

Biology and Management of Common Salinas Valley Soil- Borne Insect Pests

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Background

CALIFORNIA CELERY RESEARCH ADVISORY BOARD RESEARCH PROJECT REPORT

for the period of
October 1, 1998 -- September 30, 1999

Management of *Liriomyza* leafminers with *Beauvaria* and chemically-induced plant resistance on Celery in Salinas

PROJECT LEADERS

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INTRODUCTION

The polyphagous pea leafminer, *Liriomyza huidobrensis* (Blanchard), is a major economic pest of celery in Salinas, California. Management of *L. huidobrensis* presents a significant challenge because of its intercrop movement, broad host range, lack of fallow or no-host periods, and larval development within foliage (Heinz and Chaney, 1995). Few high-risk neurotoxic pesticides are effective against *L. huidobrensis*, and resistance

Soil-Borne Pest Insects

- poorly researched and poorly understood
 - difficult to research
 - difficult to sample
 - difficult to control

Soil-Borne Pest Insects

- poorly researched and poorly understood



corn rootworm



clover root curculio

Soil-Borne Pest Insects

- poorly researched and poorly understood



rice water weevil



cucumber beetle larva

Biology of Soil-Borne Insects

- What are they doing?
 - Shredders
 - Predators
 - Herbivores
 - Fungal Feeders

Biology of Soil-Borne Insects

- What are they doing?
 - Although the plant feeders can become pests, most arthropods perform beneficial functions in the soil-plant system
 - Shred organic material
 - Stimulate microbial activity
 - Mix microbes with their food
 - Mineralize plant nutrients
 - Enhance soil aggregation
 - Burrow
 - Stimulate the succession of species
 - Control pests

Biology of Soil-Borne Insects

- What's down there?
 - Springtails
 - occasionally large numbers of springtails occur in greenhouse crops where they can injure young plants
 - some species injure sprouting seeds, roots and tender shoots



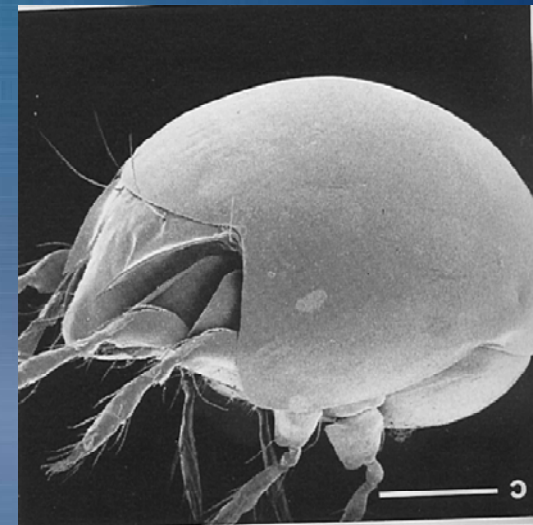
Biology of Soil-Borne Insects

- What's down there?
 - sowbugs/pillbugs
 - not an insect, a crustacean
 - occasionally damage roots, seedlings, foliage and fruit which contact the soil
 - seldom damaging under field conditions



Biology of Soil-Borne Insects

- What's down there?
 - Mites
 - 100's of species occur in soil
 - a few can be damaging to germinating seeds
 - most are poorly studied



Biology of Soil-Borne Insects

- What's down there?
- specialized insects
 - Aphids/mealybugs
 - most species are foliage feeders but a few inhabit soil
 - lettuce root aphid



Biology of Soil-Borne Insects

- What's down there?
- specialized insects
 - potato tuberworm



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Biology of Soil-Borne Insects

- What's down there?
- General pests
 - white grubs
 - wireworms
 - flea beetle



Biology of Soil-Borne Insects

- What's down there?
 - Garden Symphylan
 - most closely related to millipedes and centipedes



Garden Symphylan

- occurs most commonly on both coasts
- northern CA, Oregon, Washington, British Columbia
- found in Europe, northern Africa
- introduced into Argentina
- likely native to Europe



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Garden Symphylan

- wide host range
 - many vegetables – beans, celery, sweet, corn, carrot, broccoli, spinach, tomato
 - field crops such as field corn, clovers, sugarbeets
 - also ornamental and flowers
- symphylans feed on yeast, algae, dead insects, organic matter



