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Gardening for Beneficial Insects

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Why encourage beneficial invertebrates?

- **Alternatives to pesticides**
  - **Less frequent need to use sprays**
  - **Enables avoidance in pesticide free gardens**
  - **Adds caution into the decision to spray**
- **Pest suppression**
  - **Less damage, fewer outbreaks**
- **Food web engineering!**
  - **Promotes biodiversity (e.g. birds, other insects)**
- **Educational opportunities**
  - **Highly visible insects and activities**
- **Being a good neighbor**
  - **Export beneficials not pests to neighbors!**

The good old days! pre-1940's pest control

- **Household**
  - *Clothes moth*: camphor, naphalene, *p*-dichlorbenzene
  - *Fumigation*: ethylene oxide, hydrocyanic acid
- **Garden and farm**
  - Nicotine, methyl bromide, acetonitrile, calcium copper and lead arsenates, pyrethrins, rotenone

Dipping apples in 1% hydrochloric acid for 4 min removes 66-73% of the arsenic residue: 1930

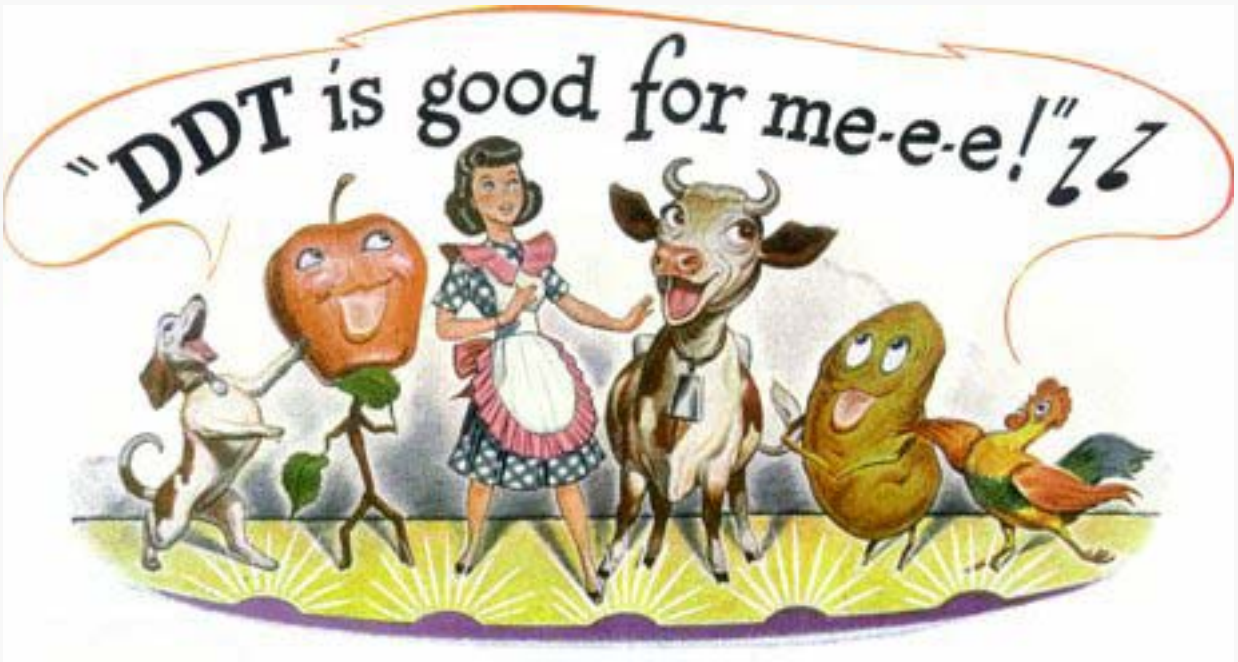
Average arsenic after treatment: 0.006 grains/lb

FDA tolerance:

1927: 0.025 grains/lb

1932: 0.01 grains/lb

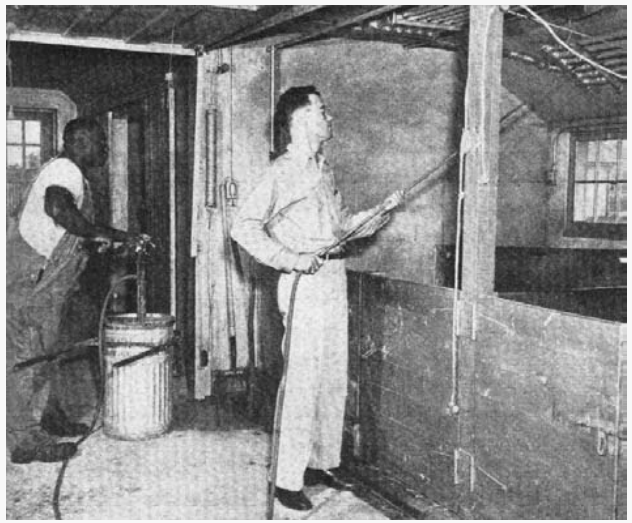
Introduction and wide-scale use of synthetic pesticides from 1946

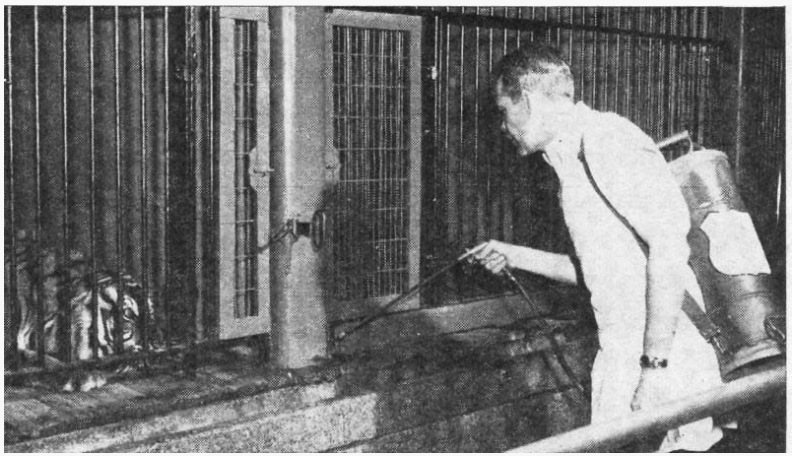


Pyrethrum flower imports peaked at 13 million lbs 1945, but feel sharply in 1946, not resuming until 1955

Wide-spread use in the home, farm and zoo!

Over-reliance; treated as an aspect of the new age!



