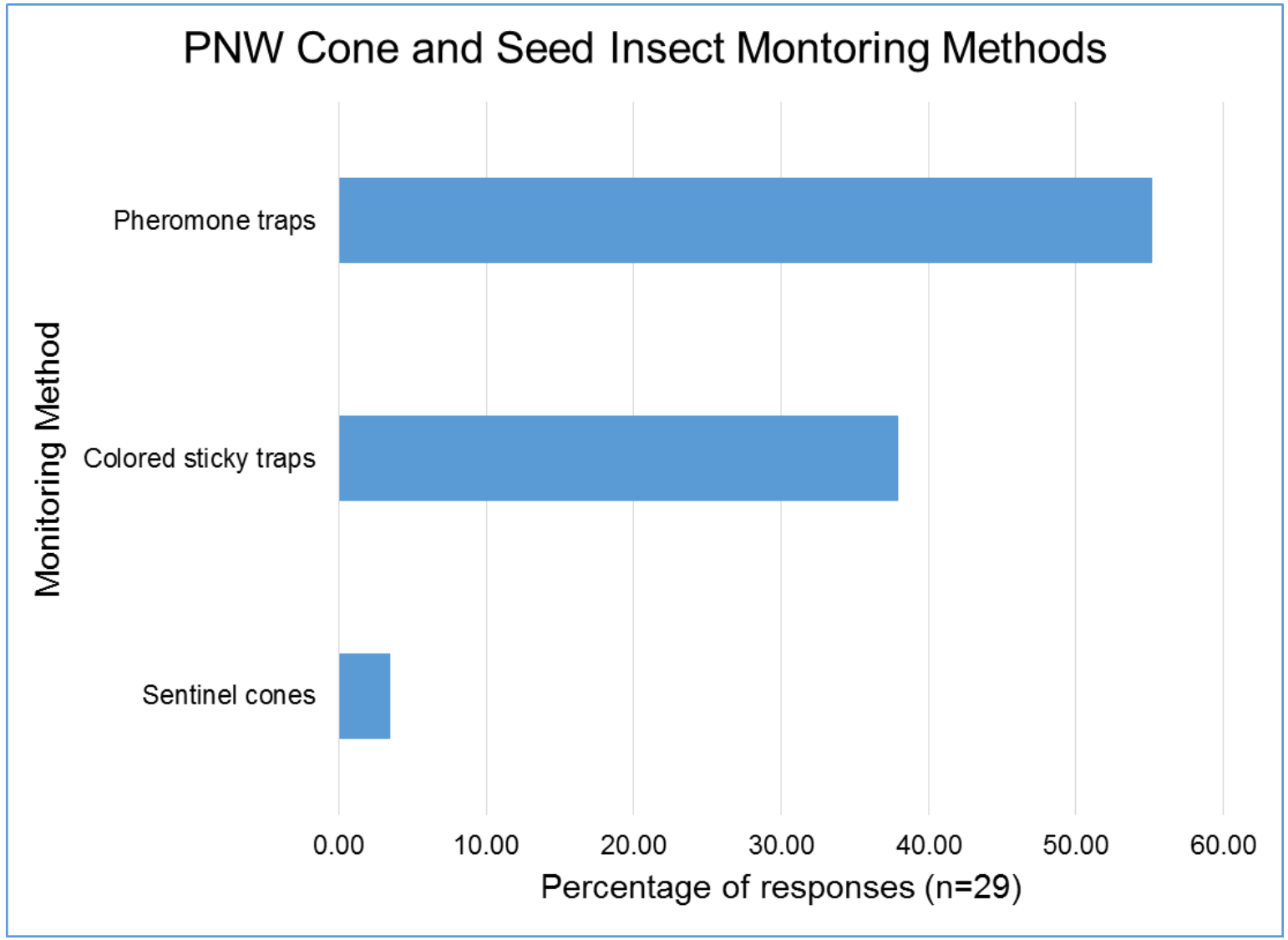
SURVEY: DAMAGING DISEASES



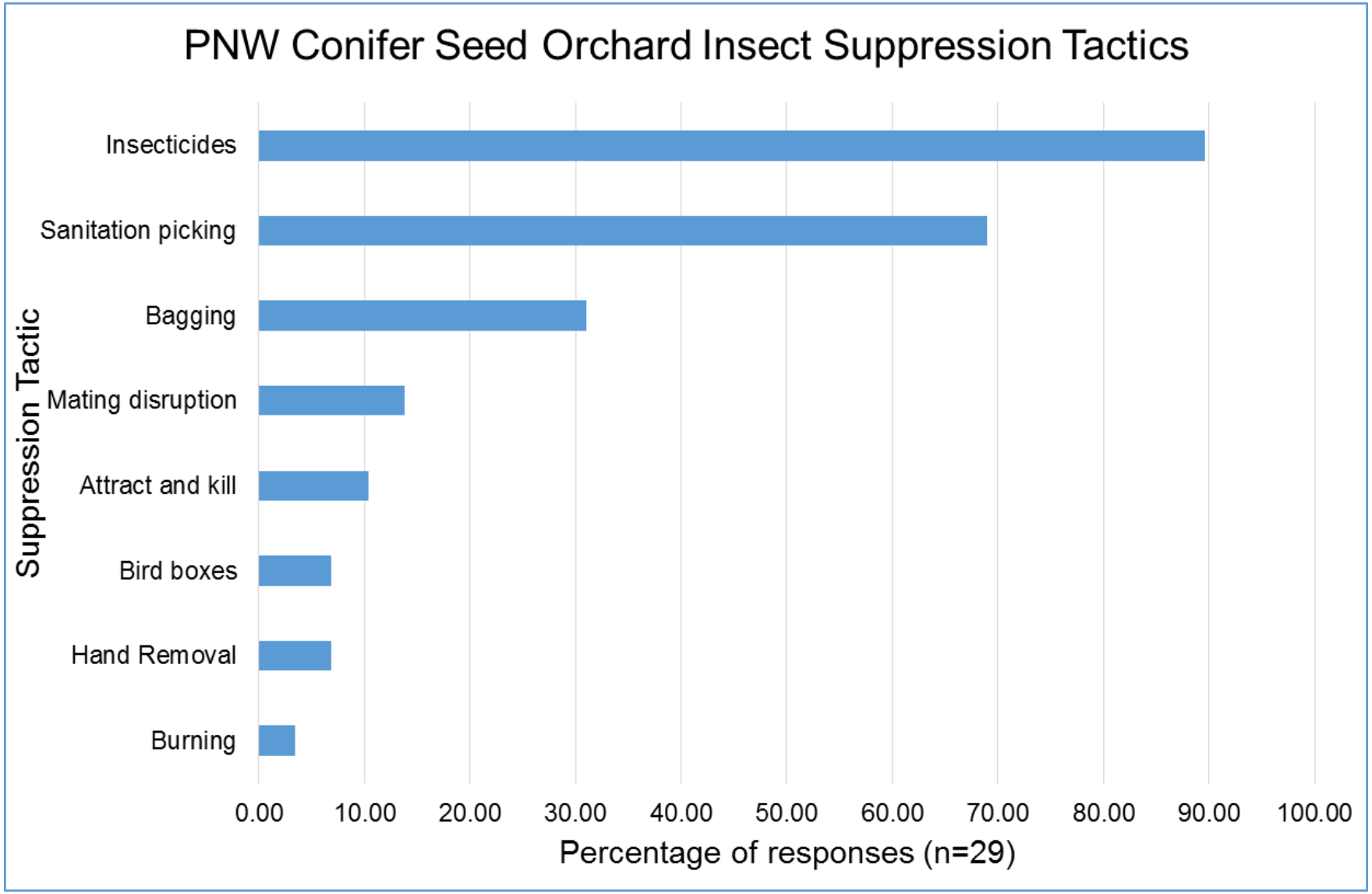
NWSOMA Survey Results: Damage Severites of PNW Conifer Seed Orchard Insects

