



Pollinator Habitat in Agriculture

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Today's Webinar:

- 1) What Pollinators Need
- 2) What Producers Need
- 3) Bee Friendly Farming
- 4) Additional Resources

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What do pollinators need?

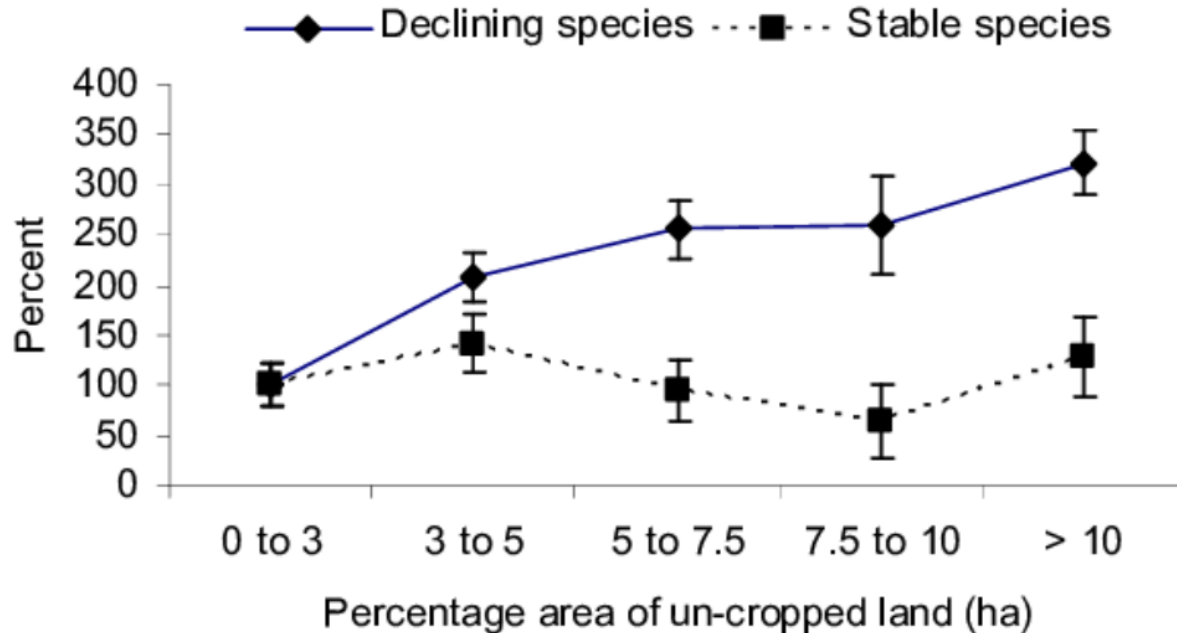
- Diverse, preferably native floral resources rich in pollen and nectar
- Continuous bloom of host plants
- Mix: woody, herbaceous, grasses
- Nesting areas
- Habitat connectivity
- Clean drinking water
- Area with reduced pesticide use

Benefits of pollinator habitat

- Environmental stewardship
- Biodiversity
- Pollinator health
- Pest management
- Pollination and production
- Soil health
- Water health



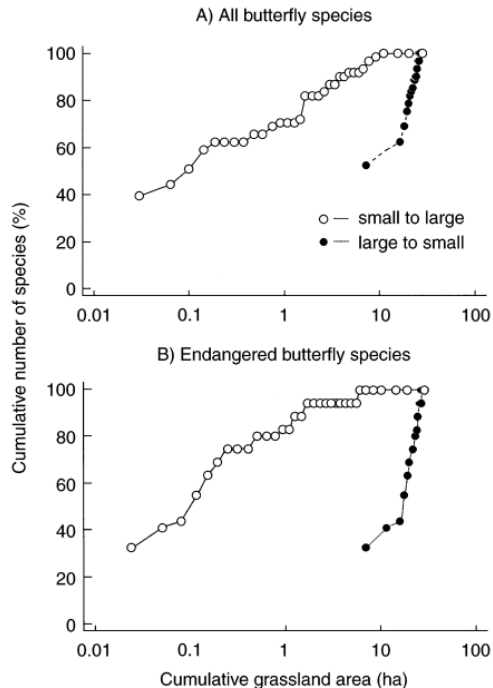
Pollinator Health



- Increase in the number of bee groups between 0–3% and 3–5% uncropped land, but no [significant] increase beyond this
- Farms with habitat approximately 2x the biomass of invertebrates per unit area as the control farms

Holland *et al.* 2013

Pollinator Health



- Small fragments supported more butterfly species (even when only endangered species were considered) than the same area composed of only one or two fragments.
- Species numbers of parasitoids, but not of herbivores, benefited from habitat subdivision in landscapes
- Small habitat fragments should be scattered enough to cover a range of geographical area wide enough to maximize beta diversity and the spreading of risk
- Large habitat fragments should be close enough to allow dispersal among fragments, to reduce the extinction probability of area sensitive species, and to stabilize predator–prey interactions.

Tscharntke et al. 2002

Pest Control

- Abundance of natural enemies and hoverfly richness was enhanced in flower strips.
- A reduction in the number of aphids by 75% in adjacent potato crops.
- 40% reduction of pest-induced crop damage near flower strips.