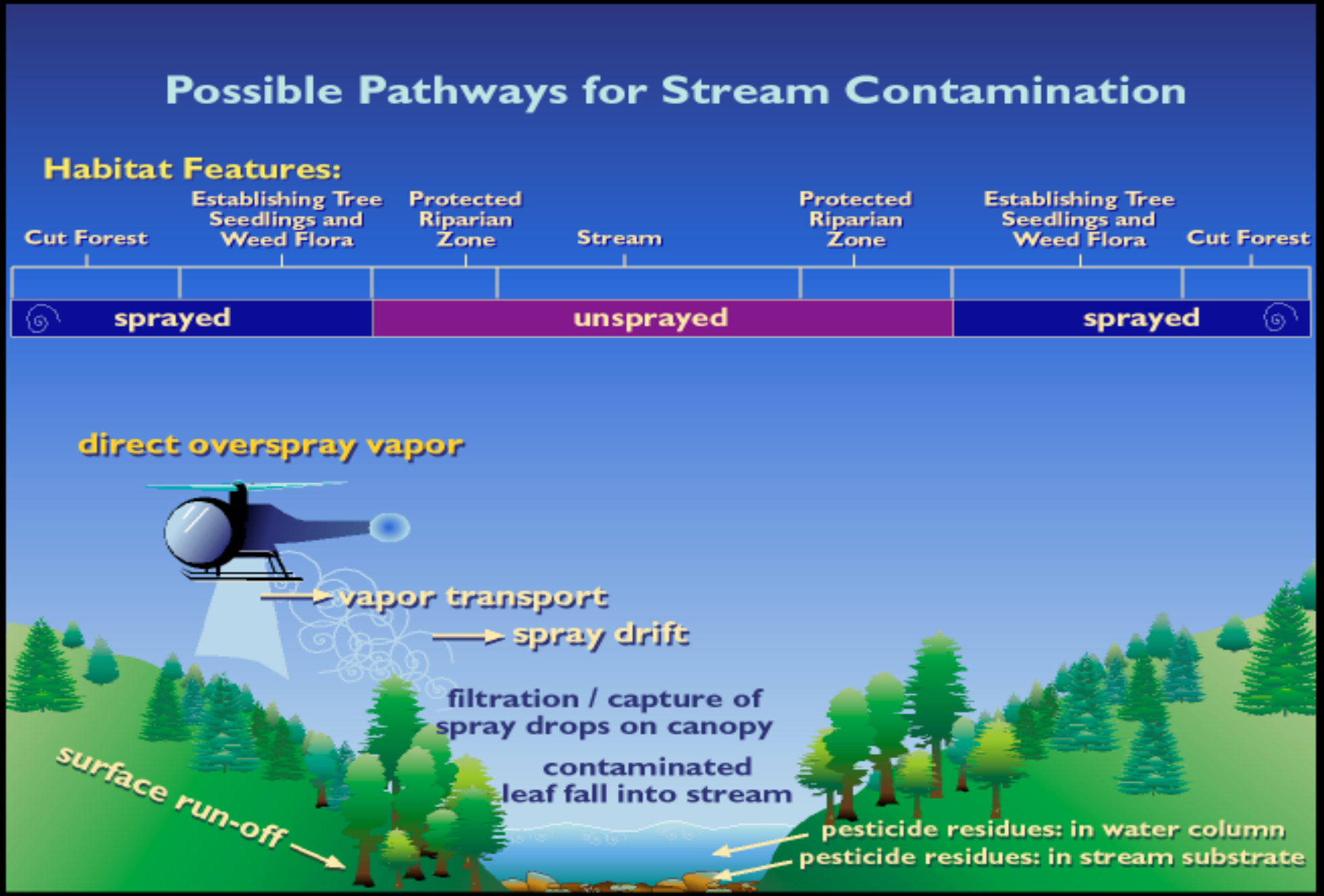


The biggest problem: spray application is not efficient

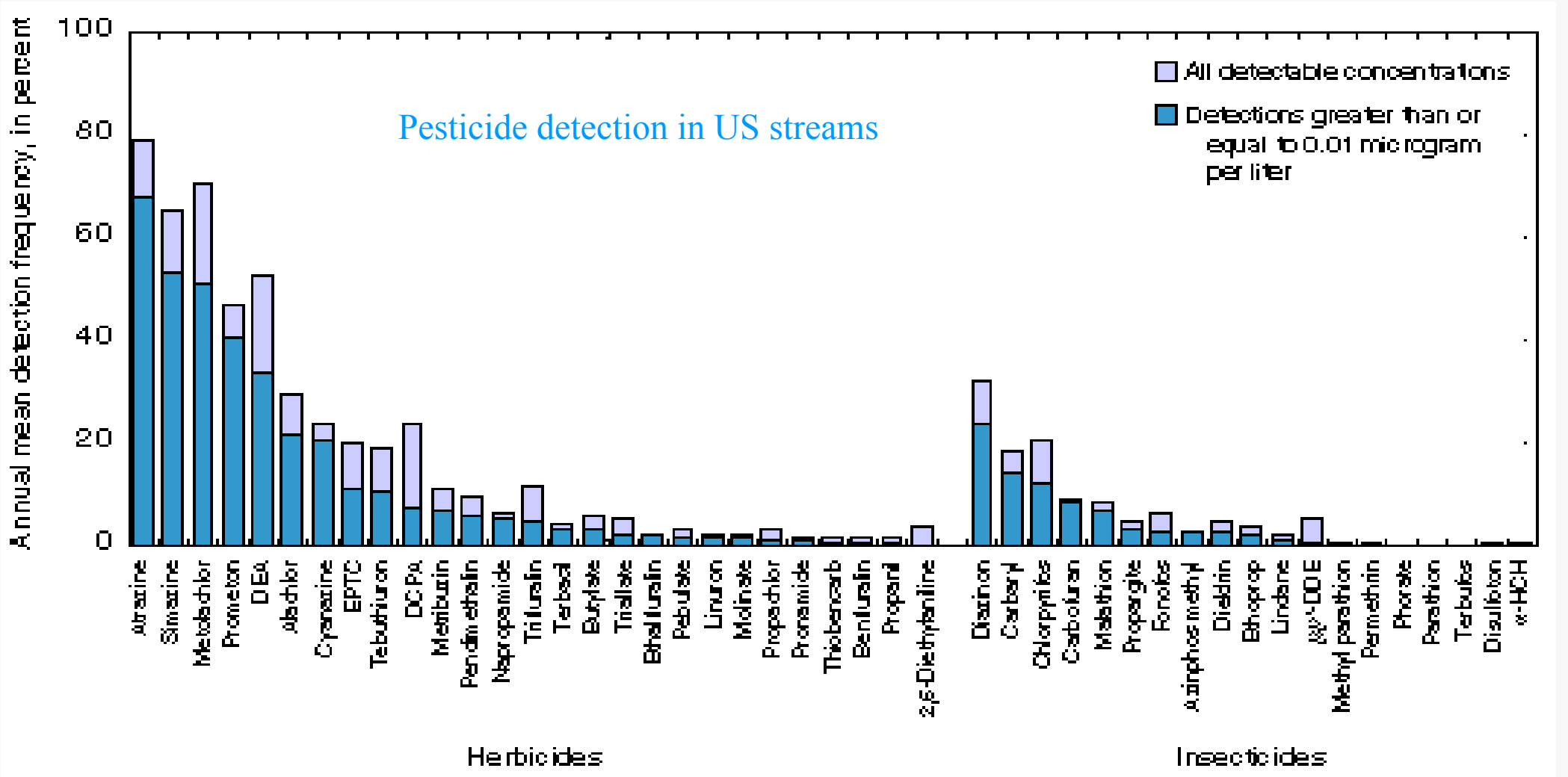
(Graham-Bryce, 1977)

Pesticide	Application method	Target	Efficiency of utilization
Demeton-S-methyl	Foliar spray	Aphids on sugar beet	0.000008%
Dieldrin	Seed treatment	Wheat bulb fly larvae	0.0015%
Dimethoate	Foliar spray	Aphids on field beans	0.03%
Lindane	Foliar spray	Capsids on Cocoa	0.02%
Dieldrin	Aerial swarm spray	Locusts	6.0%