Garden Symphylan

Infestations

- infestations seldom cover an entire field, but rather one or more small areas of $\frac{1}{4}$ to several acres
- first indication of a symphylan infestation is a small area of stunted, unhealthy plants
- the plant stand may be only a fraction of what it should be
- in severely infested areas, crops may be completely destroyed or severely damaged



Garden Symphylan

Infestations

- crop losses continue in the same general areas of the field year after year, with the affected area increasing in size by about 10 to 20 feet each year.
- symphylans damage sprouting seeds, seedlings before or after emergence or older plants
- feed primarily on root hairs and rootlets and their ability to injure crop decreases as plants get larger
- pitting of older roots
- transplants may be stunted



Garden Symphylan

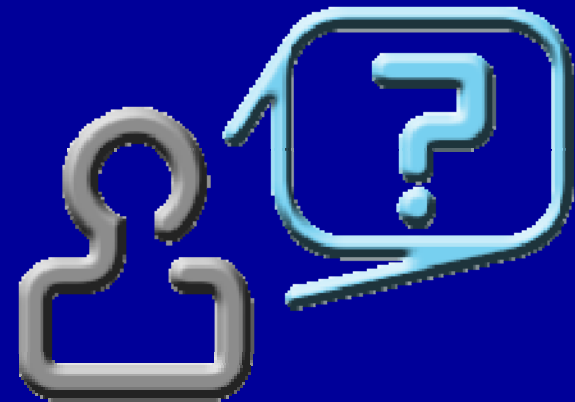
Life Cycle

- symphylans prefer soil temperatures $\sim 65^{\circ}\text{F}$ but temps from 54 to 68°F are suitable
- most likely to be found near surface around roots unless conditions are unfavorable
- unable to dig their own tunnels
- use earthworms tunnels, natural cracks, root crevices
- packed soil is not favorable
- need moist soil (but so do plants)
- move about 12 inches per day

Garden Symphylan

Management

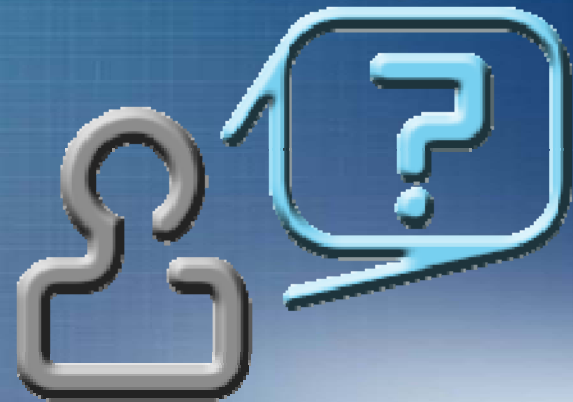
- loam soil most suitable for symphylans
- also high OM, good moisture holding capacity
- cultivation can help with control
- flooding
- some indication there are differences among crop cultivars
- insecticides
 - pyrethroids



Garden Symphylan

Management

- treat entire field or spot treatment?
 - is this pest the problem or something else
- take 10 shovels of soil
 - if more than 1 symphylan per shovel, treat



Garden Symphylan

Management

- treat entire field or spot treatment?
- is this pest the problem or something else
 - place thick slices of raw potato on the soil surface within moisture
 - don't push potato into soil and compact soil
 - cover the bait with a solid plastic dome (large enough not to cause excessive heating or condensation; 6 X 6 inch round white plastic pot with no drainage holes or a styrofoam cup is adequate) to protect the bait from drying out
 - leave the bait in place for 24 to 36 hours, remove cover, and count symphylans on the potato slice and soil surface underneath

Garden Symphylan

Management

- treat entire field or spot treatment?
 - is this pest the problem or something else
- if symphylan counts ~75 per potato slice, complete stand loss may occur
 - significant stand loss will occur at lower symphylan populations

Garden Symphylan

Management

- control erratic
- can move to avoid poor conditions
- often do not know this is the problem
- not a heavily researched organism

Seed Corn Maggot

Seed corn maggot or onion maggot??