Tschumi et al. 2016

- Flower strips can benefit pest control services in adjacent fields by 16% on average.
- Pollination decreased with distance from plantings
- Perennial and older flower strips with higher diversity enhanced pollination more effectively.

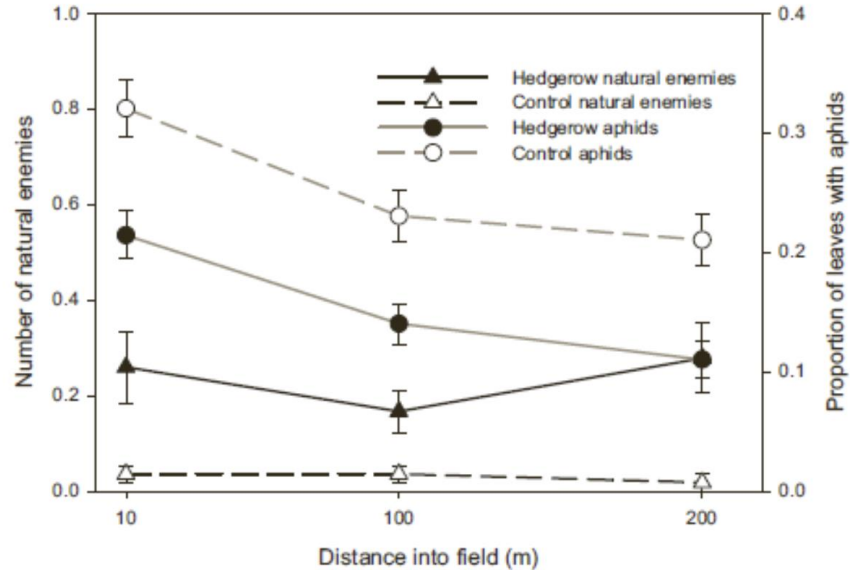
Albrecht et al. 2020



MSU Extension

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Pest Control



- Pest control greater in hedgerow sites than weedy edge sites.

- Hedgerows benefits can extend 100–200 m into crops.

Morandin et al. 2014

Pest Control

- IPM can reduce insecticide applications by 95% while maintaining or enhancing crop yields through wild pollinator conservation

Pecenka et al. 2021

- Diversification schemes generally achieve
 - Natural enemy enhancement,
 - Reduction of herbivore abundance,
 - Reduction of crop damage, from a combination of bottom-up and top-down effects

Letourneau et al. 2011



Pollination and Production

- Soybean yields increased between 6% to 18% with bees

Rocha & Freitas 2013

- Soybean yields were increased by 18%

Bletter et al. 2017

- Benefits of native and honey bee populations on self-pollinating crops
 - 15% increase in cotton yields
 - 12.3% to 15.8% increase in canola yields

Esquivel et al. 2021



Pollination and Production

- Presence of bees can increase pollen yield, decrease risk of *Botrytis*, can decrease shot berries.

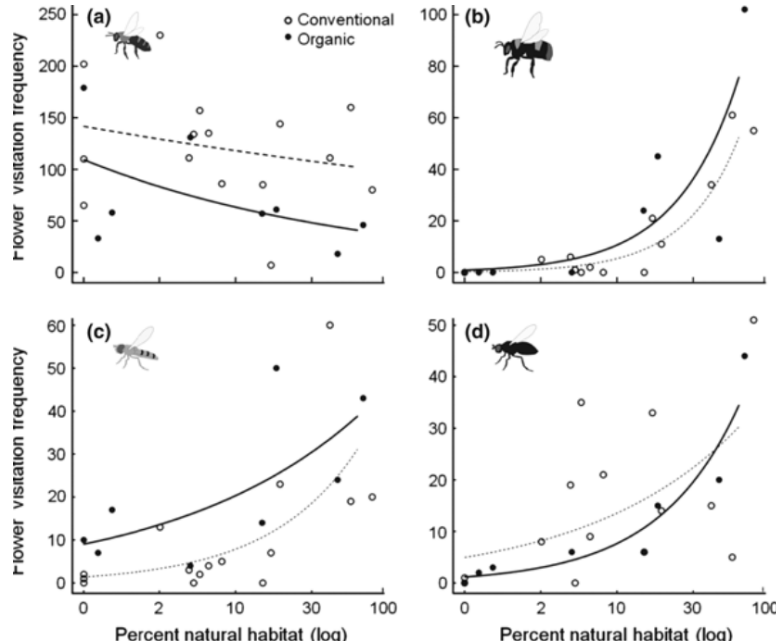
Hogendoorn *et al.* 2016

- Bee pollen can enhance fermentation kinetics without affecting wine quality

Amores- Arrocha *et al.* 2020



Pollination and Production



- Wild bee species visited almond flowers in orchards with adjacent semi-natural habitat or vegetation strips.
- Wild bee species richness and flower visitation frequency, but not honeybee frequency, were related to fruit set.
- Fruit set increased with increasing percentage of natural habitat surrounding the orchards.