Possible Pathways for Stream Contamination

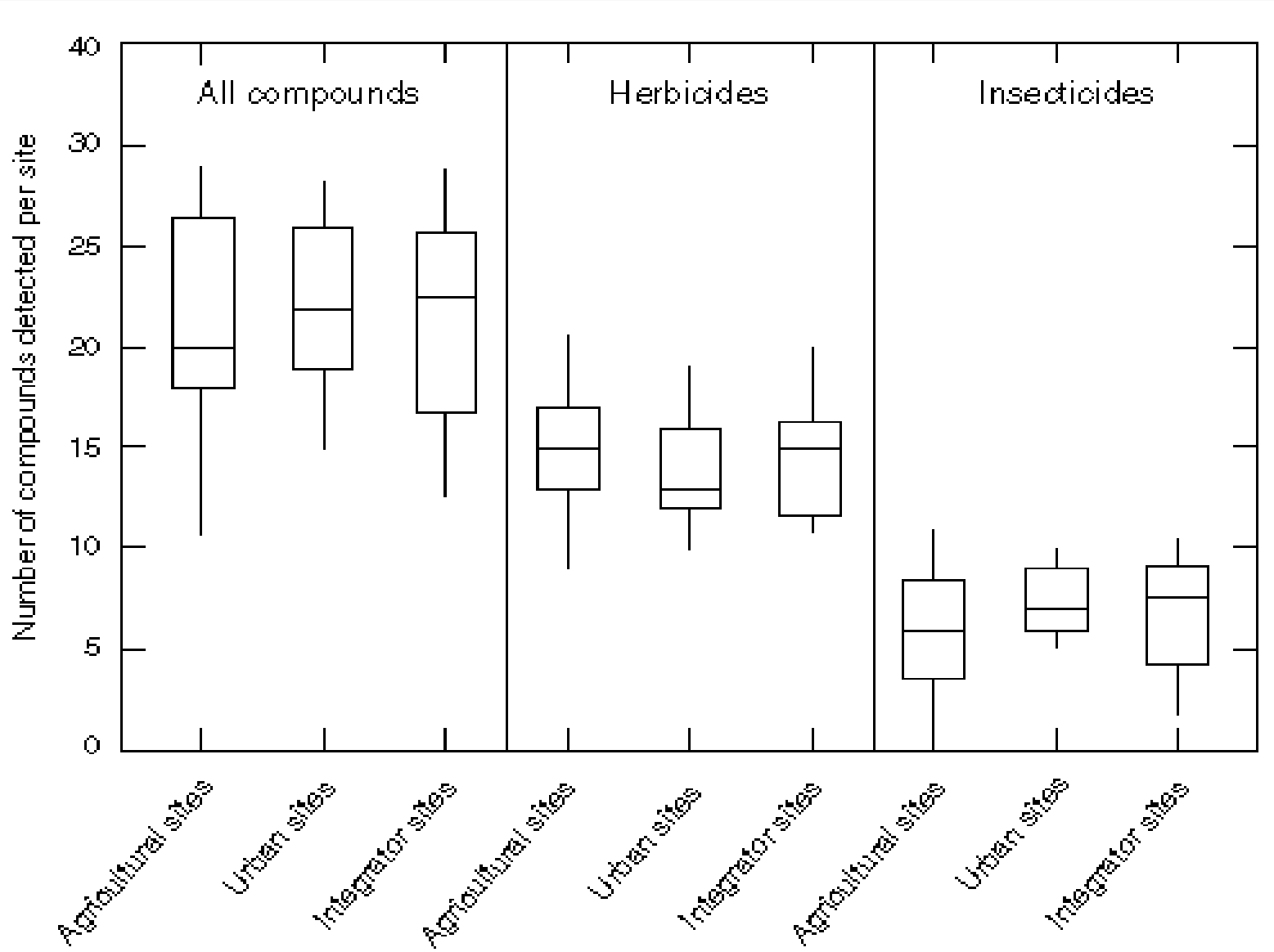


Pesticides turn up in our streams and rivers



NAWQA Pesticide National Synthesis Project

Urban pesticide use contributes to stream contamination



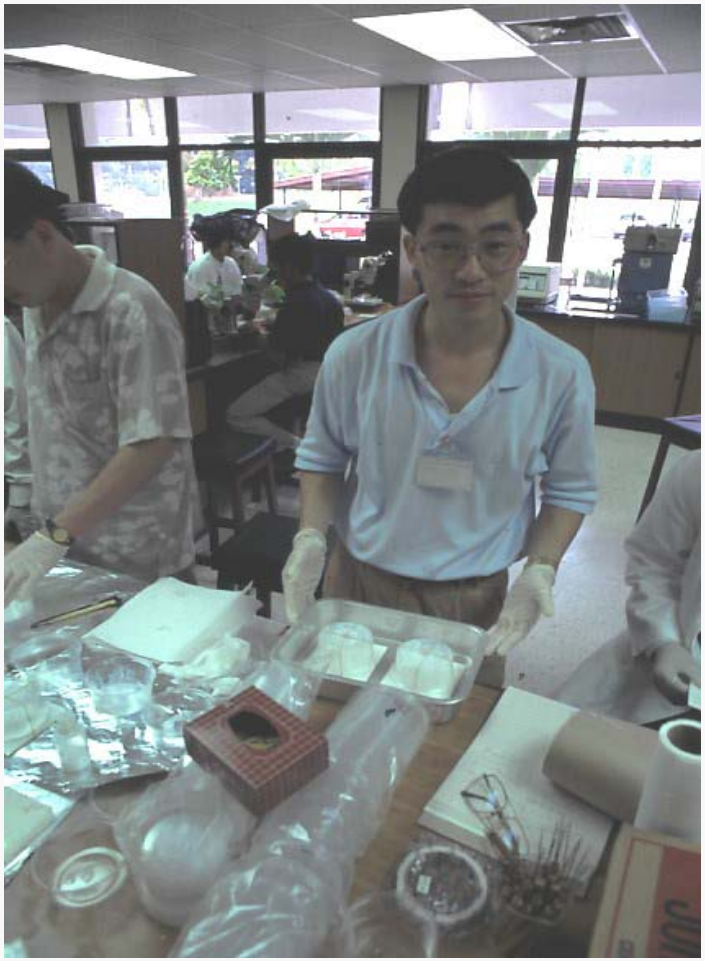
Continued concerns about wildlife declines and loss of flora in agriculture systems