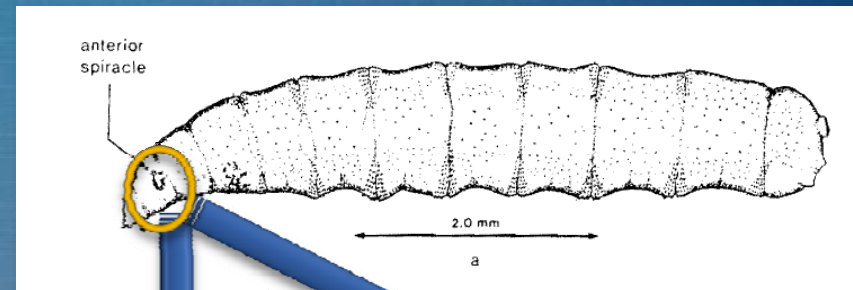
Adults: Resemble small houseflies, dark gray, SCM smaller than onion maggot

Larvae: Yellowish-white, 1/5" long when fully grown, legless, head end is pointed

Pupae: Reddish-brown, 1/5" long, cylindrical in shape, rounded at both ends

Eggs: White, 1/32" long, and oval in shape

Seed Corn Maggot



Seed Corn Maggot

- multiple generations per year
- **Onion maggot** – takes about 1150 degree-days for a generation
- **Seed corn maggot** – takes ~900 degree-days for a generation
- development occurs between 40 and 80⁰F
- soil temperature 70⁰F = 30 degree-days per day
- for both species – the larval stage takes about 40% of this total

Seed Corn Maggot

- multiple generations per year
- **Seed corn maggot** – 4 generations per year from southern US through Midwest
- larvae aestivate during summer and pupae diapause in winter
- number of generations in CA??

Seed Corn Maggot

- Seedcorn maggots burrow into seeds and prevent germination
- May feed on roots but this is usually less important
- Slow emergence and poor stand establishment are signs of seedcorn maggot activity
- Soil and weather conditions such as cool soil temperature and periods of excessive moisture favoring slow seed germination and seedling emergence increase susceptibility to seedcorn maggot infestation



Seed Corn Maggot

MANAGEMENT

Cultural Control

- disc or plow early in the season incorporating residues from a previous crop and destroying weed growth - reduces attractiveness of the field to egg-laying adults
- plant under ideal soil and weather conditions to assure rapid seed germination and minimize the seedcorn maggot problem
- crop rotation
- reduction of rotting vegetation in spring
- minimizing herbicide and cultivation damage to seedlings in spring/summer
- destroying weeds at field borders

Seed Corn Maggot

MANAGEMENT

Sampling

- seed corn and onion maggots are attracted to volatiles given off by decaying vegetation
- some studies suggest it is the microbes that are involved in the decay process
- others say it is CO₂
- cone traps baited with honey-yeast/molasses materials for decay
- cone traps baited with bonemeal which is an oviposition stimulant
- sticky traps – grey is the best color

Seed Corn Maggot

MANAGEMENT

Natural Enemies

- parasitoids are known
- generalist predators – ants, spiders, etc.
- soil borne fungal insect pathogens
- entomopathogenic nematodes

Seed Corn Maggot

MANAGEMENT Insecticides

Treatment	AI	Rate	% seedling emer.
Farmore DI400 - Seed Tmt	thiamethoxam	0.75 mg/seed	78.0 ab
Supresto - Seed Tmt	clothianidin + imidacloprid	0.5 mg/seed	86.5 a
Belay - In furrow spray	clothianidin	4 oz/ac	85.0 a
Durivo - In furrow spray	chlorantraniliprole + thiamethoxam	11 oz/ac	84.0 a
Admire Pro- In furrow spray	imidacloprid	7 oz/ac	65.5 b
Fungicide check	--	--	65.5 b

Means followed by the same letter are not significantly different ($P > 0.05$, F-protected LSD).

data from melon studies by Dr. John C. Palumbo , Yuma Agricultural Center, University of Arizona

Seed Corn Maggot

MANAGEMENT Insecticides

Treatment	Rate	% seedling emer. (at emer.)	% seedling emer. (at FTL)
Fungicide check	-	47.5 cd	45.5 e
Entrust	0.1 mg ai/seed	40.0 d	42.0 e
Entrust	0.25 mg ai/seed	54.0 cd	55.0 de
Entrust	0.5 mg ai/seed	72.0 ab	73.0 bc
Farmore DI400	0.75 mg ai/seed	75.0 ab	74.0 ab
Entrust	1 oz/ac	63.0 bc	63.0 bcd
Radiant	5 oz/ac	80.7 a	81.5 a
Aza-Direct	2 pts/ac	52.5 cd	56.0 cde
Brigade	5 oz/ac	82.6 a	84.0 a
Diazinon AG500	8 oz/ac	77.0 ab	80.0 ab
Belay	4 oz/ac	78.0 ab	78.5 ab
Coragen	5 oz/ac	74.0 ab	75.5 ab
Cyazypyr	10 oz/ac	75.6 ab	77.8 e