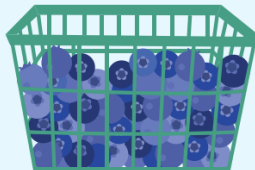
Klein et al. 2012

Pollination and Production

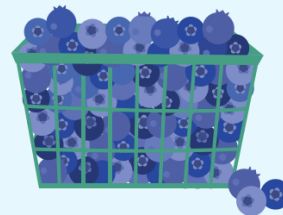
WILD AND MANAGED POLLINATORS' IMPACT ON PRODUCTION



Low production:
No pollinators



Typical production:
Managed honey bees
and typical ambient wild
pollinators in BC



Potential production:
Full pollination with managed
honey bees and increased
wild bee presence from
habitat management. This can
potentially increase revenue by
\$15,000-\$18,000/ha^{1,8}

Pollination and Production

PRODUCTION BENEFITS FROM WILD AND MANAGED POLLINATORS



Little/no pollination

Heavy pollen and the need for a compatible partner tree. No pollinators (pollinator exclusion), results in little to no yield.



Limited pollination

When pollen is not sufficiently transferred to all five carpels, fruit will be small, malformed, and less marketable.

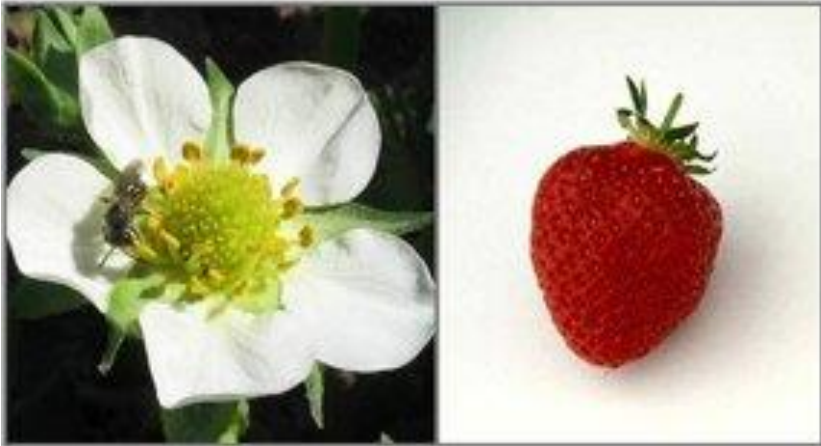


Robust pollination:

Full pollination resulting from diverse wild bee visits and correctly timed honey bee stocking results in larger, more even fruit, as well as more fruits per tree.

Pollination and Production

Cross-pollination by insects



VS.

Self & Wind pollination

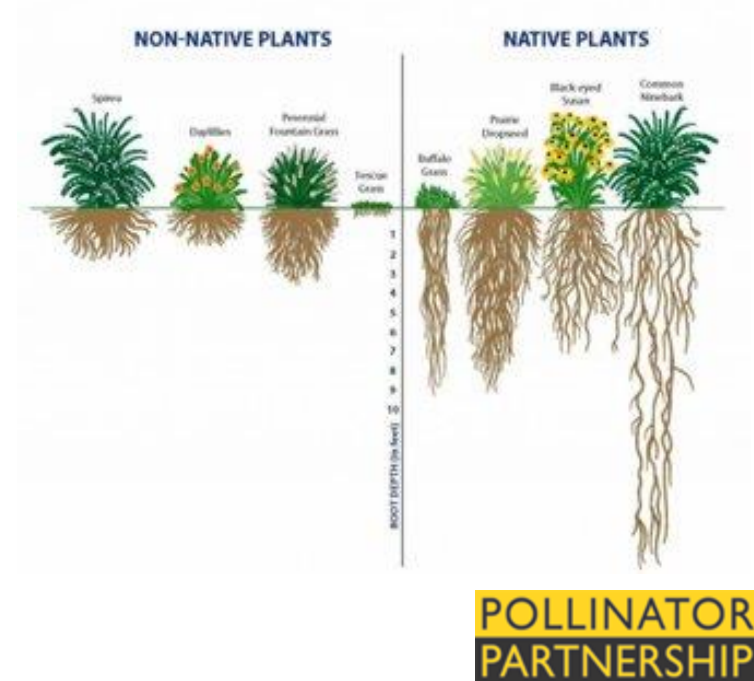


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Soil Health

- Stabilized sites experienced significantly less stream bank erosion than unstabilized sites
- Suspended sediment and dissolved nutrient concentrations increased in the downstream direction
- Increased riparian macrophyte diversity and density at stabilized sites
- Increased macroinvertebrate families and individuals at stabilized sites
- Increased fish species and native fish species at the stabilized sites

Prachiel, 2010



Soil Health

- Increased plant diversity improves soil microbial biodiversity in natural systems
Tiemann et al. 2015
- Microbial interactions in the rhizosphere of mycorrhizal plants improve plant fitness and soil quality
Barea et al. 2002
- Increased diversity facilitates increased functional contribution to soil health services and magnitude
Ferris & Tuomisto 2015
- Plant composition has dramatic effects on soil fertility and produces feedback for nutrient cycling
Hobbie 2015



Soil Health

- 44% reduction in water runoff
- 95% reduction in soil loss
- 90% reduction in phosphorus runoff
- 84% reduction in nitrate-nitrogen runoff
- No change in per acre corn and soybean yields
- No increase in weed abundance
- Reduced emissions of heat-trapping gases, especially nitrous oxide