- Pesticides
- Landscape simplification

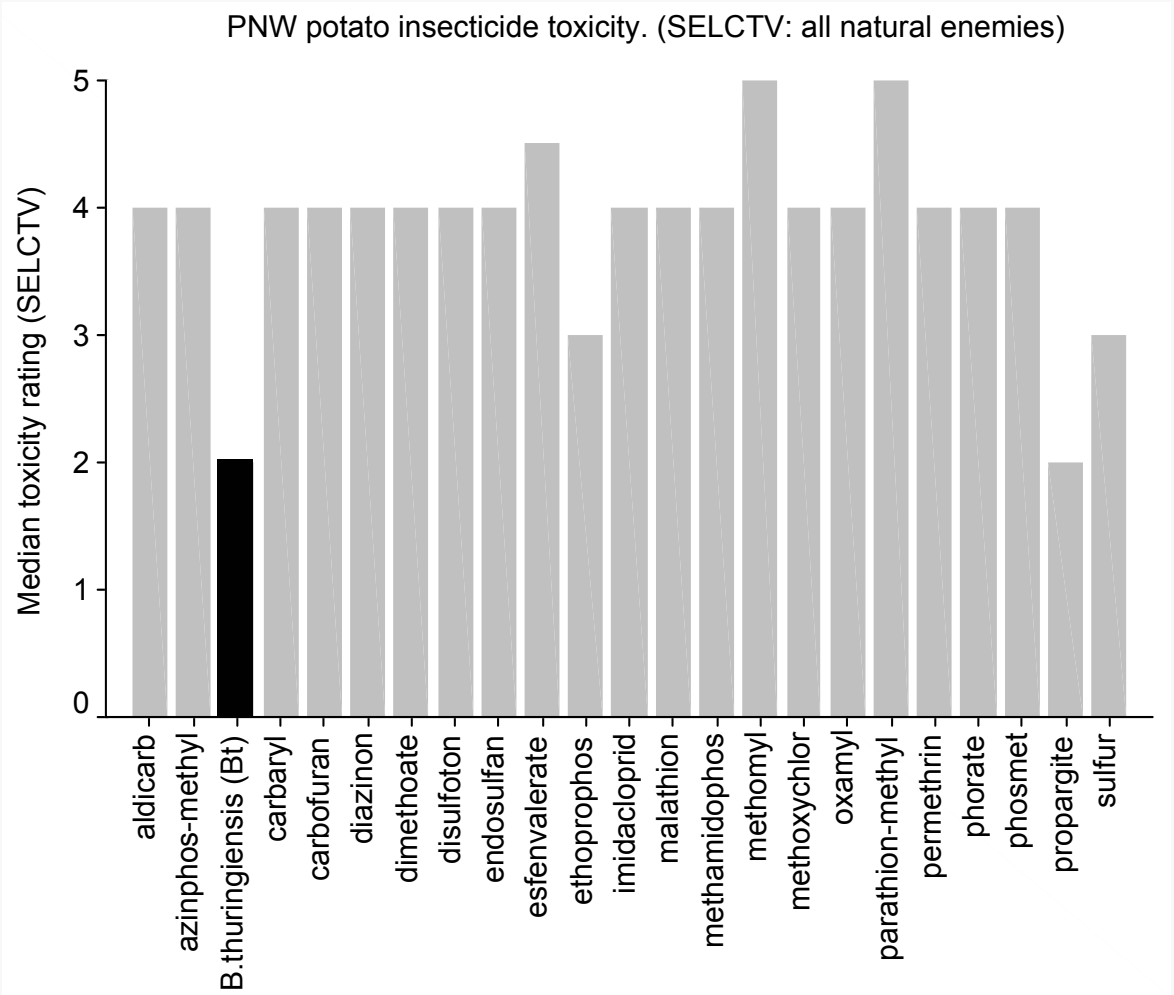
No data on garden wildlife

- Has pesticide use increased?
- Has modern landscaping simplified the garden landscape?

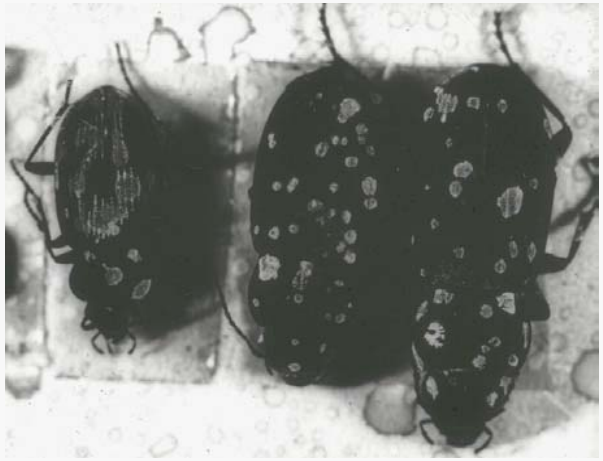
Impacts of broad-spectrum pesticides on natural enemies still cause problems



Laboratory-based bioassays provide extensive databases of pesticide impacts on natural enemies

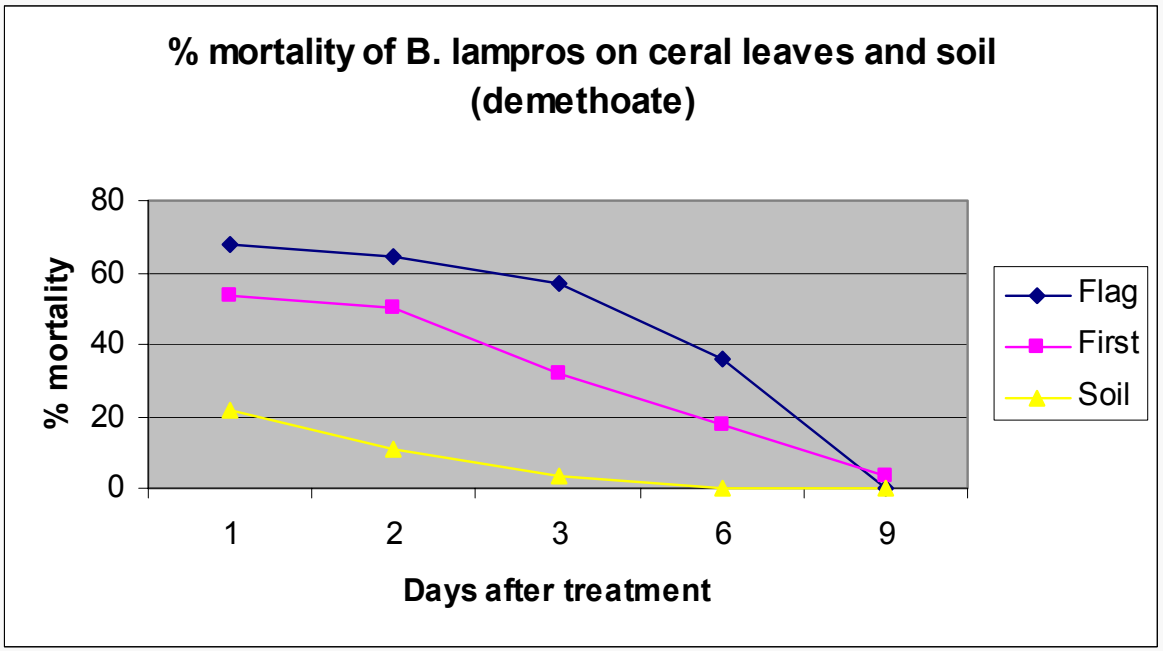


Natural enemies are exposed to direct sprays and residues and may be eradicated from fields and gardens



Carabid ground beetles with fluorescent spray drops for quantification of direct exposure

Cilgi and Jepson, 1992



Long residual toxicity may delay recovery and recolonization

Unal and Jepson, 1991

Population change in UK farmland wildlife

(Robinson & Sutherland, 2002)

	Years	N	% decreasing	No change	% increasing
Lower plants	pre/post 1950	38	79	21	0
Plants	Long term	45	60	38	2
Butterflies	1976-2000	21	14	43	43
Birds	1970-99	18	78	5	17
Mammals	1965-95	12	50	33	17