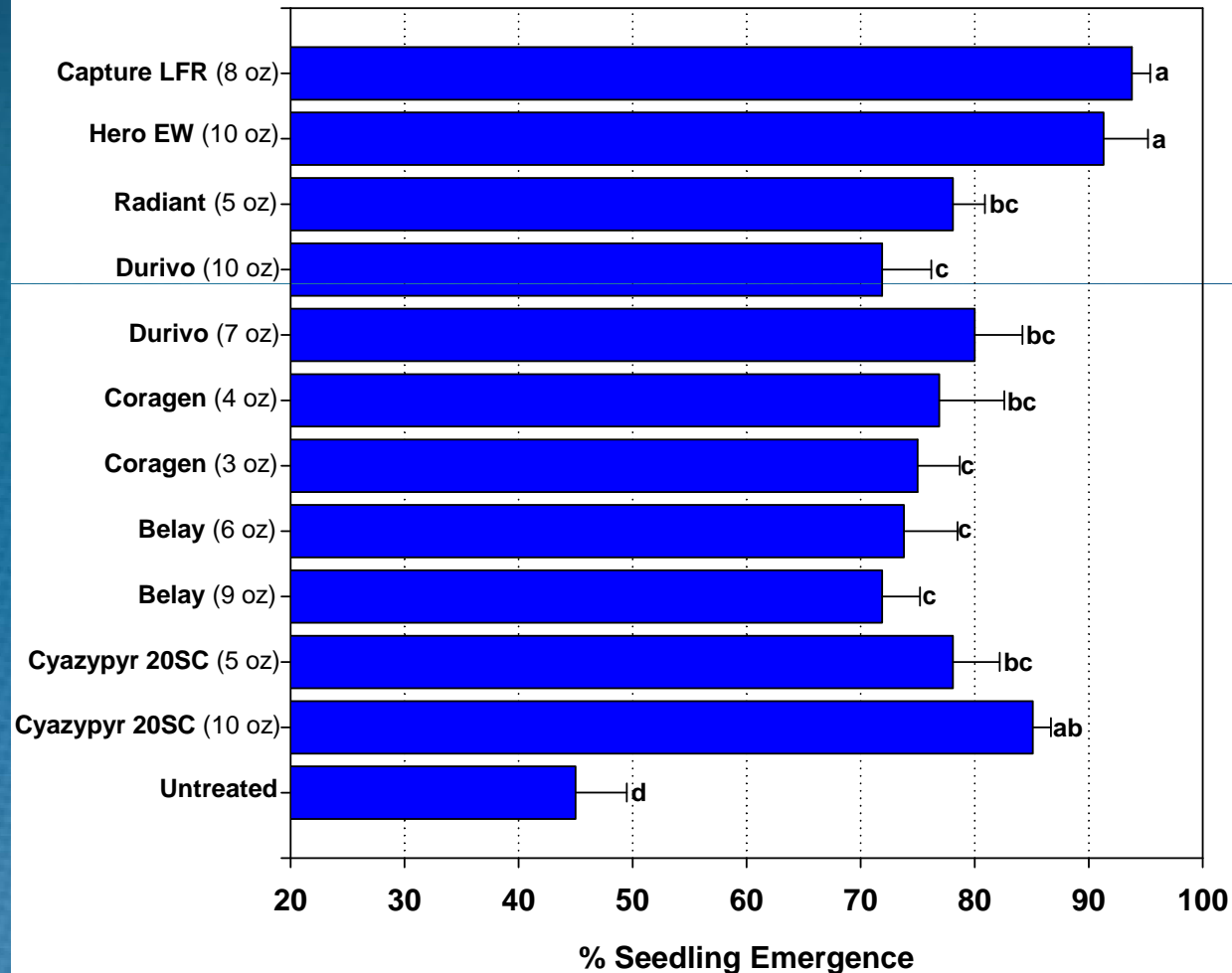
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Seed Corn Maggot