Grudens-Schuck et al. 2017



Iowa State University

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Bee Friendly Farming

Bee Friendly Farming

Sustainability



Transparency



Science



Bee Friendly Farming



Bee Friendly Farming



- More than 365,000 acres currently certified
- More than 156,000 acres of pollinator forage and habitat managed

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BEE FRIENDLY FARMING: CRITERIA



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BEE FRIENDLY FARMING: CRITERIA

1. Offer forage providing good nutrition for bees on at least 3% of cropped land. Forage can be temporary, including cover crops



Conservation Cover,
Woolf Farming



Annual set aside areas,
Art Hill



Natural habitat areas,
Stemilt

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BEE FRIENDLY FARMING: CRITERIA

1. Offer forage providing good nutrition for bees on at least 3% of cropped land. Forage can be temporary, including cover crops



Flower strips,
Anthony John



Hedgerows,
Emily Carlson



Field borders,
Emily Carlson

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BEE FRIENDLY FARMING: CRITERIA

1. Offer forage providing good nutrition for bees on at least 3% of cropped land. Forage can be temporary, including cover crops



Perennial native cover crop,
Phoenix Habitats



Cover crop,
Waterdam Ranch



Cover crop,
Patterson



Cover crop,
Billy Synk

BEE FRIENDLY FARMING: CRITERIA

1. Offer forage providing good nutrition for bees on at least 3% of cropped land. Forage can be temporary, including cover crops



Rory Crowley

BEE FRIENDLY FARMING: CRITERIA

2. Provide bloom of different flowering plants throughout the growing season, especially in early spring and late autumn.



Western blue flax
Linum lewisii



Western yarrow
Achillea millefolium



Western Goldenrod
Euthamia occidentalis

BEE FRIENDLY FARMING: CRITERIA

3. Offer clean water for bees (if not inhibited by government mandated water restrictions)



Buckets of water with burlap,
J & R Ranches



Ponds and lakes,
Vineyard 7 and 8 Estates



Creeks and canals,
WSU Mt. Vernon
Extension

BEE FRIENDLY FARMING: CRITERIA

4. Provide permanent habitat for nesting through features such as hedgerows, natural brush, buffer strips, or bare ground



Wooded areas,
Tamarack Farms



Hedgerows,
Capay Hills Orchard



Natural perimeters,
Bluff Ranch

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BEE FRIENDLY FARMING: CRITERIA

4. Provide permanent habitat for nesting through features such as hedgerows, natural brush, buffer strips, or bare ground



Undisturbed woody debris,
LaHave River Berry Farm Inc



Snags,
Huckleberry Hollow



Undisturbed bare ground,
Sierra Pac Farms- Heritage Ranch

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BEE FRIENDLY FARMING: CRITERIA

5. Practice Integrated Pest Management (IPM); reduce or eliminate the use of chemicals



Seven major components are common to all IPM programs:

- Pest identification
- Monitoring
- Guidelines for when management action is needed
- Preventing pest problems
- Using a combination of biological, cultural, physical/mechanical and chemical management tools
- After action is taken, assessing the effect of pest management
- Resistance management

BEE FRIENDLY FARMING



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Funding Opportunities

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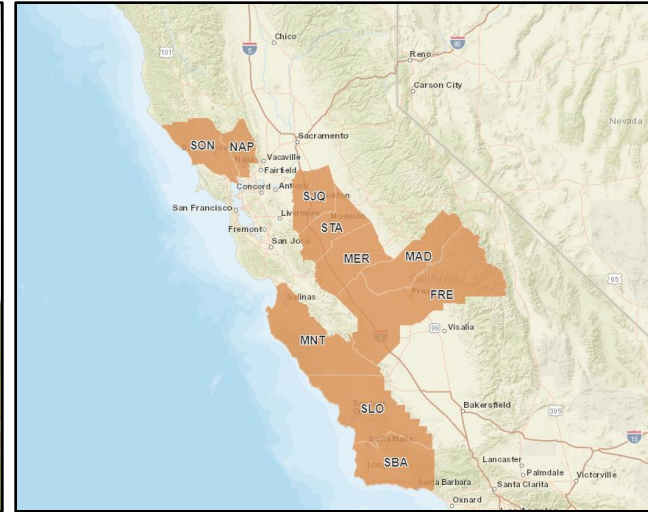
NRCS Resource Conservation Partnership Program (RCP)



Amber Barnes



Emily Carlson



CDFA Pollinator Habitat Program (PHP)



Monarch Wings Across California – Almonds (MWAC)