Landscape change, herbicide and insecticide uses dominate as concerns

Agro-ecosystems and gardens can be highly diverse






Invertebrate biodiversity contributes directly to pest limitation

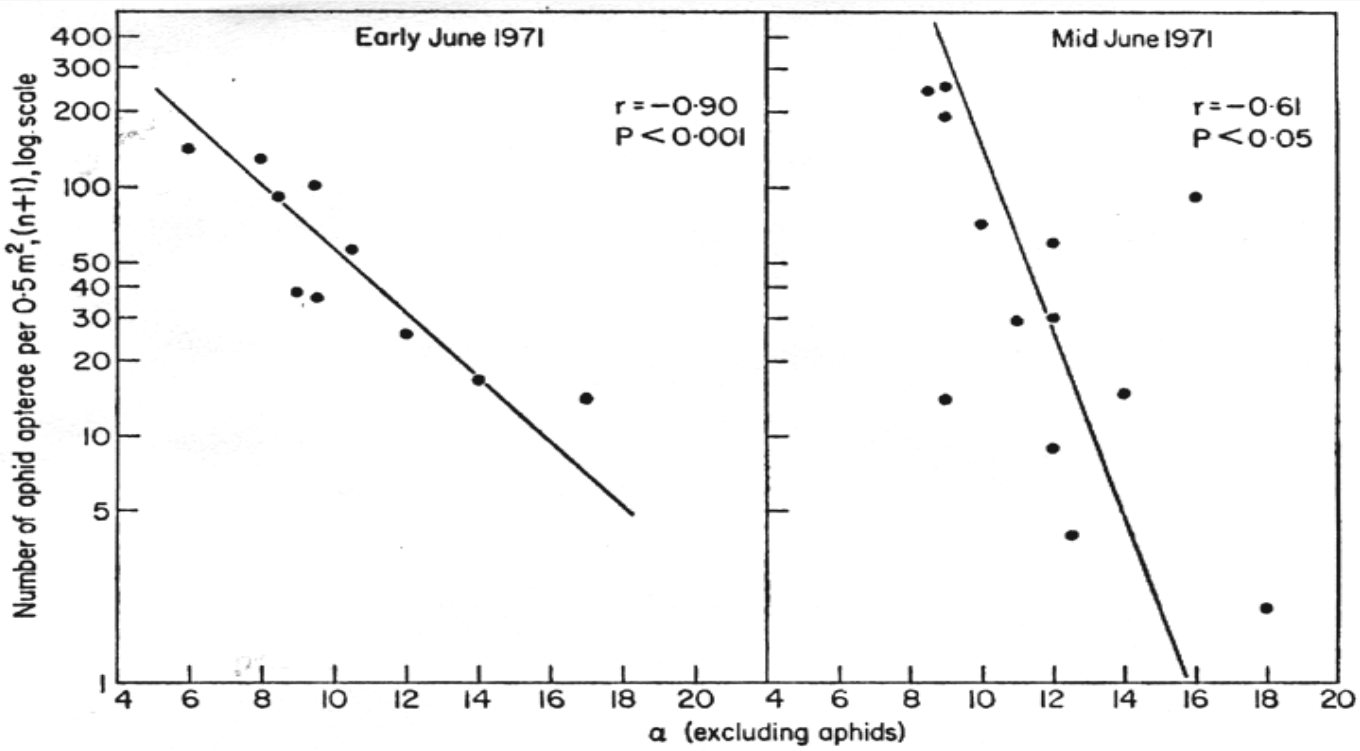


FIG. 11(ii). The correlation between arthropod diversity (α) and the density of apterous aphids in winter wheat, 1971.

Pest abundance is lower where farmland biodiversity is higher

How can biodiversity be managed?

Potts and Vickerman, 1974

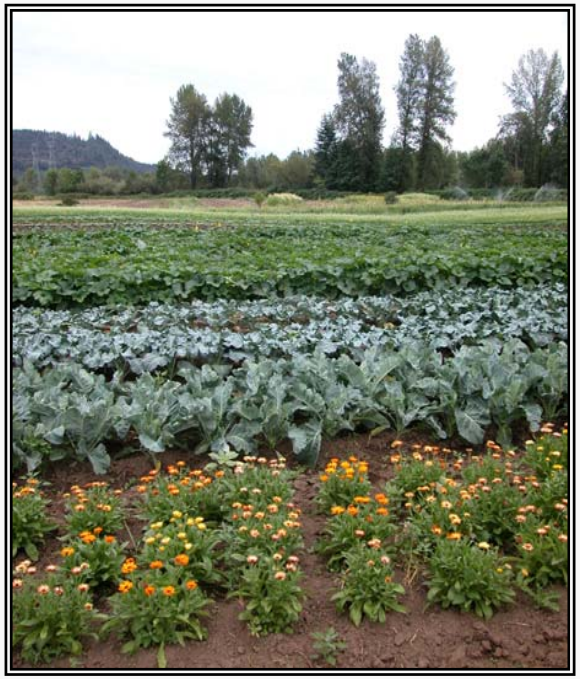
Promoting beneficial insect biodiversity

Insectary Plantings

'*Insectary plantings*' refers to the use of flowering plants (which contain resources in the form of nectar and pollen) for natural enemies of plant pests and other beneficials.

In addition to floral resources, these plantings may provide alternative prey or host food and shelter.

Insectary plants can be included in cropping systems in many different configurations



Within the crop field or orchard in strips or smaller blocks

Insectary planting tactics continued:

Among hedgerow plants, or as perennial or annual plantings in crop margins

Cover crops

Selective conservation of existing insectary plants

hoverflies

ladybird beetles

parasitoid tachinid flies

Beneficials that benefit from pollen and nectar sources

soldier beetles

Beneficials that benefit from pollen and nectar sources continued:

parasitoid wasps

green lacewings

Beneficials benefited by alternative prey and shelter

big-eyed bug

minute pirate bug

predacious stink bugs

damsel bugs

assassin bugs

Beneficials benefited by alternative prey and shelter, continued:

rove beetles

spiders

ground beetles

Factors to consider when designing insectary plantings

Timing of flowering	1. Will the floral resources be present when needed? 2. Will the flowers attract beneficials *away* from desired predatory or pollination actvities at certain times?
Characteristics of the beneficials	3. What is the relative preference that key beneficial and pest species have for the flowers? 4. What are the different requirements for nectar, pollen, shelter, and alternate hosts food among these organisms? 5. What are the relative foraging ranges and dispersal abilities of these organisms?
Agronomic considerations	6. How competitive are the plantings with the crop or other weeds? 7. Do the plantings have the potential to be weeds, or harbor weeds in the system? 8. Can the plantings serve as an alternate host for crop disease? 9. Are the plants toxic to any livestock or other local animals?
Economic & Management considerations	10. Can the planting be harvested as an additional crop? 11. What are the costs of seed, establishment, and maintenance? 12. How do these costs compare to other management options? 13. Are plantings compatible with the main pest management plan?

The maximum potential dispersal and foraging ranges for the adult stage of different natural enemies