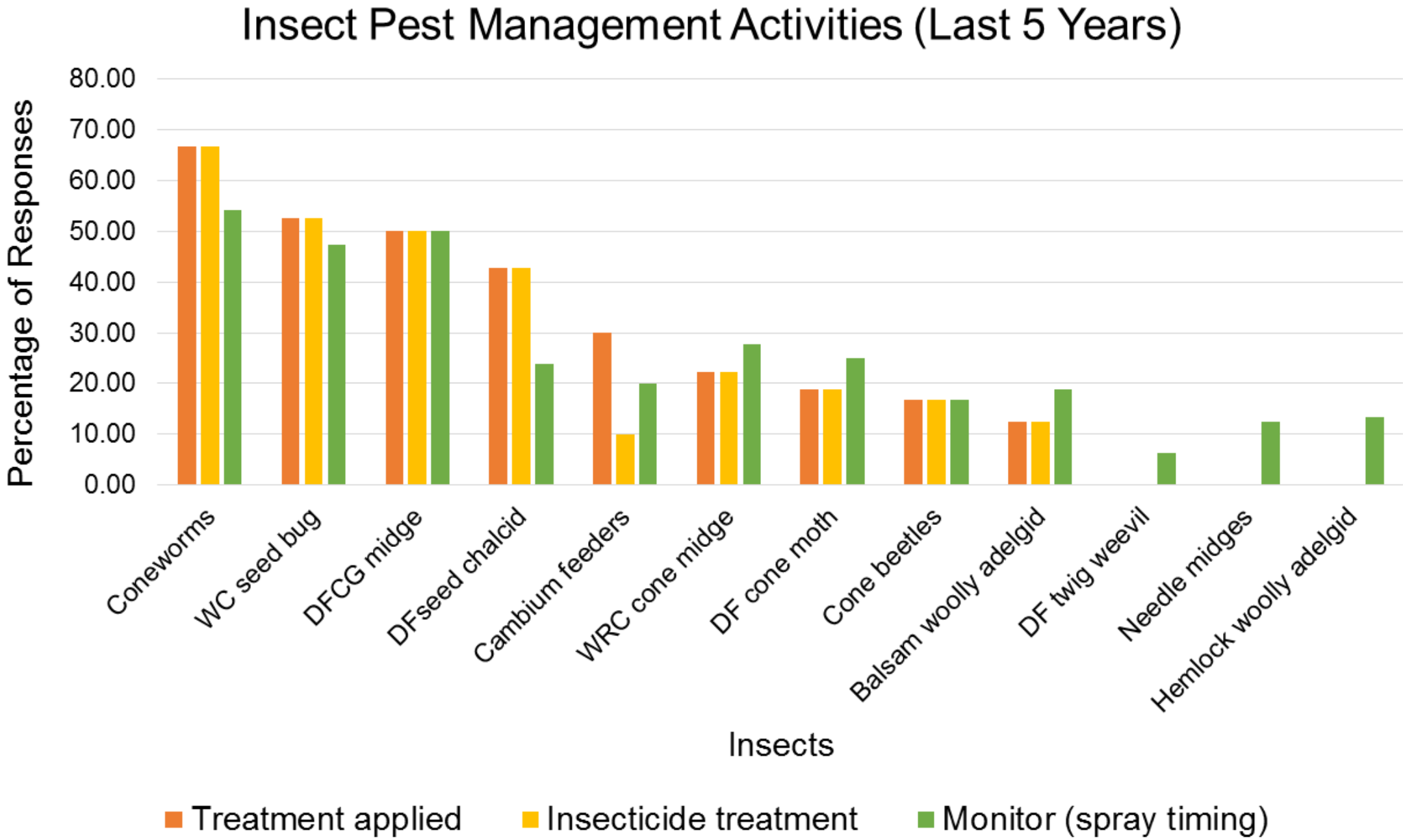


SURVEY: CONTROL

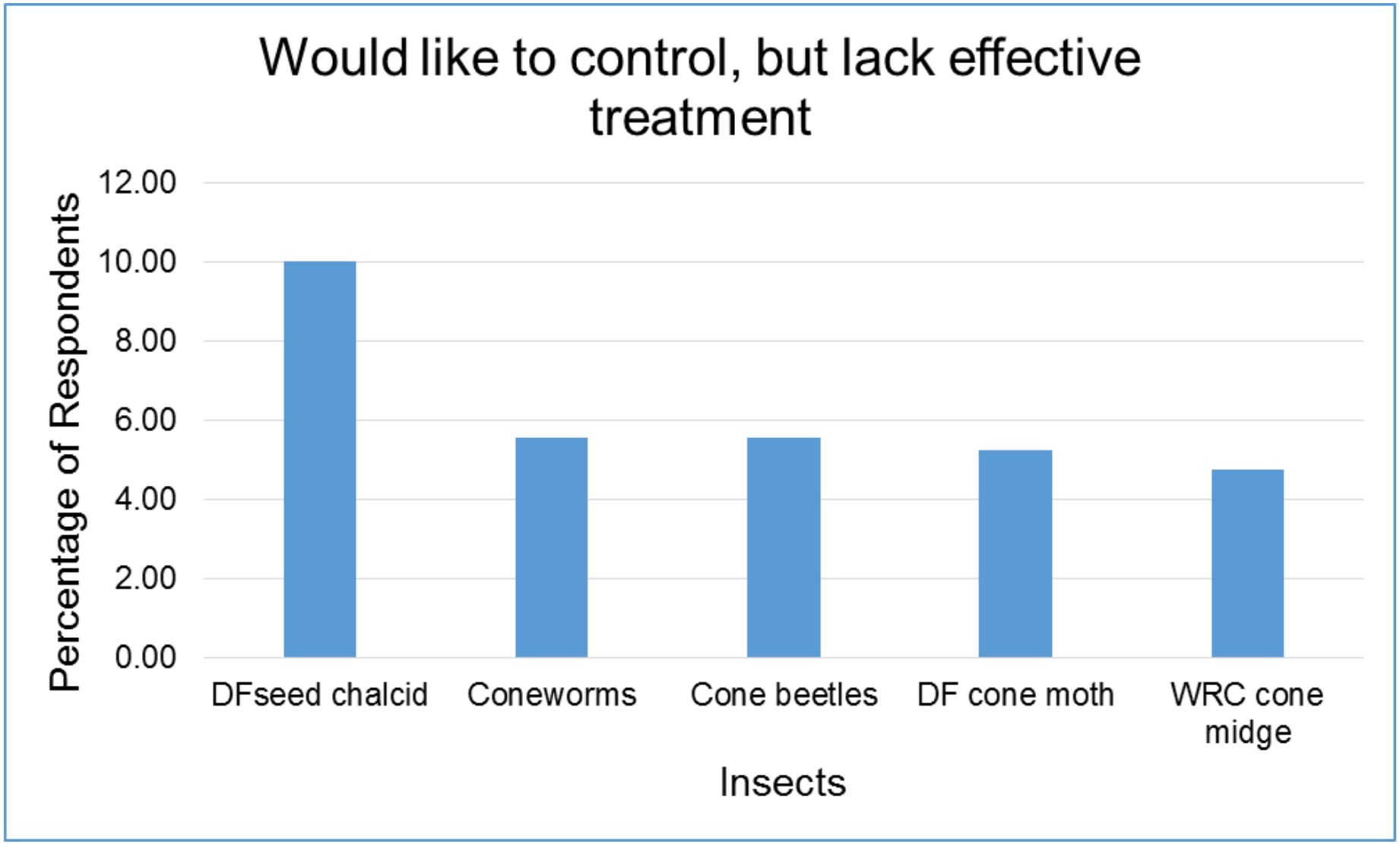


SURVEY: CONTROL

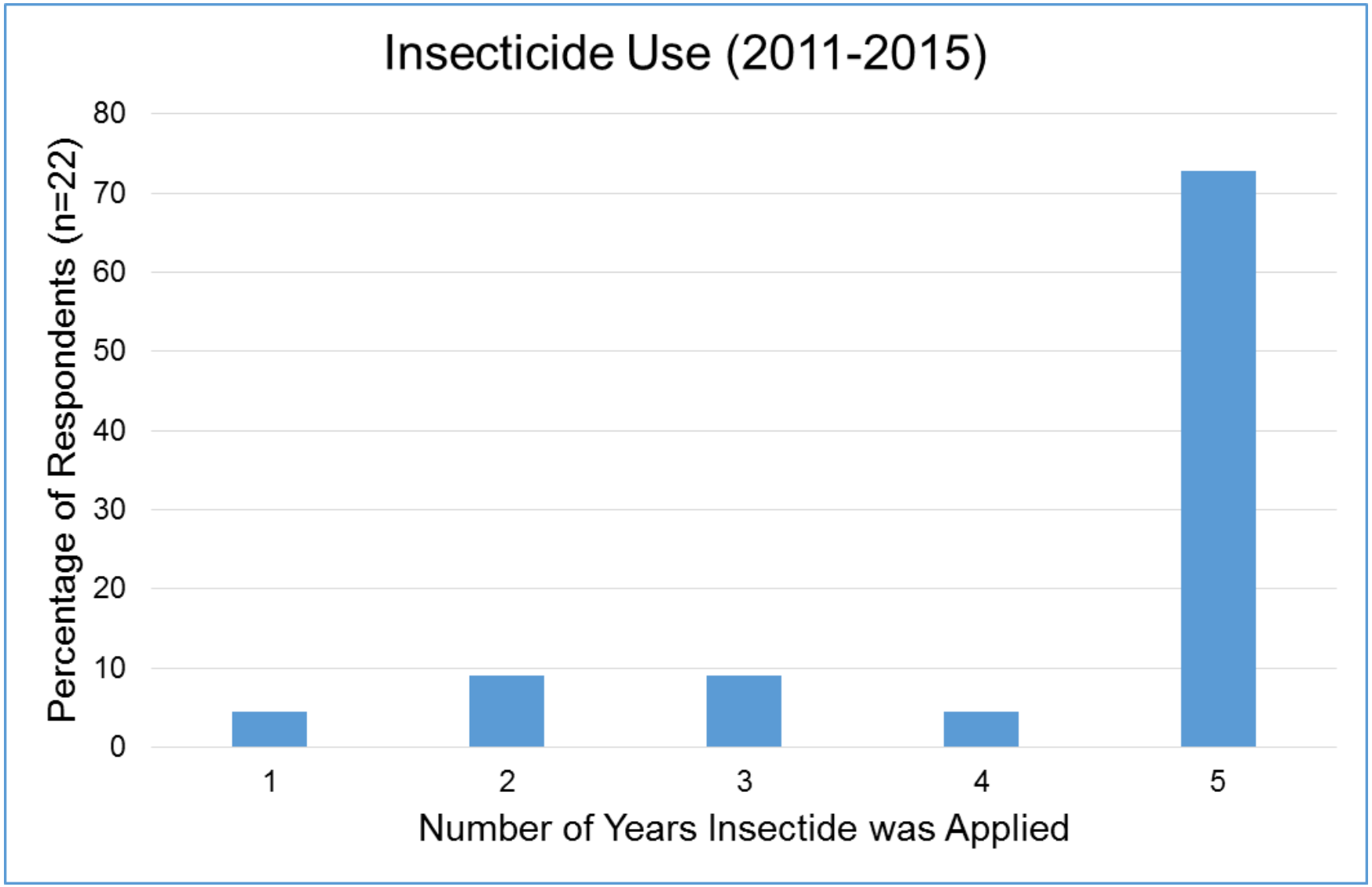



Insect Pest Management Activities (Last 5 Years)
Percentage of Responses
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Coneworms
WC seed bug
DFCG midge
DFseed chalcid
Cambium feeders
WRC cone midge
DF cone moth
Cone beetles
Balsam woolly adelgid
DF twig weevil
Needle midges
Hemlock woolly adelgid
Insects
Treatment applied
Insecticide treatment
Monitor (spray timing)