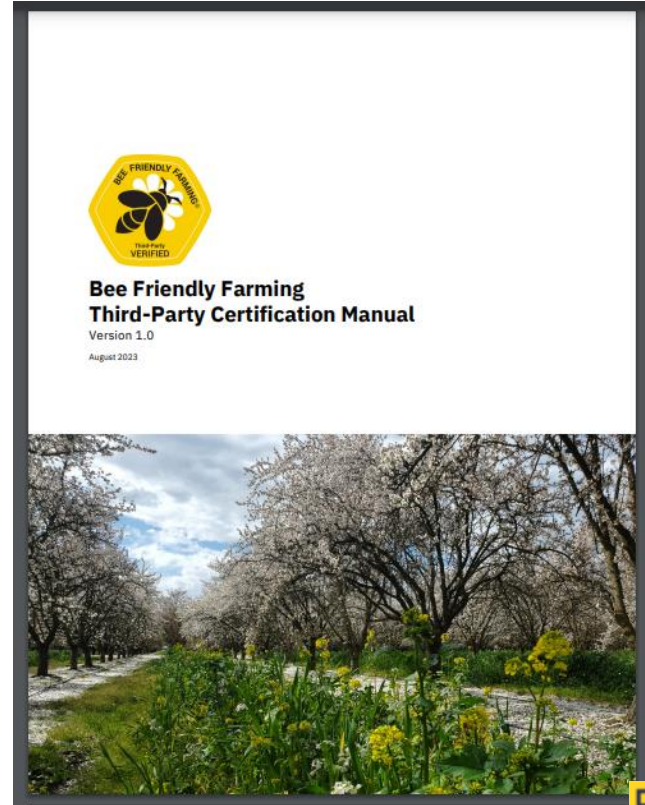




Additional Resources

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Bee Friendly Farming



Agricultural Supporting Pollinators

AGRICULTURE SUPPORTING POLLINATORS: POTATO PRODUCTION

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Created with support from SynGene

SUPPORTING POLLINATORS NEAR POTATOES

This guide is intended for growers and applicators supporting pollinators and pollination services in field-grown potato production systems.

Potatoes have perfect flowers and propagate clonally via tubers. While potatoes do not require pollinators to reproduce, their flowers provide nutrients, drawing pollinators into fields.¹ When properly protected and supported, pollinators enhance farming systems. In practice, planting potatoes year after year in the same field is inadvisable. To avoid associated pest and pathogen risks, growers should implement appropriate crop rotations, many of which are dependent on or benefit from pollinators. Establishing pollinator habitat helps promote healthy soil and crop production.^{2,3}

ON-FARM ACTION GUIDE

Habitat and forage

Establishing habitat provisions on your farm is crucial for supporting pollinators.^{4,5} Consider these elements when incorporating pollinator habitat into your farming operation:

Offer diverse soils for per-plant activities and soil via buffers and practice application management, especially around critical low-lying sites.⁶

Use selective weed control to reduce impacts of mowing and applications to pollinator habitat, especially in low-lying areas, edges, non-irrigated weeds, wildflowers, or habitat patches in low-lying areas.^{7,8}

Set aside natural areas to provide beneficial insects with habitat suitable for pollinators.^{9,10}

Establish floral strips or hedgerows, which improve the soil and production on the edges and other low-impact areas on your farm.^{11,12}

Incorporate appropriate flowering crops into rotation to provide pollinator resources to pollinators.^{13,14}

Designate locations with unfertilized, undisturbed soil for pollinators to use as nesting sites for ground-dwelling and cavity-nesting bees.^{15,16}

Integrated Pest Management (IPM)

IPM involves a long-term, preventative practice through ecosystem functions. Below is a list of strategies you can use to manage pests and mitigate risks to pollinators:

Monitor pest/disease and plan to plan in the field to avoid developing pest resistance through ecosystem functions. Below is a list of strategies you can use to manage pests and mitigate risks to pollinators.^{17,18}

Avoid spraying insecticides during bloom when bees are active, as this practice may be problematic. Pesticide application should be avoided.^{19,20}

Regularly perform farm sanitation procedures to prevent pest resistance. Consider using pest-resistant watermelon varieties.^{21,22}

Adjust irrigation appropriately. Overly saturated and with poor water infiltration may increase the risk of root rot and other fungal diseases.^{23,24}

Install habitat to attract beneficial insects, including syrphid flies, ground-squirrels, and ground-squirrels, to help with pest management.^{25,26}

Develop a pest monitoring program to inform the grower of pest resistance and to provide adaptive improvements to IPM plans.^{27,28}

¹ This strategy aligns with regenerative agricultural practices.

AGRICULTURE SUPPORTING POLLINATORS: WATERMELON PRODUCTION

POLLINATOR PARTNERSHIP

Created with support from SynGene

This guide is intended for growers and applicators supporting pollinators and pollination services in field-grown watermelon production systems. Watermelon producers have the ability to support pollinator health.

WATERMELON POLLINATION

For successful watermelon production, pollinators must facilitate pollen transfer. Honey bees are one example of efficient, easily managed pollinators. They spend an average of 6.8 seconds visiting a female flower, suggesting individual flowers are rich in resources.¹ A fruitful fertilization requires at least 1,000 pollen grains across the flower's three stigma lobes, necessitating a minimum of 8 honey bee visits per flower.² The recommended honey bee stocking rate is 0.2-5 hives/acre. Bumble bees, another efficiently managed pollinator, have the recommended stocking rate of 0.5-3 colonies/acre. Where wild bees are abundant, stocking managed bees may be unnecessary or reduced.^{3,4}