~ Short Range

ground spiders

rove beetles

ground beetles

~ Middle Range

lacewings

parasitoid wasps

predacious bugs

~ Long Range

ballooning spiders

hoverflies

ladybird beetles

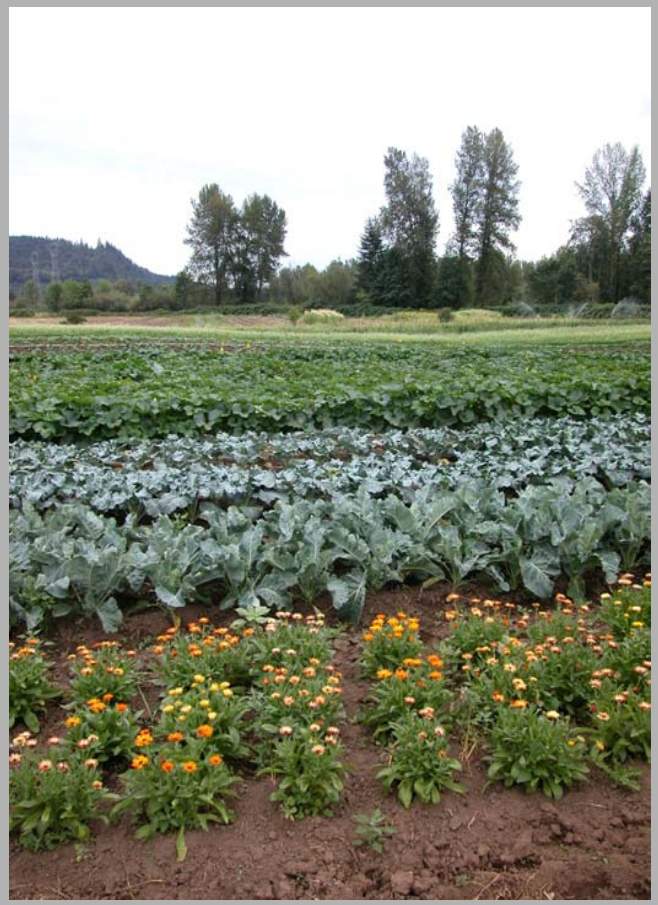
August 6th

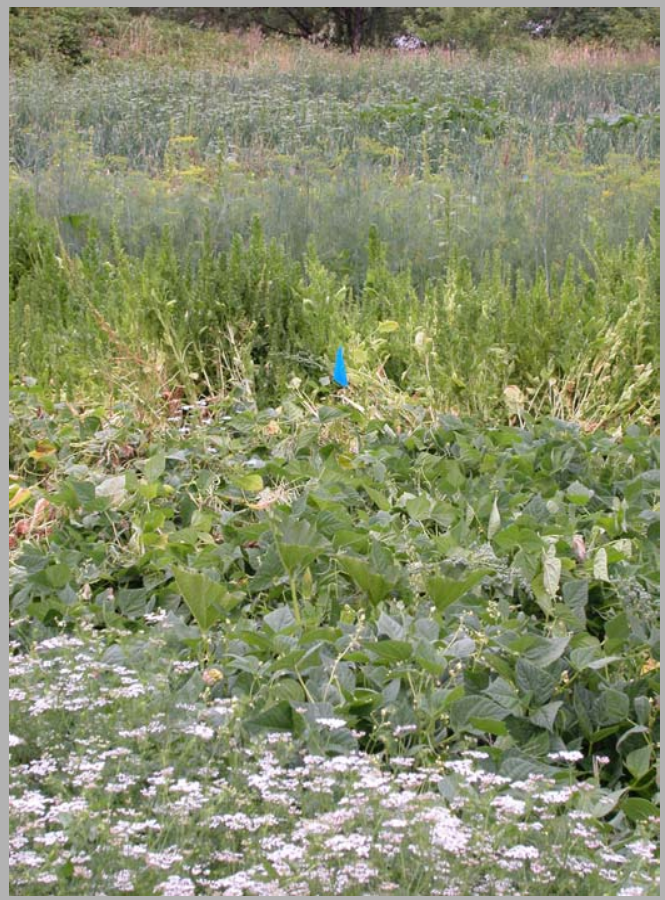
Farm Walk

Persephone Farm

Biological control measures in progress at Persephone Farm, OR

- Bird and bat houses
- Plantings of sunflowers for birds and minute pirate bug (predator of cucumber beetle larvae)
- Plantings of dill, cilantro, fennel, agastache, alyssum, calendula and orache interspersed with cash crops to attract and sustain various beneficial insects
- Attempted hedgerow (not a success) of shrubs meant to attract and sustain birds, bees, beneficial insects. Intend to try again
- Emphasis on cover-cropping fields not in cash crops, many with flowering plants such as vetch and clover
- Pastured poultry flock hopefully eats bugs in soil
- Used to release purchased ladybugs and lacewing larvae (no longer feel the need)
- Strong wild population of mustards, radishes, chickweed, speedwell etc., sustains vibrant wasp community



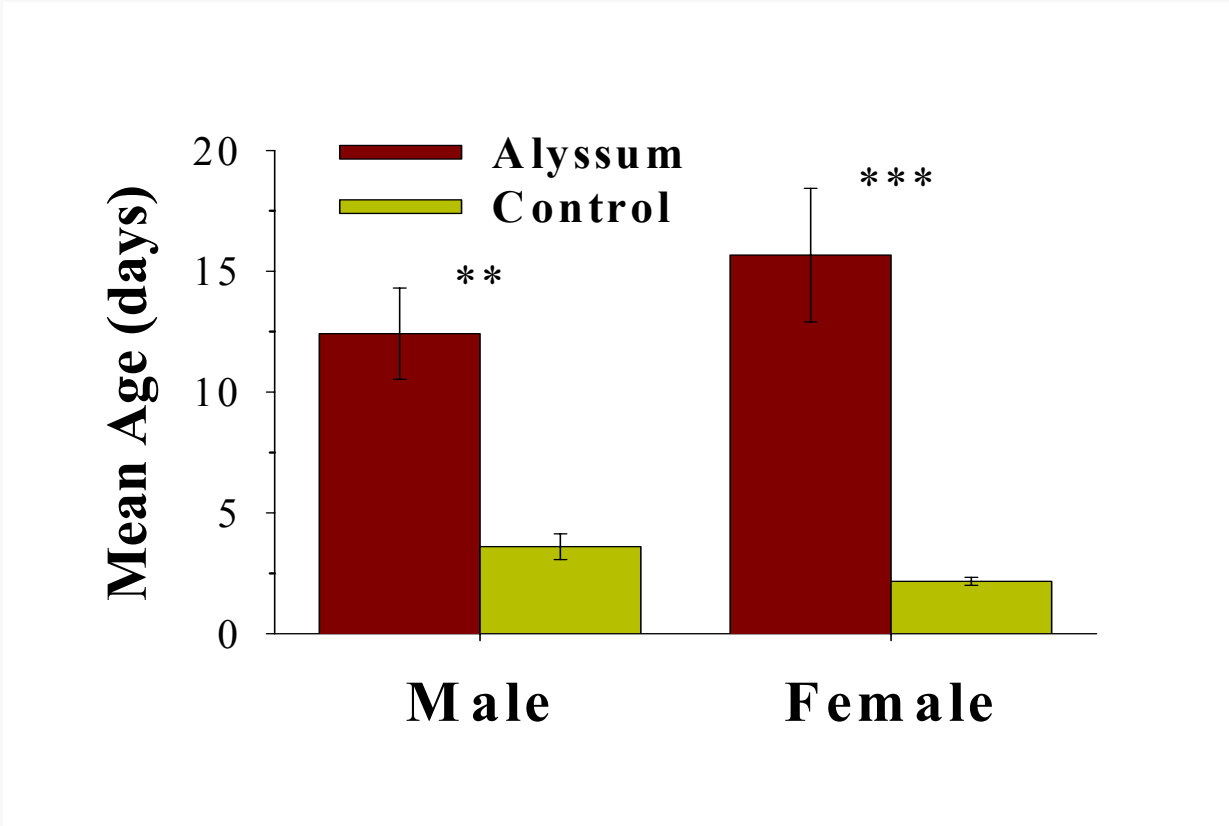


Diverse plantings, structural complexity, multiple insectary plant types to provide temporal spread