MANAGEMENT Insecticides

2011



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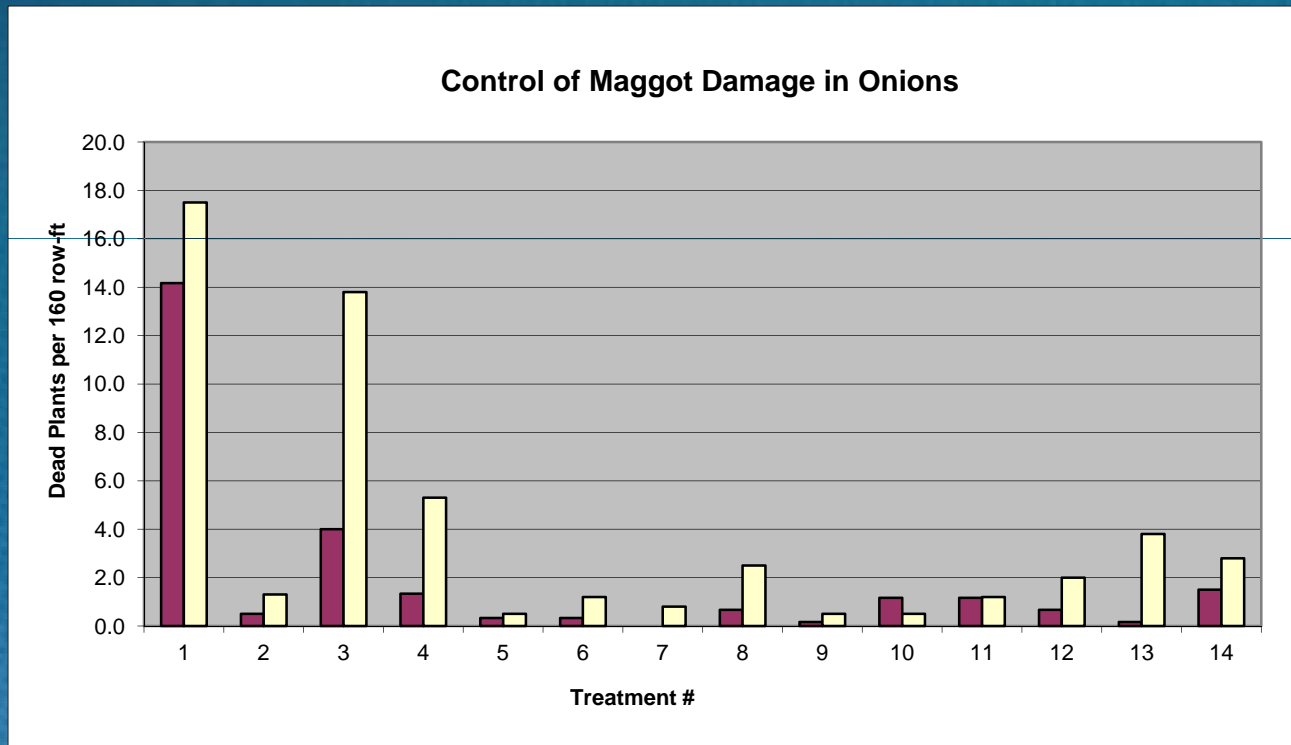
Seed Corn / Onion Maggot

Onions - Tulelake

Treatment	Chemical	Rate
1	Untreated	
2	Lorsban 4E as a drench in furrow	38.3 fl oz/A
3	Trigard 75WP	5.0 g a.i./100 g of seed
4	Lorsban 4E + Trigard 75WP	38.3 fl oz/A + 5.0 g a.i./100 g of seed
5	Regent 500	2.5 g a.i./100 g of seed
6	Entrust	5.0 g a.i./100 g of seed
7	Entrust	7.5 g a.i./100 g of seed
8	Poncho 600	50 g a.i./kg of seed
9	Poncho 600	34 kg a.i./kg of seed
10	Poncho Delta	26 g a.i./kg of seed
11	Poncho Delta	39 g a.i./kg of seed
12	Poncho Delta	44 g a.i./kg of seed
13	Poncho Delta	52 g a.i./kg of seed
14	Lorsban 15G dibbled over the seed row	8 lb/A