ON-FARM ACTION GUIDE

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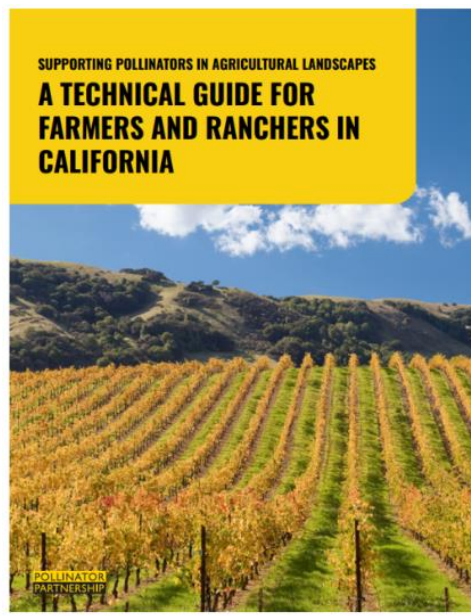
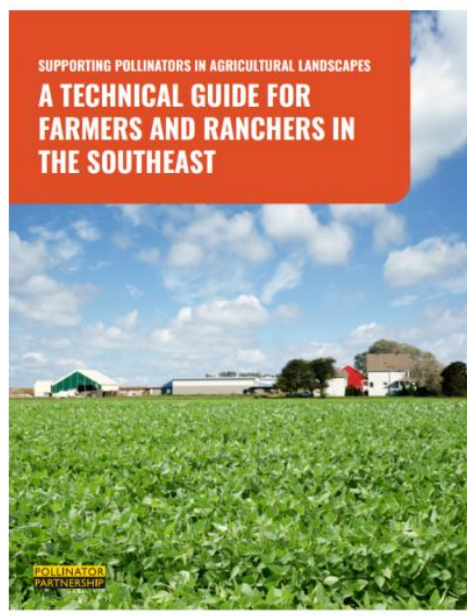
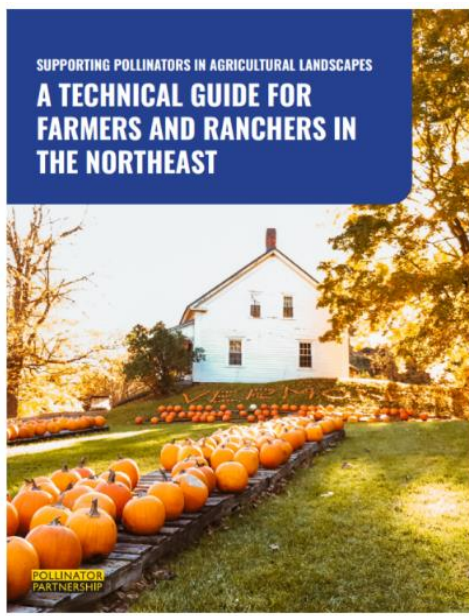
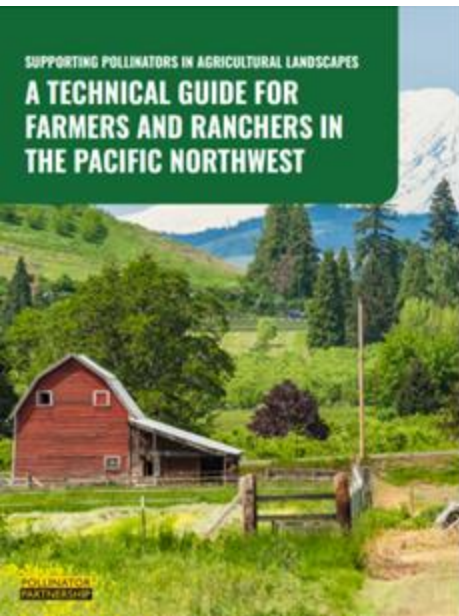
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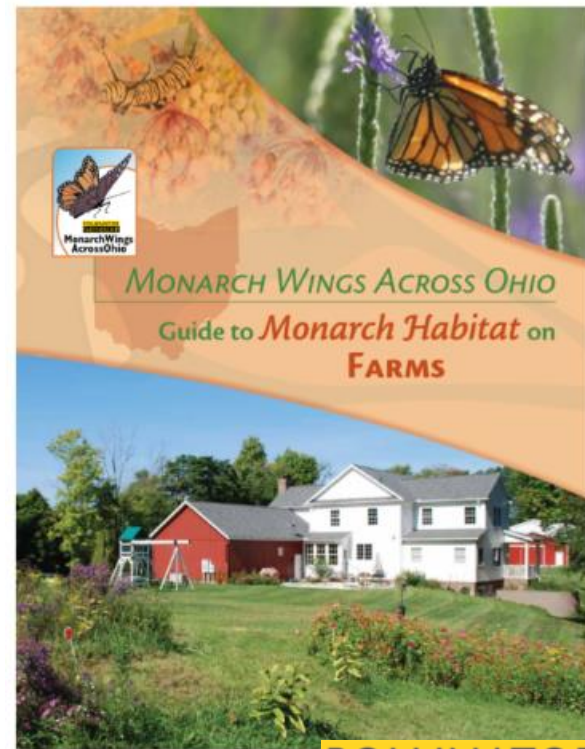
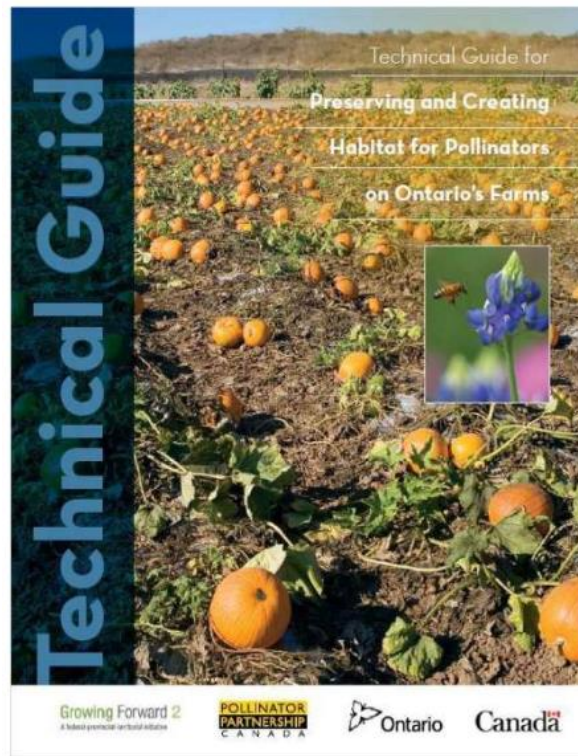
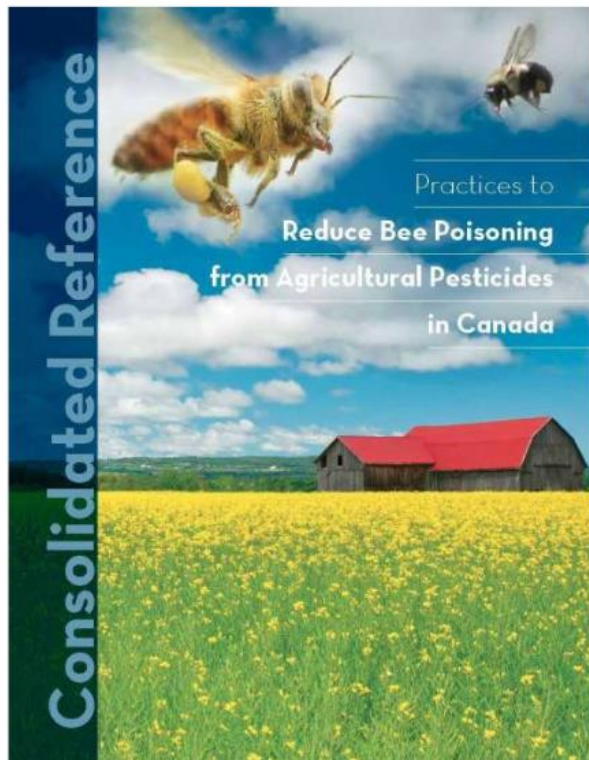
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Supporting Pollinators in Agricultural Landscapes