SURVEY: CONTROL



SURVEY: CONTROL



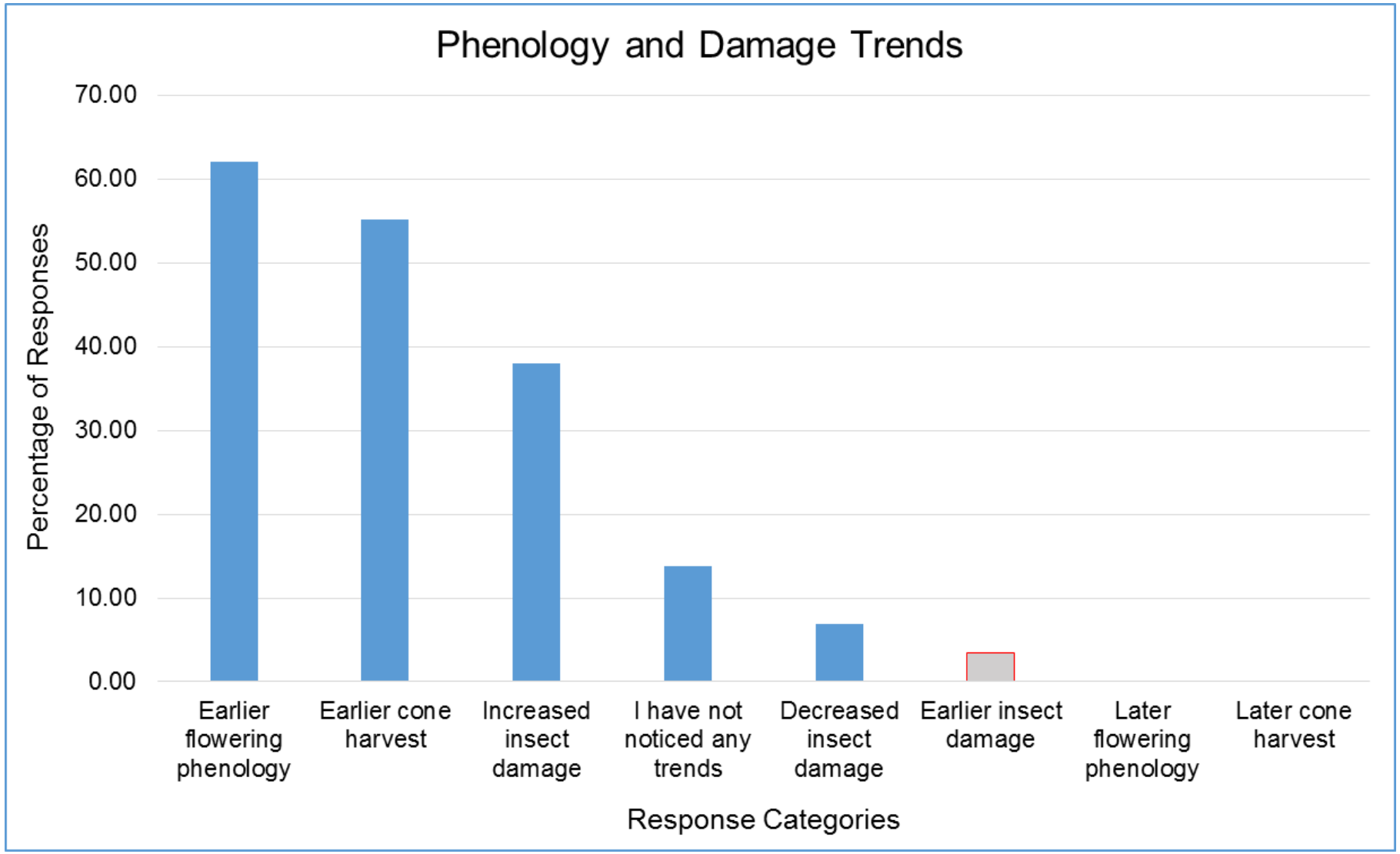
SURVEY: CONTROL

Table 1: Number of responses for insecticides used by pest during the past 5 years

	Esfenvalerate	Imidacloprid	Spinosad	Dimethoate	Btk	Permethrin	Spirotetramat	Lambda-cyhalothrin	Safer's Soap	Dormant Oil	None
DFCG midge	9	4		4			**1**		**1**		11
Coneworms	7	1		10		**3**					7
DF seed chalcid	6	1		1							14
WRC cone midge				3			**1**				13
WC seed bug	4		1			**3**		**1**			10
DF cone moth				3							12
Pine cone beetles	2										14
Cambium feeders											14
DF twig weevil											15
Needle midges											15
Woolly adelgids					1				**2**	**1**	12
POC cone gall midge	**1**										N/A
Cydia spp.		**1**									N/A

1, 2, 3 = added from comments

SURVEY: CONTROL



SURVEY: MOST CRITICAL CONCERN OR PROBLEM

Table 2. Most critical concern or problem.

Pest	Treatment Timing	Insecticides	Non-Insecticidal Treatments	Damage	Critical Issue
Port-Orford-cedar cone gall midge	Timing of first spray application	Loss of insecticide usefulness due to increased restrictions and lack of proven alternatives	Non-insecticidal treatments for cone beetles and seed bugs	Seed loss	None (3)
Dioryctria in fir (3)	Adjusting monitoring for spray decisions to synch with earlier phenologies	Difficulties and costs of insecticide treatments	Lack of control methods other than insecticides		
European pine shoot moth in Interior lodgepole	Spray timing to control Dioryctria before cone harvest	Neighbor relations and past management protocol dictate no aerial or ground insecticide use			
Douglas-fir cone gall midge on BC coast	Determining application timing	Finding insecticides that are safe to use within 30 days of cone harvest			
Cone beetle (2)	Determining if there will be a problem and how to time sprays/treatments	Development of insect resistance to the pesticides used to treat cone insects.			
Cydia spp.		Lack of available registered insecticides for *Cydia* spp.			
Adelgid and needle disease issues are difficult to treat		Availability of safe effective insecticides			

CONEWORMS

Dioryctria spp.

Hosts: Douglas-fir, spruce, true fir, pine.

One year life cycle with overlapping generations, so larvae of all sizes may be found in cones.

Larvae - brown head capsules, amber to greenish bodies; older larvae about an inch long with rows of dorso-lateral spots.

Photo: Don Manastyrski

Damaged cones have large holes and abundant coarse frass on the outside.

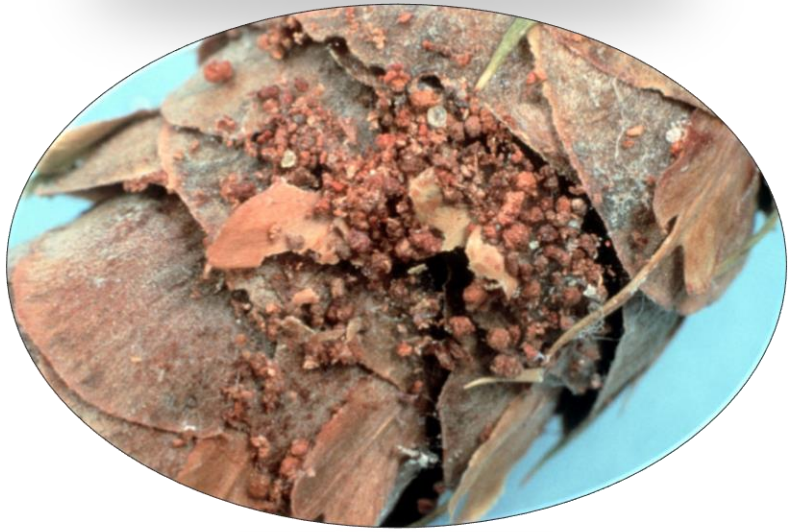


Photo: Roger Sandquist

CONEWORMS

Dioryctria spp.

One larva can destroy an entire cone.