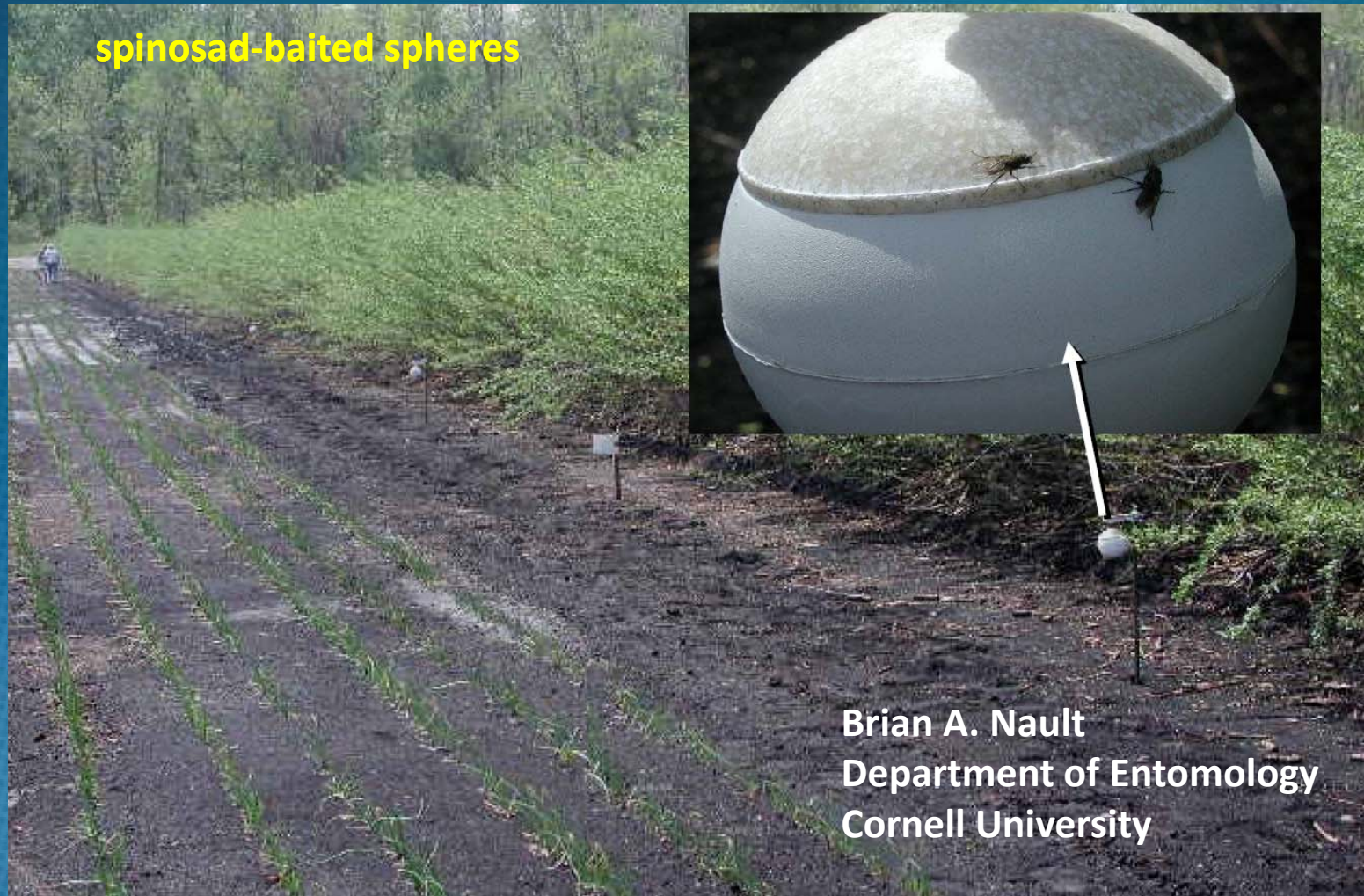
Seed Corn / Onion Maggot

Onions - Tulelake



Seed Corn / Onion Maggot

Onions – New York



Seed Corn / Onion Maggot

Onions – New York

Brian A. Nault, Dept. of Entomology, Cornell University

Summary

- Flies attracted to spinosad-baited spheres (can include additional attractants like *Delia* lure)
 - Spinosad is a safe biologically based insecticide
 - Effective for entire onion-growing season (e.g., 16 weeks) and estimated to kill 55% of flies that visit
 - One sphere estimated to kill 182 flies during season (36 females and 147 males)
 - Spinosad-baited spheres can be hung along onion field edges
 - Preliminary cost estimated to be \$5 to \$6 per trap
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