Mechanisms that underlie the success of insectary plantings

Fitness Improved: Longevity

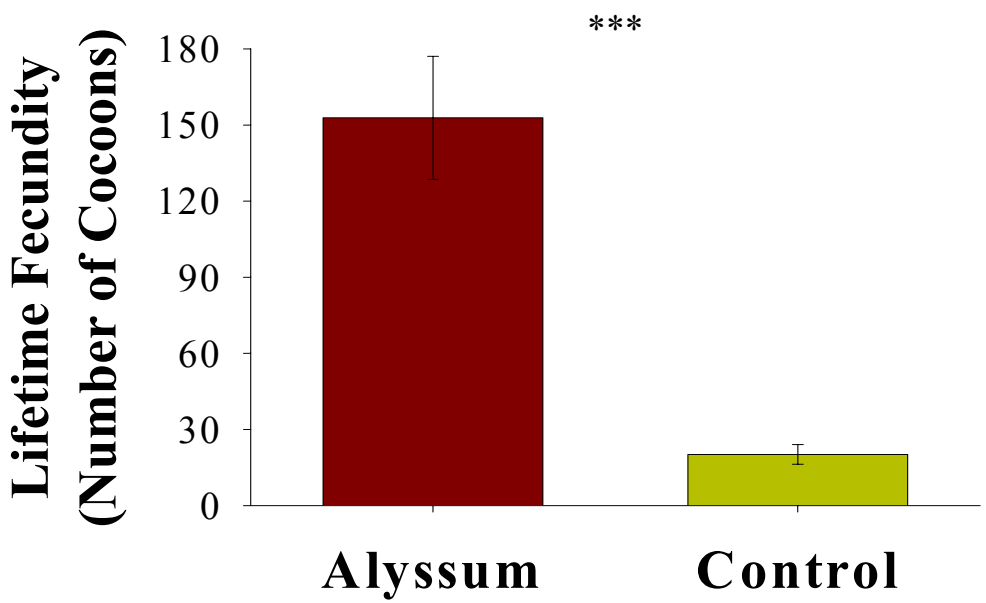
- e.g., *Dolichogenidea tasmanica* (Braconidae)



Data from Steve Wratten, NZ

Fitness improved: Fecundity

- Realised fecundity: F1 cocoons produced
  - e.g., *D. tasmanica* (Braconidae)

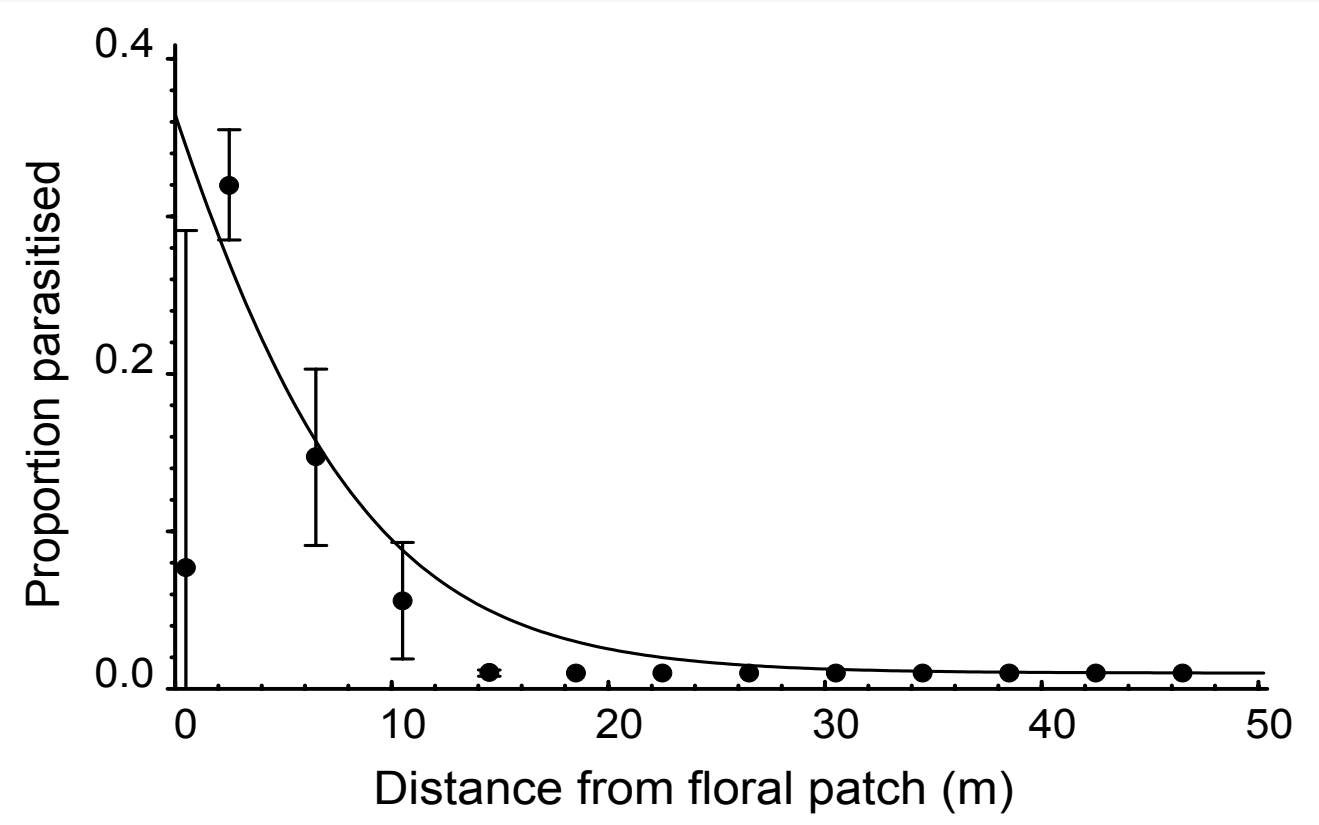


Data from Steve Wratten, NZ

Distance of enhancement of parasitism rate: no barriers

Aphidius rhopalosiphi

(Aphidiidae)