Management

Pheromone Monitoring – for first male capture.

Larval Damage Monitoring – begin 2 weeks after first male capture for damage initiation and infestation rates.

Insecticide applications – early June (esfenvalerate, dimethoate, 1-2 applications)

Mechanical – Physical exclusion by bagging cones can reduce losses.

Sanitation – Clean picking young orchards can delay insecticide use.

CAMBIUM FEEDERS

Synanthedon spp.,
Dioryctria spp.

Cambium feeding pitch moths (top center) and Dioryctria spp. (bottom center) are lighter in color than the cone feeding Dioryctria (bottom left).

Photo: Ward Strong

Photo: Terry Tuttle

Photo: Don Manastyrski

Management

Insecticide applications – apply after banding.

Mechanical – Physically remove larvae from trunk.

CONEWORMS

Dioryctria spp.

Registered pesticides for Christmas tree (Douglas-fir) in OR and WA

- Carbaryl (Sevin and others) (Group 1)
- Esfenvalerate (Asana XL and others)-Restricted use pesticide. (Group 3)
- Permethrin (Perm-up 3.2 and others)-Restricted use pesticide. (Group 3)
- Phosmet (Imidan 70W) (Group 1)
- Spinosad (Conserve, Entrust, Success and others)-Some formulations are OMRI-listed for organic production. (Group 5)

PNW Handbooks

CONE BEETLES

Conophthorus ponderosae

Hosts: Western white, sugar, lodgepole, ponderosa, Jeffrey, and lodgepole pines

- Attacked second year cones often have distinct pitch tubes at the site of beetles' entrance holes.
- Look for adult beetles or powdery frass and cone contents inside stunted cones.
- Adults are 3 to 4 mm long, shiny black, and cylindrical.
- Dead cones falling from trees in mid-summer are a good indication of infestation.

Photo by Steven Katovich

Photo by Sandy Kegley

CONE BEETLES

• Larvae feed on seeds and cone tissue pulverizing cone contents to a fine powder.
• Cone beetles can destroy 90% or more of western white pine cone crops .
• Cleaning up and removing aborted, infested cones reduces populations.

Photos by Sandy Kegley

Management

Pheromone Monitoring – early detection and monitoring.

Cone monitoring – for small pitch tubes; bisect fallen cones to confirm beetle presence.

Insecticide applications – early June (esfenvalerate, dimethoate, 1-2 applications)

Mechanical – Physical exclusion by bagging second year cones can reduce losses.

Sanitation – Raking and burning all infested cones during the summer months can provide good protection but may not be feasible.

DOUGLAS-FIR CONE GALL MIDGE

Contarinia oregonensis

Host: Douglas-fir

- Larvae form galls that fuse seeds to scales.
- Larval feeding can also restrict seed development, even if seed is not fused.
- Severe infestations can destroy all seed in a cone and cause nearly 100% crop loss.

DOUGLAS-FIR CONE GALL MIDGE

Contarinia oregonensis

Identification

- Browning cone scales and premature cone death.
- Seeds adhered to scales.
- Swollen galls along cone axes.
- Tiny, pink to orange, U-shaped larvae in galls beneath adhered seed.


Photo courtesy of Roger Sandquist


Photo courtesy of Roger Sandquist


Photo by Elizabeth Willhite

DOUGLAS-FIR CONE GALL MIDGE

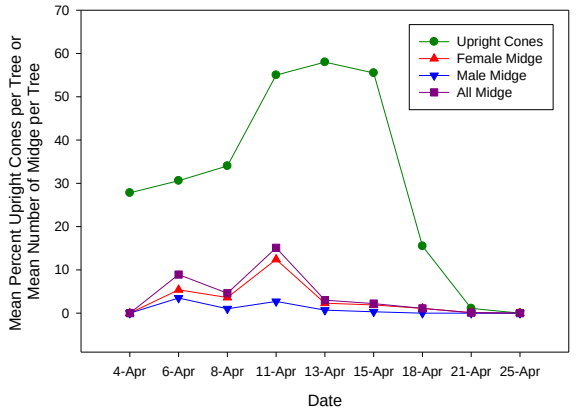
Contarinia oregonensis

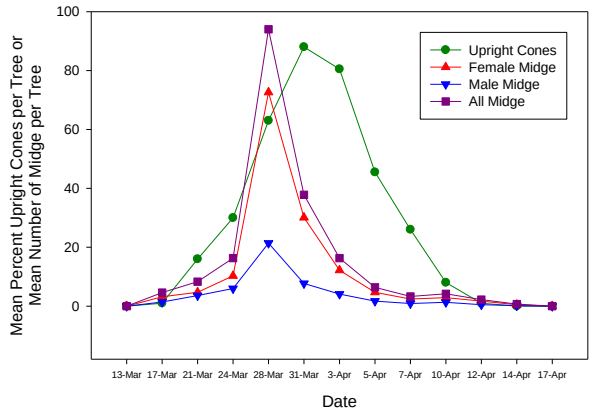
Management (Option 1)

Target life stage – adult

Pheromone Monitoring – For timing insecticide spray applications.

Insecticide Application -(Esfenvalerate, Asana™)





DOUGLAS-FIR CONE GALL MIDGE

Contarinia oregonensis

Management (Option 2)

Target life stage – larva

Insecticide Application –Trunk injection with imidicloprid (Imicide, Imajet)

Pheromone – “Attract and Kill”

Sanitation – Clean picking when orchards are young can delay use of insecticides.