Additional Regional Agricultural Guides



Protecting Pollinators from Pesticides

Protecting pollinators
from pesticides in
APPLES



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CANADA

Protecting pollinators
from pesticides
HIGHBUSH BLUEBERRY



POLLINATOR
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CANADA

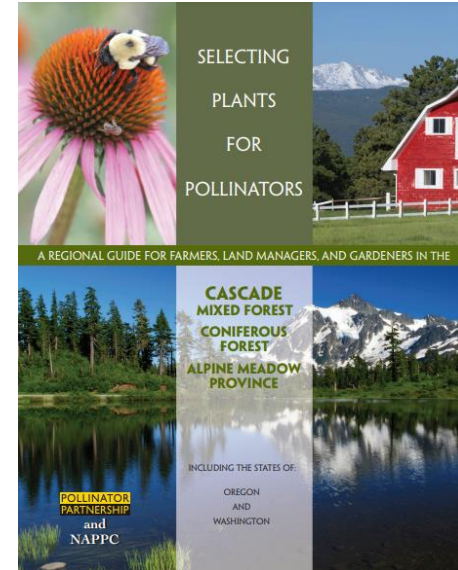
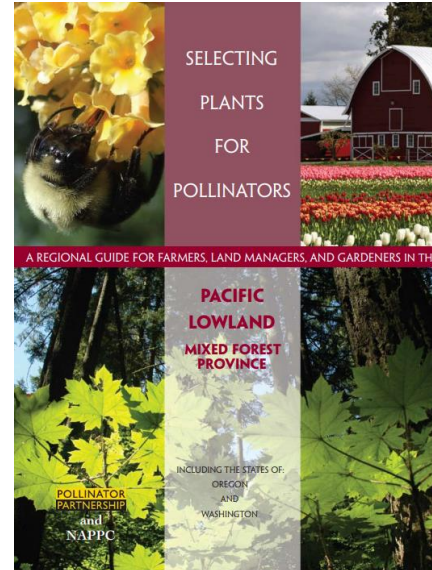
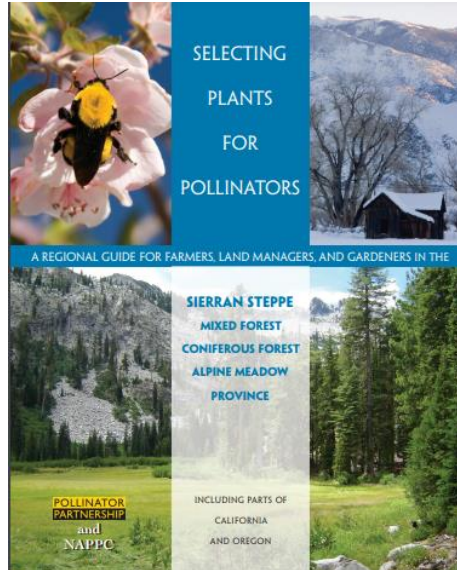
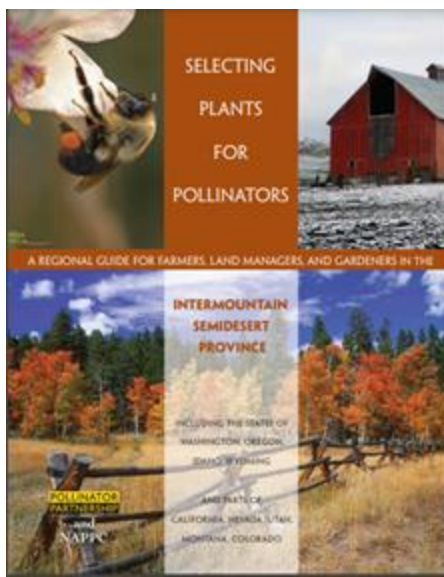
Protecting pollinators
from pesticides
CUCURBIT CROPS