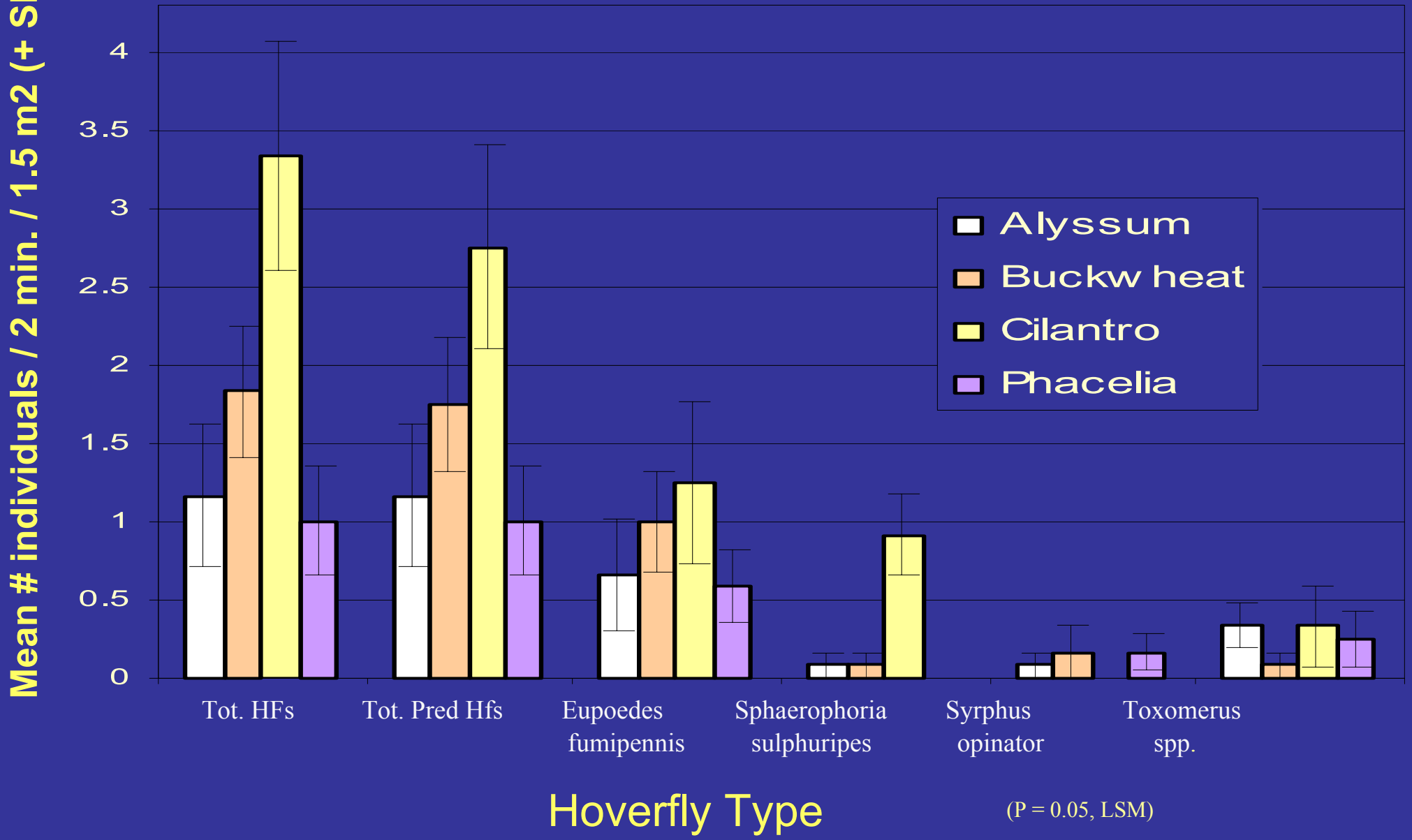


Data from Steve Wratten, NZ

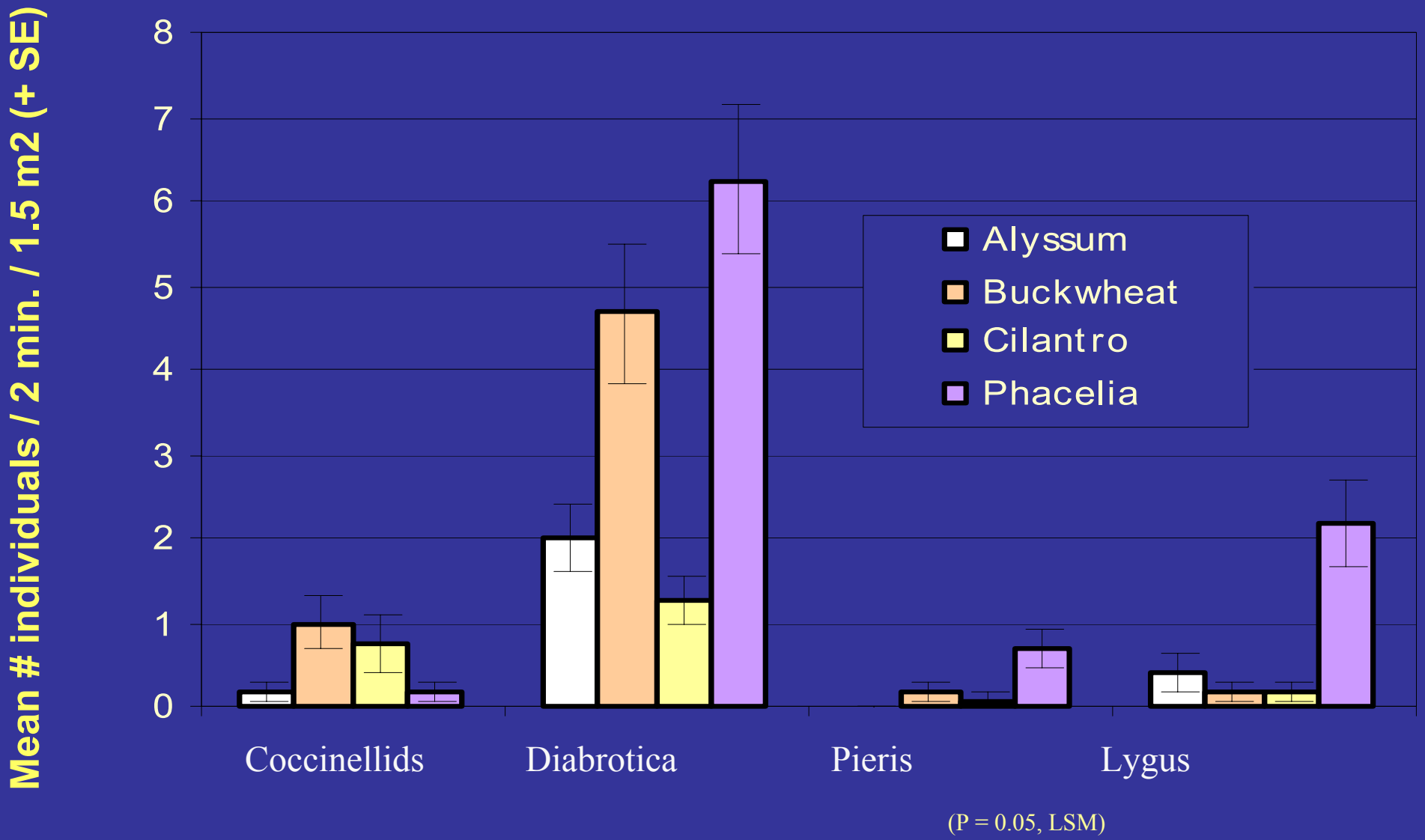
Vine rows prevent or delay dispersal

Adding the right kind of biodiversity

Hoverflies Visiting 4 Flower Types



Other Arthropods Visiting 4 Flower Types



Promoting beneficial insect biodiversity

Beetle Banks

Beetle banks' are graded low banks that are placed in fields or gardens to enhance populations of predatory beetles and spiders. They are planted with tussock- or mat-forming grasses to provide high quality, over-wintering habitat, from which these invertebrates disperse in the spring.

e.g. Orchard grass or Timothy grass

Beetle bank establishment

September and October are the best months to establish the grass sward on beetle banks.

Create habitats raised above the soil surface, with broad grassy swards on the top

Cut grasses to promote tussock formation and limit seeding

Insects benefited by beetle banks

Rove beetles (Staphylinidae): spring/summer active winged insects, that feed on fungal spores, aphids, and other plant and soil-borne prey. Also common in compost mounds and decaying vegetation.

One to two generations a year.

Insects benefited by beetle banks continued:

Ground beetles (Carabidae): night or day active, winged or wingless insects, mainly on the soil surface. They include spring and fall-breeding species, some of which may be active throughout the growing season. They only have one generation a year, and they are susceptible to local extinction following use of broad spectrum insecticides.

Adults and larvae feed on insect eggs (e.g. cabbage maggot eggs), slugs and worms, and ground-active prey, including the many pests that fall from the plant.

Some species climb plants and feed on insect larvae and eggs on leaf surfaces.

Invertebrates benefited by beetle banks continued:

Spiders, that may be ground active hunters, sheet web producers on the ground, or web-forming species in the plant canopy. May have several generations a year.

Very susceptible to pyrethrins.

OREGON TILTH, INC.

OSU IPPC, Oregon Tilth partnership: *Farm-scaping for beneficials*


Horton Road
Organics
Horton Road
Farm Walk


Benton County Fair
Aug 3 - 7
HOLIDAY FOOD DRIVE NOV 15-25
GIFTS FOR A BETTER WORLD NOV 17 - DEC 7
HOMESPUN CHRISTMAS FAIR SAT 10-5 SUN 10-4
BUGSCAPING 2003
FARMERS MARKET WED 8A - 1P
http://bentoncountyfair.com


Beetle


Plantings
The Xerces Society
Pollinators


Insectary Plantings


Farm Planning

Development of an action plan: *Garden-scaping for beneficials*

- Implementation in parks, gardens, schools
- Neighborhood schemes to gain scaling benefit
- Demonstration gardens/plots
- Evaluation experiments
- Educational opportunities