WESTERN CONIFER SEED BUG

Leptoglossus occidentalis

Hosts: Wide host range includes Douglas-fir, pines, various other conifers

- Causes substatial losses in seed orchards.
- Adults and nymphs suck out seed endosperm, causing abortion and infertility.
- Greater impacts on pines than on Douglas-fir, true firs or spruces

WESTERN CONIFER SEED BUG

Leptoglossus occidentalis

Monitoring - Conduct regular seed bug surveys.

-20 minute walk-through (not that effective).

-Try branch-tugging with a hook on a pole and count seed bugs that fly away .

-100 large lateral branches on the sunny side.

-Warm- day; mid-day when seed bugs are active.

Photo by Elizabeth Willhite

WESTERN CONIFER SEED BUG

Leptoglossus occidentalis

Management

Insecticide applications – Synthetic pyrethroids, e.g. esfenvalerate (Asana™); permethrin, lambda-cyhalothrin (Matador); Dimethoate; Spinosad.

Mechanical – Physical exclusion by bagging cones.

Photo by Sandy Kegley

Photo by Isabelle Labouc

DOUGLAS-FIR SEED CHALCID

Megastigmus spermotrophus

Host: Douglas-fir

Biology

Females lay eggs in both fertilized and unfertilized seed.

Larval presence prevents abortion and induces seed storage reserves to form like they would if the seed were fertilized (Chiwocha et. al 2006).

DOUGLAS-FIR SEED CHALCID

Megastigmus spermotrophus

Management

Insecticide applications – e.g. Synthetic pyrethroids

Female Adult Monitoring – To predict damage and time insecticide applications. Gold Rebell sticky panels (carrot rust fly traps) (Niwa 1995)

Mechanical – Physical exclusion by bagging cones

CEDAR CONE MIDGES

Mayetiola thujae, Janetiella siskiyou

Hosts: M. thujae: Western redcedar

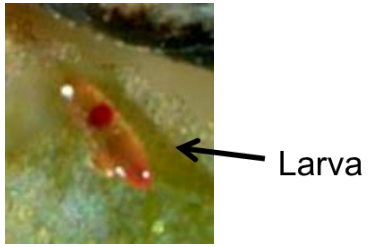
J. siskiyou: Port-Orford-cedar

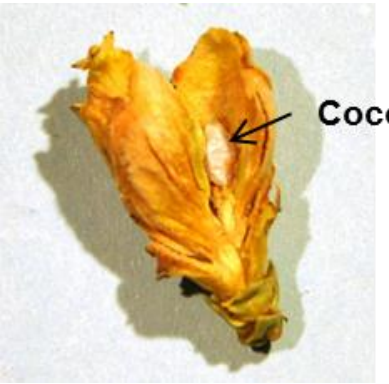
Management

Egg monitoring – February, March

Insecticide application - (Dimethoate, esfenvalerate) timed to early oviposition period (often around first two weeks in March in mid-Willamette Valley)

Temperature monitoring – January, February





MONITORING SYSTEMS

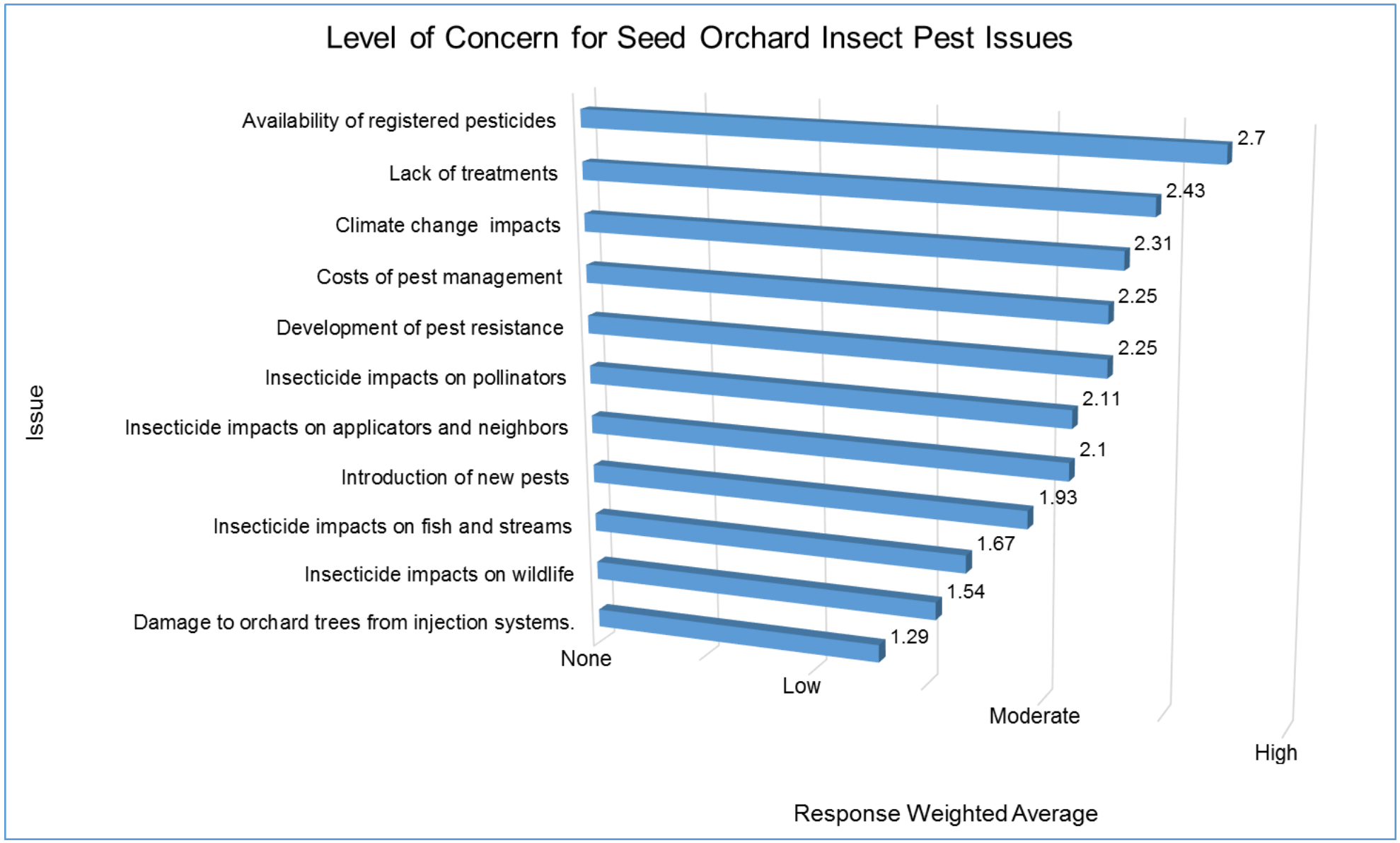
- DFCGM – pheromone trapping - detection and spray timing
- DF seed chalcid – sticky traps - detection and spray timing
- Coneworms – pheromone trapping – detection and initiate larval damage monitoring
- Coneworms – larval damage monitoring – spray timing
- Cedar midges – egg monitoring – detection and spray timing
- DF cone gall midge, DF seed chalcid, coneworms/cone moth – cut cone count monitoring – detection and damage assessment
- Western conifer seed bug, DF seed chalcid – seed radiography – damage assessment
- Cone beetles – cone monitoring – early detection