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CANADA

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Ecoregional Planting Guides







Find Your Roots

A tool for creating pollinator-friendly native plant lists for your habitat project

- 1 Welcome!
- 2 Select your ecoregion
- 3 Filter by plant characteristics
- 4 View plant list

[Next](#)

 Export  Columns  Filters

Image	Botanical Name	Common Name	Plant type	Pollinators	Min Height (ft)	Max H
	<i>Dicentra uniflora</i>	steer's head	Perennial Flower	bees	0.1	0.3
	<i>Lewisia rediviva</i>	bitterroot	Perennial Flower	bees, insects	0.2	0.3

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PEST: Pollinator Enhancement Security Tool

A tool to help weed out plants that may support common crop pests in Canada

Ash

Pests that preferentially choose this plant: *Sitobion avenae*, *Rhopalosiphum padi*, *Aphis pomi*, *Eriosoma lanigerum*, *Aphis glycines*, *Chaetosiphon fragaefolii*, *Aphis gossypii*, *Acyrtosiphon pisum*, *Rhopalosiphum maidis*, *Macrosiphum euphorbiae*, *Mysus persicae* (aphids)

Pests that incidentally choose this plant: *Halyomorpha halys* (brown marmorated stink bug)

Crops at risk: apple, strawberry

Dogwood

Pests that preferentially choose this plant: *Drosophila suzukii* (spotted-wing drosophila)

Pests that incidentally choose this plant: *Halyomorpha halys* (brown marmorated stink bug)

Crops at risk: strawberry





SCMS Blueberry Tool

A tool to help weed out plants that support common blueberry pests.

I want to...

Install or enhance habitat for pollinators
 Assess pest risk to crop from existing habitat
 Manage pests damaging or threatening my crop

Select one or more pests of concern:

Pest:

970 host plants **35** beneficials

Spotted Wing Drosophila
Drosophila suzukii
Hosts: **37**
Beneficials: **3**

Japanese Beetle
Popillia japonica
Hosts: **19**
Beneficials: **1**

Spongy Moth
Limnephila sp.
Hosts: **10**
Beneficials: **1**

Blueberry Stem Gall
Wasp Hemadas rubilipennis
SOURCES REMOVE

Hosts: **10**

Beneficials: **1**

Japanese Beetle
Popillia japonica
SOURCES REMOVE

Hosts: **19**

Beneficials: **7**

Blueberry Stem Borer
Orebia myops
SOURCES REMOVE

Hosts: **10**

Beneficials: **1**

I want to...

Install or enhance habitat for pollinators
 Assess pest risk to crop from existing habitat
 Manage pests damaging or threatening my crop

Only plants that have been identified as a host for one or more of the pests in the dataset are included. If you cannot find a plant you are looking for, it was not identified as a host for any of the pests in the dataset.
Choose one or more plants:

Pest:

[Optional] Select pests of concern:

Pests:

3 host plants **0** beneficials

Black Elderberry
Sambucus nigra
SOURCES REMOVE
Pests: **1**

Holly-Leaf Cherry
Prunella laurocerasus
SOURCES REMOVE
Pests: **1**

Coyote Bush
Quercus agrifolia
SOURCES REMOVE
Pests: **1**

Amaranthus
Amaranthus spp.
SOURCES REMOVE

Pests: **1**

American Linden
Tilia americana
SOURCES REMOVE

Pests: **1**

American Sycamore
Platanus occidentalis
SOURCES REMOVE

Pests: **1**

Arrowwoods
Viburnum spp.
SOURCES REMOVE

Pests: **1**

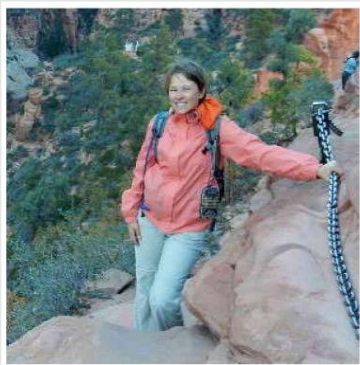
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Farmer/ Rancher Award



Blueberry Producer/ Advisor Survey





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Co-Director of Agricultural Programs



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Agricultural Coordinator



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Thank you

pollinator.org/ beefriendlyfarming.org/ / cody@pollinator.org / bff@pollinator.org