INSECTICIDES

- Dimethoate (Cygon) – organophosphate (mammalian and avian toxicity)
- Carbaryl (Sevin)– carbamate (extremely toxic to bees)
- Synthetic pyrethroids(toxic to aquatic, bees, can cause spider mite outbreaks)
  - Permethrin (Pounce®)
  - Bifenthrin (Capture®)
  - Lambda-cyhalothrin (Warrior®, Matador®)
  - Esfenvalerate (Asana®)
- Tebufenozide (Mimic™, Confirm™) – growth regulator, intereferes with chitin synthesis
- Diflubenzuron (Dimilin®) – growth regulator, juvenile hormone mimic
- Spinosad (Conserve SC®) – natural substance made by a soil bacterium that can be toxic to insects; labelled for conifer seed orchards – lepidopteran larvae, sawfly larvae, dipterous gall midges, spider mites.
- Spirotetramat (Movento®) – inhibits lipid biosynthesis – controls sucking insects?

WHAT DOES THE FUTURE HOLD?

SURVEY: ISSUES



CLIMATE CHANGE PREDICTIONS FOR THE NORTHWEST

Warmer annual average temperatures

More precipitation falling as rain rather than snow (lower snowpack)

Increased summer heat

Lower summer precipitation, less frequent but heavier rainfalls

More variable weather and extreme weather events

DROUGHTS ARE NOT NEW…

Five centuries of U.S. west coast drought:

The drought along the west coast of the U.S. that began in 2012 formed in relation to a high-pressure ridge linked to internal atmospheric variability. In this recently published study, University of North Carolina scientist Erika Wise examined this most recent drought...

…**showed that drought along the U.S. west coast has occurred periodically since 1500 C.E.** These droughts were also found to be associated with a strong ridge centered along the Pacific Northwest coast. -- NPLCC Climate Science Digest - June 2016

…BUT ARE LIKELY TO BECOME MORE FREQUENT

FOREST EFFECTS PROJECTIONS UNCERTAIN

Studies and the results of vegetation change modeling suggest that a number of different scenarios are possible for Pacific Northwest forests. **These scenarios differ dramatically, ranging from projections of forest expansion to forest dieback,** as a result of uncertainty regarding how projected temperature and precipitation changes will interact to affect drought stress in trees or otherwise modify total annual productivity. Other major uncertainties are whether increased levels of carbon dioxide (CO2) in the atmosphere would increase primary productivity or help trees withstand reduced soil moisture. **The likeliest scenario seems to be that increased forest growth could occur during the next few decades, but that at some point temperature increases would overwhelm the ability of trees to make use of higher winter precipitation and higher CO2.**

POTENTIAL CLIMATE CHANGE IMPACTS ON SEED ORCHARD PESTS

- Phenology
  - Earlier
  - Out-of-synch
- Shift in major pest assemblages, e.g. Dioryctria replace gall midge
- Increased threats from traditional “natural forest” pests, e.g. bark beetles
- Increased damage severity of current “minor” pests, e.g. hemlock woolly adelgid
- Introduced pest establishment (more favorable conditions)
- Northward expansion of seed orchard pests

SILVER LINING

Not all changes will be negative!

“So, I can go through one item after another - major changes that are going to happen under global warming -and most of them will not produce serious effects here in the Northwest, mainly because of our proximity to the ocean,” said Mass on KPLU .... He says the cool eastern Pacific will stave off dramatic warming here.

And Mass says there are plenty of other silver linings to climate change for the Northwest, from fewer injuries caused by black ice, to a longer growing season for wine grapes, and in many places, just generally nicer weather.

“Not all the changes are going to be negative,” Mass said. “I think that’s a real problem with the media, they only paint global warming as gloom and doom, everything is bad, a complete disaster. And it’s not that way. Some things will get better, some things will get worse. There’s the opportunity for us to adapt [in] places like the Northwest.

http://www.kplu.org/post/are-there-silver-linings-climate-change-pacific-northwest

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